A Water Sensitive Cities Index - Benchmarking cities in developed and developing countries

C. Chesterfield[1], C. Urich[2], L. Beck[3], K. Burge[1], A. Charette-Castonguay[2], R.R. Brown[4], G. Dunn[5], F. de Haan[5], S. Lloyd[6], B. C. Rogers[5], T. Wong[1]

[1] Cooperative Research Centre for Water Sensitive Cities, Monash University, Clayton, Melbourne VIC 3800, Australia
(E-mail: chris.chesterfield@monash.edu, kerrie.burge@monash.edu, tony.wong@crcwsc.org.au)
[2] Cooperative Research Centre for Water Sensitive Cities, Department of Civil Engineering, Monash University, Clayton, Melbourne VIC 3800, Australia
(E-mail: christian.urich@monash.edu, adam.charette.castonguay@monash.edu)
[3]Cooperative Research Centre for Water Sensitive Cities, LindseyB, Melbourne, Australia
(E-mail: lindsey@lindseyb.com.au)
[4] Cooperative Research Centre for Water Sensitive Cities, Monash Sustainability Institute, Monash University, Clayton, Melbourne VIC 3800, Australia
(E-mail: rebekah.brown@monash.edu)
[5] Cooperative Research Centre for Water Sensitive Cities, School of Social Sciences, 20 Chancellors Walk, Monash University, Clayton, Melbourne VIC 3800, Australia
(E-mail: briony.rogers@monash.edu, gemma.dunn@monash.edu, fjalar@fjalar.org)
[6] Cooperative Research Centre for Water Sensitive Cities, e2designlab, Melbourne, Australia
(E-mail: sara@e2designlab.com.au)

ABSTRACT: It is now well understood that water services play an important role in enhancing a city's liveability, sustainability, resilience and productivity. Achieving these outcomes requires a holistic understanding of a city's water system across its societal, biophysical and ecological dimensions to develop strategic initiatives that support the transition to provide more water sensitive practices. The WSC Index presented in this paper benchmarks cities across 7 goals that describe key attributes of a water sensitive city. The goals are comprised of 34 indicators across the social, technical and ecological domain. The indicators have been designed to measure progress towards achieving water sensitive city goals and assist decision-makers to prioritise actions for water-related practices. This paper presents early insights from the application of the WSC index in cities in developing and developed countries and demonstrates that the WSC Index is able provide important insights to targeted potential management actions.

KEY WORDS: Benchmarking; Index; Water Sensitive Cities

INTRODUCTION

It is now well understood that water services play an important role in enhancing a city's liveability, sustainability, resilience and productivity. Achieving these outcomes requires a holistic understanding of a city's water system across its societal, biophysical and ecological dimensions to develop strategic initiatives that support transitions towards more water sensitive practices (Ferguson et al. 2013).

To support strategic planners and decision makers to understand the current state of the urban water system, identify a vision, foster inter-city learning and enable national governments to assess their cities' urban water management trajectories in relation to other cities, the Cooperative Research Centre for Water Sensitive Cities (CRCWSC) is developing a benchmarking tool known as the Water Sensitive Cities (WSC) Index.

The WSC Index provides users with the ability to benchmark cities, based on performance in a range of urban water indicators that characterise a Water Sensitive City. This will allow organisations to set targets, model the impact of potential management responses, and collaborate more effectively with other industry organisations to deliver their water sensitive city vision.

The WSC Index is accessed through a web platform with powerful functionality to present visualisations of benchmarking results for a range of audiences, including policy-makers, service providers and community, and will offer greater insights into processes and outcomes for better urban water management.

The WSC Index is being designed in collaboration with industry partners to create a tool that is functional, useful and presents clear benefits as well as being reliable and scientifically robust. It relies on cross-organisational knowledge sharing and collaboration that will strengthen industry relationships with progress toward a shared vision.

This paper discusses early insights from the application of the WSC index in one developing and one developed city, demonstrating its applicability in different country contexts.

METHOD

While indicators have an important role in providing a common language to facilitate effective and clear communication amongst stakeholders with diverse interests (McCool and Stankey 2004), their uptake to assess or inform long-term policy for sustainable urban water management has been limited (Gleick 2003, Brown et al. 2009). Frameworks like the WSC Index and other similar approaches, such as the City Blueprints index (van Leeuwen and Chandy 2013) aim to address the information needs of decision and policy-makers (Dunn and Bakker 2009, Dunn and Bakker 2011). The WSC Index aims to broaden the range of indicators across the societal, biophysical and ecological dimensions to assess a city's water sensitivity. To ensure industry uptake and influence, end-users have been involved since the early stages of WSC Index development.

Indicators and Goals. The WSC Index benchmarks cities across 7 thematic goals that describe key attributes a water sensitive city (see Table 1). The goals are comprised of 34 indicators across social, technical and ecological domains. The indicators are scored qualitatively and quantitatively from 1 to 5 to describe a city's current situation. The indicators have been further designed to enable users to measure progress towards achieving water sensitive city goals and assist decision-makers to prioritise actions, and define responsibility and foster accountability for water-related practices.

Ensure good water sensitive governance	Increase community capital	Achieve equity of essential services	Improve productivity & resource efficiency	Promote adaptive infrastructure	Improve ecological health	Ensure quality urban space
Knowledge, skills and organisational capacity	Water literacy	Equitable access to safe and secure water supply	Maximised resource recovery	Diversify self-sufficient fit-for-purpose water supply	Healthy and biodiverse habitat	Activating connected green - blue space
Water is key element in city planning and design	Connection with water	Equitable access to safe and reliable sanitation	Low GHG emission in water sector	Multi-functional water infrastructure	Surface water quality and flows	Urban elements functioning to mitigate heat impacts
Cross-sector institutional arrangements and processes	Shared ownership, management & responsibility	Equitable access to flood protection	Water-related business opportunities	Integration and intelligent control	Groundwater quality and replenishment	Vegetation coverage
Public engagement, participation and transparency	Community preparedness and response to extreme events	Equitable and affordable access to amenity values of water-related assets	Low end-user potable water demand	Robust infrastructure	Protect existing areas of high ecological value	
Leadership, long-term vision and commitment	Indigenous involvement in water planning		Benefits across other sectors	Infrastructure and ownership at multiple scales		
Water resourcing and funding to deliver broad societal value				Adequate maintenance		
Equitable representation of perspectives						

Table 1. Goals and indicators for a water sensitive city

Analytical Frameworks. To support users to gain crucial insights into the current state of the urban water system and develop management actions, the WSC Index integrates three analytical frameworks.

City State Benchmark is based on the Urban Water Transition Framework (Brown et al., 2009), which identified six distinct states of the urban water system as a city evolves in response to socio-political drivers. The first three stages of the embedded continuum describe the evolution of the water system to provide essential services such as secure access to potable water (Water Supply City), public health protection (Sewered City) and flood protection (Drained City). These are followed by the Waterways City, Water Cycle City and ultimately a Water Sensitive City, which describe the anticipated evolution of the urban water system to deliver higher order services such as social amenity and environmental protection, provide reliable water services under constrained resources, and ensure intergenerational equity and resilience to climate change. The analysis of the indicators through this framework gives users important insights on their progress towards a Water Sensitive City.

Principles of Water Sensitive Practices describe a set of three distinct practices that are essential to deliver water sensitive services (Wong and Brown, 2009). This practices are: understanding Cities as Catchments to provide resources at different scales in fit-for-purpose applications; Cities providing Ecosystem Services to integrate urban water management into the urban landscape, providing multiple benefits such as heat mitigation, ecological health and landscape amenity; and Water-conscious Citizens and Community, where people engage in water-conscious behaviours, feel connected to their water environments and appreciate the many values of water.

Water Sensitive Outcomes, which assess the performance of the urban water system across Resilience, Sustainability, Liveability and Productivity outcomes. Resilience in this context is defined as the capacity to maintain water system services under acute or chronic disturbances. Sustainability is the capacity of water system services to deliver benefits for current and future generations. Liveability is the capacity of the water system to deliver a high quality of life. Productivity is the capacity of the water system services to generate economic value.

Case Studies. The WSC index has been applied to two city-scale case studies: a major city in Australia (AUS) and a major city in South-East Asia (SEA). The aim of these case studies was to test the functionality of the framework in delivering reliable, useful and transferable benchmarks in different country contexts.

The data for AUS were collected through a participatory workshop involving a range of participants from key stakeholder organisations, including local municipalities, the water utility, government departments, and others. The data for SEA were collected through in-depth free-flowing interviews with stakeholders from the local municipality, the water utility and government departments, as well as a desktop review of key policy documents, organisational materials and diagnostic reports.

The results for the two case studies were also compared to idealised city-states of a Drained City, Waterways City and Water Cycle City.

RESULTS AND DISCUSSION

Figure 1 shows the results of the benchmarking for each goal in the two case study cities and in relation to an idealised Waterways City and Water Cycle City. It can be seen that, as would be expected, AUS outperforms SEA and scores mostly between a Waterways City and Water Cycle City. In contrast SEA is struggling to provide the equitable access of essential services necessary to be considered a Drained City.

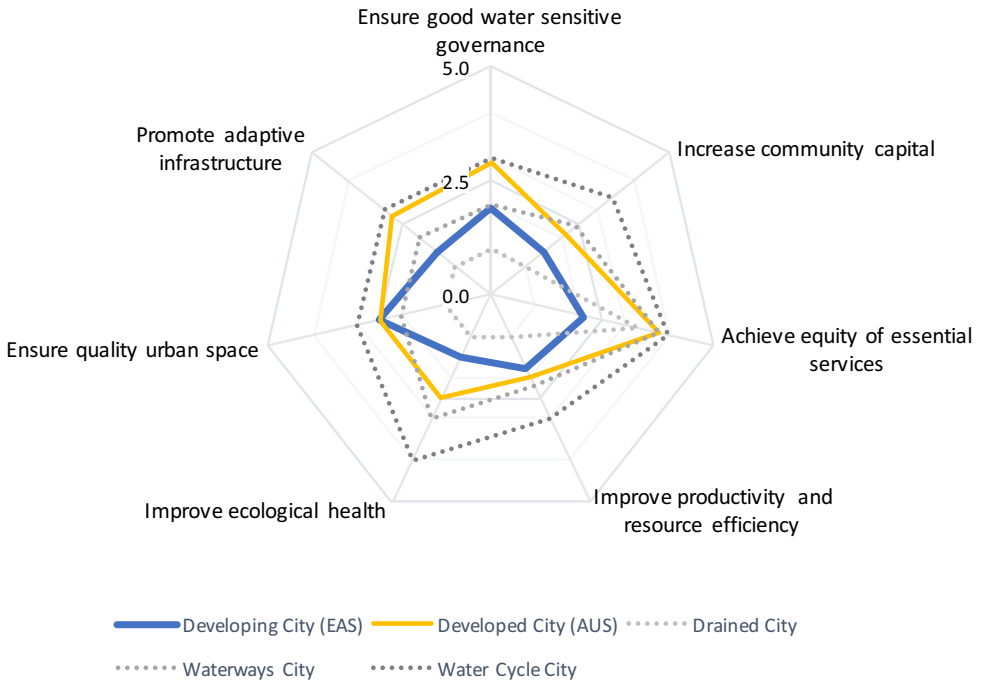


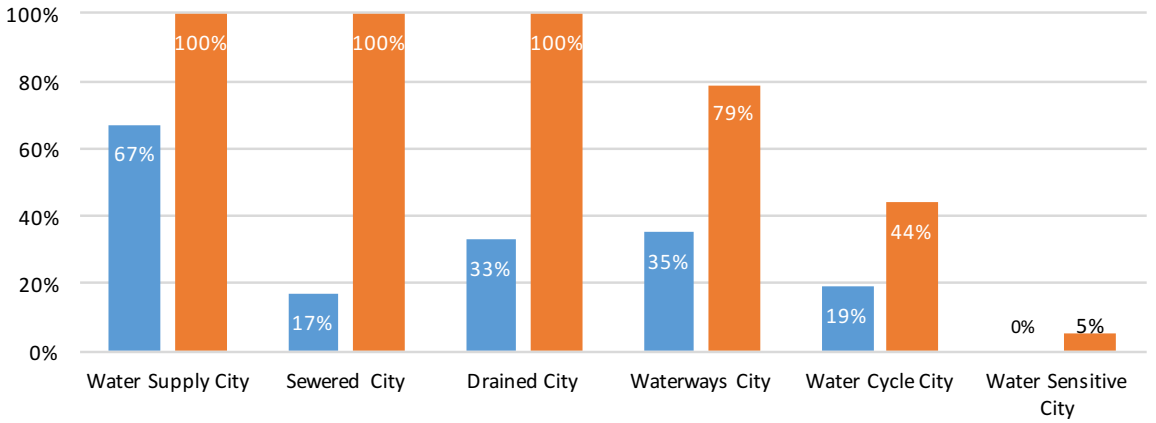
Figure 1: Comparison of goal scores for AUS and SEA

However, it can also be seen that the two cities perform similarly in terms of the provision of quality urban space. This is because SEA provides a high level of tree coverage and organises tree planting to raise awareness and mitigate impacts of climate change.

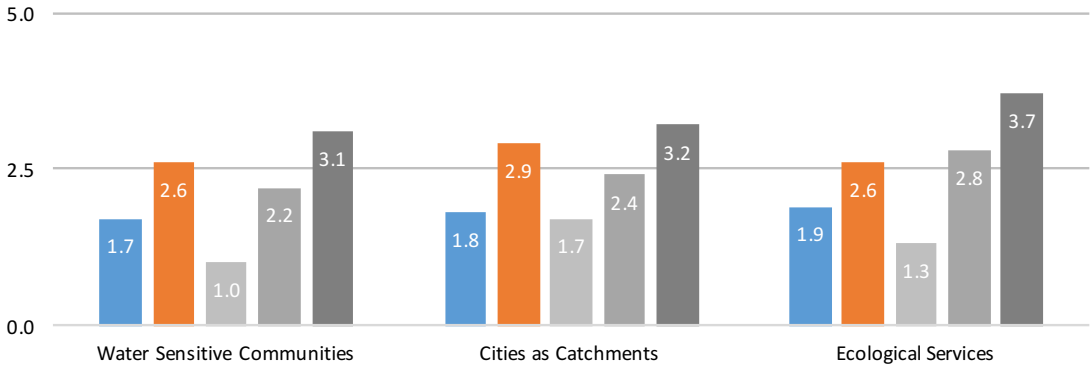
Table 2: Detailed Scores for Ensure quality urban space

	SEA	AUS
Goal 6. Ensure quality urban space	*2.5*	*2.3*
6.1. Activating connected pleasant urban green and blue space	1.0	3.0
6.2. Urban elements functioning to mitigate heat impacts	3.0	2.0
6.3. Vegetation coverage	3.0	2.0

(a) City-state benchmarks



. (b) Principles of water sensitive practice



(c) Water sensitive outcomes

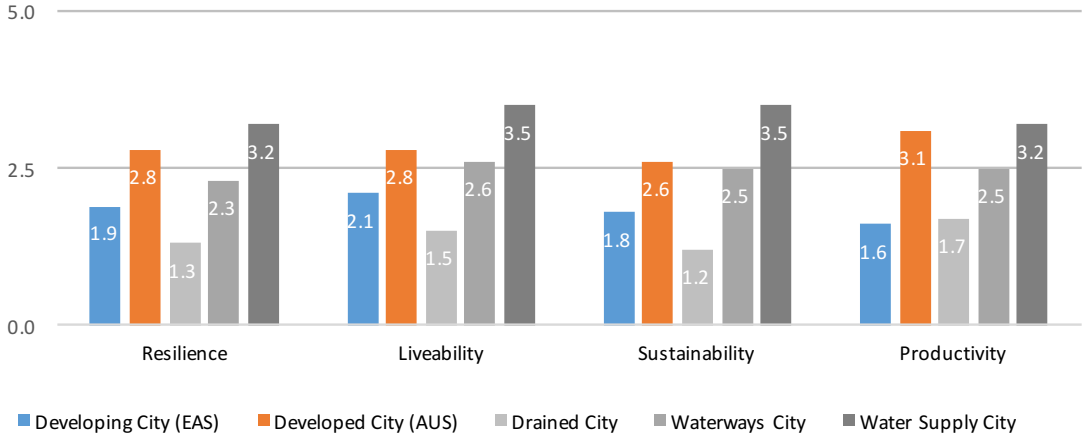


Figure 2. Comparison of case study results for the three analytical frameworks: (a) City-state benchmarks. (b) Principles of water sensitive practices. (c) Water sensitive outcomes achieved.

The results of the three analytical lenses are shown in Figure 2. The benchmarks for the city-states show clearly the lack of provision of essential services for SEA. However, as the analysis of the provided services shows, the developing SEA city provides important Ecological Services, supported by Water Sensitive Communities that improving the its Resilience, Liveability, Sustainability and Productivity. However, the results also reveal the lack of essential infrastructure services is currently overcompensated by higher level services, in all cases the performance of SEA in Figure 2b and c is much better than the idealised Drained City state. This will be addressed in the further development of the WSC Index through the introduction of weightings to adequately reflect the relative importance between essential and higher order services. While taking into account current limitations, the results to date still provide indications of target actions that improve the provision of essential services while considering their broader outcomes. For example, through the provision of multifunctional and multi-purpose water infrastructure, the developing SEA city has the potential to leapfrog towards greater water sensitivity.

The results for AUS show that the city is progressing towards the aspired Water Sensitive City. Comparison of the results to the idealised Waterways and Water Supply City state reveal a deficit in providing Ecological Services, as indicated by the comparatively lower goal score for *Improve ecological health*. It can be seen that the lower performance of indicators under this goal is impacting on Liveability and Sustainability outcomes in particular. The results indicate that the analytical frameworks are reflecting the current state of the city more adequately than for the developing city, however a more detailed analysis of this issue is required. The insights gained suggest the target management actions to improve indicators under the *Improve ecological health* goal would significantly increase a city's performance.

CONCLUSION

As the application of the WSC Index to a developed city in Australia and a developing city in South East Asia has showed, the developed tool is able to assess and benchmark a city's water sensitivity. While it is too early in the development process to fully assess the value of the individual analytical frameworks incorporated in the WSC Index, the case study results presented in this paper suggest they are promising.

The case study results have revealed current limitations in the WSC Index's ability to reflect the impact of a lack of essential water services, particularly in the context of developing cities. This limitation will be address in the on-going refinement of the framework. Overall, however, even at this early stage of development the WSC Index has been shown to provide important insights to identify potential management actions for supporting the transition to a Water Sensitive City.

REFERENCES

Brown, R., Keath, N., Wong, T., 2009. Urban water management in cities: historical,

current and future regimes. Water Science & Technology 59, 847–855. doi:10.2166/wst.2009.029

Van Leeuwen, C.J., Chandy, P.C., 2013. The city blueprint: experiences with the implementation of 24 indicators to assess the sustainability of the urban water cycle. Water Science & Technology: Water Supply 13 (3), 769–781.

Dunn, G. & Bakker, K., 2009. Canadian approaches to assessing water security: An inventory of indicators (policy report). Vancouver, BC: Governance, P.O.W.

Dunn, G. & Bakker, K., 2011. Fresh water related indicators: An inventory and analysis. Canadian Water Resources Journal, (2), 135-148.

Ferguson, B.C., Frantzeskaki, N., Brown, R.R. (2013) A strategic program for transitioning to a Water Sensitive City. Landscape and Urban Planning, 117, 32-45.

Gleick, P.H., 2003. Global freshwater resources: Soft-path solutions for the 21st century. Science, 302 (5650), 1524-8.

McCool, S.F. & Stankey, G.H., 2004. Indicators of sustainability: Challenges and opportunities at the interface of science and policy. Environ Manage, 33 (3), 294-305.

Wong, T.H.., Brown, R.., 2009. The Water Sensitive City: Principles for Practice. Water Science and Technology 60, 673–82. doi:10.2166/wst.2009.436

ACKNOWLEDGEMENTS

The support of the Commonwealth of Australia through the Cooperative Research Centre program is acknowledged. We are grateful to the many industry stakeholders who have been engaged in the WSC Index development and testing process to date.