Developing a blue-green infrastructure community engagement framework template

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Abstract

There is growing recognition that Blue-Green Infrastructure (BGI) (parklands, swales, ponds and green roofs, etc.) can reduce flood-risk and also benefit public health and improve environmental quality (air/water quality, biodiversity, etc.). Community engagement is critical to getting BGI implementation 'right' and producing more sustainable solutions, yet understandings of approaches differ and remain difficult to harmonize or resolve.
A review of the extant literature shows that many guidelines frame communities in the passive 'recipient' mode, and remain quiet about the power relations framing and conditioning engagement. The paper then proposes a set of generic template principles for the development of community engagement frameworks to facilitate and encourage greater community co-production of BGI**,** with the hope that this could then improve public preferences, accountability, efficacy and sustainability.

Keywords

Community engagement; public perceptions; local knowledge; blue-green infrastructure; sustainable drainage systems

1 Introduction

Whilst the term 'community engagement' (CE) is common in planning practice writing, it remains fuzzy in its application. There is limited practical guidance around what 'conducting

engagement' should mean, and also the who, how and when of engagement. This paper develops a set of guiding principles to underlie CE framework templates, concerning installation/retrofitting of Blue-Green Infrastructure (BGI) in the built environment.

The need for BGI in and around urban developments is increasing due to increased flooding, yet negative potential reactions from communities that will live, work and recreate around BGI can be a limiting factor to its adoption. Developing locally understood and supported BGI will be essential to ensuring its longer-term sustainability, communities' willingness to pay for, behave around and maintain devices, and the potential for wider rollout and upscaling to produce effective city-scale (and larger) systems.

CE frameworks are widely used in health, education, development and Local Authority settings, but have thus far been little employed around Green Infrastructure (GI) and BGI. This is despite studies such as Maher (2020) emphasising the importance of community engagement in BGI development to enable transition towards more water-sensitive cities. A few examples of CE frameworks around BGI exist in the literature (City of Gary 2014; Catchlove et al. 2007), however, the development of a set of common principles for different contexts has not yet been considered. CE frameworks will differ according to site, priorities (flood risk, water quality, urban greening, etc.) and community requirements and desires, however the principles of inclusivity, co-learning and co-development should arguably hold regardless of context.

More BGI is urgently needed for managing flooding (and other reasons), so it is crucial that common principles are developed to frame processes by which communities are listened to and involved. Hopefully, communities and practitioners can then develop more shared understandings, and installations be more appreciated, used and cared for by surrounding populations.

The rest of the paper is split into five sections. The following describes methods used in collecting and analysing articles for this study, after which some key terminology is clarified. Section Four explains the need to approach BGI-CE as a serious and distinct matter, considering the who, what and how. Section Five outlines our proposed BGI-CE framework template *outcome* and *process* principles to guide BGI-CE work and presents a typology of BGI-CE forms. Section Seven concludes the paper.

Importantly, we argue that process developments need to be as important as more concrete outcomes; as such, the paper's focus is on the processes of community engagement that need to surround BGI rather than the devices themselves. This paper focuses on establishing a template for factors to be included and considered within and around approaches to engagement, rather than the equally important work that has been conducted around consensus building (see Innes and Booher 1999; Susskind 2010). This is because, prior to pursuing such efforts, it is vital to understand and act upon questions of the who, how and when of engagement, which this paper can hopefully help develop thinking around. Further, very valuable guides exist to planning and developing community engagement strategies (see for example Daly et al. 2015; Community Place 2014), although such guides work at a more applied level and do not attempt to address and develop upon core founding principles, as this paper does. The work thereby represents a timely contribution, as there is little literature available to provide guidance at the more general, theoretical level upon the principles of how communities might be more effectively engaged with BGI work.

2 Methods

This review was undertaken to provide a conceptual understanding of Community Engagement (CE) and propose a generic foundation template for BGI Community Engagement (BGI-CE) frameworks. As such, it draws on literature from several relevant fields (urban planning, urban ecology, and landscape planning). The key questions to answer

were, what does CE mean in the context of BGI, and what key principles are essential to guide it. The review pursues a scoping review approach rather than a systematic one (Munn et al. 2018), for the purpose of clarifying concepts and developing typology and principles. A such, the literature considered, whilst wide and varied, is not intended to be fully comprehensive as this was felt to be less useful at this time. As such, it was structured into three key stages: (i) search and sift, (ii) development of conceptual definition of CE in BGI context, and (iii) thematic synthesis of BGI-CE principles, inspired by and simplified from the *conception, selection, search, retrieval, review and appraisal* approach outlined in Sandelowski and Barroso's (2007) well-respected work.

Literature searches were undertaken across bibliographic databases (such as Science Direct and Google Scholar) as well as grey literature. Sources include peer-reviewed materials presented in journals, books and international and national conferences, supplemented by non-peer-reviewed literature from other sources, including international and national non-governmental organisations, national and local government bodies, academic institutes and some commercial organisations. A structured Boolean search was conducted using a wide range of terms related to BGI and CE. An example of strings and terms searched included: green or blue-green and (parkland* or wetland*) and (infrastructur*) and (communit* or engag* or participat*).

The review was designed to be inclusive; as such, there were no restrictions by country or study type. We anticipated variability in what is described as BGI, so articles were read carefully to be sure they adequately referred to BGI or GI in a water-management context and not, for example, just green infrastructure *per se*. Because 'blue-green' is a relatively recent and still emergent phrasing, but the interdependence of the 'blue' and the 'green' has been recognised for much longer, a number of articles are included whose titles refer in the first instance only to green infrastructure. However, on reading, these articles express concern

with water retention, flows and quality and so were deemed relevant to the study (for example, Gill et al. 2007). Similarly, others refer expressly to blue infrastructure whilst having concern for the green (for example, Deak and Brucht 2007).

Our approach to conceptualizing CE was based on a 'best fit' framework approach (Carroll et al. 2013), using pre-existing questions to analyse the literature. Each article was assessed for what, when, why and how CE is described. The development of a framework for BGI-CE was based on a thematic analysis, which enabled identification of key themes and ideas from the literature. Themes were added (or merged) and changed as the analysis progressed; this synthesis of the literature provided a framework for the key principles within BGI-CE to emerge. From this review of the literature, we identified the principles which researchers and practitioners considered fundamental to well-planned BGI-CE; we then identified possible best practices that could better inform future efforts. It was not practical to systematically test the veracity of information presented in the literature, but we did seek to ensure that wherever possible, results were based on data coming from multiple sources.

It is important to note that we are not discussing things from the perspective of the physical installations installed post-engagement, but rather from that of the engagement undertaken. The effectiveness of BGI-CE is presented in terms of 'outcome' and 'process' goals (Chess and Purcell 1999); while the former focus on successful outcomes or results, the latter consider characteristics of the engagements. As Chess and Purcell (1999 2686) emphasise, 'neither "good" process nor "good" outcome is sufficient by itself' (Chess and Purcell 1999, 2686).

3 Clarification of Terms

Blue-green infrastructure (BGI)

'Blue-Green Infrastructure' (BGI) is something of an umbrella concept, sitting alongside and overlapping with Green Infrastructure (Ghofrani, Sposito and Faggian 2017). It refers to a

more integrated systems approach to managing, reintroducing and/or improving green and the blue infrastructure present, or not, in the built environment. The hyphen is used in recognition of their interdependence and the value in taking a whole-systems approach to their provision and maintenance. Thinking is oriented towards improving climate resilience, enhancing amenity functions and a range of further multiple benefits (improved biodiversity, urban water quality and public health, enhanced urban aesthetics, reduced urban air pollution, etc., Fenner 2017b; Lawson et al. 2015; Tzoulas et al. 2007; Karlsson and Kalantari 2017).

BGI is ever-more needed in both new and established developments for a variety of reasons, one of the principal being flood risk management. Risks from flooding worldwide are rising (Milly et al. 2002); it is estimated that around one billion people are presently at risk, with at-risk assets argued to have reached $46 trillion by 2010 (Jongman, Ward, and Aerts 2012). Climate change impacts could further be profound, increasing the severity and frequency of extreme rainfall (Allan 2011; Bates et al. 2008); increased urbanisation will only exacerbate this situation. By 2050, an estimated 70% of the world's peoples will live in urban areas (United Nations 2014), meaning more people, buildings and infrastructure inevitably being sited on floodplains (Jha, Bloch and Lamond 2012). Continued economic development on the current model would increase the volume of impermeable surfaces (buildings and hard-paving, car-parks, footpaths, etc.), reducing filtration opportunities and increasing surface runoff (Wheater and Evans 2009).

BGI is a term that emerged late in the first decade of the 21st Century (see for example Selman 2008; Gledhill and James 2008) and has since become increasingly mainstream (Gill et al. 2007; Zavrl and Zeren 2010; Liao, Deng and Tan 2017; Thorne et al. 2015). BGI aims to produce a more naturally-oriented water cycle and contribute to urban environments' amenity functions by bringing more closely together Green Infrastructure (GI) and water management (Novotny, Ahern and Brown 2010; Hoyer et al. 2011). BGI approaches to

managing urban flood risk have been proven to have significant advantages over grey infrastructure when implemented and integrated at micro-, meso- and macro-levels (Casal-Campos et al. 2015; Ellis 2013).

The approach has gained widespread support and is increasingly being adopted, for example in the USA, UK, Netherlands, Sweden and France (Frantzeskaki et al. 2017; Haghighatafshar et al. 2014; Perini and Sabbion 2016). However, many planners and developers still shy away from adopting BGI due to uncertainty about communities' (and their representatives') feelings (Thorne et al. 2015).

BGI might be framed as one more stage in the discursive evolution of GI (Thomas and Littlewood 2010; Wright 2011), given that the 'green' has always to some extent been concerned with the provision and retention of the 'blue'. Similarly, as Fletcher et al. (2015) have noted, a range of terms are already in use for GI-based storm water management systems. However, BGI looks to the value in adopting a broader, more integrated, multi-scalar focus upon the complete hydrological cycle (from water-butts and rain-gardens, through open green spaces and retention ponds, up to de-culverting and re-naturalizing rivers) (Lawson et al. 2015).

Community Engagement (CE)

The importance of CE in fields such as health (Bolton et al. 2015), education (Morin et al. 2016) and urban planning (Foth et al. 2009) is widely recognised. However, the concept has been used inconsistently in the literature and there are many different understandings. The difference is not only disciplinary, but often depends on different sets of values. It frequently acts as an umbrella term covering the whole range of public involvement and consultation. Of late, CE has been used as a buzz-phrase covering everything from conducting community preference surveys to *creating* awareness or *educating* the public. Ross, Baldwin and Carter (2016) note a variety of ways of viewing the differences between community engagement

and public participation, from a semantic shift to a fundamental philosophical development; they observe, however, a significant shift in online searches towards the former.

Focusing only on communication *from* practitioners (one way, *help them*) can overlook opportunities for all parties to learn. Such a conceptualisation can be seen in some recent BGI projects, where engagement is framed as 'planners, design professionals and other experts helping or educating communities to realise some set vision' (Papacharalambous et al. 2013, p. 138). The urban planning field has tended to be wider in scope. The Royal Town Planning Institute (RTPI 2005, p.5) define CE as 'those actions and processes which take place to establish an effective relationship with individual and organisational stakeholders', whilst the Australian Institute for Disaster Resilience (AIDR 2013, p.2) define it as 'the process of stakeholders working together to build resilience … and the development of strong relationships built on mutual trust and respect'. Both apparently place more weight on process over outcomes. This paper contends that BGI-CE needs to be a broad, inclusive and continuous process with two-way, open and clear communication, transparency and accountability, responsiveness to local context and a focus upon both process and outcomes.

4 Blue-Green Infrastructure Community Engagement (BGI-CE)

BGI now appears with growing frequency in urban planning literature (Victoria State Government 2017; Maidstone Borough Council 2016; Newcastle City Council 2016; Ramboll Group 2016); however, there is still little clarity about appropriate processes for ensuring community understanding, awareness and approval, and how these might or should differ from, for example, approaches undertaken with GI. Aside from evidence suggesting that visible stormwater runoff can evoke negative perceptions (Stahre 2008), and that local communities are not adequately engaged with water management issues (Rolston, Jennings and Linnane 2017), there are other reasons why BGI-CE developments may need to differ from those concerned solely with GI.

Firstly, there may be more potential for community resistance to BGI, connected with:

- Concerns surrounding water-related health and safety issues (drowning, and ill-health from untreated/polluted water, CIRIA 2013; Keeley et al. 2013; Bastien, Arthur, and McLoughlin 2011);
- Neighbourhoods losing valued green-space to water (Backhaus, Dam and Jensen 2012);
- Perceptions of low-cost effectiveness, or reluctance to accept extra costs (Ossa-Moreno, Smith and Mijic 2017; Keeley et al. 2013);
- Belief in the low efficacy of BGI flood-risk management (Everett et al. 2015), and
- Concerns over where longer-term management responsibilities and maintenance costs will lie (McKissock et al. 2003; Todorovic et al. 2008).

Secondly, BGI advocates premise its value over traditional grey infrastructure around the argued multiple further benefits, especially for nearby communities. Yet evidence suggests these may not always be well understood by said communities (Everett et al. 2015; Chan 2015; Apostolaki and Jefferies 2005; CIRIA 2013). BGI can be highly technical, and so communicating its means of operation, the potential benefits, and conveying the need for behaviour-change in order to realise these may require deeper and longer-term conversational engagement. Maximizing the potential multiple benefits of BGI will require effective CE throughout (Lawson et al. 2014; O'Donnell, Lamond and Thorne 2017). Processes currently employed around the development and installation of GI have been critiqued for not providing sufficient opportunities for public participation and negotiation (Thomas and Littlewood 2010). However, attempts at engaging with communities can often be difficult and challenging.

The traditional approach to 'CE' has been deemed one-way and "provider-centric" or *passive*, merely conveying information and not listening to and learning from community feedback (Bovaird 2007; O'Donnell, Lamond and Thorne 2017). Such an approach has been deemed

inadequate in a GI or BGI context (Keeley et al. 2013), because communities will have greater experiential contact with installations and should feel sufficient ownership and empowerment to interact with them, if many proposed benefits are to be realised (Kati and Jari 2016). Manzo and Perkins (2006, p. 335) therefore advocate that urban planners pay special attention to "participation and empowerment" in the planning process.

The most popular alternative has been to promote more two-way CE; "co-design" (Scott et al, 2016), "co-production" (O'Donnell et al. 2018) and "citizen participation" (Rosol 2010). Yet these may produce undesirable outcomes, if social, economic and cultural capital enable and disable different groups' participation, leading to questionable 'environmental justice' (Buijs et al. 2016; Rydin and Pennington 2010; Lovell and Taylor 2013). Communities will never be homogeneous and relations of dominance, exclusion, and differential power may often pertain (Castells 2011), both within and between communities and practitioners.

Effective CE should ensure that all voices, problems and proposals are listened to (Fenner 2017b), negotiating hierarchies that might otherwise marginalise some interested parties. One constraint is that BGI projects are still in their infancy (Haase 2015), and so despite community engagement's importance being acknowledged, specific guidelines are incomplete and the way it might best be managed is often poorly understood, despite Lovell and Taylor's call (2013, p.1457) for practitioners to:

> *[B]e cognizant of and acknowledge existing geometries of power and the potential mobilization of 'green' planning discourse in the service of urban elites, and the vulnerability of the process to the uneven distribution of power.*

Who are the community?

Whilst the term 'community' is widely used, answering the question 'who are the community?' is not always straightforward (MacQueen et al. 2001). Meikle and Jones (2013) argue for thinking around five community types:

- Interest (people who share the same interest or passion)
- Action (people trying to bring about change)
- Place (people brought together by geographical boundaries)
- Practice (people in the same profession or who undertake the same activities), and
- Circumstance (people brought together by external events/situations)

Practitioners need to firstly learn if their concerned ‘communities’ are geographically located and/or more socially, identity or practice-based. The impacts and potential benefits of BGI may transcend singular interests, groups and practices. In most cases, because BGI devices will occupy a space, BGI-CE may try to address a ‘community of place’. Usage of the term 'community' in a spatial context often implies a sense of identity and harmony, potentially glossing over social, economic and cultural differences (Head 2007). Susskind (2010) pointed out that engagements can fail when ‘wrong parties are at the table’; Talen (2000) suggests that this needs thinking through carefully. Understanding the heterogeneities present even within local communities will be essential to effective engagement, especially when research has indicated that access to proposed BGI benefits (such as health and wellbeing) may not be shared equally (Jennings, Larson and Yun 2016, Thorne et al. 2015).

Successful BGI-CE should ideally work against urban social inequalities, encouraging more equity and justice (Raymond et al. 2016). Inequalities could be entrenched socio-economic/-cultural differences not easily mapped onto observable demographics (Kabisch and Haase 2014) and so not reflected in current BGI-CE frameworks (Young 2011). This calls into question any BGI-CE focusing simply on working with community ‘representatives’ or ‘groups’, without recognising that those who accede to such positions, or join such groups, may be more socially-privileged and with the time, resources, confidence, vocabulary and inclination to discuss with decision-makers (Carr 2012). Greater efforts will be required to convince some community members of the value of engagement (Everett et al. 2016). BGI-

CE should target the involvement of groups perhaps not traditionally interested in consultation: these groups will be affected, positively or negatively, by installations; their awareness of potential benefits could affect whether these are realised, as their behaviour could affect devices' performance and sustainability; see Lamond and Everett (2019) on 'social practices', for example.

In addition to identifying the concerned communities, it is essential to provide clarity about those conducting the engagement, their funders and their organisations, considering the many interests, influences and complex relations involved in making changes to either established or proposed new built environments. It would be inappropriate to develop BGI-CE work without clear initiator positions, skills, interests, etc. (Daly et al. 2015). Practitioners need be clear about who they are, their objectives and their motivations. Clarity here could significantly influence communities' acceptance of the engagement process.

What is engagement?

'Engagement' and 'participation' are sometimes used as synonyms. We might therefore begin by considering Arnstein's (1969) 'ladder of participation' (fig.1) as an established and widely-recognised typology. Here, levels of 'engagement' are divided into three: (i) non-participation, such as manipulation and therapy; (ii) tokenism, such as informing, consultation and placation, and (iii) citizens' power, such as partnership, delegated power and citizen control.

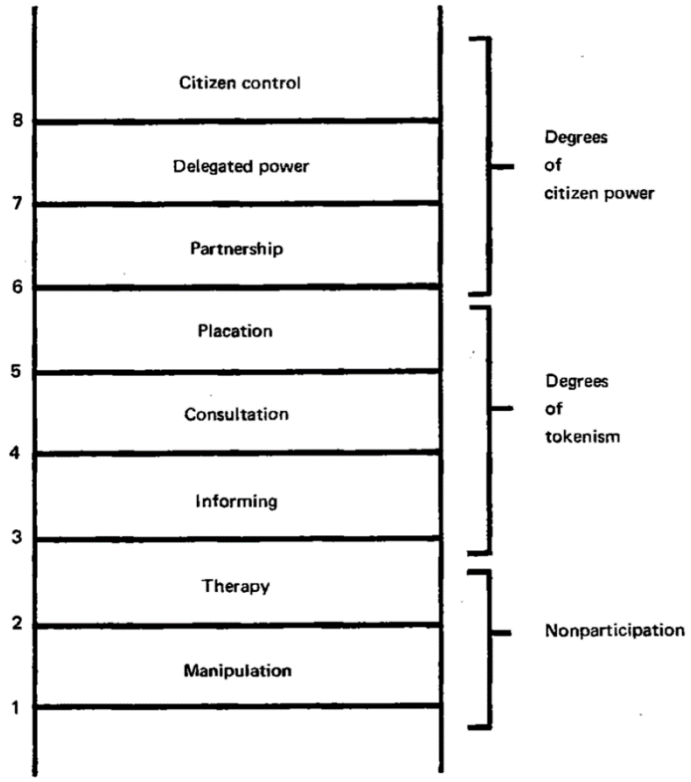

Figure 1. Arnstein's Ladder of Participation

With 'non-participation', engagement substitutes for genuine participation, the intention being to enable practitioners to 'educate' or 'fix' communities. With 'tokenism', communities may be heard or allowed to have voice, but lack power to ensure their views are heeded. With 'citizen power', there is not only two-way communication, power is also 'redistributed through negotiations between citizens and power-holders… [who] agree to share planning and decision-making responsibilities' (Arnstein 1969, p.221). As such, we contend that BGI-CE should focus not only on outputs (public buy-in for project(s), but also the processes that can build bridges between practitioners and communities, where BGI can gain relevance. This form of engagement challenges the notion of communities as 'recipients'.

How to engage?

There are many techniques adopted in community engagement, including film, theatre, poetry, art, meetings, events, exhibitions, and school activities. The Scottish National Standards for Community Engagement provide ten standards that are a useful reference point for ensuring quality and effective engagement (Communities Scotland 2005). Likewise, Wates (2014) provides a list of techniques that can be adopted when engaging communities in planning and design. These include different ways of people interacting, types of event, types of organisation, and so on. There is, however, a need to carefully select BGI-CE techniques. As mentioned, the information around BGI can be complex, the capacities and interests of different communities may vary widely (Buijs et al. 2016) and engaging under-represented populations can be difficult (Lovell and Taylor 2013; Gosman 2013). Traditional, passive strategies such as posting notices (even in native languages) could be insufficient. Any technique needs to recognise the diverse knowledge needs of community groups (Hamel and Tan 2021; Assmuth et al. 2017).

Serious thought therefore need be given to designing materials and techniques, to not entrench inequalities. Some techniques may ensure only passive engagement (O'Donnell et al. 2017), or could entrench power dynamics (Lovell and Taylor 2013). Some have suggested creatively combining several techniques to leverage their benefits (White, Kingston and Barker 2010), or using planning outreach liaisons to encourage more democratic outcomes (Oshun, Ardoin and Ryan 2011). A number of participatory and visualisation techniques have been trialled that warrant consideration for BGI-CE (Jose, Wade and Jeferies 2015; Raymond et al. 2016; White et al. 2010; Tress and Tress 2003). The desired outcome could also influence choice of technique; for example, engagement with the goal of communities' and practitioners' *consciousness-raising* will require particular approaches (Sangiorgi 2011). Overall, techniques should be used which allow communities to express themselves in ways they can control.

Some engagement strategies focus on short-term interventions at different points, such as design and agenda-setting. However, owing to the nature of BGI (interests, concerns, awareness, etc.), there is arguably need for longer-term engagement from planning, through design, commissioning, management and delivery, to monitoring and evaluation (and beyond, to ensure new residents remain aware). The importance of engaging communities from early on has been highlighted as being central to effectiveness on a number of occasions (Fenner 2017a; Kati and Jari 2016). Most guidelines and academic literature emphasise engaging communities from the outset (AIDR 2013; Daly et al. 2015; Manzo and Perkins 2006; Mirza, Vodden and Collins 2013). Overall, flexibility is essential to make room for any change or need for change in the process (Community Place 2014). This underscores Innes and Booher's (1999) idea that the processes should make room for learning, change and building shared meaning. Likewise, Susskind (2010) argues for an adaptive approach that can respond to changing conditions.

Conceptualizing practitioner BGI-CE relationships

The BGI-CE framework template presented here builds on these basic participation principles to explain patterns of engagement between practitioners and communities. As the basis for a typology of BGI-CE, we assume that for any interaction between practitioners and communities to be considered, three factors are important. These are termed BGI-CE *dimensions*: direction of communication; level of acceptance, and level of influence:

- The *direction of communication* can be one-way (unidirectional) or two- or more 'way' (multidirectional). Unidirectional is when practitioners provide information with no opportunity for feedback and discussion, demonstrating unequal power akin to Arnstein's (1969) 'non-participation'. Multidirectional recognises communities' capacity and voice and can mean *mutual learning*, improving coordination and decision-making.

- *Level of acceptance* refers to the degree to which practitioners take communities' ideas and interests onboard. Low acceptance would be rejection, whilst higher acceptance would mean accommodating at least some ideas.
- *Level of influence* refers to the extent to which communities influence actual decision-making, whether they have a seat at the table and a vote, or voice, on the final choices made.

5 A BGI-CE Framework Template

Typology

Based on the exchanges identified above, we offer four types of BGI-CE, depending on levels of acceptance and influence (Figure 2), assuming that one-way communication does not qualify as 'engagement'. This framework template is suggested as a starting point for developing approaches to BGI-CE. A table of examples drawn from the literature with detailed explanation is provided in Table 1:

- **Low acceptance, low influence:** Practitioners have full control of the process and may only seek input from communities through questionnaires or asking for comments around planning and design. No obligation to consider the information or feed this into decision-making.
- **High acceptance, low influence:** Practitioners recognise that communities have needs and desires that could help ensure quality BGI. They work with communities to improve design specifications and review potential impact. Final decision-making lies with practitioners.
- **Low acceptance, high influence:** Practitioners do not engage communities to understand their needs, but present and allow them to partake in decision-making.
- **High acceptance, high influence:** Power and control are relocated, with more equal community-practitioner control in analysis, planning and design. Communities provide

information, which is considered and discussed. They also have a role in the decision-making.

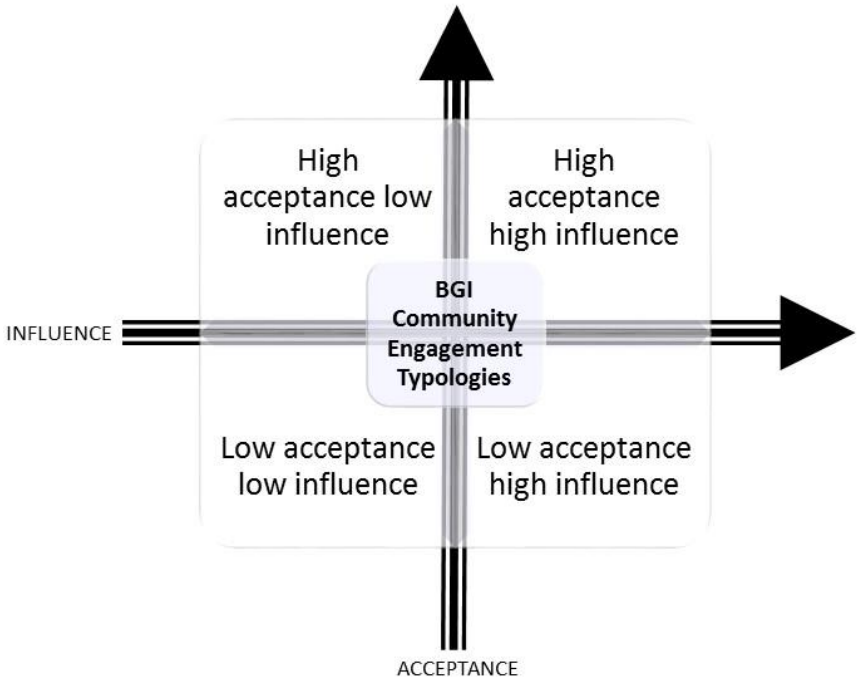

Figure 2. A typology of BGI-CE

This breakdown is based on practitioners being the initiator. However, within BGI literature, there has been a rise in advocating that engagement be community-initiated in a 'bottom-up' process, rather than top-down (Joint Nature Conservation Committee 2019; Lovell and Taylor 2013; Young 2011). Cuts in public infrastructure funding (Krätke 2004; Rosol 2010) have meant cities needing to find new ways of initiating and managing BGI developments. Community-initiated engagements, whereby practitioners have a reduced role but the exercise is still a two-way process, could be a viable alternative (Buijs et al. 2016); however,

Parkinson, Taylor and Mark (2007) have warned of the danger that such interventions might be easily derailed through organisational and capacity issues. What this suggests is that a successful BGI infrastructure should not only focus on the result (outcome), but that the process that leads to the outcome is as important.

Principles

Despite recent developments and calls for more community engagement in BGI projects, there is still no consensus among researchers and practitioners regarding on what the process and outcome should look like. This could negate the efficacy and sustainability of implementing BGI. From the literature reviewed, we identified key process and outcome principles that are essential components in BGI planning. This section will outline a set of principles developed from the literature that can be used as the foundations for developing effective BGI-CE frameworks:

- Outcome goals (people, process and design) provide the focus for developing measures to assess BGI community development outputs.
- Process goals (power relations and engagement techniques) will be useful in evaluating success in efforts at inclusivity and encouraging voice – the process.

A series of examples drawn from the literature with further explanation is provided in Table 2.

Outcomes

People Outcome Principle (POP): The POP of BGI-CE addresses three main themes: capacity building and awareness creation (both for community and practitioners) (O'Donnell et al. 2017); community ownership (Thorne et al. 2015), and community integration (Shandas et al. 2010). BGI-CE should be a platform for enhancing community and practitioner knowledge. Community understanding might usefully be raised around issues such as device management (Shandas et al. 2010) and potential benefits (Everett et al. 2016), and improving

people's capacity for and inclination towards environmental stewardship (de Roo 2011; Gifford 2008; Shandas and Messer 2008). Engagement must firstly recognise the potential for mutual learning (Greenway 2017), rather than presuming a *deficit model* of communities waiting to be filled with knowledge (Irwin and Wynne 1996). Communities will often hold valuable local information around local water flows and soil conditions, dis/preferences and behaviour or 'social practices;, that could enable more effective planning (Baptiste, Foley and Smardon 2015; Schäffler and Swilling 2013; Robertson 2017; Lamond and Everett 2019). Secondly, local communities should be encouraged to continue engagement with BGI, taking ownership around management, maintenance and in/appropriate behaviour, which could in turn reduce BGI life-cycle costs and increase willingness-to-pay (Thorne et al. 2015). In the City of Portland, OR, Shandas et al. (2010) found residents who had been engaged (via how-to guides and in-person tutorials) more likely to spend time maintaining 'their' BGI. Thirdly, BGI-CE should aspire to improve community interaction. People have been found to engage more socially in improved surroundings, and so it would be hoped that BGI might help encourage community and sub-communities' interaction, cohesion and resilience (de Roo 2011; Sullivan et al. 2004; de Roo 2011; Lovell and Taylor 2013). BGI-CE should therefore be seen not only as a means to an end (green infrastructure encouraging community bonding) but as an end in itself, the engagement process facilitating such interaction.

Process Outcome Principle (PrOP): Recent research has highlighted the need to ensure that processes leading to the establishment of BGI are seen to be collaborative and inclusive (Hansen and Pauleit 2014; Kabisch et al. 2017). PrOP will include ensuring that: BGI is socially equitable, sections of communities bearing costs according to ability and sharing in the benefits (Thorne et al. 2015; Raymond et al. 2017); BGI is co-designed, not simply imposed from above (Lovell and Taylor 2013; Adegun 2015), and that BGI-CE promotes

social inclusion, ensuring voices are heard, regardless of socio-economic background (Kabisch and Haase 2014; 2BG 2008).

Design Outcome Principle (DOP): This third key principle seeks to ensure that projects can be scaled up into integrated city and larger-scale systems (Foster, Lowe, and Winkelman 2011; Shandas et al. 2010). More often than not, BGI projects begin as small and local interventions, and so scalability needs to be a focus in order to achieve true potential benefits (Keeley 2013). To aggregate benefits up to city, county and even national levels, multiple parties will need to be engaged at critical points (Foster et al. 2011).

Studies have emphasised the expected or hoped-for outcomes of BGI, especially for ecosystems and human health (Tzoulas et al. 2007). Whilst achieving these might be said to be the key final goal of the BGI-CE process, we have shown here that it should not be the only desired outcome. However, if the final output is not properly delivered, it could negate the perceived success of the entire process. The key themes under this principle will therefore include delivering improved BGI designs (Kati and Jari 2016), ones that can be scaled up and integrated into city systems (Foster et al. 2011) and ones that fit local contexts (Derkzen, van Teeffelen, Verburg 2017).

Processes

Power Process Principle (PPP): Power is a key concept when studying interactions between different groups, who may have different competing interests, discourses and worldviews (Olsson et al. 2014). It will play an important role in shaping interactions, and the nature or felt justice of outcomes achieved (Rydin 2007). In recent times, there have been calls for practitioners to recognise the power dynamics at play in BGI-CE; enrolling more powerless groups is a major theme in looking to reduce any possible negative impacts (Derkzen et al. 2017, Lovell and Taylor 2013, O'Donnell et al. 2017).

Engagement Process Principle (EPP): While multiple different BGI-CE techniques can and have been used (Shandas et al. 2010), Lovell and Taylor (2013) note that BGI-CE techniques should consider what will work best for different target groups (see also Mirza et al. 2012) with different knowledge needs (Assmuth et al. 2017). Two major themes in BGI-CE will be that techniques should: seek to dismantle or loosen existing power relations to promote social justice; endeavour to encourage local understanding and participation, and aim to learn from communities to improve outcomes.

For engagement techniques to ensure justice, they will need to be inclusive and transparent. Inclusiveness is important, otherwise segments of society might be excluded; transparency is important to develop and maintain trust. This will involve avoiding approaches that allow dominant discourses to be imposed (Derkzen et al. 2017),All ensuring democratic outcomes (Oshun et al. 2011), and actively promoting inputs from less powerful neighbourhoods and residents (Lovell and Taylor 2013). Enhancing community understanding and participation will involve discussing BGI in clear and appealing ways (using local terminology rather than technical/academic jargon (Voskamp and Van de Ven 2015; Community Places 2014), ensuring strong local links through participatory activities (Wild, Ogden and Lerner 2008), and ensuring local communities are clear about their roles and involved at all stages (O'Donnell et al. 2017; Jarvie et al. 2017).

6 Conclusion

A Blue-Green Infrastructure (BGI) approach argues for the sense and sustainability in employing more integrated systems-thinking in the management of water and green spaces in the urban environment. BGI-CE will require a different approach because it encompasses different forms and levels of ownership and management, interests and knowledge, scale and interconnections with other components of the built environment. This paper has argued that

while some forms of community participation will work in the context of grey infrastructure or even green, the approach to BGI-CE could usefully be somewhat different.

This paper has proposed a set of underlying template principles for Blue-Green Infrastructure Community Engagement (BGI-CE) frameworks to be employed around planning and development, to improve community awareness and understanding, and buy-in and behaviour. We have reviewed and synthesised literature around BGI-related developments, to make the case for viewing BGI-CE as not only outcome-oriented, but also process-oriented. BGI-CE frameworks need to emphasise two-way communication whereby local community knowledge, opinions and participation in decision-making are recognised as being important. The approach practitioners take will depend on a number of factors and will need to vary within and between projects. What we can say, however, is that engagements will exist across four major types, ranging from low influence and low involvement to high influence and high involvement. This paper has argued for practitioners to move towards the high involvement, high influence end of the scales.

We have also argued that it is essential BGI-CE frameworks focus on the entire life of installations. Due to increased public and political interest in BGI, there is greater potential for conflicts to emerge if communities are not engaged from the outset. Developing BGI-CE from the very beginning of the planning process and then maintaining it through implementation and beyond, could help to encourage sustainability.

Our work has important implications for urban planning practitioners. It can potentially help decision-makers, designers and planners to prioritise more holistic and inclusive BGI-CE processes. It can also focus attention on how the institutional arrangements used to produce and manage urban infrastructure might help account for quality and equity problems therein. Further research is now needed to understand how developing BGI governance regimes

(changes in property rights, ownership and adoption issues, market-driven BGI, etc.) might positively or negatively affect community engagement processes.

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Table 1: Some examples of major Blue-Green infrastructure projects – based on review of literature

Article	Context	Community engagement relationship approach	Type of community engagement	Techniques used	Section of community engaged
New Orleans, USA: Living with Water (Papacharalambous et al. 2013, Waggonnner and Ball 2017)	New Orleans experiences floods regularly and existing forced drainage systems have proven inadequate. In 2010, the State of Louisiana's Office of Community Development - Disaster Recovery Unit developed an Urban Water Plan that incorporates blue-green concepts.	In Phase One of the project, a series of meetings were held with neighborhood group leaders 'to communicate, via presentations and discussions, basic Urban Water Plan concepts and principles. The goal was to enable neighborhood leaders to communicate knowledge and principles on sustainable integrated water management to their respective communities'. In Phase Three, further community meetings were held with presentations and discussions. The goal was to communicate findings and design work, and 'encourage the adoption of the Urban Water Plan by… the community'.	**One-way, low acceptance, low influence**. Community did not feel they had been engaged.	Meetings and outreach efforts that included presentations	Neighbourhood leaders
Kumpulanpuro brook and the Vallilanlaakso public park, Helsinki, Finland (Kati and Jari 2016)	The area has suffered from severe storm-water flooding in recent years, which was the main reason for the storm-water management plan for the brook.	The plan was prepared by practitioners and decision-makers. There is no evidence of any form of input from members of the local community at the onset of the project. Local communities were engaged in latter part of the project.	**Two-way, low acceptance low influence**. There was weak dialogue between the managers and local communities. This lead to managers underestimating socio-cultural meanings. Suggested solutions were significantly different between residents and managers.	Public meetings and electronic questionnaire	Not specified
Hoboken, New Jersey, USA (Bailin 2014, Cruijsen 2015, Ghofrani et al. 2017)	The city is susceptible to flooding, hence a retention and infiltration BGI-influenced water drainage approach was implemented.	The design was based on interactions among urban planners, water management engineers and architects exploring the performance of five scenarios based on the Storm Water Management Model. Local communities were not engaged in the design stage of the project. Despite the project's strong emphasis on an evidence-based approach to making decisions, there was interaction with the Community	**Two way, low acceptance high influence**	Formation and interaction with a Community Emergency Response Team	Not specified

		Emergency Response Team in the final decision made.			
Welsh Water's RainScape Project - RainScape Llanelli (Dŵr Cymru Cyf [Welsh Water], 2017)	There is a need to reduce the surface water entering sewers. The project uses various techniques, including grass channels to catch, redirect and slow down surface water.	The community was involved in the design through holding drop-in sessions with customers that live near the scheme. The project was designed to get in touch with residents to hear their views before the project started. For example, schoolchildren were heavily involved in the design of the scheme	**Two-way, high acceptance, high influence.**	Consultations	Locals, school-children, etc.
De Vliert, ’s-Hertogenbosch, Netherlands	The need to repair an old sewer system and to combine this with local infiltration.	Every household in the community was spoken to and local people were involved in the design of items like the manhole covers and parts of a new playground. However, there was no evidence to suggest that the locals had any influence on the final decision-making process.	**Two-way, high acceptance low influence.**	One to one consultations	
Slovo Park, South Africa (Adegun 2015)	In response to delayed state intervention, the Slovo Park Community Development Forum (SPCDF), made efforts to upgrade that incorporate stormwater drainage and other infrastructure.	The SPCDF engaged with professionals and non-governmental agencies on technical support for service provision and infrastructure development and this helped facilitate engagement with the state.	**Community initiated BGI**	One to one discussions and informal workshops	Professionals, academics and NGOs who facilitated engagement with the state

Table 2: BGI community engagement framework: themes, indicators and relevant examples with citations

BGI community engagement principles & outputs	Themes	Indicators and examples	Citations
People oriented outputs	**Capacity building and awareness creation**	Enhancing community understanding of BGI	(Everett et al. 2016, Thorne et al. 2015)
		Allowing practitioners (i.e. ecologists, planners, and designers) access to community expertise and local knowledge (shared Learning)	(Carden et al. 2016, Lovell and Taylor 2013, O'Donnell et al. 2017)
		Break down socio-institutional barriers (e.g. lack of knowledge and understanding).	(O'Donnell et al. 2017)
		Building a robust local evidence-base	(McConnachie and Shackleton 2010, Schäffler and Swilling 2013)
		Increasing knowledge for wiser BGI management	(Shandas et al. 2010)
		Improving public education and access to information and social learning	(Gledhill and James 2008, O'Donnell et al. 2017)
	Community ownership	Formation of stewardship and encouraging appropriate behaviour around infrastructure	(Andersson et al. 2014, Everett et al. 2016, Thorne et al. 2015)
		Enhancing community perceptions and positive experience of asset performance of BGI.	(Thorne et al. 2015, O'Donnell et al. 2017)
		Exploring potential for behavioural and cultural change	(Everett et al. 2016, O'Donnell et al. 2017)
		Empowering neighbours to design and create the development of public places within their own neighbourhood	(Semenza et al. 2007)
		Enhancing local sense of place	(Landscape Institute, 2013)
		Promoting community use of parks and green spaces	(Leeds City Council, 2015)
		Encouraging leadership, ownership and participation in managing and shaping local greenspaces.	(Hyland et al. 2013)
		Securing community interest and pride	(UK Green Building Council 2015)
	Community integration	Enhancing community bonding	(Semenza et al. 2007)

	Building trust and confidence	(Davis and Naumann 2017, Lovell and Taylor 2013, O'Donnell et al. 2017)
	Negotiating differences in community opinion	(Everett et al. 2015)
	Fostering community spirit	(Landscape Institute, 2013)
	Improving social control and social cohesion	(Michelle de Roo 2011)
Process oriented outputs	Resolving complex technical issues e.g. integrating newly created space (infrastructure) with existing space/ infrastructure	(Landscape Institute, 2013)
	Considering the needs of all potential users	(Everett et al. 2016, Kabisch and Haase 2014, Joint Nature Conservation Committee 2019)
	Increasing satisfaction with results	(Everett et al. 2016, Lovell and Taylor 2013)
	Gaining community acceptance of BGI designs	
	Enabling real inclusion in decision-making	(Llausàs and Roe 2012, Joint Nature Conservation Committee 2019)
	Ensuring social inclusion	(Cornwall Council, 2011) (Lovell and Taylor 2013, Thorne et al. 2015)
	Protecting lower income neighbourhoods.	(Wolch et al. 2014)
	Encouraging bottom-up participation (helping ensure planning ''solutions'' are not imposed from above)	(Lovell and Taylor 2013)
	Promoting community involvement through all stages	(Lovell and Taylor 2013)
	Leveraging resources effectively and efficiently	(US EPA 2017)
Outcome oriented outputs	Encouraging improved design of green infrastructure	(Schäffler and Swilling 2013)
	Ensuring that neighbourhood-scale projects contribute to an integrated city scale system	(Foster et al. 2011, Lovell and Taylor 2013)
	Guaranteeing that final outcomes fit the local context	(Derkzen et al. 2017)
	Promoting solutions which can be implemented	(Atkins, 2014)
	Producing outcomes that are relevant to the lived experience and challenges of local daily life	(Atkins, 2014)

Engagement technique	**Dismantle power differentials and ensure justice**	Avoiding sophisticated techniques in which dominant discourses are imposed through participatory processes (i.e. being careful of elite capture)	(Derkzen et al. 2017, Raymond et al. 2016)
		Ensuring democratic outcomes	(Oshun et al. 2011)
		Actively promoting inputs from less powerful stakeholders (neighbourhoods and residents) beyond those traditionally engaged	(Lovell and Taylor 2013, O'Donnell et al. 2017)
	Enhance local understanding and participation	Encouraging strong links with local people by organising participative activities	(Wild et al. 2008)
		Presenting outcomes in a clear and appealing way (i.e. using local terminology when discussing BGI)	(Shandas et al. 2010, Voskamp and Van de Ven 2015)
		Adopting approaches that ensure local communities are involved in the development and post-development phases	(Jarvie et al. 2017, Shandas et al. 2010)
		Promoting active engagement. This must move beyond passive engagement (e.g. notices explaining the functions of BGI assets)	(O'Donnell et al. 2017)
Power relations		Actively enrolling powerless groups into the project from the onset	(Derkzen et al. 2017)
		Producing a two-way communication that provides room for dialogue	(Everett et al. 2015)
		Maintaining governance structures that enable community participation (i.e. the ability to talk freely) in decision-making	(O'Donnell et al. 2018)