International Perceptions of Urban Blue-Green Infrastructure: A Comparison across Four Cities

Supplementary Material

Case Study Cities

1. Newcastle-upon-Tyne, UK

Newcastle, with a population of 280,000, is situated on the north-western bank of the River Tyne in north-east England. A compact urban core is surrounded by residential areas and substantial green belt land to the north and west of the city. Newcastle faces a range of environmental challenges including flooding, poor air quality and an urban heat island effect (Newcastle City Council and Gateshead Council, 2015). In 2012, Newcastle experienced a severe rainfall event where 50 mm fell within a two-hour period, causing extensive flooding to approximately 1200 properties, predominantly due to surface water runoff (Environment Agency, 2012). Newcastle is also at risk of fluvial flooding; in December 2013 the River Tyne flooded parts of the Quayside after a tidal surge from the North Sea raised river levels (Newcastle City Council, 2016).

Following these events, Newcastle City Council (the Lead Local Flood Authority) and partners have invested in improving the city's resilience to future flooding through a combination of blue, green and grey infrastructure. Several exemplar schemes showcase effective delivery of BGI (Blue-Green Infrastructure) through local and regional partnerships, e.g., sustainable drainage system (SuDS) ponds as part of the Newcastle Great Park development, and the Killingworth and Longbenton surface water management scheme that comprised a new underground overflow pipe, five surface attenuation basins and disconnected Longbenton Letch (stream) from the combined sewerage network and diverted into Forest Hall Letch (O'Donnell et al., 2018). A key component of the Newcastle City Strategic Surface Water Management Plan is a proposed network of 'Blue-Green corridors' to capture rainfall in the city center and transport it to the Tyne, with a goal of maximizing the social and environmental benefits of managing water above the ground in attractive blue-green systems (Amec Foster Wheeler, 2016). The signing of the *Newcastle Declaration on Blue and Green infrastructure* in 2019 by ten key stakeholder organisations (including Newcastle City Council, the Environment Agency, and Northumbrian Water) demonstrate the aspiration for BGI coupled with a change in attitudes and ways of working (UFR, n.d.).

2. Ningbo, China

Ningbo is a major port and industrial hub, situated southeast of the Yangtze River Delta in Zhejiang province. The 2020 population is *c.* 7.5 million and projected to reach 10 million by the 2030s. Ningbo is sensitive to seasonal climatic effects, particularly in the wet season when cyclonic storms (typhoons), tidal surges and intense rainstorms frequently visit the region (Chan et al., 2012). More than 44 typhoons are estimated to have impacted the city since the 1950s, causing 12 large floods and a total economic impact exceeding 93 billion RMB (Tong et al., 2007). Typhoon Fitow (October 2013), exhibiting a maximum 24-hr rainfall of 263mm, caused widespread pluvial flooding as runoff overloaded the city's drainage network (currently designed for 1-in-5 to 1-in-20 year events), affecting over 2.4 million people (Tang et al., 2015).

The outdated drainage systems in Ningbo (and many other Chinese cities) currently operate in exceedance of their design standards, and are unable to cope with the combination of rapid urbanization, reduction in permeable greenspace, and high intensity of cyclonic-enhanced rainstorms (Chan et al., 2018). The Sponge City Program (SCP) was initiated by the Chinese Government in 2013 to tackle these urban water challenges; mitigating flood risk while storing water to meet future demand by retrofitting existing cities with BGI to facilitate the absorption of rainwater and subsequent storage, purification and reuse (MHURD, 2014). The SCP is founded on pilot projects in demonstration zones within the 30 cities selected to trial this approach (Qiao et al., 2019). Participating cities must ensure that 20% of their urban land includes 'sponge' features (e.g. rain gardens, swales, wetlands, ponds, and permeable paving) by 2020, and 70-85% annual precipitation should be managed onsite. Strategies will improve stormwater management capacities from current low standards (1-in-1 to 1-in-5 year events) to 1-in-30 year events (*ibid.*). The SCP is being delivered within an urban governance framework that promotes development and urbanization in tandem with improving the natural environment and maintaining pre-development hydrological flow regimes (Jiang et al., 2017).

3. Rotterdam, the Netherlands

As a low-lying port city situated in the Rhine-Meuse Delta, Rotterdam has a close connection with water; approximately 85% of the city is up to 7m below sea level and the remaining 15% lies in unembanked areas (City of Rotterdam, 2013). Increasing the city's resilience to the impacts of future climate change (notably rising sea levels and flooding from extreme rainfall events) is a key priority as outlined in the Rotterdam Climate Change Adaptation Strategy (City of Rotterdam, 2013) and subsequent Rotterdam Resilience Strategy (City of Rotterdam, 2016). A multi-layer-safety approach has been adopted and focuses on three key aspects: 1) maintaining and strengthening existing infrastructure (dykes, barriers, sewers), 2) redesigning the city to create more space for water storage by promoting BGI, and 3) working with other city projects to link adaptation and spatial planning (Ministry of Infrastructure and the Environment, 2015). Multifunctional space, multiple beneficiaries, and multi-agency partnerships and funding are key, as is using urban water policy to help improve the quality of life of city residents (de Graaf and van der Brugge, 2010).

Over the last two decades, Rotterdam has produced numerous reports and guidance to support the transition to greater climate resilience, founded on the 2007 ambition to become 100% climate-proof by 2025 (maintaining functionality of the economic and social systems in the city with minimal disturbance during extreme weather events) (Municipality of Rotterdam, 2007). *Waterplan 2 - working on water for an attractive city*, progressed from the 2001 Waterplan by focussing on sustainability and adaptation at the scale of the Rotterdam Metropolitan Region. The 3rd edition of Rotterdam's Waterplan (2013) comprises 13 sub-water plans in accordance with the urban typologies of the city (Municipality of Rotterdam, 2013).

Rotterdam Weather-Wise (Rotterdam Office of Climate Adaptation, 2019) can be considered the 4th edition of Rotterdam's Waterplan. This promotes a bottom-up approach, involving both public and private actors, and focuses on small scale measures that will increase the city's resilience to future climate change impacts while improving outdoor public spaces. This development is increasingly visible in the city, including several water squares, extensive BGI, depaving projects, 220,000 m^2 of green roofs, and a rooftop park functioning as flood defence (Buro Sant en Co, 2014).

4. Portland, Oregon, USA

Portland is located near the confluence of the Columbia and Willamette Rivers. The city of Portland, with a population of around 653,000 (United States Census Bureau, 2019), is the largest of the twenty-four cities in the region's urban growth boundary (UGB). UGB's are required around each city and metropolitan area in Oregon to protect farm and forest lands from development (Metro, 2014). This model of compact development has led to Portland being recognized as a world leader in smart growth (Mohammed et al., 2016).

Portland's climate has two distinct seasons—a wet season from October-March when approximately 70% of precipitation falls, and a dry season from April-September (Fahy et al., 2019). Substantial investments have been made by government agencies, nonprofits, and private landowners to reduce nuisance flooding, improve water quality, and enhance fish habitat.

A $1.4 billion grey infrastructure project completed in 2011 has been complemented with an extensive system of green streets. These investments are expected to decrease discharges from the combined sewer system into the Willamette River from fifty times per year to an average of four times each winter and once every third summer (Netusil et al., 2014). The ‘Gray to Green’ initiative invested widely in BGI implementation to alleviate loadings on the piped infrastructure system and reduce adverse impacts on urban watercourses. These ongoing efforts have, to date, delivered over 900 green streets (bioswales), more than 400 ecoroofs, over 32,000 street trees, and invested in widespread culvert replacement or removal; purchasing of properties at high flood risk from willing sellers, and; reconnected and restored urban streams, floodplains and native vegetation (BES, n.d). In 2018, the City Council adopted one of the most aggressive green-roof policies in the United States that requires any new buildings with a net building area of 20,000 square feet or more to have a green roof. As of 2019, there were almost 1.4 million square feet of green roofs in the city of Portland (Netusil and Thomas, 2019).

Survey (UK English)

Figure S1. Survey home page with language selection box in the top right.

Survey Questions

In several questions, respondents were asked to rank from ‘very significant’ to ‘very insignificant’. Here, we present the exact language used in the survey. However, for clarity, in the manuscript and the statistical analysis in Supplementary Material C, e.g., Table C.2., we use the term ‘significant’ in a statistical sense and report perceptions of significance from the survey as perceptions of relative ‘importance’.

1. What do you think are significant water challenges in your City? Please give each challenge a score from 1 (very significant) to 10 (not significant).

_______ Drought risk
_______ Fluvial (river, stream, creek) flood risk
_______ Coastal flood risk and storm surges
_______ Sea level rise
_______ Increasingly frequent extreme rainfall events
_______ Water quality deterioration and river health
_______ Aging/outdated water and wastewater infrastructure
_______ Combined sewer overflows
_______ Water supply
_______ Sanitation
_______ Saturated soils
_______ Low groundwater levels

_______ Subsidence
_______ Other (please specify):

2. How significant are the following benefits of Blue-Green infrastructure to you? Please select one option per line.

Benefit	**Very significant**	**Significant**	**Neither significant or insignificant**	**Insignificant**	**Very insignificant**	**Don't know**
Flood risk and stormwater management						
Water quality improvement						
Air quality improvement						
Carbon sequestration						
Groundwater recharge and river base flows						
Increased attractiveness/ aesthetics						
Increase in property prices						
Reducing urban heat						
Educational opportunities						
Enhanced biodiversity						
Health and wellbeing improvement						
Rainwater use (e.g. rainwater harvesting)						
Recreational opportunities						
Improved sense of place						
Noise reduction						
Provision of jobs, e.g. building/maintenance						

3. Who are leading the way in implementing Blue-Green infrastructure in your City, and who should lead the way? Please select all options that apply.

Organisation	**Are leading the way**	**Should lead the way**
Local Government (e.g. Local, Municipal or Provincial Authorities, City Agencies)		
Elected Officials		

Private Water and Sewerage Company/Water Board/Water Authority		
Public Water and Sewerage Company/Water Bureau		
Environment Agency (UK), US Environmental Protection Agency (USA)		
Not-for-profit organisation		
Consultants		
Developers		
Individual champions, e.g. property owners, researchers, professionals working in this field		
Community programmes/groups		
Other (please specify):		

4. Which are the most effective factors for driving Blue-Green infrastructure implementation? Please select all options that apply.

☐ National Government legislation
☐ Local Government (e.g. Local, Municipal or Provincial Authorities, City Agencies) plans
☐ Local Planning Authority guidance
☐ Local Flood Authority guidance
☐ Multi-agency approaches
☐ Public-private partnerships
☐ Recognition of the multifunctionality of Blue-Green infrastructure
☐ Quantification and monetisation of the benefits and costs of Blue-Green infrastructure
☐ Lobbying from local communities, e.g. for agencies/organisations to reduce flood risk
☐ Other (please specify):
☐ Don’t know

5. What is needed to improve the uptake of Blue-Green infrastructure? Please select one option per line.

Strategy	**Very significant**	**Significant**	**Neither significant or insignificant**	**Insignificant**	**Very insignificant**	**Don’t know**
Clearer maintenance responsibilities						
Stronger national legislation						
Stronger local legislation and regulations						
Requirement for Blue-Green infrastructure in all new developments						

Increased awareness (developers)						
Increased awareness (policy-makers)						
Mandatory standards, design and/or construction codes						
Increased local authority expertise and capacity						
Stronger enforcement from the planning system						
Increased funding for Blue-Green infrastructure						
Wider range of funding resources						
Better coordination at all levels of Government						
More Blue-Green infrastructure champions						
Best practice examples						
Improved valuation of the multiple benefits and costs						
Change in cultures and behaviours						
Improved community engagement, education and outreach						
Post-project monitoring and evaluation						
Continued research into processes and functionality						

Responses to the free text option in questions 1, 3-4. NE = Newcastle, N = Ningbo, P = Portland and R = Rotterdam.

Question 1. What do you think are significant water challenges in your City?

Respondent ID	'Other' response
NE42	Pluvial flood risk; Pinch points in the infrastructure network
P14	Lack of affordability
P2	low stream flows and high water temperatures
P22	Increased intensity of winter events and drought in summer, high water temps
P4	Increase in portion of lots that are impervious in new development and redevelopment.
R22	Extreme heat
R27	Drought is very important, but in my opinion especially relevant in existing urban areas, not relevant in new build areas.
R34	The challenges interrelate through already existing complex (infrastructure) networks.
R4	Important is not the same as a substantial (big) risk… the above is filled in according to importance.

Question 3. Who are leading the way in implementing Blue-Green infrastructure in your City, and who should lead the way?

Respondent ID	'Other' response – who are leading the way
N22	Ministry of Housing and Construction Bureau
N29	Some of the stakeholders listed should participate but not necessarily lead.
N7	Government initiate legislation for the rewards and punishments measures to control the private developers to implement the Blue-Green infrastructure
NE2	Landowners, land agents, surveyors, planning/engineering/landscaping consultants,
NE24	no one organisation is leading the way - it is more via partnerships leading
P10	We don't have private water or sewer authorities so not ranked.
P11	The City/Agencies were definitely leading but it's become less of a priority.
P17	marked for both in cases where some individuals are leading the way while others are not in the same grouping
R22	Question is not entirely clear.
R24	I think everyone should contribute, no distinctions.
R34	Difficult, considering the complexity to differentiate. Area-orientated alliances and programming should be leading.
R7	Housing corporations should be involved considering they own/manage large portion of properties.

Question 4. Which are the most effective factors for driving Blue-Green infrastructure implementation?

Respondent ID	'Other' response – who are leading the way
N29	I think these may be regional specific. In China, national initiative from the central government would still be the most influential factor to drive any infrastructure building while local government would have the knowledge and capital on the ground to implement it. PPP is now a fashion but it still needs to be driven from the government. This might not be true for other countries.
NE24	catchment plans
P10	The original CWA lawsuit by local activist Nina Bell, spurred adoption of green infrastructure by the City of Portland BES. Without that I am not sure Portland would be leading the charge!
P14	Local Design, Construction, and Maintenance guidance (In addition to Planning)
P2	methods for addressing long-term maintenance; clearer research on effectiveness to establish/update BMPs
P22	NGOs
P8	Commitment from community, i.e. community places value on blue-green infrastructure
R4	Money.
R5	Courage to deviate/ to think freely + sufficient resources for realisation and operation.

Statistical analysis

Table S1. Ranking of the water challenges identified by the whole sample population and for each case study city. The values represent the median ranking for each water challenge. Lower rankings denote greater importance of the challenge. The most important challenges for each group are highlighted in grey. Water challenges that have (statistically) significantly different rankings between one or more cities are listed in the final column.

Water challenge	All	Newcastle	Ningbo	Portland	Rotterdam	P-value (Kruskal-Wallis)	Sig. dif. and p-value (Dunn's)
Fluvial flood risk	3	4	3	4	3	0.871	
Increasingly frequent extreme rainfall events	3	2	3	2	2	0.649	
Water quality deterioration and river health	3	4	3	3	3	0.680	
Ageing water and wastewater infrastructure	4	3	5	3	4	0.073	
Combined sewer overflows	4	3	4	5	4	0.634	
Coastal flood risk and storm surges	5	4	4	9	2	0.005	R – P (0.003) Ne – P (0.048)
Sea level rise	5	4	5	5	2	0.610	
Water supply	5	7.5	5	5	4	0.010	R – Ne (0.007)
Saturated soils	5	5.5	5		5	0.771	
Drought risk	6	7	7	6	4	0.031	R – Ne (0.036)
Sanitation	6	8	5	6	4	0.004	R – Ne (0.002)
Subsidence	6	6.5	7	9	3	0.004	R – P (0.003)
Low groundwater levels	7	8	7	7	4	0.004	R – Ne (0.002)

Significant differences at the p = 0.05 level are reported, based on Kruskal-Wallis Independent samples test and Dunn's Post Hoc Non-Parametric Test, adjusted by the Bonferroni correction for multiple tests). Ne = Newcastle, N = Ningbo, P = Portland, R = Rotterdam.

Table S2. Percentages of respondents in the whole sample population and each city that regarded the benefits of Blue-Green infrastructure (BGI) as very important or important. The highest percentages are highlighted in grey. The final column lists the cities where the percentage of respondents regarding the benefits as very important or important are (statistically) significantly different.

BGI Benefits	All	Newcastle	Ningbo	Portland	Rotterdam	P-value (Kruskal-Wallis)	Sig. dif. and p-value (Dunn's)
Flood risk and stormwater management	97	94	94	100	100	0.591	
Water quality improvement	97	94	100	100	94	0.566	
Health and wellbeing improvement	95	94	100	100	88	0.285	
Enhanced biodiversity	94	100	94	87	94	0.495	
Increased attractiveness/aesthetics	92	100	94	87	88	0.470	
Improved sense of place	92	94	88	93	94	0.929	
Rainwater use (e.g. RWH)	84	81	88	73	94	0.444	
Educational opportunities	81	100	71	87	69	0.139	
Air quality improvement	80	81	82	87	69	0.698	
Reducing urban heat	78	50	94	87	81	0.037	N – Ne (0.033)
Groundwater recharge and river base flows	73	56	82	80	75	0.317	
Recreational opportunities	72	100	76	47	63	0.008	Ne – P (0.006)
Carbon sequestration	66	63	65	100	38	0.003	P – R (0.001)
Increase in property prices	56	44	76	60	44	0.167	
Noise reduction	56	56	76	47	44	0.166	
Provision of jobs	52	56	53	67	31	0.176	

Significant differences at the p = 0.05 level are reported, based on Kruskal-Wallis Independent samples test and Dunn's Post Hoc Non-Parametric Test, adjusted by the Bonferroni correction for multiple tests). Ne = Newcastle, N = Ningbo, P = Portland, R = Rotterdam.

Table S3. Testing for statistically significant differences between respondents' disciplinary backgrounds and perceptions of the very important benefits of Blue-Green Infrastructure (BGI). Disciplinary backgrounds include: Engineering, Environmental Management, Implementation, Landscape Architecture or Design, Planning, and Strategy and Policy/Finance (see Table 1).

BGI benefits	**P-value (Kruskal-Wallis)**	**Significantly different disciplines and p-value (Dunn's)**
Flood risk and stormwater management	0.131	
Water quality improvement	0.021	
Increased attractiveness/aesthetics	0.268	
Health and wellbeing improvement	0.170	
Enhanced biodiversity	0.727	
Improved sense of place	0.958	
Rainwater use (e.g. rainwater harvesting)	0.679	
Reducing urban heat	0.775	
Recreational opportunities	0.888	
Groundwater recharge and river base flows	0.033	Landscape Architecture or Design – Strategy and Policy/Finance (0.038)
Educational opportunities	0.098	
Air quality improvement	0.294	
Increase in property prices	0.342	
Provision of jobs	0.232	
Carbon sequestration	0.117	
Noise reduction	0.305	

Significant differences at the p = 0.05 level are reported, based on Kruskal-Wallis Independent samples test and Dunn's Post Hoc Non-Parametric Test, adjusted by the Bonferroni correction for multiple tests).

Table S4. Effective socio-political and instrumental drivers for implementation of Blue-Green Infrastructure (BGI) in the four cities. The values show the percentage of respondents that selected each driver, for each city, and overall (respondents could select multiple options). The most effective drivers are highlighted in grey. Drivers that have (statistically) significantly different percentages between one or more cities are listed in the final column.

Drivers	All	Newcastle	Ningbo	Portland	Rotterdam	P-value (Kruskal-Wallis)	Sig. dif. and p-value (Dunn's)
Local Government plans	87	88	94	87	75	0.471	
Recognition of the multifunctionality of BGI	68	75	59	80	56	0.404	
Local Planning Authority guidance	63	75	65	53	56	0.598	
Multi-agency approaches	63	88	35	73	56	0.015	Ne – N (0.013)
Public-private partnerships	60	56	59	60	63	0.988	
Quantification and monetisation of the benefits and costs of BGI	60	69	41	80	50	0.109	
National Government legislation	52	69	88	47	0	0.000	R – Ne (0.001) R – N (0.000)
Local Flood Authority guidance	43	63	35	27	44	0.215	
Lobbying from local communities*	30	50	12	40	19	0.062	

Significant differences at the p = 0.05 level are reported, based on Kruskal-Wallis Independent samples test and Dunn's Post Hoc Non-Parametric Test, adjusted by the Bonferroni correction for multiple tests). Ne = Newcastle, N = Ningbo, P = Portland, R = Rotterdam. *Lobbying for local communities, for example, for agencies/organisations to reduce flood risk.

Table S5. Perceptions of who are leading the way in Blue-Green Infrastructure (BGI) implementation in the case study cities, illustrated by the percentages of respondents that selected each category. The groups with the highest percentages in each city are shaded in grey. Statistically significant differences between the cities are listed in the 'Sig. dif.' column. WSC (Water and Sewerage Companies). *Environment Agency refers to the relevant national organisation in each country, e.g. the Environment Agency (UK), Environmental Protection Agency (USA), Ministry of Infrastructure and Water Management (Netherlands) or the Housing and Construction Bureau (China).

Organisation / stakeholder	**All**	**Newcastle**	**Ningbo**	**Portland**	**Rotterdam**	**P-value (Kruskal-Wallis)**	**Sig. dif. and p-value (Dunn's)**
Local Government	84	81	94	73	88	0.423	
Individual champions	58	69	18	87	63	0.001	N – Ne (0.019) N – P (0.001)
Community	53	38	6	87	88	0.000	N – P (0.000) N – R (0.000) Ne – P (0.039) Ne – R (0.030)
Public WSC	47	19	24	80	69	0.000	Ne – R (0.030) Ne – P (0.004) N – P (0.009)
Environment Agency*	42	69	47	27	25	0.044	
Elected Officials	34	19	35	40	44	0.470	
Not-for-profit	31	31	6	80	13	0.000	P – Ne (0.005) P – N (0.000) P – R (0.000)
Private WSC	31	88	12	20	6	0.000	Ne – R (0.000) Ne – N (0.000) Ne – P (0.000)
Consultants	28	38	6	53	19	0.018	N – P (0.019)
Developers	25	6	6	33	56	0.002	R – N (0.006) R – Ne (0.007)

Significant differences at the p = 0.05 level are reported, based on Kruskal-Wallis Independent samples test and Dunn's Post Hoc Non-Parametric Test, adjusted by the Bonferroni correction for multiple tests). Ne = Newcastle, N = Ningbo, P = Portland, R = Rotterdam.

Table S6. Perceptions of who should lead the way in Blue-Green Infrastructure (BGI) implementation in the case study cities, illustrated by the percentages of respondents that selected each category. The groups with the highest percentages in each city are shaded in grey. Statistically significant differences between the cities are listed in the 'Sig. dif.' column. WSC (Water and Sewerage Companies). *Environment Agency refers to the relevant national organisation in each country, e.g. the Environment Agency (UK), Environmental Protection Agency (USA), Ministry of Infrastructure and Water Management (Netherlands) or the Housing and Construction Bureau (China).

Organisation / stakeholder	All	Newcastle	Ningbo	Portland	Rotterdam	P-value (Kruskal-Wallis)	Sig. dif. and p-value (Dunn's)
Developers	56	100	24	67	38	0.000	Ne – R (0.002) Ne – N (0.000)
Local Government	50	56	18	40	88	0.001	N – R (0.000)
Elected Officials	47	75	12	60	44	0.002	N – P (0.041) N – Ne (0.002)
Consultants	39	81	24	40	13	0.000	Ne – R (0.000) Ne – N (0.005)
Environment Agency*	39	50	18	73	19	0.003	P – R (0.012) P – N (0.008)
Public WSC	36	38	24	27	56	0.211	
Individual champions	34	44	24	33	38	0.668	
Private WSC	31	50	29	40	6	0.052	
Community	27	31	24	33	19	0.778	
Not-for-profit	19	25	24	20	6	0.515	

Significant differences at the p = 0.05 level are reported, based on Kruskal-Wallis Independent samples test and Dunn's Post Hoc Non-Parametric Test, adjusted by the Bonferroni correction for multiple tests). Ne = Newcastle, N = Ningbo, P = Portland, R = Rotterdam.

Table S7. The percentages of respondents from each city that regard different strategies for improving the uptake of Blue-Green infrastructure (BGI) as very important or important. Strategies with the highest percentages in each city are shaded in grey. Statistically significant differences between the cities are listed in the 'Sig. dif.' column.

Improving BGI uptake	**All**	**Newcastle**	**Ningbo**	**Portland**	**Rotterdam**	**P-value (Kruskal-Wallis)**	**Sig. dif. and p-value (Dunn's)**
Increased awareness (policy-makers)	94	94	94	93	94	1.000	
Wider range of funding	94	100	100	86	88	0.277	
BGI in new developments	92	100	88	100	81	0.128	
Increased funding for BGI	91	94	94	87	88	0.832	
Clearer maintenance responsibilities	89	88	100	73	94	0.110	
Increased local authority expertise and capacity	86	81	94	93	81	0.508	
Increased awareness (developers)	84	88	76	87	88	0.824	
Mandatory standards	84	94	100	93	50	0.000	R – Ne (0.004) R – N (0.000) R – P (0.005)
Stronger local legislation and regulations	84	88	100	87	60	0.006	R – N (0.005)
Best practice examples	84	81	100	71	81	0.083	
Improved community engagement, education and outreach	84	100	76	87	73	0.106	
Improved valuation of multiple benefits/costs	83	88	88	87	69	0.397	
Post-project monitoring and evaluation	83	81	100	80	69	0.103	
Change in cultures and behaviours	83	100	71	87	73	0.088	
Continued research into processes and functionality	81	94	94	87	50	0.003	Ne – R (0.010) N – R (0.008)
Better coordination	76	81	88	71	63	0.238	
Stronger enforcement from the planning system	74	81	94	86	33	0.000	R – Ne (0.007) R – N (0.000) R – P (0.014)
More BGI champions	73	88	71	80	53	0.097	
Stronger national legislation	68	88	88	73	20	0.000	R – Ne (0.000) R – N (0.000) R – P (0.001)

Significant differences at the p = 0.05 level are reported, based on Kruskal-Wallis Independent samples test and Dunn's Post Hoc Non-Parametric Test, adjusted by the Bonferroni correction for multiple tests). Ne = Newcastle, N = Ningbo, P = Portland, R = Rotterdam.

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