Submission
No 105

INQUIRY INTO ADEQUACY OF WATER STORAGES IN NSW

Organisation: Monash Water for Liveability

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MONASH water for liveability | MONASH University

The Director
Standing Committee on State Development
Parliament House
Macquarie St
Sydney NSW 2000

10 September 2012

To The Director

Re: Inquiry into the adequacy of water storages in NSW

Thank you for the opportunity to contribute to the NSW Legislative Council Standing Committee on State Development *Inquiry into the adequacy of water storages in NSW.*

We understand that the inquiry is focussed on the adequacy of water storages in NSW to meet existing and future agricultural, urban, industrial and environmental needs. We also understand that knowledge and experiences in relation to water storages, and any other related matters, from other Australian and international jurisdictions are welcomed.

This submission has been prepared by Monash Water for Liveability, in collaboration with: Central West Councils Salinity and Water Quality Alliance, Central West CMA, Orange City Council, Sydney Metropolitan CMA, and Marrickville Council.

Monash Water for Liveability (previously Monash University Centre for Water Sensitive Cities) specialises in inter-disciplinary research and the application of urban water management knowledge to enhance the resilience and liveability of Australian cities and towns. It is from this perspective that we believe we can contribute informed and constructive knowledge and experiences to this inquiry.

The NSW organisations with which Monash Water for Liveability has collaborated are partners of the newly established Cooperative Research Centre (CRC) for Water Sensitive Cities, and the precursor research program 'Cities as Water Supply Catchments' (Orange City Council is involved through the Central West Councils Salinity and Water Quality Alliance). These organisations contribute a thorough understanding of local challenges and opportunities in relation to the planning and management of water systems across NSW.

Our underlying thesis is that the adequacy of centralised water reservoirs will be considerably enhanced if cities and towns that share these sources with other users (rural and environmental) can become more 'water sensitive' and make greater use of decentralised alternative sources of water. Water sensitive cities and towns will require less water from existing centralised sources and in so doing will be more resilient and liveable.

We would welcome the opportunity to present our submission to the Standing Committee on State Development. Please contact Ross Allen on (should you need any clarification on our submission.

Yours Sincerely,

Rob Skinner
CEO, Monash Water for Liveability

New South Wales Legislative Council
Inquiry into the adequacy of water storages in NSW

Monash Water for Liveability Submission
prepared in collaboration with:
Central West Councils Salinity and Water Quality Alliance, Central West CMA, Orange City Council, Sydney Metropolitan CMA and Marrickville Council

Improving the 'adequacy' of existing centralised water storages by developing an integrated portfolio of centralised and decentralised water systems in cities and towns in New South Wales.

Executive summary

The way in which we utilise and manage water storages, in both urban and rural settings, is intrinsically linked to the wider water system. Considering in isolation a single component (e.g. centralised storage reservoirs) of a complex, integrated system will invariably lead to sub-optimal solutions with unintended negative system consequences, while opportunities for greater whole of community benefits may be missed.

There is now broad acknowledgement that the way we plan, design and manage water systems and services must move beyond traditional and linear "supply-demand" approaches towards a 'water sensitive' approach to provide a greater capacity to meet a broad range of community needs into the future (Ferguson et al. 2012).

The introduction of integrated water management strategies together with the adoption of water sensitive planning, design and management can reduce urban water demands from centralised water reservoirs and increase resilience to future variability and uncertainty in climatic and anthropogenic factors such as the energy market, water demands, and global and domestic economics. It is through a process of dynamic optimisation that current vulnerabilities associated with water obtained from a small number of centralised sources can be addressed. In addition to building water system resilience, a portfolio of water sources can also contribute to more liveable urban environments by supporting ecosystem services, healthier urban environments and improved amenity.

The resilience of urban water systems is at its strongest when multiple water sources are accessed through a range of infrastructure solutions applied at a range of scales (including decentralised, precinct and centralised water supply schemes), supported by non-structural measures (including water use efficiency, legislation and regulation, and behaviour change). A diversity of water sources accessed at a range of scales enables preferential use of available sources with lowest cost and environmental risk ahead of options with higher cost and environmental risk.

A range of temporal and spatial conditions also influence water system resilience through impacts on both water demand and supply. Biophysical factors include rainfall depths and temporal distribution, development density, proximity to existing infrastructure, and capacity of existing infrastructure. Socio-political factors include community needs engagement, and political, industry and community knowledge and capacity. A 'water sensitive' approach to water planning and management is therefore fit-for-place, incorporating a portfolio of structural and non-structural elements that respond to local context.

Traditional governance and service delivery models for water management are being challenged and renegotiated as communities demand a greater level of engagement around water management and environmental sustainability. To ensure ongoing water supply resilience, future governance and service delivery models will need to be adaptive and underpinned by a flexible institutional regime. They will also need to support and reinforce sustainable practices and social capital, while recognising the implicit link between society and technology. The valuation of future urban water infrastructure, including green infrastructure, should ensure economic analysis of options include direct and indirect (non-monetary) costs and benefits.

Augmenting the capacity of existing urban water supplies for Sydney through additional alternative water sources including wastewater recycling, and decentralised stormwater harvesting and use could extend the water supply horizon beyond 2025 whilst also enhancing the resilience of the water supply system and liveability of the city. A 'water sensitive' approach to urban water planning and management would also benefit regional cities and towns across NSW.

Submission Contents

Preface

This submission has been prepared by Monash Water for Liveability, in collaboration with: Central West Councils Salinity and Water Quality Alliance, Central West CMA, Orange City Council, Sydney Metropolitan CMA, and Marrickville Council.

Monash Water for Liveability brings together nationally and internationally recognised academic and industry experts in urban water governance, hydrology, urban water planning and management, stormwater treatment technologies, urban climatology and environmental economics. We specialise in inter-disciplinary research and the application of urban water management knowledge to enhance the resilience and liveability of Australian cities and towns. It is from this perspective that we believe we can contribute informed and constructive knowledge and experiences to this inquiry.

The New South Wales organisations which have contributed to this submission are partners of the newly established *Cooperative Research Centre (CRC) for Water Sensitive Cities*, and the precursor research program *Cities as Water Supply Catchments* (Orange City Council is involved through the Central West Councils Salinity and Water Quality Alliance). These organisations contribute a thorough understanding of local challenges and opportunities in relation to the planning and management of water systems across NSW.

Introduction

Over the last decade there has been a growing body of local and international expert commentators calling for major changes to the way urban water systems are managed in order to address the increasing social and environmental challenges facing cities around the world (Ewert et al., 2012; Wong and Brown, 2008).

The question of how our water systems can support liveable, sustainable and productive communities is now being explored by the water sector throughout Australia. There is broad acknowledgement that the way we plan, design and manage water systems and services must move beyond traditional approaches to a 'water sensitive' approach to provide a greater capacity to meet a broad range of community and environmental needs into the future (Ferguson et al. 2012).

The way in which we utilise and manage water storages, in both urban and rural settings, is intrinsically linked to the wider water system. A holistic approach is therefore required when reviewing the adequacy of water storages to meeting current and future needs. This holistic approach needs to consider contemporary strategies for securing higher levels of water supply security and resilience that are based around a diversity of water sources and distributed storages as important elements of system-wide storages and water efficiency. Further, the way in which institutional and governance arrangements enable or hinder the successful integrated operation of our water systems must also be considered. Optimising a single element of a complex, integrated and mutli-faceted system will invariably lead to suboptimal solutions with unintended system consequences that result in an overall reduction in efficiency and increase in costs.

Adopting a 'water sensitive' approach to water planning and management

Managing water in both urban and rural settings is becoming increasingly complex as we seek to protect, maintain and enhance natural systems while providing multiple services and benefits to society. This submission addresses the adequacy of water storages by demonstrating how the demand for water from these storages can be reduced by the adoption of water sensitive planning and management in cities and towns in NSW.

In making this submission, we assert that 'water storages' must be considered within the context of 'water systems' and an inquiry into the adequacy of water storages cannot ignore contemporary approaches in attaining a higher level of water supply security and resilience, as well as the additional multiple benefits derived from these approaches.

The physical and institutional infrastructure of an urban water system delivers many services to cities and towns including:

- supply security;
- public health;
- flood protection;
- waterway health;
- amenity and recreation;
- energy use / emissions;
- societal prosperity; and
- intra and inter-generational equity.

Urban water management strategies that best protect and enhance the full suite of values and benefits from a total water cycle perspective are likely to result in more resilient solutions over the longer term.

International, National and State context

The International Water Association's (IWA) Cities of the Future program recognises that water, through its interactions with other urban planning sectors, plays a central role in the development of the liveability and resilience of cities (Binney et al., 2010). This work also recognises that water system security and resilience are best achieved through integrating centralised and decentralised systems.

At a national level, a vision for Australian cities is outlined in the Australian Government report: *Our Cities, Our Future - A National Urban Policy for a productive, sustainable and liveable future* (2011). Water Sensitive Cities, in which urban water cycles are designed and managed as integrated systems enmeshed with urban design and communities, form an important niche within the vision for 'cities of the future' articulated by the IWA Cities of the Future program (Wong et al., 2012).

A vision for Water Sensitive Cities and Towns is represented by three underpinning principles (pillars) (adapted from Wong and Brown, 2009):

- cities as water supply catchments
  (cities providing access to water through a diversity of sources at a diversity of supply scales);
- cities providing ecosystem services
  (the built environment supplementing and supporting the function of the natural environment);
- cities comprising water sensitive communities
  (the existence of socio-political capital for sustainability, and water sensitive decisionmaking and behaviours by citizens).

While ensuring reliable urban water services is an important function of the water sector in Australia, contemporary practice in the water sector is adopting a water sensitive approach to urban water management that expands management objectives from a focus on water supply and wastewater disposal to deliver a wider range of services to communities (e.g. ecosystem services, urban heat mitigation) (Wong et al., 2012).

The National Water Commission (2011) report: *Urban Water in Australia – future directions* states that the future urban water sector challenge is "to enhance its effective contribution to more liveable, sustainable and economically prosperous cities in circumstances where broader social, public health and environmental benefits and costs are clearly defined and assessed". The Productivity Commission (2011) inquiry into *Australia's Urban Water Sector* found that economic reforms are needed to make this transition, with the concept of 'economic efficiency' to encapsulate many of the more specific objectives that should be pursued in the urban water sector, including those related to water security, water quality, flood mitigation and the environment.

In Sydney, the 2010 Metropolitan Water Plan identified that a combination of existing storage dams and desalination capacity together with expanded water recycling and water efficiency could meet greater Sydney's water supply needs through to 2025. Augmentation of Tallowa Dam (Shoalhaven water supply system), large-scale water recycling in the Sydney's west, potential upscaling of the Kurnell desalination plant and continued improvements in water efficiency may be required to meet greater Sydney's water supply needs beyond 2025 (NOW 2010). While recent rainfall across NSW has reduced immediate water security concerns in many regional cities and towns, developing an increased resilience of water systems to future climate uncertainty is still of high importance.

Augmenting the capacity of existing urban water supplies through additional alternative water sources including wastewater recycling, and decentralised stormwater harvesting and use could extend the water supply horizon for Sydney beyond 2025 whilst also enhancing the resilience of the water supply system and liveability of the city.

A ‘water sensitive’ approach to planning and managing water systems is consistent with State Goals identified in *NSW 2021: A plan to make NSW number one* (NSW Government, 2011). In particular, SG21: Secure potable water supplies, SG22: Protect our natural environment, and SG23: Increase opportunities for people to look after their own neighbourhoods and environments are aligned with the vision and objectives for Water Sensitive Cities. In the Cabinet endorsed Action Plan for the Central West Region (Central West Catchment Action Plan 2011-21), more specific Catchment Goals (CG) and Management Targets (MT) that relate to a ‘water sensitive’ approach are articulated. These include CGW2: Contribute to achieving balanced use, efficiency, movement, and connectivity of water within the catchment landscape and improve water quality, and MTW4: By 2021, there is an increase in projects contributing to use, efficiency, movement, connectivity and water quality

In Victoria, the State Government is supporting integrated projects and developments in urban centres to use stormwater, rainwater and recycled water to provide Victoria’s next major water augmentation (Living Victoria MAC, 2012). This policy objective of the Victorian Government recognises that transformation change is required in the way we plan and managed urban water systems to enhance resilience and liveability as urban populations continue to grow.

An overarching objective of the Living Victorian policy is ‘to drive integrated projects and developments in Melbourne and regional cities to use stormwater, rainwater and recycled water to provide Victoria’s next major water augmentation’.

Cities and towns are water supply catchments with under-utilised water resources including stormwater and recycled wastewater. These are central to delivering alternative water sources for use on a fit-for-purpose basis. Therefore distributed local storages are important elements of ‘system storages’ used to best optimise the capture and local use of alternative water sources to reduce the competition for non-urban water supplies.

Living Melbourne, Living Victoria

The Living Melbourne, Living Victoria Implementation Plan (2012) outlines a new approach to planning and managing urban water resources in Victoria.

This more flexible, integrated and transparent approach will reduce reliance on large-scale investments and encourage innovative, local-scale investments. It also recognises community concern about value for money, and the importance of maintaining and enhancing liveability.

The new approach includes changing how alternative water supplies (rainwater, recycled water and stormwater) are used in order to reduce pressures on our drinking water supplies, improve the liveability of our urban areas and reduce negative impacts on the environment.

water.vic.gov.au/livingvictoria

Developing a diversity of water sources: a portfolio approach

A city’s water supply resilience is at its strongest when multiple water sources are accessed through a range of infrastructure solutions applied at a range of scales (including decentralised, precinct and centralised water supply schemes), supported by non-structural measures (including water use efficiency, legislation and regulation, and behaviour change). In addition to large scale dams, infrastructure solutions may include rainwater tanks on individual properties, precinct-scale stormwater harvesting and treatment facilities including wetlands and ponds, regional wastewater recycling, and city-scale indirect potable reuse.

In addition to building resilience of water supply systems, non-structural measures aimed at reducing per capita water demand can also deliver major benefits to wastewater systems. These include the delay in network infrastructure augmentation associated with population growth, and the associated increase in costs to transport additional wastewater through the network. There is also the potential to delay or avoid increasing the capacity of centralised wastewater treatment plants (Coombs et al., 2011).

The importance of local context

Water system resilience is influenced by local climate and other temporal and spatial conditions influencing both water demand and supply. Biophysical factors include rainfall depths and temporal distribution, development density, proximity to existing infrastructure, and capacity of existing infrastructure. Socio-political factors include community needs engagement, and political, industry and community knowledge and capacity. For example, as development density increases the effectiveness of rainwater harvesting will decrease owing to a progressively smaller building spatial footprint/dwelling while the same condition would present a stronger business case for localised wastewater treatment and recycling owing to lower recycled water reticulation cost (Wong et al., 2011).

A process of to build resilience, applied at a range of scales, will overcome current vulnerabilities associated with water obtained from a small number of centralised sources. In addition to building water system resilience, a portfolio of water sources can also contribute to more liveable urban environments by supporting ecosystem services, healthier urban environments and improved amenity as discussed in later sections of this submission.

Decentralised systems and local water reuse

A retrospective desktop study by Knights and Wong (2008) compared the performance of an assumed 500 ML/d desalination plant to a strategy of implementing rainwater tanks in Sydney single dwelling properties. This study found simulated reservoir levels at the Warragamba and Upper Nepean dams over the period 1998 to 2006 would have been higher (refer Figure 2) and, more importantly, comparable in its effect to that of the desalination plant but with significantly lower energy consumption and operating cost. The findings of this study directly challenge the assumption that rainwater tanks are not a drought proofing measure and showed that they can provide a reliable alternative supply when combined with our existing storage networks, even during the most extreme drought conditions.

Cadia Water Re-use Scheme

Cadia Valley Operations is a gold/copper mining venture located approximately 25 km south of the City of Orange. Approximately 75% of the final treated effluent from the Orange Wastewater Treatment Plant (WWTP) is exported to Cadia Valley Operations.

The supply of around 9 ML per day on average of treated wastewater is a prioritised water source for the ore extraction process and supplements water sourced from the Lachlan Valley. As the City of Orange grows, there will be sufficient effluent produced to exceed the 10 ML per day water requirement for the Cadia Valley Operations.

watersecurity.orange.nsw.gov.au

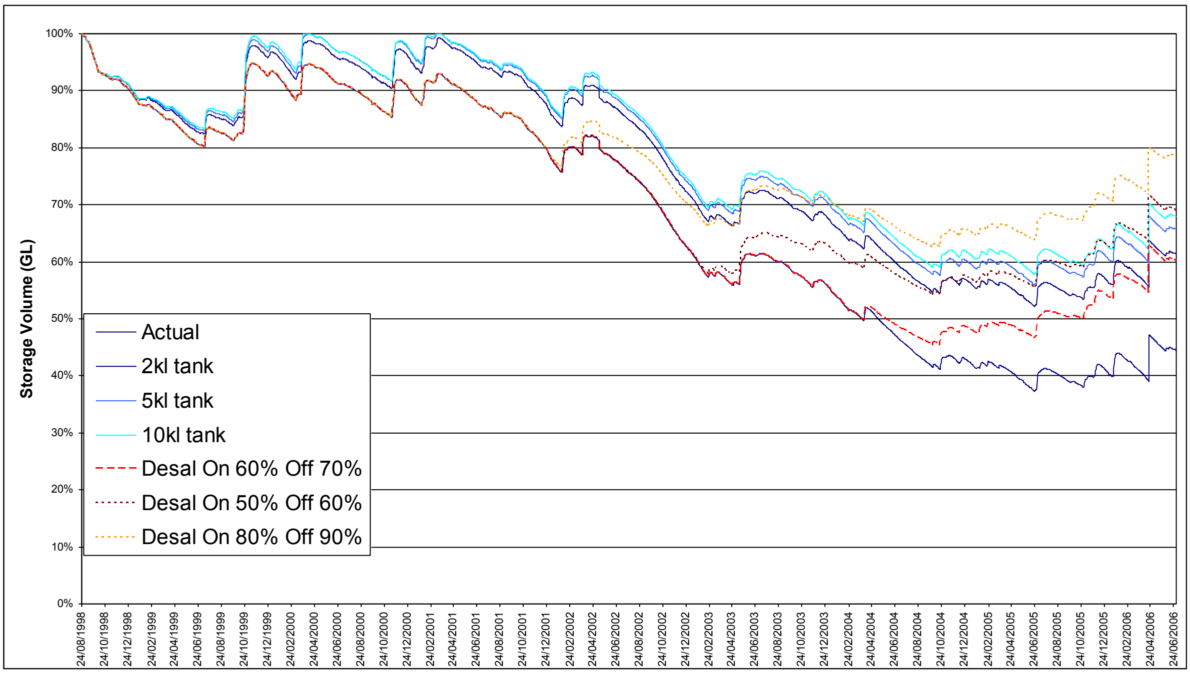

Figure 2 Predicted water storage levels in Warragamba and Upper Nepean dams over the period 1998 to 2006: a comparison of water augmentation by desalination and rainwater tanks (Knights and Wong, 2008)

Droughts experienced in NSW over the last decade have highlighted the significant effect of increasing global temperature on antecedent soil conditions of large, forested water supply catchments leading to significant reductions in runoff from rainfall events. The hydrologic process of ‘wetting of the catchment’ before runoff is generated doesn’t apply to impervious urban roof surfaces, where runoff is generated in almost all rainfall events. Analysis undertaken by Coombs et al. (2011) as part of a system-wide study prepared for the Living Victoria Ministerial Advisory Council demonstrated that in Melbourne, a 50% decrease in median rainfall resulted in an 85% reduction in runoff from its traditional (pervious) water supply catchments but only a 30% reduction in the volume of water that can be effectively harvested from a 3KL rainwater tank.

Economic studies (e.g. Marsden Jacob Associates, 2006) have shown that precinct-scale stormwater harvesting schemes are typically more economically efficient than rainwater tanks and thus an even more economically effective solution may be found with a hybrid network of system storages involving rainwater tanks and ponds.

A diversity of water sources accessed at a range of scales (decentralised, precinct and centralised infrastructure) enables preferential access to available sources with lowest cost and environmental risk ahead of options with higher cost and environmental risk. Combined with non-structural measures to reduce water demand, this enhances the resilience of urban water systems.

The current draft City of Sydney decentralised water masterplan is one example of how this approach is being taken up in NSW by local government.

Stormwater: an under-utilised resource

There has been substantial scientific investigation and industry-based discussion on water sources including desalinated water, recycled wastewater (for both indirect potable reuse and non-potable use), rural/urban water transfers and rainwater. However, until recently there has been considerably less emphasis placed on urban stormwater as part of a portfolio of water sources. While much debate has focused on rainwater tanks, it should be noted that this is only one of a host of options in relation to the management of rainfall and stormwater as a resource.

Urban stormwater treatment and harvesting represents a significant opportunity to provide a major new water source for use by urban centres, while simultaneously helping to protect valuable waterways from excessive pollution and ecosystem degradation (PMSEIC, 2007). Harvested stormwater, if treated to potable standard, could also provide an alternative source of water integrated with a centralised water supply scheme, as is the case in a number of cities including the city of Singapore and Orange, NSW.

Providing affordable essential services like water requires prudent and financially efficient investments in water systems (Ewert et al., 2012). Analysis of the unit cost of water supplied from a range of sources and scales (Marsden Jacob Associates, 2006) showed that stormwater harvesting and use ranged from $0.10 to $1.50/kL. This compared favourably to a number of other water sources (e.g. dams and surface water: $0.15 to $3.00/kL; seawater desalination: $1.15 to $3.50/kL).

Blackmans Swamp Creek Stormwater Harvesting Scheme, Orange

Blackmans Swamp Creek Stormwater Harvesting Scheme involves the capture of a portion of the high flows in Blackmans Swamp Creek during storm events. Harvested stormwater is transferred to nearby Suma Park Dam to augment Orange’s bulk water supply. Raw water from the dam is purified using ozone treatment and biologically activated carbon filtration.

The city of Orange drains to Blackmans Swamp Creek and due to the large impervious areas in the catchment, reliable runoff occurs after every rainfall event.

The project is capable of providing up to 900 ML per year of additional water into Orange’s raw water supply. Under current licencing, the scheme can only be used when Suma Park Dam is below 50 per cent of capacity; however, Council is seeking approval to extract water from the creek when Suma Park Dam is below 90 per cent of capacity.

watersecurity.orange.nsw.gov.au

However, while traditional financial evaluation remains important, the emerging recognition of the broader value of water highlights the need for commensurate broadening of traditional economic evaluation frameworks. This evaluation should account for the “whole of life” social and environmental values of water and reflects on community values along with traditional, quantitative metrics (Ewert et al., 2012).

Urban stormwater is a readily available and under-utilised resource in cities and towns that can be cost effective. Increased stormwater harvesting and use as part of a portfolio of water supplies can build resilience while also supporting enhanced liveability.

Figure 3 shows the amount of stormwater and wastewater generated in Australian capital cities in comparison to reticulated water supplied to meet each cities water demands (PMSEIC, 2007). As much as 90% of water demands in cities do not require potable water quality standard and it is evident that the combined total of wastewater and stormwater generated within the city footprint far exceeds the water demand of each city.

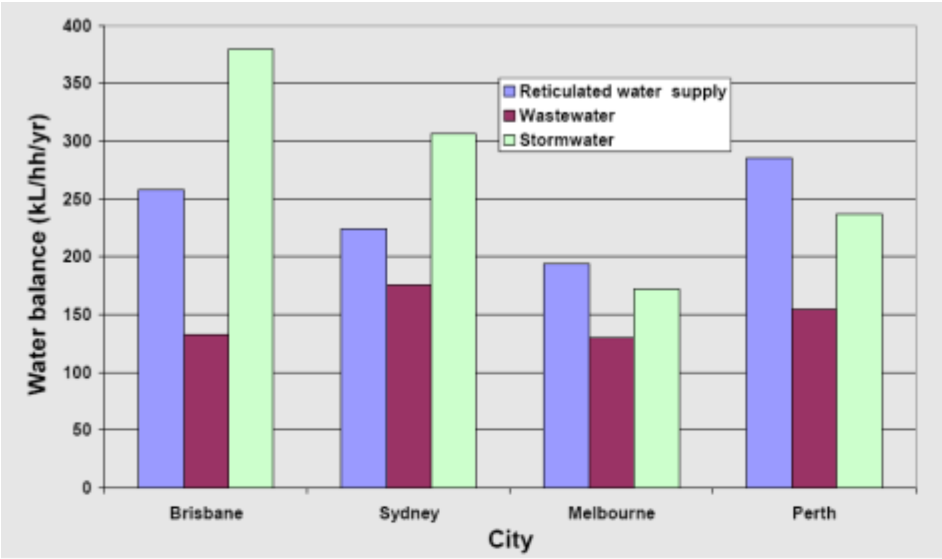

Figure 3 Reticulated water supply compared with wastewater and stormwater generated in Australian Cities (PMSEIC, 2007)

Wastewater generation is proportional to population. Urban stormwater runoff is generated during almost all rainfall events due to the significant area of impervious surfaces that characterise urban landscapes. This contrasts with rural and forested areas where some 10-20% of rainfall becomes surface runoff, with the remainder being infiltrated or evapotranspired.

There appears to be a widely held perception that there is a lack of space for stormwater retention in the urban footprint. Catchment yield (the volume of stormwater that can be effectively harvested) is dependent on complex inter-relationships of factors including climate, development density, storage size, demand volume and demand profile. Along with other contextual considerations, these factors influence the proportion of total stormwater runoff that is available for harvesting and use.

Harvested stormwater is currently used almost exclusively for garden and open space watering and there is generally a mis-match of demand pattern and supply pattern (i.e. the demand for garden and open space watering is often non-existent or low during and in the days following rain events). Mitchell et al. (2006) demonstrated that by utilising harvested stormwater for uses that have a more uniform demand pattern (e.g. toilet flushing), stormwater yields could be substantially increased. Research and development of stormwater treatment technologies (e.g. Wong et al., 2012) will facilitate the use of harvested stormwater for non-potable domestic purposes in the immediate future.

Orange Managed Aquifer Recharge Project

Orange City Council is examining the possibility of using the Basalt Aquifer to the south of the city for Managed Aquifer Recharge (MAR)

The Basalt Aquifer could potentially be used to store harvested stormwater during wetter periods for use during drier times.

A desktop analysis has been completed. The next stage, which includes the Establishment of bores close to the city will assist in understanding the capacity, economics and operational requirements of MAR in different rock types.

watersecurity.orange.nsw.gov.au

Delivering multiple benefits to society through water

The way we manage urban water, particularly urban stormwater, influences almost every aspect of our urban environment and quality of life. Water is an essential element of place making, both in maintaining and enhancing the environmental values of surrounding waterways and in the amenity and cultural connection of the place (Wong et al., 2012).

Relative to other forms of capital, ecosystem services are often unaccounted for or undervalued in economic valuation frameworks due to their non-market and indirect nature. Natural ecosystems that have been retained in cities and towns, typically located along creeks and waterways, or in scattered pockets throughout the city, offer some of the greatest value returns per capita for the land area in which they occupy (Crane and Kinzig, 2005).

Urban ecosystem services are often identifying elements of a city (e.g. harbour views; leafy suburbs) and exert strong influence on liveability (NSW Department of Planning, 2010). However, tensions between built and natural environments often result in the erosion of the resilience and function of urban ecosystems (Walker et al., 2004). In recognition of this tension, policy-based recognition of the value of the various ecosystem services that exist within urban areas should be framed as systems-based management objectives (as defined by community expectations). This will enable positive and engaging management targets, that support and enhance the liveability of a city, to be defined (SMCMA, in draft).

A water sensitive approach to harnessing the potential of alternative water sources can deliver benefits in addition to water security and resilience that are related to urban liveability, environmental protection and ecological sustainability of the built and natural environment. Stormwater runoff is generated throughout the urban environment and its management near its source of generation provides the best opportunity to realise these additional benefits.

The range of benefits that can be gained from a water sensitive approach to stormwater management include:

- enhancing urban water supply security – urban stormwater is a significant water source generated close to where it is needed;
- building resilience to climate change – stormwater harvesting systems based on proven bio-physical technologies can be low energy/ low emission solutions;
- improving urban microclimate, thereby reducing air-conditioning requirements and energy use and improving public health;
  - the significance of keeping water within the landscape, combined with the role of vegetation and orientation of building elements, are urban design issues that will critically influence the urban micro-climate (Endreny, 2008);
  - analysis of mortality and extreme temperature shows a marked threshold temperature beyond which significant increases in mortality occur (Nicholls et al., 2008), so even relatively slight ameliorations of extreme temperature through improved urban design can have the potential to save lives;
- improving urban waterway health through hydrologic and pollutant controls – it is well documented that uncontrolled stormwater runoff from urban areas degrades creeks and waterways (e.g. Walsh et al., 2004). Treatment and harvesting of urban stormwater leads to positive management of the water quality and natural hydrology of urban creeks and waterways to improve waterway ecosystem health (Fletcher et al., 2007);
- improving urban design – stormwater harvesting using green infrastructure enhances social amenity and opportunities for public recreation in addition to its potential for influencing micro-climates in urban areas.

Supporting water sensitive communities

Traditional governance and service delivery models for water management are being challenged and renegotiated as communities demand a greater level of engagement around water management and environmental sustainability. To ensure ongoing water supply resilience, future governance and service delivery models will need to be adaptive and underpinned by a flexible institutional regime. They will also need to support and reinforce sustainable practices and social capital, while recognising the implicit link between society and technology.

With access to a diverse range of water sources, the importance of co-development and co-design of urban water strategies with local governments and communities is emphasised. The planning and development of enabling policies that foster models that promote a greater level of integration of stakeholders in the governance and operation of urban water systems are needed. Valuation of future urban water infrastructure, including green infrastructure, should ensure economic analysis of options include direct and indirect (non-monetary) costs and benefits.

Water conservation

Water conservation measures that influence societal expectations and behaviours in relation to water use are critical to the resilience of future water systems and the future development of system storages in NSW water infrastructure. The scope of these interventions is broad and includes strategies such as community education, public participation, community co-design and co-management of future supply infrastructures and services, water restrictions and a host of other strategies identified by the community for the community. Water supply policy-makers must not continue to assume that communities wish to be only passive consumers. There is increasing evidence that communities wish to be involved in a range of ways from providing information through to co-design and co-management of future water systems.

In addition to investigating new water storage options, the very effective public awareness campaign on the scarcity of water and the importance of water conservation practices during the recent drought should not be overlooked as an integral part of enhancing the resilience of water supplies across NSW.

Wilford L.A.N.E 'Living Lane', Newtown

Wilford L.A.N.E. Living Lane is a beautiful and multi-functioning garden occupying a portion of shared land reserved (but no longer required) for future road widening. The living lane was established through an innovative co-governance arrangement between Marrickville Council and the Wilford Lane community.

Through a participatory process of planning and co-design, Council and Wilford Lane residents, businesses and property owners developed an award-winning multi-functional and locally appropriate solution for an underutilised public area. The living lane provides:

- rainwater harvesting
- stormwater treatment
- local flood mitigation
- useable green space for the neighbourhood, affording microclimate benefits for physical and mental health, and
- a deterrent to anti-social behaviour.

wilfordlaneproject.blogspot.com.au

Cost, reliability and risk of diverse water sources

Different water sources have unique reliability, environmental risk and cost profiles with the tendency for sources of high reliability to also have associated high cost and environmental risk profiles and vice versa. System-wide analysis of greater Melbourne (Coombs et al., 2011) demonstrated that augmenting traditional (centralised) water systems with appropriate combinations of allotment, precinct and regional decentralised water sources (rainwater, stormwater, recycled wastewater), supported by non- structural measures, can avoid the high financial costs and investment risks associated with the construction and management of large, centralised infrastructure.

In the future, NSW communities will have the greatest water supply resilience if they have the capacity to dynamically access, over short and longer timeframes, a portfolio of diverse sources that continually deliver an acceptable balance of economic and environmental costs and benefits, and supply security, that reflects the prevailing local climate and socio-demographic conditions.

Balancing short and long-term water supply solutions

For greater Sydney, existing dams, existing water recycling schemes and the Kurnell desalination plant contribute to a diverse water supply approach and address short-term water supply needs. However, if Sydney is to be resilient in the longer-term, it will be important that current investments in desalination and large scale recycling schemes are viewed as strategic solutions that can ‘buy time’ for other more cost effective and sustainable solutions, such as stormwater and recycled wastewater, to incubate towards realising their full potential. Likewise, current high storage levels in many water supply dams across the State as a result of recent rainfall patterns should not be a reason for reduction in government’s efforts in maintaining a high community awareness of the scarcity of water and cities’ vulnerability to the future climate conditions. Instead, they should be viewed as a buffer to enable alternate water supply and demand options that can increase the resilience of local water systems to be investigated, planned and implemented.

Implementation of distributed local stormwater harvesting and wastewater recycling schemes will take longer than for large, centralised infrastructure (e.g. desalination) and will typically span land renewals cycle of city precincts and towns. Like the current practice of water sensitive urban design, implementation of rainwater and stormwater harvesting schemes, and wastewater recycling schemes will take advantage of opportunities presented by greenfield and brownfield (urban renewal) development projects, as well as the growing number of initiatives by local government to secure alternative water for public open space irrigation. The timely development of appropriate policy and planning instruments is essential when implementation is tied to progressive urban development and redevelopment activities.

Unlike the traditional centralised water systems, which have benefited from over two centuries of dedicated research and development (and associated learning around appropriate governance mechanisms) urban stormwater harvesting and use schemes at precinct and regional scales are relatively recent concepts. Stormwater harvesting schemes are often inappropriately assessed in terms of their effectiveness as a stand-alone solution, whereas their true value is as an integral part of a water supply system incorporating a diversity of water sources at a range of scales. Local stormwater harvesting and use schemes require further research and implementation to strengthen the 'proof of concept' (particularly in relation to quantifying the value of multiple-benefits provided), and to support the development of appropriate governance and servicing models.

If in the future NSW cities and towns can develop a more resilient water supply system by adopting a ‘water sensitive’ approach to water planning and management, it may be possible for cities and towns to support rural and regional industries and environments by supplying fit-for-purpose water.

With urban water supply security addressed by existing infrastructure for the short term in many cities and towns; now is the time to direct significant attention to developing future water supply and use options with low economic and environmental costs, and broad societal benefits for long-term sustainability. This should be based on developing locally appropriate portfolios of water sources, accessed through a mix of centralised and decentralised infrastructure, and supported non-structural measures. This ‘water sensitive’ approach to urban water planning and management will build resilience and enhance the liveability of NSW cities and towns into the future.

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