CRC for
Water Sensitive Cities

Vision and Transition Strategy

for a Water Sensitive Greater Sydney

CRCWSC Integrated Research Project 1:
Water Sensitive City Visions and Transition Strategies

Australian Government
Department of Industry, Innovation and Science
Business Cooperative Research Centres Programme

Vision and Transition Strategy for a Water Sensitive Greater Sydney
Water sensitive city visions and transition strategies (IRP1)
IRP1-3-2018

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Executive summary

This Vision and Transition Strategy defines a vision of a water sensitive future for Greater Sydney, NSW, and outlines the broad steps the city should take to enable a transition towards this future. It is the outcome of a project by the Cooperative Research Centre for Water Sensitive Cities (CRCWSC), which brought together 51 leading thinkers across water, planning, environment and development in Greater Sydney in a series of action research workshops. Participants considered the city's long-term water aspirations, benchmarked today's water sensitive performance and explored strategic priorities for the short- to medium-term that will be important in pursuing their water sensitive city vision.

Sydney's unique water story

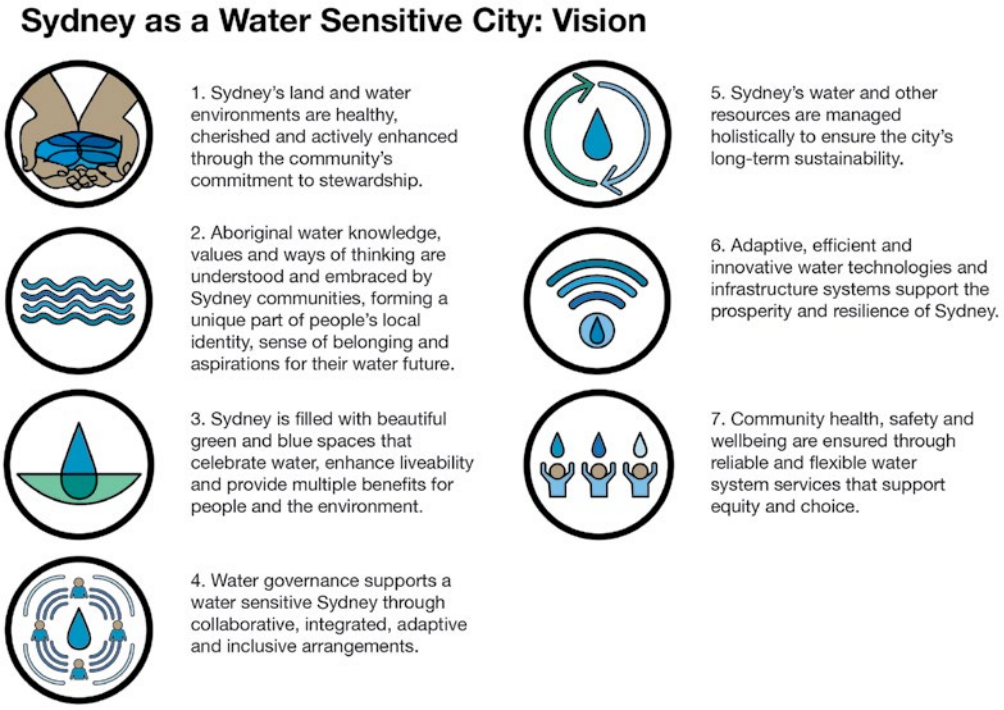
Greater Sydney has a unique, complex relationship with water that has been shaped by its diverse landscape and population. The people and culture of the Eora Nation were sustained by a diverse natural landscape and rich biodiversity spanning across the ocean, beaches, coastal estuaries, and rivers extending to the Blue Mountains. The iconic natural features of the area attracted people from all over the world and gradually the natural landscape was transformed by land clearing for farming and exploitation of the region's rich natural resources.

As the population boomed in the 19th century, public health became the key driver of investment in water supply and sewerage systems. Urban and water planning arrangements emerged in an increasingly complex governance landscape to guide development, environmental protection and flood risk mitigation. Today, Greater Sydney faces a changing climate and rapidly growing population, and is presented with a new challenge of how to manage its water in a way that enhances liveability and ensures Sydney remains a great place to live for future generations.

Vision of a water sensitive Greater Sydney

The 50-year vision for Greater Sydney as a future water sensitive city depicts the values and outcomes to be ensured over the long-term:

Sydney is a beautiful, prosperous and resilient city with thriving communities, healthy ecosystems and cherished urban landscapes supported by active water stewardship.

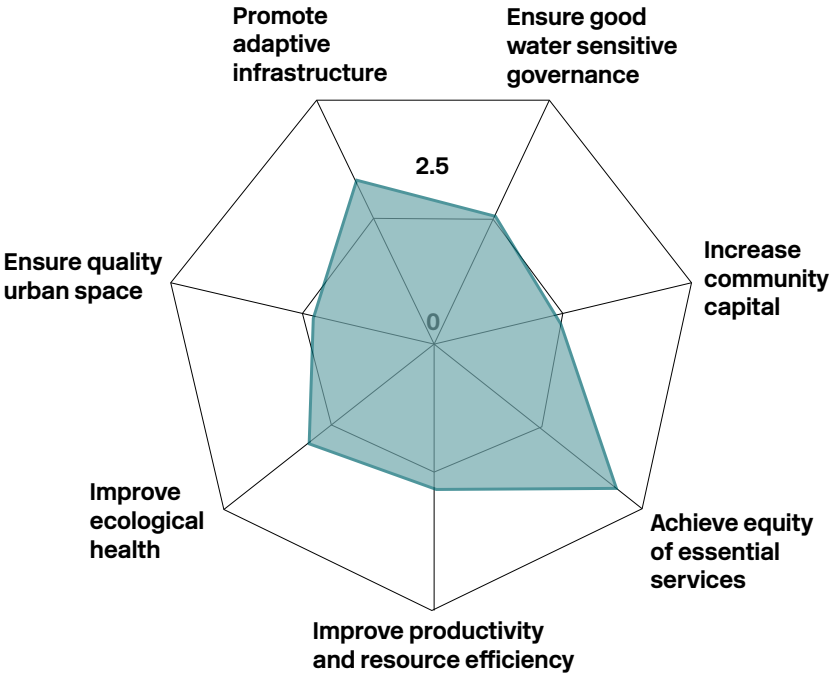


Current water sensitive performance

To understand Greater Sydney's current water sensitive performance, the CRCWSC's Water Sensitive Cities Index (WSC Index) benchmarking tool was used. Sydney's performance in the Index suggests it is strongest in the goal of *achieve equity of essential services* (3.9/5.0) and *improve ecological health* (3.0/5.0). Areas for improvement include *ensure quality urban space* (2.0/5.0) and *increase community capital* (2.3/5.0).

Interpreting these results against the six city-states of the Urban Water Transitions Framework highlights Greater Sydney's high performance in the provision of basic services of water supply and sewerage. Improved flood risk management in some parts of city would help increase the drained city status. Beyond these, Sydney has shown good progress in the waterway and water cycle city states, with room for further innovation to increase these ratings as it becomes more water sensitive.

Given the large geographic areas of Greater Sydney, benchmarking different parts using the WSC Index would give more in-depth insight into priority management actions for improving scores for specific locations.



Water Sensitive City — **8%**
Water Cycle City — **31%**
Waterway City — **94%**

Drained City — **67%**
Sewered City — **100%**
Water Supply City — **100%**

Transition assessment and strategic recommendations

Greater Sydney's progress towards its vision was analysed using the CRCWSC's Transition Dynamics Framework, which assesses the presence of important enabling factors that would support a city's transition to a new practice. This analysis indicates that Greater Sydney has made significant advancements, with strong leadership from champions around specific issues, demonstration projects of successful water sensitive practice, and a range of policy tools to guide new practices.

Greater Sydney has been building momentum towards achieving its vision of a future water sensitive city. However, strategic attention is needed to overcome the social and institutional barriers that could impede further on-ground progress.

To further advance Sydney's water sensitive city transition, particular focus is needed on establishing platforms that will support collaboration across diverse stakeholders to drive new solutions for the broad range of issues associated with water sensitivity. Specific high level strategies recommended to address priority transition needs in the short- to medium-term include:

I. Create formal and informal networks for driving Sydney's water sensitive city agenda to support a collaborative, flexible and integrated governance approach.

II. Embed Sydney's water sensitive city vision in organisational policies, plans and strategies.

III. Establish a cross-organisational framework that enables and drives an integrated and strategic approach for managing the whole water cycle.

IV. Increase knowledge about the social, technical and design solutions that are not yet sufficiently developed to deliver the full scope of Sydney's water sensitive city vision.

V. Identify and establish pathways for implementing water sensitive solutions through innovation and investment.

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Glossary

CRCWSC	Cooperative Research Centre for Water Sensitive Cities
Collaboration platform	A forum, network, group, program, project, or other mechanism for connecting a diverse group of stakeholders in order to share knowledge and information, develop ideas and establish a collective voice.
Greater Sydney	The area consisting of 35 local councils extending from Wyong and Gosford in the north, to the Royal National Park in the south, including the Blue Mountains to the west.
IRP1	CRCWSC Integrated Research Project 1 *Water Sensitive City Visions and Transition Strategies*.
Narrative	A well-articulated rationale that is tailored to a particular audience and makes a compelling case for a particular practice or action, including a description of its ecological, economic, and social benefits.
Traditional Owners	Traditional custodians of Greater Sydney's catchments, together with other Aboriginal people who have made it their home.
Transition	A fundamental shift in cultures, structures and practices as society changes from one pattern of socio-technological development to another, usually more sustainable pattern.
Transition Dynamics Framework	A framework that conceptualises how system-wide changes in practice (e.g. the transition to water sensitive practices) unfold over time, based on the establishment of key enabling factors: individual and organisational champions, platforms for connecting, science and knowledge, projects and applications, and tools and instruments.
Urban form	The physical characteristics that make up the built environment, including urban density and size, parcels and buildings, public spaces, ecological assets and key services such as transport and drainage.
Urban Water Transitions Framework	A framework that conceptualises different forms of urban water servicing as a city responds to evolving drivers: Water Supply City, Sewered City, Drained City, Waterways City, Water Cycle City, and Water Sensitive City.
WSC	Water Sensitive City; a WSC provides water system services in a way that reflects an integrated approach to infrastructure, the built form, the environment, governance and community, in order to deliver outcomes that support the enduring sustainability, liveability, resilience and productivity for a place's community and ecosystems.
WSUD	Water Sensitive Urban Design; an approach to the planning, design and maintenance of urban landscapes that will deliver WSCs through protecting and enhancing natural water systems and integrating the management of the total water cycle.
WSC Index	A tool to benchmark and diagnose the water sensitive performance of a place (from the municipal to metropolitan scale), based on 34 indicators organised by seven goals: good water sensitive governance, community capital, equity of essential services, productivity and resource efficiency, ecosystem health, quality urban space, and adaptive infrastructure.

1. Introduction

1.1 About this report

The Cooperative Research Centre for Water Sensitive Cities (CRCWSC) was invited to develop a WSC vision and transition strategy for Greater Sydney. This forms part of the *Water Sensitive City Visions and Transition Strategies* Integrated Research Project 1 (IRP1), which aims to deliver a suite of participatory methods and associated tools for guiding cities and towns in accelerating their water sensitive transitions. Sydney is one of six case studies conducted as part of the IRP1 project, the others being Perth, Adelaide, Townsville, Bendigo and the Gold Coast.

The Sydney case involved facilitation of stakeholder discussions across a series of three one-day workshops, stakeholder interviews, a literature review and the application of benchmarking and diagnostic tools to inform detailed analysis. 51 of Sydney's leaders and strategic thinkers from across water, planning, environment, community and other related sectors participated in the project between July and September 2017.

This report presents the key outputs of the project. Its purpose is to provide a framework for orienting and coordinating strategic action across the many different stakeholders who will need to collaborate for Greater Sydney's envisioned water future to be achieved. It is anticipated that this summary report can be used as a resource to inform the design and implementation of operational programs of action within key agencies and other organisations.

This report is complemented by a companion document, *Benchmarking, Envisioning and Transition Planning for a Water Sensitive Greater Sydney: Final Case Report*, which provides a full description of the case study methodology as well as the detailed analyses that underpin the results.

Alongside the production of practical guidance for Sydney's water sensitive transition contained in this report and its companion document, the engagement process has strengthened relationships amongst stakeholders and built momentum and commitment for driving Sydney's transition towards its envisioned water sensitive future.

1.2 What are water sensitive transitions?

As cities and towns globally are grappling with the challenges of climate change and rapid urbanisation, practitioners, decision-makers and academics are recognising the importance of water in supporting urban liveability, sustainability and resilience for a city's long-term prosperity.

In Australia, the vision of the Water Sensitive City (WSC) is now widely used to represent an aspirational concept in which water has a central role in shaping a city. In a WSC, people are not disrupted by flooding, and can enjoy reliable water supplies, effective sanitation, healthy ecosystems, cool green landscapes, efficient use of resources, and beautiful urban spaces that feature water and bring the community together.

A WSC incorporates innovative infrastructure, design and governance solutions. For example, water recycling at different scales through wastewater recovery and stormwater harvesting provides a diversity of water sources and improves the health of downstream rivers and creeks by reducing pollution and flow impacts. Water sensitive urban designs integrate nature-based infrastructure into the landscape to provide hydraulic and water treatment functions, as well as amenity benefits such as an aesthetic environment and mitigation of urban heat island effects. Integrated and collaborative land use and water planning results in catchment-scale approaches to enhancing flood resilience and connecting areas of green and blue to create ecosystem and recreation corridors throughout the city footprint. Citizens are active in caring for water and the environment, and there is cohesion amongst the community as their sense of place and collective identity is nurtured through their connection with water.

Many places are starting to articulate aspirations represented by the WSC concept. Becoming a WSC requires a significant departure from the conventional mode of water servicing, which typically manages water as separate streams for water supply, wastewater and stormwater through large-scale, centralised infrastructure. These traditional water systems have given us critical benefits such as clean water, safe sanitation and effective drainage, and this mode of servicing is still an important part of a WSC.

However, we now recognise that adaptations are needed to address key social and environmental vulnerabilities that result from conventional approaches, such as degraded waterways, uncertain and extreme rainfall patterns and growing community expectations for improved liveability.

The Urban Water Transitions Framework depicted in Figure 1 is a heuristic tool developed to help cities understand their present water management orientation and define their short and long-term sustainability goals. The framework identifies six distinct developmental states that cities may move through on their path toward increased water sensitivity. Most cities in the world would appear somewhere on this continuum, however, a city's journey from a water supply city through to the aspirational WSC is not linear.

Australian cities are typically somewhere between a drained city and a water cycle city, with observable features across all six of the city-states.

Becoming a WSC requires significant changes in policy and practice as the water servicing system moves through different city-states. A successful transition will therefore rely on commitment and alignment amongst many different people and organisations.

Developing a shared perspective of water today, a compelling vision for the future and a framework to guide coherent strategic action is critical for establishing the understanding, motivation and capacity amongst stakeholders to drive their WSC transition.

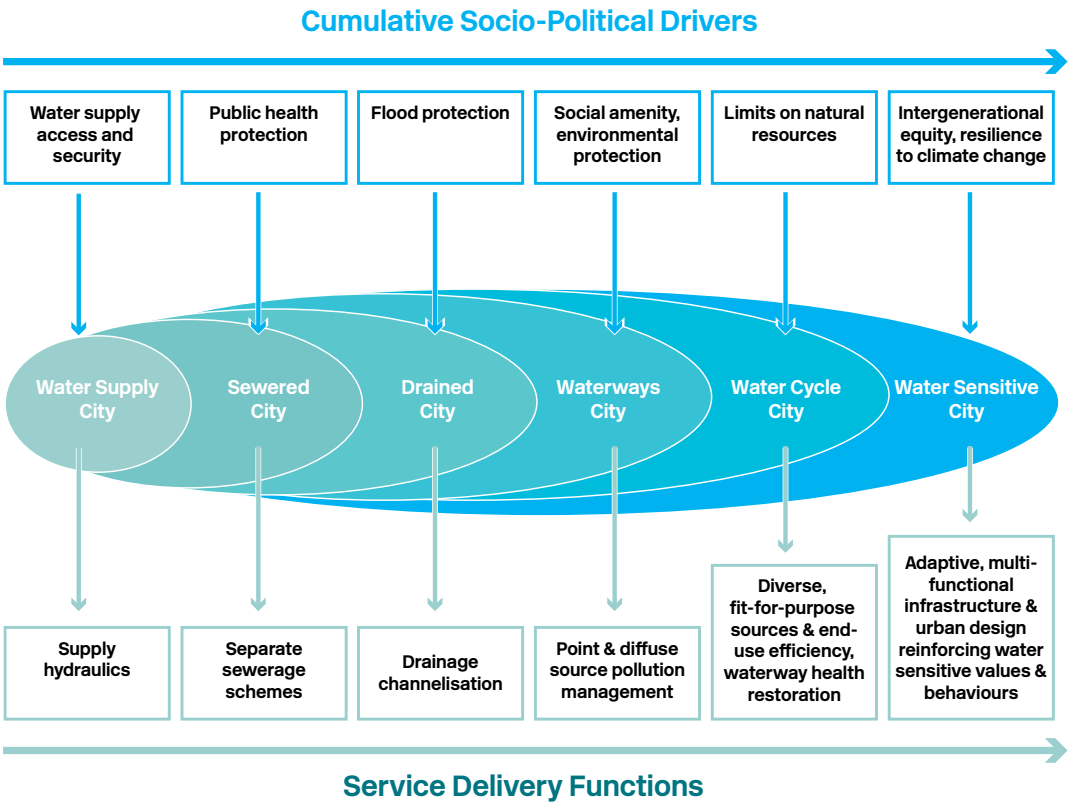


Figure 1. Urban Water Transitions Framework (Brown, Keath & Wong, 2009) [1]

[1] Brown, R., Keath, N., & Wong, T. (2009). Urban water management in cities: historical, current and future regimes. *Water Science and Technology*, 59(5), 847–855.

2. Greater Sydney's water story

The collaborative development of Greater Sydney's water story established a shared understanding of the trends that have shaped its current context and will continue to influence its future.

This provides a foundation for reflecting on the future for water in Sydney, with its communities' evolving aspirations for liveability amidst growing institutional complexity and climatic uncertainty. Figure 2 summarises Greater Sydney's water story so far.

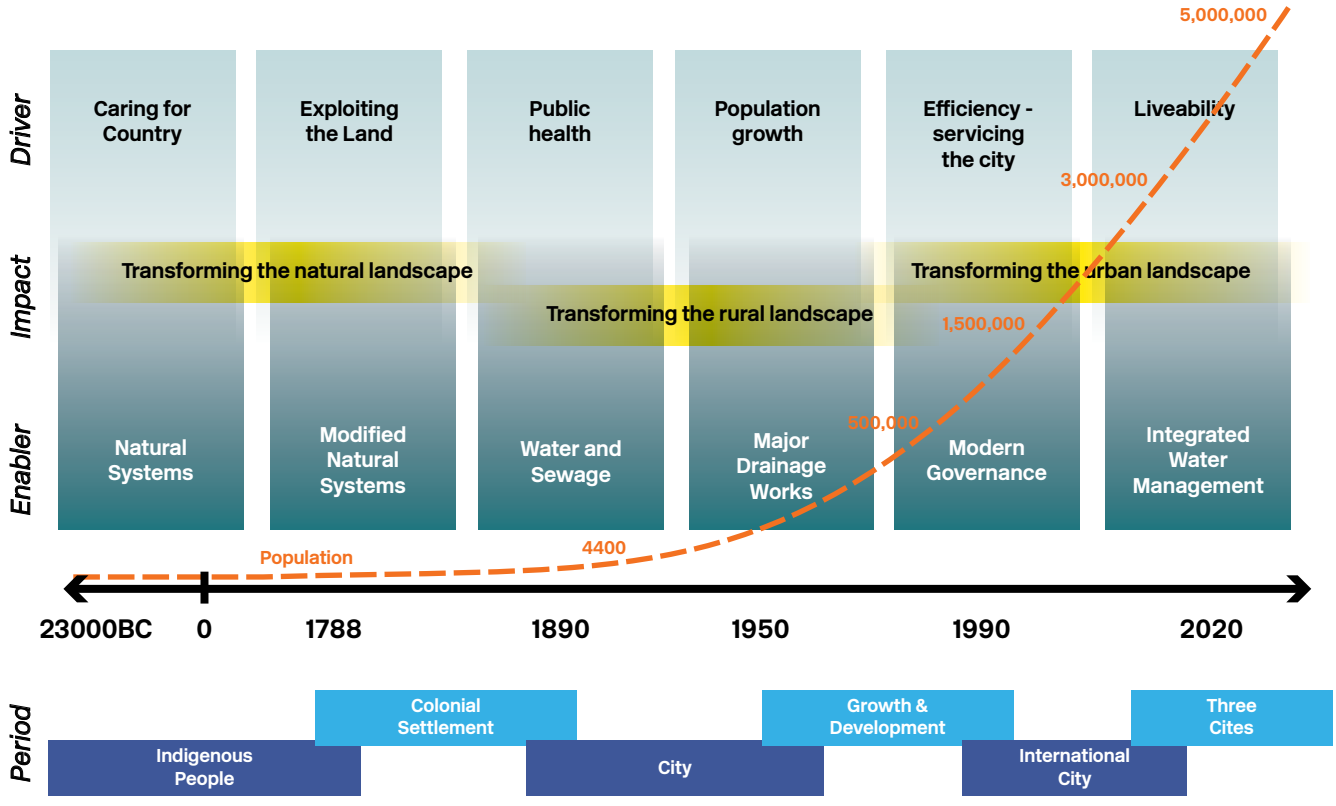


Figure 2. Greater Sydney's water story

2.1 Looking to the past

Pre-1788: Eora Nation, caring for country, natural landscapes

The Sydney region has been the country of the Eora Nation for more than 20,000 years. Prior to European settlement, their people and culture was sustained by a diverse landscape and rich biodiversity that spanned ocean and beaches, extensive coastal estuaries, and rivers extending to the Blue Mountains through plains and forest.

1788 – 1890: Penal settlement, exploiting the land, transforming natural landscapes

This continuous connection of Indigenous people and country was severely disrupted by the arrival of Governor Phillip and the first convicts transported to the new colony of New South Wales. Water supply played a major role in the struggle for the colony's survival. The convicts and colonists who followed gradually transformed the natural landscape by clearing the land for farming and exploiting the region's rich natural resources. The harbour and rivers were vital for the colony's survival (Davies and Wright, 2013).

1890 – 1950: Public health and the first utilities

The population of Sydney boomed in the late 19th century with a rush to exploit the rich natural resources of NSW, whether it was gold or timber or farming. Disease began to take a heavy human toll in the rapidly growing city. Typhoid and cholera were widespread and feared. New understanding of human waste and polluted water as the causes of these diseases led to the creation of the Water Supply and Sewerage Board and the first significant investment in constructing substantial water supply and sewerage systems for the city.

In the first half of the 20th century, the First World War, Great Depression and Second World War held back growth and prosperity, and there was little significant investment in infrastructure other than a number of small reservoirs and some employment schemes for rock-lined or concrete drainage channels.

1950 – 1990: Urban growth and development, major infrastructure, urban planning and governance experimentation

The end of the Second World War brought with it a new energy and nation building vision. A great period of infrastructure investment began with construction of the Warragamba Dam, an engineering triumph and still one of the largest urban water supply reservoirs in the world. The expanding city saw old problems of water pollution and environmental degradation emerge on a massive scale. Huge investment in expanding the sewerage system to service the suburbs was supported by the Federal Government. New legislation and institutions such as the State Pollution Control Commission were established to regulate industry and divert waste from waterways to the sewers.

A number of urban and water planning arrangements emerged in an increasingly complex and shifting governance landscape of somewhat variable effectiveness in guiding urban development, protecting the environment and managing the risks of flooding that were becoming a potential threat to community well-being.

1990 – 2000: International city, economic reform and the efficiency mindset

Recession, debt from the infrastructure boom and governance complexity and inefficiency drove a wave of reforms in the 1980s and 1990s. Governments and government institutions constantly reformed and restructured in pursuit of financial efficiency. The Water Board was downsized and was corporatized, splitting into the Sydney Catchment Authority and Sydney Water Corporation in 1998. A major environmental initiative to clean up Sydney's waterways was launched. Sydney Water's 'Clean Waterways' program, designed to reduce sewer spills and improve water quality at ocean outfalls, was followed by the NSW Stormwater Trust, which funded councils to develop and implement stormwater management plans. For a time, Sydney led the nation in these initiatives to protect and improve the health of its waterways. However, momentum ebbed at the end of the century when the water supply crisis of 1998 spurred a focus on water quality, and the onset of the Millennium Drought shifted politcal priorities.

2000+: Third wave of population growth, liveability and the three cities

The 2000 Olympic Games and the new millennium heralded the coming of a third great wave of population growth and urban expansion in Sydney. Like the post-war 'boom' period, there are significant threats from this ongoing growth to the environmental health and liveability of Sydney. The economic efficiency mindset, characteristic of government in the 1990s, is giving room to the emergence of liveability as an important driver of urban policy, institutional settings and investment in infrastructure. The complexity of planning, developing and servicing one of the world's great cities demands new governance thinking and institutional cultures and behaviours. New technologies and funding arrangements such as public-private partnerships may offer innovative new approaches for the city. Centralised command-and-control style management to exercise narrow 'city servicing' institutional functions has become a somewhat outdated policy setting in an era of unprecedented urban population growth and diversity.

From this need the Greater Sydney Commission has emerged as a new institutional instrument for collaboration and integration of effort. With it comes the idea of three cities that each have distinct characteristics, needs and priorities: the Eastern Harbour City, the Central River City and the Western Parklands City.

Sydney has transformed from Country cared for by the clans of the Eora Nation, to a British penal colony struggling for survival in a strange new world, to a bustling and prosperous frontier town, to a modern post-war city, and to today, widely acknowledged as one of the world's greatest cities, its prosperity and liveability underpinning a third great wave of population growth.

Water system services provided by the region's waterways was the reason for the colony's initial establishment; these have also been a critical enabler of Sydney's growth and to a large extent, define its international image today. The scale and complexity of the infrastructure and nature of water system services has been accompanied by a 'modernising' of governance over time. It is critical that water system services and the way they are governed continue to evolve. While housing affordability and transport tend to dominate debates about urban planning, recent shifts have shown a desire to move from a single focus on cost efficiency towards more integrated urban and water planning for the delivery of liveability outcomes. This emerging policy direction may provide opportunities to re-engage with the First Nation peoples and recognise their ongoing connection with the lands and waters of the Greater Sydney region through a stronger voice in determining the future.

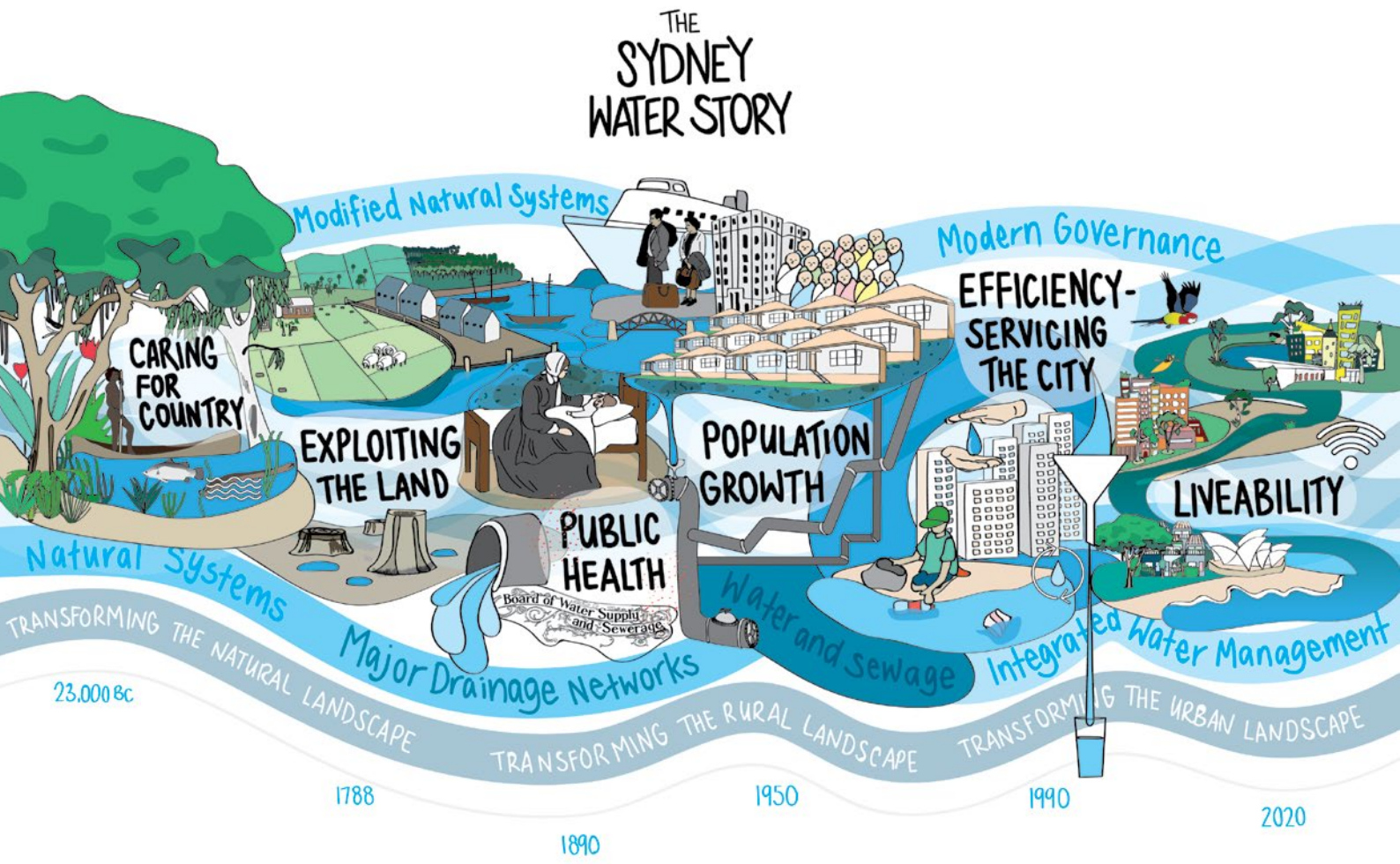


Figure 3. Greater Sydney's water story.

2.2 Looking ahead to Sydney's water future

Sydney is currently the largest city in one of the most urbanised countries in the world, recognised internationally for its liveability and iconic built and natural features. It now faces the challenge of maintaining and enhancing its liveability and sustainability in the face of trends such as climate change and population growth, while also maintaining affordability and equity for its diverse communities.

The impacts of climate change are already being experienced across Greater Sydney. Urban heat is a major issue, particularly for parts of Western Sydney where temperatures can be significantly higher than in the eastern suburbs. It is predicted that in the next few years, higher intensity storms and rainfall events will increase the risk of major flooding in the Hawkesbury Nepean floodplain and urban waterways. Intense rainfall will also create more frequent sewer overflows and increase stormwater first flush loads. Longer periods of hot, dry weather will increase bushfire risk in the Blue Mountains and Royal National Parks, which comprise a large portion of the metropolitan water supply catchment. Storm surge will put low-lying infrastructure such as pump stations and sewers at risk, as well as the health of coastal wetlands.

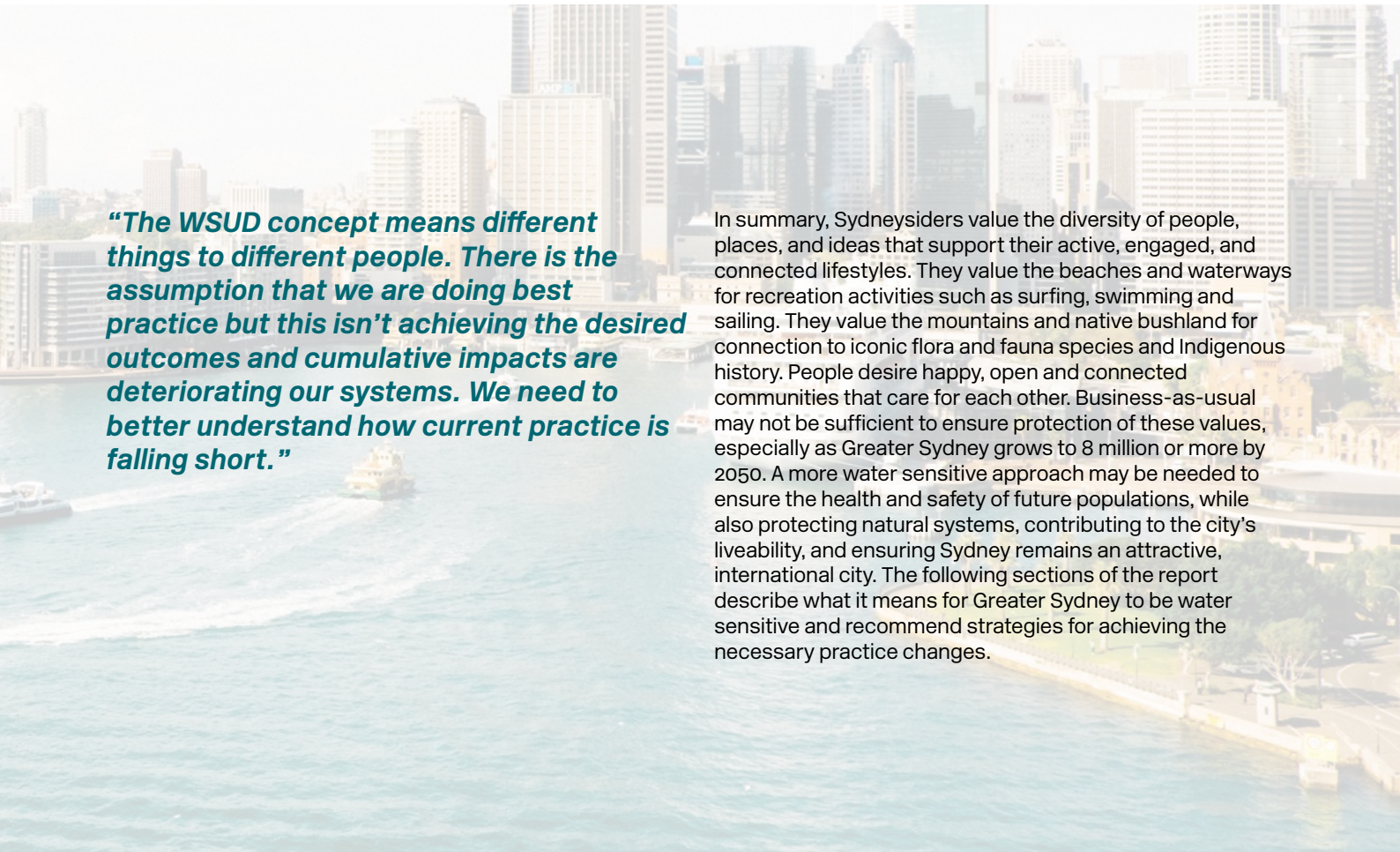
"We are planning in an uncertain space; the scale of investment needed and source of funding for roads, water, transport and housing; the aging of assets and upcoming cost of renewal; a lack of understanding of the impacts of development on the rivers. But there are opportunities to overcome these challenges. We need to adopt a combination of approaches; to have smaller, more flexible, adaptable and modular systems and continued research to test ideas and assumptions."

Population growth and urbanisation are also putting pressure on existing water systems, processes and infrastructure. Higher population creates a higher demand on water resources, more pollution in the environment, and increased loads on water infrastructure. Globalisation and the increasing cultural diversity of neighbourhoods raises issues of equitable and affordable access to water services and amenity. Negative impacts of urbanisation are observed in the loss of green space and natural areas, and increased impervious surfaces due to extensive development.

This is being experienced in both the new developments of Western Sydney and through increasing infill in the eastern parts of the city. This development causes changes in ecosystems and habitats, and in some instances, loss of species. It also exacerbates the urban heat island effect, which further impacts on people's health, wellbeing and behaviours.

While these drivers are a challenge for Greater Sydney's water systems services and processes, they also present a need and an opportunity to change the 'business-as-usual' approach. This may need to go beyond consideration of alternative water sources and innovative ways of re-using water and resources. The diversity of cultural backgrounds, differences in quality of environments and access to opportunity in Greater Sydney suggest that a greater focus on the role of water system services in supporting social equity will be important. This could include creating community connections to water and water-related environments, which in turn creates opportunities for learning and social cohesion.

Extensive greenfield and infill development provides opportunities to trial and implement innovative approaches to water service delivery. New developments will also provide the opportunity to test quality urban space solutions that mitigate extreme heat and provide multiple benefits. A need for higher density living will reduce private green space, increasing the importance of public open spaces that provide the community with broad benefits, including opportunities to connect with the environment and each other.



"The WSUD concept means different things to different people. There is the assumption that we are doing best practice but this isn't achieving the desired outcomes and cumulative impacts are deteriorating our systems. We need to better understand how current practice is falling short."

In summary, Sydneysiders value the diversity of people, places, and ideas that support their active, engaged, and connected lifestyles. They value the beaches and waterways for recreation activities such as surfing, swimming and sailing. They value the mountains and native bushland for connection to iconic flora and fauna species and Indigenous history. People desire happy, open and connected communities that care for each other. Business-as-usual may not be sufficient to ensure protection of these values, especially as Greater Sydney grows to 8 million or more by 2050. A more water sensitive approach may be needed to ensure the health and safety of future populations, while also protecting natural systems, contributing to the city's liveability, and ensuring Sydney remains an attractive, international city. The following sections of the report describe what it means for Greater Sydney to be water sensitive and recommend strategies for achieving the necessary practice changes.

3. Vision for a water sensitive Greater Sydney

The 50-year water sensitive vision for Greater Sydney aims to orient and align the actions of stakeholders over the long-term. The aspirations of participants for their city's water future are expressed as a suite of outcome statements with accompanying rich descriptions. The timeframe enables people to stretch their ambitions beyond today's systems and constraints to reflect on the transformative change that is possible over such a period.

Sydney is a beautiful, prosperous and resilient city with thriving communities, healthy ecosystems and cherished urban landscapes supported by active water stewardship.

Sydney as a Water Sensitive City: Vision

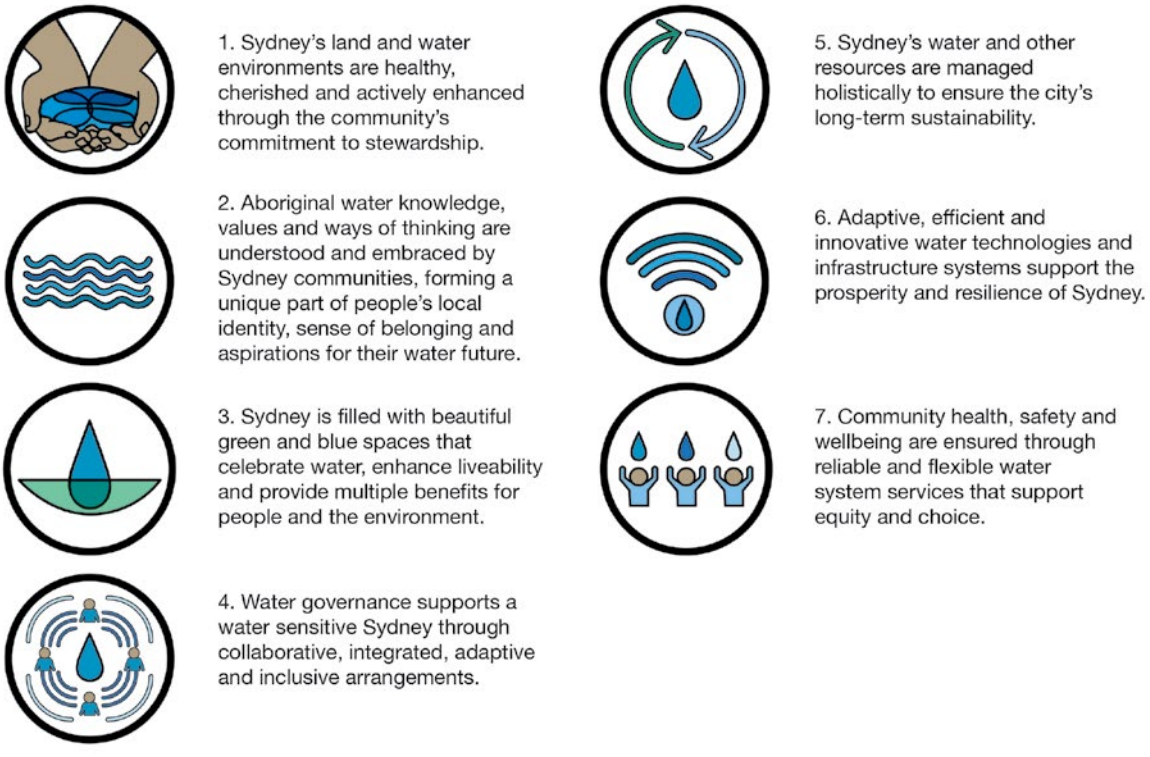


Figure 4. Sydney's WSC Vision - Central River City.

1. **Sydney's land and water environments are healthy, cherished and actively enhanced through the community's commitment to stewardship**. People enjoy swimming and fishing in their local waterways. Sydney's water environments, including Sydney Harbour, the Hawkesbury-Nepean, Parramatta and other Rivers, and the city's many bays, beaches, creeks and lagoons are recognised internationally for their health and cultural significance. Water pollution is managed proactively to ensure clean and healthy waterways. Native iconic and threatened species thrive in surrounding bushland and in connected, urban habitats. People understand and value the interconnectedness of waterways, terrestrial environments, groundwater aquifers, and weather patterns. Waterways have legal standing and are afforded intrinsic rights, and previously degraded waterways have been reimagined and recreated. Citizens are empowered as custodians of the environment through education and opportunities for action, and advocate for improved environmental health outcomes. Sydney has a low ecological footprint, and water-related programs designed to continuously enhance ecological health are supported by sustainable and effective funding sources.

2. **Aboriginal water knowledge, values and ways of thinking are understood and embraced by Sydney communities, forming a unique part of people's local identity, sense of belonging and aspirations for their water future**. Water is respected, loved and valued as the basis of life and nature by Sydney people. Ancient saltwater and freshwater Aboriginal stories are intrinsic to all Sydneysiders' identity and sense of belonging. These stories, values and knowledge of the water system are widely shared, recognised in education programs and broader community conversations, and drawn on to inform long-term water planning. They contribute to fostering evolving relationships amongst all people and the co-creation of Sydney's water future.

3. **Sydney is filled with beautiful green and blue spaces that celebrate water, enhance liveability and provide multiple benefits for people and the environment**. Its urban environments are green, peaceful and of high quality. A diversity of places celebrate water, encourage social cohesion and enhance people's connection to water. People in the Eastern Harbour City enjoy Sydney's beaches, harbours and coastlines for their amenity, recreation and lifestyle values. People in the Central River and Western Parklands Cities are proud of Sydney's clean rivers and creeks that flow alongside green, multi-functional parklands. Neighbourhoods are walkable with shady, pleasant streets and shared paths. Everyone in Greater Sydney can access areas of recreation and amenity. The built form incorporates living, green vegetation coverage and urban environments function as habitats for local species. Urban heat is mitigated through water sensitive solutions. Water and land use planning are integrated to ensure the delivery of multiple benefits.

4. **Water governance supports a water sensitive Sydney through collaborative, integrated, adaptive and inclusive arrangements**. Water is governed through a catchment approach and includes all elements of the water cycle. Collaboration amongst people and organisations, integration across sectors and disciplines, and supportive organisational cultures deliver broad water sensitive outcomes for Sydney. Decisions are made openly and transparently through the sharing of data, knowledge, stories and insights. Place-based decision-making is underpinned by system thinking and takes into account broad social, environmental and economic outcomes. Roles, responsibilities and accountabilities of people and organisations are clearly articulated and well understood. Traditional Custodians and Aboriginal people are valued as partners in water decision-making and occupy leadership roles in water organisations. Community values are incorporated in decision-making through innovative engagement processes. Citizens participate actively in water governance and are empowered to shape decisions in the water sector.

5. **Sydney's water and other resources are managed holistically to ensure the city's long-term sustainability**. Integration and alignment of water, land management, energy, communications, and waste sectors enables the delivery of broad social, environmental and economic outcomes. A holistic approach to water policy and planning takes into account the embodied and consumed energy and other resources that form part of the system. Stormwater and wastewater resources are managed to improve environmental flows and utilised for irrigating green spaces. Nutrients, water, biogas, biosolids and other resources are recovered from wastewater and reused fit-for-purpose. Local food production is supported by the water system to provide benefits for the local community, including jobs and urban greening.

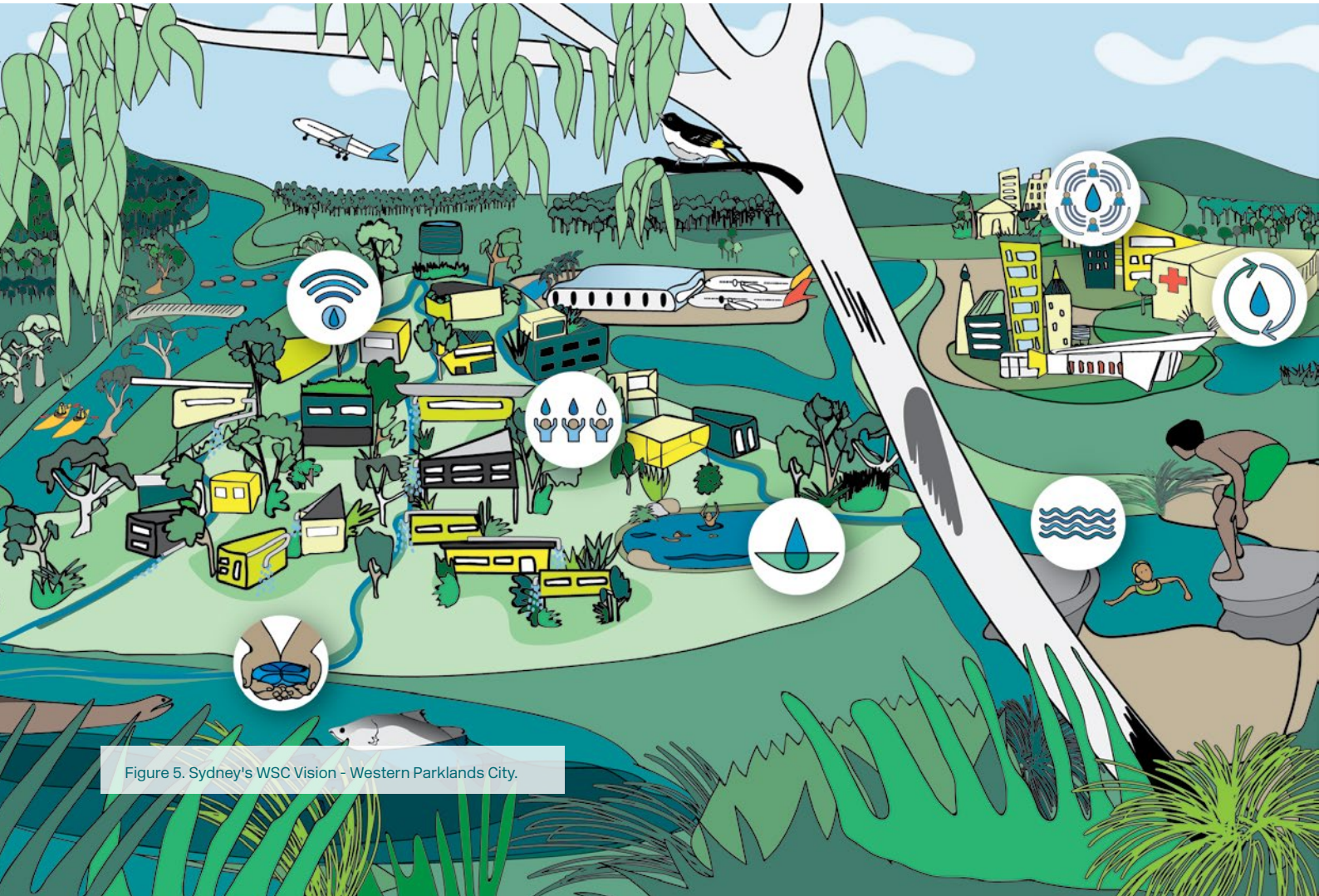


Figure 5. Sydney's WSC Vision - Western Parklands City.

Figure 6. Sydney's WSC Vision - Eastern Harbour City.

6. **Adaptive, efficient and innovative water technologies and infrastructure systems support the prosperity and resilience of Sydney**. Fit-for-purpose water is delivered to residents via an optimised supply portfolio and through infrastructure at multiple scales. Household-scale technology, such as smart metering and onsite recycling, along with community education programs, influence consumer behaviour and drive potable water consumption to less than 50 litres per person per day. Scenario modelling informs the design of infrastructure that is robust and resilient to future uncertainties. People use integrated decision-making frameworks to assess solutions according to optimal scale, cost and energy. Technological innovation is fostered through a culture of learning and experimentation, an enabling regulatory environment and adaptive planning frameworks. Market structures support the range of water system participants needed to deliver broad water sensitive outcomes. Strong relationships between government agencies, public and private organisations and the research sector allow for rapid transfer and adoption of the latest research and knowledge.

7. **Community health, safety and wellbeing are ensured through reliable and flexible water system services that support equity and choice**. Everyone in Sydney has access to safe, reliable and affordable drinking water and sanitation services. Sydney's catchments are protected and water infrastructures are robust to ensure high quality drinking water. Water system services are adaptable to suit multigenerational and multicultural living. People are prepared to cope with natural hazards and extreme events such as bushfires, extreme heat and flooding in locations like the Hawkesbury-Nepean basin. Emergency response systems are in place to ensure effective communication of information and emergency plans. Sydney's pattern of growth accommodates flood risk, and is managed with respect to enhancing the city's resilience to climate change impacts, particularly for vulnerable communities. Sydney's areas of water-related amenity are accessible to everyone and its communities thrive amongst the green, cool places that promote physical and mental wellbeing.

4. Assessing Greater Sydney's current water sensitive performance

Planning Sydney's transition to its WSC vision requires a detailed understanding of its current performance in relation to its aspirations. The CRCWSC's Water Sensitive Cities (WSC) Index[2] is a benchmarking tool designed for this purpose. It articulates seven WSC goals, which organise 34 indicators representing the major attributes of a WSC. These indicators are also mapped to the idealised city-states represented in the Urban Water Transitions Framework (Figure 1) to provide a benchmarked city-state.

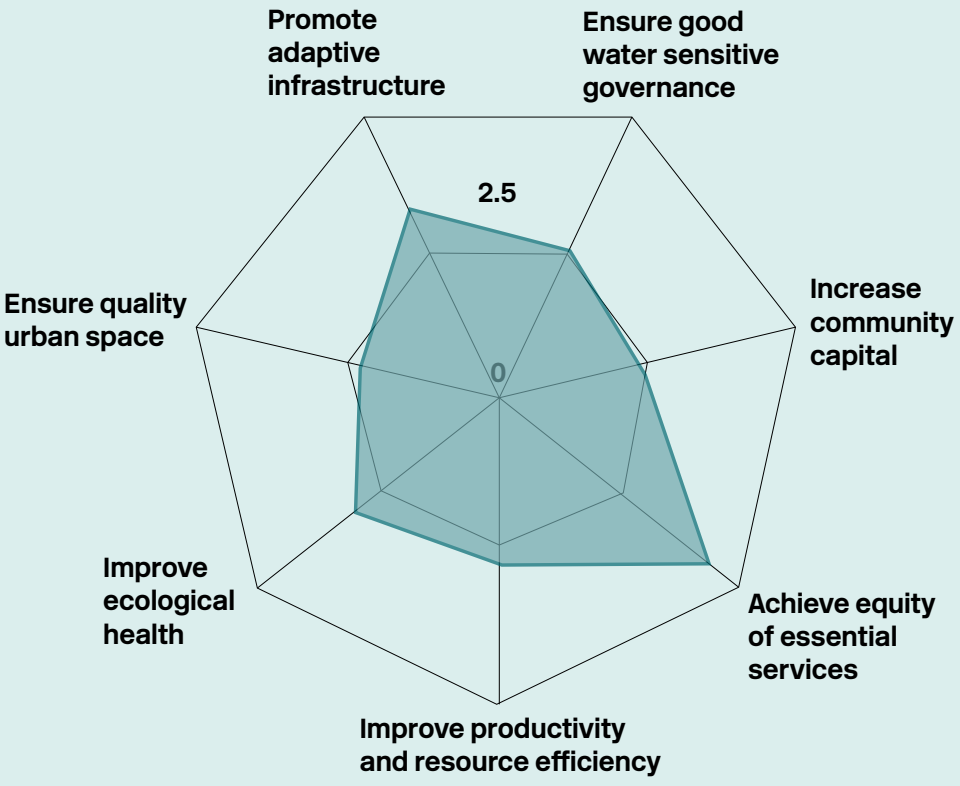
While a city's local WSC vision may not emphasise all indicators of the WSC Index to the same degree, the tool enables diagnosis of key areas of strength and weakness. These insights can then inform the prioritisation of actions and provide a framework for ongoing monitoring and evaluation of a city's water sensitive performance.

4.1 Sydney's WSC indicator scores

The WSC Index was applied to Greater Sydney to benchmark current water sensitive performance. Participants reflected on the challenge of determining a score that represents all of Greater Sydney, given its scale and diversity. There may be value in applying the WSC Index across the city at smaller scales, potentially for the 'three cities' defined by the Greater Sydney Commission (Figures 4 to 6).

Figure 7 below shows the WSC Index goal results for Greater Sydney (shown by the shaded teal area). Table 1 below provides the individual indicator scores for each goal.

Figure 7. Greater Sydney's performance (shaded teal area) for the WSC Index goals



[2] CRCWSC. (2018). *Water Sensitive Cities Index*. Retrieved from https://watersensitivecities.org.au/solutions/wsc-index/

Table 1. WSC Index scores (goals and indicators) for Greater Sydney

WSC Index Goal and Indicators	Score /5	WSC Index Goal and Indicators	Score /5
1. Ensure good water sensitive governance	**2.4**	**4. Improve productivity and resource efficiency**	**2.7**
1.1 Knowledge, skills and organisational capacity	2.0	4.1 Benefits across other sectors because of water-related services	2.5
1.2 Water is key element in city planning and design	2.0	4.2 Low GHG emission in water sector	3.0
1.3 Cross-sector institutional arrangements and processes	2.0	4.3 Low end-user potable water demand	3.5
1.4 Public engagement, participation and transparency	2.5	4.4 Water-related commercial and economic opportunities	2.0
1.5 Leadership, long-term vision and commitment	2.5	4.5 Maximised resource recovery	2.5
1.6 Water resourcing and funding to deliver broad societal value	2.5	**5. Improve ecological health**	**3.0**
1.7 Equitable representation of perspectives	2.5	5.1 Healthy and biodiverse habitat	2.0
2. Increase community capital	**2.3**	5.2 Surface water quality and flows	3.0
2.1 Water literacy	3.0	5.3 Groundwater quality and replenishment	3.0
2.2 Connection with water	3.0	5.4 Protect existing areas of high ecological value	4.0
2.3 Shared ownership, management and responsibility for water assets	2.0	**6. Ensure quality urban space**	**2.0**
2.4 Community preparedness and response to extreme events	2.0	6.1 Activating connected urban green and blue space	2.5
2.5 Indigenous involvement in water planning	1.5	6.2 Urban elements functioning as part of the urban water system	2.0
3. Achieve equity of essential services	**3.9**	6.3 Vegetation coverage	1.5
3.1 Equitable access to safe and secure water supply	5.0	**7. Promote adaptive infrastructure**	**2.8**
3.2 Equitable access to safe and reliable sanitation	4.5	7.1 Diverse fit-for-purpose water supply system	3.0
3.3 Equitable access to flood protection	3.0	7.2 Multi-functional water system infrastructure	2.5
3.4 Equitable and affordable access to amenity values of water-related assets	3.0	7.3 Integration and intelligent control	2.5
		7.4 Robust infrastructure	3.0
		7.5 Infrastructure and ownership at multiple scales	2.5
		7.6 Adequate maintenance	3.0

4.2 Sydney's benchmarked city-state

Figure 8 summarises the city-state benchmarking results for Greater Sydney, which interprets the scores in Table 1 against the modelled requirements for the six phases of the Urban Water Transitions Framework (Figure 1). Percentage attainment for each city-state ranged from 100% as a Water Supply City and Sewered City through to 8% as a Water Sensitive City. This section summarises the key elements that contribute to the overall percentage attainment of each city-state and highlights priority gaps that will need to be addressed to improve the scores.

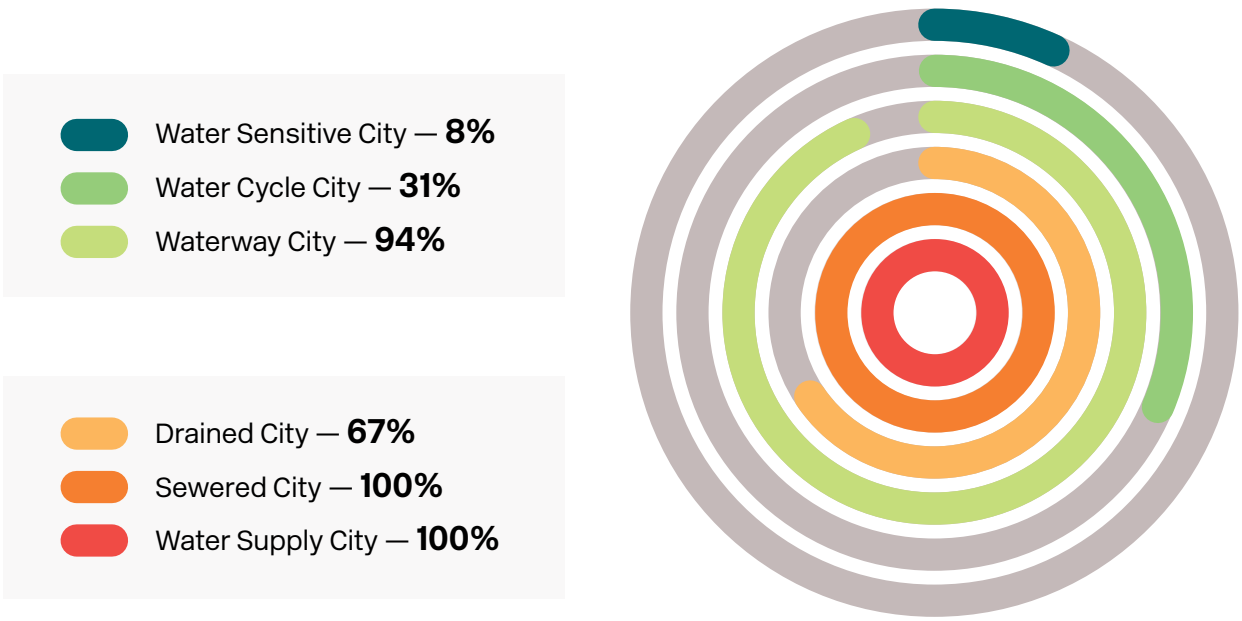


Figure 8. Summary of Greater Sydney's performance against the ideal measures for each city-state

100% Water Supply City and Sewered City

Greater Sydney is well regarded for water security and rated 100% as a Water Supply City. Sydney sources the majority of its water from its surrounding catchments, with 80% of the supply sourced from the Warragamba Dam. The catchment area covers 16,000 square kilometres and includes several world heritage national parks. In the case of low rainfall, the Sydney Desalination Plant can supply water for up to 1.5 million people.

Water supply is managed centrally, provided at an affordable cost to end users and with reliable public health outcomes.[3] Sydney Water reported 100% compliance with the Australian Drinking Water Guidelines (ADWG) health guideline values for 2015-2016 and 99.5% compliance with the ADWG aesthetic guideline values.

Similarly, Sydney Water provides wastewater services to 1.8 million properties, ensuring safe and reliable sanitation and 100% attainment of a Sewered City. Sydney's sewerage system consists of 24 separate sewer systems linking to 16 wastewater treatment plants that treat wastewater and discharge to the environment.

While the system is safe and reliable, there is concern about overflows. Significant investments may be needed to achieve reductions in sewer overflows for an incremental improvement, however investment in other water quality improvement initiatives could also increase the city's liveability. In addition, the water and resources currently discharged to the environment through ocean outfalls could be harvested and used as a valuable resource.

67% Drained City

Greater Sydney rated 67% as a Drained City. The region's drainage services are the joint responsibility of local government and Sydney Water. The system generally operates effectively on a day-to-day basis, however not all residents have equitable access to flood protection. Extensive development in the floodplains of the Hawkesbury, Georges and Cooks Rivers, and within local flood flow paths, exposes people and property in these areas to significant flood risk. Many small-scale flash flooding events also occur from everyday rainfall events across Eastern Sydney. These flood events have a significant impact in many places, and communities are not well prepared for flood events.

Some data collection and modelling exists to support knowledge of these risks (e.g. the City of Sydney flood management plan process) however much of this work is undertaken by councils and is not yet comprehensive or consistent across the city. Practical implementation of adaptation and mitigation strategies is often limited by resources, capability and commitment. Flood modelling and risk assessments are often performed for a specific local government or sub-catchment area rather than the full catchment.

Improvements across each of these dimensions would help Sydney achieve 100% Drained City status.

"Flooding is a hot topic in Sydney – we are needing to increase housing yet we are pushing development into floodplains."

[3] Sydney Water. (2016). *Annual Report 2015–16*. Available at https://www.sydneywater.com.au/web/groups/publicwebcontent/documents/document/zgrf/mdk1/~edisp/dd_095614.pdf

94% Waterway City

Greater Sydney rated 94% as a Waterway City, reflecting diverse water-related environmental assets and recent advancements in policy and regulatory arrangements for their management and protection. While significant investment in the late 1990s and early 2000s led to the creation of the Stormwater Trust, which supported a total water cycle approach to managing stormwater, a loss of funding led to its closure. Community activism and the famous *Turn back the Tide* concert of 1989 led to efforts to clean up Sydney's beaches and the establishment of the ocean outfalls for wastewater. While coastal beaches and the iconic Sydney Harbour are readily accessible to residents of Eastern Sydney, ensuring access to high quality amenity in Western Sydney remains a challenge.

The general public values waterways for amenity and recreational purposes and desire clean, swimmable water environments. Increased regulation and the decrease in industrial activity in the last 30-40 years has reduced some causes and types of contamination, though there remains a historical legacy of pollution and neglect that has caused significant decline in the health of water environments.[4] While people value water for recreation and amenity, there is little understanding of the entire catchment and the impact of their everyday behaviours.

"The impact of stormwater pollution on water quality and amenity is a big topic. The community wants a healthy environment – they want clean rivers and waterways for swimming, fishing, and visual amenity."

There have been a number of initiatives to improve waterway health such as the 'Clean Waterways' program of the 1990's. Sydney Olympic Park and the adjoining Homebush Bay, were once amongst the most polluted sites in the Sydney Region. Recent environmental remediation works, revegetation, habitat management, removal of industry and banning of chemicals have significantly improved ecological functioning. Catchment groups (such as the Cooks River Alliance, Parramatta River Catchment Group, Georges River Combined Councils Committee and Sydney Coastal Councils Group) are also working collaboratively to improve river and catchment health.

31% Water Cycle City

Greater Sydney has begun to diversify its water supply, reflected by its 31% attainment of the Water Cycle City status. Non-potable water sources include household rainwater tanks, groundwater extraction from private bores in some councils, stormwater harvesting and reuse and wastewater recycling and reuse. Stormwater management remains a challenge in Sydney since responsibility lies with both Sydney Water and local councils, and there is limited state policy or coordinated planning in place. Planning for greenfield developments generally consider stormwater and waterway health separately from water supply and wastewater. The main strategic document for water in Sydney, the Metropolitan Water Plan, is based on a supply-demand balance rather than a water sensitive approach to managing water.

Despite this challenge, some local councils are demonstrating considerable vision and innovation in activities such as stormwater harvesting and sewer mining, but the approach to water sensitive urban design remains ad-hoc across Greater Sydney.

"There is some collaboration, but not enough. There are a few individuals barking but there is no single vision or goal across the water sector."

During the Millennium Drought, uptake of demand management measures was common through the installation of water saving fittings, fixtures and appliances due to successful behaviour change programs. Because of these measures and increased community awareness around water usage, Greater Sydney is seen as a world leader in reducing residential potable water usage. Despite its significant population increase, Sydney is using no more potable water than it did in the 1970s.

Sydney's urban water sector has mostly focused on system augmentation through large scale, centralised infrastructure. It was reported that during this period regulation hampered innovation at the local level. However, in 2006 with the Water Industry Competition Act (WICA), NSW introduced Australia's first third-party licensing system to enable the private sector to enter the urban water industry.

[4] Rijke, J., Farrelly, M., Brown, R., & Zevenbergen, C. (2013). Configuring transformative governance to enhance resilient urban water systems. *Environmental Science and Policy, 25*(ii), 62–72.

"We need governance arrangements that support innovation...we are not keeping up with innovation. This is critical with population growth."

Sydney's first large residential recycled water scheme was at Rouse Hill. It is Australia's largest dual-pipe residential recycling scheme, supplying up to 2.5GL per day to 32,000 properties in Sydney's north-west suburbs for non-potable use.[5] In 2015-16, Sydney Water recycled 36GL in the Greater Sydney region and, including schemes operated by others, there was a total of approximately 270 recycled water schemes in operation with the potential to recycle around 70GL.[6]

8% Water Sensitive City

Greater Sydney rated 8% as a Water Sensitive City, achievement of which is largely attributed to equity of essential services of water supply and sanitation. Both supply and sanitation services are accessible to everyone; they are safe, secure and affordable. Sydney's protection of existing areas of high ecological value also contributes to the 8% Water Sensitive City rating.

To achieve a Water Sensitive City, Greater Sydney will need to fulfil the multiple objectives of ecosystem protection and restoration, security of supply, flood control, public health, amenity, liveability and economic sustainability, among others. While Greater Sydney has begun to make strides towards a Water Sensitive City, significant efforts are still needed in order to transition current water management practice to water sensitive practice.

[5] Sydney Water, above n 3.
[6] Watson, R., Mukheibir, P., & Mitchell, C. (2017). Local recycled water in Sydney: A policy and regulatory tug-of-war. *Journal of Cleaner Production*, 148, 583–594.

5. Advancing Greater Sydney's water sensitive city transition

Greater Sydney's transition towards its water sensitive city vision will require significant changes across the structures, cultures and practices of urban and water system planning, design, management, engagement and decision-making.

These changes are likely to happen over a long time frame, in the order of decades, as new water sensitive practices are established and replace old practices. CRCWSC research has identified that water sensitive transitions unfold over six phases: an (1) issue with old practice emerges and (2) becomes more defined; people develop (3) shared understanding and agreement about the issue; (4) knowledge about solutions is disseminated; and new solutions are (5) diffused through policy and practice, and eventually (6) embedded as new mainstream practice.

The CRCWSC's Transition Dynamics Framework (see Appendix A for more detail) sets out five types of enabling factors that help to drive progress through these phases of change: **champions, platforms for connecting, science and knowledge, projects and applications, and practical and administrative tools**. Together, these five factors create an enabling environment for accelerating a water sensitive transition.

Building the momentum for transition will require a diverse range of strategies and actions that progressively establish these enabling conditions. Strategies and actions with the most impact during the early phases of transition will be different from those during the later phases. It is critical to identify a city's current transition progress to ensure that actions are prioritised according to the effectiveness they will have in accelerating the WSC transition.

This section presents recommended strategies for advancing Greater Sydney's water sensitive transition based on an analysis of the city's current transition progress. Strategies are identified to advance the overall water sensitive Sydney vision, as well as its individual thematic elements.

5.1 Assessing Sydney's WSC transition progress

The CRCWSC's Transition Dynamics Framework was used as a diagnostic tool to assess the presence or absence of enabling factors as an indicator of progress towards Greater Sydney's aspired change in practice as it advances towards its water sensitive city vision (Table 2). It provides a checklist of the factors that should be deliberately and sequentially built up to inform the prioritisation of strategies and actions.

The overall transition progress assessment for Greater Sydney suggests that significant advancements have been made towards its water sensitive vision. However, it is at risk of stagnation if critical enabling conditions are not established to shore up Phase 2 (issue definition) and Phase 3 (shared understanding and issue agreement), and start pushing into Phase 5 (policy and practice diffusion). A brief explanation and justification of the transition assessment follows.

Table 2. Assessment of Sydney's overall transition progress

Transition phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
1. **Issue Emergence**	Issue activists	N/A	Issue highlighted	Issue examined	N/A
2. **Issue Definition**	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	N/A
3. **Shared Understanding & Issue Agreement**	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
4. **Knowledge Dissemination**	Aligned and influential champions	Building broad support	Solutions advanced	Significant solution demonstrations	Refined guidance and early policy
5. **Policy & Practice Diffusion**	Government agency champions	Expanding the community of practice	Capacity building	Widespread implementation and learning	Early regulation and targets
6. **Embedding New Practice**	Multi-stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

Notes: Green boxes indicate the enabling factor is fully present and regression into the previous phase is unlikely. Yellow boxes indicate some presence, however they are vulnerable to regressing to the previous phase. Red boxes indicate a complete absence of the enabling factor, and that progression is unlikely without first establishing the preceding enabling factors.

Individual champions across Greater Sydney advocate for elements of the water sensitive city agenda. However, it is challenging for them to become connected and aligned without a common vision or sense of shared strategic purpose, particularly given the number and diversity of actors and institutions involved in Sydney's water, planning, environment and development sectors. There are a number of water sensitive city champions with significant influence across these sectors and key organisations are driving individual aspects of Sydney's water sensitive vision. However, there are not yet key organisations driving collective action towards the vision as a whole.

Similarly, a number of collaboration platforms support existing initiatives (e.g. river catchment groups, individual projects) or drive particular issues. However, these platforms are yet to develop a collective voice on Sydney's holistic water sensitive city vision and have not yet focused on building broad support for the transition agenda.

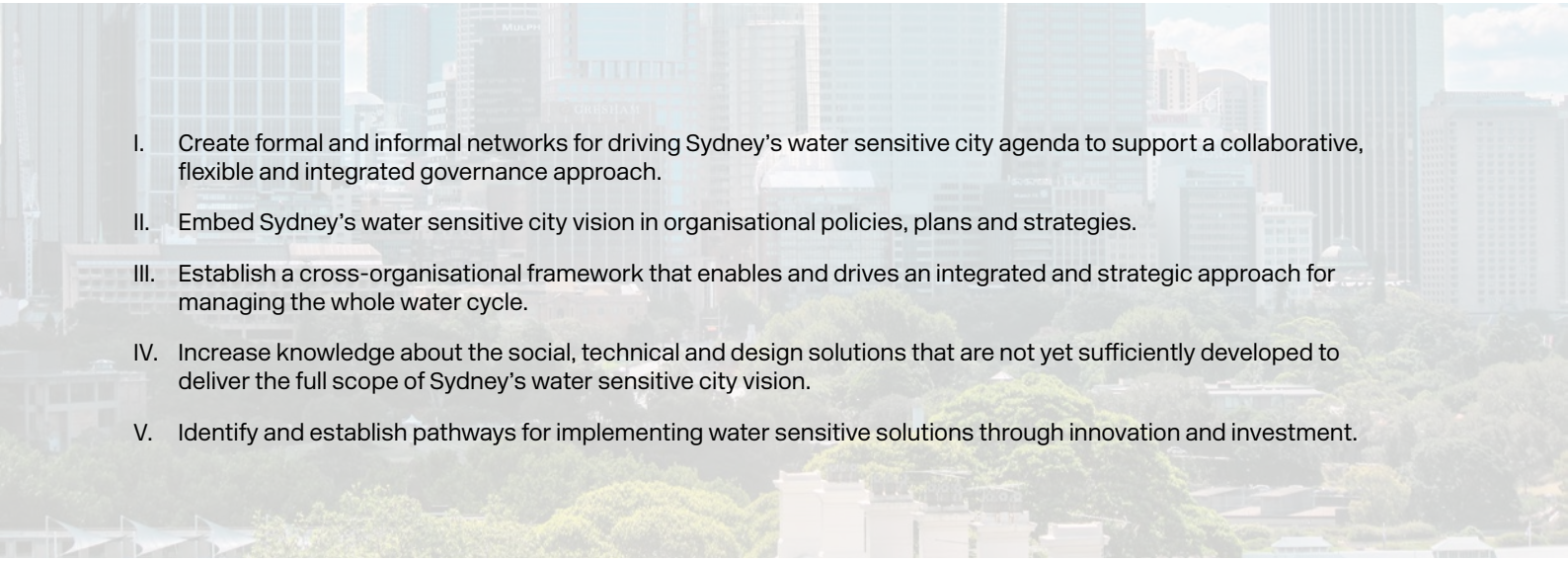
Innovative solutions have been developed and demonstrated at significant scales that reflect aspects of Sydney's water sensitive city vision, such as low potable water demand, wastewater recycling, and multi-functional urban design (e.g. Central Park, Green Square). There are also smaller scale water sensitive urban design solutions being trialled across Sydney and projects for improving waterway health, most of which are being driven or led by local government. [7] Widespread roll out and scaling of these innovations, however, has not yet been achieved and they are not linked with a comprehensive strategy that provides coherence with a common vision and a learning agenda. There are also many elements of the Sydney vision that still need significant solution exploration, experimentation and demonstration.

Policies such as the *Metropolitan Water Plan* and *Directions for a Greater Sydney* have begun to articulate broad liveability and sustainability outcomes that are consistent with Sydney's water sensitive vision. Practical guidance for implementing these outcomes is somewhat limited, however, and will need to be developed to drive the achievement of these aspirations.

[7] See, for example, Tawfik, S. (2016). *Pursuing sustainable urban water management through co-governance: A case study of Marrickville Council*. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

5.2 Strategies for advancing Sydney's overall vision

Based on the above assessment of Greater Sydney's transition progress, which is only summarised in this report, five overarching strategies are recommended to advance Sydney's water sensitive transition:



I. Create formal and informal networks for driving Sydney's water sensitive city agenda to support a collaborative, flexible and integrated governance approach.

II. Embed Sydney's water sensitive city vision in organisational policies, plans and strategies.

III. Establish a cross-organisational framework that enables and drives an integrated and strategic approach for managing the whole water cycle.

IV. Increase knowledge about the social, technical and design solutions that are not yet sufficiently developed to deliver the full scope of Sydney's water sensitive city vision.

V. Identify and establish pathways for implementing water sensitive solutions through innovation and investment.

I. Create formal and informal networks for driving Sydney's water sensitive city agenda to support a collaborative, flexible and integrated governance approach

Sydney's most significant challenge in transitioning to a water sensitive city is arguably the complexity of actors, structures and processes involved in the governance of water. This complexity has grown with time, as service expectations for water supply, sanitation, drainage and waterway health have evolved and responsibility for policy, planning, service delivery and regulation have become institutionally separated. With the number of actors and institutions and the size of the city, it has been difficult to implement a total water cycle approach to water management when organisations are generally only responsible for certain parts.

To progress Sydney's transition to a water sensitive city, water governance will need to become more integrated and adaptive so that it can account for the entire water cycle. While large-scale institutional reform may ultimately be needed to streamline Sydney's institutional arrangements, this may be unrealistic in the short-term and would need comprehensive consideration as to the form and appropriateness of reform solutions.

However, greater integration and collaboration can still be achieved through collaborative networks that are committed to a shared agenda for driving water sensitive outcomes. Both formal and informal networks are needed so that stakeholders have the freedom to explore issues and opportunities that may sit outside current policy and programs, while maintaining the support and endorsement of the authorising environment.

Collaboration platforms already exist across Greater Sydney but tend to be focused on specific issues and provide limited opportunity for exploration of the broad range of outcomes associated with a water sensitive city. An informal water sensitive cities network that is comprised of local champions and influential organisational representatives could help drive action on the ground and advocate to decision-makers for reforms and investments that will enable practice change. This could be complemented by formalised partnerships between key agencies to drive strategic programs and initiatives.

II. Embed Sydney's water sensitive city vision in organisational policies, plans and strategies

Driving collective action towards Sydney's water sensitive city vision will involve individual organisations committing to action and investment that progressively achieves the aspired outcomes. It is therefore critical to embed the vision in formal policies, plans and strategies to provide a framework for supporting intra- and inter-organisational alignment and the implementation of solutions. Formalising support for the water sensitive city agenda in Sydney will also create a supportive policy environment, which can lead to investment in water sensitive solutions more broadly.

Securing the commitment to, and endorsement of, Greater Sydney's water sensitive city vision amongst organisational leaders and decision-makers will be critical for embedding the vision in formal structures. Articulating a compelling narrative that links the benefits of the envisioned water sensitive city to organisational priorities and a broader city vision will help to harness the support of leadership and the general community.

III. Establish a cross-organisational framework that enables and drives an integrated and strategic approach for managing the whole water cycle

Sydney's water sensitive city vision will be achieved through the design and implementation of urban spaces and infrastructure systems that are multi-functional, providing a range of benefits that deliver Sydney's ecological, liveability and resource efficiency aspirations.

This will require an understanding of the synergies between natural and engineered water systems, taking advantage of the opportunities across all streams of water (e.g. supplied water, wastewater, stormwater) and working within the interfaces between the water system, the built form and natural landscapes.

In order to achieve this, Greater Sydney will need to adopt an integrated and strategic approach to managing the whole water cycle and its surrounding landscapes that is more consistent and efficient. This type of approach would help mitigate the existing flash flooding issues across the city, as well as inform the development of more water sensitive solutions to managing and re-using wastewater. Establishing such an approach across organisations and sectors is challenging, particularly in the context of the scale of Sydney and the complexity of its institutional arrangements.

A framework is therefore needed to provide clarity and direction for organisations to understand how their individual responsibilities, investments and activities can contribute to the collective achievement of Sydney's water sensitive city vision. Such a framework could include holistic policy, a cross-agency implementation strategy, standards and targets, and collaborative governance mechanisms. It would need to be coherent and comprehensive, articulating and aligning objectives across organisations, clarifying roles and responsibilities, and enabling the identification and pursuit of opportunities that prioritise integrated water sensitive outcomes that offer social, economic and environmental benefits across the city.

IV. Increase knowledge about the social, technical and design solutions that are not yet sufficiently developed to deliver the full scope of Sydney's water sensitive city vision

Innovation will be at the heart of a successful transition to a more water sensitive Greater Sydney. This requires a strong foundation of knowledge generation and application, as novel solutions are explored, tested, refined and eventually mainstreamed. These solutions may be technical in nature (e.g. new green technologies), they may be design-focused (e.g. new built form templates), or they may be social (e.g. new engagement processes).

The type of knowledge required changes over the course of a transition. Early on, new knowledge is needed to better define issues and to establish the need for an action or response. Where the need is unfamiliar, knowledge on the various responses or solutions available and their associated costs and benefits may be required. Developing and implementing novel solutions can be challenging and carry significant risks. In these cases, pilot-scale testing and demonstrations of solutions can help to prove the concept, highlight benefits, and build capability in the delivery of solutions. This can include insight into how risks can be managed, whether they be technical, financial or reputational. Ultimately, comprehensive knowledge of solutions will need to be developed and harnessed to support decision-making and guide implementation.

Sydney has made significant strides towards a water sensitive city, however there are aspects that require new knowledge in order to inform the development and implementation of solutions that address the full scope of its water sensitive city vision. While Sydney's water sector has been able to effectively service its residents with safe and reliable water and sanitation services, the need for flexibility and choice in water service delivery has not yet been explored. The importance of incorporating Aboriginal knowledge and values into water planning and decision-making has only just recently been recognised. More work is needed to determine how to effectively engage and empower people to drive water stewardship practices. Community resilience is an issue currently being explored by Resilient Sydney; solutions for increasing resilience needs further investigation, especially in relation to flooding. The functioning of Greater Sydney's entire water cycle needs further study, with a particular focus on the importance of groundwater and groundwater-dependent ecosystems and their role in total water cycle management.

A deliberate and strategic approach to addressing these knowledge gaps would help Sydney accelerate progress towards its broad water sensitive city vision.

V. Identify and establish pathways for implementing water sensitive solutions through innovation and investment

Becoming a water sensitive city will require a range of innovative solutions across social, technical and design domains to be developed, trialled and implemented. Participants have reflected on difficulties experienced in enabling uptake of such innovations, citing a range of perceived institutional barriers, such as complex organisational and legislative arrangements, a multitude of stakeholders with diverse interests, and regulatory limitations associated with water pricing. Some have commented that these barriers present difficulties for allowing competition in the water sector.

While regulatory reform is one solution that has received recent attention, it can take a long time to implement. In the short term, stakeholders can identify alternative pathways for driving innovation and investment that navigate these barriers. Such pathways could include establishing strategic funding programs, developing cross-sectoral partnerships that leverage co-investment opportunities, identifying significant opportunities to demonstrate innovations at scale, developing strategic business cases for trials and demonstrations, resolving specific institutional barriers, setting policy targets, investing in capacity building, and supporting innovation through investment in evaluation and learning.

A strategic cross-organisational approach to driving innovation and investment in water sensitive solutions would help Sydney accelerate progress towards its broad water sensitive city vision.

5.3 Strategies for advancing individual vision elements

A more detailed assessment of Greater Sydney's transition progress was also conducted, using the CRCWSC's Transition Dynamics Framework (Appendix A) to consider each of the individual thematic elements of the city's water sensitive vision.

Figure 9 below summarises the current transition progress for each individual vision theme and highlights the variety across specific elements. Vision themes early in their transition will require different types of strategies to progress further change than those later in their transition.

This analysis informed the development of specific recommendations for strategies to advance each part of Greater Sydney's water sensitive city vision. The following sections present a brief explanation and justification of the transition progress assessment and associated recommended strategies.

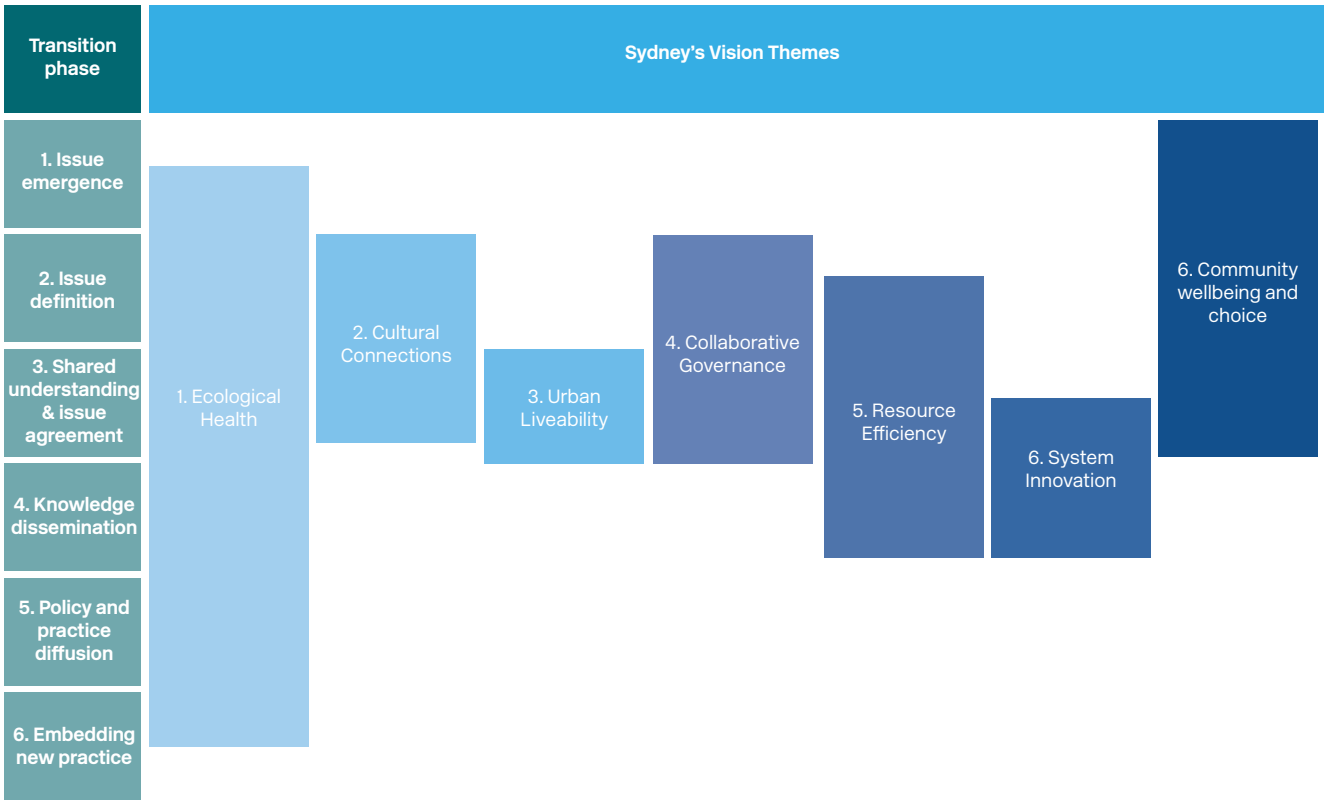


Figure 9. Summary of transition phases for each of the vision outcomes

Vision outcome 1: Sydney's land and water environments are healthy, cherished and actively enhanced through the community's commitment to stewardship.

There are strong protections for existing areas of high ecological value through an extensive national parks and heritage sites system, reflected by an advanced phase of transition for this dimension. In contrast, groundwater management is early in its transition towards the envisioned outcome. Groundwater resources are not currently considered an important ecological asset for Sydney and there is limited understanding of the threats and potential resource value of these systems.

"Groundwater use is not talked about enough. It is out of sight out of mind. Sydney doesn't have major groundwater. We don't rely on it for water supply so groundwater-dependent ecosystems are not considered much."

Stormwater pollution is currently the major threat to Greater Sydney's waterway health. Some good progress has been made, but fragmented management across local councils makes it challenging to implement a catchment-wide approach to water sensitive urban design and managing stormwater.

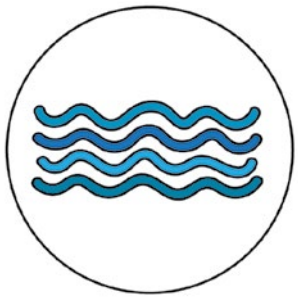
Leading champions in waterway health are the river catchment groups (e.g. Parramatta River Catchment Group, Cooks River Alliance, Georges River Combined Councils Committee and Sydney Coastal Councils Group), which bring together local governments, state agencies and community representatives to improve the health of the river catchments. However, there is not yet a holistic, city and region-wide approach to improved water quality and ecological health.

"The impact of stormwater pollution on water quality and amenity is a big topic. This pollution is the biggest threat to [Sydney's] waterway health."

The ingredients that support active community stewardship, such as water literacy, connections and shared responsibility, are midway through its transition. There is general engagement with communities around waterway health through issue-specific programs such as Streamwatch. However, engagement tends to take the form of consultation rather than active empowerment of community members as stewardship partners.

Table 3. Recommended strategies to advance healthy land and water environments and community stewardship

No.	Strategy	Outcome
1.1	Develop new knowledge about Greater Sydney's groundwater-dependent ecosystems	Better understanding of the system's functioning, threats and potential values
1.2	Create collaboration platforms for people and agencies to examine groundwater management practices	Better knowledge of solutions for managing and protecting groundwater-dependent ecosystems
1.3	Identify and consolidate lessons from existing ecosystem health improvement projects	A holistic suite of solutions, guidelines, policies and standards
1.4	Develop and communicate a compelling narrative that articulates the importance of ecosystem health in delivering broad societal benefits	The authorising environment supports initiatives that may challenge current practice but are needed to achieve healthy ecosystems and waterways
1.5	Develop and implement a coherent and comprehensive healthy waterways and catchment strategy for managing Sydney's natural assets as an integrated and dynamic system	A mechanism exists for guiding target-setting, governance reforms and implementation planning
1.6	Monitor and evaluate the condition of natural assets and areas of high ecological value	Consistent and effective implementation and continuous improvement of existing standards and practices
1.7	Explore a full suite of solutions for engaging and empowering communities in water-related planning, decision-making, innovation and action	Solutions for engaging the community as stewardship partners, beyond a traditional consultation approach, are identified



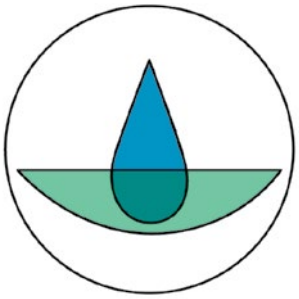
Vision outcome 2: Aboriginal water knowledge, values and ways of thinking are understood and embraced by Sydney communities, forming a unique part of people's identity, sense of belonging and aspirations for their water future.

"Community and indigenous groups need a seat at the table. They are sometimes represented at project level but not so much in planning."

Sydneysiders have good connections with their water environments, based mainly around amenity and recreation. However these are not yet explicitly linked with Aboriginal water values and representation. While there are some opportunities for Aboriginal communities to contribute to water planning and decision-making, this engagement is generally done as traditional consultation, reflecting a relatively early stage of transition. Reconciliation Action Plans and Local Aboriginal Land Councils are beginning to facilitate better engagement processes, however structures and processes are not yet set up to enable effective implementation.

Table 4. Recommended strategies to advance cultural connections based on Aboriginal water knowledge, values and ways of thinking

No.	Strategy	Outcome
2.1	Develop new knowledge about how to effectively and meaningfully incorporate Indigenous knowledge and values into water planning and decision-making	Solutions exist for effectively and meaningfully incorporating Indigenous knowledge and values into water planning and decision-making
2.2	Advance platforms to facilitate collaboration between Traditional Owners and the water industry	A community-wide understanding and appreciation of diverse historical, cultural and spiritual connections to water
2.3	Advocate for water planning and decision-making to meaningfully involve Traditional Owners and to account for a broad range of cultural, spiritual and other water values	A broad appreciation of the need for, benefits of and opportunities for greater involvement of Traditional Owners in water planning and decision-making



Vision outcome 3: Sydney is filled with beautiful green and blue spaces that celebrate water, enhance liveability and provide multiple benefits for people and the environment.

The Greater Sydney Commission is advocating for the integration of water system planning and urban planning so that standards and service outcomes that link to a broad vision of urban liveability can be achieved, as reflected in its *Directions for Greater Sydney* report and District Plans. Innovative design projects such as Central Park and Green Square demonstrate a collaborative approach to achieving multiple benefits, reflecting good transition progress in some parts of Sydney. However, these projects are considered isolated efforts and do not yet reflect a consistent shift in practice across Sydney. Many efforts to include water sensitive urban design in projects are rejected due to perceived costs and problems of maintenance. While the *Metropolitan Water Plan* for Greater Sydney does incorporate aspects of liveability, it is not linked to a legislative framework that would support its translation into practice.

"As we move through time, open space will be a challenge. We will see greater need to deliver multiple level functions. How we integrate these will be important. Linking the blue and green."

Table 5. Recommended strategies to advance blue-green environments that support urban liveability

No.	Strategy	Outcome
3.1	Advance existing platforms to connect champions and develop a unified voice calling for better integration across water, planning, development, environment and transport sectors	A community of water sensitive practice amongst water, planning, development, environment and transport professionals focused on implementing solutions for the creation and connection of high quality urban spaces
3.2	Consolidate existing preliminary practical guidance for quality urban space solutions and identify gaps that need to be addressed	Comprehensive guidelines for creating high quality, multi-functional urban spaces that are linked to local environmental plans and development control plans
3.3	Incorporate a learning agenda into existing and new projects and demonstrations of quality urban space solutions to develop evidence of costs, benefits and risks	Knowledge of the capabilities needed for the effective implementation of multi-functional urban spaces
3.4	Strengthen policy, regulation and targets to improve the implementation of quality urban space solutions	Widespread and consistent adoption of integrated approaches to the planning and implementation of quality urban space solutions

"We are creating suburbs that we won't like in the future. We need to think about the whole system. We need true collaboration between public and private entities to support WSUD outcomes and create spaces that celebrate and support the water cycle to create green areas."

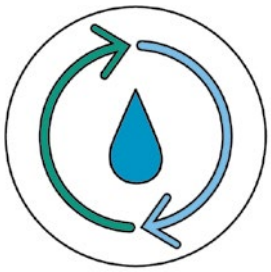
Vision outcome 4: Water governance supports a water sensitive Sydney through collaborative, integrated, adaptive and inclusive arrangements.

Small-scale projects that demonstrate collaborative governance arrangements are being implemented across Sydney, such as the river catchment groups, the Living Laneways Program at Inner West Council and the Water Smart Cities program. There are opportunities to learn from and build on these examples to create more enabling structures, processes, cultures and capabilities. Collaboration is encouraged in the NSW Government's Metropolitan Water Plan but the plan does not provide guidance on how to effectively collaborate and it is not embedded within a broader legislative framework to give it strength.

Table 6. Recommended strategies to advance collaborative, integrated, adaptive and inclusive water governance

No.	Strategy	Outcome
4.1	Incorporate a learning agenda into new and existing trials of collaborative governance solutions	Lessons are incorporated to improve governance solutions at multiple scales and demonstrate commitment to collaborative governance frameworks
4.2	Develop and communicate a compelling narrative that articulates why collaborative governance structures, cultures and processes are necessary	The authorising environment supports initiatives that may challenge current practice but are needed to effectively empower community and other partners in water planning and decision-making
4.3	Establish a platform to advocate for a collaborative governance framework based on a shared water sensitive city vision and identify opportunities for demonstration of collaborative governance solutions	Regular communication and deep relationships are fostered between stakeholders and a culture of collaboration is embedded amongst a broad network of stakeholders

Vision outcome 5: Sydney's water and other resources are managed holistically to ensure the city's long-term sustainability.



Sydney is leading the nation in water conservation, with the importance of low water consumption well understood by the community. Resource recovery is core business for private sector companies such as Veolia and Flow Systems, and the Water Industry Competition Act was the first of its kind in Australia, intended to enable competition in this space. These advances reflect significant progress for Sydney towards some aspects of its resource management vision. Reuse of resources beyond wastewater (e.g. stormwater, waste heat, nutrients) is less advanced, as is the reduction of greenhouse gas emissions. While targets exist for greenhouse gas emissions, these have been established by a national agenda and have yet to be translated to provide significance for the local Sydney context (although it could rapidly progress due to its relevance nationally and internationally).

"Recycled water investment has been slowed for economic reasons. Lifecycle cost is not being considered, we need to be looking to new approaches. And we need to consider closing-the-loop more seriously. I think this has fallen off the agenda since the desalination plant was implemented as this back-up solution has taken the pressure off water security."

Table 7. Recommended strategies to advance holistic and sustainable resource management

No.	Strategy	Outcome
5.1	Implement demonstrations with an explicit learning agenda about supply-side solutions for low end-user potable water demand, including recycled wastewater projects in areas beyond new developments	A business case for a broad scope of solutions, including supply-side solutions, informed by evidence of costs, benefits, and risks and knowledge of the capabilities needed for their effective implementation
5.2	Develop a strategic business case for solutions that support resource recovery and low greenhouse gas emissions	An understanding of the costs, benefits, risks, and opportunities for a holistic approach to resource recovery and low greenhouse gas emissions in the water sector
5.3	Develop new knowledge of technical and governance solutions for increasing resource recovery and reducing greenhouse gas emissions	A broad scope of solutions to be trialled and demonstrated for efficient resource recovery
5.4	Embed Sydney's WSC vision into policy, planning and design standards that enable resource recovery in accordance with the vision	An administrative environment that is coherent, consistent, coordinated and comprehensive for enabling and driving planning and design decisions that achieve water sensitive outcomes

Vision outcome 6: Adaptive, efficient and innovative water technologies and infrastructure systems support the prosperity and resilience of Sydney.

Many organisations, including Sydney Water, private utilities, consultants, and some local councils and developers, are championing innovative infrastructure solutions. There are a number of projects (e.g. Green Square, Central Park) that demonstrate solutions such as recycled water schemes and multi-functional infrastructure. However, innovation for productivity benefits is less advanced. Also, challenges remain around ownership and maintenance of stormwater infrastructure (specifically green infrastructure) that need to be addressed in order to build broad support for implementation of the required solutions.

"Innovation is being discussed. Things are starting to change. Institutions are coming out of their shells but they still often meet resistance at approvals level."

Table 8. Recommended strategies to advance adaptive, efficient and innovative water systems

No.	Strategy	Outcome
6.1	Implement significant demonstrations of multi-functional, multi-scale and fit-for-purpose infrastructure solutions	An understanding of the opportunities for implementation of solutions at multiple scales, advancement of adaptive infrastructure solutions, and knowledge of the capabilities needed for their effective implementation and the broad benefits they provide
6.2	Develop and communicate a compelling narrative that articulates the importance of adaptive infrastructure in delivering Sydney's future WSC vision	Broad leadership and government support are secured for undertaking an adaptive infrastructure approach
6.3	Develop a strategic business case for adaptive, multi-functional solutions that deliver broad cross-sectoral and commercial benefits	Investment in innovative water technologies and infrastructures
6.4	Embed Sydney's vision for adaptive infrastructure into organisational policies, strategies and plans	An administrative environment that is coherent, consistent, coordinated and comprehensive for enabling and driving adaptive infrastructure approaches for the whole water cycle
6.5	Incorporate a learning agenda into existing projects that demonstrate successful operation and maintenance of stormwater infrastructure (including green infrastructure)	Capacity building packages and refined guidelines for operation and maintenance of stormwater infrastructure (including green infrastructure)

Vision outcome 7: Community health, safety and wellbeing are ensured through reliable and flexible water system services that support equity and choice.

Sydney's water supply and sanitation systems are safe, accessible and affordable for most people and are fundamental to community health and wellbeing. Other water system services such as stormwater and waterway management are less well defined and characterised by fragmented governance. Urban development is still occurring in high flood risk areas, with residents not fully understanding these risks. Work by Resilient Sydney identified that the community generally has low resilience and does not feel prepared for extreme events. Some councils have undertaken flood modelling, however this is mostly small-scale and has not yet informed the development of a holistic flood risk management strategy.

Supporting equity and customer choice through the provision of flexible and reliable water system services is earlier in its transition but may be important for Sydney to meet its communities' needs under pressure of future challenges of growth, urbanisation and climate change. This represents a significant departure from the one-size-fits-all approach of conventional water servicing, so it is important to understand the costs, benefits and risks of this alternative approach for service providers and customers.

"We need to adopt a combination of approaches; to have smaller, more flexible, adaptable and modular systems and continued research to test ideas and assumptions."

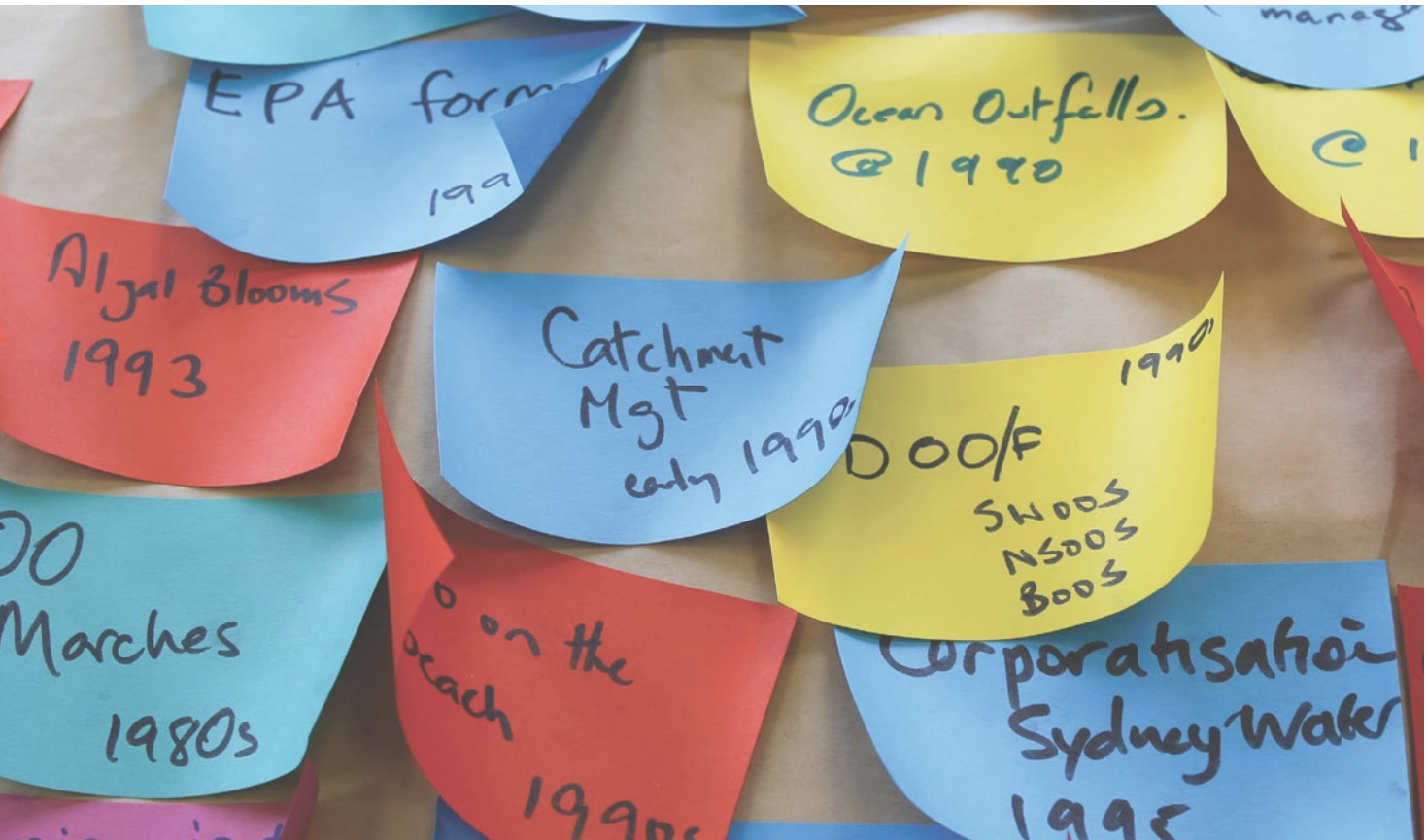


Table 9. Recommended strategies to advance community health, safety, wellbeing, flexibility and choice

No.	Strategy	Outcome
7.1	Advance platforms to facilitate a stronger collective voice advocating for a water sensitive approach to flood risk management, building on work by Resilient Sydney and modelling at a regional scale, building on the Hawkesbury-Nepean catchment experience	A collective voice around a water sensitive approach to flood risk management and solutions for water-related community resilience
7.2	Develop and implement a coherent and comprehensive strategy for managing Greater Sydney's flood risk	A systemic and consistent application of flood risk management solutions across the city
7.3	Develop new knowledge about solutions for increasing community resilience as part of an overall approach to enhancing integrated system resilience, building on work by Resilient Sydney	A suite of community resilience solutions for enhancing integrated system resilience
7.4	Examine and evaluate evidence about the need for flexibility and choice in delivering water supply and sanitation services	An understanding of the costs, benefits and risks (including avoided costs and risks) for service providers and customers in providing flexibility and choice for customers in their water supply, drainage and sanitation services

5.4 Towards strategy implementation

The vision developed as part of this transition strategy is ambitious and long term. Transitioning Sydney towards such an aspired future will involve multiple institutions and individuals acting with common purpose.

For Greater Sydney stakeholders to progress implementation of the strategies identified in this section, further work that goes beyond the scope of this current CRCWSC project will be required. Specific considerations may include:

1. Development of a long list of possible actions to drive the implementation of strategies.
2. Prioritisation of outcomes to address in the short- to medium-term, potentially drawing on the WSC Index results to inform reflection on priorities.
3. Prioritisation of actions based on factors such target outcome, feasibility, benefit, and potential leverage of current or upcoming projects, initiatives or available resources.
4. Action planning for prioritised actions to form the basis of an implementation plan with targets, timeframes, budgets, roles and responsibilities.
5. Business case development to progress particular actions or initiatives.
6. Structure and process to maintain collective momentum across stakeholders committed to implementing the strategy.
7. Strategic communications and influence approaches to secure organisational support and endorsement of the strategy implementation.
8. Framework for ongoing monitoring and evaluation of action implementation and transition progress.

Ultimately, it is intended for this Vision and Transition Strategy, and the companion report, to provide a resource for Greater Sydney stakeholders to continue collaborating through their next strategy implementation stages.

The CRCWSC has been working with other cities to support their implementation planning and can offer guidance to Sydney through the provision of tools, strategic advice, facilitation of further processes and sharing of lessons from other places.

6. Conclusion

Greater Sydney is recognised internationally for its iconic waterways, beautiful coastlines, and rich surrounding National Parks filled with biodiversity. The lifestyle that these natural assets support has attracted people from all over the world, making Sydney one of Australia's fastest growing cities. It is now faced, however, with an uncertain and changing climate, along with rapid population growth and infill development. An opportunity exists to take proactive steps to preserve and enhance Sydney's liveability, productivity, resilience and sustainability.

To explore this opportunity, 51 leaders and strategic thinkers from across Greater Sydney's water, planning, environment and development sectors came together for this CRCWSC-led project to understand Greater Sydney's unique water story, envision a future water sensitive Greater Sydney and develop enabling strategies that will be required to achieve their vision. The results of this process form a transition strategy, which provides a framework for prioritising and designing strategic action across the range of organisations and disciplines that will need to work collaboratively to facilitate Sydney's water sensitive city transition.

The insights presented in this transition strategy show that Sydney has a strong foundation to build on as it pursues its envisioned water future. The city's appetite for innovation and trialling water sensitive solutions, the dedication of individual champions to ensuring broad city outcomes, and the existing platforms for collaboration together provide a strong base to support local stakeholders in advancing their water sensitive city vision.

While Sydney's size can be a challenge in achieving integrated approaches to water management, it also provides a wealth of information, trials and experiments, and water sensitive solutions that can be drawn on and harnessed to realise the vision. Existing collaboration platforms can be expanded or new platforms could be created to foster a strategic approach to implementing and learning from a broad range of water sensitive solutions across the city.

Participants in this project agreed on shared aspirations for Greater Sydney, with vision themes of healthy environments, urban liveability, sustainable resource use, innovative infrastructure, citizen wellbeing, integrated governance, community stewardship and Aboriginal engagement receiving unanimous support. Throughout the workshop discussions, participants observed that liveability would be defined differently across different parts of Sydney, which needed to be reflected in the vision. The Greater Sydney Commission's concept of the "Three Cities" and associated district plans provide a sound framework for ensuring liveability across Sydney's diverse areas.

Champions across Greater Sydney are generally aware of the direction water management practice needs to shift, however silos within and among organisations still exist which may present challenges for collaboration towards a common vision. Due to the large number of organisations and actors in this space, it is important there is a clear, collective voice that drives an agenda for coherent water sensitive city action. To this end, there are several existing opportunities in Sydney that can be leveraged to create a platform for unifying the range of voices and supporting a coordinated and integrated approach to water management.

Another critical focus area for advancing Sydney's transition includes meaningfully engaging with the community, and especially Aboriginal communities, in order to understand their water values and how these values can be incorporated into water planning and decision-making. Platforms for engaging with communities exist in some parts of Sydney and provide a strong foundation to build upon, however they will need to be expanded in scope to include the full suite of Sydney's water sensitive city aspirations. More meaningful engagement approaches that go beyond standard consultation processes will empower residents to make informed contributions.

Engagement with Aboriginal communities will also need to be improved in order to better understand indigenous water knowledge and values, and ways to incorporate this knowledge into water planning and decision-making.

The project participants demonstrated openness, motivation and commitment for undertaking collective action to achieve their shared water sensitive vision. Building on this momentum and broadening industry and public support will put Greater Sydney in a strong position to accelerate its ongoing transition to achieve its water sensitive city vision.

Appendix A: Transition Dynamics Framework

This Appendix presents the framework and methodology applied to analyse Greater Sydney's transition progress in Section 5.

Transitions theory is a body of interdisciplinary research that studies how transitional changes are driven and enabled over time. CRCWSC research has drawn on this knowledge base to develop the Transition Dynamics Framework (Brown, Rogers and Werbeloff, 2016; Brown, Rogers and Werbeloff, 2017). This Framework identifies six distinct phases of change during a city's water sensitive transition (Figure 1).

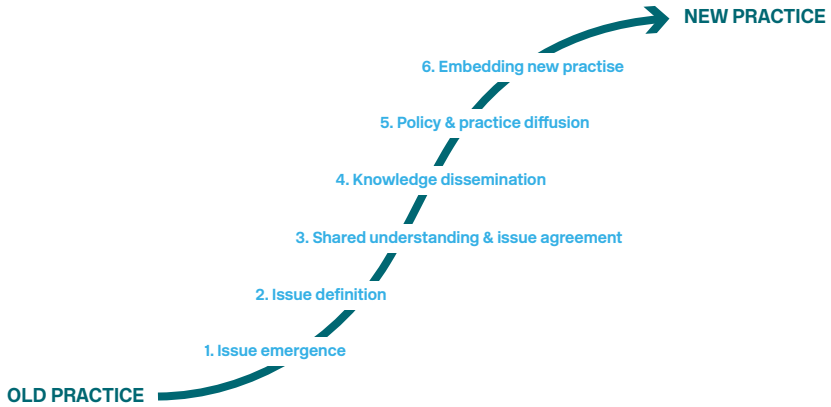


Figure 1. Six phases of change during the transition to a new practice

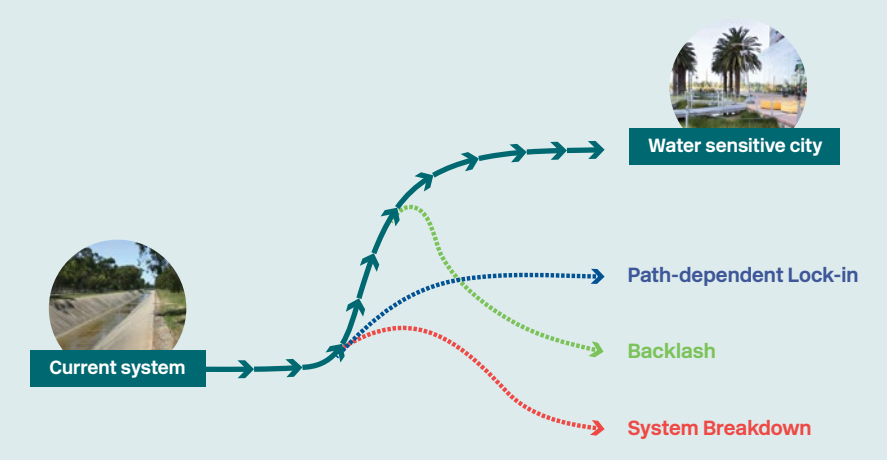


Figure 2. Transition pathways: Successful transition, lock-in, backlash and system breakdown

As a city moves through each phase sequentially, enabling conditions are established to support its trajectory towards its WSC vision and avoid the risk of change pathways that reflect lock-in, backlash or system failure patterns (Figure 2).

Actions to orient and drive change towards a city's envisioned water sensitive future need to progressively establish these enabling conditions. Actions with the most impact during the early phases of transition will be different from those during the later phases. It is critical to identify a city's current phase of change to ensure that actions are prioritised according to the effectiveness they will have in accelerating the WSC transition.

The CRCWSC's Transition Dynamics Framework sets out five types of enabling factors that need to be present throughout a transition: champions, platforms for connecting, science and knowledge, projects and applications, and practical and administrative tools. Together, these five factors create an enabling environment for a WSC transition and, mapped against the six transition phases, they create a matrix (Figure 3) for a deeper understanding of the current transition phase for each vision outcome.

The Transition Dynamics Framework was used as a diagnostic tool to assess the presence or absence of enabling factors as an indicator of progress towards Greater Sydney's aspired change in practice as it advances towards its water sensitive city vision. A range of desktop and engagement activities provided data on Sydney's enabling environment to apply the Framework.

The Framework provides a checklist of the factors that should be deliberately and sequentially built up to inform the prioritisation of strategies and actions.

Desktop review

Participant Interviews

Benchmarking discussions (WS1)

Transition Phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
1. Issue emergence	Issue activists		Issue highlighted	Issue examined	
2. Issue definition	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	
3. Shared understanding & issue agreement	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
4. Knowledge dissemination	Influential champions	Building broad support	Solutions advanced	Solutions demonstrated at scale	Refined guidance and early policy
5. Policy and practice diffusion	Organisational champions	Expanding the community of practice	Capacity building	Widespread implementation and learing	Early regulation and targets
6. Embedding new practice	Multi-stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

Figure 3. Transition Dynamics Framework (adapted from Brown et al., 2016; Brown et al., 2017)

References

Brown, R.R., Rogers, B.C., & Werbeloff, L. (2016). *Moving toward Water Sensitive Cities: A guidance manual for strategists and policy makers*. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

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