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What Does Good Green Infrastructure Planning Policy Look Like? Developing and Testing a Policy Assessment Tool Within Central Scotland UK

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ABSTRACT

This paper develops and tests a new self-assessment policy tool that illuminates the quality of planning policy for green infrastructure (GI). Working with 19 local planning authorities within the UK Central Scotland Green Network area (CSGN), the multi-functional coverage and strength of GI policies in statutory development plans were assessed. The tool was built from fusing two existing but unrelated initiatives addressing GI standards; Building with Nature and Integrating Green Infrastructure (IGI). The results reveal surprising variation across the functional coverage of GI-related policy and strength of associated policy wording, suggesting a significant vulnerability for how GI is mainstreamed in decision-making processes. To address this knowledge exchange deficit, the best performing policies were captured and adapted to inform a suite of model policies with global application. Significantly, the policies champion the different functions performed by GI and stress the need for early and ongoing involvement throughout any development process with funding for long-term stewardship post-development. The results serve as a catalyst for improved dialogue and social learning across planning, and wider built/natural environment teams and professions to plug identified policy gaps. In particular, there is recognition of the need for planning policy responses to move outside their usual environmental remit and engage with other policy sectors using more holistic policy hooks such as placemaking, placekeeping and the climate emergency. We argue that this tool has universal applicability in many planning systems for improving the policy response and imperative for GI, thereby increasing the potential for better spatial planning delivery.

Introduction

GI has matured significantly as a strategic concept in planning policy and practice at international, national, regional and local levels, leading Jerome, Sinnett, Burgess, Calvert and Mortlock (2019, p. 174) to claim that the "advocacy argument has been won". However, there still remains significant concern at its operationalisation, differing definitional interpretations and perceived importance in planning processes (Johns, 2019; Matthews, Low, & Byrne, 2015; McWilliam, Brown, Eagles, & Seasons, 2015; Mell, 2019; Wright, 2011). Such definitional and operational ambiguities raise a fundamental question as to what good GI policy actually looks like. Our paper addresses this

challenge explicitly through the development and application of a GI policy assessment tool that evaluates how well GI policies cover the priority multiple functions that GI performs (Hansen, Olafsson, Alexander, Rall, & Pauliet, 2019: Jerome et al., 2019), together with an assessment of the strength of policy wording (McWilliam et al., 2015). To date, there have been limited assessments of the effectiveness of GI policies in development plans with most attention focussed on planning case studies; albeit with some notable exceptions (Lennon, 2015 (Ireland); (Mell, Allin, Reimer, & Wilker, 2017) (Germany and UK); (Johns, 2019) (USA); (McWilliam et al., 2015) (Canada); (Jerome et al., 2019) (UK)). Here, Roe and Mell (2013, p. 655) highlight the key role played by policy in the delivery of GI, in particular through the "optioneering of GI development". The focus on policy becomes particularly important in countries which pursue a plan-led system where development plans (and resultant policies) have a statutory status; for example, across the UK and Holland (Buitelaar, Galle and Sorell, 2011).

Our GI policy assessment tool was developed to assess the efficacy of GI performance across 19 local development plans in Central Scotland Green Network (CSGN) in the UK (Figure 1). A multi-criteria framework based on GI functions was established, drawing heavily on the Integrating Green Infrastructure (IGI) Approach (Glasgow Clyde Valley Green Network Partnership (GCVGNP, 2017) and the Building with Nature GI benchmark study (Jerome et al., 2019). The framework, with its resultant 23 assessment criteria, enabled a systematic approach to GI assessment covering design, wider
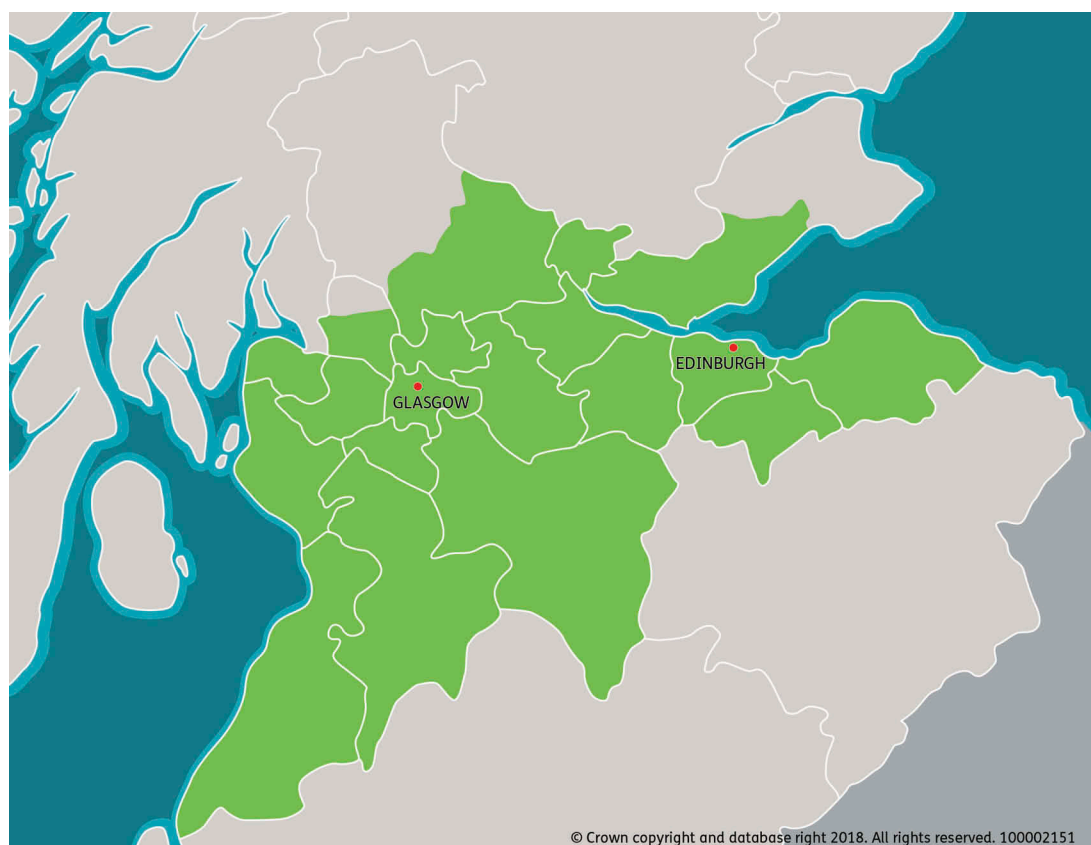
Figure 1. The Central Scotland Green Network area, encompassing 19 local authorities across central Scotland.

context, biodiversity, water, access and greenspace functions, together with the strength of the associated policy wording within each local authority plan.

The paper proceeds with a literature review of GI identity and multifunctionality, highlighting the barriers to mainstreaming within spatial planning more generally. Here, mainstreaming represents an important and often overlooked spatial planning component, relating to how well a concept (such as GI) which is well established in one policy domain (the environment) is normalised within the routine actions and decisions of other policy domains (e.g. economic and social), where it is not so well established (Karlsson-Vinkhuyzen, Kok, Visseren-Hamakers, & Termeera, 2017; Scott, 2019). This is followed by a brief introduction to the Scottish planning policy context, after which the paper then describes the methodology leading to the development of the tool and its subsequent testing across 19 local authorities. The headline results are then presented with the final section discussing their significance, for Scottish and wider spatial planning policy.

Green Infrastructure: Identity, Function and Barriers in Spatial Planning Theory and Practice

Spatial planning faces significant challenges globally including reconciling and managing different agendas and priorities associated with the achievement of sustainable development (UN, 2015) including public health, water management, housing, economic growth, biodiversity and climate change (Mell, 2014; Wilker, Rusche, & Rymsa-Fitschen, 2016). However, these challenges are often diagnosed and treated within separate sectoral silos leading to disintegrated development amidst competing ideas of what success actually means (Scott et al., 2013). This has to be viewed against a context of significant reduction in human and physical resources for local authorities under austerity, seriously impacting upon actions (Gray & Barford, 2018).

GI represents a concept and approach that has the potential to address these challenges when positioned within more holistic social-ecological systems thinking and nature-based solutions (Connop et al., 2016; Jerome et al., 2019; Lennon & Scott, 2014; Nesshöver et al., 2017) . A widely used definition, in this vein, from the EU Commission (2015) sees GI as a " … strategically planned network (multiple scales) of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services such as water purification, air quality, space for recreation and climate mitigation and adaptation. This network of green (land) and blue (water) spaces can improve environmental conditions and therefore citizens' health and quality of life. It also supports a green economy, creates job opportunities and enhances biodiversity".

However, this definition is somewhat over simplistic. Despite its championing of multifunctionality, it is often researched and implemented from the perspective of a single benefit. For example, in the US, stormwater abatement dominates the GI literature (Johns, 2019; Meerow & Newell, 2017). Furthermore, it fails to recognise the differential spatial and distributional impacts of claimed benefits with losers and winners and the necessary trade-offs and disbenefits that might occur as a result of interventions in specific settings (Andersson et al., 2015; Juntti & Lundy, 2017). Wright (2011, p. 1004) observes; "searching for a single fixed definition of "green infrastructure" is problematic because the concept is evolving, divided and gravitating toward socio-economic centres".

Thus, in Table 1 we have identified distinctive themes emerging from the now mushrooming academic and grey literature on GI that capture both its potential and complexity. Here the bolded sections (authors' emphases) capture the additionality of GI. However, this represents both a strength in terms of its flexibility and adaptability, but also a weakness in terms of its overall tangibility (Matthews et al., 2015).

Table 1. Major themes emerging from GI literatures.

GI Theme/function	Definition
Connected and managed network of multiple benefits for people	Benedict and McMahon (2006, p. 12) **"an interconnected network** of natural areas and other open spaces that conserves natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife". A **strategically planned network** of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas (European Commission, 2015, p. 3). Mell, Henneberry, Keskin, and Hehl-Lange (2013, p. 297) The biological resources in urban areas that are human modified and primarily serve an overt function and which are **intentionally designed and employed primarily for widespread public use and benefit** If designed and sited appropriately, UGI (urban green infrastructure)can **represent nature based solutions to interrelated issues associated with urbanisation** that are relevant to all public authorities. This includes flooding, urban heat island, air quality, recycling, biodiversity and health & well-being of communities (Connop et al., 2016, p. 99).
Multifunctionality	Hansen and Pauleit (2014, p. 516) "The concept of multifunctionality in GI planning means that **multiple ecological, social, and also economic functions shall be explicitly considered instead of being a product of chance.** Multifunctionality aims at intertwining or combining different functions and thus using limited space more effectively". Hansen et al. (2019, p. 100) Multi-'functionality' in the context of green infrastructure stands for a **broad understanding of functions** (including, for example, buffering of climatic extremes, biomass production, provision of habitats and species movement routes or opportunities for social interaction and nature experience.
Integration and conflict management	Matthews et al. (2015, p. 157) The GI approach thus provides a **comprehensive framework to accommodate competing interests** and, in practice, to engage environmental objectives and dominant economic imperatives. Wright (2011, p. 1015) "It is crucial for practitioners to understand 'green infrastructure' and how it is used and shaped in practice in order to enhance **the potential of the concept through negotiation**. This may also open up opportunities to gain positive impacts of ambiguity such as 'creative outcomes' and 'joined up' thinking ".
Delivery at, and across, multiple scales	"Green Infrastructure includes established green spaces and new sites and **should thread through and surround the built environment and connect the urban area to its wider rural hinterland.** Consequently, it needs to be **delivered at all spatial scales** from sub-regional to local neighbourhood levels, accommodating both accessible natural green spaces within local communities and often much larger sites in the urban fringe and wider countryside" (Natural England 2009, p. 7). Tzoulas et al., 2007, p. 6) It can be considered to comprise of all natural, semi-natural and artificial networks of multifunctional ecological systems within, around and between urban areas, at all spatial scales. **The concept of Green Infrastructure emphasises the quality as well as quantity of urban and peri-urban green spaces.**
Engineering system and SMART technologies	" ... adaptable term used to describe an **array of products, technologies, and practices that use natural systems** – or engineered systems that mimic natural processes – to enhance overall environmental quality and provide utility services" (USEPA, 2013).
Public Participation	However, due to green infrastructure's considerable societal benefits, **all groups of society should have a say in its planning and implementation to ensure that it meets their requirements** (Wilker et al., 2016, p. 230).
Social Justice and equity	Over the past two decades, the **uneven accessibility of urban greenspace** has become recognized as an environmental justice issue as awareness of its importance to public health has become recognized (Wolch, Byrne, & Newell, 2014, p. 235).
Narratives	"In all three cases, **framing and telling stories about green infrastructure play a crucial role.** In the Ruhr, the term green infrastructure is directly used to stimulate regional debates on sustainability, while green infrastructure rhetoric in Manchester has been interrupteddue to institutional shifts. In the Capital Region of Denmark, it is obsolete and embedded in other local discourses, i.e. climate change adaptation" (Reimer & Rusche, 2019, p. 1558).

(Source: Authors)

Notwithstanding Wright's (2011) critique on the dangers of seeking GI definitional purity, Matthews et al. (2015) make a compelling argument that the confusion and conflation of GI with green space may dilute the value of GI as a strategic spatial planning tool and approach. Here Benedict and McMahon (2006, p. 2) offer a useful distinction " …Green space is often viewed as something that is nice to have; GI implies something we must have". This reinforces, in our view, the need for a clearer differentiation between green space and GI and the functions and outcomes that are delivered, although this point is contested in the literature (see Wolch et al., 2014). We conceptualise this in Figure 2. Here, green space naturally provides some benefits through the ecosystem services it delivers, which can be significant according to local context. However, GI is about making planned interventions for specific function(s) and pre-defined multiple benefits within multi-scalar networks.

This introduces the idea of GI being both a network of green features but also a planning delivery mechanism. GI is also an asset that provides "critical" infrastructure (Benedict & McMahon, 2006), equivalent to road, water or power network, that delivers multiple social, environmental and economic benefits, which are then managed strategically within an integrated network (Hansen & Pauleit, 2014: Schaffler & Swilling, 2013). However, the narrative framing GI as a universal positive does have its limitations. GI interventions need to be backed up by science and evidence and effective monitoring, otherwise perverse impacts could ensue. GI's vulnerability is perfectly illustrated in research on Ontario's planning system (McWilliam et al., 2015, p. 466). The findings indicate that Ontario's land use planning policies are not sufficient to protect green infrastructure from the longer term impacts of residential encroachment due to inadequate policies (in terms of wording) and lack of overall monitoring.

These differing definitional functions identified in Table 1 are, therefore, much more than academic navel gazing (Wright, 2011) and raise important concerns as to why, seemingly, GI mainstreaming in spatial planning policy and practice has been somewhat limited and subservient to other economic and social considerations (Connop et al., 2016: Lennon, 2015). The key barriers preventing improved GI mainstreaming are summarised below.

Perhaps the biggest barrier is that GI does not easily generate direct financial revenue to the managers/providers such as taxes and donations, although considerable progress has been made with payments for ecosystem services schemes (Reed et al., 2017). Thus, GI benefits often occur as external effects where those paying for the provision are not necessarily those who directly benefit most, particularly for cultural and regulating services such as flood risk management and health benefits. Consequently, cutting resources for GI planning, management and delivery is widespread as the benefits of GI investments are not easy to capture or to transfer (Hanley & Barbier, 2009). This is exacerbated by the more tangible costs of maintenance which impact on budgets such as those for parks and leisure services departments.

The demand for GI is not always easy to define and assess against quantifiable metrics and indicators which, in themselves, are beset with tensions arising from the need to secure short-term financial gains from development versus the long-term benefits delivered by some GI components. These tensions reflect the way conventional accounting methods treat GI as a liability, ignoring the wider benefits to society because benefits, including health, flood risk regulation, biodiversity etc., are not readily accounted for, whilst the associated costs for greenspace management are (Horwood, 2011).

However, when extending the accounts to incorporate natural capital accounting (Hein et al., 2016; ONS, 2017) where wider social and environmental (external) benefits are costed, GI becomes a net-asset rather than a liability (Hölzinger, 2016). Furthermore, evidence for claimed multiple benefits from GI are becoming more prevalent in the literature, albeit highly localized. For
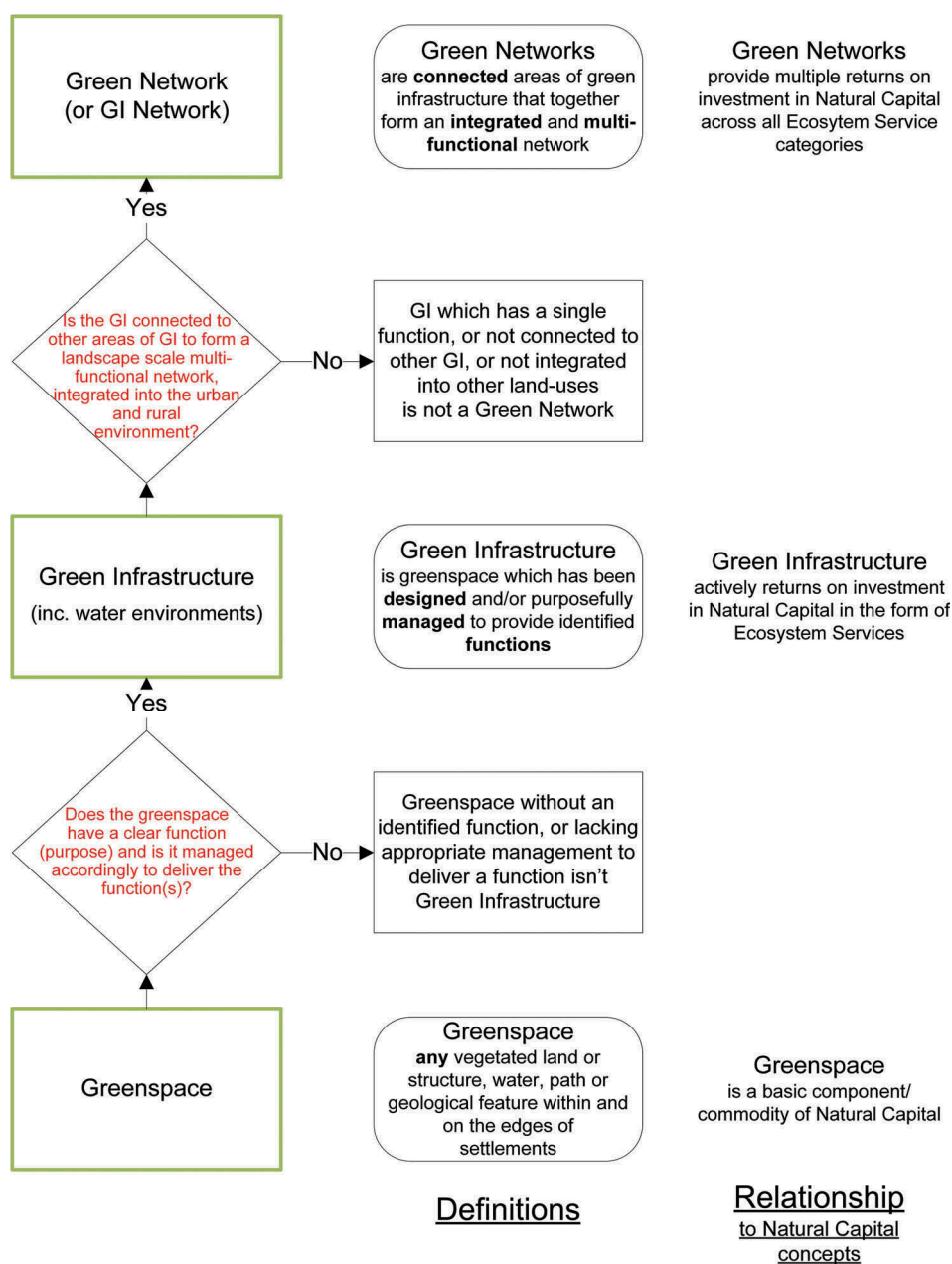
Figure 2. Relationship of greenspace to green infrastructure to green networks.
(Source: Authors)

example, area-based policies and siting decisions have significant implications for affecting local environmental and social justice considerations (Hansen & Pauleit, 2014). In many cities, multiple deprived neighbourhoods where health challenges tend to be the most critical often have relatively poor access to safe and well-maintained GI (Scott, Carter, Hardman, Grayson, & Slaney,

2018; Wolch et al., 2014). This thinking has now extended to planning policy recognising the crucial impact that the planning system has on the delivery of GI. For example, the Natural Capital Committee (2015, p. 43–44), an independent advisory committee to the UK Government, stated in its third 'State of Natural Capital Report' that improving urban GI is cost-effective in the long term, concomitant with the need to build better GI policies into development plans;

> Given that over 80% of England's population now lives in urban areas, the quantity and quality of green infrastructure (GI) in our urban areas is of critical importance. It is not just an issue of wellbeing and economic benefits, but one of equity and distribution, too. [...] Investment in GI is often the first to be sacrificed during periods of financial pressure, but this is a false economy. [...] GI needs to be fully incorporated into urban planning systems, to help avoid short termism. **Building GI into long-term development plans will not only ensure its benefits from the outset, but will also avoid costly retrofitting in the future.**

It is this opportunity that provides the impetus for this paper within a method and associated dialogue tool that is usable in practice and which has global applicability.

Scottish Planning Policy and Green Infrastructure

International planning systems vary but are all based on the legislation and regulations that define them. These legal codes vary from country to country and therefore generate different approaches to planning. Scotland has a plan-led system where legislation requires decisions on planning applications to be made in accordance with the development plan, unless material considerations indicate otherwise (Scottish Government, 2014). The purpose of planning is set out under paragraph 2 of Scottish Planning Policy (2014) which states:

> Planning should take a positive approach to enabling high-quality development and making efficient use of land to deliver long-term benefits for the public while protecting and enhancing natural and cultural resources

The government introduced a presumption in favour of development that contributes to sustainable development with subsequent local plan policies and decisions guided by the following principles (Scottish Government, 2014, p. 9):

- giving due weight to net economic benefit;
- responding to economic issues, challenges and opportunities, as outlined in local economic strategies;
- supporting good design and the six qualities of successful places;
- making efficient use of existing capacities of land, buildings and infrastructure including supporting town centre and regeneration priorities;
- supporting delivery of accessible housing, business, retailing and leisure development;
- supporting delivery of infrastructure, for example transport, education, energy, digital and water;
- supporting climate change mitigation and adaptation including taking account of flood risk;
- improving health and well-being by offering opportunities for social interaction and physical activity, including sport and recreation;
- having regard to the principles for sustainable land use set out in the Land Use Strategy;
- protecting, enhancing and promoting access to cultural heritage, including the historic environment;

- protecting, enhancing and promoting access to natural heritage, including green infrastructure, landscape and the wider environment;
- reducing waste, facilitating its management and promoting resource recovery; and
- avoiding over-development, protecting the amenity of new and existing development and considering the implications of development for water, air and soil quality.

Figure 3 captures the overall governance framework within which planning sat at the time of the GI policy study in 2017. The Scottish Planning system has currently changed with a new Scottish Planning Act in July 2019, but we are presenting the structure of planning as it was then. Notably GI is explicitly mentioned within subject policies under the generic headings of placemaking and sustainability, thus helping mainstreaming. Our focus is on the strategic and local development plans where policies therein provide the statutory context for decision making for planning applications.

Methodology

A multi-criteria framework was used to develop an assessment tool that captured the different functions of GI (Hislop & Corbett, 2018). The tool was initially constructed from the IGI Approach developed and promoted in Scotland by the GCVGNP (2017), capturing the lessons learned from a range of GCVGNP

Figure 3. The place of planning within the Scottish government. (Scottish Government SPP 2014, par23).
Source: (Scottish Government SPP 2014, par23)

design studies commissioned across the Glasgow and Clyde Valley region. The IGI Approach is based on seven core GI 'design elements': design, functions (water management, habitat networks, access networks and greenspace) and management, considered within a wider GI context (GCVGNP, 2017). This was then benchmarked against the 'Building with Nature' project developed by the Gloucester Wildlife Trust and the Centre of Sustainable Planning and Environments at UWE (Jerome et al., 2019).

The Building with Nature GI Benchmark was originally funded through the Natural Environment Research Council (NERC) and developed and tested a set of 23 standards drawing from extensive academic and policy literature reviews and detailed workshops with developers and key built environment stakeholders. The resultant qualitative standards apply throughout the development process; from initial masterplan to construction and delivery that enables accreditation at different stages, including post – construction. The standards are split into core and option packages, covering core aspects of the planning, design and management of GI, together with nature conservation, water management, and health and wellbeing options; summarised in Table 2.

Consequently, the hybridised framework (Figure 4) used for this research, built explicitly upon the synergies between these two GI standards projects (Table 2), which provides reassurance that the tool is founded upon a combination of rigorous peer-reviewed academic research, stakeholder engagement and user experiences in practice. The framework was also bounded by Scottish planning guidance which necessarily limited its ability to engage with wider social and environmental justice issues reviewed earlier (e.g. Hansen & Pauleit, 2014; Wolch et al., 2014). As shown in Table 2 the comparison between the two approaches revealed remarkable symmetry, albeit with the notable exception of access networks.

Having established the skeleton framework, detailed policy assessment criteria were drafted, drawing upon the statements expressed in both the Building with Nature standards and the IGI Approach, and then crafted into succinct assessment criteria agreed by the authors which articulate explicit requirements for each Design Element (Figure 4). The draft criteria were presented to the CSGN Trust's Regional Advisory Forum for comment and approval and, with only minor changes, the final assessment framework with 23 criteria was created for testing (Figure 4: A to W).

Assessing Green Infrastructure Policies

GI policies were assessed across 19 CSGN local authorities' Local Development Plans (LDP) (or Local Plans if an LDP had not been completed) and in adopted Supplementary Guidance as part of the LDP. LDPs and Supplementary Guidance are statutory documents and, therefore, applicants and the planning authority are legally bound to comply with the policies within them in decision making processes. Non-statutory planning guidance was not assessed as part of this research.

At the time of the assessment (January–June 2017) where local authorities had proposed LDPs or had draft Supplementary Guidance in the final stages before being fully adopted, these were assessed in favour of extant LDP/Local Plans and supporting Supplementary Guidance. The rationale for this was that the draft documents contained the current approach of the local authority to GI policy, even if this had not yet been through the full process of adoption and approval. Table 3 shows the plans that were included in the assessment of GI policies and their status at the time of the assessment.

For each of the 19 CSGN local authorities keyword searches were undertaken using 'Green Infrastructure' plus the individual functions (i.e. access/active travel, biodiversity/habitat, greenspace/open space, suds) and other assessment criteria labels within local plans and associated supplementary guidance for policies and supporting text. The relevant text of these were then subjected to a contents analysis to determine which assessment criteria the policy was associated with (if any) with a crude assessment undertaken of the extent of coverage of the assessment criteria

Table 2. Requirements of UWE's 'GI Benchmark' and GCVGNP's 'IGI approach related to GI design elements.

GI Design Elements	UWE 'GI Benchmark' Building with Nature	GCVGNP 'IGI Approach'
1. Design Process	• GI is specifically addressed early in stakeholder consultation and community engagement and is a key design principle • GI forms a multi-functional network	• GI is designed into proposals at an early stage alongside grey infrastructure (e.g. transport, water, energy, waste) • GI is designed to be multi-functional (i.e. provide more than one purpose from the same land take)
2. Wider Context	• GI connects to and reflects the wider landscape and built character of the local environment • The scheme considers the quality and function of GI in response to local need (e.g. in the LDP)	• GI is designed to contribute to the wider matrix of green infrastructure and the Green Network • GI is designed based on site analysis and survey for optimum functional delivery
3. FUNCTION Wildlife/ Habitats	• The scheme delivers ecological enhancement, contributes to and records net biodiversity gain in line with local priorities • GI effectively connects to wider, coherent ecological networks • The scheme promotes the consideration of biodiversity in all aspects and phases of construction	• GI contributes to habitat connectivity, based on habitat network analysis, understanding of priority areas and site survey.
4. FUNCTION Water Management	• GI: minimises water demand; minimises surface run-off; encourages re-use; manages water for maximum benefit; and considers how these functions will change in the future • The design for Sustainable Urban Drainage Systems (SuDS), and all its components, follows current good practice in terms of design, implementation and long-term management • GI has been used to improve water quality	• GI provides nature-based SuDS (e.g. Naturalistic ponds and detention basins planted with native marginal plants) • SuDS ponds and basins are publicly accessible and contribute to the recreational amenity of the development
5. FUNCTION Access Network		• GI encourages active travel, by providing off-road walking and cycling routes linking all parts of the development with key destinations
6. FUNCTION Greenspace	• GI is accessible and close to where people live to promote health, wellbeing and active living • The scheme encourages all people to use and enjoy GI, considering how the needs of local people may change • GI is designed to be accessible at all times of year, employing street furniture and other features, to encourage optimal use	• GI provides recreational/amenity needs by meeting the local authority greenspace provision standards and the CSGN access standards (maximum 400m walking distance from all homes to multi-functional greenspace)
7. Stewardship	• The scheme includes management, maintenance and monitoring of all GI features post-development to ensure that their multiple-functions are sustainable over time, and includes community involvement	• To ensure the GI matrix is sustained, a management plan for how the GI will be delivered, managed, maintained and funded is required

(Source: Hislop & Corbett, 2018, p. 16)
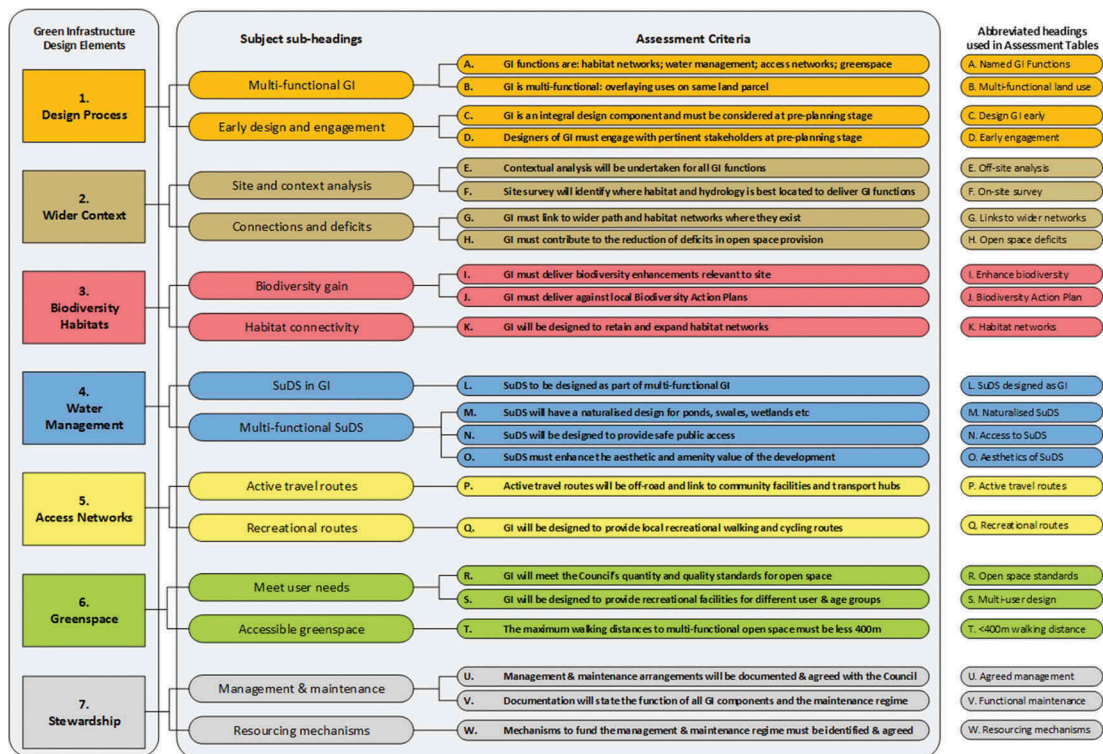
Figure 4. Criteria used to assess green infrastructure policies across the CSGN area.
(Source: Hislop & Corbett, 2018, p. 18)

Table 3. Local development plan (or local plan) policies assessed as part of the study and their status at the time of the assessment.

CSGN Local Authority	LDP: Proposed or Adopted	Year of Adoption
Clackmannanshire	Adopted	2015
East Ayrshire	Adopted	2017
East Dunbartonshire	Adopted	2017
East Lothian	Proposed	
East Renfrewshire	Adopted	2015
Edinburgh	Adopted	2016
Falkirk	Adopted	2015
Fife	Proposed	
Glasgow	Adopted	2017
Inverclyde	Adopted	2014
Midlothian	Proposed	
North Ayrshire	Adopted	2014
North Lanarkshire	Local Plan	2012
Renfrewshire	Adopted	2014
South Ayrshire	Adopted	2014
South Lanarkshire	Adopted	2015
Stirling	Adopted	2014
West Dunbartonshire	Proposed	
West Lothian	Proposed	

(Source: Hislop & Corbett, 2018, p. 19)

by the policy (no coverage – score = 0 (white); some coverage – score = 1 (light grey); most coverage – score = 2 (grey) and full coverage – score = 3 (dark grey)).

An assessment of the strength of the policy wording was simultaneously undertaken (weak phrasing – score = 1 (light grey); medium phrasing – score = 2 (grey) and strong phrasing – score = 3 (dark grey)). Crucially, however, the policy wording strength cannot score higher than the policy coverage.

An example of a LDP policy is shown below (Table 4) which illustrates how policies (and their supporting text) were scored in the assessment. The text relating to the strength of wording is underlined.

An assessment scoring card was created to record the coverage and strength of GI relevant policies in each CSGN local authority.

Figure 5 shows an example of a completed scoring card for West Dunbartonshire's Proposed LDP (2015). It shows the GI relevant policies that were identified and scored from the proposed LDP and the GI relevant SG document. The scores are presented on a colour-coded scale (or light to dark in black and white) to ease visual interpretation of the table. The highest scores for individual assessment criteria are aggregated to provide an overall policy coverage and strength of policy wording score, expressed as a percentage of full coverage or strong wording for all criteria.

The whole scoring process was undertaken independently by two assessors and then compared, with any disparity discussed and reconciled collectively through discussion. Initially there were more discussions given the familiarisation with interpreting the assessment criteria and discussing boundary issues, but thereafter scoring was found to be relatively consistent.

Significantly, the assessment framework does not have specific criteria for monitoring of the GI policies as there are already formal requirements in local plans for ongoing monitoring and evaluation of all policies. However, the monitoring of GI interventions does become important as part of the wider diffusion of social learning required to help mainstreaming processes.

Table 4. An example of the assessment of a local development plan policy.

West Dunbartonshire's Proposed LDP (2015): Green Network Policy 2	Comment
8.3.6 Development <u>will be required to</u> follow the Integrating Green Infrastructure approach to design by incorporating SuDs, open space, paths and habitat enhancements at a level proportionate to the scale of development. Development will be considered in relation to further information and detail to be provided within supplementary guidance.	• Strong phrasing (Score = 3) • Full coverage of Criterion A (Score = 3)

(Source: Hislop & Corbett, 2018, p. 154 adapted)

Results

CSGN-Wide Assessment of GI Policy

Figure 6 provides a summary table across the 19 authorities, highlighting both GI coverage and strength of relevant policy wording across the CSGN area. As in Figure 5, the scores are presented on a black and white coded scale to ease visual interpretation of the table (and in colour online). It is immediately apparent that there is a wide variation in both coverage (42% of full coverage for the CSGN area) and policy strength (23% of full strength for the CSGN area), with no authority scoring well on both indicators.

Figure 6 also shows the highest scores achieved across each of the 23 GI Assessment Criteria for both coverage and strength across all the CSGN local authorities. 14 of the 23 GI Assessment Criteria
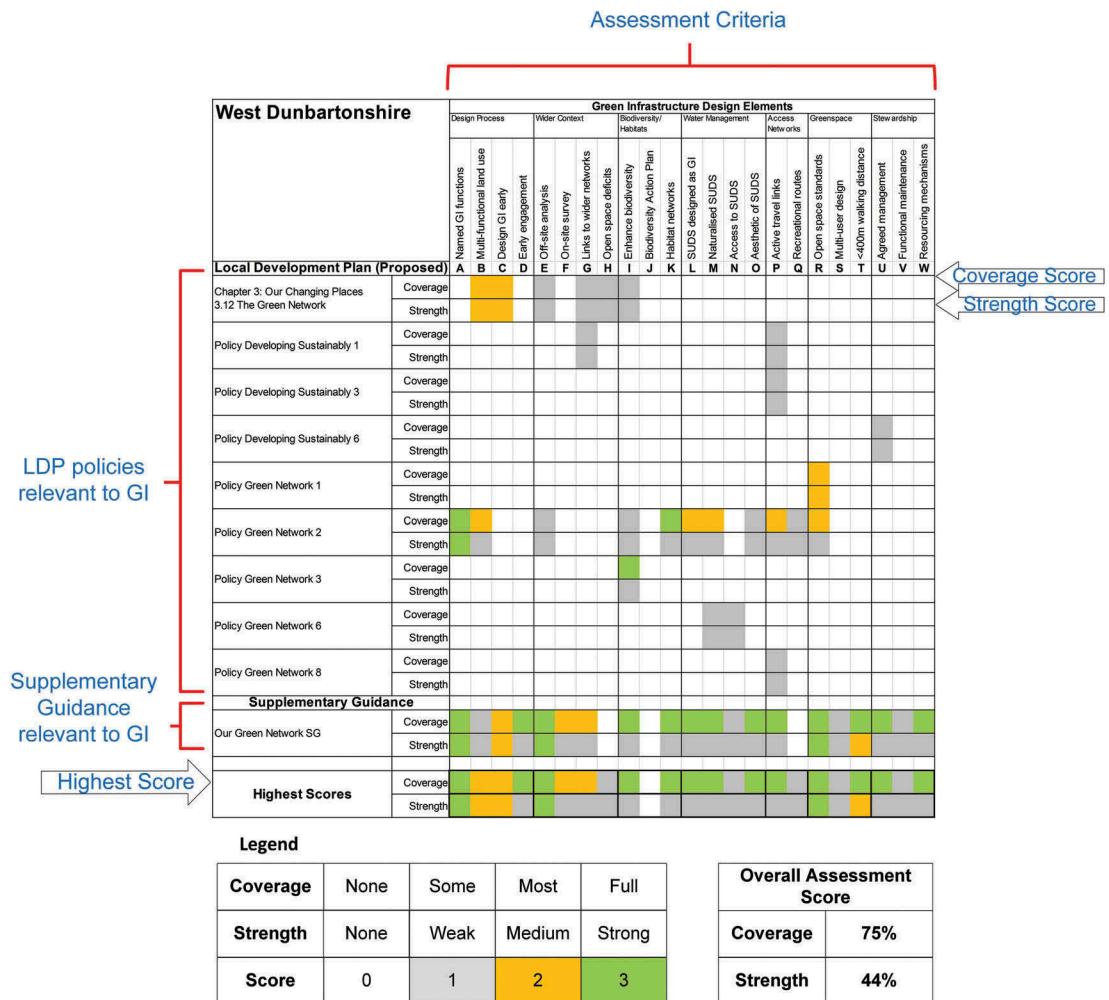
Figure 5. A completed example of the Scoring Card template used to record the assessment of GI Policies.
(Source: Hislop & Corbett, 2018, p. 160 adapted)

have the highest score (full coverage and strong wording scores) in at least one local authority statutory document, and 22/23 of the GI Assessment Criteria have a full coverage score. The 'Enhance biodiversity' (Criterion I) GI Assessment Criterion has 5 high scores for policy strength and 10 high scores for full policy coverage. Clackmannanshire Council's Local Development Plan Policy EA2 (Habitat Networks and Biodiversity) provides a good example.

All development proposals will be expected to fulfil […] the following [criterion]: maximise the potential of their development to contribute positively to biodiversity conservation and enhancement.

The GI Assessment Criteria 'Open space standards' (Criterion R) and 'Agreed management' (Criterion U) have 4 high scores for policy strength and 6 high scores for full policy coverage. Glasgow City Council's Interim Planning Guidance 12 'Delivering Development' is an example of strong wording used within a policy that provides full coverage of the 'Open space standards' (Criterion R): New residential development (including conversions) is required to provide access to good quality

CSGN Local Authority — Green Infrastructure Design Elements

Design Process				Wider Context				Biodiversity/ Habitats			Water Management				Access Networks		Greenspace			Stewardship		
Named GI functions	Multi-functional land use	Design GI early	Early engagement	Off-site analysis	On-site survey	Links to wider networks	Open space deficits	Enhance biodiversity	Biodiversity Action Plan	Habitat networks	SUDS designed as GI	Naturalised SUDS	Access to SUDS	Aesthetic of SUDS	Active travel links	Recreational routes	Open space standards	Multi-user design	<400m walking distance	Agreed management	Functional maintenance	Resourcing mechanisms
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W

Rows (each with Coverage / Strength): Clackmannanshire, East Ayrshire, East Dunbartonshire, East Lothian, East Renfrewshire, Edinburgh, Falkirk, Fife, Glasgow, Inverclyde, Midlothian, North Ayrshire, North Lanarkshire, Renfrewshire, South Ayrshire, South Lanarkshire, Stirling, West Dunbartonshire, West Lothian, **Highest Scores**

Figure 6. The overall assessment of GI policy coverage and strength for 23 GI assessment criteria in CSGN local authority statutory documents.

(Source: Hislop & Corbett, 2018, p. 22 adapted)

recreational open space. This includes provision for children's play areas, amenity open space/parkland, outdoor sport facilities, allotments and community gardens, in accordance with the standards set out in Table 1.

The GI Assessment Criteria 'Habitat networks' (Criterion K) and 'Links to wider networks' (Criterion G) have a high number of full coverage scores (8 and 7 respectively) but interestingly a low number of strong policy wording scores (2 and 0 respectively). The only GI Assessment Criterion that doesn't get at least one full coverage score is 'Functional maintenance' (Criterion V), reinforcing the difficulty exposed in 'placekeeping'.

These results reveal that in Central Scotland no one authority has a comprehensive suite of strong GI policies that cover all the design considerations, functions and stewardship requirements for the delivery of good GI in developments. It may be that those responsible for developing policy are not yet fully conversant with the breadth of considerations that GI policy should cover, or that there is a lack of confidence or political acceptability to write/approve such policies. Whatever the reason the sharing of good policy writing practice between planners within a wider social learning environment, realising the multiple functions GI provides, would undoubtedly improve the situation.

The Extent of GI Policy in LDPs versus Supplementary Guidance

Figure 7 shows the percentage of full coverage of GI policies provided by the LDP (or Local Plan), in contrast to Supplementary Guidance for each CSGN local authority ranked by the overall percentage of coverage score.

When all scores for all local authorities are averaged, it provides a score for CSGN-wide GI policy of 23% of full policy coverage in LDPs and 20% of full policy coverage in Supplementary Guidance (SG). However, six local authorities did not have any GI relevant SG for assessment. For local
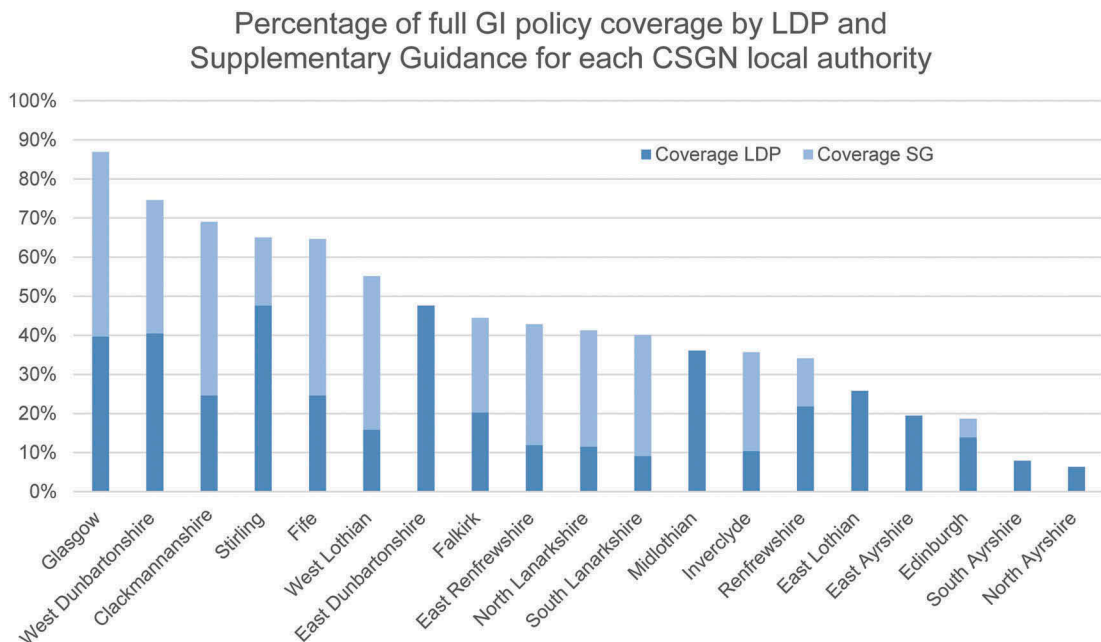
Figure 7. Percentage of full GI policy coverage by LDP and supplementary guidance for each CSGN local authority. (Source Hislop & Corbett, 2018, p. 24)

authorities that have relevant SG it is the repository for more GI policy coverage than the LDP (e.g. Glasgow: LDP 40%, SG 47%; Clackmannanshire: LDP 25%, SG 44%; East Renfrewshire: LDP 12%, SG 31%). These results show that SG currently plays an important role in enhancing GI policy. A recent review of the planning system advocates the removal of statutory SG from LDPs, which means that GI policy that currently resides in SG will either be lost, or will have to be transferred to future local or national policy plans.

Discussion

So How 'Good' is GI Policy?

The results reveal that GI policy across the 19 CSGN local authorities is highly variable but with a significant number of incomplete, inconsistent and weak profiles, reinforcing the wider literature over the way GI is currently (de)valued in the planning process (Hansen and Pauliet, 2014; McWilliam et al., 2015; Wilker et al., 2016). On a more positive note, most authorities' policies do recognise the multiple benefits realised by GI, but these are tempered by the relatively weak wording, particularly where GI investment and maintenance are concerned; findings that echo work on GI policy in Ontario by McWilliam et al. (2015). Words such as "taking into account" or "where possible" provide multiple opportunities to avoid the perceived costs (Hanley & Barbier, 2009). Table 5 shows an example of an LDP policy which fully covers the GI assessment criterion 'I' (Enhance biodiversity), but it is weakened with the wording "should seek to".

The performance for GI policy coverage revealed variable performance across the 19 local authorities. Interestingly, the highest scoring criteria tend to reflect well established policy areas such as enhancing biodiversity; active travel routes and open space standards. Whereas, the lowest scoring criteria tend to reflect newer policy areas such as public access to SuDs; maintenance specifications for GI components and early discussions with stakeholders; areas where local authorities often lack the necessary experience or confidence to raise with developers (Hislop & Corbett, 2018). Significantly, there are wider research gaps evident in literature over integrated water management and SuDS (Williams et al., 2019) and financing mechanisms for GI (Scott, Holzinger and Sadler, 2017) which hinder policy further here. This also is exacerbated by the impact of austerity on the planning resources within local authorities which can restrict the extent to which GI multi-functionality can be embedded in policy and/or achieved on the ground (Gray & Barford, 2018).

Table 5. An example of an LDP policy which provides full coverage of a policy criterion, but has weak wording.

West Dunbartonshire's Proposed LDP (2015): Green Network Policy 3	Comment
New developmentshould seek toenhance biodiversity as part of the green network.	• Weak phrasing (Score = 1) • Full coverage of Criterion I (Score = 3)

(Source: Hislop & Corbett, 2018, p. 155 adapted)

Towards Model Green Infrastructure Policies

The variation in performance across GI coverage and policy wording strength suggests that there is a significant knowledge exchange deficit in the understanding of GI functions and prioritisation of
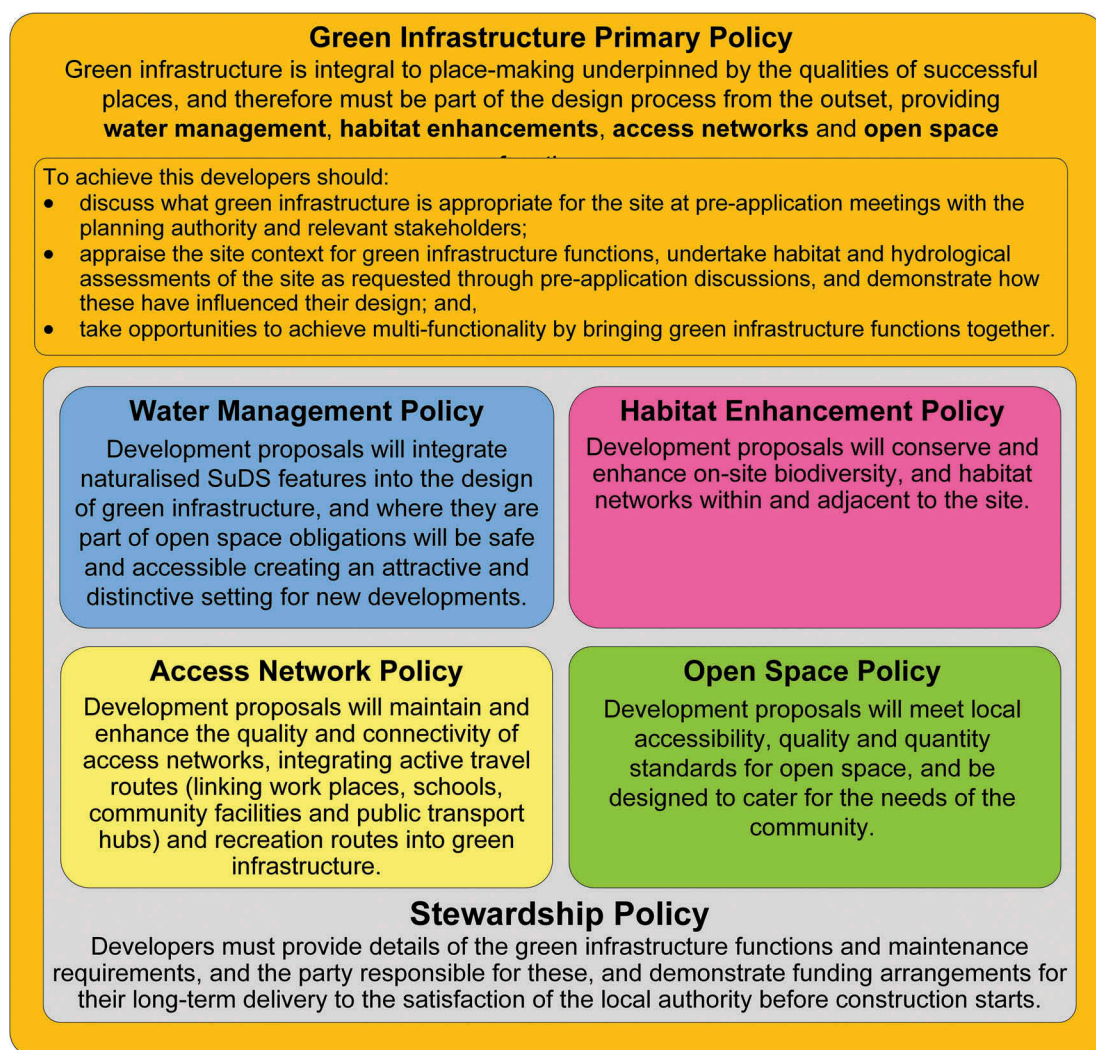
GI in policies and plans. This provides an opportunity space for this research to draw on the best practice evident to develop "model" policies, to help improve the design and content of all local plans across all the CSGN local authorities, with wider application to other countries' plans. For example, following an analysis of their existing policies using the method employed in the central Scotland study, Bath and North East Somerset Council have used such model policies in their own draft local plan to ensure a comprehensive suite of GI policies.

The model policies were developed as a comprehensive package, based initially on the highest scoring policies identified in the CSGN GI policy review (Figure 5). For each assessment criteria the high scoring policies were subjected to a content analysis for suitable text. Each of the policy texts associated with each GI assessment criteria were amended, merged and refined to produce hybrid draft model policies. These were then presented to 14 senior planners (Falkirk Council; South Lanarkshire Council; East Dunbartonshire Council; Renfrewshire Council; Inverclyde Council; Glasgow City Council; City of Edinburgh Council; Scottish Natural Heritage; Planning Aid Scotland; Clydeplan; Scottish Government Planning and Architecture Division) for comments and suggestions over two iterations on how they might be improved. The overall response to the policies was extremely positive, with all participants recognising how they might use the policies, and how they might inform the drafting of Scottish Government's fourth National Planning Framework and ensure more consistency of GI policy in development across Scotland.

Figure 8 shows the model GI policies where it is important to view and use these policies as a complete package or bundle, to ensure that GI multi-functional potential is addressed simultaneously without selective cherry picking. However, it is also important to ensure that they are adapted to local context rather than simply parachuted in which can lead to problems in their operationalisation in the planning process.

Implications for GI Mainstreaming

This research provides an important starting point for spatial planners globally to improve the way that GI is mainstreamed in planning policy. In the UK, development plans provide a statutory basis for land use decisions, so the quality of the policies within them will help shape priorities for development and thus effective GI policies will, in theory, boost mainstreaming. Here we define mainstreaming as a process that enables the translation and acceptance of GI into established decision-making procedures involving economic, social and environmental interests (Karlsson-Vinkhuyzen et al., 2017; Scott et al., 2018). Drawing from the model policies in Figure 8, we suggest, for maximum mainstreaming potential, that GI should not just be located solely within the environmental chapter, within one all-singing all-dancing policy, which is the commonly encountered approach. Rather, discussions should be held across local authority planning teams about the multi-functional role and benefits GI can secure in design, housing, transport, water management, open space and recreation, with dedicated GI policies created within those policy areas explicitly. This necessarily means engaging with policy planners across different departments, notably highways, drainage and building conservation. Thus, our model policies and performance on the 23 assessment criteria provide a starting point for discussions on how GI's multifunctional potential and improved policy wording can be realised. Mainstreaming works best with specific policy hooks with more political and public traction, such as the recent climate emergency and placemaking/place-keeping terms (Scott et al., 2018). A key role here is to translate the GI message as a positive development within these wider holistic initiatives.

Green Infrastructure Primary Policy

Green infrastructure is integral to place-making underpinned by the qualities of successful places, and therefore must be part of the design process from the outset, providing **water management**, **habitat enhancements**, **access networks** and **open space**

To achieve this developers should:
- discuss what green infrastructure is appropriate for the site at pre-application meetings with the planning authority and relevant stakeholders;
- appraise the site context for green infrastructure functions, undertake habitat and hydrological assessments of the site as requested through pre-application discussions, and demonstrate how these have influenced their design; and,
- take opportunities to achieve multi-functionality by bringing green infrastructure functions together.

Water Management Policy

Development proposals will integrate naturalised SuDS features into the design of green infrastructure, and where they are part of open space obligations will be safe and accessible creating an attractive and distinctive setting for new developments.

Habitat Enhancement Policy

Development proposals will conserve and enhance on-site biodiversity, and habitat networks within and adjacent to the site.

Access Network Policy

Development proposals will maintain and enhance the quality and connectivity of access networks, integrating active travel routes (linking work places, schools, community facilities and public transport hubs) and recreation routes into green infrastructure.

Open Space Policy

Development proposals will meet local accessibility, quality and quantity standards for open space, and be designed to cater for the needs of the community.

Stewardship Policy

Developers must provide details of the green infrastructure functions and maintenance requirements, and the party responsible for these, and demonstrate funding arrangements for their long-term delivery to the satisfaction of the local authority before construction starts.

Figure 8. A suite of 'model' GI policies derived from the highest scoring policies identified in the CSGN GI policy review.
(Source Authors)

However, policies do not exist in a vacuum and have to be factored into wider decision-making processes with four main considerations. First, there is the lead given by national and or regional planning guidance, which shapes any plan priorities and, indeed, becomes a material consideration itself. Second, there is the way that other policies in the plan are worded and prioritised in comparison. Third, there is the set of values and perceptions of elected members (decision makers) as they interpret these policies in particular contexts, supported by the planning officer's recommendations. Finally, there is the way that GI is viewed and perceived by other stakeholders in the planning process, through informal and formal participatory processes which determines how well GI is incorporated into initial ideas and plans and then dealt with during and after planning permission has been given and development starts. Consequently, the mainstreaming aspect is

complex and multifaceted and thus provides a fertile ground for further research and to augment the policy matrix to cover mainstreaming criteria more explicitly (Scott & Hislop 2019).

The methodology, associated assessment framework and model policies reported here are transferable to any planning system and GI policy making process at any scale (national, regional, local and/or neighbourhood). Here, its inductive foundations, hybridising two separate GI initiatives drawing across academia and practice, help give it credibility and usability (Jerome et al., 2019; GCVGN, 2017). The inductively derived model policies provide an important "learnt experience" for knowledge exchange and use in wider planning practice discussions. It is clear, however, that the model policies and wider tool do not explicitly address the issues of social equity within GI which highlights a fertile area of planning policy research and development (Wolch et al., 2014).

Conclusions

Given the definitional and conceptual ambiguities surrounding GI in the literature, we have developed and tested a policy assessment tool built upon a solid foundation of both peer reviewed research and good practice. In so doing we have identified a research and practice need relating to what good GI policy looks like. The tool developed for this research was used successfully across 19 local authorities in the CSGN Scotland UK, with results informing for their own spatial planning practice with wider national and global applications to planning theory and practice.

First, the research has highlighted the importance of undertaking research on GI policy in development plans. It has exposed a consistent weakness in policy wording, highlighting its vulnerability when policies are used in decision-making processes. This vulnerability is reinforced by the definitional and operational ambiguity found in the literature. Consequently, other policy imperatives such as housing, economic development and transport can all too readily trump GI. Thus, policy wording matters but is rarely assessed in research endeavours (McWilliam et al., 2015).

Second, the research revealed significant variation in GI coverage across the 23 criteria (Figure 6). Why there should be such differences is a cause for concern, and perhaps reflects the different way GI is perceived and defined in planning authorities, but also how little knowledge exchange is apparent, highlighting both good and weak practice. We did find improved coverage in well-established policy areas such as enhancing biodiversity; active travel routes and open space standards – as opposed to the newer policy areas such as public access to SuDs; maintenance specifications for GI components, which fared less well. We also found significant weaknesses and omissions with policies covering stewardship and long-term funding and maintenance, which highlights the limitations of the planning system in taking a long-term view; yet a key component of spatial planning (Scott et al., 2013).

Third, to help address the wording and functional deficits of GI policy, we designed a suite of model policies to improve knowledge exchange, capturing the best performing policies across the 19 authorities. These model policies provide a starting point for a wholesale discussion around mainstreaming GI policies; helping them to deliver key planning functions outside their usual environmental remit. Here we recommend bringing together key players and stakeholders across the built and natural environment to co-design an improved GI narrative within which they co-design their own policy responses and thus turbo charge mainstreaming processes. For those authorities who had gaps in their profiles this has provided an important opportunity for social learning and policy review.

Fourth, these findings should serve as a wakeup call to planning and municipal authorities globally in the way that GI policies are designed, operationalised and monitored. From a design

point of view there is a need for improved knowledge exchange and sharing of good practice. There also needs to be a more inclusive process in plan formation, where different planners across the policy areas work collectively on strategic issues such as climate change, biodiversity and health and well-being – recognising the role that GI can play in addressing these agendas. Here poor performance on the policy matrix should not be seen as a stick to beat beleaguered planners with; rather it should be seen as an opportunity space to build stronger policy. In particular, there is a need to move away from single based GI policy in the environmental sections towards a suite of policies that cover the relevant GI functions we have identified (Figure 4), each located in relevant chapters; for example, covering housing, economic development, transport and water.

Fifth, the smart assessment framework and 23 assessment criteria provide a readily accessible, freely available, self-assessment tool that can be used in planning research and practice to assess the efficacy of extant and proposed GI policies in development plans or separate strategies. In so doing, it is important that at least two assessors are used and ideally should involve those across the different functions within planning teams (i.e. forward planning and development management). Indeed, the assessment process can serve as an important social learning and evaluation role through discussion around the scoring that can be most beneficial.

Finally, the tool has been built from a robust evidence base and is applicable at a variety of scales. We believe these research processes and outputs fill an important research and practice gap. However, this is only a pilot study and there is still considerable potential to develop the framework further with future work now looking at how to use results from the policy matrix to assess GI mainstreaming. In particular, how much of the matrix is dependent on the environmental chapter and the extent to which GI is recognised in wider social, health and economic benefits as illuminated by (Wolch et al., 2014).

Furthermore, there is a fertile research agenda looking at how the policy aspects are then used in the development of proposals, decision making and delivery phases, with evaluation processes built in from the start. This is an important area of future planning research to help us understand how the policy cycle applies to GI and how we can start to better realise GI potential.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Alister J. Scott is a geographer, chartered planner (MRTPI) and "pracademic" who works at disciplinary and professional boundaries and edges in dealing with interdisciplinary problems. His career has encompassed both policy and academic positions. His current work centres around mainstreaming nature in policy and decision making amidst a concern for better strategic planning. Research projects have focused on mainstreaming ecosystem services, green infrastructure, maximising the potential of the rural urban fringe, improving urban living and using games as public participation tools. This research informs his teaching in areas of environmental governance and regulation, urban environmental issues and risk management. Alister is currently chair of the Building with Nature Standards board and chair of Heriot Watt RTPI partnership board.

Alastair Corbett has worked in the environment sector for over 20 years after a career change from engineering. His work has mainly been in the public sector and focussed on promoting the societal and biodiversity benefits of good quality and multifunctional greenspace within urban areas. Initially this was through community focussed projects but over the last 12 years with the GCV Green Network Partnership his work has become much more strategic in nature, seeking to influence and support fellow professionals in the way they consider and deliver a City Region-wide Green Network.

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