

Benchmarking Auckland's stormwater management practices against the Water Sensitive Cities framework

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Benchmarking Auckland's stormwater management practice against the Water Sensitive Cities framework

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Prepared for Auckland Council

Executive summary

Why benchmark stormwater management practice?

Stormwater management in Auckland has experienced considerable flux in recent years. The amalgamation of regional and district councils to establish Auckland Council as a unitary authority marked a significant change in the institutional arrangements for stormwater, requiring new accountabilities, policies, procedures and guidelines. The Auckland Plan now presents the region's long-term strategic direction.

It is timely to consider how stormwater management practice can contribute to the articulated vision of Auckland as the world's most liveable city. This project was commissioned by Auckland Council's Stormwater Unit to inform the development of the 2015-45 Stormwater Asset Management Plan and other stormwater management activities of Auckland Council.

This report, by the Cooperative Research Centre for Water Sensitive Cities¹, presents an assessment of stormwater management practice in Auckland, benchmarking the region's current aspiration, policy and on-ground action against scientifically accepted world's best practice for sustainable water management. It analyses Auckland's transition towards its aspired city-state, identifies key challenges and proposes a strategy and suite of recommendations for advancing Auckland's stormwater management towards a Water Sensitive City.

What is a Water Sensitive City?

Water management in 21st century cities has become increasingly challenging. The need to cater for population growth in the context of climate change projections, resource constraints, environmental degradation and evolving community expectations requires cities to look to more innovative responses in order to ensure continued liveability and resilience. The concept of a Water Sensitive City has emerged as a guiding vision for cities seeking to address these various challenges in a way that delivers a liveable and resilient city.

A Water Sensitive City is based on holistic management of the integrated water cycle to protect and enhance the health of receiving waterways, mitigate flood risk and create public spaces that harvest, clean and recycle water. It uses water management as a means of delivering better liveability outcomes more broadly, and recognises that a water sensitive approach to urban development and regeneration processes can help deliver on a range of objectives critical to the liveability of a city, such as biodiversity, public green space, healthy waterways, connected communities and cultural significance. Ultimately, a water sensitive approach is underpinned by a recognition that water can contribute to the creation of connected, vibrant and liveable communities.

Stormwater and the Water Sensitive City

Historically, stormwater was regarded as a nuisance and traditional drainage systems were built to swiftly channel stormwater away from cities and into receiving waterways in order to mitigate flood risk. However, it is increasingly recognised that this approach creates a range of environmental vulnerabilities and, in particular, has severely degraded the health of urban waterways waterways and disconnected communities from their amenity and recreational opportunities.

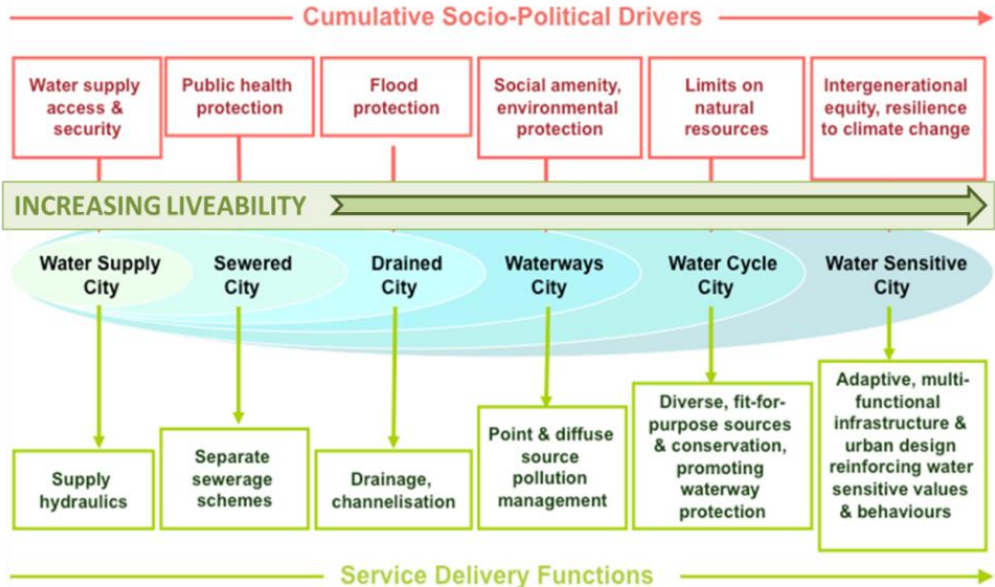
¹ The CRCWSC is an AUD\$100 million applied interdisciplinary research program funded by the Australian Government and more than 70 research, industry and government partners (watersensitivecities.org.au)

In a Water Sensitive City, stormwater is instead regarded as a resource that can be managed not simply to mitigate flood risk but to help deliver a range of desirable outcomes. Water sensitive planning and design can improve the health of urban waterways while simultaneously creating green corridors through the city, providing recreation spaces and improving amenity for the community. Stormwater presents an alternative water source that can be harnessed to avoid energy-intensive and costly infrastructure. Ultimately, a Water Sensitive City is a liveable city, and good stormwater management is critical to ensure growth that maintains and enhances a city’s liveability.

Transitioning to a Water Sensitive City

Industrialised cities typically feature large-scale centralised infrastructure, which has historically met the critical needs of water supply, public health protection and flood management as cities grew. However, it is now acknowledged that this style of service delivery has also led to increased environmental and social vulnerabilities, and as society’s demands and expectations evolve, a more complex and challenging policy and management context for water servicing is required.

The Urban Water Management Transitions Framework represents these evolving socio-political drivers and service delivery functions as six distinct developmental ‘states’ that cities typically move through, or are expected to move through, in response to society’s increasing liveability, sustainability and resilience aspirations for urban water management. These city-states form an embedded continuum, culminating in the Water Sensitive City. The framework was developed as a benchmarking tool for understanding a city’s present water management approach and defining its short and long-term goals. It has been employed by UNESCO-IHE, the Asian Development Bank, UN-HABITAT and CRCWSC to benchmark water management in cities globally.



Liveability and the Urban Water Management Transitions Framework (adapted from Brown et al., 2009)

The more complex drivers on the right of the framework require new infrastructural and institutional capacities. Transitions research makes explains that the shift to this side is challenging, since existing technologies, institutions and knowledge typically create path dependencies that are difficult to overcome. A combination of technological lock-in, institutional inertia and fragmentation and the challenge of reorienting professional and organisational capacity towards a new approach all serve as barriers to sector-wide transformation. Success therefore requires concerted and ongoing effort, requiring ongoing commitment, monitoring and investment to steer change in desirable directions.

How was Auckland’s stormwater management practice benchmarked?

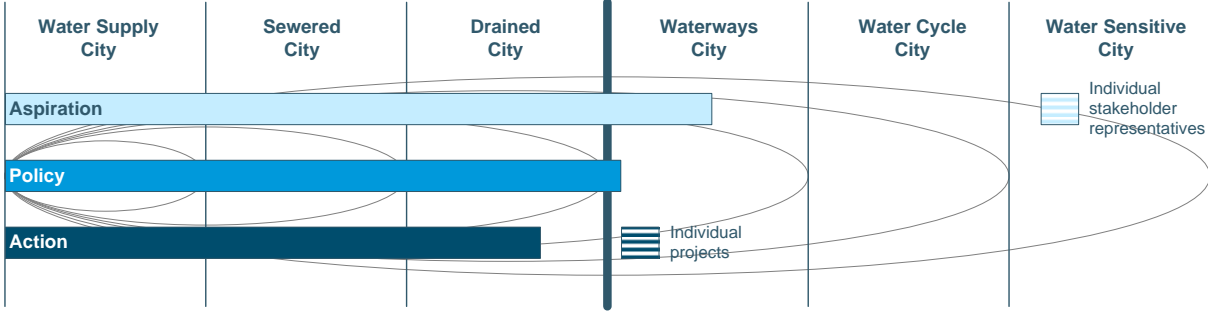
Two benchmarking assessments formed this project. First, the Urban Water Management Transitions Framework was used to benchmark Auckland’s stormwater management practice against scientifically accepted world’s best practice for sustainable water management.

Second, the transition progress for Auckland’s stormwater management practice was assessed, using a framework derived from contemporary research that charted six distinct phases of change in the transition from a Drained City to a Waterways, Water Cycle and Water Sensitive City, from the initial issue emergence through to the eventual embedding of the new practice as business as usual.

The assessment methodology was qualitative, drawing on the deep experience and perspectives of 38 representatives of key stakeholders within and outside Auckland Council, as well as key policy and organisational materials.

Where is Auckland’s stormwater practice now?

Auckland aspires to a Waterways City and is developing policy in this direction; however, the majority of on-ground action reflects the Drained City.



Assessment of Auckland’s current aspiration, policy and action for stormwater management practice

Aspiration: The region’s harbours and beaches are highly valued by the community and their preservation is fundamental to the vision of Auckland as the world’s most liveable city, as articulated in the Auckland Plan. Māori’s have strong cultural values of healthy waterways, providing a strong driver for managing stormwater from a Waterways City perspective. Interview and documentary evidence shows that current aspirations across the sector coalesce around the Waterways City. The language of water sensitivity is becoming increasingly adopted across Auckland and some individual stakeholder representatives aspire to a Water Sensitive City in itself. Water cycle management, fit-for-purpose supply and integrated planning for water and land use are not identified as an aspiration.

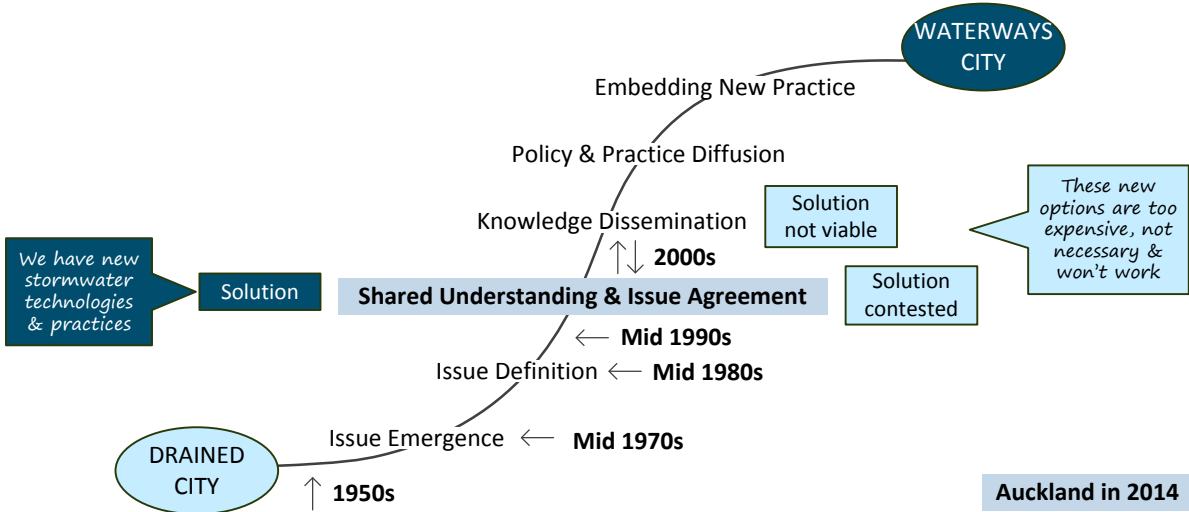
Policy: The stormwater policy space is currently in development, with potential to drive Waterways City related outcomes. The Stormwater Unit has clear environmental health objectives within a hierarchy of priorities, in which positive environmental outcomes are pursued when the opportunity arises on specific projects, rather than requiring it as standard practice. Important steps forward are being made with the Proposed Auckland Unitary Plan and the proposed amendments to the National Policy Statement for Freshwater Management. However, many stakeholders anticipate that these policy directions are likely to be softened to accommodate the priority of affordable land development. Auckland Council has obligations to co-manage land and water resources with iwi, grounded in their values associated with ecosystem guardianship.

Action: Drainage services and flood mitigation are the major drivers for on-ground stormwater initiatives. While individual projects have adopted waterways city principles, mainstream practice is in the Drained City. Sediment control is a consenting requirement for new land developments; however, indicators of stream and harbour health reveal continued degradation. Integrated catchment solutions and comprehensive source control of stormwater pollution are limited in practice. Wastewater overflows to receiving waterways occur in some parts of the central Auckland and each year up to 10 kilometres of natural streams are piped to enable land development.

What is Auckland’s transition progress?

Auckland’s current stormwater management transition is benchmarked to be at the ‘shared understanding and issue agreement’ phase.

Auckland’s transition from a drained city began in the 1970s, when waterway health emerged as an issue. Scientific research on the extent and causes of the problem then led to broad recognition that stormwater has a major impact on receiving water environments. Efforts to advance stormwater management have focused on establishing strategic frameworks, guidelines and catchment plans intended to encourage best practice and intervention, leading to the ‘knowledge dissemination’ phase of the 2000s. Since 2010, Auckland Council’s attention and resources have been internally targeted, as focus has been on integrating the diversity of approaches from legacy councils into a unified way forward across all activities of the Auckland Council. Within this context, Auckland has returned to the ‘shared understanding and issue agreement’ phase.



Auckland’s progress from a Drained City to a Waterways City

What are Auckland’s challenges for advancing stormwater management practice?

A lack of strategic alignment across key stakeholders is the overarching challenge for further progress towards a Waterways City.

Stormwater management is an inherently complex topic, which has been intensified for Auckland as a result of council amalgamation, which represented a recent major reform to the institutional roles and responsibilities for stormwater management practice. In the fragmented context for Auckland’s stormwater management practice, a shared vision and joined-up strategy is critical for mobilising individual stakeholder priorities, knowledge and resources towards a common goal.

How can Auckland achieve water sensitivity?

The following recommendations will help Auckland Council achieve water sensitive stormwater management. Their purpose is to consolidate and move beyond the current transition phase of ‘shared understanding and issue agreement’ through to ‘embedding new practice’ as effectively as possible. They are presented as a suite of three packages, for sequential or parallel implementation.

Package 1: Strategic positioning, addressing Auckland’s overarching challenge by creating the pathway and opportunity to develop a joined-up and shared vision and strategy for water sensitive stormwater management.

Key Issues	Recommendations
Disconnection of narrative from the liveability agenda and broader benefits of stormwater management	1.1 Connect water sensitive stormwater management with Auckland’s liveability agenda
Lack of strategic vision and plan that is shared across organisational units	1.2 Conduct an independent assessment of the current state of Auckland’s stormwater system, its needs and practical opportunities for improving the overall sustainability of the waterway environment
Unclear political and business case for water sensitive stormwater management	1.3 Harness existing corporate knowledge about water sensitive stormwater management
Risk of loss of corporate knowledge	1.4 Develop a shared strategic vision for stormwater management
Lack of consensus on stormwater related issues and solutions	1.5 Develop a value proposition for water sensitive stormwater management
	1.6 Synthesise outcomes from 1.1 to 1.5 to develop a stormwater strategy

Package 2: Network capacity and learning, facilitating the most effective conditions for deepening the knowledge base and expanding the professional and stakeholder network explicitly participating in advancing water sensitive stormwater management.

Key Issues	Recommendations
Overly narrow professional network	2.1 Establish a sector-wide capacity building program that targets a wide range of policy, planning, decision-making and technical actors
Lack of multi-sectoral champions and political leadership	2.2 Provide enabling platforms for technical, policy, planning and decision-making champions of water sensitivity
Lack of knowledge and trust in water sensitive technologies	2.3 Develop a dedicated learning and demonstration program for Auckland as a Water Sensitive City
	2.4 Form scientific and practice partnerships with local organisations and international networks

Package 3: Enabling structures and tools, facilitating the organising structures and enabling tools that will expedite the on-ground practice of water sensitive stormwater management.

Key Issues	Recommendations
Structural separation and lack of clear and joined-up total water cycle management roles across Council	3.1 Develop bridging cultures, structures, processes and resources to support strategic alignment across relevant stakeholder groups
Lack of statutory tools and mandates	3.2 Integrate water cycle responsibilities within a common organising framework
	3.3 Develop robust methodologies, evaluation tools and evidence for analysing the costs and benefits of stormwater management options
	3.4 Implement statutory, non-statutory and practice tools for advancing water sensitive stormwater management practice

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Glossary

Actors	Individual people or organisations that have a role in how water is valued, planned, designed, managed, financed or used
City-state	Developmental states of a city that represent distinct characteristics of water service delivery functions in response to different socio-political drivers
Drained City	The city-state which provides drainage services to protect people and property from flooding, as well as make land available for property development. The Water Supply City and Sewered City are embedded within
Institutions	Social structures that provide formal and informal ‘rules’ to determine what actors can do in different situations
Sewered City	The city-state which provides sanitation services to protect public health. The Water Supply City is embedded within
Stormwater management practice	The aspirations, policies and on-ground actions associated with managing the quantity and quality of stormwater
Transition / Transformative change	Fundamental shift in the cultures, structures and practices of a system
Vision	An imagined, long-term desired future
Waterways City	The city-state which provides stormwater pollution and hydraulic impact management services to improve the ecological health of waterways and enhance urban amenity. The Water Supply City, Sewered City and Drained City are embedded within
Water Cycle City	The city-state which provides integrated water management services, ensuring that supplies from diverse sources such as stormwater, greywater and recycled wastewater are put to their most appropriate use. The Water Supply City, Sewered City, Drained City and Waterways City are embedded within
Water Sensitive City	The city-state which provides holistic water planning and management of the integrated water cycle and emphasises adaptive, multi-functional infrastructure and urban design in its service delivery solutions. The Water Supply City, Sewered City, Drained City, Waterways City and Water Cycle are embedded within
Water Sensitive Design	An approach for urban, land use and water infrastructure design that provides an environmentally sensitive response to the local water context
Water Supply City	The city-state which provides water supply services to support people’s sustenance and shelter, as well as for productive purposes.
Water system	The natural and capital infrastructure, institutional structures and processes, and the actors that use or influence the planning and management of all parts of the water cycle.

1.0 Introduction

1.1 Why benchmark stormwater management practice?

Stormwater management in Auckland has experienced considerable flux in recent years. The amalgamation of regional and district councils to establish Auckland Council as a unitary authority marked a significant change in the institutional arrangements for stormwater, requiring new accountabilities, policies, procedures and guidelines. The Auckland Plan now presents the region's long-term strategic direction.

It is timely to consider how stormwater management practice can contribute to the articulated vision of Auckland as the world's most liveable city. This project was commissioned by Auckland Council's Stormwater Unit to inform the development of the 2015-45 Stormwater Asset Management Plan and other stormwater management activities of Auckland Council. Phase 1 of the project involved a city-wide benchmarking assessment of stormwater management in Auckland against scientifically accepted world's best practice for sustainable water management. Phase 2 involved identifying key challenges and opportunities for improving stormwater management in the Auckland context.

This report by the Cooperative Research Centre for Water Sensitive Cities (CRCWSC) presents an assessment of stormwater management practice in Auckland, benchmarking the region's current aspiration, policy and on-ground action using the Urban Water Management Transitions Framework (Brown et al., 2009). The report analyses the transition towards Auckland's aspired city-state and identifies key challenges. The report then proposes a strategy and suite of recommendations for advancing Auckland's stormwater management towards a Water Sensitive City and the world's most liveable city.

1.2 CRC for Water Sensitive Cities

The CRCWSC² is a collaboration between more than 70 research, industry and government partners from Australia and abroad. It brings together interdisciplinary research expertise and industry leaders to undertake research that will revolutionise water management in Australia and overseas. Established in 2013, the CRC has a research budget of over AUD\$100 million over nine years to deliver the socio-technical urban water management solutions, education and training programs, and industry engagement required to make towns and cities water sensitive.

This report's authors are researchers with the Society Program of the CRC, which focuses on understanding and delivering the social and institutional transformations needed to support Water Sensitive Cities, including community attitude and behavioural change, governance & economic assessment practices, management systems and technological innovation.

² <http://watersensitivecities.org.au/>

2.0 Water Sensitive Cities

2.1 What is a Water Sensitive City?

Water management in 21st century cities has become increasingly challenging. The need to cater for population growth in the context of climate change projections, resource constraints and evolving community expectations requires cities to look to more innovative responses in order to ensure continued liveability and resilience.

The concept of a Water Sensitive City has emerged as a guiding vision for cities seeking to address these various challenges in a way that delivers a liveable and resilient city. A Water Sensitive City is based on holistic management of the integrated water cycle and emphasises flexibility, diversity and adaptability in its solutions. Following this approach, the urban hydrological cycle is managed in a way that protects and enhances the health of receiving waterways, mitigates flood risk and creates public spaces that harvest, clean and recycle water. Importantly, a Water Sensitive City uses water management as a means of delivering better liveability outcomes more broadly, and recognises that a water sensitive approach to urban development and regeneration processes can help deliver on a range of objectives critical to the liveability of a city, such as biodiversity, public green space, healthy waterways, connected communities, and cultural significance. Ultimately, a water sensitive approach is underpinned by a recognition that water can contribute to the creation of connected, vibrant and liveable communities.

2.2 Stormwater and the Water Sensitive City

Stormwater management is a critical part of the transition towards water sensitivity and liveability more generally. Historically, stormwater was regarded as a nuisance. In response, traditional drainage systems were established to swiftly channel stormwater away from cities and into receiving waterways in order to mitigate flood risk. However, it is increasingly recognised that this approach creates a range of environmental vulnerabilities and, in particular, has severely degraded the health of urban waterways and disconnected communities from their amenity and recreational opportunities.

In a Water Sensitive City approach, stormwater is instead regarded as a resource that can be managed not simply to mitigate flood risk but to help deliver a range of desirable outcomes. In particular, water sensitive planning and design can help improve the health of urban waterways while simultaneously creating green corridors throughout the city, providing recreation spaces and improving amenity for the community. Stormwater capture in this way also presents a potential alternative water resource that can be harnessed in times of short supply or to avoid potentially costly infrastructure investment. Ultimately, a Water Sensitive City is a liveable city, and good stormwater management is critical to ensuring growth unfolds in a way that maintains and enhances a city's liveability.

In response to these environmental vulnerabilities and liveability opportunities, cities globally are applying new concepts in stormwater management practice. While different parts of the world have adopted their own vocabulary, technologies and design guidelines (e.g. WSD, WSUD, LID, LIUDD, SUDS)³, in common is a recognition that an interdisciplinary and integrated approach is needed if the wide-ranging objectives of stormwater management are to be met⁴.

2.3 Urban Water Management Transitions Framework

The Urban Water Management Transitions Framework (Brown et al., 2009) is a benchmarking tool used to understand a city’s present approach to water management and define its short and long-term goals in relation to water servicing (Figure 1). The framework identifies six distinct city ‘states’ that cities move through on their path toward more sustainable water management. Importantly, linear movement through each state is unnecessary, and it may be possible for cities to ‘leap-frog’ from one state to another, thereby expediting the realisation of more sustainable water infrastructure. Further, a city’s water management approach may not necessarily be located entirely in one state. That is, the city may manage different parts of its water cycle in different states (i.e. wastewater is managed following a Sewered City approach, but stormwater is managed in accordance with the Waterways City). Taken together, the states form an embedded continuum that represents the growing liveability, sustainability and resilience of a city’s urban water management approach.

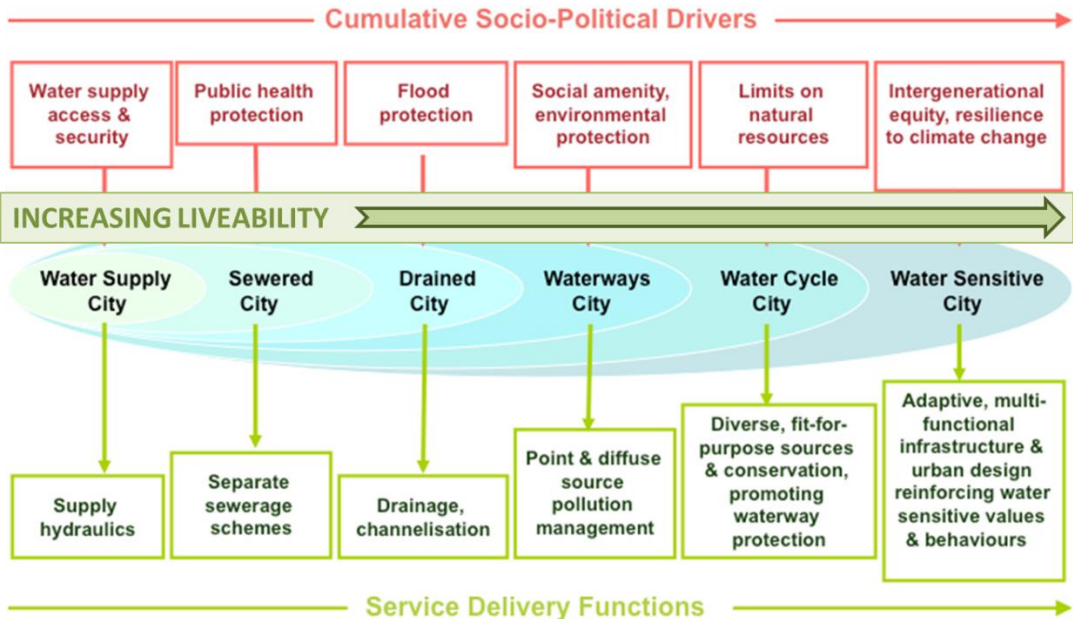


Figure 1. Liveability and the Urban Water Management Transitions Framework⁵

³ WSD = Water Sensitive Design; WSUD = Water Sensitive Urban Design; SUDS = Sustainable Urban Drainage Systems LID = Low Impact Design; LIUDD = Low Impact Urban Design and Development; WSUD = Water Sensitive Urban Design; SUDS = Sustainable Urban Drainage Systems

⁴ See, for example: Auckland Council (2013) Guideline Document 2013/004: Water Sensitive Design for Stormwater; Water Environment Federation and American Society of Civil Engineers/Environmental & Water Resources Institute (2012) Design of Urban Stormwater Controls; Construction Industry Research and Information Association (2007) CIRIA C697 The SuDS Manual; Engineers Australia (2006) Australian Runoff Quality: A Guide to Water Sensitive Urban Design.

⁵ Adapted from Brown et al. (2009)

The first three city states (the Water Supply City, Sewered City and Drained City) represent the historic developments in the delivery of water services in industrialised cities in response to evolving socio-political drivers of water supply access and security, public health protection and flood protection. The Water Supply City represents the most basic state of modern water management, and provides water supply services, which can be used to support people’s sustenance and shelter, as well as for productive purposes. The Sewered City builds on the previous state and is driven by a desire for better public health and hygiene. It provides sanitation services, which can improve public health and, as a result, enable people to be more productive. The Drained City provides drainage services, which can protect people and property from flooding, as well as make land available for property development.




Perth
Perth’s water system is operating under a traditional regime of large-scale centralised infrastructure supply, sewerage and drainage infrastructure. There are policy steps towards stormwater quality management but stormwater actions to improve waterway health are yet to be mainstreamed. Under chronic drought conditions, there are aspirations to manage the water cycle in an integrated way.




Rotterdam
Rotterdam, in the Netherlands where more than 60% of the land is below sea level, is acutely aware of historic and future water management challenges. It aspires to integrating water management with urban planning and design to deliver a Water Sensitive City and formal policies for water cycle management are being developed. However, on-ground action remains largely in the Drained City.

Globally, industrialised cities in these first three states tend to have similar characteristics, since they have typically addressed the evolving socio-political drivers through large-scale centralised infrastructure. Until recently, this approach has served the needs of cities relatively well. However, there is now broad acknowledgement that the way water servicing is planned, designed and managed must move beyond the traditional approach so that the community’s urban water needs can continue to be met, despite uncertain future conditions. Cities are therefore starting to explore the question of how a liveable, sustainable and resilient city can be supported by its water system.

The last three states mark a significant shift beyond mere existence needs, toward more sophisticated goals of greater water self-sufficiency and improved liveability. The Waterways City provides stormwater pollution and hydraulic impact management services, which can improve the ecological health of waterways, make them attractive for recreation and related business opportunities, connect communities with their waterways, increase a sense of place, and enhance cultural values associated with healthy waterways. The Water Cycle City provides integrated water management services, ensuring that supplies from diverse sources such as stormwater, greywater and recycled wastewater are put to their most appropriate use. The Water Sensitive City provides urban design services, which can improve the city’s amenity, including aesthetic appeal and thermal comfort, which in turn increases its attractiveness for a range of investments.

Many cities are taking significant steps to advance practice towards a Water Sensitive City, although a fully developed example is yet to be realised. The socio-political drivers and service responses for the last three states can become increasingly complex and context-dependent, as the institutional and infrastructural features that deliver water sensitive outcomes will vary with the local conditions. Leading cities are currently going through a process of understanding and defining the performance indicators that would represent a Water Sensitive City for their context to guide practice in this direction.

	Water Supply City	Sewered City	Drained City	Waterways City	Water Cycle City	Water Sensitive City
<p>Melbourne</p> <p>Melbourne aspires to a Water Sensitive City and is implementing a new policy designed to drive generational reform in how the urban water cycle is managed, prioritising harvested stormwater and recycled wastewater over traditional supply sources. Protection of downstream waterways through water sensitive stormwater management is mandated for new developments and formal incentives are in place to encourage this practice.</p>				 <p>Action</p>	 <p>Policy</p>	 <p>Aspiration</p>

	Water Supply City	Sewered City	Drained City	Waterways City	Water Cycle City	Water Sensitive City
<p>Singapore</p> <p>Singapore has overcome severe water security and flood management challenges through developing an integrated water system that includes reclaimed wastewater and stormwater from its local catchments. Its Active, Beautiful and Clean (ABC) Waters Program is a formal policy for delivering green, liveable and healthy landscapes and waterways so that Singapore can realise its vision of becoming the world’s first Water Sensitive City.</p>				 <p>Action</p>	 <p>Policy</p>	 <p>Aspiration</p>

The Urban Water Management Transitions Framework (Figure 1) has been employed by UNESCO-IHE, the Asian Development Bank, UN-HABITAT and the CRC to benchmark water management in cities globally. UNESCO-IHE’s SWITCH City Water Summit adopted the framework as a tool to benchmark over 27 cities in both developed and developing countries on the basis of their existing water supply, sanitation, and drainage services. The assessment produced two clear clusters of cities along the transition continuum (Figure 2); cities in developing countries were aggregated at the Water Supply City end of the scale, and those in developed countries clustered between the Drained City and Waterways City states.

In any city, the ease of moving toward the Water Sensitive City state is determined by the city’s history, ecology and geography, as well as by the existing technologies and institutional (governmental and organisational) structures that govern water management. The question of how to transition towards greater water sensitivity is one many cities are currently grappling with, and has been the subject of extensive research. The results of the UNESCO assessment suggest that the transition from the Drained City to the Waterways City is particularly challenging, as discussed in more detail in Section 2.4.

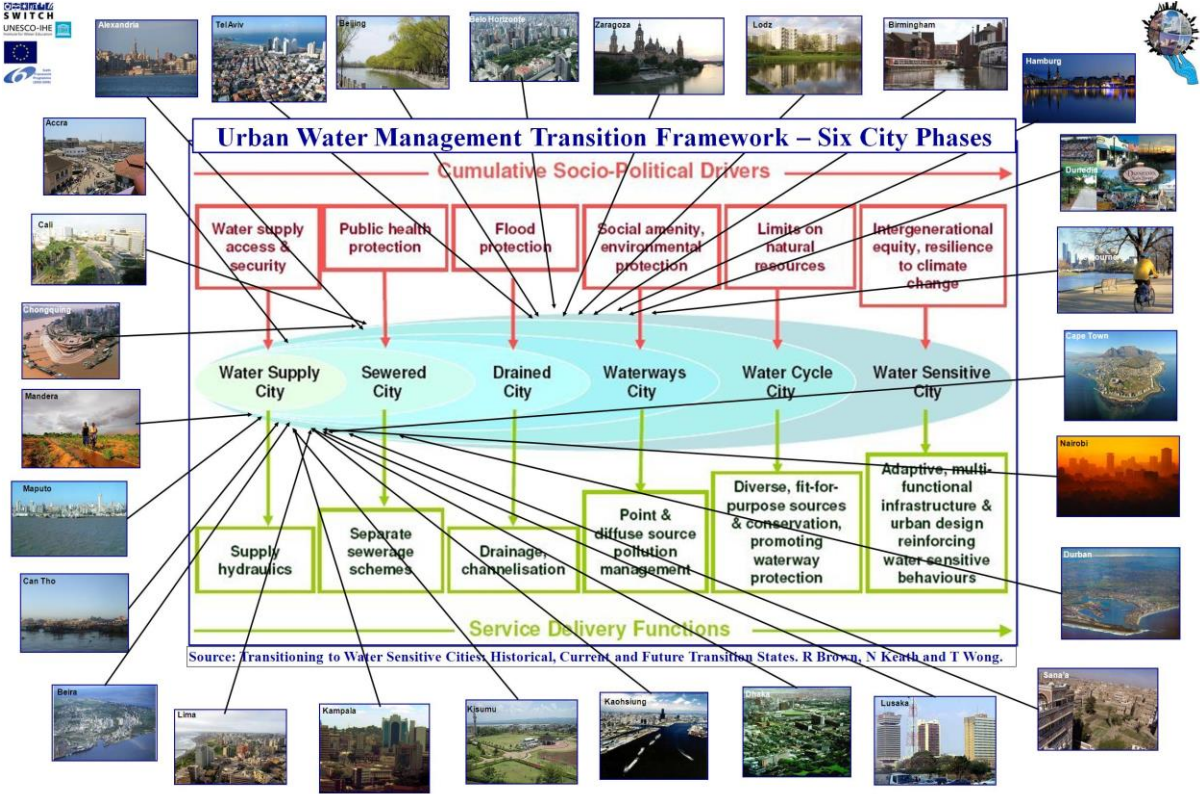


Figure 2. Benchmarking results from UNESCO-IHE’s SWITCH City Water Summit⁶

⁶ Jefferies and Duffy (2009)

2.4 Dynamics in the transition to Water Sensitive Cities

As the UNESCO assessment revealed, most developed cities are clustered between the Drained and Waterways City, highlighting that transitioning further along the continuum is a challenge faced by urban water sectors around the world. The transition from a Drained to a Waterways City is particularly challenging as it requires a fundamental reorientation of existing infrastructures, institutions and approaches to water management. As Figure 3 demonstrates, the water servicing needs of the first three city states have traditionally been met through large scale, centralised infrastructure typically provided by city engineers. However, the more complex and inter-related needs of the last three city states requires a shift to an interdisciplinary approach to provide more flexible and integrated infrastructures and institutions at both centralised and decentralised scales.

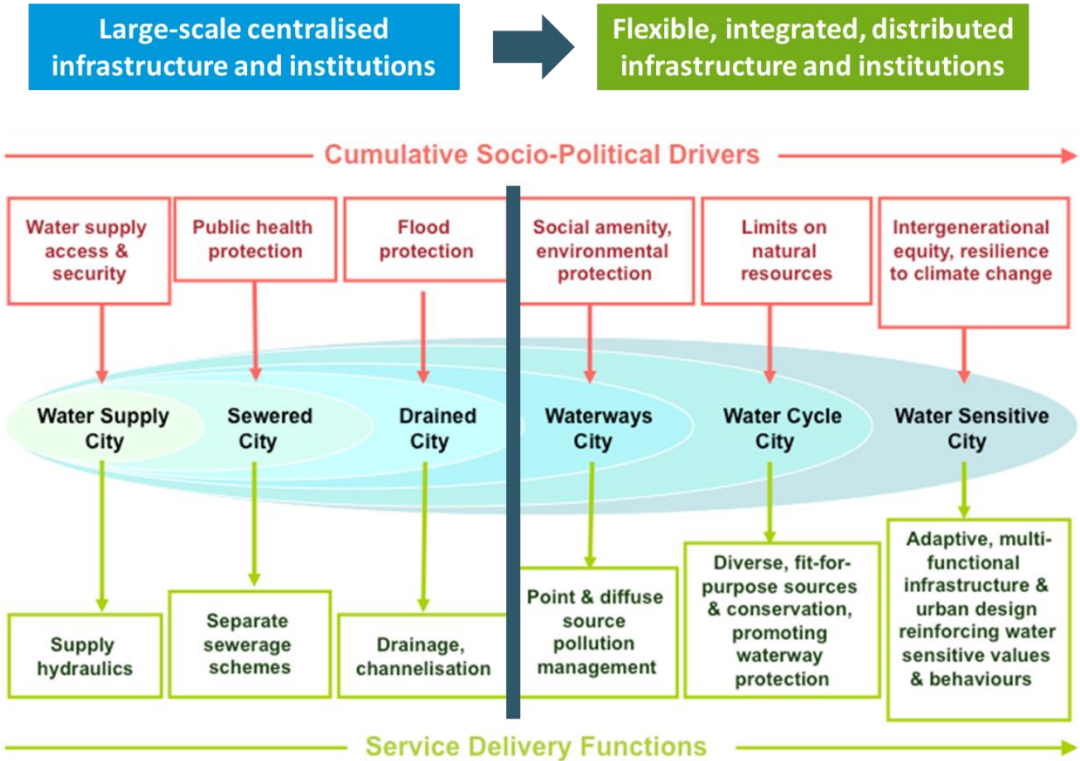


Figure 3. Challenges for urban water transitions⁷

The transition from the Drained to a Waterways City is particularly challenging as stormwater pollution cannot be managed successfully through existing centralised technology, but generally requires a holistic approach, including at source control and distributed systems in combination with communal or centralised infrastructure. Given the more complex socio-political drivers and service delivery functions on the right hand side of the framework, the shift across the halfway point of the continuum is a significant transition.

⁷ Adapted from Brown et al. (2009)

Research in this area makes clear that this transition process is challenging because the framework of existing technologies, institutions and people’s capacities typically create a path dependency that is hard to overcome. A combination of technological lock-in, institutional inertia and fragmentation and the challenge of reorienting professional and organisational capacity towards a new approach all serve as significant barriers to sector-wide transformation. The results of current research into sector-wide transformation processes indicates that realisation of change on the ground requires mutually reinforcing change across infrastructures, institutions and practices. Further, the results of this research make clear that a focus on technical innovation is not enough, and that the social and institutional dynamics that underpin any city’s transition attempt is key when trying to move entrenched water management systems into new directions.

Importantly, successful sector-wide transformation requires concerted and ongoing effort. Transitions research makes clear that there are a number of potential pathways in a transformation process, as reflected in Figure 4. While the ideal transition trajectory results in stabilisation of a new practice, there are a number of alternative, less desirable pathways that can unfold. As such, ensuring a successful transition process requires ongoing commitment, monitoring and investment to steer change in desirable directions.

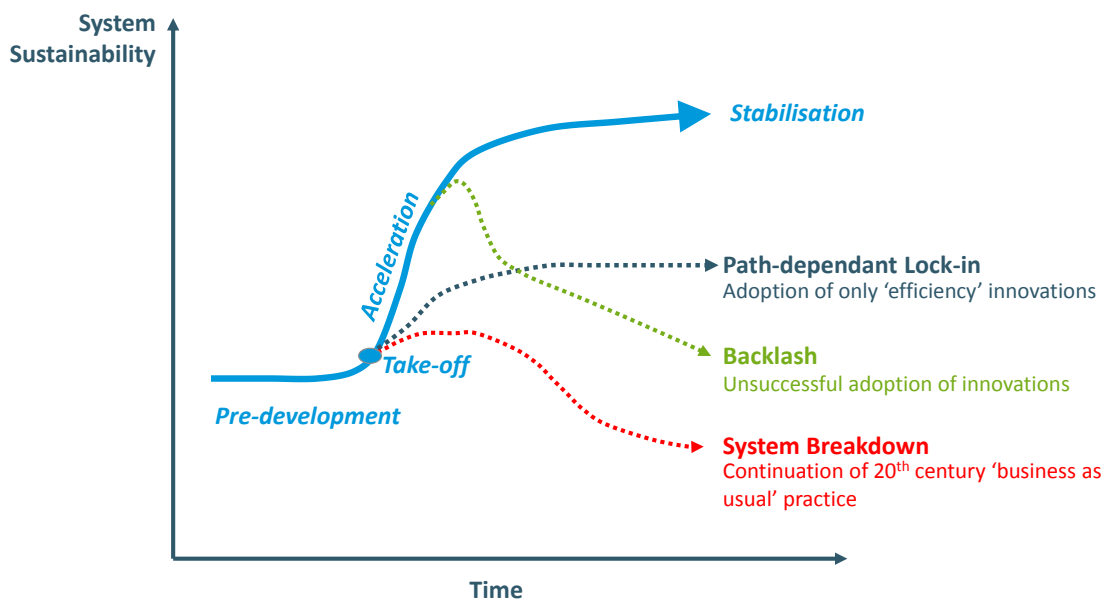


Figure 4. Different transition pathways⁸

⁸ Van der Brugge and Rotmans (2007)

In the transition from a Drained City to a Waterways City (or subsequent city states), contemporary research results show that six distinct phases of change can be observed, reflected in Figure 5. Taken together, these six phases chart the initial issue emergence through to the eventual embedding of the new practice as part of a business as usual approach. In the issue emergence phase a particular problem is identified (i.e. poor waterway health), and in the issue emergence phase, a cause of that problem is identified (i.e. stormwater pollution). The shared understanding and issue agreement phase is characterised by a common understanding of, and agreement on, the problem, its causes, and its repercussions. Solutions are not yet agreed on, but the need for action is acknowledged. From this point, the knowledge dissemination and policy and practice diffusion phases are marked by greater agreement on the appropriate solutions among a broad cross-section of stakeholders. The final transition phase is the embedding of the new practice into mainstream practice. More detail on each of these phases, and how they relate to Auckland’s stormwater management approach, is outlined in Section 3.2.

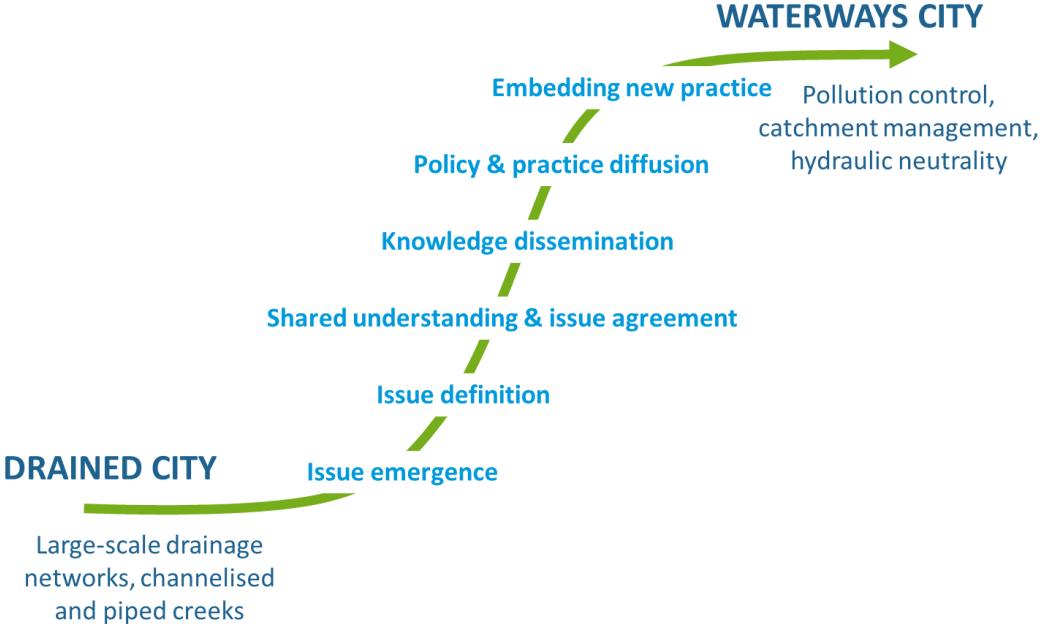


Figure 5. Key phases in the transition from a Drained City to a Waterways City⁹

⁹ Adapted from Brown et al. (2013)

Each phase can be assessed across a typology of five factors: actors, bridges, knowledge, projects and tools. The term ‘actors’ refers to the individuals and organisations that are involved in or engaged with the issue. In an ideal or typical transition pathway, the actor network typically grows over time, as a greater cross-section of stakeholders becomes engaged with refining the new practice and its implementation process. ‘Bridges’ refers to bridging organisations that facilitate collaborations across science, policy and industry spheres. In the early phases of a transition, bridging organisations can help to deepen understandings of the problem, and at later phases can assist with translating the new practice into action. ‘Knowledge’ refers to the evolving scientific understanding of the problem and the potential solutions. The term ‘projects’ refers to experiments or demonstration projects to test the viability of new technologies or approaches, from the development of scientific prototypes through to demonstration projects that serve as proof of concept of a new approach. Finally, the term ‘tools’ is used to refer to administrative and practice tools such as best practice guidelines, legislative and market mechanisms used to help embed the new practice. An assessment of Auckland’s current stormwater management approach across each phase of the transition in relation to each of these five factors is contained in Section 3.2.

Over these six phases, narratives about the new practice typically change. A narrative is the dominant description of a particular practice, and the content of a narrative will typically change over the course of a transition. For example, in the early phases of a transition (the issue emergence and definition phases), the dominant narrative may reflect a realisation that stormwater pollution is causing poor waterway health and by the end of a transition (the embedding new practice phase), the narrative could be that improved stormwater management helps deliver enhanced liveability outcomes. Over the course of a transition it is generally possible to observe a narrative in support of the new practice (advocating narrative), as well as a narrative that challenges the new practice or believes it is either unnecessary or inappropriate (contesting narrative). Narratives are a useful indicator of the dominant perception of current practices, and the change in narratives over time can usefully reveal the stage a city is at in a transition.

2.5 Benchmarking Auckland’s stormwater management practice

The frameworks presented in Sections 2.3 and 2.4 were applied in this project to benchmark Auckland’s current city-state¹⁰ and transition progress towards its aspired state of a Waterways City.

2.5.1 Qualitative assessment

The benchmarking assessment is qualitative to facilitate an integrated and detailed understanding of Auckland’s stormwater management within its real-world context. Qualitative analysis ensures that all relevant variables (especially those that may not be immediately apparent) are considered and enables the integration and synthesis of multiple sources of evidence.

¹⁰ Given the inherent contextual nature of what water sensitivity means, it is unlikely there will be a standard set of performance indicators that hold across all cities globally. As a benchmarking tool, the Urban Water Management Transitions Framework has not yet reached the stage of maturity where a suite of indicators and measures for the city-states in different urban contexts has been defined; development of such a suite is a core topic of current research. Nevertheless, the framework’s application as an objective measure of the sustainability of a city’s water management approach is universally accepted in scientific literature and has been widely used in practice as a conceptual benchmarking and comparison tool.

The following four sources of evidence were used in the assessment:

- Interview data that includes reflections, self-assessments, observations and perceptions from a broad range of stakeholder representatives within and outside of Auckland Council (see Section 2.5.1)
- Analysis of current initiatives as included in publicly available policy, organisational, management and other documentary evidence, as well as other written information made available as part of this project (see Appendix A for list of documentary evidence)
- Stormwater management experience as reported in cities elsewhere internationally, with a particular focus on cities in Australia, USA, Singapore and the UK
- Contemporary social science research theory and empirical evidence on effective strategies and techniques for enabling successful transition and change processes.

2.5.2 Interview data collection

Interviews were conducted with key stakeholder representatives from across Auckland Council, other government agencies, the private sector and broader stakeholder groups. A number of different interview formats were adopted as the project progressed through its different phases:

- Oral histories of the development of stormwater management practices across Auckland
- Benchmarking interviews to assess current stormwater management practice in Auckland
- Diagnostic interviews to unpack key issues and opportunities for Auckland's current context
- Group interviews to explore possible strategic leverage points in-depth

Interviews were conducted with representatives at executive, management and officer levels (where possible) of the following organisational units.

- Auckland Council's Stormwater Unit (10 interview participants)
- Units beyond Stormwater in Auckland Council (11 interview participants)
 - Elected Representatives
 - Environmental Services
 - Engineering and Technical Services
 - Stormwater Natural Resources and Special Input – Resource Consents
 - Environmental Strategy and Policy
- Auckland Council's Council-Controlled Organisations (7 interview participants)
 - Watercare Services Limited
 - Auckland Transport
 - Waterfront Auckland Development Agency
- External organisations (10 interview participants)
 - Consultants
 - Developers
 - Researchers

We did not have the opportunity to engage directly with the Kaitiaki Forum or Local Board meetings as part of this project and it was decided that interviewing representatives from only a select few iwi or Local Boards would not suffice. We sought to address this limitation in the first instance by reviewing available documentation where Local Board, iwi and the general public have expressed

interest and preferences around stormwater management¹¹. Furthermore, we asked other interviewees about their views on the role of the Local Boards and Iwi, and the perception of Auckland's stormwater management that would likely be held by those stakeholders. We recommend this report is circulated to these groups to seek further feedback on its implementation.

All interviews were conducted on the condition of anonymity and confidentiality. Interviewees were advised that the content of their discussions would only be made available to the report authors.

Anonymous quotes have been used throughout this report as evidence to represent key perspectives that were articulated during the interviews. While the quotes provided may not resonate with all stakeholder representatives, they represent the range of views expressed and have been sampled from across the full spectrum of interviewees. Quotes have been carefully selected to ensure the identity of interviewees remains protected.

2.5.3 Data analysis

The research was conducted in two phases. Phase 1 focused on benchmarking Auckland's stormwater management aspirations, policy and on-ground actions according to the Urban Water Management Transitions Framework (Figure 1). 'Aspirations' refers to the dominant goal for stormwater management across the sector as articulated by key actors, 'policy' refers to the vision for stormwater management as contained in policy documents and 'action' refers to the mainstream, everyday and business as usual practice on the ground.

Auckland's changing practice in stormwater management was then assessed using process indicators for each phase of change (Figure 5) that have been identified through research on stormwater transitions. Phase 2 focused on identifying recommendations for advancing stormwater management in Auckland.

2.5.4 Research validation

Validation processes are critical for ensuring the robustness of qualitative research projects, through testing the accuracy of the synthesised insights gained from interpretation of multiple sources of evidence.

The results from Phase 1 (benchmarking) were validated through the dissemination of a draft summary benchmarking statement to interviewees for comment. Separate workshops with internal and external stakeholder representatives, and some follow-up interviews, were conducted to confirm the benchmarking results presented in the summary statement.

The results from Phase 2 (diagnosis of opportunities and challenges) were validated through the dissemination of the draft report to interviewees and other stakeholder representatives for comments. A template was provided for participants to document their comments and refinements as necessary, following their review. Feedback was sought either via Auckland Council project representatives or directly to the report authors.

¹¹ For example, Auckland Council (2012) Legal Framework for Obligations to Māori and Under Te Tiriti O Waitangi/Treaty of Waitangi – Part A; Auckland Council (2012) Legal Framework for Obligations to Māori and Under Te Tiriti O Waitangi/Treaty of Waitangi – Part B; Independent Māori Statutory Board (2012) The Māori Plan for Tamaki Makaurau; Whiria Te Muka Tangata: The Māori Responsiveness Framework; Albert-Eden Local Board (2011) Local Board Plan; Auckland Council (2013) Elected Member Handbook: Governance Arrangements for Local Boards

3.0 Stormwater management practice in Auckland

3.1 City-state

Auckland aspires to a Waterways City and is developing policy in this direction; however, the majority of on-ground action reflects the Drained City.

Auckland’s transition from a drained city began in the 1950s, when waterway health emerged as an issue. Since then, scientific research on the extent and causes of the problem has led to broad recognition that stormwater has a major impact on receiving water environments.

Efforts to advance stormwater management over the last 20 years have focused on establishing strategic frameworks, guidelines and catchment plans intended to encourage best practice and intervention. However, there has been limited progress beyond an agreement and understanding that stormwater quantity and quality both need to be addressed.

“We know what to do, but knowing is not doing”

Figure 6 benchmarks the state of stormwater management aspirations, policies and actions across Auckland.

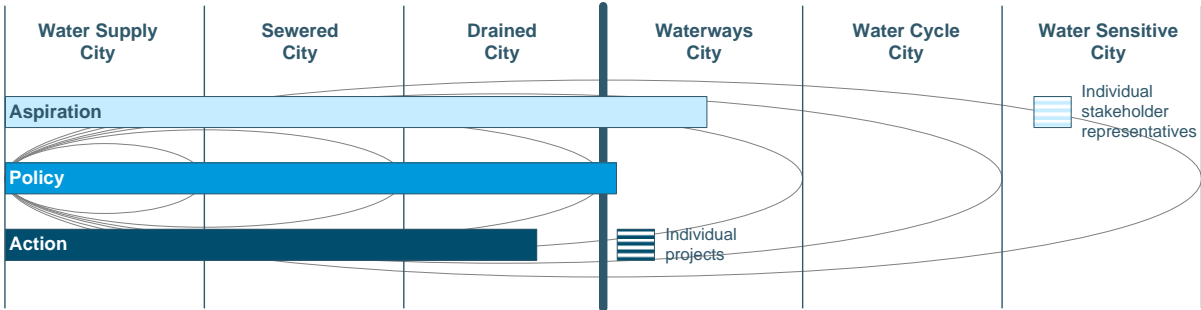


Figure 6. Assessment of Auckland’s current aspiration, policy and action

“There are some attempts and aspirations to get to a Water Sensitive City, but from a practical sense, what is important is still flood protection...the idea that people are actually connected to water and that we need a different approach for water (given all the changes we expect in the future) is not fully realised”

“Everybody wants clean, healthy, productive marine environments but this is not reality. Addressing the disconnect is actually very, very difficult. It’s dollars, tough decisions about development, methodologies and things”

3.1.1 Aspiration

The region's harbours and beaches are highly valued by the community and their preservation is fundamental to the vision of Auckland as the world's most liveable city, as articulated in the Auckland Plan. This suggests there is a strong driver for managing stormwater from a Waterways City perspective because it is designed to enhance social amenity and environmental protection.

The iwi have a particularly special relationship with water environments, valuing a spiritual dimension natural ecosystems in the form of a mauri, or life force possessed within. The protection of mauri is one of the predominant aspirations for contemporary water management, as iwi become increasingly concerned with the cultural impacts of declining waterway health, as well as the impacts on aquatic food resources.

Interview and documentary evidence shows that current aspirations coalesce around the Waterways City. The Stormwater Unit Strategic Direction report¹² refers to water sensitive communities and the need to protect the environment and urban amenity through water sensitive stormwater management.

“Now what we're saying is that we actually need to focus on the whole, a more holistic approach to stormwater and in particular, seek to reduce volumes of stormwater that are running off, seek to provide more onsite management”

“I think there's an awareness and engagement of that broad message [of a waterways city]...and there's now commitment [to that vision]”
“We're moving towards what I would describe as much more non-traditional elegant solutions in terms of treating stormwater”

The language of water sensitivity is becoming increasingly adopted (e.g. in the Proposed Auckland Unitary Plan¹³ and GD04¹⁴) across Auckland and some individual stakeholder representatives aspire to a Water Sensitive City in itself. Water cycle management and fit-for-purpose supply are not identified as an aspiration. Stakeholder representatives outside the stormwater space, including Council-Controlled Organisations, other water practitioners, urban designers or city planners, generally do not have explicit or prioritised aspirations for water sensitivity and the connection between improved stormwater management and delivering liveability outcomes is not widely perceived.

¹² For example, Auckland Council (2012) Legal Framework for Obligations to Māori and Under Te Tiriti O Waitangi/Treaty of Waitangi – Part A; Auckland Council (2012) Legal Framework for Obligations to Māori and Under Te Tiriti O Waitangi/Treaty of Waitangi – Part B; Independent Māori Statutory Board (2012) The Māori Plan for Tamaki Makaurau; Whiria Te Muka Tangata: The Māori Responsiveness Framework; Albert-Eden Local Board (2011) Local Board Plan; Auckland Council (2013) Elected Member Handbook: Governance Arrangements for Local Boards

¹³ Auckland Council (2013) Proposed Auckland Unitary Plan, notified 30 September 2013

¹⁴ Auckland Council (2013) Guideline Document 2013/004: Water Sensitive Design for Stormwater

3.1.2 Policy

The stormwater policy space is currently in development, with the potential to drive Waterways City related outcomes. The draft Stormwater Unit Strategic Direction Plan that addresses operational matters within the Stormwater Unit has clear environmental health objectives; however, it also outlines a hierarchy of priorities in which positive environmental outcomes are pursued when the opportunity arises, rather than as a mandatory requirement. Finalisation of this draft plan, and development of implementation plans for enabling change in on-ground action, is yet to be done.

Important steps forward are being made with the Proposed Auckland Unitary Plan, in which new stormwater provisions encourage stronger adoption of water sensitive design in new greenfields development and, where possible, in brownfields redevelopment. Discharge consents are required for large impervious surface areas that discharge directly to the environment. For new developments and redevelopment, onsite hydrologic controls are required in Stormwater Management Area – Flow (SMAF) areas, and for high contaminant generating activities onsite design effluent standards for zinc and copper must be met. In addition, there are more stringent rules around development in floodplains and overland flowpaths.

However, these provisions do not cover all forms of development (e.g. there is emphasis on residential development), and there is a perception that the enforceability of some provisions may be limited. Emphasis is also placed on private land developers, with less attention given to capital projects of Auckland Council or CCOs. Further, many stakeholders anticipate that these initiatives are likely to be softened to accommodate the priority of affordable land development, and are therefore not necessarily perceived as complementary objectives.

The proposed amendments to the National Policy Statement for Freshwater Management¹⁵ (NPS-FW) also indicates steps towards a Waterways City, and if it can be implemented as envisioned, with community targets and environmental limits being established to achieve desired outcomes, may offer strong foundations for advancing water sensitive stormwater practice on the ground. However, there is a perception amongst interviewees that its introduction will have stronger implications for rural waterways than urban environments. It is also unclear how it will be implemented for the Auckland context, or over what timeframe, so more work is required before it can be judged whether it will be effective policy for driving a Waterways City.

The planned development of Auckland Council's Water Strategic Action Plan also shows promise in enabling a Waterways City, if framed broadly enough to integrate the various perspectives required. However, interviewees were not generally aware of any recent development of this strategy and some surmised that it had been deferred while work on the NPS-FW is undertaken.

¹⁵ Ministry for the Environment (2013) Proposed amendments to the National Policy Statement for Freshwater Management 2011: A discussion document

The Hauraki Gulf Marine Park Act 2000 seeks to protect and enhance the Hauraki Gulf, requiring actions to support its life sustaining ecosystems¹⁶. To this end, the Hauraki Gulf Forum has been established as a statutory body with responsibility for managing the Gulf in an integrated way. The Act requires the Forum to report on the state of the environment in the Hauraki Gulf every three years, including on progress that has been made towards its integrated management. A Hauraki Gulf Marine Spatial Plan (“Sea Change”) is under development until September 2015 in a collaborative partnership between the Hauraki Gulf Forum, Auckland Council, Waikato Regional Council, the Department of Conservation and Ministry of Primary Industries, as well as community representatives. These various structures have significant implications for stormwater policy, as they present legislative requirements for water sensitive catchment management to limit the input of sediment, nutrients and other contaminants into the Gulf.

The iwi’s kaitiakitanga, or guardianship, value bestows obligations on the Māori to protect the interests of future generations, which has important implications for stormwater management and the health of receiving water environments. Under the Resource Management Act, resource managers must recognise and provide for the Māori relationship to their land and water, with particular regard to kaitiakitanga. The Treaty of Waitangi requires Auckland Council to partner with iwi in co-governance arrangements for Auckland’s natural ecosystems, including freshwater, coastal and marine environments. To support this model of co-governance Auckland Council has proposed a Māori responsiveness framework¹⁷, which incorporates three key objectives, all of set a strongly policy agenda for water sensitive stormwater management: effective Māori communication and engagement; contribution to Māori wellbeing; development of Māori capacity.

“This whole concept of water sensitive design, sustainability, greening...it’s there but it’s not integrated”

“At a high conceptual level we might all say yes, a Water Sensitive City’s good, but we’re not together on the how”

“Generally we’ve got ideas on how to resolve some of these problems, there’s just not the mechanisms to do it”

“It’s nice to have water sensitive design but there’s lots of gaps being created in the process, which are directly related to policies and legislation, they’re not technical gaps”

“We obviously all will have parts to implement it but who manages the processes of planning for it and delivering on it”

¹⁶ Hauraki Gulf Forum (2009) Governing the Gulf: Giving effect to the Hauraki Gulf Marine Park Act through Policies and Plans

¹⁷ Auckland Council (2012) Auckland Plan

3.1.3 Action

Drainage services and flood mitigation is the major driver for on-ground stormwater initiatives. While individual projects have adopted Waterways City principles, for example the La Rosa Gardens Reserve Daylighting Project and the Long Bay development on the North Shore, Auckland's mainstream practice is in the Drained City.

Sediment control through end-of-catchment ponds and proprietary treatment devices, for example, is a consenting requirement for new land developments. However, integrated catchment solutions and source controls of stormwater pollution are limited in practice. Treatment requirements are based on what is achievable with basic technologies, generally, rather than what will deliver good environmental health outcomes, and contaminants beyond sediment (e.g. heavy metals, nutrients) are not currently considered under the Regional Plan: Air, Land and Water. The Proposed Auckland Unitary Plan includes provisions for treatment on site of high contaminant activities, which is a requirement in the Special Housing Areas. Wastewater overflows to receiving waterways occur in some parts of the central Auckland, Watercare submitted a network consent and plan to address overflows over time, including provision of Waterfront and Central Interceptor projects. Each year up to 10 kilometres of natural streams are piped to enable land development¹⁸.

Indicators of stream and harbour health reveal continued degradation and the existing legislative, institutional and intervention arrangements appear to be insufficient to arrest further deterioration of the Hauraki Gulf¹⁹ and other receiving environments. In the absence of an independent environmental regulator, it is difficult for Auckland Council to ensure minimum standards of environmental performance when there are competing pressures. Processes and structures for environmental protection exist within Auckland Council; however, they are typically poorly resourced compared with other priority areas, which limits the extent of planning, project, monitoring and compliance activities that can be undertaken.

"I think people are getting on-board with the idea and the value, but implementation is hard"

"A lot of streams are relatively polluted and I think people have just grown accustomed to putting up with stuff"

"Our methodology actually hasn't delivered the outcomes that we think we are delivering"

"We have to get this balance between growth and development, cheap growth and development, and bigger growth and development, and water sensitive growth and development... where Auckland actually sits – I don't think it's ever been figured out"

"It's 'nice to have' but not 'must have' sort of stuff"

¹⁸ Auckland Council (2012) Stormwater Unit Strategic Direction 2012-2015

¹⁹ See, for example, Hauraki Gulf Forum (2011) State of our Gulf: State of the Environment Report 2011

3.2 Transition progress

Auckland’s current stormwater management transition is benchmarked to be at the ‘shared understanding and issue agreement’ phase.

The lack of alignment between Auckland’s aspiration, policy and action for stormwater management practice indicates it is in the midst of a transition from a Drained City to a Waterways City, with new knowledge and expectations developing, but with further progress to be made before water sensitive stormwater management is embedded as a mainstream practice. Auckland’s journey to its current position in the ‘shared understanding and issue agreement’ phase can be characterised according to the changing narratives about stormwater management (Figure 7).

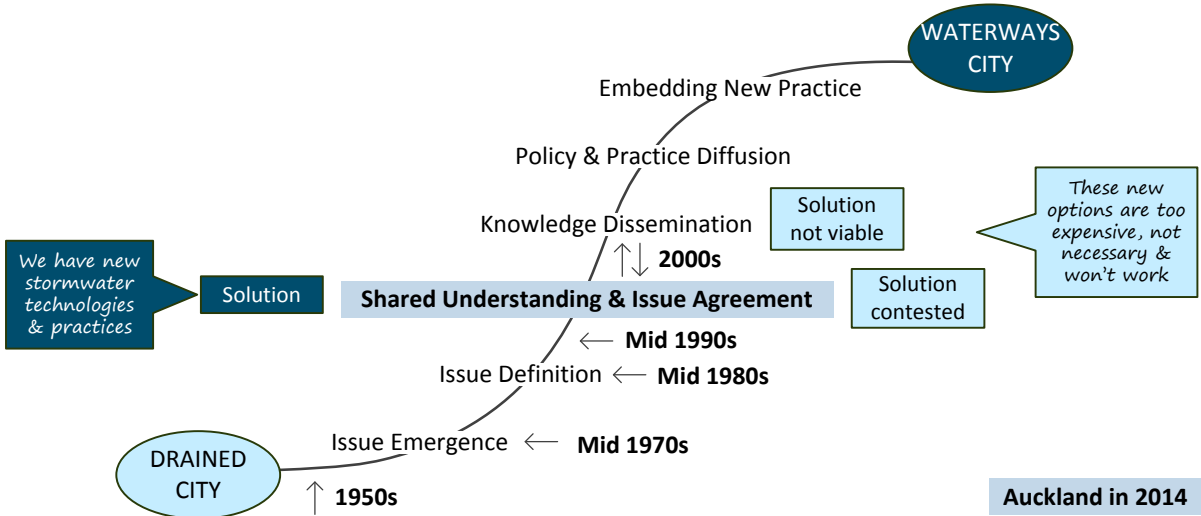


Figure 7. Auckland’s progress from a Drained City to a Waterways City

Progress through each phase is also identified through institutional structuring features that indicate the processes that have established new policies and practices around stormwater management. These features (actors, bridges, knowledge, projects and tools) develop over time to achieve each new phase.

Table 1 provides a summary of the typical institutional features observed in cities going through the transition towards water sensitivity. The phases from ‘issue emergence’ to ‘embedding new practice’ are listed from bottom to top, reflecting the transition curve in Figure 7. The key advocating and contesting narratives during each phase are listed in Table 2.

The following sections describe each phase of Auckland’s transition to date, with the evolution of the advocating and contesting narratives, and institutional development across indicators of actors, bridges, knowledge, projects and tools for advancing water sensitive practices.

Table 1. Evolution of narratives during Auckland transitions towards a Waterways City

Transition Phase	Dominant Narratives	
	Advocating Dominant message of waterways city advocates	Contesting Dominant message of waterways city contestants
Embedding New Practice	Solution delivers prosperity & liveability	Solution is insufficient for meeting a wider set of needs
Policy & Practice Diffusion	Solution works	Solution not viable
Knowledge Dissemination	Responsibility	Solution not viable ✓✓
Shared Understanding & Issue Agreement	Solution ✓✓	Solution contested ✓✓
Issue Definition	Cause ✓✓	Problem & cause contested ✓✓
Issue Emergence	Problem ✓✓	No problem ✓✓

✘ indicates no presence ✓ indicates some presence ✓✓ indicates complete presence
 Empty cell indicates initiatives for developing the feature have not yet been implemented

Table 2. Process indicators currently present as Auckland transitions towards a Waterways City

Transition Phase	Institutional Features				
	Actors Key networks of individuals & organisations	Bridges Organisations, structures & processes for coordination & alignment	Knowledge Research, science & contextualised knowledge	Projects Experiments, demonstrations & focus projects	Tools Legislative, policy, regulative & practice tools
Embedding New Practice	Multi-agency coalition	Formalised institution	Next research agenda	Standard practice	Political mandate Coordinating authority Comprehensive regulation
Policy & Practice Diffusion	Policy & decision coalition	Science-industry-policy-capacity building	Modelling solutions ✓ Capacity building ✓	Numerous field experiments	Legislation & regulation Market offsets Regulatory models
Knowledge Dissemination	Informal policy coalition	Science-industry-policy-capacity building	Advanced technological solutions ✓	Major scientific field demonstrations	Best practice guidelines ✓✓ Targets
Shared Understanding & Issue Agreement	Technical solution coalition ✓✓	Science-industry-policy ✗	Basic technological solutions ✓✓	Minor scientific field demonstrations ✓	Draft best practice guidelines ✓✓
Issue Definition	Science leaders ✓✓	Science-industry ✓✓	Cause-effect ✓✓	Laboratory & prototypes ✓✓	N/A
Issue Emergence	Issue activists ✓✓	N/A	Issue discovery ✓✓	Scientific studies ✓✓	N/A

✗ indicates no presence ✓ indicates some presence ✓✓ indicates complete presence
 Empty cell indicates initiatives for developing the feature have not yet been implemented

3.2.1 Issue emergence (1970s to 1980s)

Public recognition that the way Auckland managed its water had significant impact on the health of receiving water environments emerged in the mid-1900s, when people expressed concern over the impacts on public health from wastewater discharges from schemes such as the Orakei and proposed Browns Island wastewater treatment plants²⁰.

However, the links between waterway health and stormwater management did not emerge until scientific studies on the contaminant loads in Auckland's harbours were undertaken²¹. A 1976 appraisal of 301 estuaries across New Zealand highlighted contaminant loads in estuaries from urban and rural discharges; a 1983 study of Upper Waitemata Harbour Catchment Study showed links between land-use and sediment accumulation; a 1988 study of Manukau and Waitemata Harbours showed moderate heavy metal pollution in certain sites.

These studies underpinned Auckland's movement into the 'issue emergence' phase of its transition from the Drained City, prompting activism²² around waterway health issues and driving an agenda for more detailed studies of the causes and effects of aquatic ecosystem degradation.

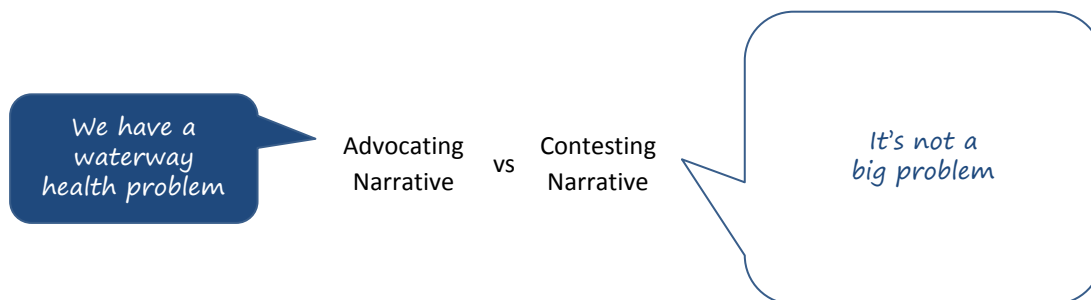


Figure 8. Dominant narrative for stormwater management in Auckland (1970s to 1980s)

3.2.2 Issue definition (1980s to 1990s)

Ongoing concern about the effects of urban runoff on waterway health was expressed by individuals and groups over the 1980s and early 1990s, which encouraged more work to be undertaken to better understand exactly what the issues were and stormwater's role. In this 'issue definition' phase, international experts were sought out and invited to bring their knowledge and experience to Auckland, working with local stormwater practitioners and researchers to develop new insight on the impacts of urban stormwater on receiving environments and potential solutions.

²⁰ Fitzmaurice, J.R. (2009) History of Auckland Wastewater and Mangere Wastewater Treatment Plant. 3rd Australasian Engineering Heritage Conference.

²¹ Descriptions of these studies are found in Streat, J., Bishop, M., Heslop, V. (2009) Re-visiting the past to help shape the future: Auckland Regional Council's stormwater policy. 6th South Pacific Stormwater Conference 2009.

²² The Manukau Claim was lodged in 1984, which highlighted issues of ecological degradation in Manukau Harbour (Waitangi Tribunal, 1985. Report of the Waitangi Tribunal on the Manukau Claim (WAI-8). Waitangi Tribunal Department of Justice. Wellington, New Zealand)

Technical reviews of stormwater management were undertaken from 1988 through the Stormwater Quality Control Program (SQCP), a collaborative initiative between the Auckland Regional Council (ARC) and the territorial authorities, designed to understand and respond to stormwater management challenges across the Auckland region. The Manukau Harbour Action Plan (MHAP, 1987-1990), another cooperative program between key stakeholders, also produced technical reviews to improve understanding on contaminant sources, effects and management options²³.

This phase also saw establishment of the 1991 Resource Management Act (RMA), which required regional councils to set out issues, policies, objectives and methods for integrated resource management within their region. The RMA provided a legislative framework within which stormwater impacts on the environment could be managed, delegating different responsibilities for land use control, coastal marine areas and contaminant discharges to regional councils and territorial authorities.

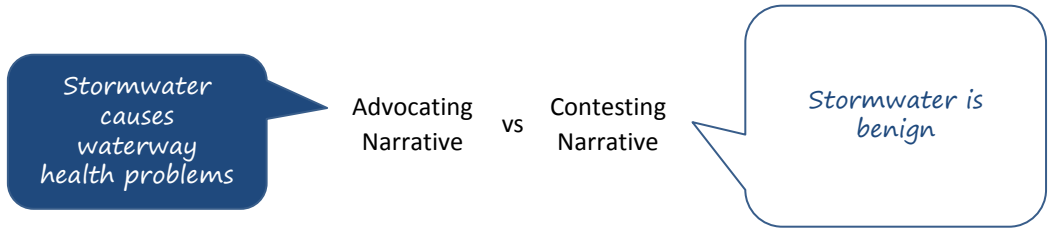


Figure 9. Dominant narrative for stormwater management in Auckland (1980s to 1990s)

3.2.3 Shared understanding and issue agreement (1990s to early 2000s)

In the next phase, ‘shared understanding and issue agreement’, technical coalitions started to consider what strategic frameworks would be suitable and practical underpinnings for stormwater management solutions for Auckland. In particular, a stormwater liaison group between the ARC and the territorial authorities²⁴ was formed to prepare a non-binding 20-year urban stormwater strategy for the region. This Auckland Regional Stormwater Strategy Statement (ARUSSS), published in 1998, built on technical reports produced in the issue definition phase to outline recommendations for the ARC and Auckland’s territorial authorities to address the impacts of stormwater on the urban environments through their asset, catchment and financial plans.

Alongside the ARUSSS, the Auckland Regional Policy Statement²⁵ (ARPS) was notified in 1996 as a statutory tool under the RMA. This outlined the key resource management issues for the region and an overarching planning framework for managing them, which included setting an objective for maintaining and enhancing the quality of receiving waters. In relation to stormwater management, the ARPS encouraged territorial authorities to require adoption of the Best Practicable Option (BPO) for controlling stormwater quality in catchment developments through their district plans. A BPO approach aimed to account for the discharge characteristics, the sensitivity of the receiving water and both the treatment technology’s performance and cost²⁶.

²³ Streat et al. (2009)

²⁴ Territorial Authorities-Auckland Regional Council Stormwater Liaison Group (TA-ARC SWLG)

²⁵ Operative in 1999

²⁶ Streat et al. (2009)

Development of the Proposed Auckland Regional Plan: Air, Land and Water (PARP: ALW), notified in 2001²⁷, also helped to generate shared understanding amongst technical and policy actors on how stormwater discharges and wastewater overflows can be managed in an integrated way. The PARP: ALW proposed Integrated Catchment Management Plans as an instrument and required mandatory adoption of stormwater BPOs in land developments, although the scale of their implementation was not prescribed.

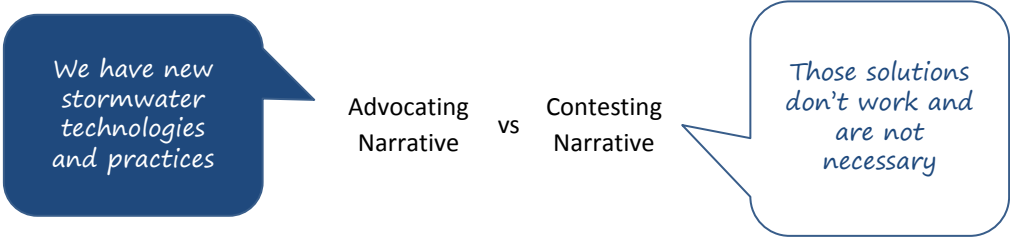


Figure 10. Dominant narrative for stormwater management in Auckland (1990s to early 2000s)

3.2.4 Knowledge dissemination (2000s)

The previous strategic work established the foundations for ‘knowledge dissemination’ across key stakeholders in Auckland. In this phase, the ARC took a leading role in promoting water sensitive stormwater management and building the capacity of the sector for implementing the new practices. The ARC produced a range of manuals and technical guidance documents, including TP10: Design Stormwater Guideline for Stormwater Management Devices²⁸, which outlined ARC’s preferred design approach for stormwater management devices, and TP124: Low Impact Design Manual²⁹, which presented a low impact approach for managing stormwater in residential land development.

Some individual territory authorities also produced practice notes for guiding implementation, and projects that trialled a low impact, or water sensitive, approach to stormwater management solutions were initiated during this phase (e.g. Waitakere Council’s Project Twin Streams and North Shore Council’s Long Bay development). These projects enabled different stakeholders to come together and collectively identify some of the opportunities and practical challenges associated with water sensitive stormwater management.

²⁷ Fully operative in 2013

²⁸ Auckland Regional Council Technical Publication 10 (originally published in 1992, revised in 2003)

²⁹ Auckland Regional Council Technical Publication 124 (published in 2000)

A 2004 review by Boston Consulting Group³⁰ identified a lack of an overall regional approach with confusing layers of information and responsibilities to support stormwater decision-making. In response, the ARC established the Stormwater Action Plan³¹ (SWAP) in 2004 to provide a more coordinated and integrated framework for addressing stormwater management problems. Five work streams, reflecting the Boston Consulting Group recommendations, were planned for implementation over 10 years:

1. Provide an effective and agreed framework for stormwater management through integrated catchment management plans
2. Deploy regional stormwater solutions that include source control, best practice techniques and environmental understanding
3. Build broader commitment through education and communication programs
4. Ensure organisations have sufficient resources and capacities for delivering stormwater solutions
5. Secure sufficient funding for stormwater management through developing alternative sources.

A Stormwater Action Team was established and significant funding was invested in delivering the actions outlined in the SWAP. A 2008 review of SWAP by international experts³² found the program was having an important and successful role in disseminating knowledge and improving stormwater practice across Auckland. Nonetheless, many of institutional issues raised by the Boston Consulting Group, including the development of suitable funding schemes, had not been resolved or comprehensively addressed by the end of this phase.

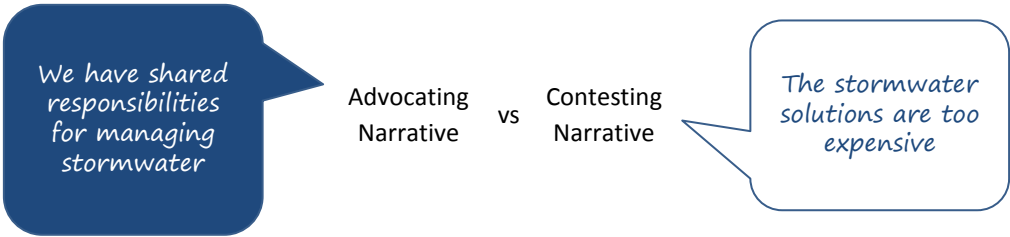


Figure 11. Dominant narrative for stormwater management in Auckland (2000s)

³⁰ Boston Consulting Group (2004) Auckland Regional Stormwater Project: An action plan to deliver improved stormwater outcomes

³¹ Auckland Regional Council (2004) Auckland Regional Stormwater Action Plan: A coordinated approach to regional stormwater management and the delivery of improved stormwater quality outcomes

³² Auckland Regional Council (2008) Review of Stormwater Action Plan: Report of International Expert Panel

3.2.5 Back to shared understanding and issue agreement (2010 to 2014)

Stormwater management in Auckland has experienced considerable flux in recent years. The amalgamation of the Auckland Regional Council and territorial authorities to establish Auckland Council as a unitary authority marked a significant change in the institutional arrangements for stormwater, requiring new accountabilities, policies, procedures and guidelines. Functional responsibilities for different parts of stormwater management (e.g. statutory planning, consent processing, catchment planning, technical design, capital works, asset management) were devolved across Auckland Council. Watercare and Auckland Transport also became influential Council-Controlled Organisations for stormwater and waterway health outcomes.

During the transition period for this major institutional reform, focus has been given to integrating the diversity of approaches from legacy councils into a unified way forward in all the activities of Auckland Council. For stormwater management, amalgamation has presented an opportunity to develop a coordinated regional approach for improving practice. However, the different starting points for stormwater management in each legacy council (for example, philosophy, land use rules, design standards, asset management systems) means that developing alignment across Auckland is challenging.

Within this context, the last four years has seen a return to the 'shared understanding and issue agreement' phase, in which Auckland Council's attention and resources have been internally focused during this period of consolidation. Individual departments have been establishing new structures and processes to deliver on their functional roles and responsibilities. To this end, the Stormwater Unit developed a Strategic Direction statement³³ for 2012 to 2015 (draft issued in 2012, final version yet to be published), which articulates its four priorities in hierarchical order:

1. Asset operation/renewals
2. Growth
3. Flooding
4. Environmental improvement.

A 2012-2032 Stormwater Asset Management Plan³⁴ (AMP) was developed, covering the entire Auckland Council region, and the next version of the AMP is due to be developed in 2014. Most recently, previous technical guidance documented in ARC publications was updated and integrated in the GD04: Water Sensitive Design for Stormwater³⁵, which aims to bring policy planners, stormwater engineers, landscape architects and other design practitioners working on land development and land-use planning projects to the same level of understanding through the provision of comprehensive guidance on water sensitive design.

As well as operating in its own business environment, the Stormwater Unit has actively engaged with other parts of Auckland Council, supporting the Sustainable Catchments Program as part of the Environmental Services Unit, and working with the Planning Division to include stormwater provisions in the Proposed Auckland Unitary Plan.

³³ Auckland Council (2012) Stormwater Unit Strategic Direction 2012-2015

³⁴ Auckland Council (2012) Stormwater Asset Management Plan 2012-2032

³⁵ Auckland Council (2013) Guideline Document 2013/004: Water Sensitive Design for Stormwater

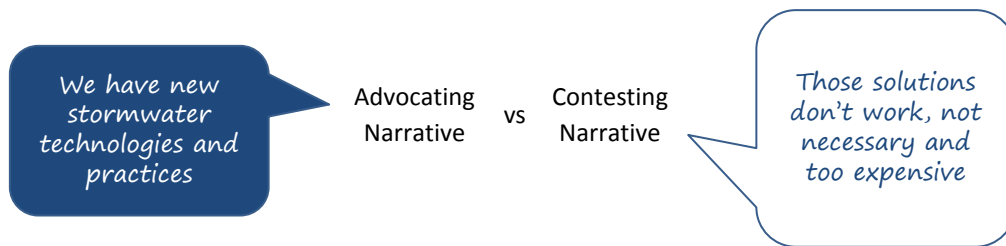


Figure 12. Dominant narrative for stormwater management in Auckland (2010-2014)

3.3 Key challenges

A lack of strategic alignment across key stakeholders is the overarching challenge for further progress towards a Waterways City. Within this challenge there are specific issues for water sensitive stormwater management in relation to strategic positioning, network capacity and learning, and enabling structures and tools.

This section provides a high level summary of the challenges as raised across the interviews. Each key issue highlighted was an issue that reached saturation, i.e. the majority of interviewees raised this as an issue, albeit from multiple perspectives.

3.3.1 Auckland's overarching challenge

Stormwater management is an inherently complex topic, given the diversity of stakeholders involved, the range of objectives that need to be accommodated and the often fragmented institutional environment for coordinating planning, policy, implementation and regulatory functions. For Auckland, this complexity has been intensified, with amalgamation representing a recent major reform to the institutional roles and responsibilities for stormwater management practice.

The fragmented nature of current stormwater management practice in Auckland is reflected by the range of perceptions, interpretations and values associated with the benchmark results of this project. Some stakeholder representatives were frustrated at a perceived lack of progress towards water sensitivity and felt that further progress is currently vulnerable, with statements made indicating concern that Auckland Council's commitment towards water sensitivity has recently weakened. Other stakeholder representatives felt that the transition towards a Waterways City was inevitable, and that while progress would be slow, it was only a matter of time before water sensitive stormwater management became mainstream practice. Still others felt that the benchmarked practice was redundant against a dominant agenda of growth, with statements made indicating a perception that water sensitivity would always remain 'nice to have', rather than an essential priority.

"We've got the people who have the passion to do it but you'd think...it's not 1991 when the Resource Management Act came in and all this stuff was news. 2013, 26 years later and not much has changed"

"When you take a step forward you sometimes take half a step back...I mean, we're certainly moving in the right direction"

“I think now we’re starting to realise that to make change, we need to change and we need to look at development and there’s always that transition period”

“I don’t think we do even near as much as we probably have the potential to do. I think there’s a lot of talk and I think not as much action”

In the fragmented context for Auckland’s stormwater management practice, a shared vision and joined-up strategy is critical for mobilising individual stakeholder priorities, knowledge and resources towards a common goal. An overarching framework is needed to establish clear assignment of roles and responsibilities (shared or otherwise) that collectively deliver on the envisioned outcomes.

Our review of documentation from earlier studies and assessments of stormwater management practice in Auckland³⁶ found that this lack of strategic alignment has been previously observed. Collectively, these reports suggest that stormwater management in Auckland is underperforming according to industry and international best practice standards. Many of the shortcomings identified were systemic in nature and concerned the whole framework for stormwater management in Auckland. The identified shortcomings highlight the need for targeted, strategic effort to transform stormwater management in Auckland.

Whilst some of these previous reports assessed the pre-amalgamation context, it remains probable that if concerted effort is not made to address the identified shortcomings, these limitations will continue. The lack of a shared vision and joined-up strategy is therefore a fundamental challenge that needs to be resolved if the aspirations for stormwater management in Auckland are to be realised.

3.3.2 Specific challenges for strategic positioning

Key Issue: Disconnection of narrative from the liveability agenda and broader benefits of stormwater management

The current narrative, or the way stormwater professionals talk about the outcomes and benefits of water sensitive stormwater management, is limited in scope. Existing conversation and advocacy around stormwater management appears to be limited to discussions on technical achievements in relation to pollution control and (less often) improving the ecological health of waterways. The current observed narrative does not incorporate ongoing dialogue with reference to the full suite of benefits that can be realised through a water sensitive approach that manages stormwater as part of a whole cycle. This may include improving community amenity, reducing reliance on expensive and energy-intensive water source, mitigating extreme heat, increasing biodiversity, and providing migration corridors for plants and animals.

³⁶ Notably the following strategic reviews: Auckland Regional Stormwater Project, The Boston Consulting Group, (May 2004); Review of Stormwater Action Plan: Report of International Expert Panel (April 2008); Gap Analysis of Stormwater Asset Management Practices, AECOM, (August 2012); and Asset Management Framework Review, GHD, (May 2013)

Most significantly, these potential outcomes from water sensitive stormwater management align strongly with Auckland’s desired outcome as the world’s most liveable city, but this dialogue and connection was not generally observed during the project.

“Need to connect water to liveability”

“Growth alongside water sensitive design is a win-win”

It was strongly suggested across diverse participants that there is a low level of knowledge and appreciation of water issues by the public, with limited public understanding of the risks to the health of their highly valued coastal environment if stormwater is not managed in a water sensitive way. This disconnect between what the Auckland public know and expect could therefore be very significant, as there may not be sufficient public motivation and implicit mandate for the leadership of Auckland Council to prioritise the environment and social amenity opportunities associated with water sensitive stormwater management practices in infrastructure investment and planning decisions.

“It’s hard to capture people’s imagination about stormwater”

Strengthening the connection between water and the Auckland’s liveability aspirations is critical for embedding a narrative amongst stakeholders that prioritises water sensitive stormwater management as a fundamental part of Auckland’s ongoing and future growth.

Key Issue: Lack of strategic vision and plan that is shared across organisational units

Stormwater management is a typically challenging issue for cities, since it involves water practitioners, policy-makers, environmental regulators, land developers, urban designers, road engineers, landscape architects, researchers, politicians and community members. It is a particularly complex challenge for Auckland Council as stormwater management related activities are highly distributed across a range of internal departments that are responsible for setting policy, planning catchments, designing public spaces, consenting applications, implementing capital works, maintaining assets and monitoring compliance. Beyond Auckland Council’s internal departments, as Council-Controlled Organisations, Watercare is responsible for the region’s water supply and sewerage which interfaces with stormwater management, and Auckland Transport manages the road network that forms an integral part of the stormwater system.

While this type of organisational fragmentation is not unique to Auckland, managing stormwater effectively in this context becomes a significant integration challenge. Throughout the project, a range of interviewees observed that while each of the different organisational units within Auckland Council and its Council-Controlled Organisations had defined goals and objectives, they were typically disconnected from other units that had shared stormwater-related responsibilities. Some interviewees suggested that both structural and cultural challenges contributed to this lack of

alignment, with concerns raised about a lack of clarity and enforced accountability within and between different organisational units.

Consequently there was widespread recognition of the need for better integration of water management activities in Auckland, particularly since as a unitary authority, Auckland Council aims to provide a streamlined approach to service delivery. Therefore, more bridging structures, processes and resources to support strategic alignment and accountabilities across each of the important actor groups are needed to ensure consensus around priorities, common commitments and consistent messages on key water issues.

“There’s no clear agreement on priorities between all the relevant organisations, so we haven’t made much progress in the last ten or fifteen years”

The lack of an overarching and shared vision for stormwater management exacerbates the current integration challenges for formulating a strategy to realise water sensitive stormwater management across Auckland. A shared vision is needed to capture the imagination of, and buy in from, each of these groups and generate deep understanding of the mutually beneficial outcomes that could be achieved for Auckland through water sensitive practice.

“There is no shared understanding of what the issue [with stormwater] actually is, which isn’t recognised at the moment, it’s a big blindspot. We need the shared vision in order to have a more planned and strategic approach to stormwater across Auckland”

“We need a common understanding of what we’re trying to achieve”

Catchment-wide integrated planning is important for translating shared visions into water sensitive outcomes on the ground, through the provision of a broad framework for informing the selection and prioritisation of individual projects. Many interview participants expressed a perception that recent organisational changes have shifted focus to decision-making about individual projects without reference to a prioritised framework based on holistic catchment-wide planning.

The process of developing a water vision for Auckland would also be valuable in itself, since it appears that key stakeholders need an opportunity to learn together, recognise that everyone is connected through shared aspirations and concerns, understand each other’s priorities, challenge different perspectives and appreciate their interdependencies in collectively achieving a shared aspiration.

Vision for Melbourne as a Water Sensitive City³⁷

Planners, policy-makers, engineers, urban designers, landscape architects, community engagement specialists and researchers from across Melbourne's water sector participated in a series of five collaborative visioning and strategy workshops. The process was designed to envision Melbourne's desired water

future, uncover the underlying challenges and map out strategic transition pathways for realising the vision. Participants highly valued the opportunity to take time out from their daily responsibilities to reflect collectively on Melbourne's potential as a Water Sensitive City and how it might be delivered. The suite of strategic recommendations produced was welcomed by the sector, which was seeking solutions to the many challenges it faced in developing an integrated and water sensitive management approach.



Key Issue: Unclear political and business case for water sensitive stormwater management

The Auckland Plan is not currently leveraged to provide a clear political business case that ties the stormwater narrative to Auckland's aspiration to become the world's most liveable city. In fact, a recurring perception was articulated that water sensitive management practices conflict with the urban development goals of the Auckland Plan, despite the plan's explicit aspirational outcome statements that go hand-in-hand with water sensitive management: climate change resilience; equitable society; recreational and sporting opportunities; clean waterways and coastlines; sustainable water consumption; biodiversity; networks of parks, bush and wetlands; green technologies; innovation; strong economy; beauty; vibrant urban spaces; stunning coastal areas; celebrated Māori identity. Two of the transformational shifts identified in Auckland Council's first Long Term Plan (2012-2022) also relate to improved stormwater management: 'strongly commit to environmental action and green growth' and 'radically improve the quality of urban living'.

"We need to figure out what kind of growth we want"

This perceived conflict between urban development and water sensitivity is based on beliefs about the viability of water sensitive solutions in the context of financial constraints and competing priorities. Given that the need to accommodate an additional one million people by 2040 is the dominant driver for current infrastructure planning, it was considered by a number of participants that stormwater needed to be managed in more traditional ways, with the social amenity and ecological health of the city considered a lower priority.

³⁷ For more information see Ferguson et al. (2012) Melbourne's Transition to a Water Sensitive City: Recommendations for Strategic Action (downloadable from www.waterforliveability.org.au/wp-content/uploads/Recommendations-Report_FINAL2.pdf)

“We need a fundamental change in philosophy in how land is developed. With each new development that doesn't incorporate water sensitive design principles, there's a lost opportunity”

Water sensitive stormwater management was perceived by some people as financially unviable, based on assumptions about the costs associated with installation and maintenance challenges, land area and delays to development. Real and perceived costs incurred through water sensitive design can make it difficult for developers to justify the business case for implementing such an approach. However, it was also observed that these types of assumptions have not been robustly or transparently tested in assessing best value, since there is no comprehensive evidence base of the costs and benefits of different types of water infrastructure for the Auckland context.

“There are a lot of unexplored assumptions about the costs of 'green' projects”

“There is not much knowledge on or experience with renewing assets, so we assume pipe replacement is cheap, but we don't really know”

“Because we are unclear about what outcomes we are trying to achieve through stormwater management, we are judged on capital spend, not on whether the money was well spent”

Assessment of best value requires consideration of the benefits, as well as the costs. According to contemporary science, the challenge for water sensitive stormwater management is that many of the benefits are realised over the medium to long-term and are not currently measured in tangible market terms. Therefore, while water sensitive stormwater management could be conceived as directly supporting the aspirations of the Auckland Plan, it is simultaneously difficult to account for its multiple benefits without a cohesive vision for how water sensitivity directly contributes to liveability, resilience and sustainability outcomes. This means there is no clear articulation of the value proposition for water sensitive stormwater management in Auckland, translating the vision into specific market benefits, such as drainage, and non-market benefits, such as urban amenity, physical and mental wellbeing, and ecological health.

“There's no agreement on the value proposition for a more water sensitive approach to water management, so there's been no real progress”

“The business case can't be proved on such singular measures, we need to find a way of assessing benefits of water sensitive design more holistically that takes into account all the multiple benefits it can provide”

“It’s hard to value the benefits in a meaningful way”

“There are significant business opportunities in remediating or improving the environment that haven’t been captured yet”

Robust methodologies for transparent assessment and comparison of costs and benefits of different servicing options have not been developed. For example, current approaches do not typically consider the opportunity costs of business-as-usual approaches. The financial benefit that Auckland derives from tourism, fishing and other environment-related industries is not systematically valued and included in the costs and benefits assessment of water sensitive approaches.

Similarly, lifecycle costs of water sensitive stormwater infrastructure are potentially much lower than assumed in current analyses. New technologies and practices typically have higher costs when they are first introduced. These incubation costs are often subsidised by governments, with return on investment gained as insights and learning are developed as the innovation matures.

“The cost-benefit analysis hasn’t been put cohesively and strategically yet”

“We need a more objective understanding of what is expensive, what is affordable, compared to what is available to spend and what outcomes we are trying to achieve. At the moment, there’s no actual benchmark to assess this”

Some of the costs currently associated with water sensitive design are likely to be directly attributable to Auckland’s institutional structures and processes that had been established for managing traditional stormwater drainage systems and do not efficiently accommodate the requirements of water sensitive stormwater management. For example, the consenting process can take much longer for applications that have elements that depart from standard drainage practice, making it difficult for land developers to apply for innovative water sensitive features whilst maintaining their construction programs. Likewise, it seems that Council maintenance programs are not currently set up to manage water sensitive infrastructure as part of a whole asset system, since ‘non-engineering assets’, such as natural waterways and green infrastructure, are not yet robustly valued and accounted for in asset management planning. The costs associated with their operation and maintenance programs are therefore not typically managed as efficiently as programs for traditional asset management.

“We need to include natural assets as part of the asset plans”

“Green infrastructures are not given a capital value, so no funding is allocated for maintenance”

Key Issue: Risk of loss of corporate knowledge

Auckland has been implementing individual water sensitive projects for two decades, leading to significant technical knowledge and experience across the stormwater industry. These individual projects are yet to be scaled up, through leveraging the opportunity to learn from both the successes and failures of on-ground demonstrations in an effort to improve and refine water sensitive technologies, designs and practices.

“We have had a number of demonstrations over the years, but I’m not sure what happens to the learnings”

“There hasn’t been any mechanism to bring the learnings together”

An articulated impediment for Auckland Council is that most water sensitive demonstration projects were established prior to amalgamation (examples include Project Twin Streams and the Long Bay and Stonefields residential developments). Given the focus on developing a unified approach across the organisation, there is a strong perception that there has been limited strategic evaluation (i.e. what did and did not work) of these legacy Council projects with a view to learning and improvement. Notwithstanding the importance of looking forward with a unified perspective, this lack of explicit and directed opportunity to revisit previous experience risks the loss of significant organisational memory and capacity about water sensitive stormwater management, potentially missing the opportunity to learn from previous achievements and mistakes to advance practice.

“We need to recognise and celebrate the progress we have made”

“[With amalgamation] we have left behind the learnings”

Key Issue: Lack of consensus on stormwater related issues and solutions

Understanding of stormwater related issues and solutions for Auckland's specific context does not appear to be comprehensively underpinned by the latest international and local science on the technical, environmental, social, institutional and economic dimensions of Water Sensitive Cities. For example, there remain some unknowns around the sources and impacts of a broad range of contaminants (including nutrients, sediments, heavy metals, pathogens and pharmaceuticals), the links between the effectiveness of stormwater management interventions and environmental outcomes, and the costs, benefits and willingness-to-pay for water sensitive infrastructures in Auckland. Widespread monitoring and reporting of local conditions, such as the state of Auckland's receiving environmental health, field-based performance of stormwater treatment systems, and community perceptions of water sensitive approaches could also be strengthened.

“Even after all these years, the understanding of the sources of contaminants [in the harbour] is still not sufficiently well developed”

3.3.3 Specific challenges for network capacity and learning

Key Issue: Overly narrow professional network

Auckland currently has a strong technical solution coalition for water sensitivity, demonstrated by the well-attended stormwater industry conferences and seminars that bring together stormwater and design practitioners. Stormwater champions have been operating in this technical space for over 20 years and have successfully contributed to advancing the knowledge of water sensitive stormwater management. This is evidenced by the introduction of design guidelines, the implementation of pilot projects and the inclusion of water sensitive stormwater provisions in the Proposed Auckland Unitary Plan.

While these have been important steps for advancing stormwater practice to date, the current stakeholder network does not yet include a broader coalition of actors working across multiple domains and sectors, which means mutually reinforcing shifts in different areas of practice are difficult. Actors at the executive and management level in the policy and decision-making space are not yet identified as being part of Auckland's extended stormwater practitioner network. There does not appear to be significant community involvement in water sensitive management as standard practice, which is also important for mobilising political support and leverage for water sensitive stormwater initiatives.

The technical capacity for water sensitive planning and design in Auckland was highlighted as being adequate, supported by strong university education programs. However, interviewees consider the sector's knowledge, skills and experiences to be currently disjointed, with a perception that individuals operate in relative isolation to improve stormwater management practice within their own sphere of influence. Further, knowledge about water sensitive practice is largely held by people directly involved in the stormwater industry, with limited dissemination or engagement with other actors that have broader or other priorities, but remain important to deliver desired stormwater outcomes.

Auckland Council is well-positioned to lead, resource and implement a capacity building program for developing the sector-wide, and nation-wide, knowledge, skills and experience to advance water sensitive stormwater management practice. Recent work to develop a stormwater education plan, commissioned by Auckland Council's Stormwater Unit³⁸, provides a framework for the development of such a program for the Auckland context; however, its implementation has not yet been realised. Advancing water sensitive stormwater practice is likely to be difficult without a capacity building program dedicated to developing, coordinating and disseminating the latest technical and scientific knowledge, insights for policy development and practical lessons for implementing water sensitive solutions in challenging contexts.

Water by Design³⁹, South East Queensland

South East Queensland has developed Water by Design, a comprehensive and well-resourced capacity building program for water sensitive design, as an integral element of the region's Healthy Waterways Strategy. Its scope is both broad and deep, aiming to develop, coordinate and disseminate the knowledge, skills and tools needed for advancing Water Sensitive Cities. The program adopts a diversity of engagement modes, including seminars, training courses, site visits to demonstration projects, study tours, guidance manuals, case study materials and participatory workshops.

Key Issue: Lack of multi-sectoral champions and political leadership

Driving water sensitive approaches typically requires strong leadership and commitment from the management and political levels of an organisation to endorse and empower teams responsible for the operational delivery of stormwater management. An absence of executive leadership would make it challenging for Auckland Council to work through the barriers and uncertainties that come with implementing a new water management practice. This reinforces the need to build the political case for water sensitive cities to ensure executive teams have the mandate to provide this leadership.

“The key is leadership and structure”

“We need clarity on leadership and [organisational] accountability”

There is an assumption that someone is addressing the move towards Water Sensitive Cities – but no one is, there's no umbrella organisation taking ownership, so it's just not happening”

³⁸ Regional Stormwater Education Implementation Plan: Fostering a Water Sensitive Auckland, August 2013

³⁹ <http://waterbydesign.com.au/>

There are a lack of initiatives dedicated to fostering, empowering and coordinating Water Sensitive City champions across executive, management and project levels of the many organisations involved in stormwater. For these committed and innovative champions to maximise their opportunities for bringing a water sensitive perspective to relevant decision-making and management processes, they need to work within an organisation that provides enabling platforms for them to communicate with their network and share knowledge widely and whose culture is supportive of their activities.

“We have no champion to push water sensitivity to the next level”

Key Issue: Lack of knowledge and trust in water sensitive technologies

The development and implementation of a new approach such as water sensitive stormwater management within Auckland’s established system requires time for new technologies and associated practices to mature through learning and demonstration. Since water sensitive planning and design challenges the provision of traditional drainage priorities, it is not surprising that the technical knowledge, implementation capacity and institutional structures need to evolve.

Auckland Council lacks a dedicated learning and demonstration program, underpinned by secure long-term funding. Such a program would identify key knowledge and capacity gaps and prioritise projects that address these deficiencies. Without a framework for mapping deliberate steps to build knowledge and trust in the new water sensitive approach, embedded in an organisational culture that is willing to learn from both successes and failures, accepting of legitimate risks and mistakes, and encouraging of experimentation, scaling up water sensitive practice to become mainstream will be challenging.

“We need to leverage learnings from these demonstration sites”

Cities currently in the process of mainstreaming water sensitive practice have had leading organisations (such as government-owned water utilities and development agencies) take a critical step in underwriting a large-scale demonstration project, accepting economic, performance and maintenance risks in order to locally test the Water Sensitive City concept. Waterfront Auckland’s popular and acclaimed revitalisation of the inner city waterfront exemplifies what can be achieved through government leadership and innovation. Landmark demonstrations of water sensitive precincts are needed in Auckland to provide a showcase for technical and institutional learning, evidence building and interdisciplinary and inter-organisational collaboration.

Lynbrook Estate, Melbourne

The development of Lynbrook Estate as a large-scale demonstration project was a critical turning point in Melbourne's transition to water sensitive urban design. Through scientific monitoring and practical experience, the demonstration site proved to developers and local government authorities that the new innovative technologies could achieve both stormwater quality treatment outcomes and perform adequate drainage functionality, as well providing significant urban amenity to the area. The project also enabled better understanding of design and construction issues associated with these (at the time) new technologies, which was important for refining the technical knowledge and practical guidance available to support stormwater professionals.

Large-scale demonstrations with an explicit learning agenda would provide a basis for exploring the current assumptions made by Water Sensitive City opponents and advocates, as well providing the evidence needed for assessing infrastructure options according to best value for the community. They would also provide a means for active engagement with communities to build their awareness and capacity about the impacts of traditional stormwater management and the potential of water sensitive alternatives.

"We're not so good on the monitoring"

"There is no monitoring of outcomes. We have no clear idea why we are doing certain projects, and what we hope to get out of them (i.e. A for financial benefit, B for environmental benefit)"

3.3.4 Specific challenges for enabling structures and tools

Key Issue: Structural separation and lack of clear and joined-up total water cycle management roles

The highly fragmented institutional arrangements for Auckland's water sector makes it challenging for integrated management of the different aspects stormwater, including policy, catchment planning, urban design, consents, capital investment, asset management and monitoring. In particular, the separation of water responsibilities between Watercare and Auckland Council's internal departments brings clear challenges for moving towards a water sensitive approach.

There currently lacks an accountability framework that optimises a total water cycle management approach for ensuring water resource security, providing adequate supply, sewerage and drainage services, and importantly, protecting the health of receiving waterways. In other cities with similar arrangements it has been suggested that this context can led to singular objectives being prioritised, since without shared key performance indicators and frameworks for explicitly considering the potential synergies and trade-offs of every water decision, it is difficult to achieve integrated or total water cycle outcomes.

Closing the organisational water cycle, Singapore

Singapore's Public Utility Board⁴⁰ (PUB) is responsible for all parts of the country's water cycle. Its overall mission is to ensure an efficient, adequate and sustainable supply of water and it has five strategic thrusts:

1. Water for All (robustness, reliability and sustainability of supplies)
2. Conserve, Value, Enjoy (managing water for its values)
3. Competence (ensuring technical and innovation capability)
4. Connections (with customers, communities, scientists, other countries)
5. Creating Value (rather than cost-cutting for the short-term)

The PUB's organisational structure is designed to enable all its goals to be delivered, with focus on shared priorities and joined-up outcomes.

A lack of integrated structures for water management can also mean there are inefficiencies in how the costs and benefits across a whole water system are accounted for and distributed. For example, investment in capital works and the ongoing operations and maintenance of infrastructure can be more efficiently managed through consolidated financial models that allow for the income generating water services (e.g. water supply, sewerage) to offset other aspects of service delivery (e.g. environmental protection, drainage). A fragmented organising arrangement also makes it difficult for water service customers to navigate the interfaces with multiple organisations responsible for water management.

There needs to be more integrating structures and activities to improve strategic alignment across the region, as well as a strong commitment to investing in the transaction costs that inevitably come with working collaboratively across multiple business units. Interviewees across each of the stakeholder groups raised concerns that the recently revised structure of Auckland Council's Stormwater Unit may not align well with a water sensitive stormwater management approach, suggesting that coordination and collaboration may be difficult to achieve.

The current development of the Environmental Strategic Action Plan and the recent establishment of the City Centre Integration Group are promising examples of initiatives that aim to support bridging across Auckland Council departments and other organisations. However, there is a lack of mutual accountability frameworks, shared performance indicators and peer learning networks (e.g. between executive, management and project staff). Asset management plans are currently developed within individual business units, limiting the potential to account for and manage the multiple and integrated values of assets. Place-based developments, such as the Special Housing Areas and the Waterfront redevelopment, require the integration of different perspectives to deliver on a shared vision and should be pursued as opportunities for leveraging the momentum, connections and knowledge to support cohesive processes for infrastructure development.

“There hasn't been meaningful discussion or debate with all the relevant parties to identify the possible solutions or options to meet everyone's various needs...the issue is who leads that kind of collective conversation”

⁴⁰ <http://www.pub.gov.sg/>

“[Water management] doesn’t feel coordinated in an ongoing fashion. We have lots of one-off strategies, but not a consistent approach, and nothing enduring”

Key Issue: Lack of statutory tools and mandates

Mainstreaming water sensitive stormwater management will require a wide range of practice, legislative, policy and regulatory tools to support uptake and institutional embedding. While technical practice tools, such as the recently published GDO4⁴¹, are well developed for Auckland, there are a lack of economic modelling and computational practice tools to support planning, design and decision-making about water sensitive stormwater solutions.

Administrative mechanisms to encourage and require water sensitive stormwater management practice, such as pollution control targets, consenting rules and financial levers are also under-developed for Auckland. The Proposed Auckland Unitary Plan makes important steps forward in this regard, incorporating stormwater provisions that consider the impacts of stormwater contaminants and flows, with an aim to better regulate land use management and development for improving environmental and community outcomes. However, there are still significant advancements in this domain that could be made to improve water sensitive stormwater management practice.

“The key issue is how to create win-win options for developers. At the moment you can meet the targets required without a water sensitive design approach, so why would you go with water sensitive design?”

Given the contextual nature of what is considered water sensitive for individual projects, as well as the diversity of stormwater solutions that could deliver water sensitivity, prescriptions of which specific measures should be implemented often constrains innovative practice and can lead to perverse outcomes. In administrations with process or input rules, approaches that divert from standard designs risk consenting delays or rejections, prescribed measures may be unobtainable or they may not necessarily result in water sensitivity for the specific local context. Auckland Council lacks mechanisms that focus on achieving desired outcomes, through statutory and non-statutory tools that reward water sensitive innovation and deter non-water sensitive outcomes in general. Such tools might include legislated targets for improved environmental health, mechanisms to streamline the consenting process for water sensitive designs, provision of design support to developers during the pre-application phase, and financial incentives and disincentives for implementing solutions that will achieve the desired outcomes.

*“Projects are not framed from an outcome perspective”
“Expectations for new developments are not clearly articulated”*

⁴¹ Guideline Document 2013/004: Water Sensitive Design for Stormwater (Auckland Council, December 2013)

“The guidelines don’t require or encourage developers to look at things more holistically or in an integrated way”

“Need to find a way to require a more holistic approach to development”

MUSIC⁴² as a compliance tool, Melbourne

In Melbourne, the MUSIC software is used as a regulatory compliance tool, in which land developers must demonstrate their proposed stormwater management design achieves the regulated pollution reduction targets for sediment, nitrogen and phosphorous. If their design is not deemed to comply, the developer must pay Melbourne Water, who is responsible for Melbourne’s waterway health, a financial contribution to offset the costs of an alternative pollution reduction measure elsewhere in the catchment.

Resistance to change in practice is to be expected and some actors will not respond to incentives, instead requiring change to be mandated through regulation. Auckland Council does not yet mandate its performance expectations. Doing so would also require supportive mechanisms to facilitate practice change in reality. There is a perception amongst some interviewees that regulatory levers are not all grounded by the practical realities of implementation in a local context. For example, rules that require developers to install stormwater quality treatment devices that will be subsequently vested in Auckland Council need to be accompanied by funding mechanisms that ensure the new system’s ongoing operation and maintenance costs are accounted for (through adequate developer contributions, as one example).

“Currently, development is largely determined by developers – Council hasn’t taken the lead in determining how and where development should take place”

“We’re still attached to the belief that the market will deliver the outcomes we’re seeking...but it hasn’t happened so far”

Achieving a balance between aspirational and achievable outcomes demands the input of many different stakeholder perspectives. There was strong concern expressed that under the constrained timelines of the Proposed Auckland Unitary Plan, there was insufficient opportunity for all key stakeholders to contribute to development of its provisions. Nonetheless, in the absence of an overarching strategic framework that connects Auckland’s vision for water with operational business plans, the promising administrative tools currently in development risk not achieving the desired outcomes.

⁴² www.ewater.com.au/music

Monitoring and compliance of administrative rules is critical if they are to be effective for changing practice. Achieving Auckland's vision to be the world's most liveable city will require the environment and water sensitivity to be prioritised and integrated within development and infrastructure decisions. There is a perception that Auckland Council's internal structures and processes for providing regulatory oversight may be insufficiently resourced for ensuring the aspired water sensitive outcomes are achieved.

“Environmental stewardship has been diluted”

4.0 Recommendations for achieving water sensitivity

The following suite of recommendations will enable Auckland Council to achieve the realisation of the Waterways City or water sensitive stormwater management, identified as the aspiration for stormwater management practice in Auckland. The purpose of the suite of recommendations is to consolidate and move beyond the current transition phase of 'shared understanding and issue agreement' through to 'embedding new practice' as effectively as possible.

The recommendations are based on a critical analysis and interpretation of four sources of evidence:

- Interview data that includes reflections, self-assessments and observations from a broad range of stakeholder representatives within and outside Auckland Council
- Analysis of current initiatives as included in policy, organisational, management and other documentary evidence that is publically available and other written information made available as part of this project
- Stormwater management experience as reported in cities elsewhere internationally, with a particular focus on cities in Australia, USA, Singapore and the UK
- Contemporary social science research theory and empirical evidence on effective strategies and techniques for enabling successful transition and change processes.

It is important to highlight that these recommendations have been formulated from a basis of a strong consensus of the current stormwater management challenges for Auckland (as summarised in Section 3.3). This consensus is based on the collective reflections and feedback from a diverse group of stakeholder representatives over the course of this project, combined with a comprehensive review of the secondary documentary evidence comprising four overarching (and numerous topic specific) independent evaluations and benchmarking studies conducted over the last 20 years.

4.1 Overview of recommendations strategy

The recommended actions have been grouped into a suite of three packages of related activities:

- Package 1 – **Strategic Positioning**. This package addresses Auckland’s overarching challenge by creating the pathway and opportunity to develop a joined-up and shared vision and strategy for water sensitive stormwater management.
- Package 2 – **Network Capacity and Learning**. This package facilitates the most effective conditions for deepening the knowledge base and expanding the professional and stakeholder network explicitly participating in advancing water sensitive stormwater management.
- Package 3 – **Enabling Structures and Tools**. This package facilitates the organising structures and enabling tools that will expedite the on-ground practice of water sensitive stormwater management.

As shown in Figure 13, each Package is aligned with developing more powerful and supportive transition dynamics. While Package 1 consists of foundational recommendations that should underpin all activities, Auckland Council could implement the suite of packages in parallel or sequentially over time.

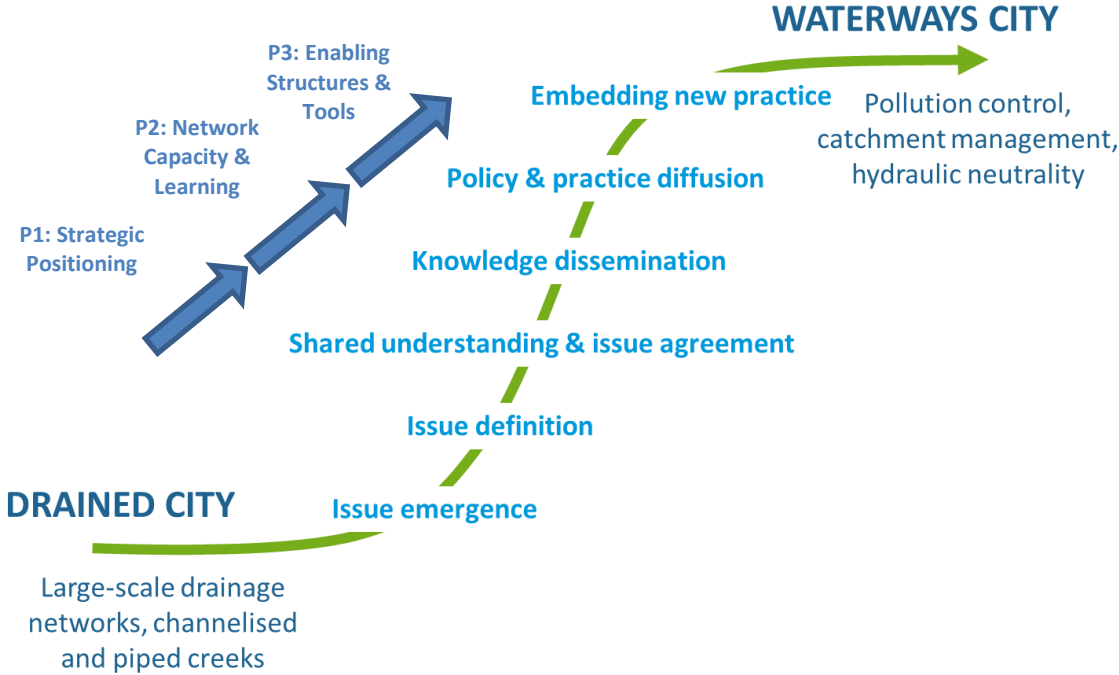


Figure 13. Recommendations strategy for achieving water sensitive stormwater management

While development of a detailed action plan (including responsibilities, timeframes and implementation steps) for the recommendations provided is beyond the scope of this project, we highlight that the next step for Auckland Council and other organisations involved in stormwater management will be to find ways to leverage these recommendations.

The majority of the recommendations contained in Packages 1 and 2 could be implemented within existing institutional structures and key projects that already underway may provide useful platforms (e.g. Water Strategic Action Plan, Environmental Strategic Action Plan, Low Carbon Strategic Action Plan, National Policy Statement for Freshwater Management, Special Housing Areas, Waterfront redevelopment). The recommendations in Package 3 are likely to require the introduction of more formal institutional reforms.

4.2 Package 1: Recommendations for strategic positioning

The recommendations presented in Table 3 address the specific challenges identified in Section 3.3.2:

- **Disconnection of narrative from the liveability agenda and broader benefits of stormwater management**
- **Lack of strategic vision and plan that is shared across organisational units**
- **Unclear political and business case for water sensitive stormwater management**
- **Risk of loss of corporate knowledge**
- **Lack of consensus on stormwater related issues and solutions.**

Collectively the actions address the need to capture the lessons from the last 20 years' of investment in stormwater demonstration projects across Auckland (1.3) and to facilitate a scientific consensus on the state of stormwater related issues and solutions (1.2). Along with the valuation process (1.5) this activity will contribute to shaping the common narrative about contemporary stormwater management beyond the technical discourse and link it more explicitly to the broader liveability agenda (1.1). These actions are central to enabling an informed strategic visioning process (1.4) that will clarify the shared understanding and anticipated costs and benefits of water sensitive stormwater management, and underpin subsequent detailed stormwater strategy formulation (1.6) to be embedded in Council asset and organisational management planning processes.

Table 3. Package 1: Recommendations for strategic positioning

Recommendation	Expected Outcomes	Key Actions	Responsibility Timeframe
1.1 Connect water sensitive stormwater management with Auckland’s liveability agenda	Leverage of political and community capital in support of Water Sensitive Cities	Articulate and communicate how a Water Sensitive City approach can contribute to the liveability, resilience and sustainability of Auckland as part of the Auckland Plan	
1.2 Conduct an independent assessment of the current state of Auckland’s stormwater system, its needs and practical opportunities for improving the overall sustainability of the waterway environment	Consolidated and contextualised knowledge on the latest scientific and practical insights for water sensitivity in Auckland as a foundation for advancing stormwater management practice	Engage an independent panel of eminent scientists and leading practitioners to review local and international knowledge as it relates to the technical, environmental, social, institutional and economic dimensions of Auckland’s water system and its opportunities for becoming a Water Sensitive City	
1.3 Harness existing corporate knowledge about water sensitive stormwater management	Consolidated sector capacity for water sensitivity as a resource for mobilising action towards water sensitive stormwater management	Revisit water sensitive stormwater projects, including those established by legacy councils, to learn from previous achievements and mistakes	
1.4 Develop a shared strategic vision for stormwater management	Orientation and connection of individual stakeholder priorities and goals within an overarching framework for realising collective outcomes	<p>Implement a visioning and strategic planning process for Auckland’s transition to a Water Sensitive City, involving a broad range of stakeholder representatives</p> <p>Lead comprehensive catchment-wide planning that meaningfully involves all key stakeholders so that the prioritisation and selection of individual stormwater projects are informed by a broader framework, ensuring that the accumulation of stormwater interventions throughout a catchment will lead to increasingly improved catchment outcomes.</p>	

Implementation plan to be developed by Auckland Council

Recommendation	Expected Outcomes	Key Actions	Responsibility Timeframe
1.5 Develop a value proposition for water sensitive stormwater management	Articulated political and business case for advancing stormwater management practice towards Water Sensitive Cities	Identify, quantify and value the wide range of market and non-market benefits of Auckland as a Water Sensitive City	Implementation plan to be developed by Auckland Council
1.6 Synthesise outcomes from 1.1 to 1.5 to develop a stormwater strategy	Strategic positioning of stormwater and other areas of administration and clarification of roles, responsibilities and development needs	Allocate clearly delineated executive level responsibility for developing the Water Sensitive City strategy and delivering on key recommendations in this report Facilitate a process of strategy formulation that involves senior staff from all key areas of Auckland Council, Watercare and Auckland Transport, and incorporates the ideas, knowledge and experience of staff within these organisations (from across all levels), as well as other related stakeholder groups	

4.3 Package 2: Recommendations for network capacity and learning

The recommendations presented in Table 4 address the specific challenges identified in Section 3.3.3:

- **Overly narrow professional network**
- **Lack of multi-sectoral champions and political leadership**
- **Lack of knowledge and trust in water sensitive technologies.**

These actions are designed to collectively improve the fostering and expansion of the professional network across sectors and job types to improve the human resource capacity across Auckland for water sensitive stormwater management (2.1 and 2.2). This needs to be supported by a dedicated learning program that focuses on a number of activities including the transfer and sharing of knowledge and the trialling and experimentation with demonstration initiatives to contextual and adapt existing technologies to Auckland conditions (2.3). This work should be supported by Auckland participating in the existing and active international and scientific networks focused on Water Sensitive Cities (2.4).

Table 4. Package 2: Recommendations for network capacity and learning

Recommendation	Expected Outcomes	Key Actions	Responsibility Timeframe
2.1 Establish a sector-wide capacity building program that targets a wide range of policy, planning, decision-making and technical actors	Wide dissemination and industry engagement with technical, policy and practical knowledge for advancing Water Sensitive Cities	<p>Implement and expand the capacity building program proposed in the Regional Stormwater Education Implementation Plan: Fostering a Water Sensitive Auckland (August 2013)</p> <p>Set a clear common objective with iwi for developing mutual appreciation and capacities to work together to manage stormwater in a water sensitive manner and ensure Māori values are meaningfully reflected in stormwater decision-making</p> <p>Facilitate local networks to better coordinate, disseminate and mobilise the knowledge, skills and experience in Auckland’s water sector</p> <p>Proactively learn from experiences in other cities that have implemented new water sensitive approaches and developed technical and institutional expertise</p>	Implementation plan to be developed by Auckland Council
2.2 Enable and empower technical, policy, planning and decision-making champions of water sensitivity	Water Sensitive City priorities and perspectives are integral to relevant decision-making and management processes	<p>Foster an organisational and broader industry culture that supports Water Sensitive City champions</p> <p>Engage a broader network of champions through developing a shared Water Sensitive Cities vision and clearly articulating its liveability, sustainability and resilience values</p> <p>Provide executive level endorsement and empowerment of teams responsible for the operational delivery of water sensitive stormwater management</p>	

Recommendation	Expected Outcomes	Key Actions	Responsibility Timeframe
<p>2.3 Develop a dedicated learning and demonstration program for Auckland as a Water Sensitive City</p>	<p>Key knowledge and capacity gaps are identified and projects that address these deficiencies are prioritised</p>	<p>Foster an organisational culture that is dedicated to embedding ongoing demonstration learnings and experimentation in its practice</p> <p>Incorporate an explicit learning agenda into all innovative water sensitive projects</p> <p>Leverage existing and future demonstration projects to learn from their successes and failures with the aim of scaling up water sensitive practice</p> <p>Secure a dedicated funding source to implement innovative demonstration projects</p> <p>Implement landmark water sensitive precinct demonstrations as showcase and learning opportunities</p> <p>Regularly evaluate and adapt standards, guidelines and implementation plans based on new insights so they continually reflect best knowledge and practice</p>	
<p>2.4 Form scientific and practice partnerships with local organisations, international networks and other cities working towards water sensitive city visions</p>	<p>Awareness, understanding and adoption of leading scientific thought and best practice applications</p>	<p>Participate in international collaborative and research networks focused on water, liveability and sustainability (such as the CRC for Water Sensitive Cities and ICLEI-Local Governments for Sustainability Water Campaign)</p> <p>Invest in research and practical applications of the latest science to extend local knowledge and develop insights that are directly relevant for advancing Auckland's stormwater management practice</p>	

Implementation plan to be developed by Auckland Council

4.4 Package 3: Recommendations for enabling structures and tools

The recommendations presented in Table 5 address the specific challenges identified in Section 3.3.4:

- **Structural separation and lack of clear and joined-up total water cycle management roles across Council**
- **Lack of statutory tools and mandates.**

Water sensitive stormwater management is best facilitated by an organisational setting that reinforces and supports a total water cycle approach, involving optimising the synergies between the water streams (supply, sewerage, stormwater, and receiving waterways) in all land use and development decisions and investments. This will require introducing a range of new and shared institutional and accountability arrangements over time (3.1 and 3.2). At the same time, Council will need to adapt existing methods and valuation techniques for stormwater management to the Auckland context so that valuations that reflect the full costs and benefits are considered in total water cycle decision-making (3.3). Finally Council will need to craft a range of enabling tools including regulated stormwater and development targets, assessment tools and internal organisational resources to ensure development compliance and ongoing practice.

Table 5. Package 3: Recommendations for enabling structures and tools

Recommendation	Expected Outcomes	Key Actions	Responsibility Timeframe
3.1 Develop bridging cultures, structures, processes and resources to support strategic alignment across relevant stakeholder groups for Water Sensitive Cities	Clear and joined-up roles, responsibilities and accountabilities for the water cycle	<p>Review operational arrangements to ensure alignment with a Water Sensitive Cities approach to stormwater management</p> <p>Connect operational business plans with a shared Water Sensitive City vision that aligns water management objectives and priorities</p> <p>Implement formal and informal mechanisms that facilitate collaboration and integration horizontally across different organisational units and vertically across hierarchical levels</p> <p>Invest in the transaction costs associated with working collaboratively across multiple business units</p>	Implementation plan to be developed by Auckland Council

Recommendation	Expected Outcomes	Key Actions	Responsibility Timeframe
3.2 Integrate water cycle responsibilities within a common organising framework	Explicit consideration and accounting for the synergies and trade-offs of water servicing options	<p>Reform Auckland’s institutional arrangements for water cycle management to integrate responsibilities for waterway health, water supply, sewerage and drainage within a common organising framework</p> <p>Assign executive level responsibilities for key outcome areas and shared executive level accountabilities for outcomes across all the priorities of the total water cycle</p> <p>Foster a culture within the common organising framework that values collaborative, interdisciplinary and multi-functional approaches, and prioritises shared responsibilities and collective goals (including across organisational units) for water management</p>	Implementation plan to be developed by Auckland Council
3.3 Develop robust methodologies, evaluation tools and evidence for analysing the costs and benefits of stormwater management options	Rigorous base for transparent cost-benefit assessments	<p>Explore and test key assumptions about lifecycle costs by compiling and contextualising evidence from Auckland and elsewhere on the lifecycle costs and benefits of stormwater management solutions</p> <p>Develop assessment methodologies and tools that accounting for the incubation costs of innovative technologies and practices, the reducible costs through institutional reform and the opportunity costs of business-as-usual stormwater management</p>	

Recommendation	Expected Outcomes	Key Actions	Responsibility Timeframe
<p>3.4 Implement statutory, non-statutory and practice tools for advancing water sensitive stormwater management practice</p>	<p>Innovation that lead to water sensitive outcomes is enabled and rewarded; practices that do not are deterred</p>	<p>Implement mechanisms that are well designed and sufficiently resourced for delivering outcomes that are both aspirational and achievable, by developing them in partnership with all key stakeholder representatives and within an overarching strategic framework for water management</p> <p>Introduce industry-standard economic and computational modelling tools to support planning, design and decision-making for water sensitive stormwater solutions</p> <p>Introduce administrative tools, such as regulations, targets, financial incentives and design support, that focus on achieving desired outcomes rather than prescribing specific implementation measures</p> <p>Mandate compliance with performance expectations for water sensitivity in Auckland, while ensuring there are supportive mechanisms to facilitate practice change in reality</p> <p>Provide the environmental regulatory arm of Auckland Council with sufficient resources to ensure effective monitoring and enforcement of stormwater management and receiving waterway health requirements</p>	<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Implementation plan to be developed by Auckland Council</p>

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Appendix B Author biographies

Dr Briony Ferguson is a Research Fellow with the CRC, Monash University's School of Social Sciences and the Monash Water for Liveability Centre. Her research explores how strategic development and institutional change can enable transitions in urban water systems to create more liveable, sustainable and resilient cities. The recent focus of Briony's work has been on developing diagnostic tools for informing strategic initiatives to facilitate transformative change in the way urban water servicing is planned, designed and managed. Briony has an interdisciplinary background, with a PhD in Environmental Sociology, a Bachelor of Civil Engineering (Honours) and Bachelor of Science. Prior to joining Monash University, Briony pursued her interest in sustainable urban water management as an engineering consultant on a variety of water infrastructure projects in Australia and Vietnam. These engineering experiences gave Briony a strong appreciation for the socio-technical nature of infrastructure development and the critical need for social, political and institutional contexts to be considered in delivering sustainable outcomes.

Professor Rebekah Brown is Program Leader (Society) at the CRC, a professor with the School of Social Sciences at Monash University and Director of the Monash Water for Liveability Centre. As a social scientist and civil engineer, she has dedicated the last 15 years to developing new socio-technical understandings of urban water governance. Rebekah has published over 100 scholarly papers and led national and international research projects. Rebekah's research has developed a unique framework for policy-makers and strategists to assess urban water development trajectories, benchmark sustainable urban water management regimes and design institutional capacity building programs. She has been recognised with national industry and government awards for her work on creating a new socio-technical research platform for advancing more sustainable urban water futures.

Lara Werbeloff is a PhD student with the CRC, Monash University's School of Social Sciences and the Monash Water for Liveability Centre. Her research is focused on exploring the process of institutional change in urban water sector transformations with a view to understanding how institutional change processes can be harnessed to facilitate the realisation of more Water Sensitive Cities. Lara has a Bachelor of Laws (Honours) and a Bachelor of Arts (Honours), with a major in environmental science. Prior to joining Monash, Lara worked as a lawyer, practising in the field of environmental law, among others.