IWA Cities of the Future Program

Spatial Planning and Institutional Reform Conclusions from the World Water Congress, September 2010

By Peter Binney, Alieta Donald, Vicki Elmer, Jamie Ewert, Owen Phillis, Rob Skinner and Ross Young.

1. Overview

The world is becoming increasingly urbanised with more of the population residing and working in cities. While increasing urbanisation and economic growth can provide significant community benefits they also present a range of challenges.

At the same time as resource use is escalating, climate change effects will mean that fresh water is scarcer in many cities, waterways are more stressed and flood risks are greater in the future.

In response there is a growing aspiration to ensure cities reduce their ecological footprint in order to become more sustainable, and to improve their structure and function to make them more liveable.

Climate changes also mean that the design of cities must build in structural and institutional resilience to further shocks. A key means of mitigating climate change shocks is to ensure that all of the potential sources of water in a city are incorporated in the urban water cycle.

For the water sector, this means integrating existing centralised systems with new sources of decentralised water management systems, and continuing to push the traditional boundaries of water and sewage management into the areas of water use efficiency and urban design.

From the perspective of spatial planning and institutional reform, the key to realising the aspiration of Cities of the Future will be the expansion of collaboration of the water sector to include those responsible for all facets of city planning, infrastructure and service delivery.

Historically the water sector has only had a limited influence on decisions that affect the shape and density of cities. Most commonly these decisions have considered the delivery of water infrastructure and services late in the planning process or have added these services incrementally as cities expand.

A Cities of the Future approach employs a new strategy where the delivery of all urban infrastructure and services are planned through a partnership approach between urban planners, the water sector and other sectors together to meet sustainability and liveability objectives set by the community.

Recognising that current institutional arrangements have limitations when it comes to addressing these issues, this paper describes a collaborative method to improve city planning, presents a series of principles and tools that can be considered for this planning, and offers a series of strategic actions that can be considered in implementing this approach.

It is recognised that different city, state and national cultures will influence the way in which urban planning decisions are made. This paper draws largely on experience in Australia. For those places which have different cultures and water management pressures, the reader must interpret the recommendations contained in this paper from their own perspective.

Table of Contents

Authors

This paper has been prepared by the Spatial Planning and Institutional Reform Working Group of the IWA's Cities of the Future Program. The working group comprises Peter Binney[1], Alieta Donald[2], Vicki Elmer[3], Jamie Ewert[2], Owen Phillis[2], Rob Skinner[2] (Chair) and Ross Young[4].

[1] Kiwone Sustainable Solutions
[2] Melbourne Water Corporation
[3] University of California
[4] Water Services Association of Australia

2. Background

The IWA Cities of the Future Program

Cities around the world face different challenges. For example, some cities face the challenges of rapid population growth and ethnic diversity; some face the challenge of declining prosperity; and others are facing the changes wrought by the effects of a changing climate.

A city will be successful if it can manage its challenges and seize its opportunities in such a way that it reduces its ecological footprint while simultaneously improving its liveability and its resilience to the shocks of future climate change or population growth. The management of water in the city is critical in this process.

The IWA will lead in this field by convening and stimulating discussion and action around these important topics in the area of water and sanitation services, and with other planning agencies.

The overall objective of the IWA Cities of the Future program is to:

> *Recognise that water, and its interactions with other urban sectors (e.g. energy, transportation, etc), is a central focus in the development and redevelopment of urban areas in the developed and less developed world.*

The more specific objective for the next five years is to:

> *Encourage urban water managers to systematically collaborate with other professionals and the local community to redesign water management systems integral with other city services in order to deliver sustainable water services but at the same time to enhance life both within and beyond the urban environment.*

The Spatial Planning and Institutional Reform Group

Water authorities have a significant control over a large range of water resource planning and management issues. However, within their current powers and governance arrangements, water authorities have difficulty influencing urban planning policies or regulations which predetermine the effectiveness and nature of water use and city sustainability.

The aim of the Spatial Planning and Institutional Reform Group is to:

> *Develop ways in which water authorities can engage with and influence the full range of organisations and stakeholders who determine the social, economic and environmental shape and condition of cities – to achieve sustainable and water sensitive outcomes.*

3. The Challenges of Integrating Spatial and Water Planning

The challenges of integrating water and spatial planning in a City of the Future are numerous, and will vary between cities and countries. Nonetheless several higher order challenges can be identified that cross jurisdictions.

The challenge of creating a driver for change

Those cities that have faced climate induced water scarcity, severe heat waves, population pressures or public health threats will find it relatively easy to illustrate to policy makers and the public that change is necessary. But even if cities have not had to address the challenges of climate change there are still significant risks to a city's liveability associated with population growth.

For this reason the Cities of the Future debate is about broad definition of sustainability.

The challenge of recognising the changing values of water services

Water services around the world are expanding from the traditional water and sanitation services into broader fields linked with the improvement of liveability in cities. For example, dry conditions experienced in Australia over the past decade have highlighted the important role that water plays in the urban landscape beyond the traditional functions of water supply and sanitation. Examples of this include the role of water in providing green open spaces to encourage active lifestyles and social connection, and helping to cool cities during hot summers.

The challenge of institutional divides

Water and urban planning have traditionally been delivered independently. The water sector provides a specific service to cities, and is one of many essential services considered by urban planners. There is a need for the urban planning and water sectors to work together to incorporate the increasingly complex water management objectives into urban development decisions.

The challenge of the bottom line

Traditional pricing regimes tend to encourage short term, least cost provision of traditional water sources. This can run counter to "sustainability objectives" as it does not capture the full range of social, public health and environmental externalities, and whole of life cycle costs of water management.

The challenge for the water sector is to develop investment evaluation and pricing models that capture total costs, while at the same time provide affordable services to the community.

The challenge of making it happen

Finally, the water sector faces the challenge of influencing urban planning decisions at an early stage in central, regional and local governments. The skills required for the urban water industry to be a successful advocate in these forums include social, economic and regulatory capabilities and, most importantly, collaborative influencing skills.

A framework to address these challenges

This paper presents a framework to address these challenges. This framework is summarised below (Figure 1) and is discussed in the following sections.

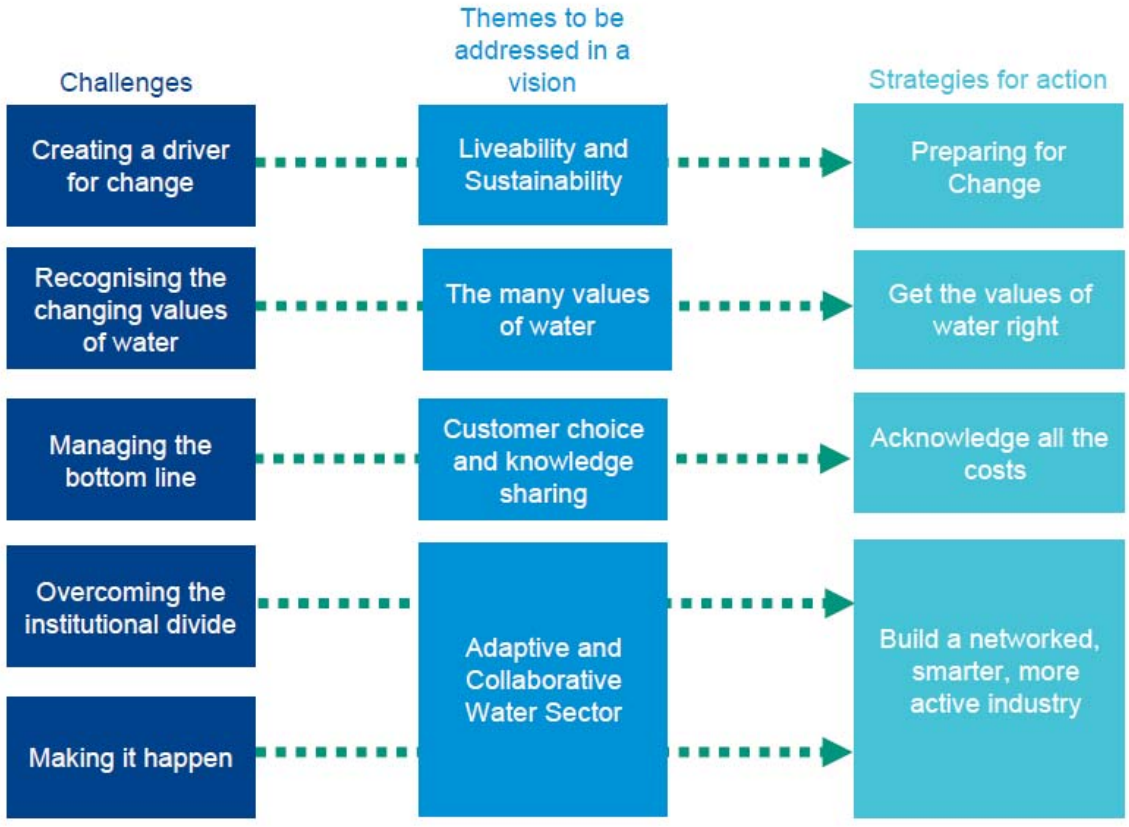

Figure 1 – The relationship between the challenges, vision for a City of the Future and strategy actions proposed in this discussion paper.

The particular challenges for cities in developing nations

The United Nations Population Fund has projected that the urban population of Africa and Asia will double between 2005 and 2030. Urban population growth in areas of developing nations that are transforming from towns into cities will face infrastructure and institutional challenges, and will need to meet them with fewer resources than developed nations.

4. Overcoming the Challenges through a Shared Vision

One path to better integrate spatial and water planning is to establish a common vision of a City of the Future in which the challenges that have been outlined are addressed in an integrated way across these sectors.

A shared vision can be developed by facilitating an interactive discussion between the many sectors that are, in isolation, developing their own visions for a City of the Future.

This discussion will allow the water sector to engage those sectors that shape city form (urban planning, transport), supply utility services to a city (energy and telecommunications) and support citizens (education and health). More broadly it can also include industry, agriculture and cross sections of the city community which have an active interest in urban sustainability.

The aim of this process is to develop a common language for sustainability and to create networks across these sectors.

By way of example, the IWA Spatial Planning and Institutional Reform Working Group initiated a series of Cities of the Future workshops in Australia to develop a shared vision of a 'water sensitive Australian city'.

The first workshop, held in conjunction with Australian Water Association's annual 'OzWater' conference in Brisbane, Australia in March 2010, attracted over 150 water professionals, urban planners, economists, municipal government representatives and researchers.

The process yielded a set of Principles which are key to a City of the Future (Figure 2). These Principles encourage consideration of the different values of water in a city and its connections with the community, science and policy making. They can be prioritised and interpreted in a local context to derive a vision for a specific city.

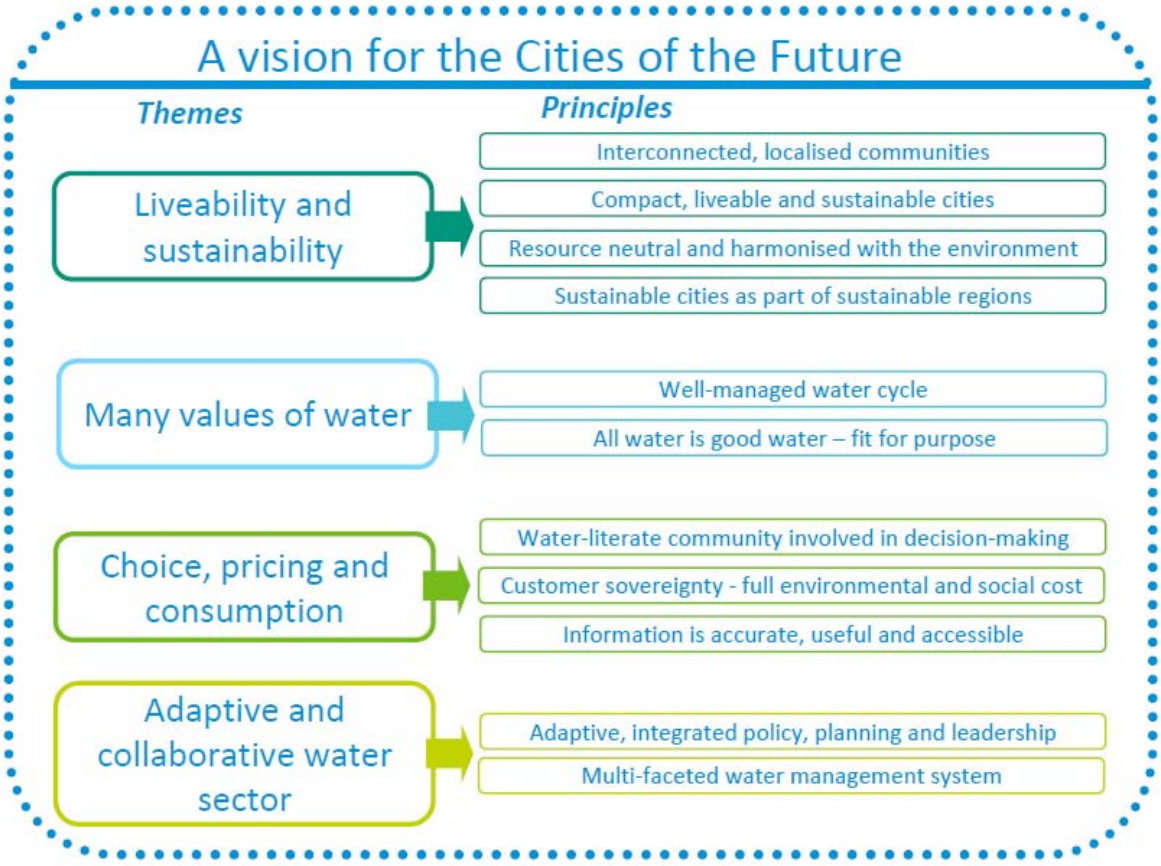

Figure 2 Principles for a City of the Future

A second workshop was held in Melbourne, Australia in July 2010 at the Australian Water Association and Waste Management Association of Australia's 'Enviro 2010' conference. It tested the practicalities of the vision produced in the first workshop with a new audience of 100 environmental practitioners. It also developed actions to apply the Principles.

The discussions held at the IWA World Water Congress in Montreal in September 2010 have allowed water industry representatives from many other countries to further evaluate and contribute to these Principles and actions.

5. Principles for a City of the Future

Theme 1 – Liveable and Sustainable Cities

Principle 1: Cities will continue to grow in population but will be increasingly liveable. A feature of cities will be more interconnected communities.

Cities are complex, dynamic systems that are likely to become more complex over time. Cities will continue to offer lifestyles – jobs, cultural attractions, recreation and sporting attractions – that will attract people in abundance. Principle 1 recognises that people value a liveable city that provides the amenity and space to maintain local connections and healthy communities.

Principle 2: Cities of the Future will provide access to safe drinking water and sanitation for all.

The United Nations Development Programme estimates that currently almost 1 billion people lack clean drinking water, 2.4 billion people have no access to hygienic sanitation facilities and 1.2 billion lack any sanitation facilities at all. Although people in developing nations count for most of these statistics, there are sections of the population in developed nations who also lack these basic services. While the technologies exist for providing low cost water and wastewater services, effective water governance is the missing link to achieving more equitable water resource management and service delivery.

Principle 3: Sustainable cities will combine a compact footprint with sustainability and liveability.

Sustainable Cities of the Future will become more sustainable and liveable by matching higher density living with ‘green urban design’ and by linking spaces to provide the ability to easily connect with other parts of the city. Lower density living will also be available within the city to provide a range of living options.

More water sensitive cities will be greener and therefore cooler. With lower 'urban heat island' effects (the tendency of urban areas to be hotter than their more vegetated surroundings), these cities will be healthier places to live in.

Principle 4: Cities will be resource neutral or generative, combining infrastructure and building design which will harmonise with the broader environment.

The urban form will generate water, energy and nutrient by-products that can meet the city's resource demands in a way which is carbon neutral.

Some cities may generate resources in excess of their needs and be able to supply demands in surrounding regions.

Cities will also be designed to operate in harmony with the broader environment. For example, cities will release water to the environment consistent with natural environmental flow patterns.

Principle 5: Sustainable cities will be part of prosperous, diverse and sustainable regions.

Cities will not function as isolated entities. Instead cities will function in harmony with their regional partners, respecting 'local identity' and valuing the flow of resources, people and information between the two.

Cities themselves will enjoy prosperous economies built upon sustainable communities, and its citizens will act to bring out the best in themselves and their surrounding regions.

Suggested actions to progress theme 1

1. Clarify the vision, definitions and measures of a sustainable city.
2. Develop a city wide urban planning framework and provide planning that clearly establishes minimum liveability objectives and standards.
3. Ensure that integrated planning includes city and regional stakeholders and provides outcomes for these regions as well as waterways and the environment.
4. Establish a comprehensive evaluation framework to assess planning options based on full lifecycle sustainability assessment. Include in this a common understanding of carbon neutrality and prepare guidelines for planners.
5. Develop resource accounts of the city's assets, resources, open spaces and biodiversity based on the principles of "urban metabolism". To enable this, develop the tools and mechanisms to collate the necessary data.

6. Develop a preferred model for the density of cities that improves sustainability and provides liveability.
7. Utilise information (analytical and experimental) and demonstration projects to showcase improvements in regulation and the vision of what a more sustainable City of the Future looks like.

Theme 2 – The many values of water

Principle 6: Sustainable cities will be served by a well-managed water cycle that – in addition to public health and water security – provides for healthy waterways, open spaces and a green city.

Water will be managed across the water cycle and watershed to deliver economic and social value for the community, and to protect and enhance environmental values and biodiversity.

Principle 7: Sustainable cities will recognise that all water is good water – based on the concept of 'fit-for-purpose' use.

It will be recognised that water has many different values and 'fit for purpose' uses. All water comprising the urban water cycle (including stormwater and wastewater) will be highly valued and managed to deliver optimal environmental and social outcomes.

Suggested actions to progress theme 2

1. Clarify the definitions and principles of integrated water management.
2. Establish a comprehensive evaluation framework to assess water management options (including centralised, decentralised, water efficiency, market based and water sensitive urban design options).
3. Clarify roles and responsibilities for integrated water management.
4. Establish, identify and evaluate a portfolio of fit for purpose water services. Develop consistent standards for use of these various sources of water.
5. Increase diversity of water sources to build resilience to climate change shocks. In doing so, investigate new sources within the city itself based on water sensitive urban design principles that create potential resources by restoring a more natural urban water cycle.
6. Develop a management framework covering risks, planning and decision making for delivering an integrated water management portfolio.
7. Expand pricing regulation emphasis from production and efficiency to also include sustainability and liveability. Broaden the definition of "least cost" assessment to "life cycle" assessment. Take full account of externalities.

8. Review urban planning provisions to ensure they create opportunities for new water sensitive urban design and green city features. If necessary undertake rezoning and/or land buy-back programs to achieve these objectives.
9. Ensure that urban planning integrates objectives of multiple sectors, incorporates information from all components of the water cycle and shares systems across organisational boundaries.
10. Define property rights for non-traditional sources of water and remove barriers to the use of alternative water supplies.
11. Use targets or other means to maximise the ability of water infrastructure to provide multiple community benefits and to improve city sustainability.
12. Utilise the water sector's technical expertise to define and communicate with the community on the concept of 'fit for purpose' water based on different water qualities.

Theme 3 – Community Choice and Knowledge Sharing

Principle 8: Cities will be served by informed, engaged citizenry and multi scale governance that enables local community choice.

Communities place greater value on their resources where they have greater control over them. On this basis, water will be valued and utilised best when its users are informed and able to exercise appropriate levels of local choice.

Communities will choose the future of their cities and the way that they live in these spaces. They will choose the pathways that they take to get to reach these goals.

Principle 9: Customer sovereignty with full environmental and social cost.

Citizens – as customers and developers – will be able to pursue their individual choices whilst ensuring sustainable outcomes by bearing the full environmental and social cost of those choices.

Being fully informed and bearing the full costs of their decisions will prompt businesses and individuals to demand efficiency and affordability in the actions that shape water consumption (e.g. water sensitive urban design in the case of builders and developers, recycled water systems, water efficient appliances). This also should apply to water imported or exported from a region embedded within products and produce.

Citizens will have a well developed sustainability ethic that informs all of their decisions. This will be backed up with appropriate tariffs, transfers and taxes that encourage good behaviour. Proper alignment of economic incentives and environmental regulation is essential for creating water sensitive cities.

Principle 10: Accurate and useful information, including smart metering.

Informed citizen choice depends upon full knowledge of the resources available, the potential benefits of different options and the evaluation of on-going performance.

Cities will draw more fully on intelligent information and management systems across a full range of networks, including smart water system design to provide information to system managers and users. These systems will synthesise data from across the water cycle and share it across utilities and customers to inform decision making.

Suggested actions to progress theme 3

1. Provide customer and industry-focused information on the economic, social and environmental costs associated with different water supply choices.
2. Develop a local resource and utilities atlas to communicate to customers.
3. Build a sense of urgency for change to more sustainable urban form.
4. Develop pricing principles that cost externalities (including nutrients and energy) to support the different values of various water sources.
5. Create a water pricing strategy that is flexible and adaptive, linked to the availability of the resource.
6. Continue to build on community and stakeholder trust in the water sector (particularly surrounding the use of recycled water) by delivering clear and reliable advice on alternative water sources.
7. Engage with customers to understand their needs for intelligent networks and smart meters. Explore the opportunities they present.
8. Establish minimum standards for water using appliances and provide customers with information to enable continued efficient water use.
9. Investigate the potential to further develop water markets that might eventually provide greater choice for consumers.

Theme 4 – Adaptive and collaborative water sector

Principle 11: Sustainable cities will be served by adaptive and integrated approaches to urban development.

Sustainable Cities of the Future will be realised when the sectors that supply services to cities work more closely with governments, planners, businesses and the community from the first stages of urban planning.

Given the linkages between water, city shape and design and energy consumption, a transformation in these and other sectors to more integrated planning will underpin the development of resilient cities in the future. This integration will occur at all scales of planning.

Principle 12 Sustainable cities will be served by a multi-faceted water management system.

The water sector will become more diverse and dynamic, drawing on integrated solutions within the water sector, across sectors and including government and the community.

The transition of the last two decades in Australia from vertically integrated (dam-to-disposal) monopolies to a range of integrated water solution providers will continue in response to the needs of customers. Some water providers may diversify to become multiple utility providers. Others may become total water cycle providers, and others still may enter the sector to provide a mix of public and private service providers.

Suggested actions to progress theme 4

1. Better define the respective role of government and the private sector in the provision of water services – for example planning and policy versus service delivery decision-making.
2. Continuously review the best ways to engage local communities and the development industry in planning and decision making.
3. Develop a metropolitan integrated management plan that has objectives and outcomes across multiple sectors.

4. Identify any unnecessary financial and regulatory barriers that might restrict competition in the water sector.
5. Build the capacity of the community, industry and government to make informed choices that test, prove, demonstrate and deliver integrated water management.
6. Identify information needs across the water cycle and collaborate and share knowledge between water authorities.
7. Develop the mechanisms to identify the risks of integrated water options and ways to mitigate them.
8. Adopt integrated urban and water planning processes to provide sustainable outcomes for cities and rural areas. To achieve this, include regional stakeholders in planning processes.

6. Strategies for Delivering the Principles

The Australian Cities of the Future workshops identified several strategies necessary to achieve a City of the Future.

Strategy 1 - Preparing for change

Achieving a sustainable city outcome requires a clear community mandate and a clear leadership response. This set of strategic actions aims to engage the community and to develop clear leadership on sustainability.

1.1 Understand community aspirations

Engage city citizens and businesses to establish their aspirations for their city. This engagement campaign will need to be carefully structured to listen to and shape perspectives of citizens in their dual roles of customers and community members, and to ultimately determine "what they want". It will also need to be sensitive to difference expectations and lifestyle preferences.

Examples:

- As a water utility that supplies the majority of South Australia with water and wastewater services, SA Water develops long term plans for regions across the state that looks towards a 25 year planning horizon. Central to this process is stakeholder engagement that gathers feedback from the community on their views of how the system is operating and how they see the system operating in the future.

- In 2006, Melbourne Water Corporation was appointed waterway manager for 8400 km of waterways in Melbourne, Australia. Many of these waterways had no existing waterway manager. Melbourne Water undertook an extensive "Making Connections" campaign to engage with local communities and to determine their expectations for this new service.

1.2 Make it tangible – what can a City of the Future look like?

An engagement campaign will need to articulate what a more sustainable city looks like. Question such as – *Who wants what (young singles, family units and older individuals all have different lifestyle preferences)? What will it look like? What are the benefits? How big will these benefits be?* – will need to be answered. Demonstration projects can provide these answers at a range of scales and be used to evaluate community receptiveness to these new approaches.

Examples:

- Barangaroo in Sydney Australia, is a leadership example for waterfront urban renewal and the role governments can play in delivering sustainability. The 22-hectare industrial site will become water positive, generate zero waste and achieve carbon neutrality by generating more renewable energy than it uses.

- The SWITCH program is an international research and capacity building program co-funded by the European Union and 33 international partners. It is based on a community of practice model that aims to develop and demonstrate more sustainable urban water practices on a global scale using demonstration cities as practical case studies.

- VicUrban is the State Government's land development agency in Victoria, Australia. The '6 Star' homes in its Aurora housing development have been rated using an Ecological Footprint technique. By using recycled water for toilet, garden and outdoor watering uses, as well as rainwater for hot water supplies, water consumption has been reduced by 45% compared with a 5 Star development. Energy use has also been reduced by 60% by using evaporative cooling and solar hot water systems. The development also reduces residents' transport footprint by 11% by encouraging pedestrian and bicycle travel and employing higher housing densities.

1.3 Create a sense of urgency for change

Climate change and a growing population are very real challenges to city water security and liveability. This drives a sense of urgency to call for change in water management.

A similar sense of urgency is required for change in urban development, as 'business as usual' development approaches in expanding or contracting cities will not provide a sustainable outcome.

While a mandate for change cannot be manufactured, it is possible to initiate public debate on the topic via a community engagement campaign. The community needs to be more "water literate" with a better understanding of the values of their local environment and the threats to them. These principles should be delivered by community leaders and the water industry, as well as highlighting the threats to city liveability beyond water issues, to build further momentum to demand change.

Example:

- The Council of Australian Governments (COAG) is the peak intergovernmental forum in Australia. COAG has established National criteria to ensure major cities have plans to manage population growth and address climate change and to ensure action is integrated across sectors. Each state is required to have plans in place by 2012 to access future infrastructure funding.

- In Western Australia, a full day 'dialogue' was held with 1500 community members to uncover sustainable ways to cater for the growth of the city of Perth. This 'dialogue' was a part of a year long *Network City* community planning process. The resulting Network City Action Plan makes recommendations on topics such as transport, city liveability and the environment.

1.4 Respond with Government leadership and commitment

Government can establish a whole-of-government leadership team to bring different sectors together to respond to a community mandate for change. This team can work with a full range of stakeholders to establish a vision for the city and a narrative that explains the links between the different sectors and the specific challenges the city is facing.

Example:

- In Melbourne, Australia, a High Level Steering Committee on Water Sensitive Cities exists to allow the heads of the various planning agencies and water utilities to collaborate on principles and programs.

Strategy 2 - Get the values of water right

Urban water systems have historically been managed to minimise risk to public health and provide water security. There is increasing recognition that the true value of water is wider than this. Understanding these values is a pivotal step in building a City of the Future. This set of actions seeks to understand and quantify the values of water to inform the choices we make.

2.1 Understand and quantify the multiple values of water

Engage with communities to understand the multiple values of water beyond its commodity value. These could include values associated with healthy waterways, cooler cities, green open spaces and choice in water services. Where possible these values should be valued economically so that they can be incorporated into business models and pricing structures.

Example:

- These values are well illustrated in Seoul, South Korea, where the Cheonggyecheon waterway restoration project saw the replacement of a large freeway with a restored river channel and the welcome return of waterway flora and fauna to the city. These new green open spaces are helping to drive local economic activity in the city.

2.2 Reflect these values in government obligations

Government can review the formal requirements of water utilities and urban planning authorities to ensure they include a clear mandate for sustainability and liveability as described by city citizens. These obligations should reflect the values identified in 2.1.

Example:

- Melbourne Water Corporation in Australia is responsible for bulk water supply, sewerage treatment, stormwater management and waterway management. It has a Statement of Obligations from the Victorian Government that requires the formation of a Waterways Advisory Committee to harness the views of community stakeholders in its strategic business planning.

Strategy 3 – Acknowledge all costs

Once the full range of costs and benefits have been identified and quantified, it will be necessary to incorporate them into the decision making of individuals, communities, private enterprise, utilities and governments.

3.1 Triple bottom line decision making

Build water authority investment processes that recognise the multiple values of water and water infrastructure rather than simply providing least cost outcomes. This may include using multi-criteria (triple bottom line) and 'least community cost' decision making models to ensure that all economic, social and environmental factors are considered in a whole of life assessment framework.

Examples:

- Yarra Valley Water, a retail water company in Melbourne, Australia, has adopted a business strategy to provide its services within the carrying capacity of nature. This means it makes all business decisions using a 'least community cost' model that considers broader community outcomes from these decisions.

- The Water Services Association of Australia is the peak body of the Australian urban water industry. It developed a Sustainability Framework that proposes a triple bottom line process for the urban water sector. This framework forms the basis of triple bottom line approaches currently in place in major water authorities including Sydney Water, Gold Coast Water (Queensland), Water Corporation (Western Australia) and Melbourne Water.

3.2 Responsive services that give citizens choice

Water businesses can offer products and services that are responsive to the wide range of priorities and preferences expressed by customers and community. Water businesses can also ensure that customers have easy access to useful information to inform their choices.

Examples:

- The Australian Water Efficiency Labeling and Standards (WELS) Scheme labels a range of domestic appliances for water efficiency, helping consumers to save water and money. The label on each appliance shows the water consumption per use (whitegoods, sanitary ware) or the water flow per minute (plumbing products) based on laboratory tests. By 2021 this will save more than 800,000 megalitres of water and reduce greenhouse gas output by 400,000 tonnes each year.

- The Sandhurst Club, in the south-east of Melbourne, Australia, offers premium residential options as a part a master-planned club community. Over half the development is dedicated to open space maintained with recycled water. This makes Sandhurst a drought free alternative to other developments that are subject to the outdoor watering restrictions that have applied in Melbourne over the past decade.

3.3 Set the right prices to inform consumption choices

Government can ensure the price of water incorporates the externalities associated with water supply such as energy costs, deferred treatment costs and social impacts. If water is priced this way, customers will have a price signal that reflects the scarcity of this critical resource.

Independent economic regulation of the water sector is being implemented across Australia to ensure that the full cost of water services are past onto customers. Similar reforms are underway in the European Union.

Example:

- In Melbourne, Australia, a surrogate value for the environment has been developed by placing a value on the nitrogen that is discharged from the city into Port Phillip Bay. This value is charged to developers if they generate additional stormwater runoff through new urban development. The funds are used to construct regional wetlands to treat these discharges. This creates an incentive to adopt water sensitive urban design to minimise stormwater runoff from their developments in the first place.

Strategy 4 – Build a networked, smarter, more active industry

The actions below will provide clear leadership on sustainability and help to reduce the ecological footprint of the services provided to a city. Doing so may generate opportunities for the private sector to play a more active role. Other opportunities will deliver smarter, more efficient and affordable services to cities.

Investing in research and actively seeking opportunities to make this 'business as usual' will drive continuous improvement.

4.1 Defining 'neutrality' and 'sustainability' – what are they?

Reducing the city footprint requires each sector to make a contribution to making the city water, energy and nutrient neutral. To do this, set a clear target to establish how this neutrality is defined and measured, and the boundary conditions of the 'city'.

Examples:

- Several major European cities, such The Hague, in the Netherlands, have established goals to be carbon neutral within a nominated time.

- Similarly, most Australian water utilities have committed to significant reductions in their greenhouse gas emissions. Sydney Water, in New South Wales, aims to become carbon neutral for electricity and energy consumption by 2020 by self-generating 20 percent of its electricity demand from renewable sources, internal energy efficiency, customer programs and purchase of carbon offsets. Melbourne Water, a Victoria utility, set and achieved targets for a 35% reduction in green house gas emissions and 40% renewable energy use. New targets have been set for zero net greenhouse gas emissions and 100% renewable energy used by 2018.

4.2 Develop city wide resource budgets

Develop a city wide resource budget that summarises the available water, energy and nutrient resources across the water supply, sewerage, stormwater and waterways elements of the water cycle. This stocktake can also identify the city's water-dependant social and environmental assets such as biodiversity, ecological services and green open spaces. This budget will highlight ways to better integrate the different systems and reduce the city footprint.

Example:

- South East Water, one of the three retail water companies in Melbourne, Australia has initiated an integrated water management strategy for a watershed that is home to 1.3 million people. This strategy will include an atlas of non-traditional water sources such as recycled water and stormwater in the region, and link this to potential industrial, agricultural and development uses.

4.3 Develop a city wide, integrated plan

Develop a plan that integrates the management of all parts of the water cycle with urban planning and relevant activities in other sectors. The aim of this plan is to integrate delivery of sustainability actions at a city wide scale to improve city liveability and resilience to climate change.

The plan should provide clear responsibilities for each component of the water cycle at a range of scales. At the Government level, planning will establish city wide objectives and provide leadership. Local level planning can then empower customers to make local choices. Integrated water management planning should also be extended to the surrounding region and neighbouring cities.

Examples:

- Rotterdam, in the Netherlands, has identified climate change as a significant risk to the city's economic future. In response the Rotterdam Climate Initiative has been developed. It proposes tackling the issues of climate change risk and economic prosperity by improving city liveability through better urban water management. The plans even propose floating cities within the Rotterdam harbour to combat the climate change risks of flooding.

4.4 Set urban planning regulations to require water objectives to be included in development from the outset.

The delivery of water services is rarely a primary consideration in urban planning decisions. As a result, opportunities to use the built form to reduce the footprint of water services can be missed.

Planning provisions, regulations and strategies at state, regional/municipal and lot scales can be developed to require water management objectives to be integrated from the outset into all urban development and redevelopment.

Example:

- In Victoria, Australia, Clause 56 of the Victorian Planning Provisions establishes integrated water management requirements for all residential subdivision proposals in urban areas. It achieves this by requiring the provision of water sensitive urban design systems on all individual lots. Recycled water systems are also required in areas where the water authority requires a dual reticulation system to be in place.

- All new houses and apartments in New South Wales, Australia are required to comply with the Building and Sustainability Index (BASIX) planning system. This ensures homes are designed to use less drinking water and be responsible for fewer greenhouse gas emissions by setting water and energy reduction targets. Targets can be met by installing rainwater tanks, water-saving fixtures, energy-efficient lighting or improved insulation.

4.5 Encourage innovation risk through pilot projects

Utilities adopt innovation risk through pilot projects that enable new technologies to be tested and evaluated in a managed way. It is important to evaluate these pilots and use them to demonstrate new possibilities to the community. It is essential that evaluation includes business case findings and public acceptance as well as considering technological results.

Examples:

- "Smart" metering technology provides real time information on resource usage. In combination with education campaigns and pricing signals it can help encourage water conservation. This technology is being successfully used in places like New York City and California to provide consumption data to customers via the web. Some European hotels have taken this further to show water consumption within showers and some buildings in the United States even show real time water and energy consumption.

- In New South Wales, Australia, the energy provider Energy Australia has partnered with Hunter Water and Sydney Water to trial smart metering technology in the cities of Newcastle and Sydney (respectively). This *Smart Grid, Smart City* demonstration trial will explore the benefits of smart metering technology in water and energy use.

- City West Water, in Melbourne, Australia, is managing the West Werribee Dual Supply project to deliver highly treated recycled water to 19,200 householders and other users. This will save 3.1 billion litres of drinking water each year. Plans are already in place to expand this scheme, including a trial of aquifer storage and recovery technology to store treated recycled water in under ground aquifers during winter in order to meet summer demands.

7. Research to Support these Strategies

The Australian Cities of the Future workshops highlighted the need for policy and planning to be based on good science and collaboration. Recognising this, the following research questions have been drawn from the actions above.

What are the benefits of Sustainable Cities?

In particular, we need to quantify the full range of social, economic and environmental benefits of a more sustainable city. "Liveability" needs to be clearly defined and quantified. The benefits may include the ecological health (biodiversity, healthy waterways), public health (improved sanitation, less pollution and cooler cities), resilience (including water security) and economic benefits.

What do customers and communities want for their cities?

What is the community's aspiration for the city in terms of sustainability and liveability? What are the aspirations of citizens as water consumers and businesses as service providers? If there are differences in these perspectives, can we identify the common values and propose strategies to reconcile the differences in decision making?

What are the different values of water?

In a City of the Future, water will be used for more than just drinking or transporting wastes. It will also provide a boarder range of social, economic and environmental outcomes. Decision making will be informed by better understanding of the ways in which water contributes to liveability in a city, and how the social values of water associated with this can be measured, quantified and included in triple bottom line assessments. Research in this area will utilise community values of water to redefine "least cost" provision of water services.

How can water management and urban planning agencies deliver more integrated outcomes?

The integration of spatial planning and water management functions is a vital element in the transition to a sustainable city. What are the relative roles of each sector in delivering integrated, sustainable outcomes? How can water authorities, urban planning agencies and other sectors be structured to enable the integration of these roles? Can alternate industry structures provide better integration? What is the right balance between regulation and market instruments?

How can technology reduce the footprint of water services?

Where are the opportunities to harvest, dispose, treat, store or use water in a city more efficiently? How can we utilise the water, energy and nutrients generated within a city? Some cities will need to find new ways to make existing water systems more efficient or more resilient to future shock. In other cities there will be opportunities to adopt innovative new technologies in expanding systems.

What is the relationship between urban density and water use?

Does densification of a city modify its water use? Where are the greatest water efficiency gains in moving to a denser urban form – in changes to the ownership and management of open space, within the home, more efficient distribution of water or other gains? How do these water efficiency improvements (if any) correlate with other sustainability improvements? Based on these results, what is the optimum density in a City of the Future?

How can externalities of water management decisions be more fully considered in urban development planning decisions?

What are the range of externalities of integrated urban and water management? Can an analytical framework based on the concept of urban metabolism provide guidance to understand these factors? Can we use this understanding as the basis for enhanced business case development? Can we develop a single framework approach for accounting for externalities in integrated urban planning processes?

Evaluate and demonstrate proof-of-concept of new approaches.

Undertake practical trials and demonstrations of the effectiveness of new approaches, such as modifying urban density or the benefits of decentralised water systems. Evaluate these trials to determine community acceptance and to understand the real cost of different technologies. Trial the application of smart metering technology for residential, community and industrial applications.

Gather international examples to demonstrate how each principle and action has already been delivered

There are many international examples of cities that are implementing the Principles or actions proposed in this paper. Generating international examples will add further credence to the Principles by demonstrating what success can look like. These case studies can also be evaluated to understand areas of success and failure that will inform local strategies.

8. Scenario Planning as a Further Strategy to Implement the Principles

When implementing the actions and strategies proposed in this paper it is important to acknowledge that historically much of our planning has tended to underestimate the rate and degree of change that can occur.

As a result we see broad evidence of planning falling behind actual conditions or having to react quickly when cities are forced to respond to severe or protracted changes in conditions.

Scenario planning tests the sensitivity of action plans to uncertain futures. It considers the likely external or internal influences within a city to see how these can interact to determine the future of that city. In this way scenario planning is a valuable additional strategy that can be applied during the implementation of action plans.

Scenario planning describes the social, political and infrastructure dimensions of a city along with its resource use and management. It also encourages qualitative consideration of how the interactions between these eventually define a city.

This information is then used to predict alternate future scenarios that might eventuate depending upon the relative strength of each dimension. Importantly, these scenarios are described as trends rather than point forecasts or prescriptive pathways. Describing the scenarios this way recognises that there is a cumulative effect arising from the planning decisions we make over time to modify approaches when unexpected challenges are encountered.

The power of scenario planning lies in debating the trajectories to the various future scenarios and allowing the insights from this to inform long term planning.

More specifically, the trajectories may highlight early indicators of the eventual outcomes. These indicators can then be employed in an adaptive management strategy to increase the likelihood of a desired outcome.

A recent example of this approach is the Melbourne Metropolitan Sewerage Strategy. The Strategy employed scenarios to describe global, national, state and city-wide events and trends in urban planning, spatial trends and institutional influence.

Two scenarios were developed through cross-disciplinary workshops involving a group of recognised experts similar to that used for the Australian Cities of the Future

workshops. The scenarios developed were entitled “We’ll be right” (effectively the business as usual approach to building our cities) and “Successful Adaptation” (where a more aggressive approach is taken to achieve a particular vision for building our cities). The Appendix provides the narrative descriptions of these scenarios.

When the two scenarios were combined with the Principles developed by the IWA Spatial and Institutional Planning Working Group, clear indicators of progress toward one future city or the other became apparent.

For instance, if a city’s transport system is becoming more efficient over time, and if citizens are becoming more water literate then the city, on these two Principles at least, is most likely moving toward a “successful adaptation” future. Conversely, if high value potable water is continuing to be used for all purposes, and if the water supply and sanitation systems remain monopolistic then the city is more likely to be on the track to the “we’ll be right” future (see Figure 3 below).

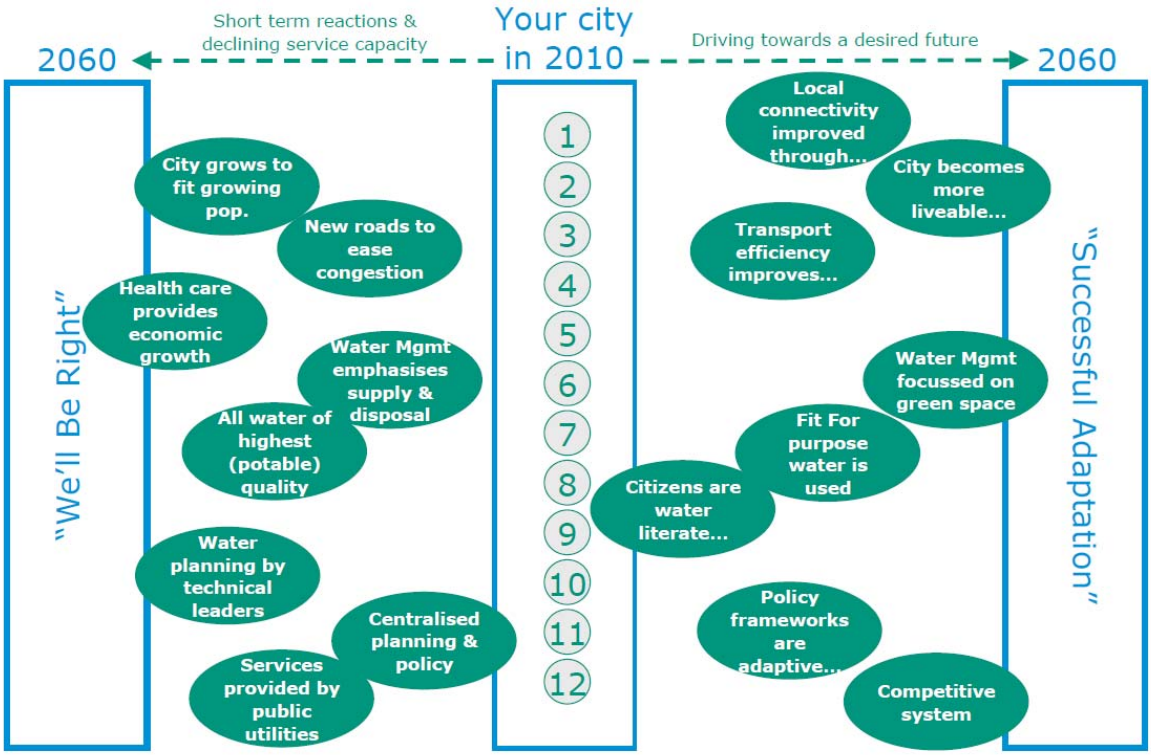

Figure 3 – A city’s trajectory towards the future can be assessed using the Principles as indicators. Trends indicate a movement towards each scenario.

This process helps to highlight the trends within a city and trajectory that it is on – is it moving towards the desired form of the city and if not, what do we need to do to get back on track?

From this assessment it is possible to develop strategies to influence the desired future by employing actions associated with clusters of indicators that are more aligned with the preferred scenario.

Scenario planning therefore provides a tool than can influence the development of a City of the Future by further describing what success looks like (or does not look like) and by guiding the decisions relating to how we will achieve this success.

9. Conclusion

Collaborative planning to deliver a shared vision for the city is a recommended approach to building a City Of The Future. This process will bring together planners from water, transport, health, employment, social services and other sectors.

This paper provides a set of Principles which can assist in the development of this shared vision. The visioning process and the resulting action strategies may benefit from a scenario planning approach. This describes alternate futures and the precursor conditions that can indicate trajectories towards one alternative or the other.

These scenarios can be used, along with the Principles for a Sustainable City of the Future, to develop adaptive action plans and chart courses of action that can respond iteratively and efficiently to the challenges that an uncertain future is likely to provide.

This approach of collaboration, visioning and development of shared action plans can be emulated in any city globally. It can offer a more efficient and action orientated response to the pressures on water resource management that come from an increasingly uncertain future of climate change and other shocks. A work plan of on-going actions to refine and extend this process has been suggested and should accompany local collaboration.

Appendix –Scenarios for 2060 from the Melbourne Metropolitan Sewerage Strategy

2060 Scenario 1 – "Successful Adaptation"

Australia has taken a leading global role in developing the industries that will generate wealth in the new millennium. These industries grew strongly given the community's desire to mitigate climate change and maintain our standards of living.

Unfortunately, while Australia acted on Climate Change early, many other countries did not. The Great Barrier Reef is greatly damaged, and the Murray Darling System is now unsuitable for traditional irrigation practices.

We saw a large shift in the urban profile of the city. Driven by resource price signals and the availability of cheap public transport, the general population has moved to apartments. Increasing intensification also occurred in the suburbs as subdivisions eliminated "backyards", with a greater emphasis now being placed on the cooling effect of local parks and public space.

The city's industry has changed dramatically with the rise of "eco-industries" which focus on climate adaptation. Most of the "traditional" industry has moved offshore to countries more tolerant of pollution and/or with the appropriate labour market.

Demand for water has grown slightly driven by rapid population growth despite considerable falls in per capita consumption. Efficient appliances are now commonplace and water prices now internalise all externalities.

Supply of water has changed significantly. Yields from dams are greatly reduced as a result of lower rainfall and periodic severe bushfire. A rising environmental consciousness prevents accessing more water from unhealthy river catchments.

New housing developments have extensive recycling and "waterless" developments are becoming attractive. The potable consumption of recycled water is quite acceptable and is preferred over desalination because of the lower "footprint" created by technological advancements. Discharges of water or nutrients is considered a wasteful option. There are a large number of water providers, both public and private, available to supply tailored solutions to suit local needs.

The community actively aims to improve the environment through their decisions. Stormwater management becomes commonplace and stormwater harvesting is used to offset potable water demands.

2060 Scenario 2 – "We'll Be Right"

The World moved to develop industries geared toward the new economy - characterised by high-tech manufacturing, environmental management and services. Unfortunately, Australia failed to succeed in the new economy. The historic manufacturing industries declined slowly as scale economics drove production to China and India. Without growth industries, total economic activity began to decline.

This decline drove workers overseas and discouraged high value migrants from coming to Australia. The nation begins to be dominated by low tech jobs.

Australia's cities grew as houses were built to house low-skilled migrants. These migrants sought "the good life" of big backyards, inefficient housing and historical consumption patterns. The city centre continued to grow in density as retired workers sought more convenient housing.

Demand for water has grown, driven by population growth despite limited falls in per capita consumption. Prices now reflect "scarcity" value however these prices do not reflect the true cost of water delivery as environmental costs and benefits are deliberately excluded from all pricing assessments. After initially decreasing in response to these price rises, residential use has stabilised and remains easily amongst the highest use per capita in the world. This trend in turn has seen a virtual cessation of innovation in water efficient appliances and practices. "Intelligent" systems are cheaper and more efficient than the traditional means of operation, but the willingness to employ such high up-front cost systems is lacking.

The supply of water remains traditional. The city is well supplied with potable water from its existing dams and desalination plants. The community is happy to install extra desalination plant capacity as droughts become longer and more severe. Stormwater is only partially captured. The supply of water is carbon intensive, and because of its importance to the community, is protected from global trends to reduce atmospheric carbon emissions. Water management is highly centralised to gain economies of scale, and the population has no choice in sources or quality of water.

Governments actively legislate to remove competitive pressures from the industry to retain effective political control over the sector. Water management has returned to a reactive footing, and has no effective voice in the form or structure of the ever-growing suburbs.

Recycling and water conservation has been scaled back on a purely economic decision basis. Effluent is discharged to the environment rather than recycled. Energy recovery from sewage remains at 2010 levels.