

WATER AND LIVEABILITY – BEYOND THE OBVIOUS

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ABSTRACT

How can water make cities more liveable? This study takes the first step in answering this question by reviewing non-academic literature to identify liveability attributes associated with water. In particular, we investigate how the concepts of (1) liveable, smart and sustainable cities on the one hand, and (2) water-themed city visions on the other, differ in the liveability attributes they address. We also identify (3) contexts and liveability attributes with which water tends to be mentioned. The investigation showed that in the conceptualisations of good urban environments, water tends to be addressed along other environmental concerns. It is also more common for water to be mentioned in the context of sustainable cities rather than liveable cities. We reviewed two water-themed city visions, which in principle, represent a more holistic perspective on urban water management, integrating water planning goals into broader urban liveability considerations: Water Sensitive Cities and Water Wise Cities. We found they addressed some liveability attributes (e.g. disaster preparedness, thermal comfort) but overlooked others (e.g. safety, housing).

INTRODUCTION

There is growing interest in the linkage between liveability and water. Water utilities in Australia have incorporated considerations of the contribution of urban water management to liveability in their strategies and visions (Melbourne Water, 2012, 2015; Metropolitan Water Directorate, 2017; Queensland Urban Utilities, 2017; SEQWater, 2017). The relationship between water and liveability has also been addressed repeatedly by WSAA which confirms interest in the sector (WSAA, 2016, 2017, 2019).

At the same time it is recognised that 'liveability' encompasses a diverse range of aspects (Balsas, 2004) and is often difficult to discern from similar concepts of smart or sustainable cities (Gough, 2015). This seems also reflected in the usage and understanding of 'liveability' in the urban water sector. Researchers (Furlong, Brotchie, Considine, Finlayson, & Guthrie, 2017; Newton et al., 2018) and policy makers (COAG, 2014; National Water Commission, 2011; Productivity Commission, 2017) agree that more clarity is needed about the water sector's role and contribution to liveability outcomes. A few attempts have already been made to systematically describe linkages between the mandate of water sector organisations and liveability, by exploring possible benefits that water can create for urban residents. (e.g. (de Haan et al., 2014; Furlong et al., 2018; Johnstone, Adamowicz, de Haan, Ferguson, & Wong, 2012; WSAA, 2016, 2019). So far, less attention has been given to the meaning of 'liveability' outside of the water sector, which could provide a context for claims to liveability formulated within urban water and the opportunities for impact this sector-specific interpretation of liveability might be missing. Consequently, it has also not been explored how the concept of liveability which is embedded in the water-themed city visions such as Water Wise Cities (WWC) or Water Sensitive Cities (WSC) relates to the conceptualisations of 'liveability' outside of the water sector.

Understanding how the relationship between water and liveability has been conceptualised thus far and whether there is anything unique that the focus on liveability highlights (as opposed to similar terms) in the field of urban water management, can be useful for more coherent and precise articulations of liveability outcomes which can be achieved along water planning goals. Conceptual clarity may inform assessment of the value of liveability benefits generated by water agencies and, subsequently, the choice of interventions and investments that best serve the residents these agencies service. But the unique focus adopted in this paper – which

compares conceptualisations of water in liveability-themed sources and liveability in water-themed sources – also brings less obvious insights. It highlights missed opportunities for the urban water sector to contribute to good urban environments that can emerge from a broader perspective on liveability. It also elucidates some aspects of the concept of ‘liveability’ that have already been recognised and criticised in other fields.

METHODOLOGY

This analysis builds on an earlier study that identified how good urban environments and liveability are defined through specific liveability attributes (Sochacka et al., submitted). For this study we conducted a qualitative and quantitative thematic analysis using the previously established liveability attributes as the coding frame. For the first stage, we captured the codes occurrence frequency to represent conceptual similarities and differences between liveable cities and other descriptors of good urban environment (e.g. sustainable and smart cities). We then explored contexts in which water was mentioned in these sources (qualitative analysis) and investigated patterns in the co-occurrence of the ‘water management’ code with other previously identified codes. The sample consisted of 27 sources (indexes and reports) that 1) proposed a holistic vision for an optimal urban environment, 2) were published in the past 5 years, and 3) provided ways of quantifying cities’ performances. Examples included the Global Liveability Ranking by the Economist, Mercer’s Quality of Living Index, the Smart Cities Report by Huawei, or Siemens Green City Index. For the second stage, we analysed two water-themed city visions: Water Sensitive Cities and Water Wise Cities and conducted a quantitative thematic analysis using liveability attributes as the coding frame to capture and compare the conceptualisations of liveability embedded in them.

This paper presents exploratory research, which is the first step in understanding the relationship between water and liveability and forms part of a broader study that includes both conceptual and quantitative analysis of this relationship.

RESULTS

Conceptualisations of good urban environment: smart, liveable or sustainable cities?

Previous analysis found a high degree of similarity in the attributes of what could be understood as

constituting a ‘good city’: quality of infrastructure, education, transportation and connectedness, health, and safety (Sochacka et al., submitted). While the term ‘liveability’ was found in 15 of 27 sources, our analysis showed conceptual distinctiveness between conceptualisations of the optimal urban living environment depending on the urban metaphors used to describe it (e.g. ‘smart cities’, ‘liveable cities’, ‘sustainable cities’). Fig. 1 shows how conceptualisations that focus on ‘liveable city’ tended to mention some liveability attributes more often than sources that focused on ‘smart’ or ‘sustainable cities’. These included attributes related to basic urban services (health, education, quality of infrastructure, safety and low crime), good physical living conditions enhanced by urban planning (mixed land use, housing quality and diversity, thermal comfort) and characteristics of thriving community life (recreation and lifestyle opportunities, culture and heritage, social and cultural diversity, business environment and innovation). Compared with sources guided by other concepts, liveability-themed sources were also slightly less likely to discuss attributes related to environmental health, e.g. waste or energy management and air quality. Not surprisingly, these were mentioned more often in sources that concentrated on ‘sustainable cities’. Sources that focused on ‘smart cities’ tended to stress the role of use of information and communication technology (ICT) in urban governance. They were also similar to ‘liveable cities’ in how often they addressed environmental issues (points 11–16 on Fig. 1) and to ‘sustainable cities’ in how they addressed social issues (particularly points 4–10 on Fig. 1). We also found sources that defined good urban environment through the perspective of ‘liveable’ or ‘smart city’ tended to address water management concerns less often than sources that focused on ‘sustainable cities’, with 33%, 50% and 57% of sources respectively (point 31 on Fig. 1).

Water in the conceptualisations of good urban environment

Water was addressed in approximately 44% of the sources analysed. Contexts in which it was discussed included: (1) water as an element of ecological footprint of cities (resource consumption), (2) water as a municipal service (water supply) (3) water as an element of local topography (e.g. waterfront), (4) water as a risk factor (flooding), (5) water as an opportunity for innovations (water management as a problem to be solved with ICT). Quantitative thematic analysis showed sources that

mentioned water were more likely to address attributes related to environmental health and resource management but less likely to mention attributes related to entertainment and leisure (recreation and lifestyle opportunities, culture and heritage) (Fig. 2). At the same time, these sources were also more likely to address aspects related to equity and inclusion as well as social and cultural diversity.

Liveability in water-themed city visions: Water Sensitive Cities (WSC) and Water Wise Cities (WWC)

We found that both WSC and WWC addressed liveability attributes associated with greenspace and recreation, disaster preparedness (especially in relation to flooding) and thermal comfort, as well as some environmental considerations, particularly those related to climate change adaptation (Tab.1). But at the same time, neither WSC nor WWC addressed liveability attributes related to safety, housing conditions and living affordability or aspects of environmental quality associated with air quality or noise management. We also noted a few differences in the liveability conceptualisations embedded in WSC and WWC. WSC addressed liveability attributes associated with the social dimension: e.g. culture and heritage. In that respect it was closer to the concept of 'liveable cities' as described in the previous section. WWC, on the other hand, addressed energy management as well as transport and connectedness, which makes the water-themed city vision it promotes closer to that of a 'sustainable city'.

DISCUSSION

Liveability – what influenced the concept formation and what it means for urban water management

Our analysis highlighted conceptual differences between liveable, sustainable and smart cities. For example, it revealed that when 'liveability' is used to define good urban environment, it differs in the frequency with which it discusses the attributes related to environmental health (less often), community life (more often) and accessibility of urban services and amenities (more often). The main attributes of 'liveability' that emerge from our analysis are consistent with other studies and highlight the influence of New Urbanism on the concept formation, the targeted audience of some of the most popular liveability indexes and the short time perspective inherent in liveability compared with

sustainability. These influences are discussed below.

The rise in popularity of liveability coincides with popular acceptance of New Urbanism in planning practice, even though New Urbanism has been more often associated with sustainability (Grant, 2003). Many attributes identified here as more commonly addressed in sources focused on liveability overlap with the defining features of New Urbanism – the focus on walkability (transport and connectedness, mixed land use and access to amenities), preserving neighbourhood character and its defining features (culture and heritage), accessibility of greenspace, a range of housing options for different residents, and general criticism of urban design which misses the goal of creating and sustaining thriving community life.

The popularity of liveability indexes, especially the Global Liveability Ranking by the Economist, has also influenced how liveability has been conceptualised by cities themselves (McArthur & Robin, 2019). What's often overlooked is that the Economist's liveability ranking was developed to inform relocation packages for employees of international corporations, thus does not adequately represent concerns of local residents (Rozek, Giles-Corti, & Gunn, 2018), particularly the less affluent ones. More broadly, defining liveability through the features that would attract temporary residents and investors (e.g. business environment and innovation) exemplifies a facet of what has been diagnosed by social researchers as a shift in urban politics towards entrepreneurialism. It is marked by changing the goal of urban governance from redistribution and service provision to boosting local economy, through 'good business climate' and appealing to the professional and creative classes (Clarke & Cheshire, 2018).

Finally, liveability's popularity has been attributed to the fact that it seems a more tangible and less elusive concept than sustainability. Liveability focuses on 'here' and 'now', compared with the long time perspective inherent in sustainability. Thus, liveability 'lies within the purview of local agencies, planners, architects, and policy and investment makers, who shape the environment within which people's needs and aspirations unfold' and within established mandates and existing laws, making local governments and agencies accountable to liveability goals more than they can be held accountable to sustainability goals (Ruth & Franklin, 2014). This focus on 'here' and 'now' is also

apparent in the presented research as disaster preparedness, climate change concerns and broader environmental considerations are less prevalent themes in sources focused on 'liveable cities'.

For water management, this has several implications. First, outside of the water sector, water is not universally recognised as a basic prerequisite of urban liveability (nor is greenspace). In fact, in developed contexts, water provision as a necessary requirement of liveability appears to be taken for granted and thus does not warrant mentioning among the key liveability indicators. Enhancing liveability, especially in developed contexts, seems to focus on amenity rather than providing basic services, which are assumed to be provided and reliable. The questions of accessibility, coverage (% of population serviced) and continuity (lack of outages) of these services rarely emerge in the context of liveability. The short time perspective also leaves out the question of potential periods of scarcity (drought) or current overexploitation of resources that may lead to scarcity in the future. Consequently, if liveability outcomes are proposed among the goals of urban water management, or if liveability is the central concept of a water agency's vision, the issues related to water security may be perceived as less pressing by the general public.

Second, 'improving liveability' seems to imply actions of universal value that deliver the betterment of everyone's living conditions or (even) happiness. However, in fact in the contexts where basic needs have been met (e.g. developed countries) enhancing liveability will rather mean facilitating enjoyment of one's preferred lifestyle. Using the term 'liveability' obscures that subjectivity and as some social researchers argue, facilitates retreat from participatory planning approaches or even de-politicisation of urban governance (Clarke & Cheshire, 2018). In practice this means realising the goal of improving liveability using water can turn into providing embellishments of value to only some residents. For example, public greenspace may be less valued by owners of private greenspace (gardens) and those looking for inner city entertainment rather than passive recreation in parks. This is because the question of 'what does liveability mean for different people and groups' is rarely posed even though there is inherent understanding that different residents have different lifestyles, needs and expectations. Although it is increasingly recognised that equity considerations are missing from many liveability indicators (Ruth &

Franklin, 2014), liveability is still often addressed at a city scale, implying that any actions to improve it will accrue to all the residents of a given city. In practice, overlooking equity in conceptualisation of liveability benefits created by urban water management may prioritise liveability improvements in already privileged areas because it may be easier to engage those communities in environmental stewardship activities, for example.

Third, liveability tends to be conceptualised as the role of 'amenity' and 'quality of built environment'. While it may seem that there is a consensus about what amenity is and what a nuisance is, these are often subjective valuations. For example, it is assumed that water sensitive urban design (WSUD) would be perceived as an amenity by the general public, even though there is research showing that constructed wetlands, particularly those that try to emulate natural environments, are not always seen as aesthetically pleasing by lay people (Nassauer, 2004). New Urbanism promotes 'walkability' as an important feature of liveable neighbourhoods, which can be achieved by increasing urban density. But densification, though promoted by urban planners, is not equally valued by the community (Clarke & Cheshire, 2018). The implications of higher densities for water management and housing typologies which can be both water sensitive and liveable are yet to be explored (CRC for Water Sensitive Cities, 2018).

How water is mentioned in sources focused on liveability shows themes urban water management rarely addresses

Some of the contexts in which water was mentioned in the sources that conceptualise good urban environment are not commonly addressed by the urban water sector. For example, access to creeks, rivers and beaches is mentioned in the analysed sources in the context of the waterfront as a premium location for property value. This is because some sources that seek to measure or envision good urban environment look at it from the perspective of real estate market investors (e.g. Knight Frank Prime Global Cities Index) and temporary residents from overseas (e.g. the Global Liveability Ranking). At the same time, while the risk of flooding is acknowledged, rarely are these two contexts brought together – the fact that proximity to water may increase the risk of inundation and property damage is not addressed. Similarly, there is no consideration of water quality or riparian vegetation, which appear to be necessary to deliver the value of a waterfront location. This strengthens the case for stormwater quality management and flooding

mitigation measures (including sea front erosion) as important for the role water can play in enhancing liveability.

Another less commonly explored context is urban water management challenges viewed as opportunities for innovation. This context is especially prevalent in sources that conceptualise 'smart cities'. In this context, gathering more data and facilitating its sharing across different agencies is a primary way of improving urban water management efficiency and solving problems. While data-driven resource management can almost certainly solve some problems, a smart city perspective may put too much pressure on the problems that can be tackled through incorporating more information, at the expense of problems that are sufficiently diagnosed, and have well documented solutions but are not solved yet due to insufficient funding, competing funding priorities, technical limitations, governance arrangements or conflicts of stakeholders' interests. Perceived as low-hanging fruit ICT solutions may take up resources that could be used for higher priority but less easily solvable problems.

Water-themed city visions are selective in the aspects of liveability they address

Water-themed city visions represent a more holistic perspective on urban water management, which integrates water planning goals into broader urban liveability considerations. Consequently, understanding which liveability attributes they address and hence, what is the liveability conceptualisation embedded in them, is important for elucidating ways in which they align and diverge from local urban agendas, and highlighting areas of potential cross-sectorial cooperation (e.g. with energy management or urban design).

On the one hand, our review demonstrated the analysed water-themed city visions addressed some liveability attributes (e.g. disaster preparedness: flooding, thermal comfort) but overlooked others (e.g. safety, housing). Greenspace is a particularly interesting example. It is sometimes proposed that water utilities may opt to or will naturally extend their mandate beyond basic services to include 'multi-functional infrastructure and urban design' as it is envisioned in the CRCWSC transition framework. But, there is a risk that, driven by the general discourse on liveability, the focus will be on greenspace and thermal comfort (as observed in the analysis of water-themed cities) and not spaces that already offer water-based recreation but depend on

effective water quality management (e.g. urban creeks). The focus on greenspace also seems to overlook that the extent of water sector influence over greenspace maintenance varies, depending on local water governance arrangements and the type of greenspace. At the same time, safety, housing diversity, living affordability, air quality and noise management are not addressed by WSC or WWC. While it is clear that not all liveability attributes relate to water, some of them warrant a second thought. For example, living affordability can be enhanced by hardship assistance programs for customers struggling to pay their water bills. Housing diversity, which may include affordable living options for tenants, may provide different options for improving water efficiency and reducing per capita demand e.g. by community-owned augmentation schemes (rainwater harvesting at multi-unit building scale). Safety, especially in Australia, is linked to water supply for firefighting as the recent bushfires have demonstrated. There is also potential for addressing some of the environmental concerns (air quality, transport and connectedness, energy management) jointly and looking for solutions that take advantage of various nexuses at precinct and city scale.

On the other hand, our review highlighted the differences between WSC and WWC visions. A stronger focus on social aspects in WSC and a stronger focus on environmental aspects in WWC suggests influence of geographically specific factors. Other research has shown that liveability is a term particularly popular in the Oceania region (McArthur & Robin, 2019) and WSC being coined in Australia may bear this mark of local liveability discourse and locally preferable lifestyle.

CONCLUSION

Amid the growing interest in the linkage between liveability and water, it seems water utilities willing to address liveability in their strategies could benefit from recognising what using this term highlights and what it obscures, particularly compared with similar concepts. Liveability, especially in developed country contexts, is more likely to focus on amenity related to comfortable and aesthetic living conditions and quality of community life. This suggests a certain degree of subjectivity related to lifestyle and aesthetic preferences, which supports a need to recognise diversity in the serviced population, divided by lifestyles, cultures, and subsequently the idea of 'liveability'. At the same time, equity and inclusion or environmental concerns are less often addressed attributes of liveability, and thus may be

worth highlighting in the concept of liveability proposed in urban water management strategies.

Water tends to be more frequently mentioned in sources that use the term 'sustainable' rather than 'liveable' cities. This suggests that as liveability becomes more popular in urban policies, water management considerations become less visible. At the same time, there are emerging contexts in which water is mentioned (e.g. as opportunity and risk in real estate investment, as an area for ICT innovation) that can justify its stronger presence as an important consideration in planning for a good urban environment in the future.

Water-themed city visions are underpinned by a holistic perspective that integrates water planning goals into broader urban liveability considerations. The review demonstrated that WWC and WSC addressed some liveability attributes (e.g. disaster preparedness: flooding, thermal comfort, greenspace) but overlooked others (e.g. safety, housing). This suggests that the concept of liveability, or more broadly good urban environment, that is envisioned within the water sector may differ from how it is understood outside of it, obstructing cooperation with other urban agencies. The water sector not recognising the full spectrum of liveability attributes and their linkage to water seems a missed opportunity. It can also make it more difficult to conduct a robust evaluation of planned supply augmentation projects or to design demand management measures when liveability trade-offs must be made e.g. during drought.

More broadly, our analysis supports a call for a more comprehensive view on water's potential contribution to liveability that looks beyond greenspace and thermal comfort; does not forget the benefit it delivers through its essential services, flooding protection and water quality management; values equity considerations and participatory urban governance; and looks for synergies with other environmental attributes (e.g. energy management). The results also prompt a question: 'liveability for whom?' and support the need to recognise various groups of service recipients, distinguished by their diverse lifestyles, cultures, socioeconomic statuses and their perspective on value delivered by water (permanent versus temporary residents, real estate investors).

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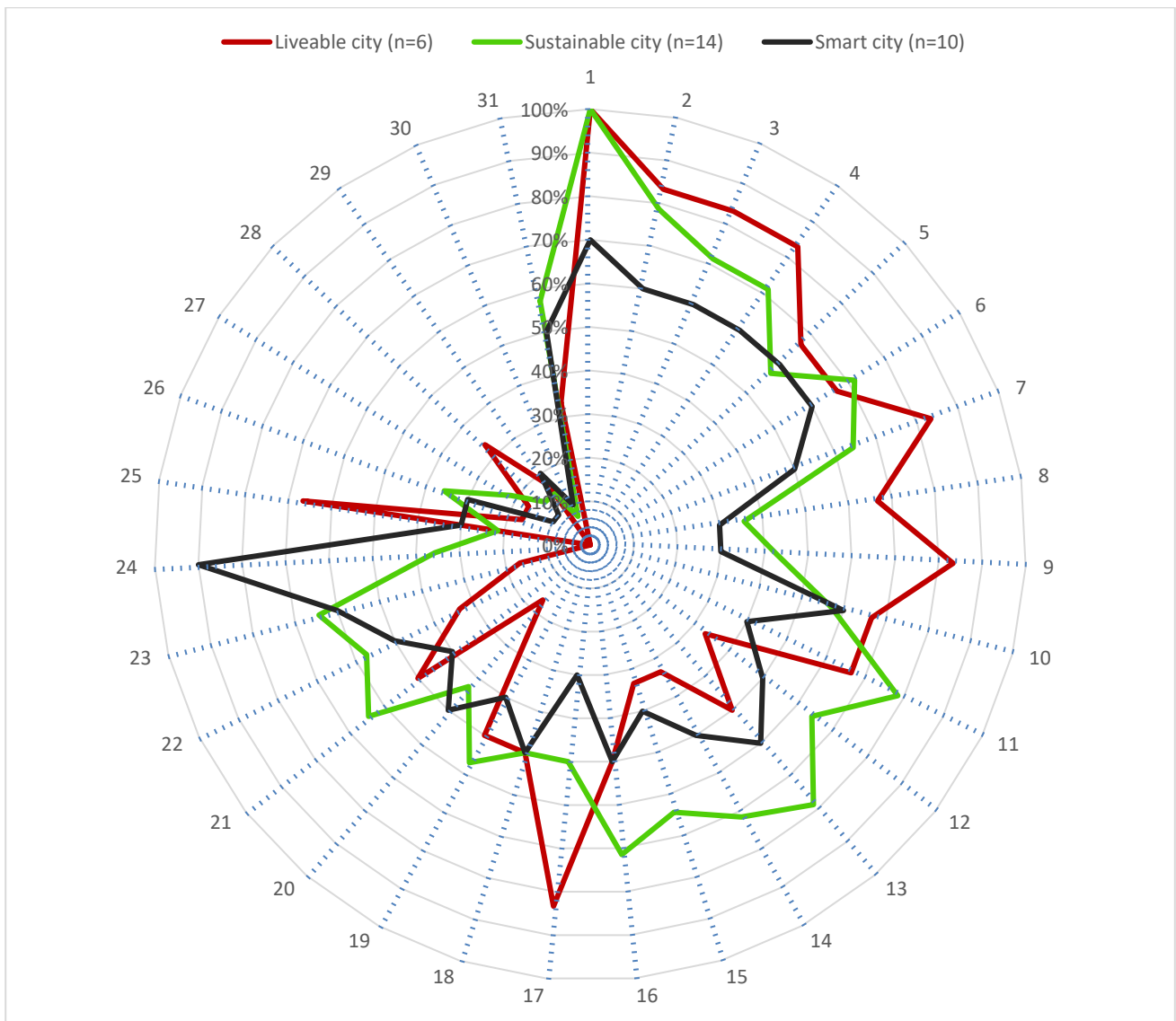
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REFERENCES

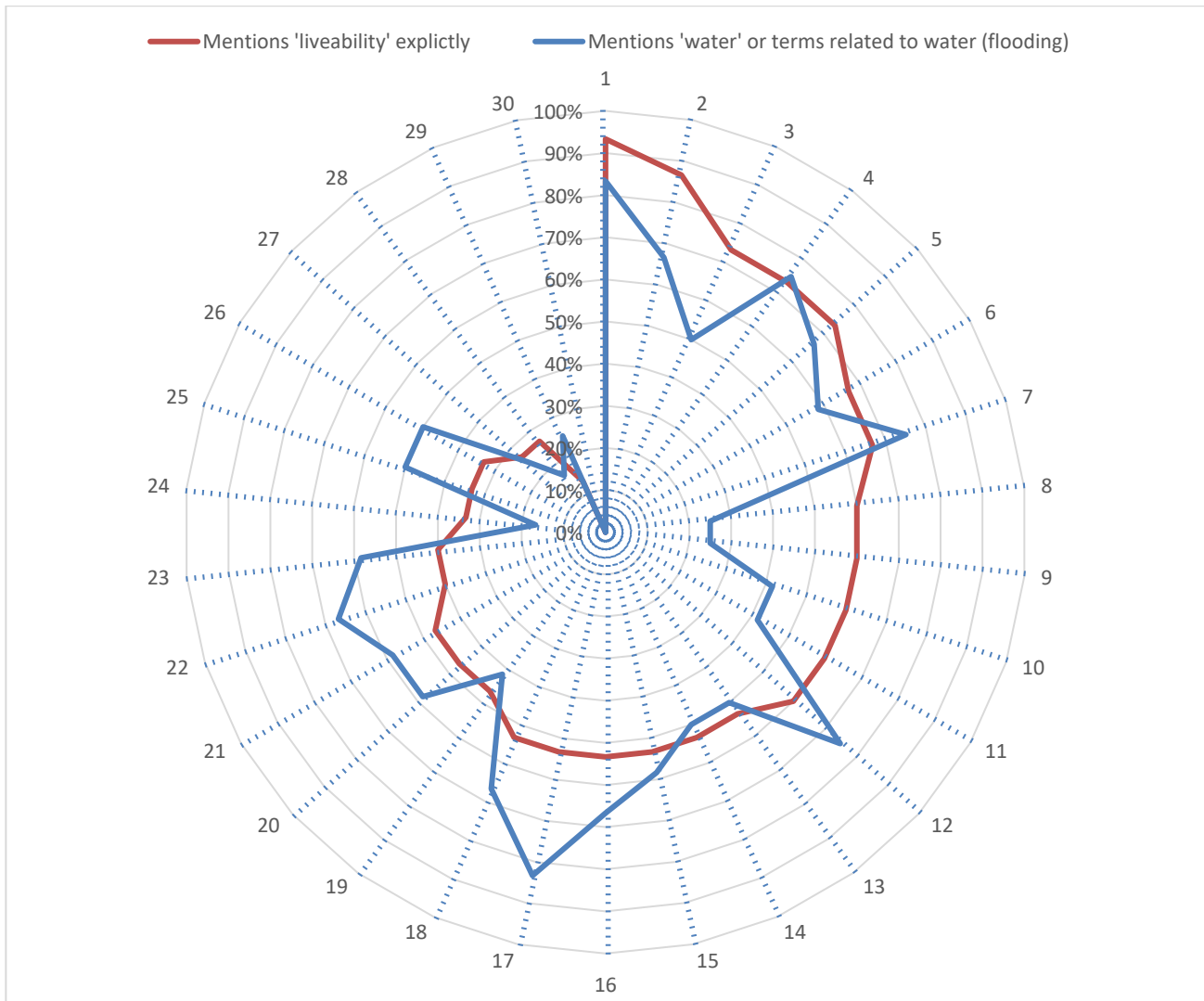
- Balsas, C. J. (2004). Measuring the livability of an urban centre: an exploratory study of key performance indicators. *Planning, Practice & Research*, 19(1), 101-110.
- Clarke, A., & Cheshire, L. (2018). The post-political state? The role of administrative reform in managing tensions between urban growth and liveability in Brisbane, Australia. *Urban Studies*, 55(16), 3545-3562.
- COAG. (2014). *National Water Commission's Assessment Report of National Water Initiative*. Retrieved from <http://www.agriculture.gov.au/SiteCollectionDocuments/water/nwi-assessment-2014.pdf>
- CRC for Water Sensitive Cities. (2018). *Water sensitive outcomes for infill developments*. Retrieved from <https://watersensitivecities.org.au/content/overview-irp4-water-sensitive-outcomes-for-infill-developments/>
- de Haan, F. J., Ferguson, B. C., Adamowicz, R. C., Johnstone, P., Brown, R. R., & Wong, T. H. (2014). The needs of society: A new understanding of transitions, sustainability and liveability. *Technological Forecasting and Social Change*, 85, 121-132.
- Furlong, C., Brotchie, R., Considine, R., Finlayson, G., & Guthrie, L. (2017). Key concepts for Integrated Urban Water Management infrastructure planning: Lessons from Melbourne. *Utilities Policy*, 45, 84-96. doi:<https://doi.org/10.1016/j.jup.2017.02.004>
- Furlong, C., Uittenbroek, C., Gulsrud, N. M., Termes-Rife, M., Dodson, J., & Skinner, R. (2018). Understanding the role of the water sector in urban liveability and greening interventions: case studies on Barcelona, Rotterdam, Amsterdam, Copenhagen and Melbourne.
- Gough, M. Z. (2015). Reconciling livability and sustainability: Conceptual and practical implications for planning. *Journal of Planning Education and Research*, 35(2), 145-160.
- Grant, J. (2003). Exploring the influence of new urbanism in community planning practice.

- Journal of Architectural and Planning Research*, 20(3), 234-253.
- Johnstone, P., Adamowicz, R., de Haan, F., Ferguson, B., & Wong, T. H. F. (2012). *Liveability and the Water Sensitive City - Science-Policy Partnership for Water Sensitive Cities*. Retrieved from Melbourne:
- McArthur, J., & Robin, E. (2019). Victims of their own (definition of) success: Urban discourse and expert knowledge production in the Liveable City. *Urban Studies*, 56(9), 1711-1728.
- Melbourne Water. (2012). *Melbourne Water Enhancing life and liveability. Annual Report 2011-12*. Retrieved from https://www.parliament.vic.gov.au/file_uploads/MelbourneWater2011-12_nHMTQGxg.pdf
- Melbourne Water. (2015). *Melbourne Water Enhancing Life and Liveability: Melbourne Water Annual Report 2014-15*. Retrieved from <https://www.melbournewater.com.au/media/259/download>
- Metropolitan Water Directorate. (2017). *2017 Metropolitan Water Plan. Water for a Liveable, Growing and Resilient Greater Sydney*. Retrieved from <https://www.planning.nsw.gov.au/-/media/Files/DPE/Other/About-us/Metropolitan-Water/2017-Metropolitan-Water-Plan.pdf?la=en>
- Nassauer, J. I. (2004). Monitoring the success of metropolitan wetland restorations: cultural sustainability and ecological function. *Wetlands*, 24(4), 756.
- National Water Commission. (2011). *Urban water in Australia: future directions*. Retrieved from <https://www.frontier-economics.com.au/documents/2014/06/urban-water-australia-future-directions.pdf/>
- Newton, P., Bertram, N., Handmer, J., Tapper, N., Thornton, R., & Whetton, P. (2018). Australian cities and the governance of climate change. *Australia's Metropolitan Imperative: An Agenda for Governance Reform*, 193.
- Productivity Commission. (2017). *National Water Reform Inquiry Report*. Retrieved from https://www.pc.gov.au/_data/assets/pdf_file/0007/228175/water-reform.pdf
- Queensland Urban Utilities. (2017). *Enrich quality of life. 2017-2022 Corporate Plan*. Retrieved from https://www.urbanutilities.com.au/~/_media/uu/pdfs/about%20us/publications/201722%20corporate%20plan_smaher.ashx
- Rozek, J., Giles-Corti, B., & Gunn, L. (2018). The world's 'most liveable city' title isn't a measure of the things most of us actually care about. *The Conversation*
- Ruth, M., & Franklin, R. S. (2014). Livability for all? Conceptual limits and practical implications. *Applied Geography*, 49, 18-23.
- SEQWater. (2017). *Water for Life. South East Queensland's Water Security Program 2016-2046*. Retrieved from <https://www.seqwater.com.au/s3fs-public/PDF%20Documents/Water%20Security%20Program%20-%20Regulated%20Document%20-%20WEB%20version%20with%20clickable%20links.pdf>
- WSAA. (2016). *Liveability indicators. A report prepared for the water industry*. Retrieved from <https://www.wsaa.asn.au/sites/default/files/publication/download/Liveability%20Indicators%202016.pdf>
- WSAA. (2017). *Next Gen Urban Water. The role of urban water in vibrant and prosperous communities*. Retrieved from <https://www.wsaa.asn.au/sites/default/files/publication/download/Next%20Gen%20Urban%20Water.pdf>
- WSAA. (2019). *Health benefits from water centric liveable communities* Retrieved from <https://www.wsaa.asn.au/publication/health-benefits-water-centric-liveable-communities>



1	Transport system & connectedness	10	Housing: quality & diversity	19	Living affordability	28	Thermal comfort
2	Education: quality & access	11	Green & public space: quality & access	20	Disaster preparedness and relief	29	Noise management
3	Business environment & innovation	12	Energy management	21	Climate change mitigation & adaptation	30	Quality of environment outside of cities
4	Quality of infrastructure	13	Air quality	22	Equity & inclusion	31	Water management
5	Safety & low crime	14	Waste management	23	Urban governance: inclusive & participatory		
6	Employment & income	15	Quality of environment in cities	24	Urban governance: use of ICT		
7	Health: access & quality	16	Environmental protection	25	Land use: mixed & access to amenities		
8	Recreation & lifestyle opportunities	17	Social & cultural diversity	26	Resource efficiency		
9	Culture & heritage	18	Economic growth	27	Social capital & cohesion		

Figure 1. Attributes mentioned in conceptualisations of liveable urban environments (in green – environmental, orange – social, blue – economic) described as 'smart cities', 'liveable cities' or 'sustainable cities'. Occurrence frequency is represented as percentage of all sources in each category.



1	Transport system & connectedness	10	Housing: quality & diversity	19	Living affordability	28	Thermal comfort
2	Education: quality & access	11	Green & public space: quality & access	20	Disaster preparedness and relief	29	Noise management
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Figure 2. What fraction of (a) sources that use the term 'liveability' explicitly (n=15) or (b) mentions 'water' (n=12), also mention another liveability attribute. The frequency of their occurrence is expressed as percentage of sources that mention any given theme.

Table 1. Liveability attributes addressed in water-themed city visions. Comparison of Water Sensitive Cities Index and Water Wise City Principles

Liveability attributes	WSC – examples	WWC – examples
Similarities		
Addressed in both WSC and WWC		
Green & public space: quality & access Recreation & lifestyle opportunities	6.1 Activating connected green–blue space 6.3 Vegetation coverage 3.4 Equitable and affordable access to amenity values of water-related assets	2.3 Enhance liveability with visible water from roadside green infrastructure to major blue–green corridors as opportunities for social inclusion: recreation, inclusive public space, economic development and transportation(...). Urban water services are essential for (...) shade and mitigation of heat islands.
Thermal comfort	6.2 Urban elements functioning to mitigate heat impacts	
Disaster preparedness & relief	2.4 Community preparedness and response to extreme events 3.3 Equitable access to flood protection	2.2 Design urban spaces to reduce flood risks. Increase resilience to flood risks by developing improved drainage solutions (...) Plan vital infrastructure to enable quick disaster recovery.
Business environment & innovation	4.3 Water-related business opportunities	4.2. Professionals with various expertise (finance, technical, social) who understand the co-benefits across urban sectors so that they may plan and implement the best solutions for urban dwellers and businesses.
Environmental protection Quality of environment in cities Climate change mitigation & adaptation Resource efficiency	4.1 Maximised resource recovery 4.2 Low GHG emission in water sector 4.4 Low end-user potable water demand	Design domestic and industrial precincts and buildings in ways that enable regenerative water services. This can lead to reduced water, energy and carbon footprints at a local scale.
Education: quality and access	2.1 Water literacy	Upgrade existing educational programs with contents related to sustainable management of urban resources and urban resilience (...)
Quality of infrastructure	7.4 Robust infrastructure 7.6 Adequate maintenance	Financial tools, linked to rigorous asset management plans, enable long lasting improved service levels with a well-maintained infrastructure.
Not addressed by either WSC or WWC		
Safety & low crime Social capital & cohesion Economic growth Employment & income Quality of environment outside of cities Housing: quality & diversity Living affordability Noise management Air quality	-	-
Differences		
Addressed by WSC but not WWC		
Culture & heritage Social & cultural diversity	2.2 Connection with water 2.5 Indigenous involvement in water planning	-
Urban governance: inclusive/participatory Urban governance: use of ICT	1.4 Public engagement, participation and transparency 7.3 Integration and intelligent control	-
Equity & inclusion	3.1 Equitable access to safe and secure water supply 3.2 Equitable access to safe and reliable sanitation	-
Waste management	4.1 Maximised resource recovery	-
Land use: Mixed use & access to amenities	3.4 Equitable and affordable access to amenity values of water-related assets	-
Addressed by WWC but not WSC		
Energy management	-	Reduce the amount of water and energy used
Transport & connectedness	-	Connect water to other services such as health, transport, food production, waste or energy (...)
Health: access & quality	-	