Submission to the Productivity Commission Issues Paper:

Barriers to effective climate change adaptation

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Acknowledgement

The Water Services Association of Australia (WSAA) acknowledges the assistance of Element Solutions and the WSAA membership in preparing this submission to the Productivity Commission's inquiry into regulatory and policy barriers to effective climate change adaptation. The views expressed in this submission reflect those of WSAA and its membership

All inputs to the report have been provided by WSAA and its members and Element Solutions have not attempted to verify their accuracy or undertake additional primary research.

Contents

1. Executive summary

The Water Services Association of Australia (WSAA) welcomes the opportunity to make a submission to the Productivity Commission's (Commission's) inquiry on *Barriers to effective climate change adaptation*.

WSAA is the peak body of the Australian urban water industry. Its members and associate members provide water and wastewater services to approximately 16 million Australians and many of Australia's largest industrial and commercial enterprises.

The impacts of climate change are already being felt in Australia, and with the water cycle highly sensitive to climate the water industry is facing an unprecedented challenge in climate change. The changing climate present risks to all facets of the urban water cycle from water supply, and growing evidence indicates that the water and wastewater sector will not only be affected by climate change, but that it will deliver many of its impacts through floods, droughts or extreme rainfall events. Water resources will change in both quantity and quality, and water, stormwater and wastewater facilities infrastructure will face a greater risk of damage. The effect of climate change will manifest from difficulties in operations to disrupted services and increased cost of water and wastewater services.

While certain actions being taken by urban water utilities may help to reduce their exposure to climate change, there is an evident need to address climate vulnerability more systematically. Some of the measures currently being implemented primarily address short-term concerns. For many utilities longer term actions may often appear to be unaffordable or unfeasible given perceived complexity, a lack of scientific information relevant to the urban environment, or a lack of coordination with other authorities related to issues such as resource protection and flooding.

Many WSAA members have been focusing on climate change adaptation over and above traditional water supply issues as they will need to adapt their infrastructure and operations to cope with the future impact of climate change.

This analysis has been developing around the key elements of the business cycle i.e. (strategic and tactical) planning needs, design and installation, operations and maintenance, customer service and business continuity. WSAA members are focused on identifying what climate change might mean for these elements.

The next stage of the water industry's adaptation work will need to include consideration of how the urban water sector can contribute to the overall community response and adaptation to climate change, especially in relation to:

- **Asset management and maintaining built infrastructure**: the large asset base and long-term horizons for decision-making make asset management and maintenance key issues for water utilities owner/operators. This is compounded by the ageing of infrastructure
- **Water quality and quantity**: new climate conditions and changed infrastructure configurations will require innovations in water treatment

- **Cities of the future**: our urban and social resilience – particularly in the face of population growth and changing demographics – will be a result of integrated and comprehensive planning.

WSAA's key conclusions and recommendations in responding to the Commission's Issues Paper are:

Effective adaptation to climate change

- Climate change presents risks to all facets of the urban water cycle.
- Water utilities are working to assess the risks climate change impacts pose to their business and to implement climate change adaptation planning.
- As regulated authorities, water utilities must select climate change adaptation responses that are cost effective, defensible and representative of sound investment.
- The definition of climate change adaptation should include reference to both proactive and reactive adaptation responses.
- WSAA recommends a risk management approach to adaptation planning will achieve an effective approach to climate change adaptation which is transparent and flexible in considering the risks involved.
- Australian utilities have developed approaches to the immediate challenges posed by climate change, and are continuing to develop strategies for the long term impacts of climate change. Approaches include: responding to water scarcity with infrastructure investment programs, water conservation and efficiency measures and strategic responses; asset management strategies; planning for urban development; monitoring for health impacts; vulnerability research.
- WSAA and its members are undertaking the AdaptWater project, which will deliver a climate change adaptation tool for the Australian water industry. AdaptWater will capture and quantify the complexity of modern water utilities' economic, social and environmental performance requirements and integrate the effects of evolving direct and indirect climate change hazards.
- WSAA does not advocate stalling the implementation of climate change adaptation strategies while waiting for new approaches to address uncertainty.

Barriers to adaptation

- WSAA agrees in principle to the Commission's classification of barriers. WSAA proposes an additional barrier category to address legacy issues where barriers to climate change adaptation occur as a result of existing infrastructure and development.
- Market failures which may inhibit effective climate change adaptation include: investment constraints, the insurance market, and the quantification of climate change impacts.
- Implementing responses to climate change challenges will require collaboration of water utilities with regulators and policy makers to develop the appropriate market, regulatory and planning structures.
- Examples of policy or regulatory barriers include: short-term regulatory horizons; unclear government roles and responsibilities; inconsistent policies; lack of coordination in response to climate change impacts; network infrastructure shared risks; information gaps; and climate data access issues.

- The organisational barriers classification should be extended to include multi-jurisdictional and supply chain barriers.
- The lack of skills and capacity in the private and public sector to prioritise, develop and determine effective climate change adaptation measures is a barrier to effective adaptation.

Addressing adaptation barriers

- Consistent information and guidance from governments on climate change impacts and appropriate methodologies for climate change quantification and climate change adaptation is essential for effective adaptation.
- Infrastructure owners need support in determining the adequate value for their properties and assets for insurance purposes.
- Clarity is required regarding the process, ownership and timelines for updates to design standards.
- To ensure the water industry is well placed to adapt to climate change the framework for economic regulation needs to ensure prices are set taking into account adaptation measures.
- In some cases the most effective climate change adaptation measures for a water business or piece of infrastructure will be non-structural, and may include changes to environmental standards or levels of service. Regulators will need to be flexible in their frameworks to accommodate potential changes.
- A review of existing climate change data available to federal, state and local governments is needed, and information should be then made freely available and centrally located for easy access.

Setting priorities for reform

WSAA and its members consider the following reform options priorities:

- A coordinated response to climate change
- Revision to regulatory frameworks to consider climate change impacts and adaptation responses
- Access to complete and consistent data
- Clarification of the roles and responsibilities of governments
- Consistent policies, methodologies and design standards
- Support to infrastructure owners in determining adequate value for insurance purposes

This submission draws on the WSAA Climate Change Adaptation in the Water Industry to be released in the first quarter of 2012, this document can be made available to the Productivity Commission.

2. Effective adaptation to climate change

This chapter focuses on WSAA's response to the Commission's questions on the following issues:

- definition of effective climate change adaptation
- making climate change adaptation effective
- current adaptation practices and research
- dealing with uncertainty

Context

The water industry is facing an unprecedented challenge in climate change. The water cycle is highly sensitive to climate, and climate change projections for Australia suggest a hotter, drier climate, rising seas and more intense fires and floods (BOM 2010). The changing climate present risks to all facets of the urban water cycle from water supply, wastewater transfer, treatment and infrastructure, to river health, drainage and flood management, including:

- Increased variability in rainfall, including an increased incidence of prolonged drought, with potential reduction in fresh water supplies.
- Increased incidence of intense storms that lead to higher volumes of water entering the wastewater system and increased overflow volumes.
- Rising sea levels and storm surges that result in greater ingress of sea water to wastewater systems and increased salinity in water sources.
- Increased temperatures will cause a greater rate of generation of hydrogen sulphide gas in wastewater networks resulting in an increased rate corrosion of the sewers and odour complaints.
- More intense and extreme riverine and drainage floods which can inundate and damage infrastructure and lead to pollution and licence breaches.
- More extreme hot days and exacerbated bushfire risk that could pose a threat to worker safety and productivity.
- Changes in soil conditions that could lead to greater risk of pipe failure.
- Disruption to electricity supplies due to increased extreme storms, high winds, heatwaves and bushfires leading to service failure due to inability to pump water and wastewater.
- Change in water quality due to increased temperature and changes in catchment vegetation and bushfire frequency.
- Increased entry of tree roots into sewers, causing blockage and overflow of sewage to the environment.
- Changes to the efficiency of temperature dependant chemical and biological processes that are used to process water and wastewater (for some processes this is an opportunity as efficiency will actually be increased).
- Changes to the capacity of water and wastewater utility to deliver levels of service.
- Changes to customer demand for water.

In facing potential climate change risks, water utilities are working to assess the risks climate change impacts pose to their business and to implement climate change adaption planning, and at the same time have embraced opportunities to play a part in the solution to climate change, by seeking to reduce their emissions through carbon abatement measures.

As regulated authorities, water utilities must select climate change adaptation responses that are cost effective, defensible and representative of sound investment.

In response to changes the water industry have already experienced such as on-going drought and other climate events, utilities have done their best to adapt, though facing uncertainty in both the climate projections for the future as well as impact on water resources and infrastructure. The development of strategies, planning approaches, new augmentations and a bigger focus on interconnectivity and collaboration have all been adopted as tools of change.

The WSAA Climate Change Adaptation in Water Industry paper (due for release in 2012) identifies a number of key priority actions have been identified for action for WSAA and its members to develop and implement:

1. Engage with economic, public health and environmental regulators to encourage them to become a 'climate ready' – so as to build a deep understanding of climate change issues, the impacts into future decision-making frameworks and the likely trade-offs required in investments in infrastructure.
2. Develop a suite of conceptual models, incorporating a 'model business case' and including the Australian Government's Critical Infrastructure Protection Modelling and Analysis Program (CIPMA) overlays, to identify vulnerable assets, infrastructure and communities.
3. Develop a collaboration with the US based Water Utility Climate Alliance (WUCA)and utilise existing WSAA relationships with the Water Research Foundation (WaterRF) and the Water Environment Research Foundation (WERF) in priority areas, developing, trialling and documenting case studies of decision-making tools such as scenario planning and real options analysis.
4. Develop a 'mud map' of stakeholders with strong interest and involvement in climate change adaptation to clarify and prioritise opportunities for collaboration in both policy and science and including international organisations such as the EU-funded program PREPARED.
5. Build and share knowledge on water utilities' responses to historical events (particularly extreme events).
6. Develop a 'model business case' for investment (in infrastructure or a program) that incorporates a climate change adaptation perspective – for use in sector capacity building and for engagement with industry regulators.
7. Collaborate to leverage access and potentially influence climate change modelling and adaptation work undertaken by CSIRO, BOM and Centre of Excellence (at the University of New South Wales).

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Defining climate change adaptation

The Commission has presented three definitions for climate change in Box 2 of the Issues Paper (page 4). Although the Commission notes that the Intergovernmental Panel on Climate Change (IPCC) adopts a wider definition than the inquiry terms of reference, WSAA prefers the IPCC definition over the other two listed by the Commission. The IPCC definition includes proactive adaptation, where there is a response to actual or expected climate change impacts:

> Adaptation is the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. *IPCC 2007*.

The other definitions presented in the Issues Paper, and the definition included in the Commission's terms of reference, are limited in their sole inclusion of reactive adaptation, where adaptation occurs only in response to actual climate change impacts. WSAA expects proactive adaptation will achieve more effective adaptation responses than limiting adaptation responses to reactive actions only.

For example, sea level rise as a result of climate change will occur incrementally, and it is prudent to plan ahead and be proactive in adaptation responses. Responses should consider both structural and non-structural approaches, and include reviewing the location of critical and expensive infrastructure in the areas that may be affected by sea level rise (such as large coastal wastewater treatment plants), or development of appropriate planning overlays.

Making adaptation effective

WSAA cautions the Commission in attempting to define the 'most effective' actions, as adaptation actions may or may not be appropriate for all situations. For example, moving to non-climate dependent water sources such as desalination is an effective response to water supply shortfall, but may not be appropriate in all circumstances.

Instead, WSAA suggests a risk management approach to climate change adaptation planning will achieve an effective approach which is transparent and flexible in considering the risks involved and the sensitivity of a particular household, community, organisation, government, or piece of infrastructure. The nature and extent of adaptation in each situation will depend on the costs and efforts involved compared to the benefits of adopting different adaptation strategies to achieve a degree of resilience.

The draft Australian Standard AS 5334 *Climate change adaptation for settlements and infrastructure*, proposes a risk management approach for climate change adaptation which follows the International Standard ISO 31000:2009, *Risk management – Principles and guidelines* (adopted in Australia and New Zealand as AS/NZS ISO 31000:2009).

Risk management techniques are effective as it requires perfect numerical data and certainty to assess, rank and prioritise risks and adaptation actions. Risk management techniques are also flexible, readily updated and are well understood by most infrastructure managers (including WSAA members) as it is used for a wide range of other applications.

However, risk management techniques do not work as well when precise numerical values are required, such as for designing and sizing infrastructure. In such cases scenario planning, real options analysis or other approaches may be more useful.

Current adaptation practices

While certain actions being taken by urban water utilities may help to reduce their exposure to climate change, there is an evident need to address climate vulnerability more systematically. Some of the measures currently being implemented primarily address short-term concerns. For many utilities longer term actions may often appear to be unaffordable or unfeasible given perceived

complexity, a lack of scientific information relevant to the urban environment, or a lack of coordination with other authorities related to issues such as resource protection and flooding.

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- **Water quality and quantity**: new climate conditions and changed infrastructure configurations will require innovations in water treatment
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A summary of the responses currently being undertaken or considered by the water industry is detailed below.

Customers and Service Delivery Standards

Declining water supply availability, particularly from surface water sources such as catchments and dams has seen a swift reaction by the water industry to adapt as necessary to ensure continuing water supply for the future. Adaptation measures that have been taken include:

Diversifying water sources: This includes moving to less climate dependent sources. There has been an increased use of greywater and blackwater recycling, stormwater harvesting and rainwater tanks, aquifer storage and recovery and desalination of sea water.

Network interconnectivity: Construction of water supply pipelines and networks connected to external supply networks to enhance opportunities for sharing and trading of available water resources.

Strategic responses: Water utilities have an increased focus on strategic planning for future sources, supply, demand, operations of water supply networks and wastewater strategies.

Water Conservation: In recognition of the different needs of customers, some water utilities have revised, implemented, amended or adapted the rules for water restriction or bans or adopted

permanent water saving measures. This has included setting of water use targets and water industry programs to promote demand management and reuse. Most governments or water utilities also offer some sort of subsidy or reward for using water efficient appliances or the installation of rainwater tanks. There are many different types of water saving grants or incentive schemes that have been successfully implemented across Australia, including those offered by the Federal Government such as shower rose exchange and low flow toilet programs.

Water efficiency: The introduction of water efficient appliances at the household level, and an increasing focus on improving the operational efficiency of water supply networks to gain optimal reservoir availability and beneficial use of water. This also includes leakage reduction programs in water supply networks and construction of pipelines to reduce numbers of open water channels that have a high incidence of evaporation. Smart metering is also gradually being introduced across Australia, with projects and case studies Victoria, New South Wales, Western Australia and Queensland. Smart meters provide real time continuous monitoring of water consumption that will provide valuable information to customers and utilities such as understanding when, how and why water is used and to identify leakages to improve water conservation.

Loss of Assets

Water utilities generally have very robust risk management systems in place to manage risks and hazard to infrastructure. These risk management practices are being adjusted to incorporate climate change risks and adaptation responses to manage them. The draft Australian Standard on Climate Change Adaptation for Settlements and Infrastructure (DR AS 5334) and Department of Climate Change and Energy Efficiency's guidelines for climate change impact assessment and risk management both recommend an approach consistent with the Australian/New Zealand Standard for Risk Management (AS/NZS 4360:2004). Vulnerability assessments identifying the extent of damage or impact under climate change are often undertaken to support risk assessments. Water utilities are starting to undertake vulnerability assessments to identify infrastructure that may be vulnerable or sensitive to climate change and then undertaking risk assessments to determine the need to manage the impacts. Vulnerability and risk assessments are being undertaken by water utilities for bushfire, sea level rise and flood management.

At a national level, the Australian Government's Critical Infrastructure Protection Modelling and Analysis (CIPMA) Program is a major initiative aimed at improving and protecting the future security of Australia's critical infrastructure. CIPMA uses collaboration and will be covering infrastructure of all areas and identifying paths to enhance resilience. A number of WSAA members are involved in the CIPMA Program.

A collaborative study between City West Water, South East Water, Yarra Valley Water and Melbourne Water, the Melbourne Metropolitan Sewerage Strategy sets out the future issues and management strategies for Melbourne's wastewater. It covers uncertainties such as climate change, population, urban growth and living standards, and uses of sewage, such as reuse or disposal. The Water Supply Demand Strategy is also developed between the same four water businesses and used scenario planning to assess the future under a variety of climate change conditions.

Asset Management

A number of states are developing or have developed strategies to detect, manage and replace concrete and metal pipelines that are subject to or risk of corrosion and have active leakage detective programs. The increasing issue of pipe corrosion is at the centre of research being undertaken by CSIRO and Australian water utilities to better understand the factors and conditions that influence copper pipe corrosion.

Eleven Australian water industry organisations are working with university and industry partners from Australia and overseas to develop national standards for cost-effective methods to manage and minimise concrete corrosion and odour emission from sewers. The work is part of an Australian Research Council Linkage Grant. This is a five-year, $19 million, national program involving water utilities from New South Wales, Queensland, Victoria and Western Australia.

In response to the frequency of power outages due to extreme events and to minimise interruption to continued supply, water utilities are investing in back-up generators and looking at other sources of power that are not dependent on the electricity grid. Sources such as wind power, bio-gas and solar electricity are being considered and developed and not only provide the benefit of non-power grid dependent sources, but contribute to the reduction of reliance on carbon intensive energy sources.

Asset Investment

WSAA expects the AdaptWater project to also assist Australian utilities in quantifying their climate change risks and assessing their asset investment programs in the context of climate change adaptation. As previously identified, water utilities must select climate change adaptation responses that are cost effective, defensible and representative of sound investment.

WSAA has existing relationships with international water research organisations and is engaging with these organisations and international utilities on addressing asset investment within the context of climate change adaptation.

The Seattle Public Utilities (SPU) face similar risks in relation to climate change as those facing the drought ravaged areas of Australia. With a primarily mountain based surface water supply, they rely on rain and snow melt for water. To build resilience into their water supply, the SPU have taken a tiered approach to infrastructure adaptation.

Tier 1: Operational adjustments (low cost, no regrets)
Tier 2: Infra-system modifications
Tier 3: Greater use of storage
Tier 4: New supply alternatives
Tier 5: New supply concepts

The Water Research Foundation's website Climate Change Clearinghouse also has many publications written by different organisations on infrastructure investment under climate change which may assist water authorities in understanding and adapting to climate change (see http://www.theclimatechangeclearinghouse.org/).

Urban form and planning

Planning for urban development necessitates consideration of emerging future issues because many elements of urban landscapes and suburbs endure up to and beyond a century. Given the increasing urgency and attention to climate change, urban planners are now starting to consider the impact of climate change in their planning. What started out as an urban design to primarily treat stormwater runoff and manage other peripheral issues, water sensitive urban design (WSUD) has transitioned into a type of design that is being considered as a tool to help cities adapt to a changing climate. WSUD may also reduce the impacts of the urban heat island effect and provide stormwater harvesting and alternative sources of water at local and regional scales. Integrated water management and projects, such as Cities of the Future, may also have the potential to influence urban planning to enable better integration of water planning in future urban development.

Continuing sea level rise and extreme storm surge events over the last century have already seen a number of changes in the Australian coastline. These changes have contributed to a greater acceptance of climate change induced sea level rise than most other climate change projections. The report on Climate Change Risk to Australia's Coast by the Commonwealth Government (DCC 2009) is a first pass national assessment investigating the risks of climate change to the costal environment, human settlement and industry. Other state and local governments have also undertaken risk, hazard or vulnerability assessments and developed policies and strategies for adaptation.

Planning panels and the legal system are also starting to recognise the gravity of the risk that existing coastal development now face and have in some instances restricted or prohibited development in an area identified for future potential coastal inundation. Governments and planning authorities have also taken or are taking the steps to produce guidelines for future development that may be subject to inundation from either sea level rise or from increased flood extent due to increased intensity of extreme rainfall events. The New South Wales Government have produced *Coastal Planning Guidelines: Adapting to Sea Level Rise* and Melbourne Water has released interim guidelines for assessing development in areas prone to tidal inundation from sea level rise in the Port Phillip and Westernport Region called Planning for Sea Level Rise. The Victorian Government is also due to release *Victorian Coastal Climate Change Hazard Guidelines* for coastal management authorities to use in their assessments of coastal development proposals.

Health Impacts

Ongoing monitoring to ensure that water supply meets appropriate standards for human consumption and wastewater is treated to relevant standards for outfall are standard requirements of all water utilities. Tools and technologies for monitoring these health risks such as fluoride, e.coli and turbidity will continual to improve and adapt.

Online real-time sewerage monitoring systems for industrial trade wastewater discharges such as those used by Sydney Water provides industrial customers and Sydney Water with real-time monitoring results on the quality of trade waste discharge. This system will enable monitoring and analysis of changes in trade waste into wastewater over time in relation to weather and climate related phenomena over time that could provide a greater understanding of climate change impacts on wastewater.

Source Water and Catchments

The South Eastern Australian Climate Initiative (SEACI) is a major research program investigating the causes and impacts of climate change and climate variability across south eastern Australia. SEACI is a partnership between CSIRO, the Australian Government's Department of Climate Change and Energy Efficiency, the Murray Darling Basin Authority, the Bureau of Meteorology and the Victorian Department of Sustainability and Environment.

Predictive modelling is a relatively new area of research that will prove useful in climate change adaptation. Melbourne Water used plume and temperature modelling in response to bushfire runoff in response to the devastating Victorian bushfires in 2009 that affected Melbourne's catchments. This tool and others like it will prove very useful in predicting the impacts of bushfires on water supplies in catchments potentially taking into account increasing frequency of bushfires and changing catchment conditions.

Many water utilities and catchment authorities have complex reservoir management systems that enable water managers to model water volumes and transfers through a water supply system. Sydney Catchment Authority have developed a real time decision support system for reservoir management to aide in long term and short term management strategies in response to water quality events due to temperature, flooding or extreme wind events.

The Commonwealth Government are performing a nationwide vulnerability assessment of seawater intrusion and its impact on coastal groundwater resources. The study is currently underway and is being undertaken by Geosciences Australia. The study is being done in collaboration with the National Centre for Groundwater Research and Training as well as state and territory water agencies and authorities.

To date water utilities have had difficulty accessing complete data from federal government research programs, this is consider by WSAA as a barrier to effective adaptation in Section 3.

Climate change asset planning tool

WSAA is leading the development of AdaptWater, a climate change asset planning tool for the urban water industry. AdaptWater will capture and quantify the complexity of modern water utilities' economic, social and environmental performance requirements and integrate the effects of evolving direct and indirect climate change hazards.

When developed this tool will have significant potential to greatly increase the effectiveness of climate change adaptation and management for urban water utilities and our 16 million Australian customers (see Box 1).

BOX 1: AdaptWater – A climate change adaptation tool for the water industry

The AdaptWater tool is an example of an industry-wide response to climate change risks. AdaptWater is being undertaken by project partners the Water Services Association of Australia (WSAA), Sydney Water and Climate Risk Pty Ltd. The Department of Climate Change and Energy Efficiency (DCCEE) has provided co-funding to the project. In addition to Sydney Water, WSAA members Melbourne Water, SA Water, Water Corporation and Queensland Urban Utilities (QUU) are participating in the tool development prototype and pilot phases.

The AdaptWater tool will be a climate change adaptation asset planning tool developed for urban water utilities. AdaptWater will capture and quantify the complexity of modern water utilities' economic, social and environmental performance requirements and integrate the effects of evolving direct and indirect climate change hazards.

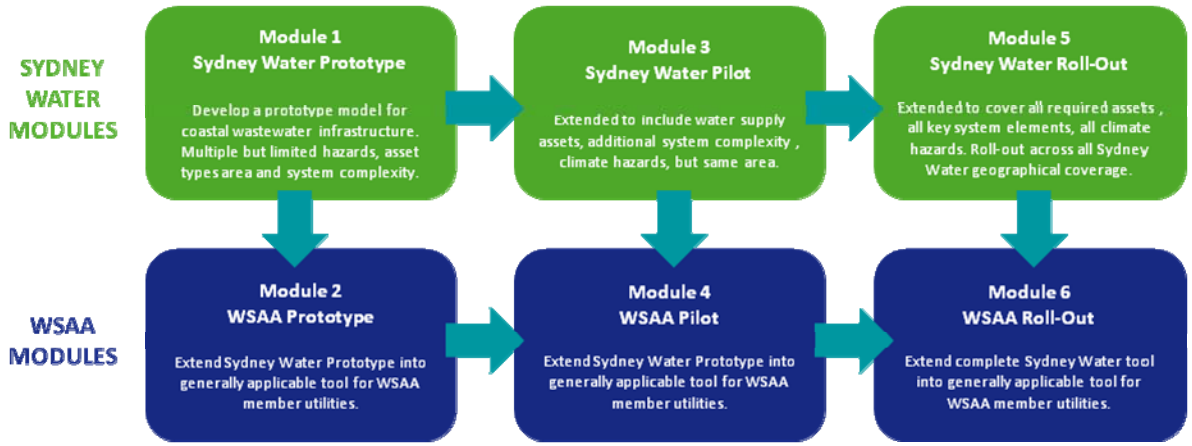
AdaptWater will take into account uncertainty, time, spatial and technical information through a systems analysis approach to give a comprehensive picture of the risks and opportunities from climate change that can be included in business decision making. AdaptWater will provide plausible adaptation cost-effectiveness projections and flexible adaptation pathways.

Features of AdaptWater

- Provides a robust and transparent climate change adaptation quantification tool for the water industry.
- Establishes a consistent approach to climate change risk and adaptation related decision making.
- Enables the user to run scenarios and determine the impact on key financial, operational, and environmental performance indicators.
- Compares adaptation measures to establish the cost-effectiveness of adaptation actions and allow prioritisation.
- Provides a flexible risk management investment/adaptation approach acceptable to stakeholders.

Project Scope

The project is being developed and delivered in six modules:



Benefits of AdaptWater

- Effectively present and communicate climate change adaptation opportunities to management and stakeholders, including financial controllers, independent regulators and environmental authorities
- Reduce capital and operational costs by strategically identifying and comparing climate change impacts and adaptation options to find the most cost effective solution
- Inform adaptation plans with robust and transparent data and analysis
- AdaptWater will provide an industry standard and independent basis with which internal and external decision makers can consider how to manage climate change for the current and future benefit of customers and utility owners.

Dealing with uncertainty

Surrounded by uncertainty and variability in almost all areas of water resource planning, including: water supply, wastewater treatment planning, drainage and flood management. It is challenging for water utilities to plan for and size their infrastructure. Assets are constructed with an expected life span, therefore it is now becoming important to understand how the requirements or expectations for infrastructure will change in the future if the climate continues to shift. Water utilities face the risk of over sizing or under sizing infrastructure due to the explicit uncertainties in climate science and the uncertainties of translating the climate science into hydrological models. Fixed assumptions, including the reliability of historical data, we have relied on in the past are changing along with the climate.

While there has been significant modelling of the potential extent and impacts of climate change in Australia, there are (and will remain) limitations to these forecasts. Work is underway to provide more localised projections and additional precision, including the NSW ACT Regional Climate Modelling (NARClim) project, which is being lead by the NSW Office of Environment and Heritage and has two WSAA members, Sydney Water Corporation and Hunter Water Corporation, as project partners.

However, given the chaotic nature and complexity of climate and limitations of modelling, uncertainty is inevitable. New approaches (such as real options analysis) will need to be developed and embedded within organisations to provide a framework for decision-making. The long-term nature of water and wastewater assets means that such tools are essential in planning and need to be developed in the near term.

WSAA does not advocate stalling the implementation of climate change adaptation strategies while waiting for new approaches to address high levels of uncertainty. Nor do we consider waiting to respond to actual impacts an appropriate option for achieving effective adaptation. To address this, it is important that climate change is communicated clearly in the terms of potential range of probabilities rather than focusing simply on uncertainty. Any adaptation management framework must be flexible and allow science and knowledge to be updated and incorporated as they are refined over time. Multiple approaches can be used in parallel to inform decision making in the absence of certainty (e.g. real options analysis, scenario analysis, Monte Carlo techniques, and multi-criteria decision making).

The concept of uncertainty has specific technical meaning for those with an association with climate science, risk management and statistics. However, the use of this terminology within the broader community can sometimes be problematic as uncertainty can be interpreted as equivalent to the concepts of unknown, incomplete or outcomes with a low confidence. Better definition of what is meant by uncertainty is therefore encouraged by WSAA.

A range of methods for climate change decision-making under uncertainty has been presented by the Water Utility Climate Alliance (WUCA, 2010). The planning approaches examined include decision analysis, scenario analysis, real options and portfolio planning. For example, real options takes into account uncertainty about the future evolution of the parameters that determine the value of a project, and the decision makers' ability to respond to the evolution of these parameters.

However there are limitations to real options (discussed in WUCA, 2010) including the willingness and ability of people to assign probabilities to situations of large uncertainty.

Other options, such as those included in the Victorian Guidelines for the development of Water Supply Demand Strategies, and being applied by the Victorian water industry are to adopt CSIRO climate change scenarios developed specifically for regions and to use these for planning purposes. Scenario based planning, combined with ongoing monitoring of climate conditions against these initial projections is required, along with five year reviews of Water Supply Demand Strategies to provide for adaptive management to potentially changing conditions.

There have been suggestions that uncertainty can be reduced by further climate research. WSAA and its members are strong supporters of research aimed at improving our understanding climate variability and change and the implications for our water, sewerage and drainage systems. However, while there will always be uncertainty in the climate science, this uncertainty should not be interpreted as an opportunity to ignore or delay assessment or risks and the planning of adaptation activities.

While it may be possible to quantify and describe uncertainties using various techniques, how decision makers and communities respond to this uncertainty is less easily resolved.

Key conclusions and recommendations

- Climate change presents risks to all facets of the urban water cycle.
- Water utilities are working to assess the risks climate change impacts pose to their business and to implement climate change adaptation planning.
- As regulated authorities, water utilities must select climate change adaptation responses that are cost effective, defensible and representative of sound investment.
- The definition of climate change adaptation should include reference to both proactive and reactive adaptation responses.
- WSAA recommends a risk management approach to adaptation planning will achieve an effective approach to climate change adaptation which is transparent and flexible in considering the risks involved.
- Australian utilities have developed approaches to the immediate challenges posed by climate change, and are continuing to develop strategies for the long term impacts of climate change. Approaches include: responding to water scarcity with infrastructure investment programs, water conservation and efficiency measures and strategic responses; asset management strategies; planning for urban development; monitoring for health impacts; vulnerability research.
- WSAA and its members are undertaking the AdaptWater project, which will deliver a climate change adaptation tool for the Australian water industry. AdaptWater will capture and quantify the complexity of modern water utilities' economic, social and environmental performance requirements and integrate the effects of evolving direct and indirect climate change hazards.
- WSAA does not advocate stalling the implementation of climate change adaptation strategies while waiting for new approaches to address uncertainty.

3. Barriers to adaptation

This chapter focuses on WSAA's response to the Commission's questions on the following issues:

- classification of barriers to adaptation
- market barriers
- regulatory barriers
- organisational barriers
- behavioural and cultural barriers.

Classification of barriers

The Commission has proposed to classify barriers to climate change adaptation using the following broad categories:

- market failures
- regulatory barriers
- behavioural and cultural barriers
- organisational barriers

WSAA agrees in principle with the categories above. WSAA proposes an additional barrier category to address legacy issues, where barriers to climate change adaptation occur as a result of existing infrastructure and development. This is a particularly significant barrier to water utilities where infrastructure is either buried or in place in low-lying coastal and floodplain areas.

Market failures

WSAA and its members has identified the following market failures that could inhibit effective adaptation:

Investment constraints: Capital constrained governments are at risk of investing in low upfront cost infrastructure at the risk of higher long term operating, replacement and maintenance costs.

Insurance market: Currently there is complexity in terms of water utilities assessing asset values and losses adequately for insurance coverage.

Climate change impacts quantification: Inability to quantify the costs of climate change and the benefits of adaptation. Climate change will require water businesses to consider the trade-offs between investing in adaptation measures during the planning or construction stage compared to adapting progressively during the refurbishment and renewal of the asset. There is no existing methodology or single "off-the-shelf" solution that could be used to handle WSAA members' quantification requirements adequately. It is for this reason that WSAA and our members are developing the AdaptWater tool for climate change adaptation (see also Box 1).

Policy and regulatory barriers

Implementing responses to climate change challenges will require collaboration of water utilities with regulators and policy makers to develop appropriate market, regulatory and planning structures. Regulators are faced with the challenge of reconciling environmental imperatives with economic objectives. In many cases there will be difficult trade-offs between climate change initiatives and the need to ensure reliability and quality, low water prices and maintain an efficient market structure. Water businesses will need to carefully consider how they can address climate challenges within the regulatory environment, and how this translates to value to their customers, stakeholders, community and the environment.

Examples of policy or regulatory barriers identified by WSAA and its members include:

Short-term regulatory horizons: Climate change adaptation requires longer planning and investment horizons then currently considered by utility regulators. The regulators are not currently considering the impact of climate change and it is unclear whether full cost recovery for adaptation will be acceptable and under what conditions. Investment and planning processes need to take into account longer timeframes when considering the benefits of capital investment.

Unclear government roles and responsibilities: The roles and responsibilities of governments in responding to climate change adaptation is poorly defined. For example, many climate change impacts are predicted on a state or national government level, but adaptation measures often need to be applied at a local government (or organisation) level. Should local government fail to implement adaptation measures appropriately, it is likely that state governments, and possibly the federal government, will be required to step in as insurer of last resort.

Inconsistent policies: Across levels of government, there are inconsistent policies in place for climate change adaptation. This includes inconsistency between state and federal policies, adjacent states and local governments (for example, sea level rise allowances). There is risk of inconsistency in climate change allowances across sectors and within businesses may leave utilities open to scrutiny, over or under investment. On the other hand, overly prescriptive guidelines about what to plan for could prevent potentially useful case-by-case assessments and identification of opportunities. It is unclear whether consistency is required in some or all cases.

Lack of coordination in response: Climate change adaptation is likely to be most effective with a coordinated response from governments. Currently, there is no forum to consider the collective cost of climate change on society across all sectors to ensure least cost adaptation response. WSAA proposes water utilities should be included in any such forum or coordination mechanism.

Network infrastructure shared risks: There is a lack of frameworks and forums to assess risks, assign responsibility and action to address cross-organisational and cross-sectoral risks for network infrastructure. For example, the water and electricity industries are co-dependent and disruption or unsuccessful adaptation of one of the two will impact the other.

Information gaps: Current requirements in legislation, standards, guidelines, and policy documents are typically based on a historical climate and do not allow for increased peak temperatures, increased rainfall intensity, and other changing climate variables. There is a lack of information

regarding climate change scenarios of design events that are permissible or the methodologies to apply them, and as a result organisations are going it alone. This risks inconsistent, and possibly inadequate, adaptation responses. For example, in some states planning policy for climate change adaptation has been introduced, but implementation has been difficult in the absence of related land use planning controls and maps (e.g. zones and overlays).

Access to climate data: Existing climate data is often difficult to access and not widely available to all stakeholders. For example, spatial datasets such as sea-level rise and flood data sets are owned by the federal government and are not freely available which results in the duplication of research.

Organisational barriers

WSAA recommends the organisational barriers classification be extended to include multi-jurisdictional and supply chain barriers, as effective climate change adaptation will require multiple stakeholders (including government agencies and government owned corporations) to consider cross cutting issues.

A key organisational barrier identified by WSAA members is the lack of skills and capability in the public and private sector to prioritise, develop and determine effective climate change adaptation measures.

Behavioural and cultural barriers

The inclusion of behavioural and cultural barriers as a category is supported by WSAA. As identified by the Commission in the Issues Paper (Box 4, page 10), risk perceptions are a barrier to climate change adaptation. Those risks with immediate consequences are perceived as priorities over climate change risks that are expected to occur further into the future, or to occur at any time but are of uncertain severity.

Local weather has been shown to influence beliefs in climate change adaptation, even though there is no clear link between weather and climate change (Weber & Stern, 2011). Such fluctuations in public opinion can result in barriers to adaptation in government organisations such as water authorities as public opinion is particularly influential on activities of government organisations.

Legacy barriers

Legacy issues are a potential barrier for climate change adaptation of infrastructure. Climatic shifts are expected within the design life of infrastructure, and existing infrastructure and development which is either in place in low lying coastal and floodplain areas or is buried is likely to be at risk. Adapting this infrastructure and development to climate change may require relocation of assets which are substantial in value, size and delivery of services to customers.

In some cases, governments may in the future decide to cease or move development out of a particular at risk area. It will be essential that utilities are engaged in this process to avoid unnecessary adaptation of existing assets.

Key conclusions and recommendations

- WSAA agrees in principle to the Commission's classification of barriers. WSAA proposes an additional barrier category to address legacy issues where barriers to climate change adaptation occur as a result of existing infrastructure and development.
- Market failures which may inhibit effective climate change adaptation include: investment constraints, the insurance market, and the quantification of climate change impacts.
- Implementing responses to climate change challenges will require collaboration of water utilities with regulators and policy makers to develop the appropriate market, regulatory and planning structures.
- Examples of policy or regulatory barriers include: short-term regulatory horizons; unclear government roles and responsibilities; inconsistent policies; lack of coordination in response to climate change impacts; network infrastructure shared risks; information gaps; and climate data access issues.
- The organisational barriers classification should be extended to include multi-jurisdictional and supply chain barriers.
- The lack of skills and capacity in the private and public sector to prioritise, develop and determine effective climate change adaptation measures is a barrier to effective adaptation.

4. Addressing adaptation barriers

This chapter focuses on WSAA's response to the Commission's questions on the following issues:

- broad based reform
- facilitating insurance markets
- regulatory responses
- government provision of public goods
- level of government responsibility

Broad based reform

Consistent information and guidance from governments on climate change impacts and appropriate methodologies for climate change quantification and climate change adaptation are priorities for WSAA members.

Currently there is inconsistent guidance on climate change impacts, for example inconsistent advice on sea level rise from the federal and state governments, and different sea level rise allowances in each state. There has been limited guidance from governments on methodologies for climate change quantification or effective decision making for climate change adaptation.

Facilitating insurance markets

WSAA has identified a number of opportunities to facilitate insurance markets in responding to climate change:

Support for infrastructure owners: Infrastructure owners need support in determining the adequate insured value for their properties and assets for insurance purposes. This will ensure replacement 'as was' is possible taking pressure off any government catastrophe disaster fund (currently policy holders provide high level estimates for replacement cost or an expensive detailed professional valuation is required) and will allow insurers to calculate their aggregation exposure in a geographic area and better manage their retentions, probable maximum loss (PML) modelling and reinsurance placements for insurers solvency.

Government charges: Eliminating government charges (Fire Service Levy, Stamp Duty and GST) from insurance premiums (currently approximatley half the total cost) to increase the number of individuals and organisations with insurance cover. Removal of these charges will allow buyers to see the cost effectiveness of covering their risk and consequently are likely to be more receptive to purchasing insurance cover and encouraged to insure for the correct replacement value (under insurance as a way of minimizing premiums is a huge problem). For example, the Fire Services Levy is an impediment to the efficient operation of the insurance market. It is in society's interest that everyone has insurance, having in place what is a fairly large Fire Services Levy helps make insurance unaffordable for those who are less able to adapt to climate change and recover from extreme events.

Mandatory insurance: Mandatory insurance for property and business interruption, similar to a compulsory third party (CTP) scheme, would build a premium pool and spread the catastrophe risk, reducing social and economic impacts of climate change impacts.

Natural catastrophe insurance: Development of a natural catastrophe risk premium pool, contributed to by insurers, federal, state, local government and other self interested financial bodies such as the banking sector. A system similar to the terrorism reinsurance scheme could implemented.

Uninsurable risks: There needs to be consideration given by governments as to how to best fill the gaps missed by the insurance industry to address uninsurable risks such as sea level rise.

Regulatory responses

While many network infrastructure organisations such as the water industry are regulated, regulation is only one approach to ensure climate change adaptation is undertaken. For example, water utilities have been assessing the implications of climate risks on their businesses and customers for a number of years in the absence of regulation (see Melbourne Water Climate Change Study 2005) and incorporating climate change into water infrastructure planning decisions. Regulation in the absence of adaptation activity may be appropriate in some circumstances, and support activities in this area in price regulated industries, but instruments to aid adaptation could also be considered.

Many aspects of water, wastewater and drainage assets are regulated, for example in relation to health, environmental and security requirements. In addition, many water utility assets are long-lived, and those designed for historical climate may function poorly under future conditions. This could result in costly upgrades, more frequent compliance breaches, or legal liability if the asset fails and was not designed based on best scientific knowledge at the time. In designing long-lived assets today, water utilities need to design assets to function robustly under the most likely future climate projected by climate scientists. In this regard, regulation should be evolving to take this into account to ensure are resilient future. This may involve improved consideration of climate change in infrastructure design regulation such as:

- sizing drainage and sewers for larger peak flows
- sizing cooling equipment and biogas collection equipment for larger/longer heat loads during heatwaves
- using different materials to reduce pipe cracking, improve bushfire resistance, or improve heat tolerance
- upgrading water treatment plants to deal with increased pathogen growth or sediment loads
- adjusting the location of sewers and other assets to avoid storm surges, sea level rise, and more extensive riverine flooding.

Current requirements in legislation, standards, guidelines, and policy documents are typically based on a historical climate and do not allow for increased peak temperatures, increased rainfall intensity, and other changing climate variables. The Australian Rainfall and Runoff Guidelines are currently being updated for a changing climate but will not be ready for several years. It is likely that many

other design standards have not been updated for climate change. The lack of clarity about the process, ownership, and timelines for these updates is a key area that industry and government could address. Other issues that would benefit from guidance include:

- the permissible climate scenarios for future years (e.g. 2030, 2050) which we should design for
- whether we should design for a single future climate or a scenario planning approach which looks at multiple futures
- under which circumstances to take different adaptation approaches, such as 'Build Now for Predicted Scenario', 'Planned Adaptation', 'Progressive Modification', or 'Build to Repair for Lifetime' (Connor et al, 2010)

Guidance on these aspects is particularly important because infrastructure is often specified to perform under a single event, be it a severe drought, a large flood, or a record heatwave. This requires precise numerical values which are not easily deduced from the probabilistic climate data available from the IPCC and other climate research organisations. It presents a challenge to selecting the design parameters and specifications for infrastructure, as well as justifying the choice to the financial regulators to enable cost recovery. Until a method is developed that is mutually satisfactory to water utilities and financial regulators, this remains a barrier to adaptation. The WSAA AdaptWater project is expected to go some way to addressing this barrier (see also Box 1).

Closely related to the above is the issue of economic regulation for natural monopolies, including the water industry. Ron Ben-David of the Victorian Essential Services Commission has stated that climate change adaptation is important. However, to ensure businesses are well positioned to adapt to climate change the framework for economic regulation needs ensure that prices are set taking into account these changing requirements. To enable businesses to demonstrate that proposed prices are prudent, clarity in the associated legislation, standards, guidelines, policy, etc. is required. The framework for economic regulations will also need to be increasingly flexible to undertake adaptation responses within a regulatory period. Therefore mechanisms to address significant changes as a result of climate change will be required. This may involve period re-openers, however, there may also be a need for additional flexibility to consider scenarios brought about through uncertainty. A potential approach may involve developing a number of potential responses (including related costs and prices) to various climate change scenarios as part of the regulatory review process, with a view to activating these responses within the regulatory period if required.

In some cases the most effective climate change adaptation measures for a water business or piece of infrastructure will be non-structural, and may include changes to environmental standards or levels of service. Regulators will need to be flexible in their frameworks to accommodate potential changes.

Risk management is considered by WSAA to be an important component of effective climate change adaptation. Climate change adaptation decision-making methodologies should primarily be based on a risk management framework. WSAA also suggest the requirement for risk reduction strategies including Business Continuity Planning be mandated for communities and businesses, and governments could consider offering a tax incentive for implementation.

Building codes and regulation of infrastructure can also help with adaptation if they are enlightened by forward thinking and a full life cycle approach. WSAA recommend the expansion of the predominant focus of the standards in the Building Code of Australia from life safety to property protection.

Government roles and responsibilities

As identified in Section 3 there are barriers to climate change adaptation as a result of unclear roles and responsibilities of governments and inconsistent policies for responding to climate change adaptation. Clarity on where federal, state and local governments have a responsibility for climate change adaptation, and or the information pertaining to climate change impacts is needed. In addition, the expectations of governments and the community on the roles and responsibilities for water utilities and their regulators requires clarification.

As previously discussed existing inconsistency in climate change policies and allowances across sectors and within businesses may leave utilities open to scrutiny, over or under investment. A review of the research and information that is currently available to federal, state and local governments is needed, and information should be then made freely available and centrally located for easy access. Climate related information has been generic to date and needs to move from the qualitative to the quantitative. There seems to be an endless amount of science and research being produced however there is a desperate need to link the research with the end users needs to facilitate informed adaptation approaches.

Governments should also provide advice on the links between adaptation and mitigation. Care must be taken to avoid maladaptation, or adaptation actions which create significant carbon emissions and therefore undermine mitigation efforts.

Key conclusions and recommendations

- Consistent information and guidance from governments on climate change impacts and appropriate methodologies for climate change quantification and climate change adaptation is essential for effective adaptation.
- Infrastructure owners need support in determining the adequate value for their properties and assets for insurance purposes.
- Clarity is required regarding the process, ownership and timelines for updates to design standards.
- To ensure the water industry is well placed to adapt to climate change the framework for economic regulation needs to ensure prices are set taking into account adaptation measures.
- In some cases the most effective climate change adaptation measures for a water business or piece of infrastructure will be non-structural, and may include changes to environmental standards or levels of service. Regulators will need to be flexible in their frameworks to accommodate potential changes.
- A review of existing climate change data available to federal, state and local governments is needed, and information should be then made freely available and centrally located for easy access.

5. Setting priorities for reform

This chapter focuses on WSAA's response to the Commission's questions on the following issues:

- criteria for assessing reforms
- priority reform options

Reform assessment

WSAA accepts the Commission's proposal to use the three primary determinants of likely benefits of reform as the criteria for assessing reforms to reduce barriers to adaptation:

- depth of reform
- breadth of reform
- cost of reform

Priority reform options

WSAA and its members consider the following reform options priorities:

A coordinated response to climate change

Climate change adaptation is likely to be most effective with a coordinated response from governments. Currently, there is no forum to consider the collective cost of climate change on society across all sectors to ensure least cost adaptation response. WSAA proposes water utilities should be included in any such forum or coordination mechanism.

In addition, a coordinated approach to assess risks, assign responsibility and action to address cross-organisational and cross-sectoral risks for network infrastructure is required.

Revision to regulatory frameworks to consider climate change impacts and adaptation responses

As regulated authorities, water utilities must select climate change adaptation responses that are cost effective, defensible and representative of sound investment. Regulators need flexible frameworks to consider adaptation to climate change.

This may include price setting which takes into account adaptation measures, and the ability to implement non-structural adaptation measures including changes to environmental standards or levels of service.

Access to complete and consistent data

A review of the research and information that is currently available to federal, state and local governments is needed, and information should be then made freely available and centrally located for easy access.

Clarification of the roles and responsibilities of governments

There needs to be clarification of roles and responsibilities for all levels of government with respect to climate change adaptation. Governments should ensure service providers, regulators, private

businesses and other parties have clear objectives and accountabilities for responding to climate change adaptation which align with specified roles, functions, resourcing, and funding.

Consistent policies, methodologies and design standards

Consistency is needed in the development of policies, methodologies and design standards for responding to climate change. A primarily risk based methodology for climate change adaptation should be introduced to enable effective climate change adaptation responses.

Support to infrastructure owners in determining adequate value for insurance purposes

Government support is required for infrastructure owners to determine the adequate insured value of their properties and assets for insurance purposes.

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