Australian Government
Productivity Commission

Towards Urban Water Reform: A Discussion Paper

Productivity Commission Research Paper

ISBN 978 1 74037 246 6

This publication is available in hard copy or PDF format from the Productivity Commission website at www.pc.gov.au. If you require part or all of this publication in a different format, please contact Media and Publications (see below).

Publications Inquiries:
Media and Publications
Productivity Commission
Locked Bag 2 Collins Street East
Melbourne VIC 8003

Tel: (03) 9653 2244
Fax: (03) 9653 2303
Email: maps@pc.gov.au

General Inquiries:
Tel: (03) 9653 2100 or (02) 6240 3200

An appropriate citation for this paper is:

Productivity Commission 2008, *Towards Urban Water Reform: A Discussion Paper*, Productivity Commission Research Paper, Melbourne, March.

JEL code: Q

The Productivity Commission

The Productivity Commission, an independent agency, is the Australian Government's principal review and advisory body on microeconomic policy and regulation. It conducts public inquiries and research into a broad range of economic and social issues affecting the welfare of Australians.

The Commission's independence is underpinned by an Act of Parliament. Its processes and outputs are open to public scrutiny and are driven by consideration for the wellbeing of the community as a whole.

Information on the Productivity Commission, its publications and its current work program can be found on the World Wide Web at www.pc.gov.au or by contacting Media and Publications on (03) 9653 2244.

Foreword

Water rationing has become pervasive in Australian cities in recent years. This is only partly due to low rainfall. An important contributor has been inadequate institutional arrangements for the management of our urban water resources.

In contrast to developments in rural areas, there is effectively no market for water in Australia's cities. The charging regimes of monopoly utilities reflect production costs, but not the scarcity value of water. Instead, restrictions are placed on particular water uses and these impose substantial hidden costs on many households. The lack of price signals to guide demand and supply also compounds the difficulties of making efficient investment decisions, including about alternative sources of water.

This study arises from the Commission's broader research program on environmental and resource issues of importance to the community. It identifies challenges confronting urban water management and canvasses potential areas for reform. It also explores how urban water markets might work in practice. The issues are complex and no definitive answers are provided. However, the directions for reform seem clear. The potential gains are sufficient to warrant, as a matter of priority, a comprehensive public review to assess options and inform the community about what is at stake.

Research for this study was undertaken in the Environmental and Resource Economics Branch under the guidance of Commissioner Neil Byron. The Commission is grateful for the assistance it received from many organisations and individuals, both in gathering information and reviewing the analysis.

Gary Banks AO
Chairman

March 2008

Contents

BOXES

FIGURES

TABLES

Abbreviations and explanations

Abbreviations

ACF	Australian Conservation Foundation
AIC	Average Incremental Cost
BBM	Building block methodology
BCA	Business Council of Australia
COAG	Council of Australian Governments
ERA	Economic Regulation Authority (of Western Australia)
ESC	Essential Services Commission (of Victoria)
GL	Gigalitres
GTE	Government trading enterprise
IBT	Inclining block tariff
IAC	Industries Assistance Commission
IC	Industry Commission
IPART	The Independent Pricing and Regulatory Tribunal (of New South Wales)
IPE	Independent Procurement Entity
LRMC	Long-run marginal cost
NCP	National Competition Policy
NEMMCO	National Electricity Market Management Company
NWC	National Water Commission
NWI	National Water Initiative
NPV	Net present value
PC	Productivity Commission
QWC	Queensland Water Commission

ROA	Real options analysis
SRMC	Short-run marginal cost
VWS	Virtual water supplier
WELS	Water Efficiency Labelling Scheme
WSAA	Water Services Association of Australia

Glossary

Aquifer	A layer beneath the surface of the ground which stores and allows water to move through it, and from which water can be extracted.
Bulk water	Water supplied by a water provider to another water provider.
Entitlement	An entitlement to exclusive access to water in each irrigation season (seasonal allocation), specified in volumetric terms or as a share of a specified consumptive pool.
Environmental flow	A water regime provided within a river, wetland or estuary to improve or maintain ecosystems where there are competing water uses and where flows are regulated.
Gigalitre	Equal to one thousand megalitres.
Groundwater	Water occurring under the ground in aquifers.
Inclining block tariff	A charging structure with successively increasing charges for each block of the commodity purchased.
Inflows	In the context of water accounting, the volume of water that flows into the storage.
Irrigation district	A reticulation network supplying water to irrigators managed by companies, trusts, statutory authorities and quasimunicipal authorities.
Kilolitre	Equal to one cubic metre or thousand litres.
Long-run marginal cost	The expected cost of bringing forward an extra unit of supply in the long term, including the associated capital expenditure for infrastructure.
Megalitre	Equal to 1000 cubic metres or one thousand kilolitres.
Scarcity-based water charge	A charge that reflects the value of water in alternative uses during periods of water shortage.

Seasonal allocation	Specific volume of water allocated to a water entitlement in a given season. Sometimes referred to as a water allocation, a water determination or a seasonal assignment.
Short-run marginal cost	The cost of providing an additional unit of supply to meet demand in the short term, reflecting the highest value use to which a commodity can be put in periods of shortage.
Stormwater	Rainfall that is collected after it has run off urban surfaces.
Third-party effect	A third-party effect (or externality) arises whenever the production or use of a good or service affects parties other than those involved in the transaction and these effects are not fully reflected in the prices paid or received by the first two parties.

OVERVIEW

Key points

- There is no effective market for urban water. Governments (operating as planners, suppliers, distributors and retailers) make supply investments and manage available water with only limited knowledge about the value that users place on the resource.
- Charging regimes now recover operating costs and a return on assets but do not reflect the scarcity of water in times of shortage. Instead, demand is managed by overriding the preferences of urban consumers through restrictions on water uses.
  - The annual cost to households of restrictions would amount to billions of dollars.
- For the past two decades, and in contrast to earlier years, most governments avoided investments to augment supply. More recently, they have embarked on a range of projects including desalination, recycling and some links to rural supplies.
  - Efficient water supply decision-making needs to be based on cost–benefit frameworks that assess the relative merits of the various augmentation options in ways that better address climate-related uncertainty and which can adapt to improved understanding of future needs and supply options.
- Policies that restrict interaction between water used by rural and urban sectors limit opportunities for inter-sectoral trade. This distorts water use and infrastructure investment decisions.
- Monopoly provision of urban water impedes opportunities to develop alternative supply sources. Reform has been confined to governance arrangements rather than the structural changes necessary to achieve more efficient outcomes.
- A well-functioning urban water market could provide more timely investment signals, a wider range of innovative supply options, greater choice of products and options for water users and more efficient use of nationwide water resources. This is attainable without compromising equity, health, safety or environmental objectives.
  - Equity concerns can be addressed effectively by targeted policy instruments.
- The direction, if not the end point, for reform seems clear. The potential gains are sufficient to warrant a comprehensive public review to determine the extent to which a more market-oriented focus could be pursued and to alert the community to the tradeoffs. Key areas that warrant investigation include an assessment of the costs and benefits of:
  - allowing a greater role for prices to signal water scarcity and to allocate resources
  - removing the artificial impediments to rural-urban water trading
  - removing barriers to competition in the supply and retailing of urban water.
- Transaction and adjustment costs need to be assessed in conjunction with how best to sequence incremental or co-ordinated reforms.

Existing inter-jurisdictional arrangements such as the National Water Initiative could be modified to progress a more ambitious and coordinated reform agenda.

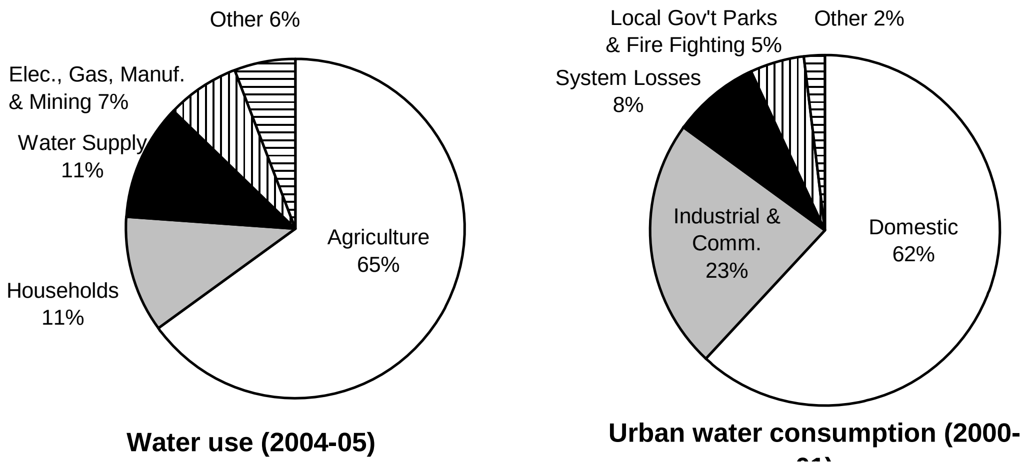
Overview

Water is used for a myriad of purposes across households, agriculture and industry (figure 1). It also helps to maintain ecosystems and provide environmental amenity.

Most of Australia’s capital cities and other urban centres have suffered severe water restrictions as an extended period of low rainfall has curtailed runoff into water storages. Limited supplies must be allocated across uses and users, and governments have chosen to do this through restrictions rather than through prices. In 2005, around 80 per cent of city dwellers were subject to long-term water use restrictions.

The failure to provide urban residents with water that many would have willingly paid for is not just a consequence of low rainfall, it also reflects policy choices. It is widely observed that urban centres are not well served by institutional arrangements for water (box 1). While institutions cannot make it rain, they are responsible for aligning long-term supply and demand, and managing periodic scarcity.

Figure 1 **Where does our water go?**



[a] Includes sewerage and drainage services.

Sources: ABS, Water Account Australia 2004-05, Cat. no. 4610.0; WSAA (2005).

Box 1 **Calls for urban water reform**

The Australian Conservation Foundation

> Historically water has been disproportionately priced in all sectors (agricultural, urban and industrial). ACF advocates a pricing system that reflects its true value and that water management authorities accelerate and strengthen water reforms by balancing principles of user pays and the removal of water subsidies with the need for access to an affordable water supply for all Australians. (ACF 2008)

The Business Council of Australia

> Australia's water problems are a direct result of a poorly planned and managed water system that has conspired to turn a sufficient supply of water at the source to scarcity for end-users. … there is no long-term shortage of water in Australia, just as there is no shortage of any other good or service we consume. Instead, the perceived shortages are due to artificial limits on supply to our cities … (BCA 2006, pp. 1-10)

National Water Commission

> … structural reform in the [urban water] sector has generally not kept pace with that in similar sectors such as gas, electricity or transport. (NWC 2007, p. 21)

The Secretary to the Treasury

> Unsurprisingly, if a commodity is effectively being given away, then demand will exceed supply and we can have no confidence that what supply there is will be directed to its use of highest value-added. So it is with water. Major cities are experiencing water restrictions of one kind or another. Quantitative rationing is incontrovertible proof of the absence of an efficient market. (Henry 2005, p. 10)

The urban water challenge — better management, not scarcity

Australia is the driest continent in terms of average precipitation, yet one of the most water-abundant in rainfall per person. Its water supply challenge is not one of scarcity per se, but of managing water resources given the variance between where and when it rains and where and when water is required.

To account for variations in rainfall, dams servicing major urban populations feature large storage capacities relative to consumption. As the current stock of dams has become less resilient to variations in rainfall, periodic scarcity has been addressed by temporarily rationing water until rains arrive. For much of this decade, however, restrictions on most urban residents' water use have been enduring.

Getting augmentation decisions right is difficult and it would be fortuitous if investment decisions always matched well with rainfall patterns. Nevertheless, during the past two decades, large scale urban water augmentation has essentially been in abeyance (apart from in Perth). Some jurisdictions have even invoked 'policy bans' on particular forms of augmentation.

Faced with dwindling water reserves, governments have recently commenced or announced major new investments in desalination, recycling, rural-urban pipelines and water grids. This has prompted many to question the reliability of analyses undertaken to assess the merits of different supply options, including how some contractual arrangements will operate — for instance, whether desalination plants will operate if dams are spilling. These new commitments will need to be integrated into institutional arrangements that may not readily accommodate them. How, for instance, should user charges be set when water is obtained from multiple sources with widely different cost structures?

There are also concerns that climatic changes are exposing weaknesses in the adaptive capabilities of planning systems that have relied on historical rainfall records. These concerns highlight the importance of robust cost–benefit frameworks to assess appropriate augmentation options in ways that better address uncertainty.

In addition to reservations about the capacity of the current institutional framework to manage periodic shortages and long-term water security, there are longstanding concerns about the efficiency of urban water services. Nationally, water policy and institutions treat urban and rural water as functionally separate. Within this constraint, urban water provision is centralised with government acting as planner, regulator, wholesaler, distributor and retailer.

Urban water provision is highly centralised

The urban water sector has little in common with 'private' goods and services. The supply chain from water storage through to delivery and waste removal is the domain of government monopolies. Charges are determined administratively and vary little in response to whether storages are overflowing or running dry.

That urban water is provided in this way may reflect its intrinsic characteristics, history and attitudes. Water and wastewater distribution networks exhibit natural monopoly traits. Urban water has a high transportation cost relative to its value, its availability can be both variable and uncertain, and it has a competing use in environmental flows. The public good aspects of safe drinking water and its essentiality for life are also raised as rationales for government provision.

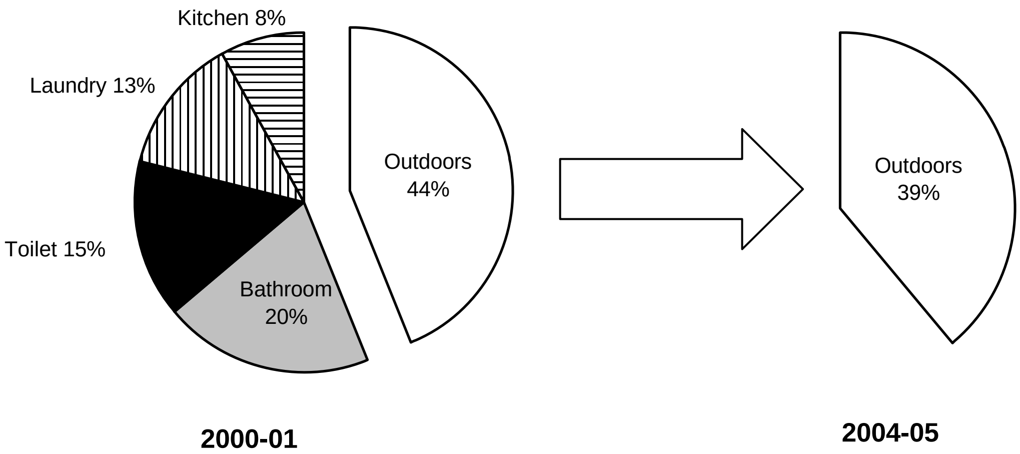
Do such characteristics mean that all facets of the urban water sector must be centralised under state control, and if so, to what extent? Further research is required to answer such questions definitively. However, the supply and consumption of urban water appears to have features in common with other (private) services with natural monopoly transmission infrastructure, such as telecommunications, electricity and gas. These latter services feature variable price, security and service offerings.

Some important reforms to the urban water sector including cost recovery and volume-based charging frameworks were achieved in the 1980s and 1990s. Since then, progress has slowed as the inter-jurisdictional agenda has shifted to rural water reform. These earlier initiatives, however, provide the foundation on which further initiatives could be introduced.

Prescriptive restrictions generate substantial hidden costs for users

In times of water shortage, supplies are conserved by restricting particular water uses (e.g. outdoor watering). Such prescriptive rationing denies households the opportunity to choose how to use and conserve water in ways they value most. Before the introduction of water restrictions early this decade, household water use nationally was roughly split equally between internal and external uses (figure 2).

Figure 2 **Water use in Australian households pre- and post restrictions**



Sources: WSAA (2005); PC estimates.

If there were an urban water market, householders confronting higher charges during droughts might opt to re-allocate their water use — for example, by reducing indoor use in order to preserve gardens or protect homes from the structural damage that can arise from drying soils. As restrictions on use eliminate such choice, householders must respond in other ways — replace or remove gardens, invest in water tanks, or shift water, often by bucket, from allowed indoor uses to proscribed outdoor uses.

These actions have costs (box 2). For example, there are costs in householders holding hoses at inconvenient times for prolonged periods. And household water storage, which is increasingly being resorted to, is an expensive augmentation option. For instance, a common 2000 litre household rainwater tank costing around $1500, holds around $3 worth of water at current mains water prices.

Box 2 The hidden costs for households are high

The costs of water restrictions are many and varied. They include: structural damage to buildings; deterioration of lawns and gardens; purchasing new watering systems; time spent on labour-intensive methods of watering; injuries from carrying 'greywater' in buckets and the emergence of 'water rage' with neighbours checking the water use of others in ways they would not contemplate for other services, such as phone use. Estimating the costs of water restrictions is difficult and various methodologies have been employed:

- For Sydney, Grafton and Ward (2007) estimated the cost per household in 2005 at about $150 above the cost of achieving the same level of water use with higher water charges. This estimate ignores the disutility costs of time spent using labour-intensive watering methods.
- For Perth, Brennan, Tapsuwan and Ingram (2007) valued the cost of time spent holding hoses. Assuming a value for 'greenness' and imputing costs based on mean wages, they estimated that the annual costs per household of water restrictions range from $67 for restrictions that allow watering twice a week using sprinklers to $870 when sprinkler bans are operating.
- For Canberra, Hensher, Shore and Train (2006) used estimates of households' willingness to pay to avoid water restrictions. To have stage 1 or 2 restrictions rather than stage 3, 4 or 5 restrictions, respondents expressed a willingness to pay an average amount of $109, $130, and $268 per year, respectively.

Approximately 80 per cent of Australia's households are subject to water restrictions. Applying the estimate of $150 per household for the cost of restrictions in Sydney in 2005, the national cost would be around $900 million. The Sydney estimate excluded many costs (e.g. installing watering systems, time spent watering gardens in permitted labour-intensive ways, and the deterioration in gardens and lawns). Since the excluded costs likely far exceed the costs included in the estimate, the annual cost of the water restrictions to Australian households is probably a multi-billion dollar figure.

The costs extend beyond households. Water restrictions have necessitated reductions in output from water-dependent, coal-fired electricity generators exacerbating lower hydro-generation output due to water shortages. These influences have led to higher wholesale electricity prices flowing through to businesses. The visual amenity of cities' open spaces has been impacted adversely and the viability of many community sports and recreational facilities compromised.

Markets could provide valuable information

With centralised planning approaches governments must rely on subjective determinations complicated by multiple and potentially conflicting objectives — planning, service delivery, regulation and water use education.

Markets could reveal information about costs, prices and valuations that would better equip water providers to make decisions about when new investment should proceed and the costs and benefits of different forms of augmentation. Assessing the relative costs and benefits of augmentation options without such market intelligence is daunting. A decision to introduce a high-cost desalination plant, for example, would reduce supply uncertainty by providing water independent of rainfall, but raise the prospect of users having to pay for excess capacity in normal times.

In principle, an urban water market could allow users to reveal their water security preferences. Some users, particularly businesses may be willing to pay a premium for more secure water, whereas others might prefer more frequent restrictions along with lower overall supply charges in most years. In essence, water users could have a role in managing their own risk of facing restrictions.

With current arrangements, little is known about how users value forgone consumption and time/inconvenience costs. Scarcity-based pricing could reveal the value of water to the community. Investment decisions then could take account of the community's valuation of the benefits (costs) of more (less) water availability relative to the costs of supply augmentation.

There are concerns about equity impacts

Many have questioned the appropriateness of allowing urban water prices to reflect scarcity because of the prospect that prices could rise for a vital essential for life during episodes of water shortage. Yet markets are almost universally accepted as superior to centralised planning strictures for the production and distribution of other necessities, including food and energy. Prices for many basic food products frequently rise and fall in response to changing supply conditions.

That said, because clean drinking water and well-functioning sanitation need to be available to all citizens — and governments are seen as answerable for this — concerns about access to water cannot be treated lightly. Preliminary analysis, however, raises doubts about whether significant equity issues would arise from treating water more like other goods and services.

Expenditure on urban water and sewerage accounts for a small proportion of households' budgets. For example, low-income households spend on average less than one dollar per day on these services. As a proportion of their gross household expenditure, this equates to between 0.2 per cent (Tasmania) to 1.4 per cent (ACT). Furthermore, given that all capital cities have both fixed access and volumetric charges, an increase of say, 10 per cent in the volumetric component would increase water bills by less than that, even less if households responded by reducing their water use.

But water restrictions are also inequitable

The implicit assumption that non-price restrictions must be fairer than price-based alternatives is open to challenge. It would be surprising if an instrument as indiscriminate as restrictions on water uses did not have its own inequities. For instance, some might consider it unfair that prescriptive restrictions mean that:

- the damage from dead gardens tends to afflict outer areas more than, usually wealthier, inner city locales
- children are banned from playing under sprinklers — most acutely felt in generally less wealthy areas with limited access to swimming pools or the sea
- households that economise indoors but have large gardens with flowers, fruit trees and vegetable plots experience very high costs, whereas households of the same composition that are heavy indoor users, but have native vegetation or minimal gardens, may be scarcely affected
- less wealthy residents are less able to avail themselves of relatively high cost options (e.g bores, rainwater tanks and commercial supplies) to mitigate the damaging effects of restrictions.

Nevertheless, if the effect of higher water prices on low-income households were considered untenable, there would be scope to use targeted measures to offset those effects while retaining the beneficial incentives from efficient prices. The options include direct measures (e.g. provision of a fixed quantum of low-priced 'essential' water to all households) and indirect measures (e.g. tax-welfare arrangements).

Current arrangements rate poorly on efficiency grounds

Urban water systems should meet safely the requirements of all users and should source water, and dispose of waste water, in an environmentally sustainable way. The centralised approach has generally delivered on these objectives but at considerable cost to households and businesses during dry periods.

Indicators of the inefficiency of urban water provision include:

- the seeming failure of supply augmentation decisions to achieve timely and least (expected) cost balancing of supply and demand
- the lack of innovative supply options, product choice and options for water users
- the lack of a relationship between the price of water and its scarcity
- the inability of water users to use water in ways that are most valuable to them
- the artificial separation of water resources into rural and urban sectors that remove opportunities for inter-sectoral trade from uses where its value is lower to uses (including environmental purposes) where its value is higher

Pursuing health, social and environmental goals in economically efficient ways would improve resource use, productivity and, ultimately, living standards.

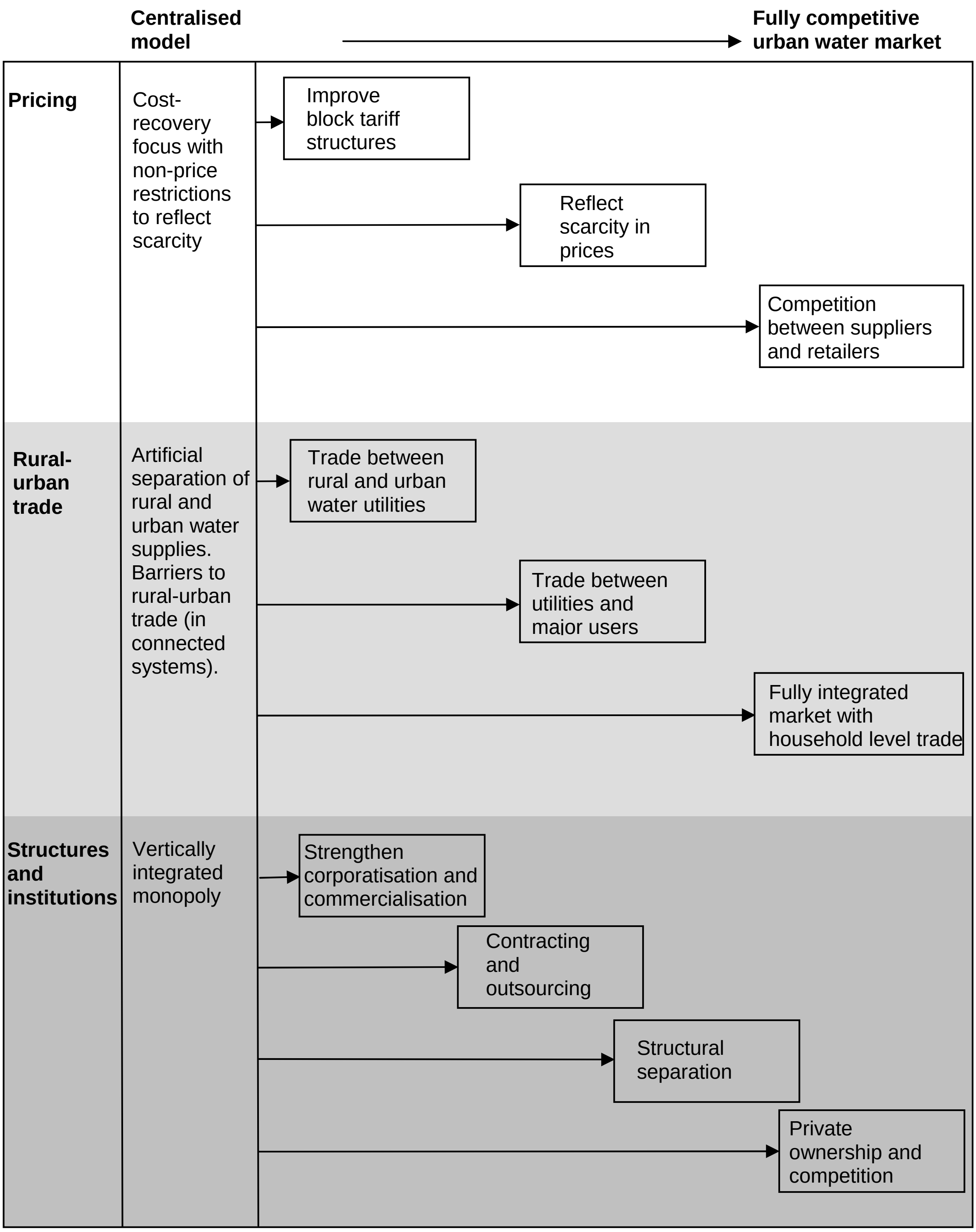
There is scope for less centralised urban water systems

Although many accept that there are significant problems within the urban water sector, views differ on the best way forward. In particular, there is debate about whether meaningful changes are feasible under standing institutional arrangements or whether more substantial structural change is needed.

In this context, it needs to be recognised that, for reasons outlined above, a competitive urban water market currently does not exist anywhere in the world. In contrast to other infrastructure services, there is little research and case study material on how an urban water market might work in practice. That said, as one commentator observed, addressing the requisite market design issues is hardly ‘rocket science’.

Given the starting point of monopoly services provided by governments which also set the rules of conduct, the potential reform canvas is vast (figure 3). The possibilities may, or may not be, mutually exclusive. Some could be introduced incrementally, others would be better approached as a package. Sequencing could be critical for some measures, less so for others. Some could involve substantial transitional and adjustment costs (e.g. structural separation of water monopoly businesses), others may not (e.g. simplifying block tariff charging structures).

Figure 3 **A potential reform menu**



While a detailed review of priorities to improve the effectiveness and efficiency of urban water provision is needed, areas that identify themselves as worthy of detailed examination include:

- the absence of scarcity-based pricing in the demand management armoury
- regulatory impediments to inter-sectoral trade between urban and rural water
- the barriers to entry in integrated urban water monopoly structures.

There is scope to improve pricing

At present, urban water utilities operate administered pricing systems that aim to ensure cost recovery. To do so, utilities adopt a range of different fixed and volumetric charging structures with multiple tiers and varying approaches to estimating system costs.

Some progress could be made by simplifying block tariff structures. A more significant reform would be to introduce a form of scarcity-based pricing to ration demand. For example, prices could increase as dam levels fell and the threat to water security increased. During a long drought prices might increase gradually over several years and then drop during a season or two of high rainfall.

As noted, potential impacts on low income households could be dealt with via an allocation of 'essential' water sufficient to meet basic needs and charged at a low price. Additional water for discretionary use would be subject to scarcity-based pricing during periods of water shortage. Such a change could allow water to be managed in a way that was more closely aligned with community preferences, and improve signals about when to invest in new water supplies.

The efficacy of using prices, rather than restrictions, to manage demand would obviously depend on how users respond to price changes. Some contend, for instance, that demand for water is not particularly responsive to changes in its price. However, recent studies suggest that even modest price changes could have a significant effect on consumption. Moreover, users are likely to adopt longer-term strategies to reduce consumption (e.g. shifting to more drought resistant gardens) leading to a stronger response over time.

Of course, a shift from managing demand by imposing restrictions towards scarcity-based pricing would pose challenges. For example, constraints such as single metering for multiple tenancies may need to be addressed.

Ultimately, it is possible to envisage a competitive urban water market (with appropriate regulation of monopoly elements of the supply chain) involving many retailers and wholesalers with different price-service-security offerings. Efficient prices would emerge and, as with other markets, exchange mechanisms might evolve — for example, spot prices or a central pool like the arrangements for the eastern electricity market.

Efficiency gains attained through competitive markets could even lead to lower water prices than would otherwise prevail with continuation of current arrangements. In particular, the likelihood of excessive costs from poor investment decisions being borne by users and taxpayers could be reduced.

Were a fully decentralised market contemplated, it would best evolve gradually, preceded by reforms of administered pricing.

Rural-urban water trading would offer access to low-cost water

Agriculture is responsible for 60–70 per cent of total water consumption and households around 10 per cent (figure 1). Integration of rural and urban water therefore provides opportunities for supply augmentation for some cities. Where water transfers are physically and economically feasible, even small diversions from rural use could make major (and relatively low-cost) contributions to urban supplementation. Such transfers could defer or obviate the need for major investment in supply augmentation.

Rural-urban water trades could be temporary or permanent. Opportunities arise for urban water transfers through:

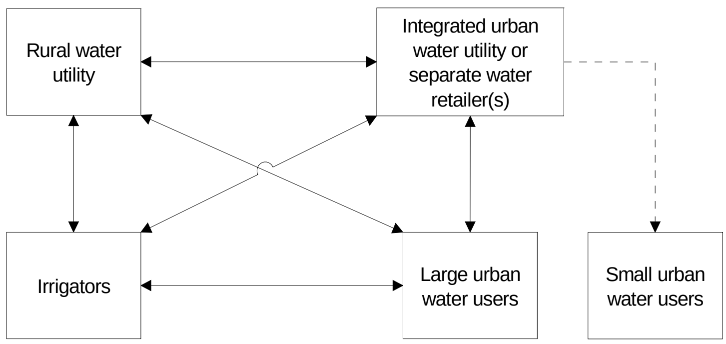
- water markets — e.g. voluntary trades
- regulation — e.g. mandated allocations for specific uses or locations
- indirect purchases — e.g. water saving investments with the gains shared between the rural (source) and urban (recipient) sectors.

Markets will often be the most efficient and equitable mode of exchange because they involve voluntary and mutually-beneficial transactions. For example, urban water users facing water scarcity may be willing to pay more for a unit of water than the return primary producers can earn on that water.

There may, however, be trade-offs between involving as wide a range of buyers and sellers as possible to capture gains from trade and the workability of rural-urban water trading. An intermediate level of integration involving large urban and rural water users would probably capture much of the available gains from trade (figure 4). Periodic supply contracts could facilitate rural-urban transfers and avoid the transactions costs associated with a formal urban water entitlement system.

The most economically feasible opportunities appear to be in Adelaide, Melbourne and Canberra, and other regional urban centres close to major irrigation districts.

Figure 4 **Intermediate integration**



Notwithstanding that rural-urban water trading could benefit both buyers and sellers, there are likely to be social and regional concerns revolving around matters such as stranded irrigation assets and the potential impact on small rural communities.

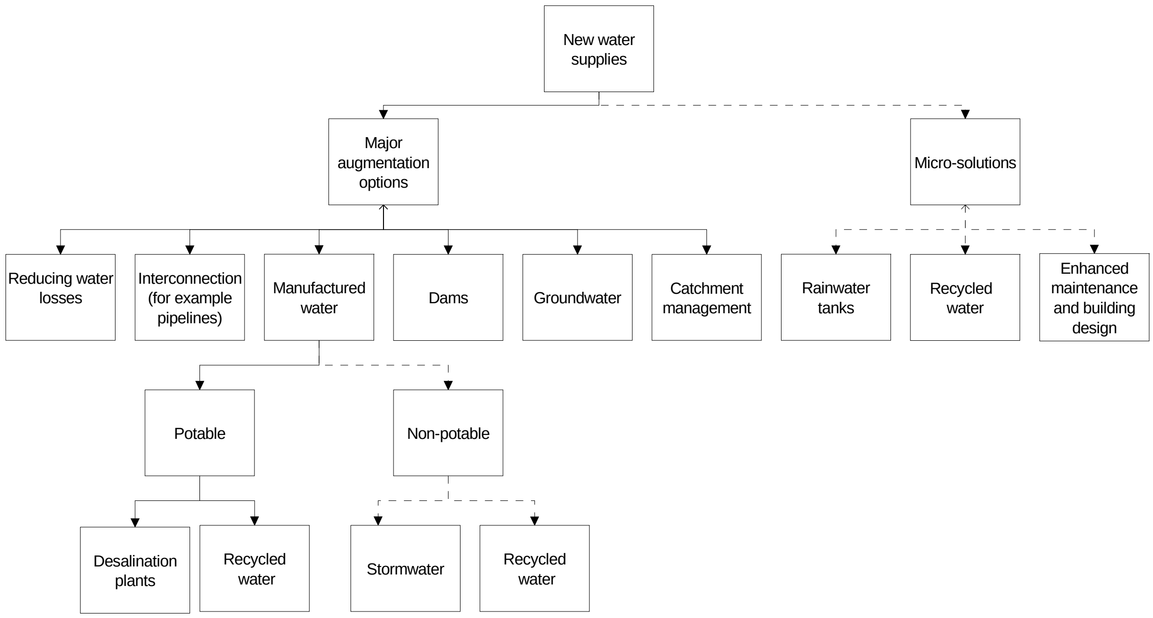
Structural and institutional reform could provide significant benefits

Compared to other utility sectors (e.g. electricity, gas, telecommunications and some modes of transport) that have undergone structural transformations, the urban water sector has changed little. Most major urban water utilities remain vertically-integrated government monopolies. There is some private sector involvement through contracted capital works and ancillary services and franchising arrangements, but no direct competition.

Modest reforms keeping existing structures intact include further commercialisation and governance reforms — dividend payout policies could be more commercially based and water utilities given greater autonomy in making investment decisions.

Private involvement could be expanded through greater use, and innovative forms, of competitive procurement. Centralised procurement typically involves specific projects (e.g. a desalination facility) or services (e.g. maintenance). An outcomes-based approach, however, has merit. Rather than specify a particular technology to provide additional water, an alternative would be to tender for a volume of water. This would enable different proposals to be ranked, and in the absence of any policy bans, least-cost augmentation options selected — whether from a dam, aquifer, changes to catchment management, desalination, recycling, stormwater harvest or purchase of a rural water entitlement (figure 5).

Figure 5 **Options for new water supplies**



The third party access provisions of the *Trade Practices Act 1975* offer a means to facilitate competition in urban water services by providing new entrants with an ability to access essential distribution infrastructure. Access regimes have been used to unlock monopoly infrastructure elsewhere, but have been used little for urban water provision or wastewater services. This is not surprising given low prices (in times of scarcity) and the risk associated with entering a market dominated by vertically-integrated government-owned water utilities.

Competitive entry could be encouraged by instituting discrete and cost reflective charging between the constituent components of water monopolies, rather than just recovering overall system-wide costs. Armed with transparent information about discrete costs — in particular the actual costs of using network infrastructure — potential entrants could more readily identify areas where existing or new services could be delivered more efficiently. More ambitious reform could involve upstream and downstream activities being structurally separated from monopoly distribution functions as occurred with energy market reforms.

Sovereign risk would need to be addressed

For water investments there is uncertainty about variability in rainfall and runoff. In this environment, it is vital that uncertainty is not exacerbated unduly if private investment is to be encouraged. It is important that government policy be consistent with competition policy principles such as competitive neutrality and ensuring the separation of policy, regulatory and commercial functions.

The provision of extensive public grants for water infrastructure investments has the potential to deter private investment. Moreover, it is very likely that government grants and subsidies already conflict with the stated objective of full cost recovery for urban water provision.

Ideally, policy initiatives should be ranked according to a consistent benchmark such as the cost per kilolitre of augmentation or water savings. For example, the cost of supplying dam water is around $0.15–$3 per kilolitre compared to costs of up to $9 per kilolitre for rainwater tanks. Indeed, one rebate scheme for water efficient dishwashers is estimated to have saved water at a cost of over $30 per kilolitre. Such benchmarks should not be the only decision criteria — reliability, flexibility and optimising a portfolio of supply options are also important — but they add to transparency and provide a safeguard against well-meaning, but inefficient, expenditures and subsidies.

The potential gains from urban water reform are worth pursuing

Prices revealed in well-functioning and integrated water markets would provide a coordinating role to achieve an efficient allocation of water. Building on the cost recovery paradigm to ascribe a scarcity value to water resources would allow costs, prices and user values to play a more influential role in guiding consumption and investment decisions in the urban water sector.

Allowing water prices to reflect both costs and scarcity would provide more timely investment signals to suppliers. This would help avoid the ‘feast or famine’ approach to augmentation investments. It would also provide signals to private sector investors about water investment choices such as building a desalination plant, recycling water and investing in water saving technology.

The monopoly provision of water and the limited recourse to third party access to distribution infrastructure contributes to systemic inertia — until sufficient (non-price) pressure is brought to force an augmentation decision. Removing barriers to competitive entry could stimulate competition in bulk water provision, retailing and wastewater recycling and foster continuing innovation and new service offerings.

Market prices would reduce the need for temporary restrictions to become enduring. Water use would be ‘democratised’:

- users could make their own informed decisions about water use — households and industry could make efficient decisions about micro-solutions (e.g on-site recycling and household greywater reuse systems)

- suppliers and users could negotiate their water price-service-security offerings — common practice in other services such as telecommunications and insurance.

There are therefore strong in-principle arguments to support the contention that the community's water use and security needs could be met more efficiently than is the case under the current centralised approach.

The *direction* for reform, if not the end point, seems clear

There is now widespread support for the view that the centralised urban water model is neither economically efficient, nor effective in achieving an appropriate balance in supply and demand over time.

However, understanding the degree to which a more market-oriented approach could be pursued in practice would require further analysis. For example:

- Would a competitive market provide the most appropriate degree of water security, or would governments need to retain responsibility for setting overall requirements?
- How should any 'above normal' revenues that accrued from scarcity pricing be treated?
- At what point would structural reforms for smaller urban systems not be worth pursuing?

Given the limited experience with variations from the centralised urban water model in Australia and internationally, it is difficult to envisage anything other than an iterative approach. Abrupt or large-scale changes could generate excessive transactions, implementation and adjustment costs.

Substantially more analysis is required to provide a clear picture of the urban, rural and economy-wide impacts of various options. Australia is a world leader in rural water reform, but resides with the international field in urban water reform. There is little experience to draw on. And our urban water sector lags other infrastructure sectors in simulation modelling, market design and cost–benefit assessments.

In addition, competition, while potentially benefiting many, would impose costs on those who have gained from the current restricted market. There are also challenging political and regional issues related to movements of water and finances between urban and rural areas. Any distributional implications and adjustment costs need to be taken into account.

The challenge for policy makers

Urban centres have varying geographic and hydrological features. Desalination might prove a more cost-effective option for coastal cities, whereas rural-urban water trading and recycling may be especially relevant for inland centres.

A flexible framework to guide reform has much to commend it. Pursuing reform under a national umbrella is likely to expedite outcomes — especially if linked to rewards and sanctions. This underlines the importance of inter-jurisdictional structures, such as the Council of Australian Government's National Water Initiative, to reignite momentum to build on earlier urban water initiatives.

The reform agenda would be most effectively advanced through a comprehensive public review to assess the extent to which more market-oriented arrangements could be pursued and to quantify the gains on offer. The review would need to address commonly held concerns and misconceptions and elaborate on the costs and benefits of any trade-offs that might be made. A better public understanding of urban water issues would assist in moderating some of the historical, cultural, attitudinal and political impasses to reform.

Among other matters, such a review should assess and provide guidance on:

- how best to engender robust and transparent assessments of various supply integration and augmentation options, with lower-cost options drawn on first
- the practical implications of using water prices, rather than just restrictions on use, to better signal system costs and the value to users of greater water security
- the impacts of removing the artificial barriers between rural and urban water integration so that a connected water market could emerge
- structural reforms and pro-competitive regulation to encourage competition into the urban water infrastructure supply chain
- minimising the distortions and efficiency losses that may arise from government subsidies directed at particular solutions.

1 Setting the scene

Key points

- While some reforms of the urban water sector were achieved in the 1980s and 1990s, progress has been slow in recent years as the reform focus has shifted to rural water.
- Deficiencies in urban water systems have become more apparent during a period of drought and uncertainty over future water availability. This has led to calls for substantial reform from a wide range of stakeholders and analysts.
- Some of the key issues relate to policy objectives, allocation of water between uses, supply augmentation decisions, innovation and dynamic efficiency.

1.1 Introduction

Drought conditions in many areas of Australia over the past several years, combined with the prospect that future climatic conditions may diverge from historic trends in ways that lower water availability, has led to renewed community, government and academic interest in the reform of the urban water sector. Large-scale investments in new water infrastructure are planned and there is debate about the decision-making processes employed, the technologies chosen and the implementation strategies planned. In the meantime, water demand is being managed through a variety of means, including water restrictions, and some have suggested that prices should play a greater role. Low and uncertain supplies have also heightened interest in how water is allocated across household, industrial, agricultural and environmental uses.

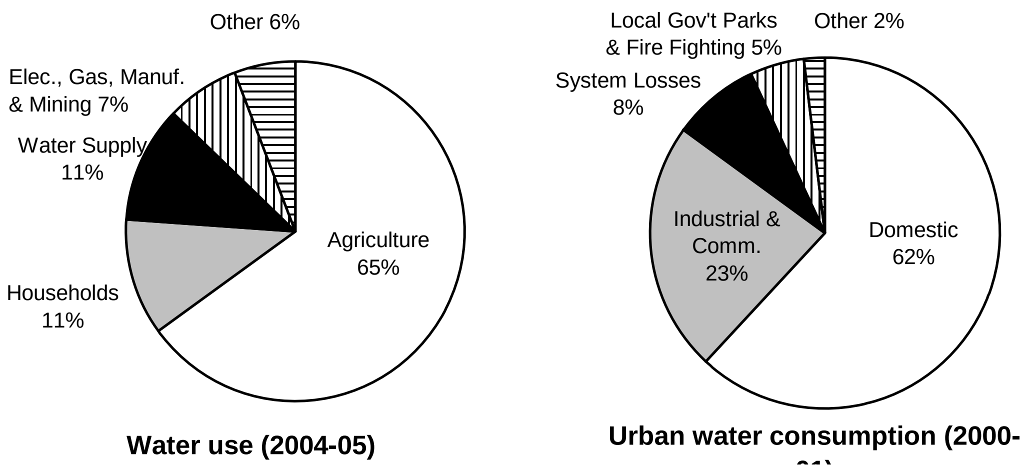
The aim of this paper is to identify the main problems and challenges facing the urban water sector and to assess available reform options. Reform options considered include changes within the existing institutional arrangements and more fundamental structural reform, including the introduction of greater competition in water markets. While the paper argues that there is a strong case for change, the objective is not to lay out a blueprint for reform. One reason is that circumstances vary across Australia and the best option for one urban centre may not suit another. More fundamentally, water policy is complex and further detailed research, involving extensive stakeholder consultation and empirical analysis, would be needed to produce a comprehensive reform agenda.

This chapter starts with some background information on the urban water sector. This is followed by a brief overview of past reforms in the sector, and a compilation of views of stakeholders and analysts on deficiencies of the current arrangements and the need for further reform. Finally, the key issues for reform are identified, which are addressed in subsequent chapters.

1.2 An overview of urban water systems

An overall perspective on water use in Australia is given in figure 1.1, which shows that around two-thirds of water extracted in Australia is used in agriculture. That is six times national household water use. Within the urban sector, domestic use accounts for more than 60 per cent of water consumption, while industrial and commercial use accounts for almost one-quarter.

Figure 1.1 **Snapshot of water use**



[a] Includes sewerage and drainage services.

Sources: ABS (2006); WSAA (2005).

Most urban centres in Australia rely mainly on water from dams. Among capital cities, the exceptions are Perth (which obtains most of its supplies from groundwater and also has a desalination plant) and Hobart (which sources around 60 per cent of its water from the Derwent River (Hobart Water 2007)). On average Adelaide obtains most of its water from dams; however, in dry years most comes from the River Murray (SA Water 2008).

The dams supplying many Australian cities have large water storage capacities compared with overseas cities. The main reason for this is the comparatively high degree of variability in rainfall and runoff in most catchments supplying urban dams in this country. This variability creates management challenges that are compounded by the fact that low rainfall tends to increase demand for water for gardens. In dry periods it is common for annual inflows into dams to be less than annual urban water use.

Table 1.1 **Capital city water storage capacity**

City	*Dam storage capacity*	*Annual consumption 2005-06*	*Supply when full (based on 2005-06 rate of consumption)*
	megalitres	megalitres	years
Sydney	2 584 300	528 260	4.9
Melbourne	1 173 000	444 365	4.0
Brisbane & SE Qld[a]	1 930 350	298 132	6.5
Perth	688 000	244 158	2.8
Adelaide	168 979	163 577	1.0
Hobart	11 000	38 150	0.3
Canberra	207 400	56 823	3.7
Darwin	265 000	34 521	7.7

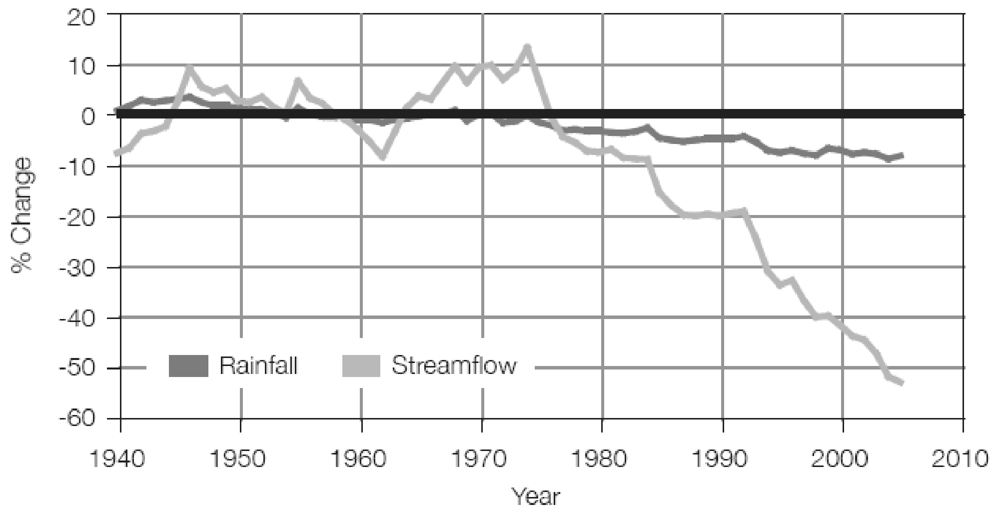
a Includes Little Nerang and Hinze Dams, as these, in addition to Wivenhoe, Somerset and North Pine supply water to the Gold Coast. The latter three dams also supply Ipswich and Logan City and a number of other local government areas.

Source: WSAA and NWC (2007).

The water storage capacities of the most dam-dependent capitals range from around four years (Canberra and Melbourne) to nearly eight years (Darwin) in terms of their 2005-06 consumption (table 1.1). Despite this, in all of these cities apart from Darwin, supplies have proven to be inadequate to prudently allow unrestricted access to water (at prevailing water charges) in recent years. Adelaide and Perth, which rely somewhat less on dam water, have also heavily restricted water use.

The traditional problem of year-to-year variation in rainfall and consequently, inflows to urban water storages, has been exacerbated by a downward trend in rainfall across much of southern Australia in recent decades. In south-west Australia, yearly inflow into Perth's dams from 1911 to 1974 averaged 338 gigalitres, from 1975 to 1996 inflow averaged 177 gigalitres, and from 1997 to 2005 it was 114 gigalitres (CSIRO 2007). As figure 1.2 shows, the reduction in inflows to Perth's dams since the mid-1970s has been much larger than the reduction in rainfall. This general relationship between rainfall and inflows into dams is normal and is due to evaporation and retention of water in soil. The relationship can be affected by the management of land and vegetation. For example, building on-farm water storages reduces inflows, whereas thinning forests increases inflows.

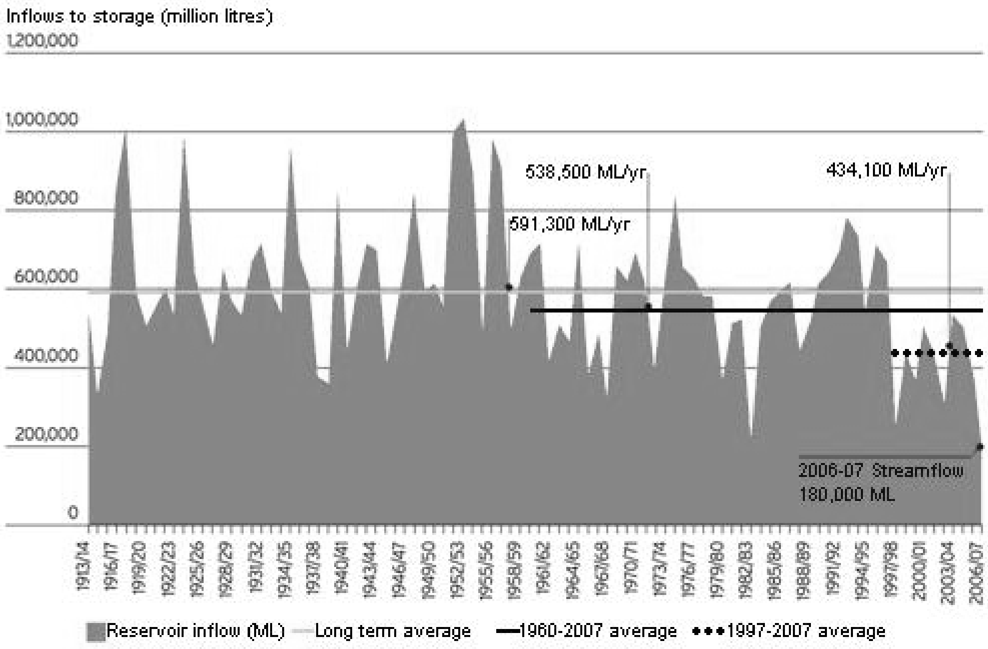
Figure 1.2 **Variation of rainfall and streamflow in south-west Australia**
Percentage change from long-term average



Source: CSIRO (2007, p. 21).

Eastern Australia has also become dryer since the 1950s. Since 1997 much of southern and central Victoria has experienced the driest ten-year period on record (CSIRO 2007). Annual inflow into Melbourne's four main dams is shown in figure 1.3. As in south-west Australia, inflow into Victoria's dams has fallen proportionately more than rainfall.

Figure 1.3 **Inflow into Melbourne's four major harvesting reservoirs**
(Upper Yarra, Thomson, Maroondah, O'Shannassy)



Source: Melbourne Water (2007).

Urban water systems comprise various components, including water harvesting, storage, treatment, distribution, retailing, as well as wastewater removal and treatment. With the advent of new technologies, such as desalination, potable water manufacture is now also part of water systems in some places. This paper covers all of these; however, emphasis is given to the supply of water, rather than the removal of wastewater.

The entities responsible for the various components of urban water systems are overwhelmingly owned by governments (some are statutory authorities, others are owned by local councils). In some cases a single water business undertakes all water supply activities — for example Western Australia's Water Corporation. In other cases there is a degree of disaggregation — for example Melbourne has one bulk water supplier (Melbourne Water) and three water retailers (each servicing a defined geographic area). Later chapters provide further information on institutional arrangements.

1.3 Past reform

In the era from European settlement through to the 1980s, Australia's urban water systems were progressively expanded to meet the needs of a growing and increasingly affluent population, the primary objective being to provide safe and reliable water supplies. Reforms to the sector were initiated in the early 1980s in response to concerns about efficiency and environmental impacts (PC 2005a). The reform effort was coordinated at the national level in 1994, when the Council of Australian Governments (COAG) agreed to implement a framework to achieve an efficient and sustainable water industry (COAG 1994). This framework was drawn more closely into the microeconomic reform process in 1995, when COAG linked jurisdictional implementation of the agreed water reforms to the National Competition Policy (NCP) and associated NCP payments to States and Territories (NCC 2003).

The 1994 framework covered both the rural and urban water sectors. In relation to the latter, the Commission (PC 2005a, p. 27) found:

> … the reform initiatives that were required of the urban sector are, for the most part, well advanced, with the widespread introduction of a consumption-based component in charges to help discourage overuse and implementation of financial cost recovery by service providers to ensure better signals for new investment. Various institutional reforms have also been implemented to increase the commercial disciplines on, and the accountability of, those entities delivering water and sewerage services, with most jurisdictions having corporatised their urban water authorities. In South Australia, the management of the water supply has been contracted out to private sector operators.

More recently, COAG developed the National Water Initiative (NWI), which was agreed to by all but two COAG member governments in 2004. Subsequently, the Tasmanian Government signed the agreement in 2005 and the WA Government in 2006. Although it addresses urban water, the focus of the NWI is on the rural water sector and initiatives requiring cooperation between governments. The NWI outcomes and actions relating specifically to urban water reform are outlined in box 1.1.

The actions for urban water included in the NWI are generally limited in scope and do not amount to a comprehensive reform agenda. A reason for this is suggested in a recent statement by the Chairman of the National Water Commission (NWC), that when the NWI was signed in 2004 ‘urban water was a footnote. The big issues then were rural water and environmental water’ (Wahlquist 2007).

Box 1.1 National Water Initiative: urban water reform

Outcome

90. The Parties agree that the outcome for urban water reform is to:

i) provide healthy, safe and reliable water supplies

ii) increase water use efficiency in domestic and commercial settings

iii) encourage the re-use and recycling of wastewater where cost effective

iv) facilitate water trading between and within the urban and rural sectors

v) encourage innovation in water supply sourcing, treatment, storage and discharge

vi) achieve improved pricing for metropolitan water [consistent with earlier paragraphs].

Actions

Demand Management

91. States and Territories agree to undertake the following actions in regard to demand management by 2006:

i) legislation to implement the Water Efficiency Labelling Scheme (WELS) to be in place in all jurisdictions and regulator undertaking compliance activity by 2005, including mandatory labelling and minimum standards for agreed appliances

ii) develop and implement a 'Smart Water Mark' for household gardens, including garden irrigation equipment, garden designs and plants

iii) review the effectiveness of temporary water restrictions and associated public education strategies, and assess the scope for extending low level restrictions as standard practice

iv) prioritise and implement, where cost effective, management responses to water supply and discharge system losses including leakage, excess pressure, overflows and other maintenance needs.

Innovation and Capacity Building to Create Water Sensitive Australian Cities

92. The Parties agree to undertake the following actions in regard to innovation:

i) develop national health and environmental guidelines for priority elements of water sensitive urban designs (initially recycled water and stormwater) by 2005

ii) develop national guidelines for evaluating options for water sensitive urban developments, both in new urban sub-divisions and high rise buildings by 2006

iii) evaluate existing 'icon water sensitive urban developments' to identify gaps in knowledge and lessons for future strategically located developments by 2005

iv) review the institutional and regulatory models for achieving integrated urban water cycle planning and management, followed by preparation of best practice guidelines by 2006

v) review of incentives to stimulate innovation by 2006.

Source: COAG (2004, pp. 19–20).

In reporting on progress in implementing the NWI, the NWC stated that the NWI actions for urban water reform 'have been overshadowed by the scale of water challenges facing Australia's major cities' (NWC 2007c, p. 21). These challenges are related to prolonged drought in many areas and uncertainty over whether future reductions in rainfall and runoff will occur, either as a result of human-induced climate change or long-term natural variation. Significantly, the NWC also found that ‘current NWI actions do not capture the extent of work currently being undertaken by individual states to address these challenges’ and that the actions by individual States are ‘understandably, often in the nature of an emergency response and vary in their strategic focus and reform nature’ (NWC 2007c, p. 21).

In light of its assessment, the NWC recommended a supplementary set of urban water actions be developed, to be implemented as additional actions under the NWI. These are designed to improve: urban water planning; institutional and market arrangements; and onground delivery of water supply and demand management options (NWC 2007c).

In addition to the NWC, many stakeholders and analysts have identified problems with the urban water sector and see the need for substantial reform (box 1.2). This widespread perception that reform is needed has provided the motivation for this paper. While the need for reform is widely acknowledged, views differ on the way forward. In particular, there is debate over whether changes possible within the existing institutional arrangements are sufficient, or whether more substantial changes are needed.

Box 1.2 **Comments on the urban water sector and the need for reform**

The Secretary to the Treasury

> … many water charging regimes in Australia seek only to recover operating costs and a return on infrastructure. Typically, the water being supplied is assumed to have no economic cost; that is, no scarcity value. Unsurprisingly, if a commodity is effectively being given away, then demand will exceed supply and we can have no confidence that what supply there is will be directed to its use of highest value-added. So it is with water. Major cities are experiencing water restrictions of one kind or another. Quantitative rationing is incontrovertible proof of the absence of an efficient market. (Henry 2005, p. 10)

The Australian Conservation Foundation (ACF)

> Historically water has been disproportionately priced in all sectors (agricultural, urban and industrial). ACF advocates a pricing system that reflects its true value and that water management authorities accelerate and strengthen water reforms by balancing principles of user pays and the removal of water subsidies with the need for access to an affordable water supply for all Australians. (ACF 2008)

The Business Council of Australia

> Australia's water problems are a direct result of a poorly planned and managed water system that has conspired to turn a sufficient supply of water at the source to scarcity for end-users. … there is no long term shortage of water in Australia, just as there is no shortage of any other good or service we consume. Instead, the perceived shortages are due to artificial limits on supply to our cities … (BCA 2006, pp. 1–10)

National Water Commission

> (1) … structural reform in the [urban water] sector has generally not kept pace with that in similar sectors such as gas, electricity or transport. (NWC 2007c, p. 21)
>
> (2) [The NWC Chairman] … criticised governments for … implementing 'policy bans' — positions taken for political reasons, such as the government stance on desalination plants, dams and other infrastructure. 'It is really important that they should all be on the table, they should go through a process of analysis, logic and evidence' he said. (Wahlquist 2007)

Professor Grafton, Australian National University

> Despite the variability in the supply of water, current water pricing arrangements mean we pay exactly the same for water when times are good as bad. But really when water is scarce, as it is now, it's more valuable, and it should be priced as such. (Grafton 2006)

Professor Quiggin, The University of Queensland

> Current policy regarding rural and urban water use displays a range of inconsistencies. … transfers of water from irrigation to other uses outside a given catchment are prohibited in many cases. … Trade between irrigation, urban and environmental water use should be enhanced, and will not entail substantial contraction of the value of output from irrigated agriculture. (Quiggin 2007, p. 45)

ACIL Tasman (in a report to the Economic Regulation Authority, Western Australia)

> … there is a growing awareness amongst water system planners and utilities of the potential for large cost savings, without sacrifice of security, through the development and management of more flexible supply and demand management strategies … While awareness is growing, translation of this into the formal planning frameworks is still at a relatively primitive stage in most jurisdictions. (ACIL Tasman 2007a, p. 13)

1.4 Key issues

Key issues and questions for urban water reform are outlined below, along with a reference to the chapter in which they are considered. These issues have been identified drawing on the views of various commentators, including those given above, and the Commission's own assessment.

Policy objectives

Government water policy generally has a range of objectives, including ones relating to: health and safety; security of supply; water use efficiency and/or economic efficiency; environmental protection; and equity. Fundamental questions for urban water reform are:

- What are the appropriate objectives for urban water policy? Is there an overarching objective that could be used to better guide policy development? (chapter 2)
- Are equity and efficiency objectives compatible? (chapter 2)

Allocation of water between uses

Water is used for a myriad of purposes by virtually all individuals and firms across all sectors of the economy. Water also helps to maintain functioning ecosystems and provide environmental amenity. When water that is suitable for these uses is in limited supply some means must be found for allocating it across uses and individuals. This raises questions such as:

- Should prices play a greater role in determining the allocation of water? Could this be done in a way that did not disadvantage people on low income, or cause other equity problems? (chapter 3)
- How should an appropriate balance between urban and rural water uses and environmental flows be achieved? (chapters 3 and 4)
- Could outcomes for the community be improved by relaxing restrictions on moving water from one use to another, such as from agriculture to urban use? (chapter 4)

Supply augmentation decisions

State and Territory Governments have announced major new investments to augment the supply of urban water, mainly in response to declining water reserves, population growth and uncertainty over future dam inflows. A range of augmentation options has been implemented or planned, including desalination plants, recycled water projects and pipelines to allow transfers from rural to urban areas.

Getting augmentation decisions right is very difficult and the stakes are often high. In earlier decades there was criticism of overinvestment in the sector, including by the Industry Commission, an antecedent organisation of the Productivity Commission (IC 1992). Common criticisms today are that there has been underinvestment in recent years and that the options chosen are not the best ones (Allen Consulting Group 2007, BCA 2006, Dwyer 2006). While it is unreasonable to expect that investment decisions will always match well with subsequent rainfall patterns, the key issue is how to get the processes and incentive frameworks right so that the best possible decisions are made in the presence of uncertainty over future climate and demand trends. Important questions include:

- Can processes be improved so that all augmentation options are properly considered, taking fully into account cost, reliability, scale, implementation time and environmental consequences? (chapter 5)
- What role should demand management (through pricing and/or water restrictions) play in dampening the need for augmentation? (chapter 3)

Innovation and dynamic efficiency

For many people, innovation and dynamic efficiency may not come readily to mind when thinking about the water sector, but they are important for several reasons. First, technology is developing rapidly in some areas, such as desalination and water recycling. Second, improved strategies are being developed for making investment decisions in the face of uncertainty. Third, there is the potential that opening up parts of the sector to competition could lead to improvements in productivity and reductions in cost. A key issue, therefore, is the extent to which reform can lead to increases in innovation and dynamic efficiency. Some important questions are:

- Are there useful reforms that could be made within the existing institutional arrangements to promote innovation and improve dynamic efficiency? (chapter 6)
- Should more fundamental structural reforms be made, with a greater role given to competition and markets, as has occurred in other utility sectors? To what extent should the various impediments to a more market-based approach, such as natural monopoly characteristics in water supply and equity and environmental considerations, condition the approach taken? (chapter 6)

2 Objectives and their achievement

Key points

- Multiple objectives for urban water systems revolve around economic efficiency, equity, water quality, water security, commercial viability and the environment. All of these except equity can be encompassed within economic efficiency.
- Current approaches to promoting equity reduce economic efficiency, yet properly-defined equity objectives can be pursued without compromising efficiency.
  - Equity needs to be kept in perspective — spending on water (and sewerage) is less than 1.5 per cent of total spending by even the lowest income households.
- An efficient urban water system requires that:
  - At the margin water is allocated to those users and uses, including environmental uses, where its value is highest.
  - Water is sourced and distributed at the lowest possible social cost.
  - Investment to add to water supplies occurs when the value of the extra water and water security to users exceeds the social costs of the investment.
- Restricting use, rather than pricing to ration demand when water is scarce, has been pursued in Australia’s cities and towns. While effective in managing urban water shortages, restrictions have led to significant costs among which are:
  - preventing users from using water in ways they value most
  - imposing significant time and inconvenience costs on most households
  - inducing many households and other customers to buy water tanks and greywater systems (usually high-cost sources of water) to reduce the impact of the restrictions.
- Under current institutional arrangements, supply augmentation has the potential to create perverse impacts with high associated costs to the community.
  - Offering customers choice in the water security/water charges mix of their water product could enhance economic efficiency and equity in water augmentation.

2.1 Introduction

What are the appropriate objectives for urban water policy? Existing water policy has a range of objectives, including efficiency, water security, public health, environmental protection, commercial requirements of publicly-owned water utilities, and equity (section 2.2).

The consideration of objectives in this chapter is conducted mainly at the level of principles, but is also informed by practical realities. Some realities are *physical or institutional* in nature. One example is the competition for 'natural water' between urban systems and rural and environmental water systems. Another is the potential, already realised in Perth and in the construction or planning stages elsewhere, to supplement natural water with manufactured (desalinated) water. Urban water, traditionally sourced mainly from dedicated natural sources, needs to be considered in relation to the other natural water systems and also to the opportunities for the efficient use of manufactured water — with the latter including recycled water and treated stormwater as well as desalinated water.

A *social* reality is the small size of spending on water in household budgets. This has implications for the equity consequences of changes in charges for water.

The remaining sections focus on the *achievement* of efficiency and equity objectives. This is done first for water management in Australia's large centres in the 'big dry' of the past decade (section 2.3).

The final section focuses on the supply side — supplementing urban water, including through transfers from the rural sector and by the introduction of manufactured water. The supplementation of water supplies currently in train involves non-traditional sources of water, and institutional and pricing arrangements that are still in development. It is therefore not possible to assess the achievement of economic efficiency and equity for water supplementation. Instead, drawing on the discussion of objectives, principles are outlined that offer guidance in determining sourcing, pricing, and institutional arrangements for new water.

2.2 Objectives for urban water

An objective of every urban centre is to have an efficient water system that reliably can meet the water requirements of households, businesses and other customers. Environmental protection is important in sourcing water and disposing of waste water, as is the balancing of urban demands and environmental demands for water when the two are in competition. 'Equity' or fairness is another important objective in planning and managing urban water systems.

As noted in chapter 1, the COAG National Water Initiative (NWI) of June 2004 agreed that the outcomes of urban water reform were to:

- provide healthy, safe and reliable water supplies
- increase water use efficiency in domestic and commercial settings
- encourage the re-use and recycling of wastewater where cost effective

- facilitate water trading between and within the urban and rural sectors
- encourage innovation in water supply sourcing, treatment, storage and discharge
- achieve improved pricing for metropolitan water (COAG 2004, para. 90).

The first two agreed outcomes are key objectives of urban water systems. The other outcomes are better viewed as means for achieving system objectives.

Judging by statements and actions by state and territory governments, five key objectives in planning and managing urban water systems are:

- efficiency — physical and economic
- security of water supply
- environmental protection
- commercial viability and a return to government on the investment in the urban water system
- equity.

The objectives of security of water supply, environmental protection and commercial viability can — like the NWI urban water outcome 'healthy, safe and reliable water supplies' — be encompassed appropriately in the economic efficiency objective. Because they are often viewed as separate objectives, however, they are considered separately.

Efficiency

Measures of *physical efficiency* in water systems often focus on the water lost from a system (through leakages and evaporation, for example), the volume of water used in producing a particular output (such as a tonne of rice or steel), or the amount of water used by consumers (for example, household water use in a year). While such measures can point to ways to improve urban (and other) water systems, measures of physical efficiency do not take into account: the value of water as a resource; the value of the services water provides to households, firms and other users; or the costs of saving water[1].

Unrealised opportunities to increase physical efficiency in water use are in themselves no more an indicator of *economic inefficiency* than is throwing out food that deteriorates in household storage. Economic efficiency considers all the costs and benefits of an action, not just the effects on the physical efficiency of water systems.

[1] In considering the limitations of physical measures of efficiency in urban water use for policy purposes, criticisms levelled at the use of activity 'gross margins' for assessing efficiency in rural water use are relevant. See, for example, Douglas, Dwyer and Peterson 2004.

Economic efficiency in urban water systems therefore brings together the demand and supply sides of the systems, such that households and other customers are provided with the water, water quality and water security that they are willing to pay for.

It is generally accepted that in most circumstances the valuations assigned to private goods and services by individuals also represent their social valuation. That is, although they sometimes make mistakes, individuals generally know better than governments and others what is most valuable to them, and how much of particular goods and services to buy and how to use them.

In the context of a water shortage necessitating a reduction in water use, this conventional view is stated by Harberg (1997):

> … the tastes and preferences of individual customers may vary widely … a particular residential customer might prefer never to wash a car in order to provide for a cherished garden. Other customers might cheerfully let all landscape die in order to retain longer-than-average showers. These taste differences are generally of no concern to the water provider. (Harberg 1997, p. 45)

In contrast with the view that ‘the customer’s preferences should determine where he/she saves water’, governments have prohibited some uses, restricted others, and left yet others unrestricted. Moreover, several governments have introduced *permanent* restrictions on some water uses, implying that, regardless of their marginal value to users and of the level of water in storages, such use can never be justified. For example, the Victorian Government (2003, p. 43) said ‘Behaviour such as hosing driveways and footpaths must become actions of the past’.

While the public health and environmental objectives of urban water management involve externalities, these can be addressed without departing from the position that water in the urban setting is a private good, the efficient allocation of which depends on the preferences and marginal valuations of its users. For example, regulatory and/or market approaches can be used to achieve desired water quality standards and environmental attributes.

Economic efficiency of an urban water system increases in the following circumstances:

- if water is shifted from water users for whom and uses in which its marginal value is lower, to users and uses with higher marginal values
- if lower-cost water supplies replace higher-cost supplies
- if a city’s water supplies are augmented at a marginal cost per gigalitre that is less than customers are willing to pay for the extra water.[2]

[2] Extra water security may be important in determining willingness to pay, even if the addition to security is not associated with an increase in water use in normal times.

The overall efficiency of water allocation in Australia depends on the relationships between the urban, agricultural and environmental water systems. Where physical linkages between the three systems exist, or can be developed for a cost less than the benefits, the ability to reallocate water continuously between the three systems to equate its marginal social value in each is central to achieving national-level efficiency in water use. Regional or functional separation of the water systems is as undesirable as isolation of the labour or capital markets in a particular region or industry from the rest of the market. An integrated market for water in which agricultural, urban and environmental interests trade freely is a desirable, and probably essential, requirement for maximising the overall value obtained from Australia's water.

Security of water supply

The higher the level of water security a city or town has, the lower is the chance that it will need to resort to tough demand management measures — price increases or non-price restrictions on water use — in times of water shortage to reduce water use substantially below 'normal' levels.

A city's water security can be increased by investing in infrastructure that adds to available water supplies. A variation on infrastructure investment is to arrange *options* to invest in infrastructure in the event that the supply/demand balance for a city's water warrants that — options contracts to buy rural water can also serve this purpose. Water security can also be increased by using somewhat higher water prices, or 'low-level' non-price water restrictions, to reduce water consumption in normal times.

If a city's annual water use is increasing as a net result of changes in population, income and other factors influencing consumption, its water security will decrease unless sufficient additions occur to available supplies — or unless the demand management measures applying in normal times are tightened.

Measuring water security and assessing its desired level is made more difficult if there is reason to think that changes are occurring in the long-term pattern of rainfall and water runoff.

Balancing the costs and the benefits of additional security is a complex task (box 2.1). Extra security comes at a cost — the cost of water-augmenting infrastructure (which in many years may not be needed) and/or of long-term reductions in water consumption.

Box 2.1 **How much water security is optimal?**

The level of a city's water security can be assessed as the proportion of years in every 50 years, say, in which its water use will need to be restricted by substantial increases in water prices or by severe non-price restrictions on the basis of expected long-term rainfall and runoff patterns. Extra water security can be obtained by investing in additional water supply infrastructure or by establishing options to access water — or by modest reductions in water use when water is relatively abundant.

It is not possible, at a cost that water customers would willingly pay, to build an urban water system that could be guaranteed always to meet water demand without the need for price increases or non-price restrictions to accommodate a relative scarcity of water. The precise nature of the tradeoff between the level of water security and willingness to pay would vary between customers, but most households and firms would choose a level of water security involving some degree of rationing sometimes — by raising price above its 'normal' level, or by introducing some elements of non-price restrictions — rather than pay a substantially higher water price every year for a 'Rolls Royce' water supply that always (more realistically, *almost* always) met their demand.

Expressed differently, a level of investment in water infrastructure that sometimes requires resort to a degree of price-or quantity-rationing of water is more economically efficient than a level that provides many billion dollars of unused capacity in all but the one-in-200 years ultra-dry period.

The level of water security that an urban population is willing to pay for is likely to increase with rising incomes. The cost of providing extra water security tends to fall with technological advances (for example, in desalination technology); these act to increase the economically efficient level of water security. In contrast, increases in the social value assigned to negative environmental impacts from augmenting water supplies act to increase the cost of enhanced security, and tend to reduce the economically efficient level of security.

Within existing urban water regimes, decisions that impact on water security are centralised in the hands of governments and their water utilities. Individual customers can influence their own water security at the margin by investing in water tanks and on-site water recycling. Government policies of relying mainly on non-price restrictions to reduce water use in times of shortage reduce water security for many households, councils, sporting clubs and other customers, causing them to invest more in enhancing their own water security. If rationing were done instead by scarcity pricing, mains water would be available to those willing to pay for it, though the higher prices would make increased own-sourcing more cost-effective relative to a situation of lower water prices and no non-price restrictions.

Environmental protection

Extracting water from streams or groundwater, manufacturing water by recycling or desalination, and disposing of waste have effects on the environment — as is the case when other human activities are undertaken. It is desirable that the planners and managers of urban water systems factor into their decisions the positive and negative effects on the value of environmental services experienced by people. Success in achieving the environmental objective is enhanced if there are signals and incentives that indicate what is environmentally valuable.

Markets for environmental water, perhaps operated by environmental managers, are one way of providing incentives for an efficient balancing of water between environmental, urban and other uses. Watson (2003), Freebairn (2003), Bennett (2005) and others have pointed to the importance of improved information on the value assigned to different water-related environmental public goods in making better decisions on environmental water — including decisions guided and facilitated by markets — and in advancing the environmental objective.

Commercial viability and dividend to government

Since 1994, urban water businesses structured as government trading enterprises (GTEs) have been placed on a more commercial basis, often involving corporatisation. The Commission has observed that:

> … governments have sought to give GTEs a greater commercial focus and facilitate competitive neutrality by exposing them to capital market disciplines and regulations similar to those faced by private sector businesses. (PC 2007, p. 152)

Urban water businesses are required to recover their full costs, including the capital costs of their infrastructure, and to pay dividends to their owner-governments. The GTEs providing water services to the mainland state capitals and the ACT paid more than $1 billion in dividends to their respective governments in 2005-06 (PC 2007, pp. 159–203).

Freebairn (2008) supports explicit resource rent taxes, with the proceeds going to consolidated revenue, in circumstances where the marginal costs of new water are substantially above the marginal costs of traditional water. The issue here is not how to ration water when demand exceeds supply, but the distribution of the economic rents available from lower-cost inframarginal water. Freebairn sees appropriation of those rents by governments as desirable for equity as well as economic efficiency.

Equity

The concept of 'equity' arises in different contexts in relation to urban water, as it does for other areas of public policy. Two dimensions of equity that appear to be important in the urban water setting are considered briefly below:

- the notion of 'entitlements' to water
- the burden of water bills for low-income households.

Another dimension of equity — equity in the demand management regime — is addressed in section 2.3.

Entitlements to water

In government statements on urban water policy the idea that *all* households are entitled to a basic allowance of water at a low or zero price sometimes appears — the rationale being that water is essential for life. Two points that are relevant in considering that view can be noted.

First, it is unusual for allocations of particular private goods or services — including essential items such as food and accommodation — to be provided free of charge to everyone, regardless of their means. Through the social security system, however, members of the community are ensured a minimum level of *income* sufficient to purchase all 'essentials of life'.

Second, provision of a water entitlement to all households at a relatively low variable (usage) charge is to a degree achieved at present through the inclining block tariff (IBT) structure. In the presence of a fixed (access) charge, which all capital cities have, a modest water entitlement at a low or even zero price is consistent with cost recovery and with a high level of economic efficiency.[3]

Spending on water in relation to household income

Keeping the size of water bills down for low-income households is an important objective of governments. Information on weekly spending per household on water and sewerage in 2003-04, by household weekly gross income quintile, is available from the ABS Household Expenditure Survey (table 2.1).

---

[3] Efficiency is compromised more with increases in the size of the low-price entitlement and consequential increases in the proportion of households using less water than their entitlement. Increases in that proportion make worse the efficiency-reducing effects of different marginal valuations of water across households.

Table 2.1 **Average weekly expenditure on water and sewerage rates and charges by state total weekly household income, 2003-04**

	Gross income quintile			*All households*
	1	3	5	
New South Wales				
a) Water and sewerage ($)	3.48	5.12	9.52	6.10
b) as per cent of total expenditure on goods and services (%)	0.80	0.57	0.60	0.65
Victoria				
a) Water and sewerage ($)	5.33	7.84	10.54	7.93
b) as per cent of total expenditure on goods and services (%)	1.28	0.91	0.69	0.89
Queensland				
a) Water and sewerage ($)	2.34	2.47	3.75	2.46
b) as per cent of total expenditure on goods and services (%)	0.59	0.30	0.30	0.30
South Australia				
a) Water and sewerage ($)	3.94	9.11	12.56	8.46
b) as per cent of total expenditure on goods and services (%)	1.08	1.28	0.86	1.04
Western Australia				
a) Water and sewerage ($)	3.93	6.79	9.60	6.62
b) as per cent of total expenditure on goods and services (%)	0.94	0.81	0.66	0.76
Tasmania[a]				
a) Water and sewerage ($)	0.77	1.31	…	…
b) as per cent of total expenditure on goods and services (%)	0.19	0.19	…	…
Northern Territory				
a) Water and sewerage ($)	3.67	8.32	11.44	7.62
b) as per cent of total expenditure on goods and services (%)	0.74	0.81	0.67	0.73
Australian Capital Territory				
a) Water and sewerage ($)	5.72	6.97	10.88	8.32
b) as per cent of total expenditure on goods and services (%)	1.40	0.63	0.65	0.79

a Entries for some cells for Tasmania were judged unreliable and are not shown.

Source: ABS, *Household Expenditure Survey 2003-2004.* Expanded CURF. Canberra.

For the 20 per cent of households with the lowest gross incomes, average weekly spending on water and sewerage ranged from $0.77 in Tasmania to $5.72 in the ACT. As a percentage of household gross income, the range was 0.19 per cent in Tasmania to 1.40 per cent in the ACT.

Moreover, given that all capitals have an access charge that in 2005-06 ranged from 21 per cent of the average household water bill in Canberra to 51 per cent in Perth (WSAA/NWC 2007), an increase of say, 10 per cent in the variable component of water charges would be expected to increase water bills by significantly less than 10 per cent — even if there was no reduction in water use.[4] Given that households respond to higher water prices by

[4] The figures mentioned relate to water only. In mainland capitals other than Melbourne, sewerage charges are entirely of a fixed nature.

reducing their water use, the effect of an increase of 10 per cent in the variable charge for water on households' water bills is reduced further.

The small amount spent on water by low-income households, together with the fact that water bills increase proportionately less than increases in volume-related water charges, suggests a weak case for avoiding price increases to ration scarce water. Nevertheless, if the effects of the required price increases on the welfare of low-income households were judged to be socially unacceptable, targeted social welfare measures could be used to offset the effects, while retaining the desired incentive effects of the price increases.

A bottom line on objectives

Given the emphasis in policy making in Australia on enhancing the efficiency with which the economy meets domestic and foreign demand, and given that objectives in the areas of water health and quality, security of water supplies, environmental quality and commercial viability of water utilities can be factored into economic efficiency, that objective has a strong claim to being treated as fundamental.

That is not to deny the need for urban water systems to rate well on equity or fairness. If, however, present urban water policies are rationalised largely on grounds of 'equity', the costs to the community are likely to be high, as discussed below.

2.3 Urban water management in the 'big dry'

Notwithstanding the investments in train — amounting to $30 billion over the next five to ten years (WSAA 2007) — the enduring use of water restrictions indicates that investment in water has not kept pace with the demands of Australia's cities at recent water prices.

Marsden Jacob Associates (2006) reported that water capital expenditure per capita in the years 2001–2005 was much lower for Adelaide ($115), Brisbane ($146), Melbourne ($172) and Sydney ($213) than for Perth ($421). It related this to differences between cities in climate scenario planning:

> Over the past five years per capita expenditure in Perth, which has incorporated a 'step-down' climate scenario into planning for many years, has been twice or more the level of water supply investment in Sydney, Melbourne, Brisbane and Adelaide, which have not adopted scenario planning approaches or not done so until very recently. (Marsden Jacob Associates 2006, p. ii)

While contemporary judgements that runoff into urban water storages would be higher than it has proved to be are important in explaining recent under-investment in urban water supplies, opposition to some investment options — including new dams and direct rural-urban water trade — has also been a significant factor. In the view of one critic of urban water policy '[the] real hidden issues in the new urban water "political correctness" are the blockade of new supply and arbitrary rationing of existing supply' (Dwyer 2006, p. 14). In similar vein, the Business Council of Australia wrote '[governments] have been slow to consider the range of options to improve supply and instead have relied on consumers' efforts to reduce demand' (BCA 2006, p. ii).

Water supplied by the water utilities in Australia's mainland capitals in the two years July 2000–June 2002 (pre-restrictions in capitals other than Perth) and in the two years July 2004–June 2006 (restrictions in force for the full period in Perth, Melbourne, Sydney and Canberra and from 3 October 2005 in Brisbane)[5] is shown in table 2.2. The volume of water supplied decreased between 10 and 16 per cent for capitals in south-eastern Australia, by 6.6 per cent in Brisbane and by 3.8 per cent in Perth. Water supplied in Darwin increased.

Table 2.2 **Water supplied to mainland capitals by type of user and average residential consumption per property**

Average 2000-01/2001-02 and 2004-05/2005-06

	Volume supplied (GL)[a]		*Of which (%): Residential*		*Commercial & industrial*		*Other*		*Average residential consumption (kL/property)*	
	2000-02	2004-06	2000-02	2004-06	2000-02	2004-06	2000-02	2004-06	2000-02	2004-06
Melbourne	483	434	60.7	61.9	27.3	27.2	12.1	11.0	226	190
Sydney	625	527	60.1	61.6	18.2	23.7	21.7	14.6	253	207
Brisbane	167	155	58.2	55.9	28.5	29.8	13.3	14.2	271	225
Adelaide	184	165	63.4	66.4	20.7	21.0	15.9	12.5	262	234
Canberra	52	50	64.5	64.9	25.7	26.5	9.8	8.6	320	251
Perth	237	228	70.1	69.4	16.2	21.3	13.7	9.3	312	273
Darwin	33	35	49.7	48.9	31.3	38.0	19.0	13.3	487	444

a Excludes environmental flows and bulk water exports.

Source: WSAA and NWC (2007).

For capitals other than Brisbane and Darwin, residential water use was between 60 and 70 per cent of water supplied. The capitals are listed in order of average residential water consumption per property in July 2004–June 2006 — Melbourne is lowest and Darwin highest. In all capitals, residential use per property fell between July 2000–June 2002 and July 2004–June 2006, the falls ranging from 28 kilolitres in Adelaide to 69 kilolitres in Canberra.

5 Water restrictions commenced in Adelaide on 23 October 2006. Darwin does not have water restrictions.

The ABS Water Account showed that outdoor use amounted to 44 per cent of national household water use in 2000-01 (ABS 2004). Households in Queensland, South Australia, Western Australia and the Australian Capital Territory reported using more than 50 per cent of water outdoors. In Victoria 35 per cent of household water was used outdoors, and in New South Wales 25 per cent. These differences reflect many factors, including differences in the nature of housing, block sizes, number of occupants per dwelling and climate.

ABS's subsequent Water Account (ABS 2006), which reports water use in 2004-05, does not provide information on outside use of water by households. It would be expected that the water restrictions would have caused outside water use to fall proportionately more than total household water use. If three-quarters of the fall in Australia's household water use between 2000-01 and 2004-05 was in outside water use, the share of outside water use would have fallen from 44 per cent to 41 per cent, and if *all* of the reduction in national household water use was in outside water the outside share would have fallen to 38.5 per cent.[6]

In managing the water scarcity experienced by mainland capitals and many other population centres since early in this century, reliance has been placed mainly on prescriptive non-price restrictions. Notwithstanding that the need to recognise the real value of water has been a theme in government communication with water users, relatively little use has been made of price increases as a demand management measure. In some instances, governments have even reduced water prices to many users as they introduced packages of measures intended to conserve water.[7]

The packages of measures used to reduce water use in urban centres have included:

- prohibitions on some outside water uses and restrictions on others for households and other water users[8]
- mandating water-saving items (for example, low-flow shower heads in new houses)
- education (for example, on physical water-efficiency of different plumbing fixtures, appliances and garden practices)

---

6 An estimate of water for 'seasonal' uses — gardens, swimming pools, spas and evaporative coolers — by households supplied by Yarra Valley Water, Melbourne's largest water retailer, put seasonal water use at 25.4 per cent of annual water use by households in 2004 (Roberts 2005).

7 For example, with the introduction of an IBT in Melbourne in October 2004, the price to households for the first 40 kL of water used per quarter was reduced from $0.79 to $0.75 per kL.

8 Many cities have targets for reducing water use. Usually, there is no requirement that individual households reduce their use, though the net result of the demand management measures is to reduce use by most households. In south-east Queensland, however, households using more than 800 litres per day (1 000 litres for households with five or more occupants) without a legitimate reason for high water use are subject to penalties, including fines up to $1 050, a ban on outdoor watering and restriction of their supplies (QWC 2008).

- moral suasion (for example, reduce shower times in the community's interest).

Although non-price measures have been the main demand management armoury of urban water authorities, some use has been made of price/quasi price measures, including:

- IBT structures, with substantially higher prices in some cities for water use above the 'essential' level
- subsidies on household water tanks, and on certain water-saving plumbing fixtures and gardening inputs
- offsets arrangements permitting swimming pools and spas to be filled if equivalent water is saved elsewhere in households.

Effects on economic efficiency

In terms of economic efficiency (section 2.2), the approach to demand management for water in Australia's state capitals and in Canberra has several problems:

- the prohibitions and other restrictions on outside uses of water prevent households using water in the ways that are most valuable to them
- the prohibitions on watering lawns or gardens, or restrictions on the times and means of watering — and the risk that existing restrictions will be tightened — induce many people to invest, often at high cost, in private water storage as insurance to protect their gardens and lawns[9]
- the IBTs mean that different households pay different water prices at the margin, resulting in inefficient allocation of water between users, and potentially creating incentives for inter-user trade
- the absence of incentives for a common marginal valuation of water across water users and uses prevents the equating of its marginal value everywhere with the marginal cost of water supply
- in addition to these distortions, there are instances of perverse incentives. For example, Crase and Dollery (2005) examined subsidies paid in Melbourne on water-saving investments for households and found the cost per megalitre of water saved ranged from $770 for AAA shower roses, through $9,069 for rainwater tanks, to $33,395 for

[9] Reporting on a study it commissioned by consultants Marsden Jacob Associates of the costs of rainwater tanks, the NWC Chairman Ken Matthews said: 'In every case, the cost per kilolitre of tank water is greater than the price charged by water utilities' (NWC 2007b). The distortion of the market for rainwater tanks by the water restrictions, the subsidies on tanks and the misleading information put about on their cost-effectiveness is reflected in waiting periods of several months for delivery of tanks.

AAA dishwashers[10]. Another example is incentives for deliberate excessive use of drinking-quality water through showers, baths and water tanks to generate additional 'greywater' for use on lawns and gardens

The limited use of price in rationing scarce urban water is inconsistent with economic efficiency and has been criticised widely (for example, Business Council of Australia 2006; Byrnes, Crase and Dollery 2006; Freebairn 2005a; Grafton and Kompas 2006a; Ng 1987; Sibly 2006; Young et al. 2006). Edwards' (2006) conclusion about demand management for water in Melbourne applies also to the other mainland capitals:

> Melbourne's demand management regime for water therefore does not allow the maximum potential value to be obtained from the available water unless the state's implicit valuations are accepted as overriding private valuations in a way that would not generally be contemplated for private goods. (Edwards 2006, p. S62)

Empirical estimates of the economic costs of water restrictions on households in three Australian cities are provided in box 2.2. Methodological and other differences between the studies pose difficulties in comparing the costs of the restrictions between cities. Economic costs increase with the severity of restrictions and with the opportunity cost and the disutility cost of the extra time spent watering using the labour-intensive methods allowed under the restriction regimes.

10 In early 2005 the variable usage charge (price) of water to Melbourne households was equivalent to $750, $880 and $1,300 per megalitre, respectively, for water in blocks 1, 2 and 3.

Box 2.2 **Estimates of costs of water restrictions for households**

Sydney: Using a Marshallian consumer surplus approach, Grafton and Ward (2007) estimated the welfare cost per Sydney household in 2005 at about $150 above the cost of achieving the same level of water use with higher water prices. This reflects the effect of prescriptive water restrictions in preventing households using a given volume of water for the purposes they value most highly.

Perth: Assuming typical preferences for 'greenness' and valuing time spent holding hoses at its opportunity cost, Brennan, Tapsuwan and Ingram (2007) estimated the annual costs of water restrictions at $67 per household for restrictions that allow watering twice a week using sprinklers, and $347 (opportunity cost of time equal to 33 per cent of mean wage) to $870 (opportunity cost equal to mean wage) for bans on the use of sprinklers. The costs were lower for people who placed a lower value on greenness, and higher for those who valued it more highly. The baseline is no water restrictions and the same water price (and hence higher water use) as with restrictions.

Canberra: Hensher, Shore and Train (2006) used choice experiments to estimate Canberra households' willingness to pay to avoid water restrictions. They found respondents were unwilling to pay to avoid low-level restrictions, including restrictions that allowed watering only on alternative days. To have stage 1 or 2 restrictions rather than stage 3, 4 or 5 restrictions, respondents were willing to pay an average amount of $109, $130 and $268 per year, respectively, given that restrictions were applied once in every ten years.

Sources: Brennan, Tapsuwan and Ingram (2007); Grafton and Ward (2007); Hensher, Shore and Train (2006).

The costs of water restrictions captured by the estimates presented in box 2.2 differ between cities, but none of the estimates includes all the costs. The impacts of the water restrictions are made clearer by the following listing of some of the costs people experience in their everyday lives. Some of those costs are experienced by many people, others by few. They include:

- the deterioration of lawns and gardens
- purchasing and installing new watering systems as changes occur in allowed methods of watering
- the need to adopt labour-intensive methods of watering when watering is permitted — a tax in kind on watering
- loss of sleep and/or leisure as a result of setting alarms to arise and water gardens in permitted time periods
- having to water in the dark
- cancelling or rearranging other activities in order to water gardens at permitted times
- inability of children to play under garden sprinklers and to use water toys

- carrying 'greywater' in buckets from showers to outdoor plants
- the need to drive cars to a car wash to clean them
- increased damage to buildings, other structures and pipes through cracking (Archicentre 2006).

The *aggregate* cost to Australian urban households of the water restrictions can be approximated by taking costs for particular cities and applying them to the entire urban population subject to restrictions. If the estimate of $150 per household for the extra cost of using water restrictions rather than price increases to ration water use in Sydney in 2005 is applied to the approximately 80 per cent of Australia's households then subject to restrictions, the corresponding estimate of the national cost is around $900 million. Given the likelihood that costs excluded from the Sydney estimate (for example, the costs of rearranging gardens and installing watering systems that are allowed under the restrictions[11], the costs — including reduced leisure and/or sleep — of time spent watering gardens in permitted labour-intensive ways, the deterioration in gardens and lawns) dominate the costs included in the estimate, the annual cost of the water restrictions to Australian households is probably a multi-billion dollar figure under recent high-level restrictions.

Water restrictions impact on people beyond their homes. They experience loss of amenity from unwatered council parks — or they pay through their rates for high-cost recycled water to keep them green. Community sporting facilities have been adversely affected. For example, some football and cricket competitions have been cancelled or their start delayed because of the state of water-deprived sports grounds (see, for example, SaveFooty.com 2007). Impacts of the water restrictions on tennis clubs in Melbourne are outlined in box 2.3.

Households and businesses in urban centres are affected also in less obvious ways by the water restrictions. For example, water restrictions have resulted in reductions in output from water-dependent, coal-fired electricity generators. This has exacerbated the reductions in hydro-generation output due to water shortages. These influences have led to higher wholesale electricity prices.

11 Grafton and Ward (2007) include an allowance for the welfare cost of household water tanks (compared with relying on price to ration water demand) but not for other changes to watering systems such as dripper hoses and greywater systems.

Box 2.3 Costs experienced by tennis clubs due to the water restrictions

Until late 2007, the stage 3A water restrictions in force in Melbourne, where water-requiring en-tout-cas (clay) surfaces are the norm, allowed tennis clubs to water only half their courts. Rotation of the courts watered was not permitted. The restriction on watering limited the use that could be made of courts. Should level 4 restrictions have been introduced, *no* watering from mains supplies would have been permitted. Many tennis clubs would have been forced to shut down unless they could arrange for water from alternative sources.

To ensure their continuing operation, some tennis clubs decided to spend in excess of $20 000 per court to replace the en-tout-cas surfaces with synthetic surfaces. In doing that they expected to save approximately 200 kilolitres of water per court each year. Burwood Tennis Club, which obtained a council-guaranteed loan to replace its five clay courts at a cost in excess of $110 000, saving an estimated one megalitre of water a year, is an example. (That cost does not include any value for the hundreds of hours of club members’ time in investigating options, planning the project, obtaining permits, and raising funds.) At current block-three water prices in Melbourne, the saved water has an annual value of approximately $300 per court.

Investing more than $20 000 to save $300 per year would usually be considered financially irresponsible. For tennis clubs — and other community sporting organisations — that course may have been their best option because of the constraints imposed on them by governments. If scarce water was rationed instead by means of price, clubs would not be put in the position of having to invest heavily in reducing dependence on mains water to ensure they could make full use of their courts and to guarantee their continued existence. With mains water available to tennis and other sporting clubs at prices even five times current prices, clubs would be able to avoid the extreme penalty costs of the ‘water only half your courts’ restriction, and they would have a stronger incentive than pre-restrictions to take cost-effective measures to save water.

In late 2007, tennis clubs were given the option of watering all their courts if they treated them with calcium chloride or magnesium chloride — which improves their capacity to retain moisture — and achieved a 20 per cent reduction in water use compared with use under the stage 3A restrictions. While this is a much cheaper option for tennis clubs than replacing their clay courts, and one that higher water prices would encourage them to consider even with no water restrictions, it does not remove the uncertainty about their future in the event that stage 4 restrictions are introduced.

Sources: Burwood Tennis Club (2007); Tennis Victoria (2007).

Equity in demand management regimes

Notwithstanding the costs of prescriptive urban water restrictions outlined above, some water utilities and governments have said that the demand management packages for their largest cities have been widely accepted. This could be seen as suggesting considerable support for those packages — in which prescriptive water restrictions are central — over other approaches to reducing the use of water when it is scarce.

One possible explanation of support for water restrictions is that, despite their experience with price movements for fresh food items as the balance between supply and demand changes, people have little conception of using prices to manage demand for water.

Or, perhaps many see it as equitable that, given the need to save water, *everyone* shares the loss from bans and other restrictions on watering lawns and gardens using fresh mains water. This might be construed as an implicit contract between householders and governments allowing unrestricted use of water at relatively low prices inside the house in return for accepting prescriptive restrictions on outside uses of water. This ‘contract’ may be seen as fairer than alternative approaches relying on higher water prices to reduce demand.

There are, however, questions about the equity of particular characteristics of the demand management regimes. One example that directly challenges the notion of an implicit contract is the treatment of households that in the absence of water restrictions use little water inside and substantial amounts outside — two-minute shower, large European garden households — vis-à-vis households of the same size and composition that are high users inside and small users outside — ‘water wallies’ inside, whose native vegetation makes do with whatever rain falls. Households in the second category may be scarcely affected by the water restrictions used in Australia’s cities, while the first group experiences high costs. Another example is the equity of denying children the experience of playing under sprinklers on the lawn while the children of pool owners can continue to swim.

There are also important higher-order questions. Have all options been considered? Would equity be enhanced by restricting the water use of each household — and other customers — to the ‘acceptable’ level, while leaving them the freedom to choose *how* to use it? Would the provision of a base level of water at a low or zero price — canvassed above under ‘entitlements to water’ and addressed in chapter 3 — with scarcity pricing for water above the base level, provide a better balance between government regulation and individual freedom, and between equity and efficiency, than the current approach? Alternatively, consistent with the approach taken to most essential goods and services, everyone could face a uniform price for all the water they use, with non-distorting income supplements targeted to low-income households.

The association representing the water supply industry has offered the following assessment of the water restrictions:

> Experience over the last several summers indicates that ongoing harsh water restrictions will not be accepted by the community and the challenge is to develop

> reliable supplies of water for our growing cities in a sustainable manner. (WSAA 2007, p. 2)

Many households bear costs from the water restrictions not only in summer, but throughout the year. Those costs *could* be removed in the short run by alternative approaches to allocating water when it is scarce. In the longer term, investment in new water supplies and their efficient integration into urban water systems, could even make the prescriptive demand management regimes for water — and their inequities — an historical curiosity.

2.4 Principles in augmenting urban water supplies

Recent decisions announced by the governments of all mainland states will mean that the traditional supplies of capital cities from dams will be supplemented by water from three new sources. Australia's first desalination plant serving an urban centre commenced operations in Perth in November 2006, and all other mainland states have plans to manufacture potable water in desalination plants. Victoria, South Australia and Western Australia have also committed to sourcing water for their capital — and in some cases for other urban centres — by transfers from the rural sector. The third new source of water is recycled water. Already making a small contribution to non-potable water supplies in many urban centres, recycled water is planned to supplement the potable water supplies of south east Queensland from 2009 (QWC 2007a).

In Queensland and Victoria the water infrastructure investments include the construction of water grids that will allow water to be moved to where it is needed within the most populous part of those states.

Implementation of the recent decisions on water augmentation will cause fundamental changes in urban water systems. In traditional systems, much of the work of capturing and transporting urban water is done by gravity. In future, urban water systems will be more energy-and capital-intensive. Cities that rely predominantly on natural water from their own catchments will in future have multiple sources of water. The diversification of sources will reduce the uncertainty about system-level available water supplies. This is most obvious in the case of desalinated water and recycled water whose availability is independent of rainfall.

Another change, albeit limited thus far, is the movement towards integration of rural and urban water systems. Agriculture accounted for 65 per cent of the 18 767 gigalitres of water extracted from the environment in 2004-05 (ABS 2006). Because urban water use is small relative to rural use, integration, like the introduction of manufactured water, reduces the uncertainty about urban water supplies. Integration could facilitate the introduction of a competitive, market-driven element to urban water systems. More generally, integration of rural and urban water systems is essential for efficiency in *national* water allocation — just as efficiency in labour and capital markets requires integration of the rural and urban components of those markets.

Integrating new manufactured water and rural water efficiently into urban water systems poses challenges, including dealing with any external costs, that are addressed in chapters 4-6. Here, some principles that can provide guidance in assessing the augmentation of urban water are outlined. These principles emerge from the consideration of the urban water objectives of economic efficiency and equity in section 2.2.

In considering the supplementation of a city's water supplies there are important decisions at the investment and operational stages. For assessing how well investment in new water performs on economic efficiency, key criteria are:

- the marginal value of the extra water in relation to the costs of providing it
- the cost-effectiveness of the extra water supplies.

A positive benefit-cost outcome for a water augmentation option does not give an economic imprimatur to the option if there is an alternative that would yield equivalent benefits at a lower cost.

After investments have been made, there are choices about how much water to obtain from each source in each period. Making these decisions will in future require decisions about when to operate desalination plants and when to transfer water from the rural sector to urban centres.

Cost-effective sourcing of water

A basic principle in considering the supplementation of urban water supplies is to consider *all* the options. The NWC has emphasised that

> … where certain options are ruled out even before evaluation, there cannot be a transparent debate about the alternatives, and communities may be saddled with less cost effective options. (NWC 2006, p. 12)

Commitments by governments to no new dams and to opposing direct trade between rural and urban water systems are striking instances of the NWC's point.

It is cost-effective and economically efficient to source as much water as possible from the lowest-cost source, and then, in turn, as much water as possible from the second-lowest cost source, and so on until water requirements are met.[12] However, setting up institutional

[12] If that requires different costs for treating the water from different sources to meet health and safety standards, those differences must be allowed for in comparing water sources.

arrangements and incentives that are consistent with sourcing an urban centre's water needs in the lowest-cost way is a major challenge.

The principle of least-cost sourcing applies in the short run in deciding how much water to draw from each existing source, as well as to longer-run decisions on investing in new water sources.

Pricing water to users when supplies come from multiple sources with different marginal costs

Meeting the efficiency condition that user prices for water are at least equal to its marginal social cost requires a marginal cost approach to pricing, as distinct from pricing based on average costs (or an average of marginal costs) for water from different sources. There are, however, alternative interpretations of marginal cost pricing of water to customers when water comes from two or more sources at different marginal costs. The merits of each from the view of economic efficiency and other criteria, within the existing institutional framework, are considered in chapter 3. With the introduction of competition to urban water systems, competitively determined market prices could potentially replace administered prices — see chapters 3–6.

Decisions on operating sunk infrastructure

For economic efficiency, decisions to invest in adding to urban water supplies need to be informed by comparing total benefits and total costs from the investment. Once the investment, in a rural–urban pipeline or a desalination plant, say, has been made, decisions need to be made on when to use the pipeline and when to run the desalination plant.

When traditional urban catchment water is in short supply, the key efficiency test will likely be 'is the marginal value of urban water greater than the short-run marginal cost of rural water transported through the pipeline or the marginal operating costs of desalinated water'? Short-run marginal costs will typically be much less than long-run marginal costs — the latter is crucial for efficient decisions on *investing* in water infrastructure. That is, the test of whether it is efficient to operate an existing piece of infrastructure is easier to meet than the test of whether it is efficient to make the investment.

When urban catchment water is in plentiful supply, the marginal value of new water to urban users is likely to be less than the short-run marginal cost of providing it. It would then be inefficient to draw on the new water supplies to meet urban demand.

With urban own-catchment water in demand for environmental purposes as well as to meet demand in cities and towns, would there be circumstances in which it would be efficient to call on desalinated or rural water for urban use in order to make extra urban catchment water available for environmental uses? There could be. In a world of certainty, the presence of those circumstances would suggest a failure to allocate urban-catchment water efficiently between city demand and environmental purposes, equating marginal social valuations for water in each. In an uncertain and dynamic world, however, the vagaries of nature and changes in environmental preferences could work to make marginal valuations of environmental water greater sometimes than those for urban water, even with efficient processes for allocating water between the two. Economic efficiency might then be enhanced by using piped rural water or desalinated water to replace urban water that is transferred to environmental uses.

The principle that short-run marginal cost determines whether to use water supply infrastructure or allow it to sit idle need not be inconsistent with the concept of full-cost recovery in the presence of other ways of recovering capital costs. For example, 'water supply insurance' charges that were independent of water use could be applied to households and other customers.[13]

Roles for governments and customers in providing water security

Governments, and the urban water utilities they own, make decisions on investment in water supplies and on demand management measures when water is in scarce supply. These decisions — along with runoff into urban water storages — are the main determinant of the water security faced by most water customers. Customers can, however, supplement their water supplies and reduce the risks of being denied access to the water they want by investing in own-source water — by installing rainwater tanks, bores or greywater systems, for example. Potentially, private firms also have a role in enhancing urban water supplies and security — see chapters 4–6.

Is it efficient for government water suppliers to adopt a one-size-fits-all approach in their urban water policies? Would it be better to give customers choice between service packages offering lower water charges with lower water security — greater chance of restrictions — and packages providing higher water charges with higher water security? This choice could be provided within traditional urban water systems depending mainly on own-catchment water, and the case for doing it is arguably strengthened in the presence of low-risk, high-cost desalinated water — for which, given a choice, many may happily pay while many others may decline it in favour of lower water bills and a higher probability of restrictions. (The number of options need not be limited to two — there could be a

[13] With compulsory insurance charges for all households, say, some may be forced to pay a significant sum for extra water security on which they place a low value. 'Water products' differentiated by their 'security/charges tradeoff' would be a way of ensuring that only those who were willing to pay for extra water security bear the (volume-independent) insurance charge, and allowing the efficiency gains from making decisions on operating existing infrastructure on the basis of short-run marginal costs — see under immediately following heading.

continuum of products allowing each household to choose its mix of low-security and high-security water.)

Allowing each household — and potentially other customers, also — to 'buy' their preferred level of water security from their mains water suppliers would provide them with extra options. It would allow water users to compare the costs of investing in rainwater tanks and greywater systems as insurance against garden-threatening watering restrictions with the costs of a high-security supply of mains water.

If the idea of more than one water security/water charges product for urban households is opposed on the equity argument that it would create 'first-class and second-class households', the equity and efficiency consequences of compelling many households to pay for a 'higher quality product' than they would prefer, and many others a lower-security water service than they would choose, need to be addressed.

3 Pricing urban water

Key points

- State-owned urban water utilities operate administrative pricing systems that are regulated with the aim of ensuring revenue equals that required for cost recovery.
- Two-part water tariffs apply in most urban areas, with a fixed access charge and a variable volumetric charge (or price).
- The volumetric charges are generally set with an inclining block tariff (IBT) structure. This means that an initial quantity of water is charged at a relatively low price and the price increases for additional water consumed.
- IBTs result in an inefficient allocation of water across households. They are purported to have favourable equity characteristics but it is not clear that this is so.
  – There is a case for replacing IBTs with a single volumetric charge (for a given level of reliability), or at least to simplify them to reduce efficiency losses.
- Generally prices are too low to balance supply and demand during extended periods of low rainfall. Other measures — such as prescriptive water restrictions — are used to achieve that balance.
- Administrative pricing could be improved by introducing some form of scarcity-based pricing to partly or wholly replace water restrictions. This could allow water to be managed in a way that was more closely aligned with individual and community preferences and improve signals about when to invest in new supplies.
  – Constraints, such as single metering for multiple tenancies and landlord billing, would need to be addressed to maximise the efficacy of this pricing reform.
- Other potential improvements to pricing arrangements should also be investigated, including adjusting prices to encourage better environmental outcomes.
- Competitively-determined prices (where possible) could potentially deliver even greater benefits than those available from modifying administered pricing arrangements. There are, however, practical costs and difficulties that need closer investigation prior to embarking on such fundamental changes.

3.1 Introduction

This chapter considers the potential for water pricing reforms to achieve better outcomes for the community by providing:

- an improved means of managing water scarcity when it arises

- more options for the way people manage their water use
- clearer signals of the need for investment in water infrastructure, helping to avoid both future scarcity and unnecessary investment.

The need to examine departures from the status quo is increased by the likelihood that developments in the water sector will make the current pricing arrangements increasingly problematic. These developments include the advent of new sources of supply (for example, rural-urban transfers, desalination and recycling), increased uncertainty over future climatic conditions, and increasing demand for water for environmental, household and industrial use resulting from ongoing population and income growth.

The simplest way that pricing reform could be achieved is through modifying practices within existing institutional arrangements — that is, to adopt better administered pricing systems for water provided by government-owned water monopolies. More far-reaching change could be achieved through broader institutional and structural reform promoting competition in the sector. This could result in administered prices being replaced, at least in part, by prices determined by the market. Both approaches are considered in this chapter.

3.2 Current arrangements

Urban water users obtain their water from state-owned water utilities. Historically, users were charged a single fixed access charge, although this has changed over the past few decades with the introduction of variable volumetric charges, mirroring trends in many other countries (OECD 1999). Volumetric water charges were accompanied by an increasing focus on cost recovery, also in common with global trends (for example, EU 2000).

Urban water utilities in Australia operate administered pricing systems. This means that they have some discretion in setting water charges but that this is limited by price caps and other constraints imposed by state regulatory bodies.

Characteristics of the current pricing arrangements

While there is some variation across jurisdictions, arrangements for pricing urban water to consumers generally involve:

- a two-part tariff, comprising a fixed access charge and a variable volumetric charge
- an inclining block tariff (IBT) structure for the variable component.

In addition, developer charges are received by water utilities for the infrastructure costs associated with new residential and industrial developments.

These pricing arrangements (in combination with supply augmentation decisions) have led to excess demand in times of low rainfall, which has been dealt with through non-price demand management tools, such as water restrictions. Non-price demand management is discussed below as a component of the current arrangements.

The two-part tariff system and cost recovery

The vast majority of water utilities charge for water using a two-part tariff. The variable charges typically are set in accord with an estimate of the long-run marginal cost of harvesting, storing, treating and delivering water to users (NWISGWC 2007). Where price equals long-run marginal cost, this indicates to consumers the expected cost of bringing forward an extra unit of water supply in the long run, including the associated capital expenditure for water infrastructure (box 3.1). Pricing at long-run marginal cost creates an incentive for people to consume an extra unit of water if, and only if, the value they place on that consumption is at least as high as the expected cost of providing it in the long run.

The fixed access charge is then set as a residual to try to ensure that water utilities receive sufficient revenue to service demand. The objective is for them to receive revenue that covers, but does not exceed, the sum of operating costs, capital costs and an appropriate return on assets. Assessing a return on assets requires assets to be valued, and in most jurisdictions the stated intention is to do this in a manner consistent with the cost of replacing them. Revenue requirements are forecast in advance by a price regulator, and caps placed on both variable and fixed charges. Without such caps there would be the potential for monopoly water utilities to achieve revenues in excess of their costs.

The approach that regulators take to estimating revenue requirements for cost recovery in the urban water sector is known as the Building Block Methodology (BBM). The BBM is also used in Australia to regulate prices set in other sectors with network infrastructure, such as telecommunication services and electricity and gas transmission and distribution.

Box 3.1 **Estimating long-run marginal cost for price setting**

Long-run marginal cost is a measure of the cost required to service demand reflecting a forward-looking estimation of the efficient pattern of investment, as well as meeting the operating costs of supply.

In practice, estimating long-run marginal cost is complex. It requires a great deal of information to estimate future demand and supply conditions, in order to plot the efficient path for investment.

Long-run marginal cost essentially has two components: operating and capital costs. While estimating operating costs is relatively straight-forward, a variety of methods are used to estimate the capital cost. The two most commonly used approaches in Australia are outlined below.

The perturbation approach

Under the perturbation approach, long-run marginal capital cost is estimated by examining how the present value of future expenditure would vary if forecast water demand were incrementally increased (or decreased).

An advantage of this approach is that different forms of expenditure — for example those specifically associated with environmental, health or quality obligations — need not be separated from general capital expenditure. However, it can be highly sensitive to the forecast levels of demand.

This approach is favoured by the Economic Regulation Authority (Western Australia) and the Essential Services Commission (Victoria).

The average incremental cost (AIC) approach

The AIC approach estimates long-run marginal capital cost by dividing the present value of the expenditure associated with supply augmentation by the expected increase in supply needed to meet the forecast demand.

It measures the cost that must be charged for an incremental increase in future output to ensure that the extra capacity meets expected changes in supply and demand. Future expenditure on capital augmentation has to be separable from other forms of expenditure, which can be quite difficult to achieve.

This is the favoured approach of the Independent Pricing and Regulatory Tribunal (New South Wales) and the Queensland Competition Authority.

Source: ESC (2005).

Inclining block tariffs

The variable component of the charges faced by households in most cities is set as an IBT. IBTs impose progressively higher prices for successive blocks of water. An initial quantity of water is charged at a relatively low price and the price increases for additional water consumed. The main rationale for IBTs is that they are a 'fair' way to provide 'essential water' at an affordable price, while encouraging conservation through the more expensive blocks (ESC 2007b). The number of blocks, and the volume and price associated with each block, varies across Australia. The relationship between the various tiers and estimates of long-run marginal cost also varies (box 3.2).

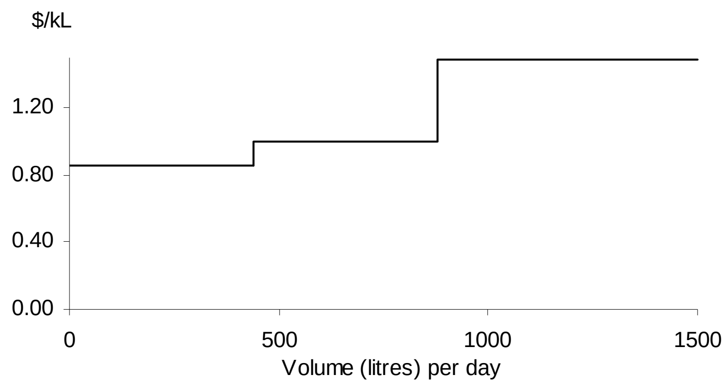
Box 3.2 **Inclining block tariffs in Australia's capital cities**

In all capital cities there is a fixed access charge for water. Capitals other than Hobart (which generally is unmetered) also have a variable charge, and, with the exception of Darwin, this takes the form of an inclining block tariff for residential customers.

The number of blocks in the tariff structure varies between urban centres. For example, Perth has a 5-tier arrangement (which is shortly to be reduced to three), Melbourne has a 3-tier system, while Adelaide has a 2-tier system. Most other urban water utilities offer a 3-block system. The period over which the IBTs are charged also varies between utilities. Additionally, there are large differences in the level of charges. Water utilities do not apply the same volumes to each of their blocks, and therefore, the level at which different rates are triggered varies.

Under the IBT for Melbourne's largest water retailer, the first 440 litres per day are charged at the rate of $0.85 per kilolitre, the next 440 at $1.00 per kilolitre, rising to $1.48 per kilolitre beyond that (ESC 2007a).

Melbourne's inclining block tariff structure



The relationship between the tiers of the IBTs and estimates of LRMC varies between cities. Generally, the higher tiers of IBTs exceed LRMC, and the lowest tier (or one of the lower tiers) is set at the LRMC level.

Source: ESC (2007a).

Separate tariff structures apply to non-residential (such as industrial and commercial) users of water in most jurisdictions. These tariff structures vary widely across States and Territories (and even within States and Territories). While the larger water utilities in New

South Wales and Victoria have a single variable charge for non-residential customers, the use of IBTs is common in most other jurisdictions (NWISGWC 2007).

Developer charges

Developer charges are up-front payments made by developers to water utilities to provide the infrastructure for new developments (IPART 2007). Developer charges vary by location, based on the cost of the infrastructure required. Households then pay these charges through the price of housing (in the case of existing infrastructure), or through rates (where new development is required). Most commonly, infrastructure is installed at the outset, and thus the developer charge is reflected in house and land prices. Infrastructure costs are a substantial component of development and construction costs, and can differ markedly based on location (PC 2004).

Demand management

Setting prices at long-run marginal cost results in demand exceeding supply in times of short-term scarcity. In order to cover this gap, governments have instituted non-price demand management measures (chapter 2). The most significant of these are water restrictions, but information campaigns, financial incentives for the use of water efficient appliances in households, and strategies encouraging the use of water efficient technologies in industry are also used. Water restrictions serve to reduce demand for water by controlling what consumers are, and are not, allowed to do with water (Byrnes, Crase and Dollery 2006). The form in which restrictions are implemented varies across cities.

Strengths and weaknesses of the current pricing arrangements

A strength of the current arrangements is that they include a two-part tariff, with fixed and variable charges. This has the potential to create more appropriate incentives for water use and conservation than having only a fixed charge, as was generally the case in Australia until the 1980s. It has been demonstrated that the introduction of variable charges has had a significant influence on consumption. For example, it has been estimated that the introduction of variable charges in the ACT resulted in a reduction in water use of up to 40 per cent (Giurietto, Graham and Letcher 2002).

Whether the variable charges are being set at appropriate levels is another question. Pricing at long-run marginal cost communicates the expected cost of consuming an additional unit of water. If the expectations underpinning the calculation of long-run marginal cost are accurate, then the incentives created for water use and conservation will be efficient. However, given uncertainty about future demand, the efficient investment path, and particularly supply from rainfall-dependent water sources, these expectations will almost certainly not be accurate. Periods of short-run scarcity are likely, and during these times long-run marginal cost pricing will fail to represent accurately the increases in the opportunity cost of water stemming from that scarcity. Australia has unpredictable patterns of rainfall. It has been suggested that long-run marginal cost is a more fitting pricing methodology when supply is more secure (Sibly 2006).

As noted in chapter 2, due to the gap between demand for and supply of water in times of scarcity, non-price demand management measures, particularly water restrictions, are used. Prescriptive water restrictions impose substantial costs on society.

Another weakness of the current arrangements, from a social welfare perspective, is the IBT structure of variable charges. By charging different prices to different households based solely on the volume of use, the relationship between the price people pay and the cost of supply is severed. This is inconsistent with the principle that 'customers should face the incremental costs of their actions, unless the service provided is attended by different costs' (Crase, O'Keefe, Burston 2007, p. 71). Non-residential users should also face the same price as residential users, provided the marginal cost of supplying the water is the same. At present, non-residential users pay prices that are often different from those faced by residential users (NWISGWC 2007).

Under an IBT, a household facing the highest tier price has a stronger incentive to economise on water use than a household on the lowest tier. Consequently, it may be that the first household saves water by forgoing consumption that it would have valued quite highly, while the second household uses some water in ways that it puts a low value on. The result is an inefficient allocation of water across households, as the cost of supplying the water does not usually depend on which household it goes to. To achieve efficiency, each user should face the same price unless there are differences in the costs of supplying them.

IBTs are purported to be an equitable means of encouraging low levels of consumption. However, their equity consequences are unclear. While they are said to reward households that use water without waste, they actually reward low levels of consumption. They can serve to reward small 'wasteful' households while punishing larger households, which by necessity require more water (Sibly 2006). Without discrimination based on the number of residents, this negative equity consequence is an inevitable outcome of IBTs.

Finally, investment is occurring in new types of supply augmentation, such as desalination plants, that have very different cost structures and supply characteristics to traditional sources of supply. While it is not yet clear how these developments will be accommodated within water pricing arrangements, it is apparent that the task of designing efficient and equitable pricing arrangements is becoming more complex. The advent of these new supply augmentations provides an additional motivation for considering whether improvements can be made to existing pricing arrangements.

3.3 Improving administered pricing

The pricing of urban water within the existing institutional arrangements can be improved in several ways, including by:

- removing or modifying IBTs to improve signals for water consumption
- adjusting prices to reflect the value of water during times of scarcity
- making other changes to improve pricing signals, such as taking account of environmental externalities and varying charges by region.

This section examines the general case for these and other reforms. There would need to be further detailed work to determine exactly how such reforms should be implemented. In some cases, such as charging prices that vary by region, further work is required to ascertain the circumstances under which the benefits of the reform outweigh the costs.

These suggested improvements are predicated on the notion that people’s use of water is influenced by its price — demand for water is, at least to some extent, price-elastic. International and Australian studies suggest that this assumption is valid overall, even though a certain quantity of water needed for essential purposes, such as health and hygiene, is likely to be fairly price-inelastic (box 3.3).

Removing or modifying IBTs

The key problem with IBTs is that different users face different incentives for conserving water, while the value to the system of conserving a unit of water does not normally vary by user. The more users that face a price for their next unit of water different from the marginal cost of supplying it, and the greater the discrepancy, the greater the efficiency losses. Community welfare could be improved by ensuring that all water users paid the same price (unless there are differences in the costs of supplying them). Therefore, a case can be made for replacing IBTs with a single volumetric charge at least for a given level of supply security.[1]

The main argument against removing IBTs is that no one should be placed under financial strain to obtain the volume of water that is essential for their health and hygiene. As noted

[1] In principle, individual users could negotiate specific water security contracts with water utilities. If transactions costs made such an approach infeasible, an alternative might be for utilities to offer a more general higher security product priced above the ‘normal’ volumetric charge.

in chapter 2, such equity concerns are sometimes overstated and, in any case, can be addressed through broader social welfare measures. However, if it is deemed desirable for 'essential' water to be provided at a low price, there are ways this can be achieved while limiting associated efficiency losses.

A simple improvement over current arrangements would be to have just two price blocks, with the volume of block-one set sufficiently low that nearly all users pay the block-two price at the margin (Edwards 2006). Alternatively, the fixed access charge could include an 'essential' allocation of water, and all other water use could be charged at the going rate. This would ensure that the value attached to the final unit of water consumed was the same across most users, while providing all users with an allocation of water at a low price to cover 'essential', or non-discretionary, uses. Under this approach the volume of water allocated to the first block would be substantially lower than the allocation made under the first block of most current IBTs. Quiggin (2007) has suggested that the basic water requirement for drinking, washing and other daily requirements would be around 50 litres per person per day, while in most regions the bottom block of the IBT is between 200 to 400 litres per day (NWISGWC 2007). An Australian study suggests that having a lower block-one allocation is also consistent with community perceptions of how much water is required for non-discretionary water use (Crase, O'Keefe and Burston 2007).

A difficulty in deciding the amount of water that represents essential use is the fact some households comprise one person, while others have five or more people. If all households are given the same allocation this will be more generous for smaller households. To address this equity problem, consideration could be given to varying the allocation of 'essential' water according to household size (Quiggin 2007; Crase, O'Keefe and Burston 2007). This would, however, introduce administrative complexity and cost, as well as potentially being open to manipulation through false reporting. These factors would need to be taken into account in assessing whether this approach should be adopted.

Some water utilities in Queensland, South Australia, Western Australia and the ACT apply IBTs not only to residential users, but also to non-residential water customers (primarily commercial and industrial firms) (NWISGWC 2007). The Victorian Government has also expressed interest in exploring this option (ESC 2006).

A case can be made that the essentials of life should be within all *individuals'* financial means, and that IBTs are one way of achieving this (although, as argued, perhaps not the best way). In contrast, the argument that *firms* have a right to the production inputs they need (including water) at prices that guarantee their viability, is untenable in an economy like Australia's. Accordingly, the equity argument for IBTs does not apply to commercial and industrial firms.

In addition, the quantity of water that firms use depends on a range of factors, including size, outputs and production processes. The IBTs that have been applied to firms do not take these factors into account, meaning that the higher prices for second and subsequent tiers are applied in a manner that bears little relationship to discretionary or wasteful water use. Varying the structure of an IBT to cater for the individual circumstances of firms would be difficult and costly, and for practical purposes, infeasible. For these reasons, there appears to be no valid rationale for adopting IBTs for non-residential water users.

The application of IBTs to non-residential users suggests that the intention could be to simply reduce water demand to ease water security concerns. That is, IBTs are being used as a form of scarcity-based pricing. As will be discussed, the key feature of scarcity-based pricing is that prices rise when the security of supply falls (not when individual customers use water in excess of some threshold) and so IBTs are poorly cast in this role.

Box 3.3 **The price elasticity of demand for urban water**

The efficacy of allowing greater recourse to price to reduce the reliance on water restrictions depends on the responsiveness of demand for urban water to price. The responsiveness (elasticity) of demand determines the price increase necessary to achieve reductions in water consumption equivalent to those from water restrictions.

The price elasticity of demand measures the percentage change in quantity demanded that would result from a given percentage increase in the price. For example, if the elasticity was -0.3, a 10 per cent increase in the price of water would bring about a 3 per cent decline in the consumption of water, other things being equal.

Elasticities are likely to be higher in the long run than in the short run. As consumers become more aware of price changes, and greater opportunities to utilise water alternatives are exercised (for example, installing water-efficient appliances), there will be a greater quantity response. Also, as price rises and water consumes a larger share of the total budget, the price elasticity typically increases.

The international literature reveals a high degree of variation in estimates of price elasticities of demand for urban water. Some estimates suggest that water is very price inelastic (-0.07 to -0.21, Jones and Morris 1984) while others approach unitary elasticity (-0.34 to -0.96, Kulreshtha 1996). These differences may reflect actual differences between urban centres and/or differences in estimation methodology and accuracy. Given the wide range, it seems likely that the latter influence is significant.

A study of Sydney (Grafton and Kompas 2006b), estimated the own-price elasticity for household water demand to be -0.35. Hoffman, Worthington and Higgs (2006) estimated the elasticity in Brisbane to be approximately -0.51. These recent Australian studies suggest that relatively modest price increases could have a significant impact on consumption in these cities. As noted previously, the introduction of variable charges in the ACT was estimated to have caused a reduction in consumption of up to 40 per cent (Giurietto, Graham and Letcher 2002).

While elasticity estimates vary significantly, they tend to indicate that there is scope to use prices to significantly affect the demand for water in urban regions. Further work in this area would help to narrow the degree of uncertainty over the relationship between price and demand. Improved knowledge could be gained through experience in using prices for demand management purposes. Also, removing barriers that impede pricing information from reaching consumers — such as improving metering and billing arrangements — can increase elasticities, enhancing the ability of price to influence consumption.

Adjusting prices to reflect the scarcity value of water

Pricing at long-run marginal cost smooths prices over time, and does not reflect short-run changes in the marginal cost caused by variable rainfall and runoff. During extended dry periods this tends to lead to demand for water (at the prevailing price) that is in excess of the supply that can be prudently made available, given the need to ensure supplies into the future. Demand must then be reduced by non-price means, such as water restrictions.

The problems with using prescriptive water restrictions to manage demand were discussed in chapter 2. Essentially, they prevent people from using water for particular purposes, or in particular ways, even when they place a high value on them. At the same time, water uses that may have a relatively low value are not constrained. This approach to demand management is inefficient.

Introducing scarcity-based pricing has the potential to manage demand for water in a way that is more closely aligned with individual and community preferences. Balancing demand and supply using price allows people to make their own water use decisions. Increasing prices during times of scarcity creates incentives for people to reduce water use in whatever ways they find convenient or least costly. Also, while restrictions result in irrecoverable time and inconvenience costs, using higher prices in times of scarcity results in financial costs to water users that are transfers to water utilities or governments (Hughes et al. 2008). That is, the costs are recovered and can be used in ways that benefit the community.

Introducing and administering scarcity-based pricing within existing institutional arrangements would be a complex task and there are different approaches that could be taken (box 3.4). The basic idea of scarcity-based pricing, however, is simple — prices should increase as dam levels decrease and the threat to water security increases. This would cause prices to be less stable than they currently are. During a long drought, prices might increase fairly gradually over a number of years and then might drop quite sharply during a season or two of high rainfall.

One approach would be to simply substitute higher prices for water restrictions. That is, pricing arrangements could continue as normal except during periods when concerns over water security arose. Then, instead of introducing water restrictions as has traditionally been done, the volumetric charge for water would be increased to achieve an equivalent fall in water use.

Other approaches involve a more substantial shift away from current practices. For example, some analysts have argued that it can be inefficient to price at long-run marginal cost at times when water is in plentiful supply, although with Australia's recent experiences with prolonged drought, concern over such inefficiencies is not widespread (ACIL Tasman 2007a).

Box 3.4 Possible approaches to scarcity-based pricing

Short-run marginal cost pricing

Short-run marginal cost (SRMC) is the cost of meeting an incremental increase in demand for water in the short term. When water supplies are plentiful it will relate to the operational costs of supplying the next unit of water (this might include, for example, water treatment costs) plus any externalities. As water becomes scarce, SRMC pricing will depend on the highest value use to which a unit of water could be put. This might be the value of forgone consumption, or the value of keeping the water in storage to ameliorate future scarcity.

Pricing at SRMC results in a balance between supply and demand (that is, the market is cleared) without the need for water restrictions. To illustrate, Grafton and Kompas (2006a) estimate that water prices in Sydney would need to be in excess of $1.80 per kilolitre (more than 50 per cent higher than prevailing prices during the study period) to balance supply and demand when water storage levels are low.

To set prices at SRMC, information is required on the variable costs of water supply and the highest value uses at different levels of scarcity. The former can be obtained from water utilities, while the latter relies on estimates of the price elasticity of demand for water. In practice, prices would need to be set for defined periods (for example, three months), taking account of factors such as dam levels, forecasts of inflows and possibly time of year.

One short coming of SRMC is that it can fail to recover the cost of long run investment decisions. In order to ensure full cost recovery of assets, SRMC pricing could be combined with a fixed charge. The fixed charge could then be calibrated with SRMC to ensure that utilities recover the cost of fixed assets as well as the cost of providing the water (the total cost of supply).

Proposals to move to pricing based on SRMC have been made by Ng (1987), Sibly (2006), Crase and Dollery (2006), Grafton and Kompas (2006b) and others.

Hybrid of short-run and long-run marginal cost pricing

Another option is to price water at the higher of SRMC and LRMC. This would address what is perhaps the main problem with the current arrangements — the deficiencies of using non-price demand management to address scarcity. This approach might have advantages compared to always pricing at SRMC as it would result in somewhat more stable prices and avoid low prices. Low prices could give confusing signals about the value of conserving water and might lead to people paying too little attention to the amount of water used by the long-lived products they buy (such as washing machines) and the gardens they establish.

(Continued next page)

Box 3.4 (continued)

Scarcity pricing as an options strategy

Scarcity pricing could be based on the opportunity cost to the water utility of using water now and, therefore, not having it available to alleviate future scarcity. From a water utility's perspective, when dams are below full capacity a marginal increase in consumption brings forward the expected date on which it will need to commit to investing in supply augmentation. Given the highly variable rainfall in many parts of Australia, this can have significant cost implications, particularly when dam levels are low. For example, it can result in a billion dollar investment being made, when, if the decision could have been safely deferred for just a few months, the investment might not have been required for a decade or more due to subsequently favourable rainfall. Accordingly, the opportunity cost of using water now can be high because, in some circumstances, it closes off the option of deferring a major investment for what could turn out to be a considerable period. As ACIL Tasman (2007a) explains:

> In an options world, in which a readiness option has been identified and the trigger point for commitment to substantial investment is approaching, any consumption of water brings forward the trigger point and increases the probability of needing to trigger the investment before, for example, a drought breaks. In these circumstances (as in the extreme peak market setting in electricity), the true cost imposed on the system by consumption can rise rapidly as system storage (or other measure of capacity to meet demand) drops. (ACIL Tasman 2007a, p. 54)

Scarcity pricing of this type can be understood as an evolution of the current LRMC approach to recognise the option values associated with investing in water infrastructure in an uncertain environment.

To illustrate, consider the case where a city's dams are full to the point of overflowing, with the spilled water being discharged to the ocean. Pricing at long-run marginal cost here will cause people to forgo some water consumption that they would have valued. Because of this, the forgone consumption imposes a cost on society, but for what benefit? The forgone consumption cannot be used to supply others or be saved for later use. There would be some saving on the operating costs of water utilities, but this could be small compared to costs to water users. For this reason, these analysts' proposals for scarcity-based pricing involve prices being set below long-run marginal cost (as typically calculated) in times of plenty.

Scarcity-based pricing is concerned with opportunity costs of using water. Using water for a particular purpose now means that it is not available either for other uses now, or for keeping in storage to bolster the security of future supply. At times when dams are overflowing the opportunity cost of water is likely to be low because using an extra kilolitre does not detract from other uses or future supply security (there may be costs associated with forgone environmental flows). As dam levels drop, however, the opportunity cost of water will tend to rise, particularly if continuing low dam inflows are likely. Scarcity-based pricing seeks to reflect this variation in opportunity cost, in full or in part, in the price of water. This tends to improve outcomes for the community as it discourages people from using water for low-value uses at times when this necessitates forgoing more valuable opportunities, such as keeping it in storage to bolster supply security.

Another advantage of using prices to balance supply and demand is that it potentially provides better signals as to the value of increasing the supply and security of water. This is because more information is gained on how highly water users value being able to maintain consistent consumption patterns as water scarcity increases. This could assist water utilities to better plan supply augmentation. It could also facilitate a greater role for the private sector in providing water during times of scarcity. For example, higher prices would be likely to increase commercial opportunities for the supply of recycled water.

As discussed previously, volumetric charges are currently set first and then the fixed access charge determined such that total expected revenue to the water utility equates to that required for full cost recovery. Under scarcity-based pricing this arrangement could continue (although there would be some added complexity as there would almost certainly be more volatile prices). This means that when the volumetric charge increased in response to increased water scarcity, the access charge would need to decline. A point might be reached where the access charge dropped to zero, meaning any further increases in the volumetric charge would result in revenue being in excess of that required for cost recovery (assuming that the access charge was not permitted to become negative, which, while theoretically possible, might cause practical difficulties).[2] Such increases would need to be permitted if the full efficiency benefits of scarcity-based pricing were to be achieved. Any excess revenue collected should be passed through to the government, rather than being retained by water utilities (chapter 2). This would mean that, while the community would be bearing higher water charges, the excess revenue could be used to reduce taxes and/or pay for services to benefit the community.

There are potential difficulties and disadvantages associated with introducing scarcity-based pricing. However, these appear to be fairly minor compared to the advantages:

- It can be difficult to estimate accurately the appropriate scarcity charge (Byrnes, Crase and Dollery 2006). However, any move in the right direction will have efficiency advantages and so precision is not essential.

[2] Some analysts have pointed out that employing IBTs reduces the potential for excess revenue because a low volumetric charge is applied to a proportion of water consumed (for example, Quiggin 2007). While this can be seen as an advantage of IBTs it does not appear to be a particularly important one, as excess revenue need not cause efficiency losses if properly managed.

- Scarcity-based pricing can introduce perverse incentives for water utilities, depending on the cause of the scarcity. If scarcity is a reflection of investment constraints that prevent appropriate supply augmentation, scarcity charges might simply provide excess revenues to water utilities (Dwyer 2006). Therefore, in the presence of inappropriate investment constraints scarcity prices can, in fact, be inefficient. If scarcity-based pricing was introduced, close attention would need to be given to institutional and regulatory arrangements to reduce the potential for this to occur.
- There are likely to be equity concerns regarding low-income households facing higher water prices in times of scarcity. To address this, price changes related to scarcity could be confined to the higher tier of a two-tier IBT. Alternatively, or in addition, these concerns could be addressed outside the water pricing system, through broader social welfare measures (Edwards 2006).
- Price volatility would increase and many water users may find this undesirable (Grafton 2006). In addition, people who take only the current price of water into account when buying water-using goods, such as washing machines, would tend to make less appropriate decisions when water prices are less stable. For these reasons, greater price volatility may be regarded as a disadvantage of scarcity-based pricing. However, the consequent reduction in the use of water restrictions (and/or lower average water bills) would be an advantage to water users. There are pros and cons to consider. In addition, new contract arrangements could be introduced to allow individual water users who dislike price uncertainty to pay a premium for a more stable price over time. Providing this option would involve departing from the 'one-product-for-all-customers' model that currently exists (chapter 2).
- For scarcity-based pricing to be successful, price signals need to be effectively transmitted to water users (ERA 2007). Current metering and billing arrangements, such as aggregate metering of multi-resident premises, can mute price signals. This issue, which is relevant to all volumetric charging for water, is discussed later in this chapter.

Introducing some form of scarcity-based pricing need not be approached as an 'all or nothing' decision. For example, it may be considered that, on equity grounds, limits should be placed on how high volumetric charges are allowed to go. If this were done, scarcity-based pricing would narrow the gap between water demand and supply, but in times of severe scarcity emergency water restrictions could still be required. The greater the reflection of scarcity in urban pricing structures, the lower the likelihood of needing water restrictions and other non-price demand management measures.

Introducing scarcity-based pricing should also not be seen in isolation from other reforms. Complementary reforms, such as integrating rural and urban water systems, could serve to constrain price increases in times of scarcity by making extra water supplies available, where the cost of providing those extra supplies is below the current scarcity price.

Other areas for improvement

Some other aspects of urban water pricing that appear to warrant further investigation are considered below.

Reflecting environmental and other externalities in prices

Using water for urban consumption can result in externalities — positive or negative effects on parties not directly involved in the supply or consumption of the water. Externalities can arise from water harvest, storage, manufacture and use. For example:

- Harvesting and storage can redirect water away from environmental flows, leading to a reduction in environmental amenity.
- Manufacturing water (through desalination and recycling) requires energy, that if sourced from burning fossil fuels, results in greenhouse gas emissions (that are implicated in climate change).
- Water use can have detrimental effects on the environment where it results in discharges of polluted wastewater.
- Storing water in dams can benefit tourism and flood mitigation (these are positive externalities).

A reform that could be considered is to include some measure of these external costs and benefits in the price of urban water. This has the potential to enhance the welfare of society by ensuring third-party effects are reflected in the level of consumption. For example, adding a component to water prices to reflect negative environmental externalities would tend to reduce water consumption and improve environmental outcomes (with the benefits of the latter outweighing the costs of the former, provided the price adjustment accurately reflected the externality).

Dealing with externalities by adjustments to administered water prices is one option and it should be assessed against others on a case-by-case basis. Requiring water utilities to meet certain environmental objectives as a community service obligation is one alternative approach that may be appropriate in some cases. For environmental flows, enabling environmental service providers to compete for water is another option (chapter 4). For some externalities, more directly targeted policy instruments may be available. For example, an emissions trading scheme would generate a price for greenhouse gas emissions, incorporating that externality into the operating costs of manufactured water.

Varying prices by location

Water utilities generally apply charges that do not vary on the basis of location — this is known as ‘postage stamp’ pricing. The result is that any cost differences associated with supplying water across locations are not reflected in charges. The potential for such cost differences to be significant depends, among other things, on the size of the area to which uniform charges are applied. In Australia, this varies considerably. For example, each of Melbourne’s three major water retailers has their own water charges, while a single set of charges is applied across the entirety of South Australia (NWISGWC 2007).

Postage stamp pricing does not create incentives for efficient water use and conservation where there are significant differences in the cost of supplying different regions. It can also create problems for the introduction of competition to the urban water sector (section 3.4). Accordingly, there are likely to be some benefits from introducing prices that vary by location. There would, however, be administrative costs and so empirical assessment would be required to ascertain whether this reform would be worthwhile in individual cases.

As discussed previously, developer charges are one aspect of the current arrangements that do vary according to location. Any evaluation of whether water prices that vary by location should be introduced would need to consider the relative merits of employing developer charges, location-based water pricing or a combination of the two.

Modifications to accommodate supply augmentation

The advent of new types of supply augmentation present new challenges to the design of pricing arrangements. For example, some approaches, such as LRMC pricing using the average incremental cost method, produce prices that reflect the average cost of different supply sources. This might not seriously compromise economic efficiency when the different sources have similar cost structures, as might have been the case in the past when augmentation predominately involved increasing dam capacity. However, where there are large difference in costs, as could be the case where investment in both a desalination plant and a new dam are planned, it is important that prices reflect the unit cost of the highest cost source.

Further issues relating to water pricing and the operation of desalination plants are considered in chapter 5.

Improving the effectiveness of price signals through metering and billing

An important limitation of the existing arrangements is that many water users do not receive a bill that has a volumetric charge for their own water use. In many states body corporates may have only one water meter, often covering twenty or more different households. Renters often do not face the individual cost consequences of their own consumption, as water charges are paid by the owner of the property. This mutes price signals to a significant segment of the community. Addressing this shortcoming is important, and would become even more so if scarcity-based pricing were to be introduced. However, while it is desirable that as many households as possible face a volumetric charge for their own water consumption, it is not costless to achieve this. The extent to which action is warranted is an empirical question.

In addition, the frequency of water billing varies between cities. Infrequent billing reduces people's awareness of price and can result in large bills that are difficult for low-income households to pay. For water users to respond to changes in price, they need to be able to see a clear link between their consumption behaviour and the size of their bills. This link would be clearer if billing was more frequent and/or there were more effective public announcements of water prices.

Improving cost recovery frameworks

As discussed previously, the current arrangements are designed to achieve full cost recovery by urban water utilities. While this is appropriate, it is necessary to examine the detail of how full cost recovery is applied to see whether improvements are possible in particular jurisdictions. This has not been done for the current study, but work by Marsden Jacob Associates (2006) suggests that further investigation could be warranted.

Full cost recovery includes an appropriate return on assets, and to calculate this the value of assets needs to be determined. In considering the asset values used in regulating water charges, Marsden Jacob Associates reported:

> The regulatory asset value of water businesses is typically well below the efficient replacement cost of infrastructure. In contrast, the regulatory asset value for setting regulated prices for other utility sectors [such as gas and telecommunications] is set precisely at the level of efficient replacement cost. (Marsden Jacob Associates 2006, p. 46)

This raises the question of whether the regulatory asset values used in the urban water sector should be calculated in a similar manner to those applied in other utility sectors. If this were done, Marsden Jacob Associates (2006) estimate that, on average, water charges in Australian capital cities would need to have been 33 per cent higher in 2005 to achieve 100 per cent cost recovery[3].

Another issue is that the rural water sector is generally further away from achieving full cost recovery than the urban water sector (NWISGWC 2007). While urban water utilities

---

[3] This estimate was not independently assessed for the current study.

are required to recover 'upper bound' costs, rural water utilities are only required to meet the lower bound level of cost recovery.[4] Further movement towards full cost recovery in the rural sector, as envisaged by the National Water Initiative, would be a positive development in its own right and could also assist in achieving greater consistency across the sectors. Greater consistency in cost recovery frameworks would have the benefit of reducing distortions in the allocation of water between rural and urban water users in the event that integration between the sectors was pursued (chapter 4).

Pricing wastewater removal and treatment

In addition to paying for deliveries of water, users pay for the removal of wastewater (sewerage and trade wastes) and stormwater. Households typically pay a fixed charge (or charges), while firms pay a fixed charge, that often varies according to the size of the connection, and may also pay a volumetric charge. While these arrangements have not been examined in detail for this study, it is noted that Freebairn (2008) has suggested that it may be feasible and desirable for charges to vary according to the pollution load — and hence the external costs — of wastewater.

3.4 Broader institutional and structural reform to improve pricing

The preceding section dealt with improvements that could be made to water pricing within the existing institutional arrangements. Options for reforming these arrangements, including by introducing competition, are discussed in chapter 6. While full discussion of the costs and benefits of such reform is left to that chapter, it is important to appreciate the implications for pricing. These include that:

- there are likely to be benefits in reforming administered pricing prior to the introduction of competition
- competition reform could decrease the need for administered pricing
- competitively determined prices could potentially deliver greater benefits than those available from modifying administered pricing arrangements.

Reforming administered pricing prior to competition

Competition reform is likely to be more successful if preceded by reforms to administered pricing. Having prices that better reflect consumer preferences and scarcity, while sending

[4] Upper bound cost recovery includes all the elements from lower bound — namely, operating maintenance, administration costs, tax and interest — as well as a rate of return on assets.

appropriate signals for new investment and supply augmentation will facilitate the transition to a competitive setting. For example, a scarcity-reflective price can provide signals for new entrants, encouraging them to offer new forms of supply. By allowing administered prices to more closely bring equilibrium between supply and demand (to the limit of the information available to decision makers), the adjustment to a more market-based approach would be less extreme.

Some institutional reform options involve vertical separation of elements of the supply chain to produce discrete business units for activities such as bulk water supply, treatment, distribution and retailing (chapter 6). If this were done the reform of administrative pricing arrangements would need to encompass the setting of prices for each of the elements.[5] Achieving cost-reflective prices for each element would be important to create commercial disciplines on each business unit, so as to encourage improved performance. Cost-reflective prices would also be important for creating the right incentives for the entry of competing private firms.

The need for administered pricing in a more competitive setting

The progressive introduction of competition in urban water provision would reduce the need for administered water prices. Markets for urban water could allow competitive pressures to determine water prices. These competitive prices would allow consumers to express their preferences in how water is used, while permitting suppliers to communicate costs.

In practice, there would probably be a continuing need for some price regulation as there are elements of urban water systems that are natural monopolies and this constrains the extent to which competition can be usefully employed. For example, water distribution is usually a natural monopoly as it would be inefficient to duplicate the network of pipes and other infrastructure needed to distribute water. Firms with a natural monopoly may charge excessive prices, giving rise to the potential for price regulation to increase efficiency. Chapter 6 provides a broader discussion of the implications of natural monopoly for urban water reform.

Benefits from competitively determined prices

In many cases the reforms to administrative pricing discussed earlier seek to mimic the prices that would emerge in a fully competitive urban water system. Generally they can only ever do this approximately as the diverse sources of information characteristic of

---

5 In some jurisdictions pricing of the outputs of some of the individual elements of the supply chain is a feature of the current arrangements. For example, Melbourne Water sells bulk water to three retail businesses that then sell delivered water to water users.

competitive markets are absent. Because of this, the benefits to the community from reforming administrative pricing may be less than those available from moving to competitively determined prices where this is possible. Moreover, competitive prices could yield additional benefits by providing signals for dynamic efficiency.

As discussed, a fully competitive sector is not likely to be achievable, given the existence of natural monopoly elements in the supply chain. Nonetheless, moving to competitively determined prices in those elements of the supply chain that are potentially contestable — such as bulk supply and retail — could yield benefits beyond those available from reforming administrative pricing. This is one of several reasons for exploring competition reform, as discussed in chapter 6.

4 Integrating rural and urban water resources

Key points

- In many cases, a small proportion of the water used in rural areas would provide a significant increase in supply to connected urban areas.
- Opportunities exist for greater use of rural–urban water transfers to alleviate localised scarcity:
  - A handful of rural–urban water transfers have already occurred and more could occur without need for major infrastructure investment.
  - In addition, there are several proposals to connect rural and urban sources through pipes.
- There are several ways to facilitate rural–urban water transfers, including through water markets, regulation and indirect purchases. Each approach has different implications for economic efficiency, transparency and equity.
  - Indirect purchase, such as funding infrastructure upgrades in irrigation districts in return for water, is often a high-cost way to transfer water between uses.
  - Markets will often be the most efficient, transparent and equitable mode of exchange, creating benefits for both the buyer and seller.
- Different levels of water market integration are possible. Ultimately, there is a trade off between involving as wide a range of buyers and sellers as possible to capture gains from trade and the workability of the scheme.
  - An intermediate level of integration, involving large urban and rural water users, would appear to capture many of the available gains from rural–urban trade and would expose urban water users to competitive market prices.
- Facilitating rural–urban trade would involve a number of implementation issues, such as managing third-party effects (including effects on environmental flows).

4.1 Introduction

The Australian and State and Territory Governments have agreed to manage water resources for rural and urban use in a way that optimises economic, social and environmental outcomes. Specific commitments are to facilitate water markets where water systems are physically shared or hydrologic connections and water supply considerations will permit water trade, and to facilitate water trading between and within the urban and rural sectors (COAG 2004).

Although several State and Territory Governments have taken steps to facilitate rural–urban water transfers, such transfers (particularly through water markets) remain relatively rare. A major reason for this stems from the historical approach to water management in Australia. Until the past decade or so, governments adopted a 'silo' approach that treated urban and rural water as separate resources. Many of the institutions and policies governing water provision still reflect this approach. As a result, existing systems poorly accommodate rural–urban water transfers.

This chapter explores options for further integrating urban and rural water resources to improve water allocation and investment decisions across Australia. It discusses:

- the main differences in urban and rural water provision and how these affect water users' abilities to reveal the value they place on water
- the rationale for rural–urban integration through water transfers
- potential modes of exchange
- opportunities for further connection between urban and rural water systems
- institutional approaches to facilitate water transfers among rural and urban users
- implementation issues, such as managing third-party effects.

The aim of this chapter is to provide a general discussion of different conceptual approaches to establishing integrated rural–urban water markets. Detailed analysis, including economic modelling, would be required to determine the appropriate approach in specific cases.

Urban and rural water

In rural areas, irrigators access water by holding an entitlement (or property right) to a share of water from a specified water source, such as a river, catchment or aquifer. The volume of water allocated to an entitlement each irrigation season depends on the total amount of water available from the water source.[1]

Property rights for water in rural areas enable irrigators to trade water with one another and, in doing so, reveal the (marginal) benefit from consuming an additional unit of water in rural areas. There are well-established markets for seasonal allocations and entitlements,

[1] Definitions for water (access) entitlement differ between jurisdictions. Differences include the parameter defining the size of entitlement (nominal volume or share); the extent to which entitlements are classified by priority or reliability (high or low); and ownership structure (for example, individual or company) (NWCWGCR 2006).

particularly in the southern Murray–Darling Basin (PC 2006b). Prices for seasonal allocations rise and fall with water availability and with demand variations, while entitlement prices reflect the discounted stream of expected prices of future water allocations (Freebairn 2005b). Derivative products, such as leases and contracts, can add flexibility to water trade in entitlements and seasonal allocations.

Urban water users do not own property rights to water and therefore cannot individually interact in markets to buy and sell water. Without a market for urban water, it is not possible to observe the marginal benefit of water use in urban areas directly. Urban charges reflect the cost of providing water; they do not reveal useful information about the marginal benefit of using water in urban areas subject to supply constraints (scarcity) (chapter 3).

Rationale for rural–urban transfers

The main argument for rural–urban transfers relates to economic efficiency. Efficiently allocating water involves equating marginal social benefits across alternative (urban, rural and environmental) uses and users of water.[2] When marginal social benefits are not equal, there is scope to improve society's welfare by transferring water from uses with a relatively low marginal value to uses with a higher marginal value. Urban water users facing severe water scarcity, for example, may be willing to pay more for a marginal unit of water than the return primary producers in a neighbouring region can earn on that water in a given year. Allowing the primary producers to sell water to urban users can make both better off and improve overall benefits to society.

Modes of water exchange

Water transfers among alternative water uses and users can occur in a variety of ways. Different modes of exchange have different implications for economic efficiency, transparency and equity. Non-price mechanisms include regulation (through planning processes), borrowing water and indirect or market-like purchases (such as funding infrastructure upgrades in irrigation districts in exchange for water) (box 4.1). Alternatively, transfers can occur through voluntary exchange at prices determined in electronic exchanges or through private negotiation.

2 Marginal social benefit is 'gross benefit less the marginal social costs of water treatment, delivery and disposal, and less any marginal external costs of water use. In the absence of external benefits and costs, the marginal private benefit is equal to the marginal social benefit' (Freebairn 2005b, p. 6).

Box 4.1 **Non-price mechanisms for transferring water**

A variety of non-price mechanisms is available to secure urban water supplies from sources currently considered 'rural'. For example:

Regulation: Administratively (re)allocating water among rural, urban and environmental water users. Examples include:

- planning processes that reallocate water among competing water users based on subjective (sometimes 'expert') judgments about relative water needs
- drought contingency provisions that reduce water available for environmental uses to secure urban and/or rural water supplies.

Indirect purchases: Indirect purchases include i) funding infrastructure upgrades in irrigation districts in exchange for water, and ii) buying land, stripping it of water entitlements and then reselling it. For example:

- The Victorian Government has announced a plan to fund system upgrades in the Goulburn Murray irrigation district and transfer one third or 75 gigalitres of the annual water savings to Melbourne.

Borrowing water: Borrowing water held in storage and paying it back later. A credit and debit system monitors exchanges. Examples include:

- The manager of the Barmah–Millewa Forest Environmental Water Allocation can carry over water in storage for several years to flood wetlands. Under certain conditions, irrigators are able to borrow water from Environmental Water Allocations during drought periods (when it is unlikely that the forest would have naturally been flooded) and repay the loan in subsequent years.
- In 2003, the NSW Government announced a plan to allow irrigators in the Macquarie Valley to borrow 60 of the 170 gigalitres of water that was usually set aside for town and stock and domestic supplies.

Sources: ABC News (2003); ACF (2006); Barmah Millewa Forum (nd); Victorian Government (2007a).

Markets will often offer the most transparent, equitable and economically efficient approach for transferring water among alternative uses and users (table 4.1). Markets reveal the values different water users place on a marginal unit of water and therefore provide a comparable and transparent basis for allocating water resources. In contrast, regulation does not directly compare the marginal benefits across alternative uses but relies on determinations that are more subjective.

Table 4.1 **Modes of water exchange between rural and urban water users**

Mode of exchange	*Efficiency*	*Transparency*	*Equity*
Regulation	• Does not explicitly reveal or compare marginal benefits across uses. • Planning processes can play an important part in reallocating water to environmental flows, particularly where no water market exists to source additional water. • Infrequent and often costly negotiation to achieve changes.	• Relies on subjective determination about marginal benefits of water in alternative uses.	• May involve mandatory transfers, creating winners and losers.
Borrowing water	• Where there is no opportunity for trade, enabling voluntary borrowing and lending within the regulatory system may improve efficiency by making both sides better off.	• Does not reveal marginal benefits of water in alternative uses.	• Can favour water users who borrow water during a drought, when the market price of water is high, and pay water back in wet years, when the market price of water is low.
Indirect purchases (water savings)	• May be more cost-effective than water supply options in urban areas. • Not likely to be optimal as per megalitre cost of water savings in rural areas is generally much greater than prices in water markets.	• Real water savings (that is, those that do not reduce water supply in other parts of the system) can be hard to measure and verify. Deals to secure water are often complex with several different components.	• Can negatively affect water availability to other water users where water savings are illusory (for example, when water savings result in reduced groundwater availability).
Water markets (for water entitlements, seasonal allocations and derivative products)	• Markets can facilitate a socially optimal allocation of water given there are measures in place to deal with differences in water delivery, treatment and external costs, and environmental flows. • Often, there is a trade-off in market design between realising available gains from trade and transaction costs. • Dynamically reallocate water in response to changing circumstances over time, most of which cannot be easily or accurately forecast.	• Revealed prices reflect marginal private benefit across different uses.	• Involves voluntary exchanges between buyers and sellers and will only occur when mutual benefits are expected.

Markets give water users the opportunity, but not obligation, to engage in mutually-beneficial transfers with other water users, whereas other modes of exchange can mandate transfers without compensation reflecting the marginal benefit of water removed. In this sense, markets are a more equitable approach for reallocating water than other modes of exchange.

Prices revealed in well-functioning and integrated water markets provide a coordinating role to achieve an efficient allocation of water. They also provide signals to private sector investors about water investment choices such as building a desalination plant, recycling water and investing in water saving technology (Freebairn 2005b). Other forms of exchange, such as indirect purchases, can lead to inefficiencies by resorting to high-cost alternatives to source water. For example, past efforts by governments to source water for environmental purposes through infrastructure upgrades have, in several cases, seen them pay many times the market price for water (PC 2006b).

Despite their drawbacks, non-market approaches to transferring water will be important where no water market exists and the transaction costs from establishing a market are high relative to the expected benefits. Further, indirect purchases of water sometimes have positive external benefits, such as salinity mitigation and enhanced service delivery to irrigators. In many cases, market approaches can operate together with non-market approaches. For example, governments use a mix of regulatory controls, indirect purchases and market purchases to provide water for environmental purposes.

Water transfers, and in particular water markets, could prove useful in providing flexibility to the management of urban water supplies (box 4.2). Chapter 5 discusses water supply planning in more detail.

Box 4.2 **Rural water markets as part of the urban water supply portfolio**

Water utilities and water users are increasingly looking at opportunities to balance supply security and costs by developing a portfolio of options with different supply characteristics. Water purchases from rural areas could prove useful in this regard. For example:

- there is scope to ramp up or down the scale of water purchases at short notice (for example, through seasonal purchases)
- purchasing water from connected systems involves few sunk investments (for example, water can be traded back to rural water users if it turns out that it is not needed in urban centres)
- a mix of water 'products' can help balance supply security and cost (for example, entitlements and long–term contracts could help meet base level water demand whereas opportunistic purchases on spot markets could help manage more variable demand)
- purchases expand supply sources and therefore provide greater supply security
- transfers help diversify supply risk if inflows into urban and rural dams are weakly correlated
- prices of direct purchases in rural markets create a benchmark for assessing the cost-effectiveness of water saving investments
- water market design is flexible and government can roll markets out incrementally.

Gaining insights from rural water reforms

Reforms to the rural water sector have seen a move toward establishing tradeable property rights to water that are separate from infrastructure access rights and water-use licence conditions (PC 2006b). This has provided increased flexibility to address specific water management issues such as water trade, infrastructure provision and external effects from water use.

A key issue for policymakers is determining the extent to which urban reforms should replicate recent rural water reforms. Differences in the nature of urban and rural water markets, such as the number, proximity and consumption of water users, will make some rural reforms less transferable to an urban context than others. There may also be lessons from implementing rural reforms that highlight areas for improvement.

Rural–urban trade is not contingent on replicating rural property right reforms in an urban setting. By undertaking institutional reforms that facilitate competition in urban water supply generally (chapter 6) and ensuring that policies preventing rural–urban transfers are retained only if supported by sound cost–benefit analysis, governments could provide scope for supply agreements or spot markets to emerge.

Opportunities for further integration of urban and rural water

Melbourne and Adelaide already access water from river systems that have water markets and there are no physical constraints preventing them purchasing at least some water from irrigators. Adelaide draws water from the River Murray, where irrigator water entitlements (in South Australia and upstream states) exceed 4000 gigalitres (Hamstead 2006). Melbourne shares the Thomson Dam with Southern Rural Water, which has a bulk entitlement providing a 45-gigalitre share of storage capacity and a 6 per cent share of its inflows (Melbourne Water 2006b).[3]

Perth accesses its water supply from the Integrated Water Supply Scheme, which connects with multiple groundwater and surface water sources in south–west Western Australia. Perth's water supplier, Water Corporation, has negotiated to transfer 17 gigalitres in water entitlements from rural supplier Harvey Water, based on the recovery of system losses by replacing open channels with pipelines (Water Corporation 2006). Opportunities for further water trade include from Harvey Irrigation Area, Wellington Dam and the Gnangara Mound (Thomas 2007).

There are opportunities to establish or expand physical connections between urban and rural water sources. The costs of different projects vary substantially (chapter 5). The most economically feasible opportunities are in Adelaide, Melbourne and Canberra, which are close to major irrigation districts. Sydney and Brisbane have more costly opportunities (Hamstead 2006) (box 4.3).

The capacities of existing and planned rural–urban connections are often small relative to overall water use in rural areas. For example, the 100 gigalitre annual capacity of the Sugarloaf (Goulburn River–Melbourne) pipeline is only approximately 5 per cent of annual water entitlements under Goulburn Murray Water, before taking into account planned water savings (DSE 2007a; GMW 2006).[4] An exception is the Thomson dam in Victoria, which has a much higher share of storage dedicated to urban supplies than irrigator entitlements.

[3] There is also an environmental bulk entitlement in the Thomson dam. The entitlement defines a minimum flow schedule and provides 10 gigalitres of annual inflows. Releases of the 10-gigalitre share are at times that achieve optimal river health. Melbourne Water (2006b) notes releases for environmental and irrigation purposes have been minimal since October 1997 due to the drought.

[4] In practice, transfers may be limited to 75 gigalitres per year. The Victorian Government has noted that the treatment plant at Sugarloaf Reservoir cannot handle any more than 75 gigalitres per annum above its current volume.

Box 4.3 **Examples of opportunities to increase physical connection between urban and rural water markets**

Opportunities to increase physical connection between urban and rural water markets vary across capital cities:

- In 2004, the SA Government (2004, p.2) identified purchasing water from irrigators in the River Murray as 'the most economical means of providing large volumes of additional water to Adelaide'. Three different scenarios were proposed, two of which would require upgrades to pump stations and interconnection between the northern and southern systems of Adelaide. Projects ranged from smaller scale transfers of up to 25 gigalitres at up to $33 million in capital costs to transfers of 40 to 80 gigalitres at up to $230 million in capital costs.
- The Victorian Government recently announced plans to construct a 70-kilometre pipeline connecting the Goulburn River with Melbourne's Sugarloaf dam with pumping capacity of 100 gigalitres per year. Previous proposals to connect Melbourne to the Goulburn system include Black River–Thomson pipe (70 gigalitres per year) and Big River–Upper Yarra pipe (80 gigalitres per year). The Victorian Government has estimated the Sugarloaf pipeline will have a capital cost of $750 million. The Victorian Government also plans to construct pipelines connecting Melbourne with Geelong (16 gigalitres per year) and the proposed desalination plant in Wonthaggi (200 gigalitres per year). There are also plans to reconnect Tarago Reservoir in Gippsland (15 gigalitres) to Melbourne's water supply system.
- Canberra's water supplier ACTEW has investigated several options to purchase up to 50 gigalitres of irrigators' water entitlements held in Tantangarra dam on the Murrumbidgee (NSW) and piping it to Canberra's storages. One option involves building a $70 million pipeline at Angle Crossing (linking the Murrumbidgee and Googong Dam) that could transfer up to 20 gigalitres of water per year.
- In addition to the existing option to transfer water from the Shoalhaven, Sydney could potentially access water from the Hunter River and the Murrumbidgee. However, little information exists on the feasibility or cost of these projects.
- Perth's water supplier, Water Corporation, outlined plans for a 100-kilometre pipeline to transfer 45 gigalitres annually from the South–West Yarragadee Aquifer. These plans pre-dated the decision to proceed with the southern seawater desalination project as Perth's next major water resource.
- Brisbane could potentially access water from irrigators in Bundaberg, which is located in the Burnett River area. However, the limited amounts of water available and the cost of the 300 kilometre pipeline to Brisbane from Bundaberg would likely be prohibitive. The Queensland Government has commenced construction of a water grid comprising a network of pipelines connecting major bulk water sources in south east Queensland.

Sources: ABC News (2007c); ACTEW (2005); Hamstead (2006); Marsden Jacob Associates (2006); QWC (2007c); South Australian Government (2004); Victorian Government (2007a); Water Corporation (2005a); WRSCMA (2001).

In contrast, the capacities of existing and planned rural–urban connections are generally large relative to water use in urban areas. The Goulburn River–Melbourne pipeline would provide the equivalent of 23 per cent of Melbourne's recent annual supply (431 gigalitres) if run at its full capacity of 100 gigalitres per year (NWC 2007a).

Hydrologic constraints will influence the timing and volume of rural–urban water transfers. For example, transmission losses, which are influenced by the water users' proximity to water storages, climatic conditions and the type of conveyance system used (that is, rivers or pipes), could make some rural–urban transfers either very costly or infeasible.

4.2 Exploring alternative institutional models of integration

There is a range of institutional approaches to integrating urban and rural water markets. Limited integration is a basic model of trade with a small number of market participants, namely urban and rural water utilities. Intermediate and full integration build on that model with progressively more complex trading arrangements, involving more market participants (irrigators, large urban water users, households) and expanded trading possibilities.

Limited integration

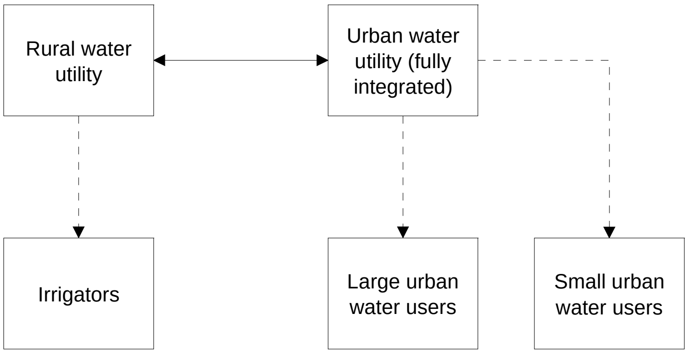
A simple approach to establishing integrated urban and rural water markets is to enable only water utilities to trade water (figure 4.1). Examples of potential trades under a limited trading approach include:

- an urban water utility could purchase water savings from a rural utility to refill urban dams over a number of years
- a rural water utility could purchase water on a seasonal basis from an urban water utility during very dry years.

Some ad hoc water trades between water utilities have already occurred. In 1997, for example, Melbourne Water transferred 49 500 megalitres from Thomson Dam to Southern Rural Water when rights in the Macalister Irrigation District were otherwise in danger of not being fully met (DNRE 2001).

Water available for rural water utilities to sell to urban water utilities may be limited. In Victoria, for example, although bulk water entitlements are tradeable, rural water utilities are obliged to meet irrigators' water entitlements, which, in reality, are what constitute the tradeable right. Consequently, often the only part of the bulk entitlement that the rural utility can trade is the allowance for distribution losses. If a water utility can reduce distribution losses, it can claim the water savings as a tradeable entitlement (DNRE 2001).

Figure 4.1 **Limited trade**[a]



a Unbroken lines indicate either party could be a buyer or seller of water. Dashed lines represent purchases by the final water users. If the urban and rural water suppliers draw on a common dam, the transfer of water from an irrigator to a large urban user may only involve an administrative amendment to the water register.

In some cases, rural water utilities also have (or have had) access to unallocated water that they could trade. In Queensland, rural water utilities have been able to auction unallocated water to irrigators (ACIL 2003). In Victoria, the Government converted 'sales' water within the Goulburn Murray Water Irrigation Area to legally-recognised entitlements and allocated 20 per cent (an average 120 gigalitres per year) to environmental flows. In consideration of the agreement with farmers to release a 20 per cent share of sales water, the Government agreed to a $93 million funding package that included system upgrades (DSE 2007b).[5] In the latter example, assigning or re-classifying 'sales' water to achieve environmental objectives may limit (rightly or wrongly) scope for future trades between urban and rural water utilities.

The ability of urban utilities to trade water to the rural sector is subject to similar constraints. Although urban bulk entitlements do not represent a collection of individual water entitlements, urban water utilities are obliged to satisfy supply security targets. However, assuming a connection exists and the urban water utility can demonstrate that it would be able to meet its supply obligations, there may be scope to trade water to rural users.

A risk associated with this limited integration approach is that it could heavily focus on water saving projects at the expense of market transactions in a similar way to recent environmental water sourcing programs. The per megalitre costs of several infrastructure

5 The package was also to recognise the recovery of an additional 25 gigalitres of high reliability water from reconfiguration of irrigation water supply infrastructure (DSE 2007b).

projects for the Living Murray Initiative, for example, were well above market prices of water (PC 2006b).

Intermediate integration

Another option for integrating urban and rural markets is to enable trade among urban and rural water utilities and large water users, such as irrigators, industry and environment service providers (figure 4.2). Examples of trading opportunities under 'intermediate integration' include:

- a willing rural seller and a willing urban buyer could enter a once-off deal
- an urban water utility could allow large water users (such as parks and sports facilities) exemptions from water restrictions in return for purchasing rural entitlements as an offset
- an urban water utility could enter into option contracts with irrigators allowing the urban utility to exercise the right to purchase water according to a pre-arranged trigger.

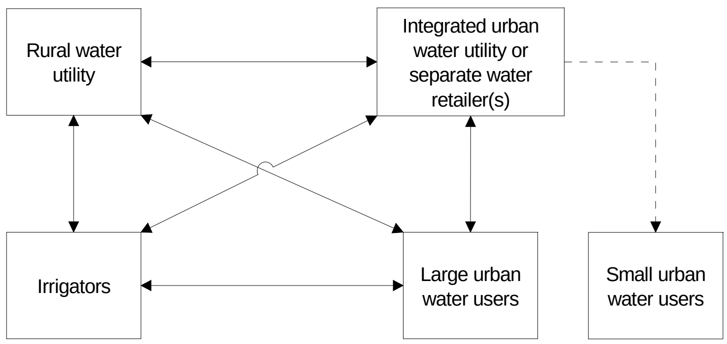
Some states have taken steps toward intermediate integration. For example:

- SA Water purchased approximately 18.4 gigalitres of water from dairy farmers in the Lower Murray Swamps for metropolitan water supplies[6] (SA Water 2005)
- the Queensland Water Commission (QWC 2007c) has foreshadowed arrangements in south east Queensland to provide the opportunity to allow trading between the new water grid manager and rural users
- regional urban water utility, Coliban Water, has constructed a pipeline to transfer up to 20 gigalitres of water per year from willing sellers in the Goulburn irrigation system to Bendigo and other urban centres (Coliban Water 2007).

A means of facilitating water trade between rural and large urban water users is through trade in entitlements. This could involve establishing a new urban entitlement system, whereby all large urban water users receive a share of a specific water source, which they can trade with each other and rural water users. A more modest (and probably less costly) approach would be enabling ad hoc entitlement purchases by large urban water users in rural markets to meet their supplementary water needs.

[6] SA Water's purchase, while very similar to a limited model, constitutes a move away from limited trade among only water utilities. In 2003, a group of dairy farmers on the lower reaches of the River Murray approached the South Australian Government, through SA Water, to sell their water allocations and land. SA Water committed to purchase 18.4 gigalitres of entitlements and about 300 hectares of associated land for almost $27 million. SA Water purchased these allocations on 'a commercial basis on the open market' (SA Water 2005, p. 14).

Figure 4.2 **Intermediate integration**[a]



a Unbroken lines indicate either party could be a buyer or seller of water. Dashed lines represent purchases by the final water users. If the urban and rural water suppliers draw on a common dam, the transfer of water from an irrigator to a large urban user may only involve an administrative transaction to the water register.

The Victorian Government and Melbourne water utilities are investigating the feasibility of establishing a market among large urban water users (Dunckley 2007; Farrier Swier Consulting 2007). The Victorian Government has flagged that a system replicating key aspects of the existing markets for farmers could be in place by 2010 (Hughes 2007). If it proceeds, it may be possible to extend the framework to rural–urban trade.

If large urban water users receive tradeable entitlements, they would be able to earn scarcity rents. (This contrasts with the limited model in which the entitlement and scarcity rents reside with the water utility.) Therefore, the method of apportioning entitlements would have equity or 'distributional' implications. Some important issues include:

- the approach to apportioning rights (such as grandfathering based on history of use, uniformly distributing rights by user class or auctioning entitlements)
- the definition of urban water rights (including allocation of supply risk).

Enabling large urban water users to trade entitlements would also call for establishing a water register to monitor holdings and transfers. According to the National Water Commission (NWC) Working Group on Compatible Registers (NWCWGCR 2005), the National Water Initiative mandates compatible, publicly accessible, and reliable water registers covering all water access entitlements and trades. The NWC Working Group interprets compatibility as applying in a 'direct sense … within and between States and Territories, where water systems are physically shared or hydrologic connections and water supply considerations will permit water trading', as well as in a broader sense of providing 'more confidence for those investing in the water industry through better and more compatible registry arrangements' (NWCWGCR 2005, p. 3).

Alternatively, large urban water users could access water from rural water users through supply contracts, without the need to establish urban water entitlements (box 4.4). For example, a contract could stipulate that the rural entitlement holder will supply a certain volume or share of their water each year, at an agreed price.

Enabling private water traders to trade into and out of urban markets would require granting access to water infrastructure. There are currently several impediments to third party access in the urban water sector, such as infrastructure pricing and health and safety issues. These impediments are relevant to all private sector competitors seeking to enter the urban water sector, such as desalination and recycling plant operators, not just those wanting to trade water under existing entitlements. Chapter 6 discusses these issues further in terms of encouraging competition in the urban water sector.

An intermediate model could capture much of the available gains from rural–urban trade by better aligning the marginal benefit of water across different uses. It would expose large urban water users and urban water utilities to competitive prices in rural markets. If variable water charges to urban households reflected the marginal cost of water purchases, these price signals could potentially pass through to urban households. Over time, rural and urban market prices could converge closer toward a price that is aligned with a social optimal allocation of water.[7]

If urban water users were able to purchase water from irrigators directly, and vice versa, the trading opportunities of irrigators would expand. It is likely more trade would occur than under a limited approach that relied predominantly on trading water savings.

[7] Some regional variation in prices is likely to occur due to transport losses — though there will be a tendency to equality of prices net of losses — and hydrologic constraints.

Box 4.4 **Urban entitlements versus supply contracts**

Establishing an urban water entitlement system is likely to impose significant transactions costs, which may be large relative to the expected gains from rural–urban water trade. However, some rural–urban transfers could occur without an urban entitlement system. Urban water users, for example, could potentially access water on a temporary basis from rural water suppliers and manage supply security through supply contracts. Like trade in entitlements, supply contracts could involve different levels of the water supply chain including wholesalers, retailers and end users.

Supply contracts could be a substitute for trade in entitlements for achieving more efficient water use. Some important considerations would be:

- the tenure of contracts relative to entitlements
- the legal status and obligations of contracts relative to entitlements
- transferability of contracts
- the transaction costs associated with negotiating contracts.

Ongoing supply contracts, combined with one-off purchases of seasonal allocations, could also be an interim measure before committing to a water trading system involving tradeable urban entitlements with large upfront costs. Supply contracts would offer an opportunity to gain experience with rural–urban water transfers and provide flexibility by postponing the large (sunk) investment associated with establishing a more complex trading framework.

Other factors influencing the efficiency of supply contracts, which equally apply to trade in entitlements, include:

- who can participate in trade (industrial users, retailers, brokers, households)
- where the trade involves an intermediary water supplier, how the water supplier passes on the costs to consumers (average cost, marginal cost).

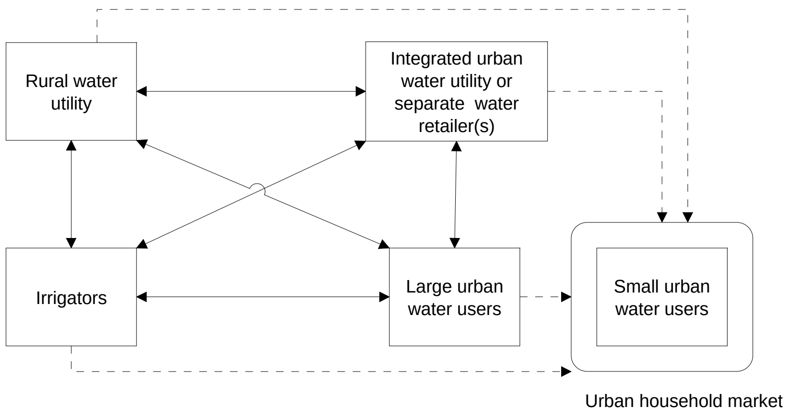
A report on the feasibility of establishing a large water user market in Melbourne recommended against establishing urban delivery entitlements, and instead suggested that a possible end point for reform is a physical spot market with a forward contract market (Farrier Swier Consulting 2007). Among other things, the report argued that the alternative model would enable large water uses to better manage risks and control transaction costs by allowing them to choose their level of participation in the market.

Full integration

If the limited model represents one end of the market integration spectrum, the other extreme would involve enabling urban households or residents to trade water. This could occur through a comprehensive property right system for urban water users or through supply contracts with rural suppliers.

Many different approaches to introducing household trade are possible. For example, households could interact with the rural market through private brokers or directly trade in electronic spot markets (figure 4.3). Regardless of the approach, the main aim of household water trade would be to facilitate efficient consumption and investment decisions by establishing prices that reflect the value for water in urban areas in times of scarcity.

Figure 4.3 **Full integration**[a]



[a] The unbroken lines indicate either party could be a buyer or seller of water. The dashed lines represent purchases by the final water users. If the urban and rural water suppliers draw on a common dam, the transfer of water from an irrigator to a large urban user may only involve an administrative amendment to the water register. This diagram represents the situation where urban households are supplied though supply contracts and do not have tradeable entitlements.

Household entitlements

Most work on tradeable household entitlements has been within the context of a discrete urban water market without rural participants (Young, McColl and Fisher 2007) (chapter 6). There has been little, if any, detailed investigation into the merits of enabling urban households to trade with rural water users.

Support for urban household entitlements within a discrete urban market has so far been lukewarm. Arguments against household entitlements in a discrete urban market include:

- the cost of establishing and administering entitlements for small customers would be prohibitively high (Allen Consulting Group 2007)
- it is unclear whether household water entitlements would deliver sufficient benefits above those provided by a centrally set scarcity price to justify the likely higher set up and administrative costs
- households' incentives to trade water may be small given water's small share of overall household expenditure (chapter 2).

As with intermediate integration, introducing household entitlements would have equity implications. For example, allocating rights on a per household basis would discriminate against households with more residents. On the other hand, there are likely to be practical difficulties in allocating rights at the resident level, such as metering and tracking changes in tenancy (chapter 3).

Household supply contracts

Theoretically, urban households could purchase water from a rural supplier, such as a rural water utility, through supply contracts. To minimise transaction costs, the water supplier could offer standardised contracts to households. Supply contracts between rural suppliers and urban households may be more feasible than entitlement trade, particularly if governments adopt a competitive model to urban water supply more generally (chapter 6).

In practice, the transaction costs associated with coordinating trades between rural suppliers and urban households are likely to be high, even with innovations that reduce these cost, such as electronic exchanges. The incremental benefits over intermediate integration (that is, an urban water retailer purchasing water from rural suppliers and passing the cost on to urban households through water charges) are less certain and may be relatively modest.

Summary of advantages and disadvantages of alternative approaches

The three alternative approaches to integrating urban and rural water markets (limited, intermediate and full) embody varying complexity, transaction costs and administrative requirements. There may also be equity implications in situations where water users receive rights to water. Policymakers need to consider these factors against the incremental gains from expanding the range of buyers and sellers in the market. Ultimately, selecting the most appropriate model involves balancing additional gains from trade and workability (BDA Group 2006).

Table 4.2 presents potential advantages and disadvantages of the limited, intermediate and full integration models. In addition to observing the broad advantages and disadvantages of different types of market integration, it is important to recognise that the limited, intermediate and full integration approaches could occur through different modes of exchange. Each mode of exchange has different implications for economic efficiency, transparency and equity.

Table 4.2 **Preliminary appraisal of three models for market integration**

Model	*Advantages*	*Disadvantages*	*Example*
Limited	• Feasible within existing institutional arrangements. • More cost effective than several other water supply options for cities. • Likely to rely on water savings, which (assuming water savings are ‘true’ savings and can be accurately measured) can have smaller third-party effects than direct trading.[a]	• Protracted bilateral negotiations would result in high transaction costs. • Transfers are less transparent than in competitive water markets. • Likely to rely on water savings, which can have a high cost per megalitre relative to the market price for water entitlements and can have third-party effects by reducing water available elsewhere in the system (that is, the purported water savings are illusory)(table 4.1).	• Urban water utility (or government) investing in water savings and transferring part of saved water to cities. (For example, *Modernising Victoria’s Food Bowl 2007*).
Intermediate	• Feasible within existing institutional arrangements. • Exposes large urban water users to competitive market prices in rural areas. • If variable urban water charges reflected the marginal cost of purchasing rural water, an intermediate model could enable more efficient consumption signals to urban households.	• Potential adjustment pressures if urban purchasers are large relative to rural markets.	• Purchasing entitlements from irrigators in water markets (for example, Murray–Darling Basin Commission environmental water purchases to meet Living Murray target).
Full	• Establishes a scarcity value in urban areas, which can inform more efficient supply augmentation, water consumption and investment decisions.	• May involve major institutional changes. • Trade based on household entitlements is likely to involve high transaction costs due to complexity. For example, a large number of market participants would make managing a water register more cumbersome.[b,c] • There would be practical difficulties in allocating rights and metering per person or per business.[b] • Potential equity issues at household level depending on how allocations are set.[b]	• na

[a] Assuming there is no intervention or reforms to property rights that reduce third-party effects from direct trade.[b] Less relevant to supply contracts.[c] Using brokers could reduce transaction costs. **na** Not available.

4.3 Facilitating efficient rural–urban water trades

Facilitating rural–urban water markets would involve a number of implementation issues. Some would apply even under limited forms of rural–urban trade. Others, although relevant to limited forms of trade, would likely become more pressing if rural–urban trade expanded and governments introduced further reforms to promote the development of competitive market structures.

Cost–benefit analysis of government policies that restrict trade

An initial step for facilitating rural–urban trade would be to make policies (or decisions) that restrict rural–urban transfers more transparent and subject to cost–benefit analysis. Pricewaterhouse Coopers (2006) noted that identifying the extent to which restrictions have curtailed rural–urban transfers is difficult because there are generally few legislative restrictions to such trade and governments do not extensively document their policy positions on the issue. Nevertheless, water service providers and others have acknowledged political reticence to take advantage of rural–urban transfers as a source of urban water supplies and some policymakers appear to discourage it (Marsden Jacob Associates 2006, Pricewaterhouse Coopers 2006).

A suggested motive for opposing rural–urban transfers is a desire to ensure water remains in agriculture, thereby protecting rural areas from further structural adjustment (Pricewaterhouse Coopers 2006). These arguments sometimes overlook the fact that introducing new urban customers for water in rural storages enhances the property rights of irrigators and increases the value of their assets.

To enable efficient trade, restrictions should be subject to rigorous and transparent cost–benefit analysis and regular review. This would imply clearly articulating, and where possible quantifying, the economic, social and environmental benefits and costs from maintaining restrictions.

Addressing potential distortions to rural–urban water trade

Several factors could distort market outcomes. These include:

- third-party effects on supply reliability
- environmental externalities
- differences in infrastructure charges between trading regions
- differences in levels of cost recovery between trading regions.

The significance of these factors, and appropriate management responses, will vary from case to case.

Third-party effects on supply reliability

Rural–urban trade could have third-party effects on supply reliability and environmental flows due to the incomplete specification of water entitlements. For example, return flows — the water that returns to the river system through run-off and seepage from the farm — can be an important factor influencing water availability (and quality) downstream. Because the specification of water entitlements is often in terms of gross water use rather than net water use, however, it does not account for changes in return flows due to water trade and land use change. Therefore, it would not account for a reduction in return flows, and consequent third-party effects, from rural–urban trade.

The extent of third-party effects from reduced return flows will depend partly on where rural–urban transfers occur. Adelaide, for example, is located at the end of the southern Murray–Darling system so there is probably less scope for third-party effects from reduced return flows downstream. Melbourne, on the other hand, would divert water from the upper reaches of the southern Murray–Darling system. Hence, all else equal, there is more scope for water transfers to have third-party effects on downstream water users through reduced return flows. (In reality, other considerations, such as changes in conveyance losses because of trade, will also affect supply reliability to third parties — see below).

The amount of additional water cities are likely to source from rural areas is also important in determining the extent of third-party effects from reduced return flows. Adelaide and Melbourne, for example, would probably each source less than the equivalent of 5 per cent of total water entitlements in the southern Murray–Darling Basin. Capacity constraints would likely limit the quantities much above this amount in the short term. If transfers to Melbourne and Adelaide are highly secure, however, water sourced for urban supplies as a proportion of water available from rural sources in southern Murray–Darling Basin may be considerably larger than 5 per cent in drier years.

Indirect purchases of water savings could potentially exacerbate the third-party effects from rural–urban transfers. One of the purported benefits of water saving investment over market purchase is that it avoids reductions in rural water use by creating ‘new’ water. However, water ‘savings’ associated with indirect purchases can be illusory. That is, measures to reduce system losses actually divert water from other beneficial uses, elsewhere in the system, that rely on return flows (PC 2006b). For example, total channel control is a water delivery technology that uses automated control gates to reduce irrigation district outfalls and improve service quality. However, district outfalls often supply downstream water users. Transferring entitlements out of the system based on illusory water savings can therefore ‘double up’ losses in return flows.

In some instances, water saving investments will result in 'true' water savings. That is, they will reduce water losses to evaporation or accessions to saline groundwater. If there is a way of accurately measuring these water savings, transferring entitlements based on true water savings may actually have *smaller* third-party effects than transferring existing entitlements. However, these water savings are likely to be far less cost effective than direct purchases. Many water saving projects, for example, have a per megalitre cost several times the market price for entitlements (PC 2006b).

There are a number of ways to address these third-party effects from return flows. Approaches that are more complex include defining all entitlements on a net water use basis or imposing charges on all water transfers to reflect changes in downstream water availability. Alternatively, government might opt for some sort of compensation. The Victorian Government, for example, is planning to transfer 75 gigalitres per year of water savings from the Goulburn region to Melbourne. At the same time, it will provide another 75 gigalitres each to rural and environmental uses.

It is important to keep the effects that rural–urban water trade has on return flows in perspective. Water transfers are not the only urban water supply option that will have third-party effects on other water users. New dams, for example, will likely have far larger and more concentrated effects on inflows into downstream storages than water trade.

Trade in water entitlements that define supply at the point of delivery rather than the source of extraction can also create third-party effects to supply reliability. Instances where third-party effects might arise include:

- where trade in entitlements does not recognise differences in supply reliability specifications between sources
- water users with entitlements from the same source share the conveyance losses or gains resulting from trade (Heaney and Beare 2001).

Heaney et al. (2006) have analysed different policy response for dealing with these issues.

Environmental and other externalities

In addition to addressing third-party effects on supply reliability, efficient allocation of water may also involve addressing other externalities associated with water storage, use and supply, such as salinity and nutrient discharge. Available options include regulatory measures (such as conditions in water-use licences) as well as market-based mechanisms (such as tradeable permits). For general discussion of environmental externalities and market mechanisms, see PC (2006b). Dwyer et al. (2006) explore issues surrounding charges for water-related externalities in a rural (irrigation) context.

Differences in structure of infrastructure charges between trading regions

Studies of rural water markets have shown that the level and form of water delivery charges levied by water utilities can affect outcomes from interregional water trade. This is because incentives for trade can arise from differences in the marginal value of water and variable delivery charges between regions (Heaney et al. 2004). In other words, the *net* marginal value of water beyond variable delivery costs drives water users' incentives to trade.

In some cases, differences in variable water delivery charges may reflect differences in the nature of supply systems. Urban and rural infrastructures, for example, have vastly different cost structures. Similarly, delivering water in a gravity-fed irrigation system will be less expensive than in a pressurised system (Heaney et al. 2004). Differences in delivery charges that reflect true variable costs do not distort trade.

If variable delivery charges do not reflect *true* variable delivery costs, however, they may distort trade. For example, setting variable delivery charges at average cost in one region could distort water use and trade incentives in that region relative to other regions that set delivery charges at marginal cost, and result in a less efficient allocation of water. Further, if a water utility recovers fixed costs through variable delivery charges, it may risk stranding its assets (Heaney et al. 2004).[8]

Differences in infrastructure charges may also affect rural–urban and urban water trades. Many urban water utilities, for example, set variable charges with reference to long run marginal cost (LRMC) (chapter 3). Melbourne Water (2006a) noted:

> … if [long run marginal cost] is calculated on a significantly different basis between authorities, then this could result in inefficient trading decisions; produce worse environmental outcomes; and result in inefficient investment in infrastructure (such as pipelines, water storage and sewage treatment facilities). (p.3)

Melbourne Water (2006a) therefore argued for consistency for calculation of LRMC where it affects decision making on water trading.

---

[8] Stranded assets can occur where there is net trade in entitlements out of an area and the remaining water users must meet the fixed costs of maintaining and replacing the water delivery infrastructure (Roper, Sayers and Smith 2006). These higher charges may in turn cause other water users to trade their entitlements out of the system. This situation may arise when an inappropriate charging regime is used to recover the costs of delivering water (Heaney et al. 2004). Several commentators have examined different options for managing stranded assets including long-term contracts and exit fees (for example, ACCC 2006; Goesch et al. 2006; PC 2006; Roper, Sayers and Smith 2006).

Differences in levels of cost recovery between trading regions

Differences in levels of cost recovery for water infrastructure can affect trade in entitlements. This is because water users' willingness to pay for entitlements will be influenced by the expected net present value of the present and future water allocations under entitlement less the expected present and future costs of infrastructure charges (Roper, Sayers and Smith 2006). Therefore, a water user who faces water charges that are below the full cost of the water infrastructure will have an (artificial) competitive advantage over a water user who pays the full cost of infrastructure.

Although rural–urban trade may be susceptible to distortions from differences in levels of cost recovery across regions, it is likely nevertheless that allowing such trade will improve efficiency. In particular, government policies that require rural water utilities to achieve a lower-bound cost recovery, as opposed to an upper-bound cost recovery that applies to urban water utilities, suggest that any distortion would tend to limit rural–urban trade by increasing rural water users' willingness to pay for entitlements compared with urban water users.[9] Therefore, while rural–urban entitlement trade may allocate less water to urban water users than is economically efficient when there are differences in levels of cost recovery, it will facilitate a more efficient allocation than under no rural–urban trade.

Having said this, movement towards consistency in cost recovery among urban and rural water utilities will be beneficial in its own right, as it will enable further efficiency gains over time.

Water for environmental purposes

The purpose of integrating water markets is to improve the allocation of water among different water uses. To achieve this, it is important that markets are open to all water users, including groups wanting to secure water for environment purposes.

Many of the environmental uses of water have public good properties (Freebairn 2005b). Hence, it is desirable that governments take steps to allocate sufficient water to environmental services to reflect their value to society. Identifying the social marginal benefit of increasing or decreasing environmental flows is complex. Environmental values are subject to uncertainty and further work is required in ecological assessments and non-market valuation of these services. That said, allowing environmental water users to participate in water markets has an important advantage in that it provides a mechanism for

9 Assuming trade is mostly from rural water users to urban water users rather than the other way around.

ensuring future modifications to water allocated to the environment are as explicit and as transparent as feasible (Freebairn 2005b).

Enabling environmental service providers to compete for water on an equal footing with rural and urban water users would have benefits for water allocation and investment. First, it would reduce waste by enabling environmental service providers to source water more cost-effectively. Second, by entering the water markets, environmental service providers would tend to increase market prices to better reflect water's social marginal value.

Adjustment pressures

Depending on the relative size of urban and rural water markets, there may be adjustment pressures associated with market integration. Dwyer et al. (2005), for example, demonstrated that when regions with relatively low levels of water consumption (such as Adelaide and Canberra) face shortfalls in water availability and trade with regions that use large volumes of water (such as irrigators in the southern Murray–Darling Basin), they have little effect on traded prices and quantities. The opposite is true, however, when large water users experience shortages and trade with small users. For perspective, adjustment pressures resulting from other factors, such as technology change and movements in markets for rural commodities and inputs other than water, will often be more important than the pressure associated with sales of water.

Water trade can be an effective tool for managing risk and easing adjustment in rural areas. A recent study on the economic and social impacts of water trade in rural water markets, for example, noted that water trading increases the parties' capacity to react to changes in circumstances. The report noted further that water trading is a catalyst for change that would in any case have happened because of drought, variation in commodity markets and rural adjustment (Frontier 2007).

Where adjustment pressures are significant, there should be consideration of whether general programs of support will be sufficient or if there is a need for more targeted adjustment assistance. Attention to the design and implementation of market reforms can also help minimise adjustment costs (PC 2001).

5 New water supplies

Key points

- Enduring water restrictions in most Australian capital cities have highlighted potential weaknesses in water supply planning and investment. Areas of concern include apparent failures to:
  - adopt the most cost-effective supply strategies
  - deal adequately with climate variability and uncertainty.
- Debate about the relative merits of different supply options suggests there is a need to develop robust frameworks for assessing supply augmentation, incorporating factors such as external effects and options value.
- Some water planners and/or utilities have adopted measures to better address climate variability and uncertainty in water planning (such as scenario-based planning) and investment strategies (such as diversification of supply sources).
- Greater interconnection between, and the introduction of new, water sources and the desire to facilitate greater competition in bulk water supply have implications for governance arrangements for supply planning and operational coordination of water sources.
- Greater competition in supply to end users would have implications for water utilities' role in managing urban supply security. Access to other water suppliers could give urban water users greater flexibility to manage their own supply security.
- Some governments have committed to large-scale seawater desalination.
  - Desalination generally constitutes a large irreversible investment in supply capacity and is subject to considerable uncertainty.
  - Desalination can reduce the supply risk associated with reduced rainfall. However, early commitment to desalination can result in loss of flexibility to respond to new information, such as rainfall patterns and changes in technology, and result in substantially higher supply costs.

5.1 Introduction

While water transfers from rural water systems enable water users to increase benefits from existing resources, in some cities increasing demands on available water (including from population growth) will necessitate investing in new water supplies. Like water transfers, however, investment in new supplies can be controversial. Balancing the gains in supply security and the costs, including potential environmental and social effects, is challenging.

This chapter discusses investments in new water supplies undertaken by governments, water utilities, businesses and households. It describes the different types of new water supply, the current approach to water supply investment in Australia, and some key issues for ensuring efficient investment. It then discusses these issues with respect to desalination investment, which many of Australia's major cities have either already committed to or are contemplating.

Types of new water supply

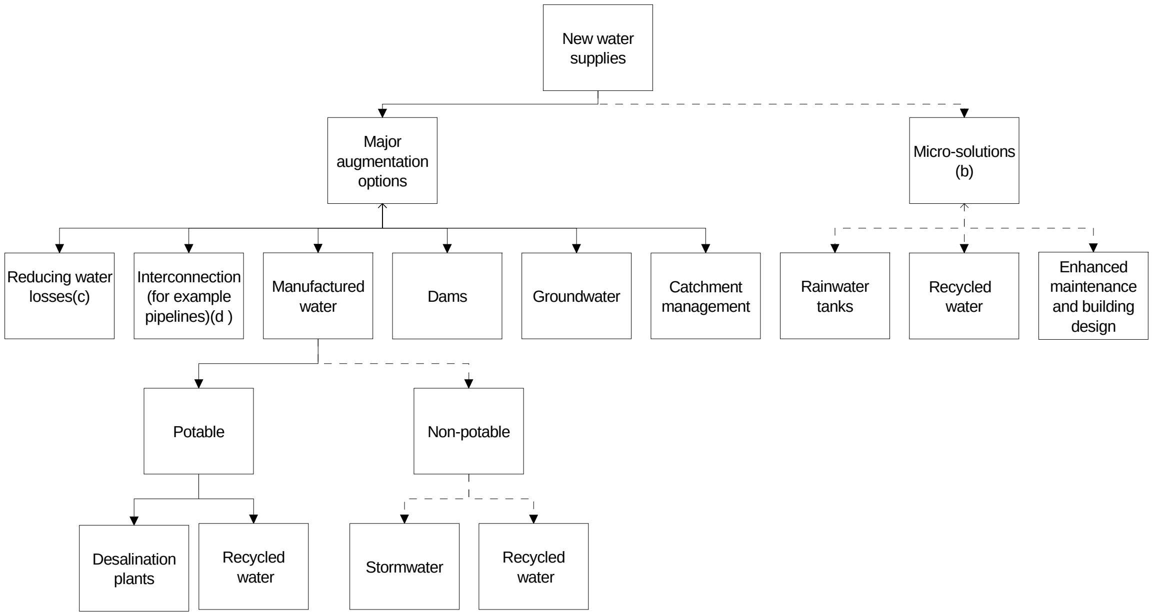
There are several ways to categorise new water supplies. These include:

- *Major augmentation versus micro-solutions* — investments range from large-scale investments (such as desalination plants) to small-scale investments (such as household rainwater tanks) (figure 5.1).
- *Rainfall-dependent versus manufactured water supplies* — most existing sources (such as dams) are highly dependent on rainfall, whereas manufactured water supplies (such as desalination) have little or no reliance on rainfall.
- *Potable supplies and non-potable supplie*s — some new supplies would augment potable water supplies, while others would substitute for potable supplies in particular uses, such as watering gardens or industrial processes.

Although all supply options contribute to overall supply security, each has different supply characteristics in terms of: how much, when and where water is available; potential uses; infrastructure requirements; and external benefits and costs. For example, stormwater is a diffuse source supply that is most plentiful in periods of high rainfall. It is generally for non-potable uses and is usually more cost-effective in purpose-built greenfield sites that do not require retrofitting (Marsden Jacob Associates 2006). Harvesting stormwater can have external effects, such as reducing the amount of (polluted) runoff entering streams and rivers. The availability of suitable storage for large-scale stormwater harvest, such as aquifers, varies among cities.

Some forms of supply management do not involve investment in new infrastructure. For example, forest thinning in catchments can increase runoff and dam inflows. Further, bushfire management can reduce risks to water availability.

Figure 5.1 **Options for new water supplies**[a]



[a]Dotted lines indicate sources outside shared potable water system. [b]'Micro-solutions' describes the physical size of specific water technologies or investments rather than their overall importance to total water supply. [c]Reducing losses in one part of the water delivery system can sometimes reduce water availability to water users elsewhere in the system, particularly in natural conveyance systems, such as rivers. [d]Although the purpose of interconnection is often to reallocate existing water rather than create new water, it can increase supply capacity to a specific area or city.

Relationship between new water supplies and water transfers

In general, water transfers (chapter 4) reallocate Australia's existing water resources among different water users (rural, urban and environmental), whereas new supply investment (such as in manufactured water) adds to Australia's total supply capacity. This distinction, however, can sometimes be blurred. For example:

- Some water transfers involve investing in infrastructure to establish or expand interconnection between different water storages, thereby increasing the supply capacity to a given region or city.
- Some forms of supply investment (such as dams) can actually reduce water available elsewhere in the system, making them more akin to a reallocation of water than a new supply.
- Some modes of facilitating rural-urban transfers, such as indirect purchase of water savings, can increase supply by reducing evaporation or accessions to saline groundwater (PC 2006b).

Current approach to investing in new water supplies for cities

As explained in chapter 1, in Australia, urban water users generally rely on state-owned water utilities to invest in new water supplies on their behalf. Water utilities implement long-term capital programs (and measures for demand management) to balance water supply and demand. Investment in new water supplies, as with other forms of infrastructure investment, is often 'lumpy' in that investments are infrequent, involve a large expansion of capacity and require large upfront costs.

Centralised planning processes guide water utilities' capital programs. Water supply plans typically involve collaboration between State government and water utilities. Plans commonly aim to manage demand and supply with reference to objectives relating to the frequency, severity and duration of restrictions (Marsden Jacob Associates 2006). The decision on how much to invest in new supplies depends in part on the assessment of public willingness to accept supply restrictions (for example, aiming to limit restrictions to 1 in 100 years and 1 in 20 years would generate vastly different investment profiles). Planners often use project unit costs, or dollars per megalitre, to prioritise the roll out of future supply investments.

Businesses and households sometimes undertake additional investments to supplement water supplied by the water utility — particularly where supplies from the water utility are subject to restrictions. Investments typically involve small-scale technologies, such as rainwater tanks and recycling systems for non-potable uses. In the longer term, businesses and households may also respond to increases in water scarcity by investing in technologies or appliances that require less water.

Governments also provide funding and direct investment in the Australian water industry to achieve economic, social and environmental objectives. Activities include providing subsidies to households to adopt particular technologies as well as funding, or co-funding with water utilities, large-scale investments that affect whole regions (chapter 6).

5.2 Facilitating efficient investment in new water supplies

Recent dry conditions and water restrictions in many of Australia's major cities have highlighted potential weaknesses in water supply planning and investment. Key areas of concern include an apparent failure to adopt the most cost-effective supply strategy by exploiting all available supply options and the inability to deal adequately with climate variability and uncertainty. With regard to the latter, the National Water Commission has noted:

> … the [National Water] Commission is concerned about disappointing performance across most Australian jurisdictions in urban water planning. Urban water shortages in

> the current drought and the rush to invest in new urban water infrastructure are evidence of planning failure. The fundamental NWI outcome of reliable urban water supplies has not been delivered. (NWC 2007c, p. 4)

Cost-benefit analysis of supply options

Unit cost, or dollars per megalitre, is a commonly used method for assessing the cost effectiveness of different supply options (figure 5.2). On this basis, it would appear optimal to access more water from lower unit cost supplies, such as rural-urban trades, and less from higher unit cost supplies, such as rainwater tanks and desalination.[1] In reality, however, often the opposite occurs. Rural-urban trades remain relatively rare, several major cities have invested in or have announced plans to invest in desalination, and governments provide subsidies for rainwater tanks.

A potential reason why water utilities and governments adopt (or promote) seemingly high-cost supply options is because unit costs do not always capture wider benefits and costs, or supply characteristics, of different supply options. For example, some planners may consider it worthwhile to pay a premium for desalination because it provides insurance against reduced water availability from rain-dependent sources. Alternatively, governments may veto certain options because of concerns over adverse social or environmental effects.

Another caveat associated with comparing unit costs for individual projects is that it may not capture fully the benefits from combining a portfolio of supply (and demand) options to minimise supply costs over time. For example, a supply option that provides access to large amounts of water at short notice can be highly valuable to a water utility because it allows the utility to defer investment until it is more certain the investment is required. In such cases, some argue, the investor should assess cost effectiveness at the portfolio level rather than the project level.

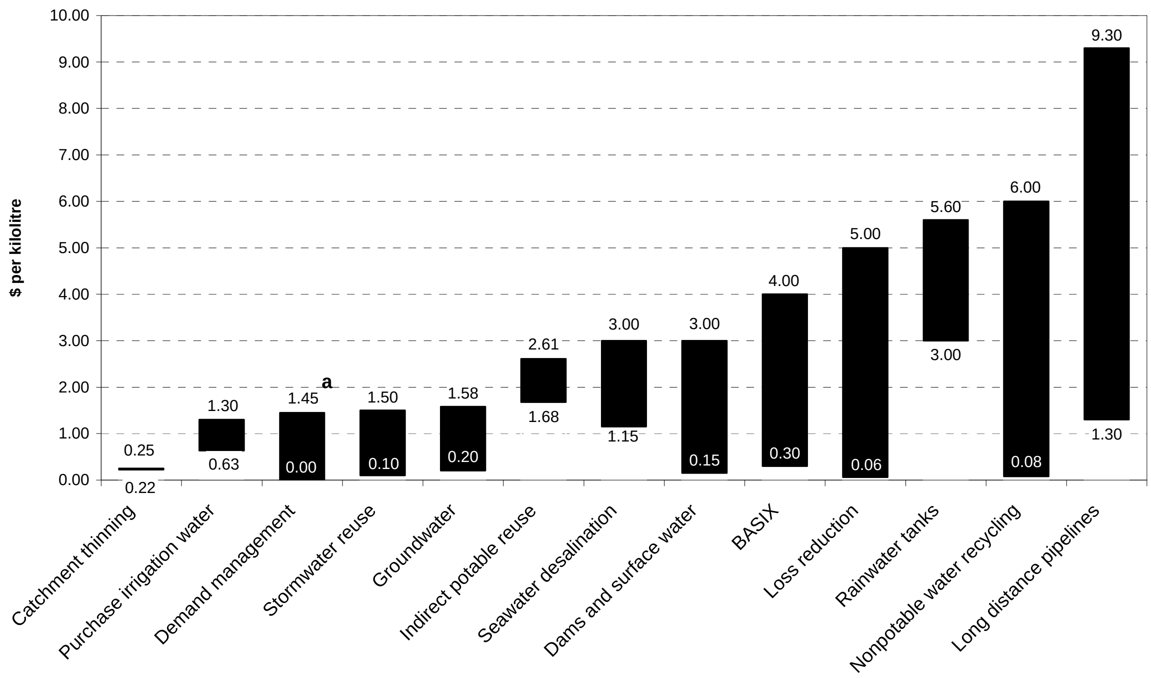
To the extent that consideration of external costs and benefits, supply characteristics and options value could greatly affect an investment decision, it is important that cost-benefit analysis deal with them in a transparent and consistent manner. This is not only important from the viewpoint of enhancing public confidence in decision making processes for augmenting supply, but also because, in the case of external costs, it might reveal innovative solutions for reducing the cost of water supply. For example, a range of measures could help mitigate negative environmental effects associated with new supplies and rural-urban transfers. Such an approach, which explicitly identifies all relevant factors and, where possible, quantifies costs and benefits, contrasts with a tendency of some

[1] The relative costs of different supply options can vary greatly depending on the location and situation.

governments and/or water utilities to preclude particular supply options from consideration (BCA 2007; Marsden Jacob Associates 2006; NWC 2006).

Figure 5.2 **Direct costs of water supply and demand options**

Sydney, Adelaide, Perth, Newcastle



[a] The study noted that it was sometimes unclear which costs had been included in the calculation of demand management costs. It further noted, in some cases, regulatory requirements may avoid the cost of augmenting water sources, but increase the cost burden to developers, appliance manufacturers or customers. To analyse options from the standpoint of all stakeholders, demand management costs should include the incremental costs to business and the community in addition to the costs to the utility.

Source: Marsden Jacob Associates (2006).

Dealing with climate variability and uncertainty in supply planning

Recent studies have identified climate as a major source of risk and uncertainty for water supply investment (Marsden Jacob Associates 2006; NWC 2007c). Marsden Jacob Associates (2006, p. 18) noted that the treatment of climate risk and uncertainty in different planning approaches is reflected in 'the relative capacity of water supply infrastructure and the levels of capital expenditure' in Australian cities. Characteristics that distinguish approaches to climate uncertainty include:

- recognition of past changes in streamflow and the reliance or rejection of long-term streamflows as the best indicator of future streamflow levels and variability
- the degree to which streamflow projections incorporate CSIRO climate change projections

- level of service requirements. That is, what probabilities/frequencies, severity and duration of water restrictions are appropriate and acceptable (Marsden Jacob Associates 2006, p. 16).

In some jurisdictions, entities responsible for water supply planning have made changes in response to uncertainties associated with climate and demand growth. Perth's water source plan, for example, includes several measures for incorporating uncertainty (Allen Consulting 2007; Marsden Jacob Associates 2006):

- water planning is based on the climate and streamflow regime since 1997 — this is characterised by much lower rainfall than the 100-year rainfall scenario commonly used by water planners in other capital cities
- water planning adopts a target of total sprinkler bans of 0.5 per cent of years (1 in 200 years) to replace the former target of 3 per cent of years (other Australian capital cities commonly adopt a 1 in 25 year sprinkler ban scenario)
- water planning includes sensitivity analysis in relation to future demand trends and the likelihood of meeting demand management targets.

Although many accept the need to account for climate uncertainty in water supply investment, identifying the appropriate response can be problematic. Incorporating uncertainty into investment planning requires balancing costs with precaution. The central question is what constitutes a reasonable level of precaution and what is wasteful investment? As one commentator put it:

> Understanding risk and developing a process for determining when you proceed with new infrastructure is important. If you get [decisions on supply capacity] wrong, either way, no one will forgive you as the commentators will be equally harsh on 'white elephants' as they would be on cities not having enough water. (Anon cited in Marsden Jacob Associates 2006, p. 18)

Box 5.1 presents a simplified example to illustrate the challenges that planners face when planning supply under uncertainty. The assumptions made in the example correspond approximately to the situation for Melbourne. Despite the complexities in getting water supply investment 'right', recent efforts to take better account of climate uncertainty have generated debate and facilitated more informed decision making. For example, the Economic Regulation Authority (ERA) of Western

Box 5.1 **Illustrative example of supply planning under uncertainty**

Melbourne's water balance (annual water supply less annual water use) after planned additions to water supplies and price increases is highly uncertain. The table below presents Melbourne's water balance in approximately 8 to 12 years time under two possible scenarios and illustrates a range of possible outcomes.

Under an optimistic scenario, Melbourne's water balance increases to 461 gigalitres (or 148 per cent of annual water use) owing to a large increase in supply from existing dams, desalination and water transfers. There is also a significant reduction in water consumption due to an increase in the water charge. This scenario assumes annual inflows return to the long-term average experienced over the past 100 years; new supplies from desalination (150 gigalitres) and water transfers (75 gigalitres) are available at full capacity; water use is highly responsive to a doubling in the water charge (Brumby 2007); and demand increases from population growth and removal of water restrictions are relatively modest.

Under a pessimistic scenario, annual water supplies still exceed annual consumption — by approximately 115 gigalitres (or 24 per cent). It assumes average inflows into dams conform to drier conditions experienced over the past ten years; average annual water transfers halve because of drier conditions (no further trades occur to meet the shortfall); demand is less responsive to the water charge increase; and there are larger increases in demand from removing restrictions and from population growth.

The example does not capture all the complexities of an urban water system. For example, there may be scope to vary the timing and scale of new supply augmentation to address any surplus or deficit in the water balance. Further, the initial amount of water in storage levels will influence investment decisions.

Hypothetical annual water balance for Melbourne in approximately 8 to 12 years

	Scenario	
	Pessimistic case	Optimistic case
Annual water supply		
Inflows into own-catchment dams (a)	413	548
Supply from new investments (desalination and water transfers)	188	225
Total annual water supply (GL)	601	773
Annual water consumption		
Consumption (baseline 2006)	446	446
Water charge increase (100 per cent)(b)	-45	-178
Effect from removing water restrictions(c)	52	32
Demand growth (d)	32	12
Total annual consumption (GL)	485	312
Annual water balance (GL)	115	461
Water balance as per cent of annual water consumption	23.7	147.8

(a) Baseline supply forecast for 2015 in Water Supply-Demand Stratgey for Melbourne includes supply increase from Tarago Reservoir. (b) Assumes price elasticities of -0.1 to -0.4 (c) Based on 'demand bounceback' of 42 GL +/-10. Original estimate related to effect of returning to pre-restrictions behaviour rather than effect of removing restrictions (d) Based on demand growth of 22 GL +/-10. Uncertainty intervals for demand growth and demand 'bounceback' were added by the Commission.The Melbourne Water Supply-Demand Strategy is based on 95 per cent supply reliability.

Source: Estimates based on Water Supply-Demand Strategy for Melbourne 2006-2055.

Australia questioned some of the assumptions that underpinned water supply planning for Perth. In its final report on its inquiry into the Water Corporation's tariffs, the ERA noted that the Water Corporation based simulation modelling to guide the timing of the South West Yarragadee pipeline on the assumptions that: a) average inflows of the past six years would continue and b) a one-in-200 year reliability. The ERA suggested that these assumptions might be overly cautious (ERA 2007b).

If institutions that enable greater competition to end users were to emerge so that individuals could take out private insurance, the need for government to insure against 'worse-case' outcomes may diminish. However, it is unclear to what extent government would see a need to offer some base level of 'insurance' that the whole community values, and how that could be best delivered.

The application of 'real options analysis' to water supply planning has been an important development for dealing with investment uncertainty. Real options analysis focuses on maintaining investment flexibility by delaying large irreversible investments that may later prove to be less than ideal (ACIL Tasman 2007b) (box 5.2). For example, a real options approach to water supply planning might prescribe developing smaller-scale supply options that allow more incremental supply investment so that the water utility can gather new information, such as on dam inflow patterns or changes in technology, and potentially avoid high sunk costs in excess capacity. An important implication of real options analysis is that the additional flexibility from avoiding large-scale investments can be sufficiently valuable to justify considering augmentation and demand management options with relatively high unit costs (ACIL Tasman 2007b).

Box 5.2 **Real options analysis**

Real options analysis (ROA) is a tool for understanding investments with uncertain outcomes. Much of the theory behind ROA originated in financial markets and has since extended into other areas such as capital budgeting for investments. The basic idea is that opportunities for investment are options — rights, but not obligations, to take some action in the future. The decision to undertake an irreversible investment essentially 'kills off' the option; the decision maker gives up the opportunity of waiting for new information that might affect the desirability or the timing of the investment. According to ROA, the opportunity cost of a lost option must be included as part of the cost of investment. Similarly, the investor should consider the value of new options created. The opportunity cost of exercising an option is highly sensitive to uncertainty over the future value of the project.

ROA is an alternative to more conventional approaches to analysing investment decisions, such as net present value (NPV), and sometimes can produce significantly different results for the value of an investment. Whereas traditional approaches to investment (such as NPV) operate on the premise that irreversible investments are now-or-never propositions, ROA recognises that investors often can delay investments. A key insight from ROA is that remaining flexible can be valuable when uncertainty is (at least partially) resolved over time. In a dynamic setting, the question becomes one of optimal timing of the investment under uncertainty, or how to exploit the opportunity most effectively.

ROA recognises that investments and expenditure can occur in stages or at smaller scale, allowing the investor to review their investment decisions based on updated information. In contrast, an NPV analysis might consider the investment as all or nothing. The approach the investor uses can influence whether or not the investment goes ahead. For example, unlike NPV, ROA recognises that the ability to abandon a project during the early stages of investment (exercise the option not to proceed with further investment) reduces downside risk if conditions prove unfavourable.

ROA can operate with a portfolio of investments. For example, an investor may develop a number of options in parallel until an identified time in the future, recognising they may not exercise all of the investment options.

ROA has many potential applications. For example, option value can give insight into the trade-off between economies of scale and flexibility in utility planning. Building large-scale plants can provide economies of scale and reduce per unit costs. However, more gradual investment in smaller scale plants would provide flexibility to respond to uncertainty in demand growth and developments in alternative technologies.

Sources: Council of Science and Technology (2005); Dixit, A. and Pindyk, R. (2001).

Governance arrangements for sourcing bulk water

Competition in the provision of bulk water is likely to be an important ingredient for balancing water demand and supply at least cost. Notwithstanding the extensive involvement of the private sector in providing services to urban water utilities (DPMC 2006), there is scope for encouraging greater private sector participation in bulk water supply by addressing governance arrangements (chapter 6). Some commentators have pointed out that the governance arrangements that underpin decisions about which sources to develop, when to develop them and how to operate (or 'dispatch') supply sources once they are in place, can create risks for potential competitors and reduce private sector participation in bulk water provision (ERA 2007a).

In Western Australia, the ERA has proposed the creation of an independent procurement entity (IPE) as a means of separating bulk water procurement from the role of the government and the state-owned water utility and, in doing so, reducing some of the potential risks faced by private sector suppliers. The ERA outlined how introducing an IPE could address any real or perceived conflicts of interest for the water utility as a supplier and seller of bulk water. These include scope for bias when selecting which sources to invest in or 'dispatch', as well as exposure to commercially sensitive information when approving bids. The ERA noted that the IPE model would also serve to clarify the role of government and reduce the risk of political interference in investment decisions:

> Government would provide a set of system security requirements that the IPE would then apply. Independence from government provides certainty for the private sector, transparency in decision making, and consistency in approach. (ERA 2007a, p. vii)

ERA noted that governance reforms to enhance competition to supply bulk water for Perth's centralised water supplies could work in tandem with a third party access regime that allowed competition for end users outside the formal procurement process.

The prospect of greater interconnection of water systems and new water supplies, such as desalination, has influenced water providers in other states to re-examine existing governance arrangements for bulk water supply. For example, there have been proposals for a 'water grid manager' in south east Queensland and in Melbourne. While these water grid manager models (box 5.3) exhibit similarities to the IPE model (for example, in each case the new entity plays a key role in supply planning and operational coordination of sources), the institutional settings are quite different.

Box 5.3 **Yarra Valley Water's proposal for a 'water grid manager'**

Melbourne water retailer, Yarra Valley Water (2007), has proposed introducing a new entity responsible for the efficient allocation and supply of bulk water. It notes that management of bulk water supplies will have 'the greatest impact on future [water] prices' in Melbourne. Therefore, it is 'critically important that arrangements are put in place that actively manage bulk water supplies in the context of a new desalination plant, the Sugarloaf Interconnector and the imminent creation of a Water Grid' (p. 20). Proposed functions of the 'water grid manager' included:

- integration and optimisation of all sources of bulk water (existing dams, groundwater, desalinated water and major sources of recycled water)
- long-term planning for future water supplies
- managing the transfer of bulk water within the water grid
- creating the mechanisms (that is, transfer rules) for the efficient transfer of water between users
- establishing storage trigger points for water restrictions with the water grid manager making recommendations to government on the appropriate levels of water restrictions
- managing the entry of third parties
- optimising the transfer of water to produce the lowest overall community cost of supplying water.

South east Queensland has developed its own version of a water grid manager (chapter 6, box 6.2).

Source: Yarra Valley Water (2007).

5.3 Desalination case study

This case study discusses some of the issues raised above with respect to desalination investment. Exploring ways to optimise desalination investment is particularly important given large-scale desalination is a relatively new form of water supply in Australia with unique characteristics. Further, the Australian and several state governments are planning to spend large amounts of public funds on desalination investment in the coming years.

Desalination investments in Australia's major cities

In 2006, Perth became Australia's first state capital to manufacture water using a large-scale desalination plant. Since then, New South Wales, Victoria, South Australia and Queensland have announced plans to construct desalination plants for urban water supplies. Western Australia has also announced plans for a second desalination plant to supply Perth (table 5.1).

Table 5.1 Desalination plants in Australia

	Capacity per year	*Proportion of current total water supply* [a]	*Capital Cost*	*Effect on typical annual water bill*	*Expected date of operation/ completion*
	GL	%	$b	$/year	
Sydney	91[b]	17	1.76[c]	100–110[d]	2009-2010
Melbourne	150[e]	35	3.1[f]	300[g]	end of 2011
Adelaide	50	30	1.4[h]	194[i]	2012
Perth (1)	45	17	0.4	44	current
Perth (2)	50[j]	–	0.95[k]	30	2011
Gold Coast	46[l]	15[m]	1.2	**na**	end of 2008

[a] Total urban water supplied = residential water consumption + commercial and municipal and industrial water consumption + other water supplied + municipal irrigation water supplied + bulk water exports. Extractions/diversions for urban supplies can be substantially more than water supplied. [b] Maximum annual capacity based on daily capacity. Option to scale up to 182.5 GL/year (500 ML/day). [c] Total cost comprises plant cost ($730 million), seawater intake and outlets ($230 million), distribution pipeline ($500 million), and other project costs ($300 million). [d] Proposed (real) price increase from 2007-08 to 2011-2012. [e] Option to scale up to 200 GL/year. [f] Includes costs of inlet and outlet tunnels and 200 GL pipe to Melbourne. [g] Commission estimate. Victoria is implementing a suite of water infrastructure projects with a total cost of $4.9 billion. The Government expects the total package of measures to double Melbourne water bills (in real terms) by 2012. The Government estimated a water and sewerage bill for a typical Melbourne household in 2005-06 was $473. [h] Cost comprises $1.1 billion desalination plant and associated infrastructure. [i] Increase in annual bill by 2011. [j] Option to increase to 100 GL/year capacity. [k] Includes $315 million required for integrating plant into the water supply system. [l] The Queensland Government has announced plans to increase the capacity of the existing project from 125ML/day to 170ML/day. [m] Plant will deliver water into planned south east Queensland water grid. **na** Not available

Sources: ABC News (2006, 2007a, 2007b, 2007d); Carpenter (2007); GCD Alliance (2007); GHD (2007); Gold Coast Water (2006); Kelton, G. and Owen, M. (2007); NWC (2007a); QWC (2007b); Sydney Water (2007a, 2007c); Victorian Government (2007b); Water Corporation (2005b, 2007a, 2007b).

The importance of planned desalination plants (relative to current water use) differs across cities. Melbourne's plant, for example, will provide the equivalent of 35 per cent of Melbourne's current water use, whereas Sydney's plant will provide the equivalent of 17 per cent of current water use. In both cases, there is an option to increase plant capacity later.

Costs and benefits of desalination

Desalination is a highly secure source of supply that could provide large-scale supply at relatively short notice for most major Australian cities (Marsden Jacob Associates 2006). A common argument for desalination investment is that, despite being relatively high cost (figure 5.2), it provides 'insurance' against the variability of rain-dependent water sources (box 5.4). Another view is that desalination is sometimes the only supply option capable of providing sufficient water in time to avert unacceptable risk to water security (see, for example, Water Corporation 2007c).

Box 5.4 Is desalinated water more valuable to consumers than natural water?

Once water is in storage (or the water supply system), a litre of water from a desalination plant has the same value as a litre of natural water. Does this imply that a desalination plant capable of providing 100 gigalitres (GL) per year will provide equivalent benefits as a dam that provides an average 100 GL per year? Under plausible assumptions the answer is no.

First, if water users are risk averse, it follows that (all else equal) they will prefer a certain water supply to a more variable supply. Hence, they will value the certainty of supply from desalination over the variability of annual dam inflows.

Second, if the marginal value of water is higher in dry years when supplies are limited than in wet years, then even risk-neutral water users will prefer the certain 100 GL supply to the variable 100 GL supply. This is because the desalination plant can supply more than the weather-dependent dam when water is most valued and supply less water when water is least valued. Hence, over time, the total value of water supplied from the 100 GL desalination plant will be greater than that from the 100 GL dam.

A corollary is that it is economically sound to invest more to obtain an expected annual 100 GL of desalination water than to collect an expected 100 GL of natural water. A more difficult question to answer is: how much more?

A risk associated with planned desalination investment is that a large proportion of plant capacity will remain unused for some time. Higher rainfall would raise dam levels, make rainfall-dependent supplies more economical and — in the absence of institutional arrangements that commit to sourcing water from desalination regardless of the availability of rainfall-dependent supplies — reduce the demands on desalination. In the interim, investors in desalination (or consumers) would bear the capital and maintenance costs of desalination plant infrastructure. The additional cost would be akin to an insurance premium.

In addition to the financial risks associated with desalination, there are also third-party effects to consider. Desalination is energy intensive. Using fossil fuels to power desalination would result in considerable greenhouse emissions. Further, desalination discharges brine into the marine environment.

To date, several state governments have indicated they will invest in renewable energy sources to offset energy used in desalination plants. The creation of markets to price carbon emissions from electricity generation would be a means of internalising the externality. A carbon price would raise further the variable cost of water from desalination relative to, say, rainfall-dependent sources.

Because ecological effects of saline discharges on the marine environment are more localised than greenhouse emissions, it is likely management responses will be more dependent on conditions at each site. In Victoria, for example, the Environment Protection Authority will set an allowable salt concentration for desalination plant discharge (Victorian Government 2007b).

Dealing with climate uncertainty in supply planning

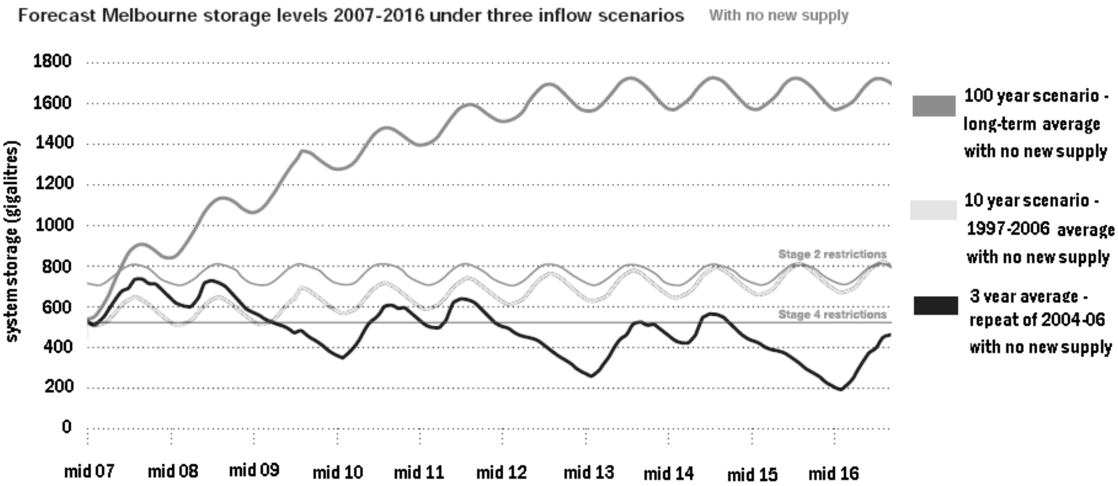
In some respects, desalination investment is a direct response to climate uncertainty. Desalination provides one of the main mechanisms for diversifying urban supply sources to include non-rainfall dependent supplies and offers insurance against further reductions in long-term rainfall (box 5.5). However, the method of implementing a desalination investment can have a substantial effect on overall costs.

When an investor faces a decision about an irreversible investment subject to uncertainty, there is an incentive to delay the investment until better information comes to hand. Delaying the investment means the investor maintains flexibility and reduces the likelihood of unnecessary sunk costs. However, the longer the investor waits before investing, the higher the probability of other costs, such as severe water restrictions.

Readiness strategies are a means of managing uncertainty associated with large investments such as desalination. Readiness strategies have short lead times that allow investors to defer expenditure until it is clear to them that further deferral would threaten security. Delaying investment can have large benefits, including reducing the opportunity cost of maintaining excess capacity. The desalination readiness strategy in the Metropolitan Water Plan for Sydney, for example, focussed on undertaking preliminary work to enable the desalination plant to come on-line at short notice. This meant that Sydney was able to defer commitment of a large portion of investment funds while maintaining capacity to respond quickly to continued water scarcity in the future.

Box 5.5 **Uncertainty, investment planning and desalination**

The benefits from desalination investment are highly dependent on uncertain factors, such as climate. This poses challenges for water planners trying to balance supply security with costs. Desalination investment could perform well under a very dry scenario, but could be a very costly option under a 'wetter' scenario. The Victorian Government, for example, recently announced plans for 240 gigalitres of new potable supplies for Melbourne by 2011. The Victorian Government water plan considered average inflows over the past 100, 10 and 3 years, respectively. (The 3-year scenario coincides with recent 'extreme' dry conditions.) Notably, desalination will account for over 60 per cent of the planned addition to Melbourne's potable supply capacity. Given existing investment plans, desalination would likely be necessary to avoid stage 4 restrictions under the 3-year scenario (see figure below). Under the 100-year scenario, however, it is likely that cheaper sources of supply would be available.



Assumptions or judgments that planners make in response to uncertainty can greatly influence investment decisions. For example:

- Scenarios — Brennan (2008) has shown that changing the low-inflow scenario used to plan for Perth's desalination plant (that is, 2001–2006) to include the 'wet year' in 2000 substantially reduces the expected benefit from the investment.
- Weights or subjective probabilities — planners may attach subjective probabilities or weights to different scenarios. For example, the Victorian Government characterised the 3-year scenario as a 'relatively unlikely scenario' (2007a, p. 22).
- Water security targets — supply planners have water security targets (implicit or explicit) that they judge to be acceptable to water users. In Perth, the Water Corporation noted:

  … a restriction category that requires a total sprinkler ban is now acknowledged as undesirable, and the State has undertaken to develop source capacity to ensure that the likelihood of a total sprinkler ban is very small. For planning purposes, the Corporation has interpreted "very small likelihood" to mean that a total sprinkler ban will be required in 0.5% of years. (p. 7)

Sources: Brennan (2008); Morris, S. (2008); Victorian Government (2007a); Water Corporation (2005a).

Governance arrangements and desalination

Desalination investment typically involves installing substantial capacity with large upfront costs. In addition to the risk of excess capacity in the event of higher rainfall, large-scale investment in desalination may also eliminate opportunities for competition from other suppliers for some time, which could have significant implications for the overall cost of meeting supply (ERA 2007a). For this reason, it is important that decisions about when to invest in (and dispatch) desalination are impartial, transparent and based on full consideration of alternatives. Governance arrangements, such as the ERA's IPE model, could be worth further investigation in this regard.

Pricing desalinated water supplies

With centrally-planned water supplies, it is common for regulators (or governments) to set variable water charges with reference to the long run marginal cost (LRMC) of future water sources (NWISGWC 2007) (chapter 3). The effect that desalination investment has on LRMC depends on the method for calculating LRMC (chapter 3). Under the 'perturbation' approach, for example, a planned desalination investment would affect LRMC when it becomes the next, lowest cost source of additional water in the water utilities' supply schedule. Under the average incremental cost (AIC) approach, on the other hand, LRMC includes the present value of future supply investments (which may include desalination) over the planning period. Hence, LRMC under the 'AIC' approach distributes costs more evenly over the planning period.

Developing estimates of the LRMC is not straightforward; it requires assumptions about when future supply (or demand) initiatives will occur and the level of water produced (saved) (Sydney Water 2007c). For example, water utilities may experience difficulties making long-term forecasts regarding the desalination plant operations and costs because investment outcomes will depend on a variety of factors, including the level of rainfall, demand and dam storage levels (Sydney Water 2007c).

An alternative (or complement) to LRMC-based pricing is to set variable charges according to short run marginal cost (SRMC) (which, in times of water shortage, includes the scarcity value of water) (chapter 3). The benefit of SRMC pricing would be that, during times of scarcity, it would provide more efficient (and transparent) signals for when to operate the desalination plant. For example, the point at which the urban scarcity price (based on, say, dam levels) exceeded the desalination plant's SRMC could act as a trigger for increasing production from the desalination plant. A fixed (access) charge could cover any revenue shortfall.

Some regulators have noted pricing according to SRMC could result in large fluctuations in price and fail to send clear signals about long-term investment. However, these problems are probably surmountable. For example, water suppliers could manage price volatility through long-term supply contracts (box 5.6). Volatile prices could be confined to the wholesale level, with retailers providing a price stabilisation service, for some customers, at a price (Freebairn 2008).

Box 5.6 **Markets for high-security desalinated water**

A private desalination operator could sell desalinated water to urban water users through long-term supply contracts. A typical customer might be an industrial water user, hotel or power generator willing to pay a premium for highly secure supplies to prevent the risk of incurring high costs from water restrictions.

Long-term contracts for desalinated supplies would be akin to high-security entitlements for surface water.[2] In some rural markets, high-security entitlements attract a premium over general-security entitlements because high-security entitlement holders are more likely to receive their full entitlement each year. Similarly, a desalination plant operator could earn a premium for a highly secure, weather-independent supply.

Some rural water users participate in markets for seasonal allocations (chapter 4). The spot price for seasonal allocations is unaffected by whether the seller acquired the allocation under a high- or general-security entitlement (a megalitre of water is a megalitre of water). Hence, there is a single market price for water allocations. In a well-functioning market, this price provides a mechanism for coordinating efficient water use decisions (chapter 4).

Enabling producers and customers of desalinated water supplies to interact in spot markets for (natural and desalinated) water would help ensure they face efficient signals. For example, the cost of producing the additional unit of desalinated water could be more than the spot price for natural water at a point in time. In this case, it would be more efficient for the desalination plant operator to honour a supply contract by purchasing seasonal allocations than increasing production. Similarly, a water user who has entered into a supply contract may place a lower value on an allocation than the prevailing spot price. Hence, it would be efficient to trade that allocation on the spot market.

Further actions for promoting efficient water use and supply

This chapter and previous chapters examine opportunities for promoting efficient water use and supply in the areas of pricing, water trade and investment in new supplies. As noted,

2 Some jurisdictions classify entitlements according to level of priority or reliability (that is, high or low). Priority or reliability reflects the frequency with which an entitlement holder receives a full water allocation.

several of these measures will rely on broader institutional and structural reforms. The next chapter examines in more detail the range of institutional and structural reforms available, highlighting both the potential gains and practical difficulties.

6 Institutional and structural reforms

Key points

- Reform in the urban water sector has focused on institutional mechanisms such as commercialisation, rather than structural changes to urban water monopolies.
- Further governance reforms to the centralised monopoly model could improve outcomes — dividend payout policies could be more commercially based and water utilities given greater autonomy in making investment decisions.
- Broader reforms could promote more efficient water use and investment, greater choice for users, and more transparent and accountable decision making.
  - Private involvement could be expanded through greater use, and innovative forms, of competitive procurement.
  - Water utilities could be disaggregated so that contestable elements (for example, bulk water supply) are separate from non-contestable elements (for example, distribution).
- Current subsidies/grants for urban water initiatives appear to conflict with broad NWI policy objectives and could encourage inefficient outcomes.
- The practical difficulties and costs associated with broader reform should not be underestimated.
  - Substantially more research and analysis is required before comprehensive changes to market structure could be introduced.
  - Changes would need to be introduced incrementally, preferably with current intergovernmental water institutions adapted to guide this process.
- Governments would continue to play a key role in competition oversight and in meeting environmental, equity and health goals.

6.1 Introduction

The efficient provision of infrastructure services, such as gas, electricity, water and transport, is crucial for competitiveness, productivity and the quality of life for all Australians. Impelled by evidence of inefficiency and inequities in service delivery, governments began reforming their monopoly infrastructure services decades ago. Reforms focused on removing impediments to effective competition and included: disaggregating natural monopoly and potentially competitive elements of service provision; separating regulatory and commercial functions; facilitating access; promoting competitive neutrality; and commercialising government businesses (NCC 1998). Various studies have identified significant national benefits flowing from such reforms (PC 1999a, 1999b; PC 2005a, 2005b).

While structural reform has long been underway for many infrastructure services, there has been relatively little change to the urban water sector. Although many water utilities have been commercialised, and some governments have restructured some supply functions, nearly all major urban utilities remain vertically integrated government-owned monopolies. Private sector involvement is focused largely on undertaking capital works and providing services under contract.

That urban water has been treated differently to other infrastructure services may reflect its characteristics such as: the competing use of water for environmental flows; the natural monopoly characteristics of water and wastewater distribution; the high 'transportation' costs relative to the value of the resource; the public good aspects of ensuring community health through safe drinking water; the variable and uncertain supply of the resource; and the risks associated with 'lumpy' augmentation investments. Further research is required to ascertain the extent to which such characteristics mean that the urban water sector is less amenable to the types of reform that have arisen in other infrastructure services. Allied to this, modelling of the wholesale and retail markets for urban water is in its infancy.

That said, it is widely accepted that competition to provide goods and services is usually the most effective way to deliver efficient prices and high quality services to consumers. Competitive pressures compel firms to: compete for customers on price and quality; compete for inputs, thereby directing resources to their most valued uses; and seek innovative ways to improve their price–product offerings. In some instances, a monopolist may provide services more efficiently than competing firms — for example, where there are large economies of scale and/or scope.[1] However, productive efficiency need not mean that the monopolist's product offerings accord with those sought by, or that they are allocated efficiently across, consumers.

Rising concerns about the longer-term impacts of climate change on water availability and the impending introduction of substantial additional sources of new water add further impetus to questions about whether the current institutional arrangements remain the most appropriate (chapter 5). Structural changes have been proposed in Queensland and reviews are underway in other states including Western Australia (ERA 2007a, b), Tasmania (MWST 2006) and Victoria (VCEC 2007).

1 Economies of scale relate to unit costs of production decreasing as output increases. Economies of scope arise where one firm can provide two or more products along the supply chain more cheaply than for each to be provided by separate firms.

The potential institutional reform agenda is varied

This chapter canvasses various approaches that could, in principle, promote improved community outcomes. Some could be addressed relatively quickly whereas others, if found to be worthwhile, would require extensive implementation strategies. All warrant further investigation.

Improving the efficiency of the government monopoly model through further governance and commercialisation reforms could be pursued at relatively low cost (section 6.2). Within this centralised paradigm, there is scope to encourage a greater degree of, and more efficient, private sector involvement (section 6.3). This could include tendering for outcomes (for example, volumes of water) rather than particular technologies (for example, stormwater harvest).

Moving away from the centralised approach, there is scope to progress broader reform in the urban water sector including:

- retaining, but restructuring, government-owned integrated supply chains to ensure cost-reflective pricing across the various 'business units'
- vertical (and horizontal) structural separation of contestable and non-contestable elements of the urban water supply monopolies.

The former, by communicating (internal) price signals, could induce competitive entry to provide various urban water services. The latter more far-reaching approach could likewise induce competitive entry but also potentially *create* competing businesses by divesting contestable elements of the supply chain. Accordingly, broader reforms could catalyse competition in bulk water provision, retailing and wastewater recycling and encourage new business opportunities (section 6.4).

Ultimately, it is possible to envisage an evolution to a fully decentralised urban water market involving many retailers and wholesalers offering different forms of product (for example, price and security). This is discussed in section 6.5. However, an important caveat is that such arrangements do not operate elsewhere in the world.

Of a different ilk, but critically important, is the need to ensure that urban water policies are consistent and that public investments are not distortionary nor in conflict with the broad objectives enunciated in intergovernmental agreements (section 6.6). Finally, section 6.7 considers issues associated with implementation, transition and adjustment. On balance an incremental approach offers advantages.

6.2 Further commercialisation of water utilities

Many government-owned water utilities have been subject to corporatisation and commercialisation to: clarify roles and responsibilities; encourage commercial charging; ensure that any subsidies are transparent; provide managerial autonomy; allow for rewards and sanctions for performance; and facilitate competitive neutrality (NCC 2005a). Nonetheless, the extent of governance reforms of water utilities has been patchy. Areas where further reforms could usefully be considered include the managerial autonomy of urban water utility boards and dividend payments to governments.

The roles ascribed to some water utilities can appear conflicting — for example, in urban settings, their roles can be (i) to sell water and (ii) to not sell water (that is, discourage water use). This points to a need for a clear delineation between where responsibility resides for service provision, resource planning, augmentation, demand management, network coordination and environmental management.

Governments sometimes restrict water utilities from pursuing particular supply augmentation options or require that they pursue specific strategies. (Grants and subsidies targeting specific outcomes can exacerbate this — section 6.6.) While it may be appropriate for governments to preside over major investment decisions that have broad economic, social and environmental impacts, this should not encroach unduly on the independence of utilities. Intervention into the management decisions of utilities can create a disconnect between responsibility and accountability. It also can create uncertainty for businesses seeking to offer contractual services if decisions are driven by considerations other than utilities' stated objectives.

Concerns have been raised that state governments have required excessive dividend payments from their urban water utilities[2] (Dwyer 2006). Dividend payout ratios for urban water utilities in 2005-06 were around 70–100 per cent — for example, 73 per cent for Sydney Water, 95 per cent for SA Water (Metropolitan) and 76 per cent for the Water Corporation (Perth, Metropolitan) (PC 2006a; 2007). Large private sector utilities in the gas and electricity sector typically pay dividends of between 50–70 per cent of net profits after tax.

Assessing if water utilities pay excessive dividends is not straightforward given the unique nature of their business, the lack of private sector equivalents, and differences in debt/equity ratios and accounting practices. Further, governments may regard water services — for which demand is relatively price-inelastic — as an appropriate target for

[2] In contrast, rural and many smaller regional urban utilities do not make dividend payments. High dividend payments need not imply excessive profits for water utilities. If water prices were lower than scarcity values, sub-optimal water profits could co-exist with excessive dividends.

higher than usual taxation, and they may consider it socially desirable to extract economic rent from the water resource.

To the extent that high dividend payouts are being made, utilities will have lower retained earnings to invest in maintenance and augmentation. Such utilities also would be at a disadvantage if competitive markets emerged.

Ensuring utilities pay dividends based on commercial criteria could help address such problems. Governments may perceive that relinquishing direct control of the management of water utilities would result in a loss of hegemony over social, environmental or other policy objectives. However, they have other means to achieve such objectives — including through fully funded and transparent community service obligations.

6.3 Procurement, contracting and privatisation

Centralised procurement to harness the benefits of competition through greater private sector involvement includes a range of possibilities. Common approaches include water utilities seeking expressions of interest to supply projects (for example, infrastructure such as a desalination facility) and/or services (for example, maintenance).

Some public-private partnerships (PPPs) have been undertaken and include 'Build Own Operate' and 'Build Own Operate Transfer' projects. Examples include the Virginia recycled water scheme (South Australia) operated by Earthtech, and Yan Yean treatment plant (Melbourne) operated by United Water. Recent analysis indicates that PPPs perform better than traditional procurement approaches in terms of construction delays and cost over-runs (Allen Consulting Group 2007b).[3] These advantages must be weighed against the transaction and financing costs of PPPs.

Centralised procurement can include auctioning licences to supply services to an entire market — for example, all water and wastewater services (Demsetz 1968). In addition to seeking operational efficiencies, governments could specify contractual conditions that extract monopoly profits up front. And, operators that overcharged or delivered poor services would risk being replaced by a rival at the expiration of the contract. Such contracts are extensively used in France (Renzetti and Dupont 2003). The SA Government has franchised the operation of Adelaide's water system to the private sector, including managing water and wastewater treatment and undertaking billing.

Typically, centralised procurement involves specific projects or services rather than outcomes. An outcomes-based approach, however has much to commend it. Rather than

3 Traditional procurement includes private involvement through 'Design and Build' and 'Design and Construct'. The differentiating factor for PPPs is that they involve private capital.

specify a technology to provide additional water, the alternative would be to tender for a volume of water. This would enable different proposals to be ranked and, in the absence of policy bans on particular options, least cost augmentation options selected — whether from a dam, aquifer, catchment thinning, desalination, recycling, stormwater harvest or purchase of rural water entitlements. In its draft report on competition in the water and wastewater services, the Economic Regulation Authority (ERA) of Western Australia proposed establishing an independent procurement entity (IPE). In essence, rather than having the state Water Corporation determine source options, the IPE would procure a portfolio of 'call options' with differing volumes, lead times and durations of supply. The portfolio of available options would enable cost-effective supply (ERA 2007b).

Privatisation of water assets could encourage investors to seek efficiencies to generate higher returns and also liberate funds for other public expenditures. Privatisation without effective competition, however, risks replacing a public monopoly with a private one with potentially worse outcomes for users. For example, the initial experience with water sector privatisation in the United Kingdom was poor (Buckland and Fraser 2000; Lobina and Hall 2001). However, outcomes improved notably from the mid-1990s after effective regulation of pricing, quality and third party access was introduced (Buckland and Fraser 2000; Renzetti and Dupont 2003).

A related, albeit more modest, means to use competition to achieve more efficient outcomes in a regulated monopoly environment is through incentive regulation whereby the performance of similar businesses are compared and better performing businesses permitted to retain part of their cost reductions. This approach has been adopted in parts of England and Wales (ERA 2007a). The structure being developed in Queensland (box 6.1) and the model adopted in Melbourne, with three retailers, could underpin this approach. (A weaker form, 'benchmark' or 'yardstick' competition, compares businesses to identify relative strengths and weaknesses.)

Issues associated with private involvement in the market

Expanding the private sector's financing and ownership of water assets could provide additional funding for infrastructure investment, more opportunity for risk sharing (for example, for investment, operations and delivery risks) and possibly more productive management and work practices. Inconsistent contracting rules, however, can increase the costs of private involvement — a recent Australian Government report suggested developing national guidelines for contracting to assist in risk allocation in public-private partnerships (DPMC 2006).

A key aspect of managing arrangements with the private sector to undertake infrastructure investments is apportioning risk between the government, private operators and water users (box 6.1). Several factors bear on the appropriate apportionment of risk. The model of private sector involvement — ranging from full private ownership to full public ownership with management or service contracts — implies a continuum of risk-sharing arrangements. Further, case-specific factors influence the ultimate risk allocation on any project. For example, contractual agreements regarding service commitments, maintenance, coverage, financial obligations and certain other considerations bear on the allocation of risk (OECD 2007).

Box 6.1 **Risk sharing and desalination**

Investments in desalination generally involve private sector involvement — although the details for some planned desalination plants are unresolved. The NSW Government contracted the design, construction, operation and maintenance of Sydney's desalination plant to private operators. Ownership and funding of the project will reside with Sydney Desalination Plant Pty Ltd (SDP), a wholly-owned subsidiary of state-owned Sydney Water.

The risk-sharing model adopted means Sydney Water will maintain a high degree of control over how much water the plant produces, which provides flexibility to shut down the plant or reduce production when cheaper supplies are available or storages are sufficiently full. Sydney Water (2007c, p. 87) has noted 'it is anticipated the plant will not operate when major dams are spilling; it will instead operate when dams fall below pre-determined levels'. This flexibility comes at a cost. For example, Sydney Water (through SDP) is obliged to pay an ongoing 'fixed' fee to the desalination plant operator, which is, in a sense, the 'insurance' value attached to having desalinated water available.[4] SDP, for example, must compensate the plant operator for fixed labour and other costs and, under certain conditions, the costs associated with shutting down, maintaining on standby, and restarting the desalination plant.

Sources: Sydney Water (2007a, 2007b, 2007c).

It is efficient for the contractual party that is best able to assess and control a particular risk to bear that risk. For example, generally the private partner should bear risk associated with operational efficiency because it is in a position to mitigate that risk. The public partner, on the other hand, is better placed to bear risk of a public-interest nature (for example, pursuit of non-commercial objectives) (OECD 2007).

Social cost-benefit analysis should be the basis for determining the model for private infrastructure provision and the associated allocation of risk. In practice, the public must balance the incentive to shift as much risk as possible onto the private sector, with the cost of compensation to the private partners for assuming additional risk (OECD 2007). In

[4] The proposed approach is for Sydney Water to collect revenue associated with the desalination project (Sydney Water and SDP required revenue) through customer bills. Sydney Water will pay SDP an availability charge (for providing the plant) and a volumetric charge for the water. The SDP revenue is used to pay operation/maintenance costs, debt repayment, electricity, contract management and administration costs, and a return on capital (Sydney Water 2007, p. 46).

some cases, governments must make tradeoffs between costs and flexibility. Material adverse effects clauses to protect private operators from sovereign risk, for example, could ameliorate risk and uncertainty to the private sector, but reduce flexibility (Hepburn et al. 1997).

6.4 Toward decentralised competition — unlocking the supply chain

Retaining the features of the urban water monopoly supply model, 'administrative restructuring' could create discrete business units within the organisation with cost-reflective pricing across the chain. Armed with transparent information about costs and prices, particularly for using distribution services, potential entrants could identify opportunities where services could be delivered more efficiently or new services introduced. This information could also be used to benchmark the performance of water businesses — indeed, clarifying roles, of itself, could engender better alignment of functions with resources.

Recent proposals to reform the south east Queensland water sector are consistent with this approach — bulk water supply and treatment, and retailing services are to be provided by separate entities; transport and distribution managed by regulated monopolies; and planning functions coordinated by a grid manager (box 6.2).

Administrative restructuring could be implemented as a precursor to the more formal structural separation that has occurred in the gas, electricity and telecommunications sectors. In these instances, former government monopolies have given way to competing businesses accessing regulated distribution networks. Applied to urban water, structural separation could entail disaggregating utilities vertically (and horizontally) to enable competition in the contestable parts of the water–wastewater supply chain (figure 6.1).

Potentially contestable segments are likely to include retailing, bulk water supply, storage, and water and wastewater treatment services. In contrast, distribution and reticulation infrastructures display natural monopoly characteristics and are unlikely to be provided more efficiently by multiple providers. That said, parts of the cost of distribution networks could be avoided by locating a new water source closer to urban centres. In some cases a reticulation network could be avoided by proximity — say recycled or desalinated water for an industrial customer.

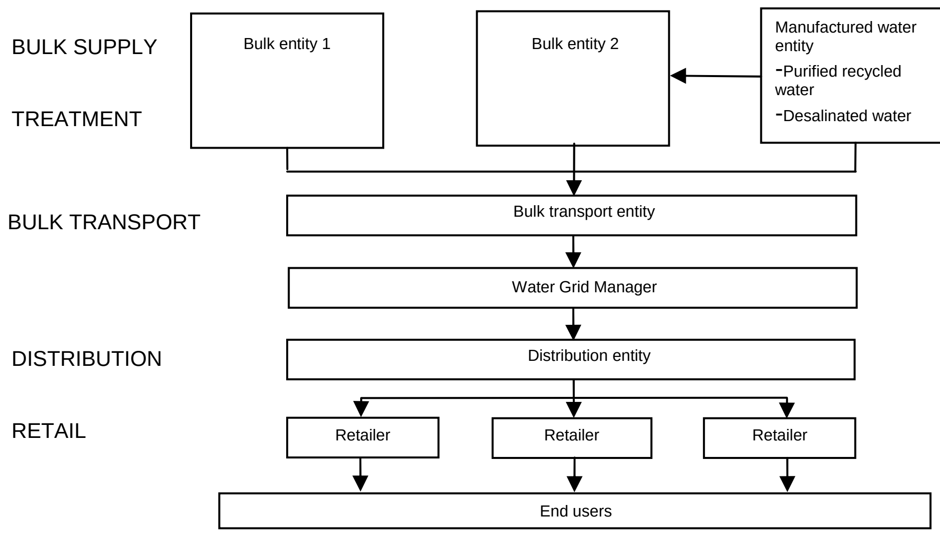
Box 6.2 **Reforms to south east Queensland's water industry**

The Queensland Water Commission (QWC) recommended a restructure of the south east region's water delivery services. The main elements include: vertical disaggregation of functions, including separation of contestable elements of water provision from natural monopoly elements (bulk transport and distribution); rationalisation of bulk water suppliers and retailers; and creation of a water grid.

There is also a possibility of introducing third-party access to the distribution network to allow competition between retailers, including new entrants. The reforms are expected to improve accountability, strengthen maintenance incentives, achieve economies of scale in regional water management, and increase water security. Key features are:

- The State Government being responsible for major infrastructure associated with the water grid, including bulk water assets, bulk water pipes and treatment plants. Three state-owned statutory authorities would provide bulk water. Two would own dams, weirs and other water sources (currently owned by 12 different entities), based on catchment areas, and associated treatment plants. The third would control Tugun's desalination plant and the Western Corridor Recycled Water Project.
- A water grid manager would be established as a non-profit statutory authority to control the sharing of water and set fair and consistent prices for bulk water.
- Local councils would jointly own all regional domestic distribution assets and three new water retailers (created by merging the current 17 retailers).
- The Queensland Competition Authority would oversee water prices.

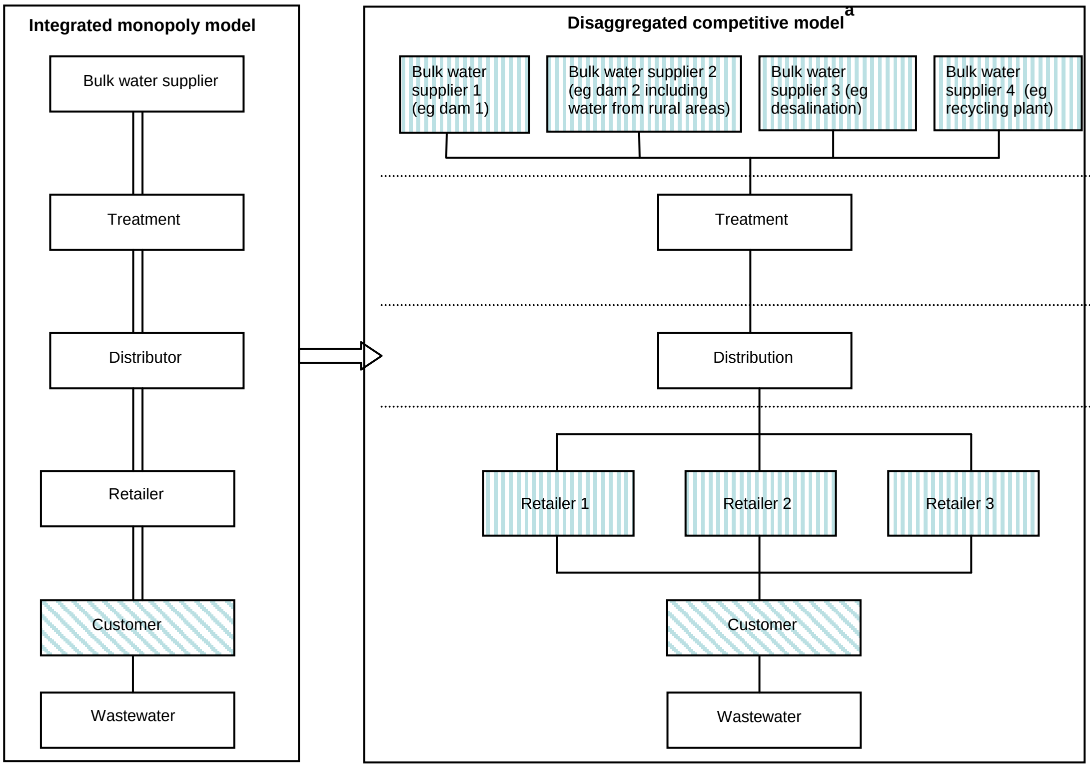
Proposed structure of south east Queensland's water industry:



In response to the QWC report, the Queensland Government opted for a Bulk 1 entity.

Source: QWC (2007c).

Figure 6.1 **Alternative structures for the urban water sector**



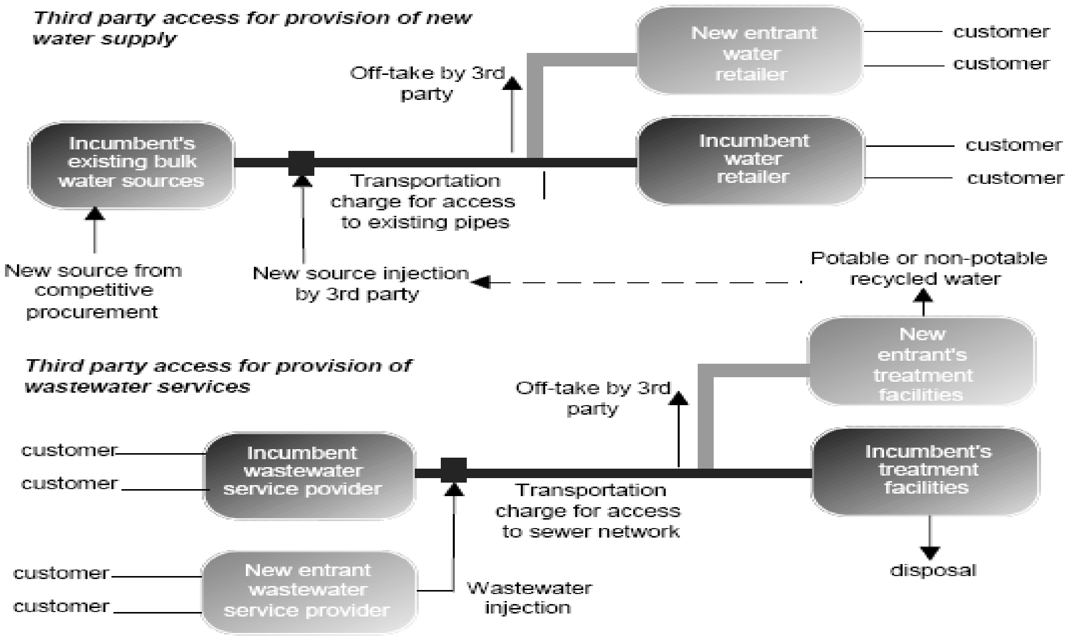
[a] Stylised representation. Desalinated water can be treated at source and injected into the network and recycled water, rather than going to a water treatment plant, would typically be diluted in a dam.

The illustration of the potential differences between an integrated and a disaggregated urban water structure (figure 6.1) conveys high level possibilities. In addition, treatment services could be contestable for potable water and almost certainly for other grades of water. Indeed, under the disaggregated model, there would be greater scope for wastewater treatment and retailing (figure 6.2).

Potential costs of structural reform could include any diminution of economies of scale and scope, or other benefits such as administrative and operational synergies. The counter to any joint management and administrative economies is that greater accountability of each separate business to 'pay its way' and minimise internal cross-subsidies could sharpen incentives for efficiencies within the supply chain.

The Independent Pricing and Regulatory Tribunal (IPART) of New South Wales (2007) found some evidence of economies of scale in water services, but few insights on their magnitude. It noted that Sydney Water was approaching a size at which water utilities in other jurisdictions have experienced diseconomies of scale (IPART 2005). According to IPART (2007) a comprehensive study of economies of scope in water services — relating to the industry in the United Kingdom — identified economies from the integration of water production and distribution (Stone and Webster Consultants 2004).

Figure 6.2 **Possible ‘injections’ and ‘off-takes’ into urban water systems**



Source: Allen Consulting Group (2007a).

The ERA’s draft report on competition in water and wastewater indicates that the minimum efficient scale for water businesses has been estimated by various studies to lie in the range between 125 000 and 1 million connections, and around 100 000 connections for wastewater services (ERA 2007b). It further noted that there appears to be little benefit from combining water with wastewater services and that horizontal separation of network/retail businesses may lead to increased dynamic efficiency through competition that could offset the loss of economies of scale.

Importantly, the ERA (2007b) posited that:

> The key issue here is whether some modifications to the arrangements that reduce the size or scope of individual operations would involve costs that might exceed the potential gains from greater competition and wider incentives for innovation and customer focus. The evidence suggests that sustained cost increases from such a restructure could, if real, be quite modest – provided that the transition and legacy costs are not excessive. (p. 70)

Facilitating third-party access

A necessary condition for stimulating competition in the urban water sector would be the capacity for new entrants to access monopoly distribution services on reasonable terms and conditions.

Administrative restructuring, of itself, is unlikely to mitigate incentives for integrated incumbents to engage in anti-competitive conduct to maximise the value of the business as a whole. Such conduct could include outright denial of access to networks or the setting of charges and/or conditions that deter access. Water utilities may have an incentive to impede competition in order to discourage ‘cherry picking’ by competitors that could threaten cross-subsidised system costs and/or dividend streams. In contrast, under structural (as opposed to administrative) separation, independent distributors would have a commercial incentive to provide services to all comers — although there would still be potential for them to seek to extract monopoly rents.

Without appropriate access regimes or other regulations to manage the market power of bottleneck infrastructure, cost savings from increased competition in the urban water sector could be captured by distributors. Part IIIA of the *Trade Practices Act 1974* (Cwth.) provides a right for third parties to share the use of essential infrastructure facilities on reasonable terms and conditions by having such facilities ‘declared’ (NCC 2002a, 2007b). State governments may also create their own access arrangements and have them certified under Part IIIA.

Applied appropriately, access regimes can: promote efficient use of infrastructure; encourage new firms to compete in upstream and downstream markets; promote efficient investment in those markets; and improve outcomes for consumers (PC 2002). Poorly developed access regimes and/or inappropriate regulation (for example, arbitrated outcomes that set access prices too low) can deter investment and detract from efficient outcomes. Access arrangements aim to promote voluntary agreement (negotiation), but regulatory provisions (arbitration) provide a means to break impasses. Experience from the telecommunications sector highlights that access regulation can be problematic where the regulated facility owner also has upstream or downstream interests (that is, it is vertically integrated). A structurally separate network overcomes much of the potential for disputes and strategic gaming.

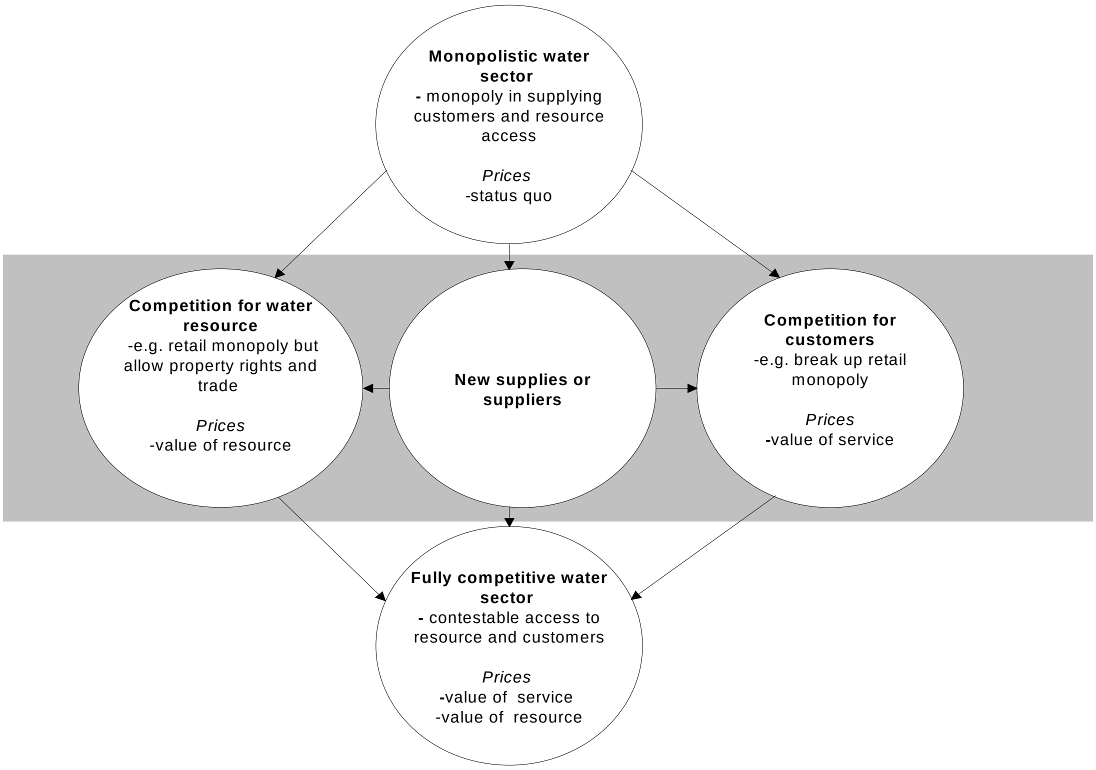
Two Part IIIA coverage cases involving access to services provided by water and wastewater infrastructure have arisen to date (NCC 2004, 2005b). One involving an application to access the waste transport services provided by Sydney Water’s sewers has resulted in the NSW Government introducing a state-based water access regime (NSW Cabinet Office 2006). That there have been so few access declarations is not surprising given the low price of water and wastewater services, and the sovereign risk associated with entering the market and competing with dominant, vertically integrated government-owned water utilities. The ERA (2007b) has recommended that a state-based access regime should be implemented in Western Australia.

6.5 Prospects for a decentralised market

Effective third party access arrangements may not, of themselves, promote robust competition. Without price signals that reflect the opportunity cost of water resources, the incentive to provide competing or new services may remain muted.

In theory, competition in water supply ultimately could deliver efficient market prices without the complexity attached to administered pricing (chapter 3). That said, improved administered pricing may be a necessary evolution — the transitional costs of removing all restraints and allowing competitive prices simply to 'emerge' would be large.

Figure 6.3 **Potential outcomes from structural reform**



How competitive structures might evolve is stylised in figure 6.3 which depicts two routes for increasing competition — competition for water users, and competition for bulk water resources. A critical dimension is whether supply augmentation occurs within existing monopoly structures or whether competitive augmentation is permitted. The following discussion, which abstracts from any inherent market failures in urban water provision and likely transitional and adjustment costs, is far from being policy prescriptive. It aims only to 'tease out' some salient issues.

Competition for customers

There is scope for more than one retailer to compete for customers on billing and payment options, metering, advisory services, and product and pricing packages, including cross-product offers. Without competitive supply augmentation, the potential benefits of retail competition — with retailers competing on service delivery (not resource costs) through operational efficiencies — would be modest, particularly given the probable dominance of reticulation costs faced by all retailers.

If retailers could access multiple water supplies with different characteristics, their ability to compete on product mix would be expanded. (Retailers might also compete to work with wastewater managers and councils to access and redistribute water from these sources.) Further, if prices were allowed to rise when supply was short, users would find it worthwhile to compare retailers' services relative to domestic water saving options.

Retail competition on price could improve the allocation of water by allowing users who value water highly to communicate this through their willingness to pay. This could reduce the reliance on non-price demand management.

The potential advantages of retail competition include:

- more product choice in terms of supply reliability and billing/payment options and enhanced opportunity for more flexible pricing
- stronger incentives for productivity improvements in retailing functions
- pressure on bulk suppliers in relation to the cost and reliability of water supply.

Benefits from retail competition would likely be greater for large users than for households, suggesting that competition could be introduced to the former first. This staggered approach was used to introduce retail competition for electricity.

Limited retail competition for water occurs in parts of England and Wales via licence conditions that allow non-incumbent businesses to service large customers. Scotland is introducing retail competition for water and wastewater services by separating retail functions from networks (ERA 2007a). In general, however, comprehensive retail competition is not prevalent. Insights can, nonetheless, be gained from other sectors. The Australian Energy Market Commission (AEMC 2007), for example, reported that competition in electricity and gas retailing in Victoria is effective. It found that customers exhibited a willingness to switch retailers, with neither brand loyalty nor switching costs significant deterrents, and that margins appeared sufficient to encourage entry and allow retailers to offer incentives. Similar benefits have been identified in the United Kingdom (Menezes 2005).

However, as noted in section 6.1, there could be important differences between electricity and water, so further investigation is desirable.

Competition for the water resource

The bulk supply of water by government monopolies originated when water was supplied from a few sources and used once. Today, physical systems are being augmented with manufactured water considered in terms of fitness for purpose — with potable and different grades of non-potable water. The supply system is therefore more complex and new prospects for competition are emerging.

Competition in bulk water supply could be promoted by:

- maintaining institutional arrangements for existing supplies, but allowing new entrants to provide augmented water
- divesting bulk suppliers into competing businesses and allowing new entry. (However, dams in the same catchment might be managed better by one entity.)

Under the former approach, existing entities could compete with new suppliers who could, for example, operate and manage desalination and/or have agreements to supply water from rural water suppliers. The second approach is akin to that undertaken for the Victorian electricity reforms where base load generation units of the State Electricity Commission were structurally separated (BCA 2006). Competition also could be fostered where there is a single bulk water asset. For example, a dam's capacity could be divided into entitlements and auctioned.

Competition to provide bulk water in the presence of supply augmentation options offers the prospect of an improved communication of the value of water which could in turn signal when new investment was appropriate. Businesses could manage a portfolio of water supply and storage assets, and offer different products in terms of reliability. Suppliers of desalinated water, for example, might offer a high reliability product at higher cost.

The potential benefits of competition in bulk water supply include:

- greater incentives for the efficient operation of water sourcing and storage assets
- incentives to draw on low-cost sources of water first
- incentives for investment in the most efficient supply source — whether expanding yields of existing operations or investing in new facilities/pipelines.

On the other side of the ledger, there could be increased costs — for instance, greater monitoring of a commercially focussed catchment manager that might pay less attention to the long-term health of a catchment if doing so did not coincide with maximum yields.

Governments would need also to be careful not to advantage one water source over another — unless there are policy-relevant market failures that meant such discrimination generated a net public benefit.

Decentralised competition — scope to move beyond theory

In theory, the greatest potential gain could arise by allowing competition for bulk supply in tandem with retail competition so that prices could reflect costs — including the scarcity value of water — and signal investment needs to suppliers. Suppliers and users could negotiate on water prices and make their own assessments about the value of supply security.

Approaches to facilitate trade could include contracts and market exchange or spot markets. Under contracting, participants — including bulk suppliers, retailers and large users — could negotiate contracts to supply water. Alternatively, a centralised exchange or pool, rather like the National Electricity Market Management Company (NEMMCO) arrangements for electricity could operate (box 6.3). Bulk water suppliers could sell water to an exchange wholesaler (possibly a grid manager) who could determine a price based on suppliers' offers and bids from retailers or large users. Derivative products, such as options and forward contracts, could emerge if participants considered them valuable and transactions costs were not too high. Other innovative proposals include tradeable household entitlements (box 6.3).

Of course, unlike the eastern seaboard national electricity market arrangements, water markets are city-specific or regional rather than national. Hence, if similar arrangements were contemplated for urban water, there would be a need for substantial analysis cognisant of specific circumstances. As noted by Swier (2007):

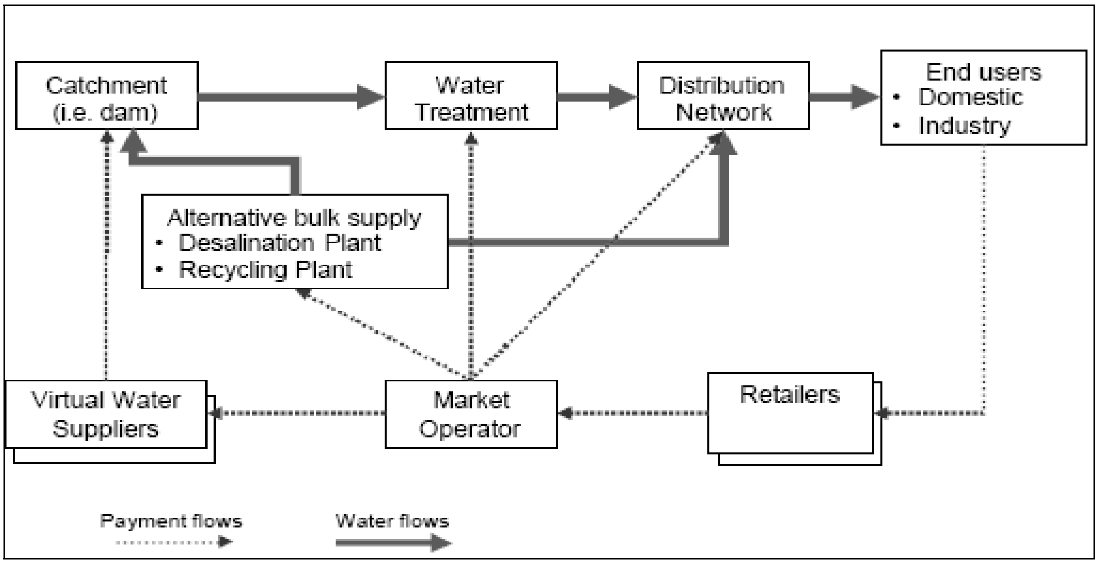
> No jurisdiction internationally has seriously considered or implemented a competitive urban water-trading market. There is no widely-accepted body of theory and research as to how urban water markets might work — arguably, however, the development of the necessary theory and concepts is not 'rocket science'. The market-design concepts are able to be based on well-established techniques developed in the operations research literature. … While Australia drew heavily on ideas developed in the US and UK to underpin the development of its electricity reforms, a similar body of research does not exist internationally for urban water trading. (p. 9)

Much more analysis is needed to determine the extent to which a decentralised competitive model could deliver net benefits, let alone rigorous analyses of the more complex proposals to establish property rights and foster competition.

Box 6.3 **Facilitating trade — property rights and market exchanges**

A potential model for virtual water suppliers

Sibly and Tooth (2007) propose creating virtual water suppliers (VWSs) who are allocated, via competitive auction, virtual portions of a dam's water stock. The VWSs, which buy and trade in limited water rights, have a water account and a financial account but no physical access to the water. Under the proposal, the market would be supported by a non-profit operator, similar to the NEMMCO, which would determine spot prices. Suppliers would submit bids to supply and the operator would set a market clearing price. The proposal includes a catchment manager (which could be private).



Markets for household water

According to Young, McColl and Fisher (2006), one way to introduce household trading would be to give each household a 200-kilolitre annual allocation, which was tradeable, and control water use above 200 kilolitres using either a scarcity price or a volume cap.

Under the scarcity pricing approach, water charges would rise gradually as dam levels fall. As the scarcity price increased, low water users would have an incentive to sell part of their 200-kilolitre allocation to large users. A cap and trade variant would involve placing a limit on water available for consumption above 200 kilolitres. Water users could then bid for a share of the available pool using a tender process. Young, McColl and Fisher suggest market design could include features to address equity concerns, such as making the first 100-kilolitre entitlement non-tradeable to protect people under financial pressure from selling their entire entitlement.

Sources: Sibly and Tooth (2007) and forthcoming; Young, McColl and Fisher (2006).

6.6 Policies that distort urban water objectives

The two major impediments to competition in the urban water sector include the setting of water prices below the cost of additional supply (chapter 2) and restrictions on augmenting urban supply with water from rural areas (chapter 3).

In addition, intervention in water investment at all levels of government raises questions about the transparency, consistency and effectiveness of the overall approach to water investment in Australia. These include:

- the degree of state government influence over supply investment decisions
- the effects of sovereign risk on private investment in water supplies
- the consistency of government subsidies with
  - generating efficient water technology and augmentation choices
  - cost recovery requirements for water utilities
- the extent to which current institutional and regulatory arrangements affect water utilities' capacities to fund investments (Marsden Jacob Associates 2006).

The provision of grants and subsidies for various large-scale projects and for micro-solutions (for example, rainwater tanks) raises two salient questions.

1. *Are grants and subsidies consistent with the cost recovery objectives for urban water outlined in the National Water Initiative?* Subsidisation can frustrate cost recovery objectives and deter appropriate investments. There is little reason why urban (and rural) water investments should not 'pay their own way'. Subsidised water supply projects can reduce the costs of water and exacerbate the inefficient price signals already received by users — that is, signalling that there is no imperative to pay the full cost of water delivery, or more for the water resource when it is scarce.
2. *Have supported projects been properly assessed in terms of some benchmark such as dollars per kilolitre saved or augmented?* If not, there is potential for inefficient and high cost solutions to be adopted. For example, one rebate scheme for water-efficient dishwashers has been estimated to have saved water at a cost of over $30 per kilolitre — this can be compared to costs of $0.15–$3.00 per kilolitre for supplying dam water and $3.00–$9.00 per kilolitre for rainwater tanks (Crase and Dollery 2005; Marsden Jacob Associates 2006). Such benchmarks should not be the only decision criterion — reliability, security and flexibility also are important. Real options analysis, for instance, might favour small, but relatively expensive, water solutions to buy time prior to committing to a large augmentation — allowing, say, climatic conditions and technological developments to be more fully assessed (chapter 5). That aside, indicative benchmarks add to transparency and provide a safeguard against well-meaning but inefficient expenditures.

Provision of subsidies/grants for urban water initiatives should be assessed carefully to ensure that they do not impede broad policy objectives or detract from efficiency. In the absence of a particular need to address policy-relevant market failures, the case for grants and subsidies for urban water projects appears weak.

In relation to this, sometimes grants and subsidies appear to be provided for solutions in the presence of 'policy bans' on lower-cost augmentation options. The Chairman of the National Water Commission (NWC) has observed:

> It is really important that … all [options] be on the table, they should go through a process of analysis, logic and evidence. To have a policy ban at the outset is, in my view, indefensible. (cited in Wahlquist 2007)

Any comprehensive strategy for an urban water reform agenda would ideally address such policy distortions in an integrated framework encompassing governance, institutions, planning, pricing and regulation. The Council of Australian Government's (COAG) National Water Initiative (NWI) provides the key elements of such a framework (section 6.7).

6.7 Implementation, transition and adjustment

Placing urban water utilities on a more commercial basis would be relatively low-cost. More substantial reforms, such as structural disaggregation and providing for competition in supply and retailing, offer the (theoretical) prospect of transforming urban water outcomes for the better. However, with the greater potential benefits come greater risks of failure and higher implementation costs (table 6.1).

Improving the allocation of water and price signals for investment could deliver benefits for many water users. Householders who have had little choice but to conform to restrictions on use or risk penalties could instead choose how and where to use and conserve water. Industrial users could benefit from a greater capacity to enter into contracts and other innovative undertakings with competitive water providers to acquire certainty on water availability. This could assist major water-using businesses to make long-term investment decisions, reduce operational risk, and, in some cases, avoid costly re-fitting or relocation. In essence, water use could be 'democratised'.

Table 6.1 **Some potential advantages and disadvantages of reforms**

Type of reform	*Potential advantages*	*Potential disadvantages*
Further commercialisation	• Improve accountabilities • Greater focus on efficient service delivery and efficient investment • Capacity for utilities to focus on core business • Reduce sovereign risk	• Diminution of government control to achieve non-commercial objectives
Competition through centralised procurement approaches	• Improve incentives for efficiency • Improve cost-service quality offerings • Capacity to extract monopoly profits ex ante via tender • Release public funds for other government objectives	• Expectation of government as supplier of last resort to rectify failures • Establishment, administrative and enforcement costs
Structural and other competition reforms	• Efficient incentives for supply augmentation and for drawing on, and investing in, low cost sources of water first • Encourage new investment and more diversified water sources • More focused roles and accountabilities throughout the supply chain • Continuing competitive pressures to innovate • Greater product choice and customer service models	• Loss of economies of scale/scope • Potential loss of system-wide planning and integration • Possible higher costs in ensuring environmental and safety objectives • Weaken capacity to maintain non-transparent cross-subsidies[a] • Strategic behaviour by service providers and access seekers under third party access regulation • Transitional, administrative and compliance costs
Addressing policy distortions	• More efficient allocation of resources (for example, pursuit of least cost augmentation) • Reduce scope for inconsistent policy signals • Reduce sovereign risk	• Reduce scope to respond with some ‘populist’ interventions[b]

a This is a disadvantage from the perspective of the government and of beneficiaries, but an advantage for current losers of any cross-subsidies. **b** This is a disadvantage from the perspective of the government and of beneficiaries, but potentially an advantage for the community as a whole.

More broadly, as part of a portfolio of pro-competitive augmentation, rural–urban integration can be seen as an important driver of nationwide efficiency gains. As observed by the Secretary to the Australian Treasury:

> … we know that the Australian economy is not allocatively efficient because we observe differences in water prices that cannot be explained simply by water transmission and purification costs. … many water charging regimes in Australia seek only to recover operating costs and a return on infrastructure. Typically, the water being supplied is assumed to have no economic cost; that is, no scarcity value. Unsurprisingly, if a commodity is effectively being given away, then demand will

> exceed supply and we can have no confidence that what supply there is will be directed to its use of highest value-added. So it is with water. Major cities are experiencing water restrictions of one kind or another. Quantitative rationing is incontrovertible proof of the absence of an efficient market. And while we ration in the cities, we manage to grow highly water-intensive crops on the driest continent on the planet. Why? Look at the prices. (Henry 2005, p. 10)

Consistent with meeting environmental and social goals, a more competitive urban water framework potentially could deliver better outcomes than central planning decisions muddied by multiple and potentially conflicting objectives. That said, much more work is required to provide a clearer picture of the economywide impacts of various reform options.

Indeed, restructuring the urban water sector and increasing competition are highly complex matters that require deeper analysis than is possible in this paper. Issues for investigation include the following:

- Sequencing of reforms — A critical implementation issue is the ordering of any structural changes, particularly in conjunction with pricing reforms (chapter 3) and reforms to integrate rural and urban water resources (chapter 4).
- Full extent of market orientation — The need for, and direction of, urban water reform is clear. However, the degree to which a market-oriented focus could *ultimately* be pursued may depend on whether urban water has unique properties.
  - If integrated system-wide planning is necessary for efficient outcomes, to what extent might the discrete project specific nature of private investment be (in)compatible with the inter-linkages in urban water (and potentially rural water) systems?
  - If climate-related uncertainty engenders a much sharper focus on providing greater water security services, would a competitive market outcome accord with a socially optimum level of water security?
- Adjustment — Expanding competition, while potentially benefiting many, would impose costs on those who had gained from a restricted market. There are also issues related to movements of water and capital between urban and rural areas. Structural reform would involve adjustment costs that need to be assessed.
- Regional variations — Urban centres have different features such as access to water catchments, rivers and ground water, and the feasibility of interconnection with rural water markets. Desalination may be an option for coastal cities, whereas recycling might be more prominent for inland centres. This means that a 'one size fits all' approach would have limited application.

A comprehensive framework to guide reform has much to commend it. Reform initiatives would have to work within, or drive changes to, the multiple objectives that governments pursue: environmental management, health, supply security, equity, revenue/dividend targets and market power. This underscores the importance of inter-jurisdictional structures like the COAG's NWI to ensure that jurisdictional boundaries do not impede the efficient management of water resources.

A modified NWI, especially if linked to rewards and sanctions (for example incentive payments), could provide the 'glue' to assist governments to overcome, what some may consider to be, intractable political difficulties. A recent World Bank study on infrastructure services observed that:

> In many countries the political economy of water has not been highly favourable to reform, which partly explains why the water sector is behind electricity, telecommunications, and transportation in restructuring and privatisation … Water reform typically has high social benefits but low political benefits, especially relative to other utility reform … (Kessides 2004, p. 256)

Ideally, the development of an effective reform agenda should be informed by an independent review. And, given the limited experience in Australia and internationally with structural and competition reform in the urban water sector, an incremental approach, starting with modest reforms, may offer advantages.

References

ABC News 2003, *Irrigators get new borrowing entitlements*, www.abc.net.au/news/stories/2003/10/13/965626.htm (accessed 21 August 2007).

—— 2006, *Perth desalination plant officially opened*, www.abc.net.au/news/news items/200611/s1792135.htm (accessed 2 December 2007).

—— 2007a, *Rann commits to Adelaide desalination plant*, www.abc.net.au/news/stories/2007/09/11/2030287.htm (accessed 2 December 2007).

—— 2007b, *Sydney desalination plant to double in size*, www.abc.net.au/news/stories/2007/06/25/1961044.htm (accessed 2 December 2007).

—— 2007c, *Water Corp offers Yarragadee aquifer assurances*, www.abc.net.au/news/stories/2007/12/20/2123833.htm (accessed 4 February 2007).

—— 2007d, *WA to get second desalination plant*, www.abc.net.au/news/stories/2007/05/15/1923683.htm (accessed 2 December 2007).

ABS (Australian Bureau of Statistics) 2004, *Water Account Australia 2000-01,* Cat. no. 4610.0, Canberra.

—— 2005, *2003-2004 Household Expenditure Survey,* Canberra.

—— 2006, *Water Account Australia 2004-05,* Cat. no. 4610.0, Canberra.

ACCC (Australian Competition and Consumer Commission) 2006, *A regime for the calculation and implementation of exit, access and termination fees charged by irrigation water delivery businesses in the southern Murray–Darling Basin*: *Advice to the Australian, New South Wales, South Australian and Victorian Governments*, Canberra, November.

ACF (Australian Conservation Foundation) 2006, *Market mechanism and water recovery for the river Murray*, Media brief, 17 May.

—— 2008, *Water Policy (Preliminary Draft ACF Policy Statement)*, Melbourne, www.acfonline.org.au/news.asp?news_id=820 (accessed 25 January 2008).

ACIL Tasman 2003, *Water trading in Australia: current trends and prospective products to improve water market function*, Report to Water Reform Working Group, June.

—— 2007a, *Framework for Water Source Procurement in WA.* Discussion paper prepared for the ERA inquiry into competition in the water & wastewater services sector, 23 October.

—— 2007b, *Options planning framework: alternative for WA water supply,* Report to the Economic Regulation Authority of Western Australia, November.

ACTEW Corporation 2005, *Future water options for the ACT region – implementation plan: a summary of the recommended strategy to increase the ACT's water supply*, April.

—— 2007, *Performance of PPPs and traditional procurement in Australia,* Final Report, 30 November.

Allen Consulting Group 2007, *Saying goodbye to permanent water restrictions in Australia's cities: key priorities for achieving water security*, Report to Infrastructure Partnership Australia, May.

Archicentre 2006, *Water restrictions to increase house cracking by 10%*, News Release, Melbourne, 30 October.

Australian Energy Market Commission 2007, *Review of the Effectiveness of Competition in Electricity and Gas Retail Markets in Victoria*, First Draft Report, October.

Barmah Millewa Forum nd, *Overview of River Flows and Managed Forest Flooding*, www.landmark.mdbc.gov.au/naturalresources/barmah_millewa/ Water_Management.pdf (accessed 20 February 2008).

BCA (Business Council of Australia) 2006, *Water Under Pressure: Australia's Man-Made Water Scarcity and How To Fix It*, Melbourne.

BDA Group 2006, *Issues and options in applying market based measures in the 'Living Murray First Step'*, Report to Murray-Darling Basin Commission, March.

Bennett, J. 2005, 'Realising Environmental Demands in Water Markets', in Bennett, J. (ed.), *The Evolution of Markets for Water,* Edward Elgar, Cheltenham, UK, pp. 165–79.

Boland, J. and Whittington, D. 2000, 'The Political Economy of Water Tariff Design in Developing Countries: Increasing Block Tariffs Versus Uniform Price with Rebate', in Dinar, A. (ed.), *The Political Economy of Water Reform,* Oxford University Press, New York, pp. 215–36.

Brennan, D., Tapsuwan, S. and Ingram, G. 2007, 'The welfare costs of outdoor water restrictions', *Australian Journal of Agricultural and Resource Economics,* vol. 51, no. 3, 243–61.

—— 2008, 'Desalination, climate change and Hanrahan's lament', Presentation at AARES 52nd Annual Conference 5–8 February, Canberra.

Brumby, J. (Premier of Victoria) 2007, *Reform of the Melbourne water industry*, Media release, 14 August.

Buckland, R. and Fraser, P. 2000, *Abnormal returns in the UK water industry since privatisation*, Working paper, pp. 00–10, Aberdeen papers in accountancy, finance and management, University of Aberdeen.

Burwood Tennis Club, 2007, *Sidelines*, Newsletter of the Burwood Tennis Club Incorporated, June.

Byrnes, J., Crase, L., Dollery, B. 2006, ‘Regulation versus pricing in urban water policy: the case of the Australian National Water Initiative’, *The Australian Journal of Agricultural and Resource Economics*, vol. 50, pp. 437–49.

Carpenter, A. (Premier of Western Australia) 2007, *Second seawater desalination plant to be State’s next major water source*, Media release, 15 May.

COAG (Council of Australian Governments) 1994, *Communiqué*, 25 February, www.coag.gov.au/meetings/250294/index.html (accessed 8 January 2008).

—— 2004, *Intergovernmental agreement on a national water initiative between the Commonwealth of Australia and the governments of New South Wales, Victoria, Queensland, South Australia, the Australian capital territory and the Northern territory*, www.coag.gov.au/meetings/250604/iga_national_water_initiative.pdf (accessed 20 September 2007).

Coliban Water 2007, Major projects: Goldfields Superpipe - Bendigo Link Project, Background information, www.coliban.com.au/projects/ColibanWater-_000.asp (accessed 2 December 2007).

Council for Science and Technology 2005, *Real Options Analysis — a tool to help make decisions about investment*, London, May.

Crase, L. and Dollery, B. 2005, ‘The inter-sectoral implications of ‘Securing Our Water Future Together’’, *International Journal of Environmental, Cultural, Economic and Social Sustainability*, vol. 1, no. 5, pp. 13–22.

—— 2006, ‘Water rights: a comparison of the impacts of urban and irrigation reforms in Australia’, *The Australian Journal of Agricultural and Resource Economics*, vol. 50, pp. 451–62.

Crase, L., O’Keefe, S., Burston, J. 2007, ‘Inclining Block Tariffs for Urban Water’ *Agenda*, vol. 14, no. 1, pp. 69–80.

CSIRO 2007, *Climate Change in Australia*, Technical report.

Demsetz, H. 1968, ‘Why regulate utilities?’ *Journal of Law and Economics* Vol 11 pp. 55–65.

Dixit, A. and Pindyk, R. 2001, ‘The options approach to capital investment’, in Shwartz, E. and Trigeorgis, (eds), *Real options and investment under uncertainty*, MIT Press, London.

DNRE (Department of Natural Resources and Environment) 2001, *The value of water: a guide to water trading in Victoria*, The State of Victoria, Melbourne, December.

Douglas, R., Dwyer, G. and Peterson, D. 2004, 'Activity gross margins and water reform', C*onnections*, www.agrifood.info/Connections/Autumn_2004/Douglas (accessed 23 January 2008).

DPMC (Department of Prime Minister and Cabinet) 2006, *A discussion paper on the role of the private sector in the supply of water and wastewater services*, Canberra, August.

DSE (Department of Sustainability and Environment) 2007a, *Melbourne Augmentation Program Sugarloaf Interconnector*, Technical Report, June.

—— 2007b, *Sales water reform package*, www.dse.vic.gov.au/DSE/wcmn202.nsf/LinkView/D3C115F9997B7295CA256FE1001C7DDC59F77945A025B123CA256FDD00136E2D (accessed 2 December 2007).

Dwyer, G., Douglas, R., Peterson, D., Chong, J. and Maddern, K. 2006, *Irrigation externalities: pricing and charges*, Productivity Commission Staff Working Paper, Melbourne, March.

—— Loke, P., Appels, D., Stone, S. and Peterson, D. 2005, *Integrating rural and urban water markets in south east Australia: Preliminary analysis*, Paper presented at OECD Workshop on Agriculture and Water: Sustainability, Markets and Policies, Adelaide, 14–18 November.

Dwyer, T. 2006, 'Urban Water Policy: In Need of Economics' *Agenda*, vol. 13, no. 1, pp. 3–16.

Edwards, G. 2006, 'Whose Values Count? Demand Management for Melbourne's Water', *Economic Record Special Issue*, vol. 82, September, pp. S54–S63.

—— 2007, 'Urban Water Management', in Crase, L. (ed), *Australian Water Policy: The Impact of change and Uncertainty*, Resources for the Future, Washington D.C.

ERA (Economic Regulation Authority) 2005, *Final Report: Inquiry on Urban Water and Wastewater Pricing*, Perth, November.

—— 2007a, *Final Report: Inquiry on Water Corporation's Tariffs*, Perth, May.

—— 2007b, *Inquiry on Competition in the Water and Wastewater Services Sector*, Draft report, Perth December.

ESC (Essential Services Commission (Victoria)) 2005, 'Estimating Long Run Marginal Cost: Implications for Future Water Prices', *Information Paper*, September, Melbourne.

—— 2006, '*2008 Water Price Review Consultation — Framework and Approach'*, Consultation paper, December, Melbourne.

—— 2007a, Tariff Schedule 1 July 2005 to 30 June 2008, www.esc.vic.gov.au/NR/rdonlyres/FF2B2368-A306-4581-B7FE-D22AB3F041A5/0/OTHYVWAnnualTariffSchedule20070531.pdf (accessed 17 September 2007).

—— 2007b, Water Tariff Structures Review Issues Paper, October 2007, Melbourne, www.esc.vic.gov.au/NR/rdonlyres/216B02CA-05F4-402E-9D31-EDFD426D5B98/0/ISPWaterTariffStructuresReviewFinalPDF20071019.pdf (accessed 12 March 2007).

European Union 2000, 'Water Framework Directive, Directive 2000/60/EC of The European Parliament and of the Council of the European Union', *Official Journal of the European Communities*, vol. 43, December, pp. 1–72.

Farrier Swier Consulting 2007, *Feasibility study and recommendations: large user water markets*, *final Report*, Report to Bulk Entitlement Management Committee, Melbourne, November.

Freebairn, J. 2003, 'Principles for the allocation of scarce water', *Australian Economic Review*, vol. 36, no. 2, pp. 203–12.

—— 2005a, *Issues in the design of water markets*, Melbourne Institute Working Paper Series, n. 18/05, Melbourne Institute of Applied Economic and Social Research, Melbourne, December.

—— 2005b, 'Principles and Issues for Effective Australian Water Markets', in Bennett, J. (ed), *The Evolution of Markets for Water*, Edward Elgar, Cheltenham, UK, pp. 8–23.

—— 2008, 'Some Emerging Issues in Urban Water Supply and Pricing' *Economic Papers*, June (forthcoming).

Frontier Economics 2007, *The economic and social impacts of water trading: case studies in the Victorian Murray Valley*, Report to the Rural Industries Research and Development Corporation, National Water Commission and Murray–Darling Basin Commission, September.

GCD Alliance 2007, *Fact sheet: the desalination plant: turning salt water into tap water*, July, www.desalinfo.com.au/_data/docs/fact_sheets/desalination%20plant%20fact%20sheet%20-%20july%202007.pdf (accessed 6 March 2008).

GHD 2007, *Seawater Desalination Feasibility Study*, Report to Melbourne Water, June.

Giurietto, B., Graham, D. and Letcher, R. 2002, 'The Economic Cost of Urban Water Supply', Paper presented at the 31st Conference of Economists, Adelaide, 1–4 October.

Goesch, T., Hafi, A., Heaney, A. and Szakiel, S. 2006, *Exit fees and interregional water trade: an analysis of the efficiency impacts of exit fees*, ABARE Research Report 06.5, Report to the National Resource Management Division, Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, June.

Gold Coast Water 2006, *FAQs: Costing the desalination project*, www.goldcoastwater.qld.gov.au/attachment/goldcoastwater/EBWS_FAQs%20Project%20Cost.pdf (accessed 2 December 2007).

Goulburn Murray Water 2006, *Annual report 2005-06*, www.g-mwater.com.au/downloads/2005_2006_Annual_Report.pdf (accessed 23 July 2007).

Gracia, F.A., Valinas, M.A.G. and Martinez-Espineira, R. 2003, 'Estimation of residential water demand: a state-of-the-art review', *The Journal of Socio-Economics*, vol. 32, pp. 81–102.

Grafton, R.Q. 2006, *Sydney Water*: *Pricing for Sustainability,* ANU Media release, 27 November.

Grafton, R. and Kompas, T. 2006a, 'Pricing Sydney Water', *The Australian Journal of Agricultural and Resource Economics*, vol. 51, pp. 227–41.

—— 2006b, *Sydney Water: Pricing for Stability*, Draft paper from the Australian National University, October, www.crawford.anu.edu.au/degrees/idec/working_papers/IDEC06-10.pdf
(accessed 15 May 2007).

Grafton, R., Ward, M. 2007, *Prices versus rationing: Marshallian surplus and mandatory water restrictions*, ANU, Economics and Environments Network Working Paper, Canberra.

Hamstead, M. 2006, *Using agricultural water for urban growth in Australia – opportunities, issues*, Paper presented at 9th International River Symposium, Brisbane, 4–7 September.

Harberg, R. 1997, *Planning and Managing Reliable Urban Water Systems.* American Water Works Association, Denver.

Heaney, A. and Beare, S. 2001, *Property rights and externalities in water trade,* Paper presented at ACIAR Water Policy Workshop, Bangkok, Thailand, 8–9 June.

—— Thorpe, S., Klijn, N., Beare, S., and Want, S. 2004, *Water charges and interregional trade in the southern Murray Darling Basin,* Paper presented at Establishing Australian Water Markets Symposium, Melbourne, 9 August.

—— Dwyer, G., Beare, S., Peterson, D. and Pechey, L. 2006, 'Third-party effects of water trading and potential policy responses', *The Australian Journal of Agricultural and Resource Economics*, vol. 50, pp. 277–93.

Henry, K. (Secretary to the Treasury) 2005, *The Task of Economic Policy,* address to the Sydney Institute, 20 June.

Hensher, D., Shore, N. and Train, K. 2006, 'Water supply security and willingness to pay to avoid drought restrictions', *The Economic Record,* vol. 82, no. 256, pp. 56–66.

Hepburn, G., Pucar, M., Sayers, C. and Shields, D. 1997, *Private investment in Urban Roads*, Industry Commission Staff Research Paper, AGPS, Canberra, October.

Hobart Water 2007, *The Derwent River*, www.hobartwater.com.au /HobartWater/Your+Water/Natural+catchments/The+Derwent+River (accessed 15 February 2008).

Hoffman, M., Worthington, A. and Higgs, H. 2006, 'Urban water demand with fitted volumetric charging in a large municipality: the case of Brisbane', *Australian Journal of Agricultural and Resource Economics*, vol. 50, pp. 347–59.

Hughes, D. 2007, 'Vic water trading a step closer', *The Australian Financial Review*, 5 July, p. 10.

Hughes, N., Hafi, A., Goesch, T. and Brownlowe, N. 2008, 'Urban water management: optimal price and investment policy under uncertainty', Paper presented at the 52nd AARES Conference, 5–8 February, Canberra.

IC (Industry Commission) 1992, *Water resources and waste water disposal*, Report no. 26, Canberra.

IPART (Independent Pricing and Regulatory Tribunal of New South Wales) 2005, *Investigation into Water and Wastewater Service Provision in the Greater Sydney Region*, final report.

—— 2007, *Literature Review: Underlying costs and industry structures of metropolitan water industries*, September.

Jones, C.V. and Morris, J.R. 1984, 'Instrumental price estimates and residential water demand', *Water Resources Research*, vol. 20, no. 2, pp. 197–202.

Kelton, G. and Owen, M. 2007, 'Water prices to rise and desalination plant set for Port Stanvac', *The Advertiser: Adelaide Now*, 5 December, www.news .com.au/adelaidenow/story/0,22606,22873600-5006301,00.html (accessed 26 February 2008).

Kessides, I.N. 2004, *Reforming infrastructure — privatization, regulation and competition*, World Bank Policy Research Report.

Kulreshtha, S.N. 1996, 'Residential water demand in Saskatchewan communities: Role played by block pricing system in water conservation', *Canadian Water Resources Journal*, vol 21, no. 2, pp. 139–55.

Lobina, E. and Hall, D. 2001, *UK water privatisation — a briefing*, Public Services International Research Institute, University of Greenwich, London.

Marsden Jacob Associates 2005, *Third Party Access in Water and Sewerage Infrastructure: Implications for Australia*, Research paper prepared for the Australian Government Department of Agriculture, Fisheries and Forestry, December.

—— 2006, *Securing Australia's Urban Water Supplies: Opportunities and Impediments*, a discussion paper prepared for the Department of the Prime Minister and Cabinet, November.

Melbourne Water 2006a, *Estimating long run marginal cost: information paper released by the Essential Services Commission, Melbourne Water Corporation response*, www.esc.vic.gov.au/NR/rdonlyres/3685E243-2687-4B85-89C7-55795BEDBB77/0/SBN_MWLRMC_20051021.pdf (accessed 2 December 2007).

—— 2006b, Thomson Reservoir, www.melbournewater.com.au/content/water/water_supply_catchments/thomson_reservoir.asp (accessed 13 June 2007).

—— 2007a, *Melbourne Water's submission VCEC inquiry into reform of the metropolitan retail water sector,* www.vcec.vic.gov.au/CA256EAF001C7B21/WebObj/Submission30-MelbourneWater/$File/Submission30-MelbourneWater.pdf (accessed 5 November 2007).

—— 2007b, *Melbourne Water Sustainability Report 2006-07*, www.melbournewater.com.au/applications/annual_report_2007/water_drought.html (accessed 24 January 2008).

Menezes, F. 2005, 'Electricity Retail Regulation', Presentation to the ACCC Conference – July 2005, on behalf of CRA International and Australian Centre of Regulatory Economics, The Australian National University.

MWST (Ministerial Water and Sewerage Taskforce of Tasmania) 2006, *Reform of Tasmania's Water and Sewerage Sector,* Discussion paper, Hobart, www.treasury.tas.gov.au/domino/dtf/dtf.nsf/LookupFiles/Water-Sewerage-DP.pdf/$file/Water-Sewerage-DP.pdf (accessed on 29 August 2007).

Morris, Sophie 2007, 'Economic assault on desalination cowboys', *Australian Financial Review*, p. 8.

NCC (National Competition Council) 1998, *Compendium of National Competition Policy Agreements*, 2nd edn, June.

—— 2002a, *The National Access Regime: A Guide to Part IIIA of the Trade Practices Act 1974, Part A Overview*, December.

—— 2002b, *The National Access Regime: A Guide to Part IIIA of the Trade Practices Act 1974, Part B Declaration*, December.

—— 2003, *NCP Reform Assessment Framework for Water Reform*, December.

—— 2004, *Application by Services Sydney for Declaration of Sewage Transmission and Interconnection Services provided by Sydney Water – Final Recommendation*, December.

—— 2005a *Assessment of governments' progress in implementing the National Competition Policy and related reforms*, Melbourne.

—— 2005b, *The Lakes R Us application for declaration of water storage and transport services – Final Recommendation*, November. Newton, P.W., Baum, S., Bhatia, K., Brown, S.K., Cameron, A.S., Foran, B., Grant, T., Mak, S.L., Memmott, P.C., Mitchell, V.G., Neate, K.L., Pears, A., Smith, N., Stimson, R.J., Tucker, S.N. and Yencken, D., 2001. *Human Settlements* , Australia State of the Environment Report 2001 (Theme report), CSIRO Publishing on behalf of the Department of the Environment and Heritage, Canberra.

Ng, Y.K. 1987, 'Equity, Efficiency and Financial Viability: Public Utility Pricing with Special Reference to Water Supply', *Australian Economic Review*, 3rd Quarter pp. 21–35.

NSW Cabinet Office 2006, *Consultation Paper: Creating a Dynamic and Competitive Metropolitan Water Industry*, www.waterforlife.nsw.gov.au/__data/assets/pdf_file/0013/1444/smwp_consult_paper_1.pdf (accessed 6 March 2007).

NWC (National Water Commission) 2006, P*rogress on the National Water Initiative: A Report to the Council of Australian Governments*, National Water Commission, Canberra, June.

—— 2007a, *Capital city water use*, www.water.gov.au/WaterUse/Capitalcitywateruse/index.aspx?Menu=Level 1_4_3 (accessed 5 November 2007).

—— 2007b, *Cost analysis of rainwater tanks for households.* Media Release # 17, 14 April.

—— 2007c, *National Water Initiative First Biennial Assessment of Progress in Implementation*, www.nwc.gov.au/nwi/biennial_assessment/docs/Biennial Assessment1_2.pdf (accessed 6 March 2008).

NWCWGCR (National Water Commission Working Group on Compatible Registers) 2005, *Compatibility of water registers*, Report to the National Water Commission, National Water Commission, Canberra, September.

—— 2006, *Dictionary of terms for water access entitlements and transactions*, National Water Commission, Canberra, April, www.nwc.gov.au/publications /index.cfm (accessed 5 November 2007).

NWISGWC (National Water Initiative Steering Group on Water Charges) 2007, *Urban water charging stocktake: water storage and delivery charges in the urban water sector in Australia*, February, www.svc044.wic032p.server-web.com/nwi/docs/UrbanWaterCharging Stocktake_Feb%2021.pdf (accessed February 2008).

OECD (Organisation for Economic Co-operation and Development) 1999, 'The Price of Water: Trends in OECD Countries', *OECD Environment & Sustainable Development*, vol. 1999, no. 5, pp. 1–170.

—— 2007 *Principles for Private Sector Participation in Infrastructure*, www.oecd.org/dataoecd/41/33/38309896.pdf (accessed February 2008).

PC (Productivity Commission) 1999a, *Impact of Competition Policy Reforms on Rural and Regional Australia*, Report no. 8, AusInfo, Canberra.

—— 1999b, 'Modelling the Regional Impact of National Competition Policy Reforms', *Supplement to Inquiry Report, Impact of Competition Policy Reforms on Rural and Regional Australia*, Canberra, September.

—— 2001 *Structural Adjustment — Key Policy Issues*, Commission Research Paper, AusInfo, Canberra.

—— 2002, *Review of the National Access Regime*, Report no. 17, AusInfo, Canberra.

—— 2004, *First Home Ownership*, Report no. 28, Melbourne.

—— 2005a, Modelling Impacts of Infrastructure Industry Change over the 1990s, *Supplement to Review of National Competition Policy Reforms*, Report no. 33, Canberra, February.

—— 2005b, *Review of National Competition Policy Reforms,* Inquiry report no. 33, Canberra.

—— 2006a, *Financial Performance of Government Trading Enterprises, 2000-01 to 2004-05*, Research paper, Canberra, July.

—— 2006b, *Rural Water Use and the Environment: The Role of Market Mechanisms*, Research report, Melbourne, August.

—— 2007, F*inancial Performance of Government Trading Enterprises, 2004-05 to 2005-06,* Commission Research Paper, Canberra, July.

Peterson, D., Dwyer, G., Appels, D. and Fry, J. 2004, *Modelling water trade in the southern Murray-Darling Basin*, Productivity Commission Staff Working Paper, Melbourne, November.

PwC (Pricewaterhouse Coopers) 2006, *National Water Initiative water trading study final report*, Report to Department of Prime Minister and Cabinet, Canberra, June.

QWC (Queensland Water Commission) 2007a, *Fact Sheet: SEQ Water Supply Projects*, www.qwc.qld.gov.au/myfiles/uploads/fact%20sheets/SEQ%20Water %20Supply%20Projects.pdf (accessed 6 March 2008).

—— 2007b, *Our Water: Water Supply Arrangements in South East Queensland (SEQ)*, Final report to the Queensland Government, www.qwc.qld.gov.au /myfiles/uploads/institutional%20arrangements/Urban_Water_Supply_Arrangements_in_SEQ.pdf (accessed 26 February 2008).

—— 2007c, Water Amendment Regulation (No. 6) 2006 Monthly Progress Report, www.qwc.qld.gov.au/myfiles/uploads/project _reports/2007-10/WARM%2006,07,08%20WCRWP%20Final.pdf (accessed 4 December 2007).

—— 2008, *Household Distribution,* www.qwc.qld.gov.au/Household+restrictions (accessed 18 February 2008).

Quiggin, J. 2007, ‘Issues in Australian Water Policy’, *Australian Chief Executive*, Committee for Economic Development of Australia, pp. 38–47.

Renzetti, S. and Dupont, D. 2003, ‘Ownership and performance of water utilities: comparison of US, UK and French public utilities’, *Greener Management International*, vol 42, pp. 9–19.

Roberts, P. 2005, ‘Residential end use research to support demand management and forecasting’, Paper presented at VicWater 2005 Annual Conference, Geelong, 8-9 September.

Roper, H., Sayers, C. and Smith, A. 2006, *Stranded Irrigation Asset*, Productivity Commission Staff Working Paper, Melbourne, June.

SA Water 2005, *Sustainability Report 2004-05*, SA Water and South Australian Government, Adelaide.

—— 2008, Pipelines, www.sawater.com.au/SAWater/Education/OurWaterSystems /Pipelines.htm (accessed 15 February 2008).

SaveFooty.com 2007, www.savefooty.com/index.php/drought-football-sports-grounds-headlines (accessed 5 February, 2008).

Sibly, H. 2006, ‘Urban water pricing’ *Agenda*, vol. 13, no. 1, pp. 17–30.

—— and Tooth, R. 2007, ‘Virtual water suppliers: introducing competition into urban water supply’, Working draft, Presentation to 3rd Annual Water Pricing Conference, Sydney 27 September.

South Australian Government 2005, *Buying Water from the River Murray*, Water Proofing Adelaide, Information Sheet, www.waterproofingadelaide.sa.gov.au/ NR/rdonlyres/2A792778-4C21-418C-9923-0899D78A01BA/0/Water _PurchRM.pdf (accessed 2 December 2007).

Stone and Webster Consultants Ltd 2004, *Investigation into evidence for economies of scale in the water and sewerage industry in England and Wales*, Final Report, for the Office of Water Services, January.

Swier, G. 2007, ‘Is there a role for urban water trading?’, *Network*, Issue 26, pp. 2–9.

Sydney Water 2007a, *Preferred Tenderer For Sydney's Desalination Plant*, Media Release, 26 June, www.sydneywater.com.au/WhoWeAre/MediaCentre/Media View.cfm?ID=382 (accessed 26 February 2008).

—— 2007b, *Sydney's desalination plant contracts: An introduction to the contracts released by Sydney Water*, New South Wales Government and Sydney Water, Sydney, www.sydneywater.com.au/EnsuringtheFuture/Desalination/pdf/Desal PlantContract_Summary.pdf (accessed 2 December 2007).

—— 2007c, *Sydney Water submission to IPART: submission to the Independent Pricing and Regulatory Tribunal Review of Prices for Sydney Water Corporation*, September.

Tennis Victoria 2007, *New water conservation plan* www.tennis.com.au/pages /default.aspx?id=3&PageID=12539 (accessed 23 January 2008).

Thomas, J. 2007, *Inquiry into competition in the water and wastewater services sector: water trading issue*, Report to the Economic Regulation Authority, Resource Economics Unit, October.

VCEC (Victorian Competition and Efficiency Commission) 2007, *Inquiry into Reform of the Metropolitan Retail Water Sector,* Issues paper, Melbourne.

Victorian Government 2003, *Securing Our Water Future*, Green Paper for Discussion, Department of Sustainability and Environment, Melbourne, August.

—— 2007a, *Our water, our future, FAQ*: *Desalination Plant*, www.ourwater.vic.gov.au/data/assets/pdf_file/0014/473/FAQs-desalination.pdf (accessed 2 December 2007).

—— 2007b, *Our water, our future: the next stage of the government's water plan*, Department of Sustainability and Environment, Melbourne, June.

Wahlquist, A. 2007, 'Water boss gives the states a spray', *The Australian*, 31 December, www.theaustralian.news.com.au/story/0,25197,22988794-643, 00.html (accessed 8 January 2008).

Water Corporation 2005a, *Integrated water supply scheme source development plan 2005, planning horizon 2005-2050*, www.watercorporation.com.au/_files/ PublicationsRegister/22/SourcePlan_2005.pdf (accessed 2 December 2007).

—— 2005b, Response to the Economic Regulation Authority's Inquiry on Urban Water and Wastewater Pricing Draft Report, April.

—— 2006, *Submission to the Economic Regulation Authority's Inquiry on Harvey Water Bulk Water Pricing*, November.

—— 2007a, *Southern Seawater Desalination Project*, www.watercorpor ation.com.au/D/desalination_plant2.cfm?uid=1018-9940-3858-1680 (accessed 2 December 2007).

—— 2007b, *The Perth Seawater Desalination Plant, Media Background Information*, water.com.au/_files/Desalination_background.pdf (accessed 2 December 2007).

—— 2007c, *Existing water sources: Perth Seawater Desalination Plant*, www .watercorporation.com.au/D/desalination.cfm (accessed 26 February 2008).

Watson, A. 2003, ‘Approaches to increasing river flows’, *Australian Economic Review*, vol. 36, no. 2, pp. 213–24.

WRSCMA (Water Resources Strategy Committee for the Melbourne Area) 2001, *Discussion Starter: Stage 1 in developing a water resources strategy for the greater Melbourne area*, State of Victoria, Melbourne.

WSAA (Water Services Association of Australia) 2005, *Testing the Water, Urban water in our growing cities: the risks, challenges, innovation and planning*, WSAA Position Paper No. 01, October.

—— 2007, *The WSAA Report Card for 2006-07, Performance of the Australian Urban Water Industry and projections for the future*, August.

WSAA, NWC 2007, *National Performance report 2005-06 Major urban water Utilities*, Melbourne.

Yarra Valley Water 2007, Submission to: *Victorian Competition and Efficiency Commission Inquiry into reform of the metropolitan retail water sector*, October.

Young, M., McColl, J., and Fisher, T. 2007, ‘Urban water pricing: How might an urban water trading scheme work’, *Droplet*, No. 5, University of Adelaide, February.

Young, M., Proctor, W., Ejaz Qureshi, M. and Wittwer, G. 2006. Without Water: The economics of supplying water to 5 million more Australians, CSIRO, May.