

Integrating Ecosystem Approaches, Green Infrastructure and Spatial Planning

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by

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Executive Summary

Introduction

This report aims to examine potential avenues for the Irish planning system to deliver sustainable and ecologically sound outcomes through principles developed from the ecosystem approach and mobilised through the green infrastructure (GI) concept. We define GI as an interconnected network of multi-functional green space, urban and rural, that is capable of delivering a wide range of environmental and quality of life benefits for local communities and wildlife.

Chapters 1 and 2 identify the key pressures, policies and solutions informing a GI approach. The European Commission outlined the following policy drivers for adopting a GI approach as follows (2013):

- a commitment for the Commission to develop a GI strategy as described in the EU Biodiversity Strategy to 2020;
- the protection and enhancement of Europe's natural capital and its Natura 2000 ecological network established under the Birds and Habitats Directives (92/43/EEC and 2009/147/EC);
- recognising GI as contributing to regional policy and sustainable growth in Europe by facilitating smart and sustainable growth (Europe 2020);
- addressing climate change and disaster risk management, e.g. the EU Strategy on Adaptation to Climate Change (2013).

Green infrastructure is based on the principle that protecting and enhancing nature and natural processes, and the many benefits human society gets from nature, are consciously integrated into spatial planning and territorial development. A GI approach to spatial planning offers the following solutions:

- enabling planning authorities to meet a wide range of objectives in an integrated manner focused on ecologically sound development outcomes, including drainage management, habitat provision, ecological connectivity, landscape conservation and management, health, well-being and community development, recreation space, climate change (mitigation and adaptation) and economic development;

- enabling local authorities to meet their environmental obligations under European and national legislation, including Strategic Environmental Assessments, Environmental Impact Assessments; Appropriate Assessment, Birds and Habitats Directives and related regulations, Nature Reserves, and Natural Heritage Areas and proposed Natural Heritage Areas.

Key Findings from Review of International and National Practice

Traditional land use planning addresses nature conservation through site-based approaches to protecting habitats and species. In contrast, a GI approach focuses on protecting, enhancing, restoring and creating new ecological networks. GI assets should be viewed as a fundamental infrastructure, enabling a planning authority to meet a range of multifunctional objectives, e.g. urban green space that contributes to biodiversity, drainage management, recreation and quality of life objectives.

Chapters 3–5 chart the emergence of GI within the Irish planning system from an initial phase from 2002, emphasising an ecological or green network approach, to its current phase of institutionalisation and mainstreaming as an alternative and proactive policy approach to the management of GI assets. While there are pockets of innovative practice, the GI approach is largely limited to eastern local authorities and larger urban areas and further work is needed to promote the GI concept as a means to satisfy multiple environmental obligations.

Developing GI Thinking in Spatial Planning Practice

A key contribution of this Eco-Plan project has been the development of an interactive learning toolkit to facilitate GI approaches among professional stakeholders: "GI Quest" (outlined in detail in Chapter 6). The GI Quest game was designed to stimulate collaborative learning and problem-solving. During the research project, this was tested and applied in two local authorities and at a regional and national level. The Eco-Plan research team has produced a GI Quest manual as a complement to this report to illustrate the concepts of "why", "what", "how" and "when" for GI planning and the application of

the GI Quest methodology. This manual and the game are available online: www.ecoplanresearch.org.

Recommendations

Chapter 8 outlines a series of 21 Eco-Plan recommendations for implementing a GI approach to spatial planning under three headings. Key priorities are as follows:

- Embedding and consolidating a GI approach in Irish spatial planning practice: GI should be advanced through the statutory development plan process and viewed as a device for enabling a planning authority to achieve its statutory objectives while meeting its environmental obligations under EU and national legislation (e.g. Strategic Environmental Assessment, Appropriate Assessment and Flood Risk Assessment). A key priority is to enhance GI implementation through development management, requiring design guidance to embed GI practice. Further research should be undertaken to investigate the role of incentives for developers to maximise biodiversity gain in the development process.
- Institutional enhancements: at a local authority level, a key priority is to overcome departmental “silos” to enable the full integration of a GI approach into planning practice through cultivating inter-departmental co-operation in the formulation of planning guidance. To further diffuse best practice, the GI approach should be explicitly advanced across a range of policy guidance at national level (e.g. transport, flood risk management and nature conservation).
- Capacity building: including building local government management support for the GI approach and a continuing professional development programme for local authority officers.

1 Introduction

1.1 Research Context

This report seeks to examine potential avenues for the spatial planning system to deliver ecologically sound outcomes through examining the intersection between ecosystem approaches (EAs) and spatial planning frameworks. In particular, we examine the emerging literature surrounding the green infrastructure (GI) approach. This approach seeks to “understand, leverage, and value the different ecological, social, and economic functions provided by natural systems in order to guide more efficient and sustainable land use and development patterns as well as protect ecosystems” (PCSD, 1999, 64). Seen to furnish “the ecological framework needed for environmental, social and economic sustainability” (Benedict and McMahon, 2002, 12), the theory and application of GI has flourished in recent years and is now advocated by many as a means to enhance ecosystem services provision via spatial planning (EC, 2012; Gómez-Baggethun and Barton, 2013; Lucius *et al.*, 2011; Rouse and Bunster-Ossa, 2013; TCPA and WT, 2012). However, a comprehensive review of literature linking the potential for GI to guide ecosystem services planning is lacking. Similarly, while a few recent commendable efforts have been made to expound what a GI planning approach might entail (Kilbane, 2013; Mell, 2013; Roe and Mell, 2013; Wright, 2011), an appraisal of the implications of this for the organisation and activity of spatial planning is conspicuous by its absence. This report addresses these lacunae.

Threats to biodiversity, and climate change mitigation and adaptation pose some of the most complex and pressing challenges facing societies and policy-makers across the globe, requiring integrated and innovative policy-making to build resilient social–ecological systems and sustainable urban and rural areas. In summary, the challenge at the urban scale is to operationalise ecologically sustainable urban regions as a means to reconcile urban development with the biosphere (Wilkinson *et al.*, 2013). However, devising means to ensure the integrity and longevity of the natural processes and ecosystems underpinning society has often been fraught with confusion on how to act and where to focus attention (Carter, 2007; Dryzek, 2005;

Owens and Cowell, 2011). Such issues are ever more pressing as the impacts of demographic growth and rising consumption patterns increasingly undermine naturally occurring processes and erode biodiversity (Baker, 2006).

One response to the interlocking challenge of biodiversity and climate change risks has been to advocate the application of an “ecosystem approach” within policy-making. In the last 20 years the EA has been researched and promoted widely as a tool to address biodiversity conservation, and, more recently, as an approach to tackle both climate change mitigation and adaptation, for example in relation to carbon storage, flood alleviation and cooling urban heat islands (O’Neill and Scott, 2011). The EA is defined by the Convention on Biological Diversity (CBD) as:

... a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way ... An ecosystem approach is based on the application of appropriate scientific methodologies focused on levels of biological organisation, which encompass the essential structure, processes, functions and interactions among organisms and their environment. It recognises that humans, with their cultural diversity, are an integral component of many ecosystems ... The ecosystem approach requires adaptive management to deal with the complex and dynamic nature of ecosystems and the absence of complete knowledge or understanding of their functioning.

Source: CBD, available online:
<https://www.cbd.int/ecosystem/description.shtml>

The EA is now seen as a major theoretical approach underpinning planning for complex systems (Smith and Maltby, 2003), at both the landscape scale (Potvin *et al.*, 2011) and within urban areas (Gómez-Baggethun and Barton, 2013), providing a framework for looking at whole ecosystems in decision-making, and for valuing the ecosystem services they provide (DEFRA, 2005). The concept seeks to convey that nature needs “to be protected not only for itself, but because it is essential

for human life and society” (Granjou *et al.*, 2013, 10). Although this concept originally emerged in the mid-20th century, it has become so influential over the past decade that it now possesses “many of the features of a Kuhnian paradigm” (Potschin and Haines-Young, 2011, 575), in its current domination of sustainability debates and prominence in directing research agendas (Braat and de Groot, 2012). Considered by some as “the last best hope for making conservation mainstream – attractive and commonplace” (Daily *et al.*, 2009, 21), operationalising the concept in day-to-day decision-making has nevertheless proved a challenge, perhaps nowhere more so than in spatial planning (de Groot *et al.*, 2010a; Geneletti, 2012).

Over the last decade, an extensive literature emerged charting the shift from land use planning, characterised by regulatory approaches, towards spatial planning, whereby the role of the planner was recast to one of co-ordinator, integrator and mediator of the spatial dimensions of wider policy streams through negotiated governance, partnership working and horizontal, as well as multi-scalar, actions (Nadin and Cullingworth, 2006; Tewdwr-Jones, 2012). While sustainability has been central to these debates, the emergence of spatial planning has been largely driven by the competitiveness agenda, which seeks to position regions in a European and global economic space (Allmendinger and Haughton, 2009). However, as we are faced with growing environmental risks, uncertainties and dilemmas, this report argues for the need to fully embed EAs into spatial planning theory and practice, proposing the notion of an ecological turn in planning. This report argues that spatial planning has the potential to contribute towards a transition to more resilient places to improve our ability to cope with complex environmental risks and disturbances. To address this, the report emphasises the need to reflect on the interactions between the principles guiding spatial planning activity, the practice that both informs and is informed by these principles, and the procedures employed to operationalise such principles and practice-informed knowledge in land use governance.

1.2 The Concept of Ecosystem Services

Modern thinking on ecosystem services stems from the 1970s and a developing belief that “by weighing the benefits to society of nature in the undeveloped

state against the benefits of resource development, an objective basis for decision-making will be achieved” (Westman, 1977, 960). This increasing desire to stimulate public interest in conservation initiatives by a utilitarian framing continued through the 1980s (Ehrlich and Ehrlich, 1983; WCED, 1987). However, it was not until the 1990s that the “mainstreaming of ecosystem services” truly emerged (Gómez-Baggethun *et al.*, 2010, 1209), with a growing number of academics from diverse backgrounds advocating the ecosystem services perspective as a means to facilitate better decision-making (Costanza *et al.*, 1997; Daily, 1997; Pearce and Moran, 1994). In 2005, the Millennium Ecosystems Assessment (Millennium Ecosystems Assessment, 2005) significantly raised the profile of ecosystem services and securely placed it on the global policy agenda (Gómez-Baggethun *et al.*, 2010). This heightened profile was subsequently reflected by the establishment in 2010 of a United Nations sponsored Intergovernmental Panel on Biodiversity and Ecosystems Services (IPBES) reflecting a desire to repeat the awareness raising successes of the Intergovernmental Panel on Climate Change (Larigauderie and Mooney, 2010). Buttressing such efforts was the publication of a report endorsed by the United Nations: *The Economics of Ecosystems and Biodiversity* (TEEB, 2010) and subsequent studies exploring the usefulness of this perspective to decision-making (Ring *et al.*, 2010; Wittmer and Gundimeda, 2012). Today, the ecosystem services concept is resolutely situated within academic and practice debates concerning how to consider more accurately the value of environmental resources in decision-making (Apitz, 2013; Gilvear *et al.*, 2013; Peh *et al.*, 2013; Tobias, 2013; van Wensem and Maltby, 2013).

Broadly conceived as “the benefits people obtain from ecosystems” (Millennium Ecosystems Assessment, 2005), thinking on ecosystem services most frequently follows the categorisation of services advanced by the Millennium Ecosystems Assessment. These are as follows (Millennium Ecosystems Assessment, 2005, 40):

- Supporting Services: services “necessary for the production of all other ecosystem services” (e.g. nutrient cycling, water cycling, soil formation).
- Regulating Services: services “necessary for the production of all other ecosystem services” (e.g. air quality regulation, climate regulation, water purification and waste treatment).

- Provisioning Services: the provision of “products obtained from ecosystems” (e.g. food, fibre, fuel, pharmaceuticals, fresh water).
- Cultural Services: the “nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences” (e.g. recreation and tourism, aesthetic values, sense of place, cultural heritage values).

These ecosystem services were then related to human well-being by their role in underpinning security, the provision of basic materials, health and social relations. All of these were conceived to facilitate freedom of choice and action. However, such delineations have not been immune from criticism with some authors questioning the appropriateness of the different categories advanced by the Millennium Ecosystems Assessment (Costanza, 2008; Wallace, 2007) and how they may be applied in practice (Lamarque *et al.*, 2011). Of particular concern is the potential to confuse structures and functions with services and benefits.

Boyd and Banzhaf (2007) offer some clarification by proposing that ecosystem services are not “the benefits people obtain from ecosystems” (Millennium Ecosystems Assessment, 2005), but rather are the “components of nature, directly enjoyed, consumed, or used to yield human well-being” (Boyd and Banzhaf, 2007, 619). In this more nuanced approach, services and benefits are not “the aspects of ecosystems utilised (actively or passively) to produce human well-being”, but “become services if there are humans to benefit from them. Without human beneficiaries they are not services” (Fisher *et al.*, 2009, 645). For example, recreation is cited by the Millennium Ecosystems Assessment as a “cultural service, however, it is the enjoyment derived from recreation that provides a human benefit through a particular form of interaction with the environment, not the service per se”.

Haines-Young and Potschin (2010) build upon this insight by proposing a “services cascade”. This model distinguishes between “ecological structures and processes created or generated by living organisms and the benefits that people eventually derive” (Haines-Young and Potschin, 2010, 115). These authors illustrate the clarity provided by their model by reference to how the presence of ecological structures like woodlands may function in slowing the passage of surface water. This capacity to reduce the intensity of river flow and

potentially diminish the likelihood of flooding may be something that will be found useful. However, this perception of “usefulness” is not a fundamental property of the ecosystem itself. Rather, the decision as to whether this function is regarded as a service or not depends upon whether flood control is regarded as a “benefit”. Society will consider or disregard this function as a benefit in different places at different times. “Therefore in defining what the ‘significant’ functions of an ecosystem are and what constitutes an ‘ecosystem service’, an understanding of spatial context (geographical location), societal choices and values (both monetary and non-monetary) is as important as knowledge about the structure and dynamics of ecological systems themselves” (Haines-Young and Potschin, 2010, 116). This acknowledgement of the complex interactions between space and society resonates strongly with the underlying assumptions and purposes of spatial planning to facilitate mutually beneficial relations between humanity and the environment (Davoudi, 2012; Spirn, 1984; Wilkinson, 2012a).

While primarily commending this model, Braat and de Groot (2012) question its “unidirectional downwards flow” and suggest that it “is often interpreted to imply that ecosystem services flow effortlessly from ecosystems to human well-being” (Braat and de Groot, 2012). Noting the assertion by Haines-Young and Potschin that a focus on the interpretation of benefits (e.g. the service of flood control) can facilitate the formulation of policies to limit the pressure on structures (e.g. woodlands), Braat and de Groot suggest that such mitigating policies account for just one aspect of how society may employ the ecosystems services paradigm as a means to facilitate more informed decision-making. Hence, complementing the approach advocated by de Groot *et al.* (2010b), these authors advance the view that careful attention to feedback from institutions, judgements, management and restoration (Braat and de Groot, 2012, 8) may provide ways to enhance the structures and functions that provide the services considered as benefits, rather than simply mitigate the pressures upon such services. Thus, in keeping with the example furnished above, increasing the size of a woodland (structure) may amplify its capacity to slow the flow of water (function), reduce flooding (service) and thereby aid flood control (benefit).

From a policy perspective, analytical frameworks and policy instruments to promote ecosystem services have often been rooted in environmental economics, such as

ecosystem valuation methodologies and payment for ecosystem services market-based policy tools (CNT and AR, 2010; DEFRA, 2007; DEHLG, 2008; EC, 2012). However, there is currently a dearth of literature that addresses the ecosystem services approach from the perspective of spatial planning and how this may be translated into planning practice through the procedures employed in the formulation and implementation of policies designed to stimulate practical interventions.

1.3 The Ecosystem Approach: a Role for Spatial Planning and Green Infrastructure?

The EA is the primary framework for action under the 1992 CBD and is defined as a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. It is based on the application of appropriate scientific methodologies focused on levels of biological organisation that encompass the essential processes, functions and interactions among organisms and their environment. It recognises that humans, with their cultural diversity, are an integral component of ecosystems. The EA comprises twelve principles (UN, 1992).

5. Conservation of ecosystem structure and functioning, to maintain ecosystem services, should be a priority target of the EA.
6. Ecosystems must be managed within the limits of their functioning.
7. The EA should be undertaken at the appropriate spatial and temporal scales.
8. Recognising the varying temporal scales and lag-effects that characterise ecosystem processes, objectives for ecosystem management should be set for the long term.
9. Management must recognise that change is inevitable.
10. The EA should seek the appropriate balance between, and integration of, conservation and use of biological diversity.
11. The EA should consider all forms of relevant information, including scientific, indigenous and local knowledge, innovations and practices.
12. The EA should involve all relevant sectors of society and scientific disciplines.

Box 1.1. Principles of the Ecosystem Approach (UN, 1992)

1. The objectives of management of land, water and living resources are a matter of societal choice.
2. Management should be decentralised to the lowest appropriate level.
3. Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.
4. Recognising potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should:
 - reduce those market distortions that adversely affect biological diversity;
 - align incentives to promote biodiversity conservation and sustainable use; and
 - internalise costs and benefits in the given ecosystem to the extent feasible.

While EA is widely promoted within nature conservation policy and practice, the regulation of land use change and the built environment is provided by the spatial planning system, which in Ireland comprises national planning legislation and policies, regional planning guidelines, county/city development plans and development management that guides and regulates the implementation of development. This report argues that spatial planning has the potential to contribute to the EA through mobilising the GI concept. Although spatial planning is not fully aligned with all 12 of the EA principles above, there is significant overlap to suggest that adopting an EA approach within spatial planning would enable a planning authority to integrate sound ecological evidence and principles into a wide range of existing planning objectives (e.g. housing and transport) while meeting its environmental obligations under EU and national legislation.

The Irish spatial planning system has been transformed over the last decade, with four new Planning Acts, the formulation of a National Spatial Strategy (NSS) (2002) (to be replaced by the National Planning Framework), new government planning guidelines, the introduction of regional planning guidelines (to be replaced by Regional

Spatial and Economic Strategies) and a shift from a narrow system of development control (with a focus on controlling undesirable forms of development) towards a more proactive development management system (to promote proper planning and sustainable development of an area). However, the Irish spatial planning system has been widely criticised for underperformance in relation to environmental management, specifically in the inadequate regulation of dispersed development and urban sprawl (see, for example, An Taisce, 2012; Kitchin *et al*, 2010; Fox-Rodgers *et al.*, 2011). At present, the EA and spatial planning are largely separate activities, with poor linkages between the two domains – institutionally, conceptually and in terms of policy tools and implementation. Moreover, there is similarly a lack of co-ordination between spatial planning and various territorial approaches towards environmental management – both internal and external to local authorities – such as river basin management plans, local biodiversity action plans, agri-environmental management and multifunctional landscape management, and a lack of progress in relation to developing climate change action plans.

However, the GI concept potentially provides a key framework to integrate EA within the spatial planning system. How this is to be achieved in practice is subject to some debate and is at the core of this report. GI planning has been an emerging theme within the spatial planning literature in recent years and provides an integrative concept for managing the built and natural environment across urban and rural space at a range of spatial scales. For example, the EEA in its *Green*

Infrastructure and Territorial Cohesion Report (EEA, 2011) defines GI and the GI approach as follows:

Green infrastructure is a concept addressing the connectivity of ecosystems, their protection and the provision of ecosystem services, while also addressing mitigation and adaptation to climate change. ... Green infrastructure helps ensure the sustainable provision of ecosystem goods and services while increasing the resilience of ecosystems. The concept is central to the overall objective of ecosystem restoration, which is now part of the 2020 biodiversity target. ... (GI planning) also promotes integrated spatial planning by identifying multifunctional zones and by incorporating habitat restoration measures and other connectivity elements into various land-use plans and policies, such as linking peri-urban and urban areas or in marine spatial planning policy.

1.4 The Eco-Plan Project: Rationale and Drivers

The Eco-Plan project addresses natural capital management, and its synergy and integration with the management and regulation of the built environment, to protect, restore, enhance and create GI to maximise biodiversity gain and to capture ecosystem benefits. The project aims to significantly enhance Ireland’s ability to meet its EU environmental obligations and to develop enhanced integrated approaches to policy-making (see Figure 1.1).

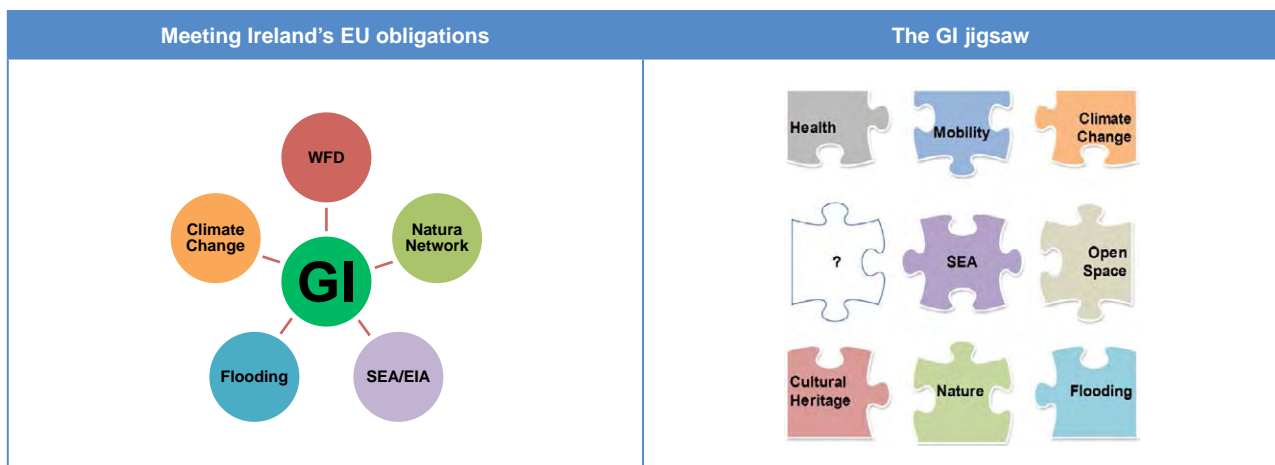


Figure 1.1. The Green Infrastructure Challenge. EIA, Environmental Impact Assessment; SEA, Strategic Environmental Assessment; WFD, Water Framework Directive.

This research addresses two of the most complex and urgent challenges facing policy-makers across the globe – biodiversity loss and climate change. Nationally, although significant progress has been made in the past decade, biodiversity loss has not been halted in Ireland and the status of many of Ireland's habitats and of some of our species is judged to be poor or bad (DAHGI, 2013). Habitat protection in Ireland is undermined by fragmented patterns of urban development and the inadequate regulation of dispersed development and urban sprawl (Kitchen *et al.*, 2010). In relation to climate change, it is now widely accepted that human interference with the climate system is occurring and climate change poses risks for human and natural systems (IPCC, 2014). The impacts of climate change across the EU territory are predicted to be uneven, but will pose key threats to Europe's urban centres, including rising temperatures (exacerbated by urban heat islands), risks to critical infrastructure (from storms and flooding events) and increased vulnerability to sea-level rises for Europe's coastal cities (O'Neill and Scott, 2011). To date, climate change research and practice has focused on macro-scale mitigation, with mitigation measures increasingly integrated into a range of policy. Policy and practice in climate change adaptation is in a formative stage, particularly in the context of research into the physical adaptation of our built environment. While the evidence concerning biodiversity loss and climate change is overwhelming, the governance of these issues and the translation of evidence into problem-solving and policy-making remains an enduring challenge. Green infrastructure potentially offers a synergetic and integrative policy concept to address climate change and biodiversity, and to integrate the management of natural capital with the planning for complex urban systems.

The Eco-Plan project contributes to a range of international and national policy areas, creating a positive feedback loop between policies designed to enhance ecosystem services and biodiversity by addressing climate change mitigation and adaptation, and policies for land use/spatial planning. Moreover, the project aims to enhance Ireland's ability to meet EU obligations in a number of key areas including EU Directives relating to water, flooding, habitats and biodiversity, environmental assessment and climate change.

1.4.1 Biodiversity policy

The research contributes to biodiversity policy implementation at European, national and local levels. At an EU scale, the research addresses the EU's Biodiversity Strategy to 2020 (2011) and Green Infrastructure Strategy (2013) target areas of (1) enhancing the implementation of nature legislation; (2) restoring ecosystems and establishing GI; and (3) contributing to averting global biodiversity loss. At a national level, the research contributes significantly to implementing and contributing to the ongoing review of Ireland's National Biodiversity Plan 2011–2016 (NBP, 2011). Specifically, the research addresses four key target areas in the NBP: (1) to mainstream biodiversity in the decision-making process across all sectors; (2) to substantially strengthen the knowledge base for conservation, management and sustainable use of biodiversity; (3) to increase awareness and appreciation of biodiversity and ecosystems services; and (4) to expand and improve on the management of protected areas and legally protected species. In addition, the research contributes to the implementation of EU biodiversity directives into Irish practice, in particular to meet obligations under the Birds Directive (2009/147/EC), the Habitats Directive (92/43/EEC) and the related Natura 2000 network (as outlined in 92/43/EEC). Therefore, the research aims to contribute in providing a framework to help local authorities meet obligations under Regulation 27 of the European Communities (Birds and Natural Habitats) Regulations 2011, whereby any public authority has a duty to comply with the requirements of European nature directives. Finally, the research aims to inform the future development of local biodiversity action plans and their relationship to local spatial plans.

1.4.2 Climate change policy

The research is timely in relation to the development of Ireland's new Climate Change and Low Carbon Development Bill, currently under development and review, and contributes to the ongoing development of the National Climate Change Adaptation Framework (2012). Green infrastructure performs a key role in relation to both climate change mitigation policies (e.g. carbon sinks) and climate change adaptation (e.g. managing increased flood risk or urban heat islands).

1.4.3 Spatial planning and urban development

While GI has emerged as a new concept within spatial planning practice, currently there is a significant implementation gap between recognising the benefits of a GI approach and the translation of these GI benefits into development outcomes through integration into statutory land use planning and regulation. Green infrastructure offers an integrative approach towards meeting a planning authority's environmental obligations, centralising ecological issues and delivering key planning goals in a more ecologically sensitive way; examples include enhanced synergies between sustainable urban drainage schemes within public park design, the integration of "rain gardens" along roads to capture surface runoff and green roofs on public buildings.

1.4.4 Drainage/flood management

The causes of flooding are complex, requiring multi-dimensional management approaches; for example, White (2013) outlines the nature of flood risk to include not only fluvial, tidal and coastal flooding, but also exposure to flood risk from surface water, including urban runoff and local drainage failure (see also the National Preliminary Flood Risk Assessment Overview Report: OPW, 2012). Climate change adds a further layer of complexity, with climate change processes likely to increase flooding vulnerability, both inland and coastal, with consequences for property, livelihoods, infrastructure, agricultural production and ecosystems (EEA, 2008). As a result, in many countries, flood risk management is constantly evolving as it moves beyond a one-dimensional "keep flood water out" approach, towards a more strategic, holistic and long-term approach of prevention, protection and preparedness characterised by increasing resilience to flooding events. Consequently, policy emphasis on adaptation and achieving greater resilience to flooding is reflected in the enactment of EU legislation in the form of the Floods Directive (2007/60/EC) (EC, 2007a). Within this context, GI has the potential to contribute to a whole-catchment framework to risk management and to work alongside structural approaches, particularly to encourage more ecologically sensitive development and enhanced drainage management to create more resilient places.

1.4.5 Implementing Strategic Environmental Assessment and Habitats Directives

As a result of recent regulations amending the Strategic Environmental Assessment (SEA), virtually all spatial plans in Ireland are subject to SEA or screening for SEA. Complementing the SEA process is the obligation to undertake screening for Appropriate Assessment (AA) of plans and projects deriving from the Habitats Directive (92/43/EEC) and transposed into national legislation and regulations. SEAs and AAs are separate legal processes, but they should be complementary and overlap in several aspects. Both processes allocate knowledge, skills and resource requirements to local authorities. The Environmental Protection Agency (EPA) has acknowledged this by producing guidance on Integrated Biodiversity Impact Assessment (STRIVE Report Series No. 106) (EPA, 2013). However, to a large extent, the SEA/AA processes remain reactive assessment procedures within the local authority system with insufficient attention allocated to alternative scenario development, potential long-term effects and synergistic and cumulative impacts of change on the natural environment. A GI approach can address these deficits by advancing a proactive and iterative approach to scenario formulation and assessment. This will enhance the potential of the SEA and AA processes in guiding policy development by promoting socio-environmental holism to encourage long-term positive synergies.

1.5 Research Aims and Report Structure

The key objective for the Eco-Plan project is to provide an evidence base for the effective integration of EA principles and nature conservation with spatial planning and the regulation of the built environment, applying the GI concept as an integrative tool. Nationally, the report seeks to contribute substantially to both conservation practice and planning practice (including urban and landscape design), building on Comhar's 2010 baseline study *Creating Green Infrastructure for Ireland: Enhancing Natural Capital for Human Well Being* (Comhar, 2010a). The specific objectives of the Eco-Plan project include:

1. providing an understanding of the EA for sustainable environmental management, including the role of spatial planning in land use regulation

and management of the built environment, and to consider the potential of the GI concept as an integrative policy tool, by examining international best practice;

2. identifying the international and national legislative and policy frameworks underpinning biodiversity and nature conservation, and to evaluate how these relate to the spatial planning system;
3. providing a baseline study of current national practice in relation to EAs, GI and spatial planning;
4. developing an interactive, cross-sectoral and stakeholder-based approach to identify pathways to integrate ecosystem service management and GI into spatial planning frameworks;
5. developing recommendations relating to (1) the integration of ecosystem services and GI into existing spatial planning frameworks; (2) the potential of existing planning tools for effective decision-making; and (3) recommendations for new policy tools.

To meet these objectives, the research underpinning this report comprised four interrelated work packages (WPs) as follows:

- WP 1 – State of knowledge review: this WP provided a review of the EA towards sustainable environmental management and an understanding of the GI concept and its application in practice.
- WP 2 – Audit of national practice: this WP provided a baseline study of current national practice in relation to ecosystem services, GI and spatial planning, including analysis of the national policy and legislative context for biodiversity and nature conservation/restoration, the national policy framework for spatial planning, and analysis of regional and county/city planning policies and practice.
- WP 3 – Case study GI workshops: a key element of the research project is the development and

application of a planning tool for a GI approach to spatial planning. To facilitate an interactive, stakeholder-based approach, the project team developed a game-based approach (GI Quest) as a social learning tool to be used with expert groups. The planning tool was applied in four workshops, one at a national scale, one regional level workshop and two workshops within local authorities.

- WP 4 – Decision-making frameworks and tools: this WP provided a synthesis of the results and findings from WPs 1–3, and provides recommendations relating to the integration of the EA and GI into existing spatial planning frameworks; the potential of development plans and development management alongside SEAs, Environmental Impact Statements (EIS) and AAs; and recommendations for new policy tools (such as new government planning guidelines, design guidelines, payments for ecosystem services, land use zoning tools for GI and nature conservation).

Accordingly, the remainder of this report is structured into six further chapters. Chapter 2 provides a literature and state-of-the-art review of the relationship between the EA, spatial planning and GI. Chapter 3 provides an audit of national practice in relation to operationalising the GI approach within the Irish spatial planning system. Chapter 4 provides insights into the re-alignment of landscape and natural capital within the development plan process, drawing on best practice insights from Fingal County Council. Chapter 5 outlines the role of a GI approach in relation to adapting the built environment to increased flood risk. Chapter 6 reports on the development and application of an interactive planning tool for developing a game-based approach to GI problem-solving and solution search. Chapter 7 provides an overall discussion of the key findings and Chapter 8 outlines conclusions and policy recommendations.

2 Protecting and Enhancing Ecosystem Services Via Spatial Planning – Reviewing the Possibilities and Implications of a Green Infrastructure Approach

2.1 Introduction

This chapter reviews the potential for a GI planning approach to respond to the challenges of operationalising the ecosystems services concept in spatial planning. This discussion is structured using Hebbert's (2009) three-*Ps* framework of principles, practice and procedures. Following an account of this framework, an array of academic and practitioner literature is reviewed to identify the core principles of the GI approach. The broader guiding principles informing GI planning activity and the range of ecosystems services that GI is believed to enhance are also identified. The report then identifies and discusses a number of themes common to GI practice. Subsequently considered are the implications of a GI approach for the procedures of spatial planning. Specific attention is devoted to the demands for transformation that a GI approach places on existing institutional arrangements and professional cultures. The final section of this chapter concludes by reflecting on where the future may lie for a GI approach to spatial planning and offers some ideas on how the concept should be allowed to evolve.

2.2 Spatial Planning: Principles, Practice and Procedures

As spatial planning is inherently concerned with social–ecological interactions (Plieninger and Bieling,

2012; Selman, 2006; Wilkinson, 2012), the “shift in the view of an ecosystem to one where people are considered part of an interactive holistic system” (Raffaelli and Frid, 2010, 4) acknowledges the role that informed planning can play in enhancing the beneficial functioning of ecosystems. Consequently, a number of recent studies promote use of the EA as a means to encourage better planning practice (Gómez-Baggethun and Barton, 2013; Niemelä *et al.*, 2011; Schäffler and Swilling, 2013; Wilkinson *et al.*, 2013). Within this emerging literature, however, limited attention has been given to addressing the principles of spatial planning and how these may be translated into practice through the procedures employed in the formulation and implementation of policies designed to stimulate practical interventions. One way to address this deficit is through the concept of “green infrastructure” (Figure 2.1). This concept “emphasises the importance of ensuring the provision of ecosystem goods and services for society and the value of functionally and spatially connected, healthy ecosystems” (Karhu, 2011, 7). In this sense, the GI concept both accommodates and transcends a focus on mitigation by proposing theoretical and applied reflection concerning how a proactive approach to planning for ecosystems services can enhance the shared benefits derived by positive social–ecological interactions.

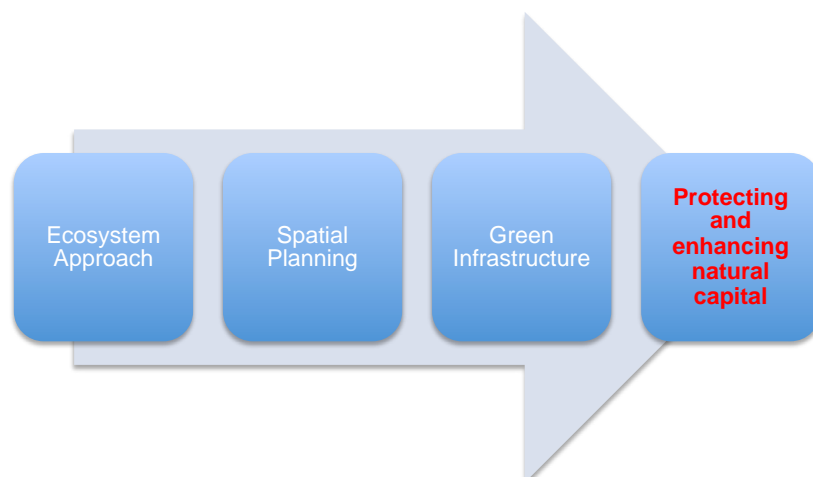


Figure 2.1. The EA approach to planning.

Hebbert's (2009) three Ps framework of principles, practice and procedures supplies a helpful structure for considering the potential offered by the GI concept to deliver ecosystems services through spatial planning. Under this typology, the principles informing planning activity concern issues of high-order reflection on what planning should seek to achieve and how this may be accomplished. They are informed by theory and debate grounded in an appraisal of past endeavours, understandings of the present and predictions of the future. Thus, planning principles represent broad perspectives on ways to better the present, negotiate the future and learn from the past. Practice differs from principles in that it relates to the analysis of particular situations that offer "a means of learning from empirical experience of actually existing realities, typically through the vehicle of case studies" (Hebbert, 2009, 359). Finally, procedure refers to planning processes, management techniques and skill sets. As such, procedure addresses issues concerning how to plan rather than what to plan. However, it is important to note that all three Ps are interrelated. Each interacts with and informs the other as "principles lay the template, knowledge of practice demonstrates feasibility and sets benchmarks, procedures make the trajectory to implementation" (Hebbert, 2009, 359). These interrelationships are illustrated in Figure 2.2. Hebbert's typology is employed to identify and discuss the principles of an ecologically informed planning approach. With reference to existing practices, an endeavour is then made to assess the procedural implications of operationalising this approach in spatial planning. From this, it is shown that a GI approach supplies a feasible and effective means to operationalise the ecosystems services concept in spatial planning.

2.3 Principles of Green Infrastructure Planning

The primary focus of planning systems in English-speaking countries has traditionally been the regulation of land use to provide a framework for economic development while minimising externalities associated with competing land uses through land use zoning and development control instruments. While land use planning has always acknowledged the importance of care for the environment, meanings, representations and the status of environmental issues as compared to development priorities have fluctuated over time (Davoudi *et al.*, 1996). Within this context, landscape preservation has been an enduring and longstanding feature of land use planning regimes. As Davoudi *et al.* (1996) argue (in relation to the UK system), planning practice has been underpinned by a "moral and aesthetic notion of the environment as backcloth and setting" (Davoudi *et al.*, 1996, 429), as advocated by early planning pioneers. This perspective has resulted in what Selman (2010) refers to as an agenda of protection, amenity and ornament, reducing landscape concerns to a "cosmetic exercise – something to do with prettification" (Selman, 2010). Alongside this concern with landscape as ornament, planning for natural heritage has been underpinned by reactive, site-based approaches involving the designation of site-specific areas for the conservation of flora and fauna. These designated sites, alongside traditional planning preservation tools (such as the UK's greenbelts, areas of outstanding natural beauty and national parks) led to an approach characterised by "islands of protection" (Owens and Cowell, 2011); in effect, a collection of environmental assets.

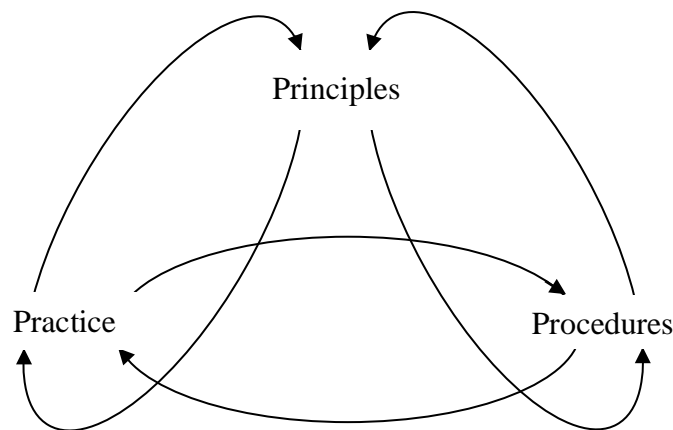


Figure 2.2. Interrelationships between the principles, practices and procedures of spatial planning.

With the much documented “spatial turn” in planning debates in the 1990s/2000s, planning systems shifted beyond narrow land use concerns to embrace a role of spatial co-ordination, characterised by flexible policy approaches and multi-scalar interventions (Albrechts *et al.*, 2003). While “sustainable development” became commonly cited as the ultimate goal within spatial strategies (Briassoulis, 1999), much literature charted the primacy given to the competitiveness agenda (particularly at the city–region scale) – see for example, Counsell and Haughton (2003). In this context, environmental assets were perceived as “development assets”, performing a key role in place identity and packaged as quality of life capital (Owens and Cowell, 2011). Discourses surrounding sustainable urban environments were dominated by narrow debates surrounding compact urban forms, viewed as delivering both central city urban renewal and addressing the emerging climate change agenda through reducing the spatial separation of daily activities and therefore mitigating greenhouse gas emissions through reduced car dependency (McEldowney *et al.*, 2005).

While sustainable development provided a flexible discourse for formulating spatial strategies, the growing focus on climate change and the heightened sense of risk from anticipated climate change impacts has provided an important emerging context for spatial planning (Campbell, 2006; Wilson, 2007). There has been limited progress in developing international agreements designed to mitigate climate change and reduce greenhouse gas emissions, so increasingly the lack of leadership in the area of climate change is being addressed at a city and regional scale. Whereas reducing greenhouse gas emissions has been a central concern for planners for over two decades through, for example, promoting compact urban forms, climate change adaptation is taking centre-stage as a key policy concern; while climate change is occurring globally, its impacts are experienced locally, where people live and work (Donaghy, 2007). Spatial planning, therefore, has a crucial role to play in terms of reducing vulnerability and transforming the footprint of the places people live and work to become more resilient to climate-related hazards so that they can cope with and recover more quickly from extreme disturbances such as flooding or heat stress (O’Neill and Scott, 2011). Through influencing the location, layout and design of development, spatial planning has the capacity to adapt the built environment to climate change by delivering a more

multifunctional environment that is safe and resilient to climatic extremes. Taking this approach can therefore limit exposure to costly retrofix adaptation after climatic events.

Similarly, biodiversity loss and conservation legislation poses considerable challenges for spatial planning practice, both in terms of scope and procedures. For example, Regulation 27 of the European Communities (Birds and Natural Habitats) Regulations 2011, places a duty on all public authorities to comply with the requirements of European nature directives [the Birds Directive (2009/147/EC) and the Habitats Directive (92/43/EEC)]. This includes ensuring appropriate responses for the conservation of protected sites, underpinned by an understanding of a habitat’s structure and function. Moreover, the ecological dimension of planning decision-making has been addressed through Environmental Impact Assessments (EIAs), SEAs and AAs. In this context, GI should be promoted as consolidating a range of planning objectives and environmental obligations in a mutually reinforcing manner; in other words, GI provides added-value to existing planning functions and obligations.

Addressing challenges emerging from climate change and biodiversity loss requires a sea change in planning processes and practices to fully integrate the ecological dimension with traditional planning concerns. Table 2.1 outlines the principles that inform this ecological turn in planning policy and practice in an international context. In this context, GI has emerged as a potential concept that may be employed to operationalise an EA within spatial planning policies and practices. The GI approach moves beyond traditional site-based approaches of “protect and preserve” towards a more holistic ecosystems approach, which includes not only protection but also enhancing, restoring, creating and designing new ecological networks characterised by multifunctionality and connectivity.

The theory and application of the GI planning concept has significantly increased over the past decade (Amati and Taylor, 2010; Barnhill and Smardon, 2012; Comhar, 2010a; Davies *et al.*, 2006; Dunn, 2010; Foster *et al.*, 2011; Horwood, 2011; Hostetler *et al.*, 2011; Kilbane, 2013; La Rosa and Privitera, 2013; Lerner and Allen, 2012; Llausàs and Roe, 2012; Mayer *et al.*, 2012; Mell, 2013; Sandström, 2008; Thomas and Littlewood, 2010; Williams *et al.*, 2010; Wright, 2011). While the origin of the term remains debatable (Allen, 2012; Pankhurst,

Table 2.1. Evolving planning principles and the ecological turn in an international context

Defining attributes	Land use planning	Spatial planning	An ecological turn in spatial planning
Purpose	Planning for the public interest	Planning for sustainable development	Planning for resilient places
Aims	Providing a land use framework to facilitate economic development	Ensuring the competitiveness of city regions within a globalised economy	Working with natural processes to enhance ecosystems services provision
Approach	Land use regulation	Spatial co-ordination	Social–ecological integration
Scope	Narrow and defined spatial and functional boundaries	Broad and fuzzy spatial and functional boundaries	Inclusive and overlapping spatial and functional boundaries with particular attention to biogeographical delineations
Logic	Static	Flexible	Reflexive, adaptive and transformative
Administration	Functional silos	Increased communication and co-operation	Full integration
Urban perspectives	Defined land uses	The compact city and urban renaissance	Landscape urbanism and ecological urbanism
Rural perspectives	Separation of town and country; rural as inherently different	Rural as supporting element to city region	Rural as equal element in social–ecological continuum
Landscape perspectives	Islands of protection, landscape as ornament and site-based approach to protecting habitats and species	Landscape as marketable asset; natural heritage as a development asset	“Multifunctional landscapes”; protecting, enhancing, restoring and creating new ecological networks; “connectivity”
Indicative policy approaches	Areas of outstanding natural beauty, green belts, land use zoning	Quality of life capital; landscape character assessments	GI hubs, parcels, individual elements, corridors and land use buffers
Design concepts	Domination of nature-intensive civil and mechanical engineering of solutions	Management and manipulation of nature; engineering solutions predominate, but less intensive methods accepted	Biomimicry and less intensive methods favoured; working with nature

2012; Roe and Mell, 2013; Rouse and Bunster-Ossa, 2013), and there are a variety of interpretations as to what it entails (Cameron *et al.*, 2012; Casperson and Olafsson, 2010; EC, 2012; Ellis, 2012; Madureira *et al.*, 2011; Sylwester, 2009), virtually all understandings are consistent with the frequently referenced definition advanced by Benedict and McMahon (2006) as “an interconnected network of natural areas and other open spaces that conserves natural ecosystem values and functions...and provides a wide array of benefits for people and wildlife”. In parallel with the concepts of structures and functions in ecosystem services theory (de Groot *et al.*, 2010b; Potschin and Haines-Young, 2011), those advocating a GI planning approach focus on how assets and functions can equip the ecosystems services deemed beneficial to society, underpinned by the core planning principles discussed below.

Firstly, at the fore among GI principles is the requirement to respect the context in which GI planning operates and to which a GI plan addresses (Eisenman, 2013; TCPA

and WT, 2012; William, 2012). Here, GI planning is seen to entail “a design vision that translates (a) planning strategy into physical reality while heeding the ecological and cultural characteristics of a particular locale – whether a region or an individual building” (Rouse and Bunster-Ossa, 2013). Informed by the works of McHarg (1969), Sporn (1984) and Hough (1989), GI planning is seen as an evidence-based approach (Gill *et al.*, 2009; Weber *et al.*, 2006) that seeks to understand, emulate and enhance local ecological and cultural distinctiveness so that it becomes “both ‘effective’ as an agent of environmental quality and ‘affective’ as an expression of local conditions” (Rouse and Bunster-Ossa, 2013, 6). To advance such context sensitivity, a GI planning approach stresses the principle of collaboration (Barnhill and Sardon, 2012; Davies *et al.*, 2006; Mayer *et al.*, 2012; Scottish Government, 2012). Such a collaborative approach applies to the conception, design, implementation and maintenance phases of a GI planning initiative (Williamson, 2003). Indeed, those advocating this approach assert that “successful green

infrastructure initiatives build on the foundation of many disciplines and engage experts from various fields in network design and review” (Benedict and McMahon, 2006, 40). Moreover, promoters of the GI approach stress the need for collaboration to extend beyond the walls of expert institutions to involve non-specialist citizens whose “subjective human needs, preferences, and perceptions are often decisive” in the formulation and implementation of successful GI initiatives (Erickson, 2006, 280).

Secondly, advocates of a GI approach contend that planning for the protection and enhancement of GI assets and functions should precede the allocation of lands for development (Landscape Institute, 2013; TCPA and WT, 2012). In this sense, GI planning should be seen to “provide a framework for future growth while also ensuring that significant natural resources will be preserved for future generations” (Benedict and McMahon, 2006, 41). In emphasising the merit of protecting GI assets and functions prior to other forms of development activity, GI is thereby regarded as “fundamental infrastructure” (Roe and Mell, 2013, 653) necessary for the delivery of a better environment for humans and non-humans alike (Beatley, 2010; Gill *et al.*, 2009; Grant, 2012).

Thirdly, GI approaches emphasise connectivity as central to promoting holistic planning approaches for ecosystem services. In a review of GI practice in the UK, Kambites and Owen (2006, 490) conclude that connectivity is “a pervasive and desirable characteristic of both green infrastructure itself and the process of green infrastructure planning”. In the context of GI planning, connectivity is used to refer to spatial integration (Andrés-Orive and Dios-Lema, 2012; Selman, 2012; Silva *et al.*, 2010), scalar integration (McDonald *et al.*, 2005; William, 2012) and institutional integration (Erickson, 2006; TCPA and WT, 2012). Accordingly, the review below discusses these various dimensions of connectivity in terms of spatial connectivity, scalar connectivity and institutional connectivity.

Spatial connectivity refers to “a physically connected system across the landscape” (Rouse and Bunster-Ossa, 2013, 19), and accounts for “the degree to which a landscape facilitates or impedes the flow of energy, materials, nutrients, species, and people” (Ahern, 2007, 270). In this sense, a GI planning approach seeks to integrate the spatial concept of ecological networks originating in landscape ecology

(Forman, 1995; Forman and Godron, 1986; Wiens, 2007) with the greenways concept stemming from a more anthropocentric spatial planning tradition (Flink *et al.*, 1993; Hellmund and Smith, 2006; Little, 1990). An ecological network is “a framework of ecological components, e.g. core areas, corridors and buffer zones, which provides the physical conditions necessary for ecosystems and species populations to survive in a human-dominated landscape” (Jongman and Pungetti, 2004). Such networks render otherwise fragmented ecosystems biologically coherent by facilitating species movement and genetic exchange (Boitani *et al.*, 2007; Opdam *et al.*, 2006). This is achieved by connecting core areas (also called hubs), such as nature reserves, via corridors (also called links) (Francis and Chadwick, 2013). Buffer zones surround these core and corridor areas and provide zones of transition to other land uses in which the network is embedded, such as an urban area or intensively farmed environment (Jongman *et al.*, 2004). Therefore, the essence of ecological networks is “biopermeability and environmental continuity” (Pungetti and Romano, 2004, 110). Greenways differ from ecological networks in their greater focus on human recreational access and mobility, as well as in their more linear format (Gobster and Westphal, 2004; Lindsey *et al.*, 2001). Although cores and buffer zones may exist in greenways, they are not essential components (Fábos, 2004; Walmsley, 2006). Ahern (1995) defines greenways as “networks of land containing linear elements that are planned, designed and managed for multiple purposes including ecological, recreational, cultural, aesthetic, or other purposes compatible with the concept of sustainable land use”. Therefore, a GI approach to planning promotes spatial connectivity along the form presented by ecological networks (cores, corridors and buffer zones) to assist biodiversity conservation, while concurrently seeking to broaden the function of the network to facilitate anthropocentric utility (Pankhurst, 2012; Sandström, 2008; Williamson, 2003). This echoes Article 10 of the Habitats Directive (92/43/EEC), which emphasises the importance of land use planning to improve the ecological coherence of the Natura 2000 network, including features with a linear or continuous structure or those that provide a stepping-stone function essential for the migration, dispersal and genetic exchange of wild species.

Scalar connectivity is intimately related to spatial connectivity, but specifically refers to the integration of local planning initiatives with those at the regional,

national and supranational levels (Allen, 2012; EEA, 2008; Steiner, 2002). In this sense, a GI approach parallels the longstanding objectives of spatial planning to encourage consistent and integrated policy hierarchies that facilitate subsidiarity while concurrently ensuring a coherent approach across spatial and administrative scales (Adams *et al.*, 2012; Hall and Tewdwr-Jones, 2010). Furthermore, Roe and Mell (2013, 653) suggest that “timescale as well as physical scale is important and embedded within both is hierarchical thinking”. In this respect, a GI planning approach is often advocated at the landscape scale in which localised site-based initiatives are related to a strategic spatial strategy for the conservation of a larger area with shared topographical, ecological and land use characteristics (Forman, 2008; Green *et al.*, 2013; Hamilton and Selman, 2005; Lerner and Allen, 2012; Matthews and Selman, 2006; Opdam *et al.*, 2006; Selman, 2006). Such “strategic thinking” (Ahern, 2007, 274) is frequently concerned with maintaining the assets and functions that distinguish landscapes while concurrently accommodating changes in land use over time (Brandt *et al.*, 2003; Jaakkola, 2012; Primdhal *et al.*, 2009; Selman, 2012). In this sense, it is considered that GI planning is “an adaptive process that, even with the best leadership, organisational structure, and appropriate goals, requires strategic approaches to assure evolutionary success” (Erickson, 2006, 288).

Institutional connectivity relates to the multiplicity of partnerships (Rouse and Bunster-Ossa, 2013, 75) necessary to enhance GI assets and functions for greater social and ecological benefits. As the movement of materials and species does not recognise administrative boundaries (Leitao *et al.*, 2006), such institutional connectivity is generally a requirement for scalar integration as the spatial networking advanced by the GI planning approach spans localities, regions, nations and even continents (EEB, 2008; Mazza *et al.*, 2011; Opdam *et al.*, 2006; Silva *et al.*, 2010). Consequently, those promoting a GI planning approach stress that “it is essential that green infrastructure planning should involve operational connections between different administrative organisations” (Kambites and Owen, 2006) as “cross-jurisdictional co-operation is imperative” to the realisation of spatial connectivity (Erickson, 2006, 34). This emphasis on partnerships and co-operation across administrative boundaries and organisational structures harmonises with contemporary efforts in the theory and practice of spatial

planning to promote joined-up thinking and integrated governance arrangements (Stead and Meijers, 2009; Thomas and Littlewood, 2010; Vigar, 2009).

The fourth core attribute of the GI planning approach is multifunctionality. It is this focus on the value of seeking to enhance multiple ecosystems services that Benedict and McMahon identify as differentiating GI planning “from conventional approaches to land conservation and natural resources protection because it looks at conservation in concert with land development and man-made infrastructure planning” (Benedict and McMahon, 2006, 2). Accordingly, those studying GI see multifunctionality as “an integration and interaction between functions” (Roe and Mell, 2013, 655). Specifically referencing the environmental, economic and community “ecosystems services” benefits provided by GI assets and functions, Rouse and Bunster-Ossa (2013, 19) assert that “these benefits derive from the multiple and overlapping functions provided across different systems – hydrology, transportation, energy, economy, and so on – that can intersect in green infrastructure”.

Hence, in its focus on connectivity and multifunctionality, a GI approach reverses traditional planning practices wherein attention is directed at the provision of single functions (e.g. drainage, conservation or recreation) in specific locations with little interest shown to spatial, scalar and institutional integration. Figure 2.3 illustrates this polarity by representing the differences between traditional approaches to spatial planning and a GI planning approach. Using a bi-planar model structured along a functional plane (x-axis) and a connectivity plane (y-axis), Figure 2.2 portrays a GI approach as antipodal to the spatial, scalar and institutional disconnect that frequently characterises traditional modes of planning activity. Similarly, it depicts a GI approach as conversely positioned to the focus of traditional planning on the provision of just one function. In this sense, it shows how the GI concept seeks to steer spatial planning towards integrated land use governance wherein the potential of multifunctional ecosystems services is realised through enhancing positive synergies between abiotic, biotic and social systems.

2.4 Practices in Green Infrastructure Planning

In this section, we provide insights into GI planning practices from the literature as a means to identify the scope and content of spatial plans that protect and enhance

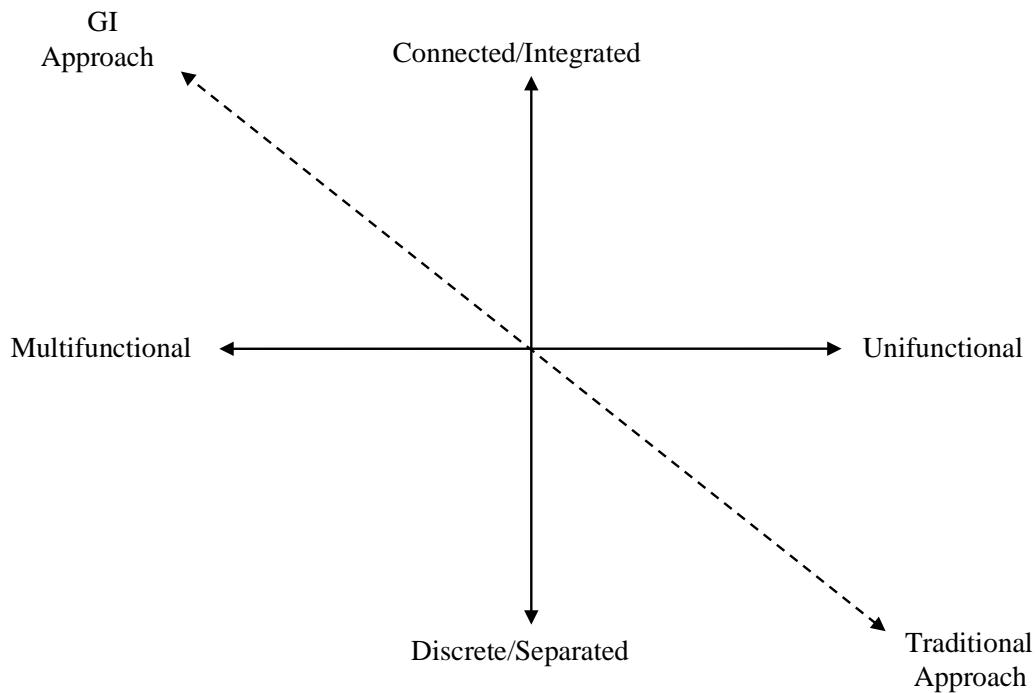


Figure 2.3. Traditional versus GI planning approaches.

natural capital. Practice examples offer orientation and may demonstrate the feasibility of delivering strategic planning principles. Such exemplars are generally supplied in the form of case studies which “are the staple of commissioned research and continuing professional development (CPD) training” (Hebbert, 2009, 362).

As a consequence of GI’s core principle of multifunctionality, such practice studies encompass a broad spectrum of ecosystems services benefits, varying from habitat provision through to community development (see Table 2.2). Nevertheless, given the multitude of functions addressed by a GI planning approach, it is unsurprising to note that different researchers emphasise different functions in their case study work. In the USA, for example, much GI-related work has centred on urban storm water management (Brown and Caldwell *et al.*, 2011; Chau, 2009; Novotny *et al.*, 2010; NYC, 2010; USEPA, 2004). Here, practice examples illustrate the viability and cost-effectiveness of a biomimicry approach to drainage design (USEPA, 2010; Stenning, 2008). This work demonstrates the achievability of drainage management through the strategic use of planting to facilitate rainwater attenuation and thereby reduce the risk of inundation. However, such research is not confined to North America. Rather, it forms a recurring feature in GI case studies with an international array of authors seeking to advocate the benefits of a less intrusive engineering approach

to drainage management (Fryd *et al.*, 2012; Grant, 2012; Kruuse, 2011; WWT and RSPB, 2012). These practices most commonly focus on the planning and design of existing GI assets to enhance their ecosystems services functions and the provision of new assets to facilitate increased delivery of a range of functions surrounding drainage management. Moreover, this line of research frequently extends beyond the urban environment and is also evident in case studies concerning broader catchments (Conservation Fund, 2007; Ellis, 2012; Weber *et al.*, 2006). Often associated with such studies are novel assessment methods and advocacy work that promote a GI planning approach for climate change adaptation (Foster *et al.*, 2011; Gill *et al.*, 2009; Lerner and Allen, 2012). These studies support the strategic use of vegetation in the built environment as a means to mitigate the urban heat island effect (Gill *et al.*, 2007) and counter flow surges during periods of heavy precipitation (Brown and Caldwell *et al.*, 2011; Hoyer *et al.*, 2011; Podolsky and MacDonald, 2008).

Another prominent theme in GI research is work focused on biodiversity conservation. This work has a strong spatial dimension and is thus predictably concerned with land use governance. As noted above with respect to spatial connectivity, much research in this area is rooted in the concept of ecological networks (Hasse, 2010; Jongman and Pungetti, 2004b; Kilbane, 2013; Sandström, 2008). While evident across a range

Table 2.2. Ecosystem services benefits of GI

Sample ecosystems services benefits of GI	Summary description	Sample references
Drainage management	Managing the flow of surface and/or subsurface water through biomimicry using engineering solutions that are less energy-intensive and expensive than those traditionally employed	Brown and Caldwell <i>et al.</i> , 2011; Chau, 2009; Ellis, 2012; USEPA, 2010; Grant, 2012; Hoyer <i>et al.</i> , 2011; Novotny <i>et al.</i> , 2010; NYC, 2010; Podolsky and MacDonald, 2008; Stenning, 2008; USEPA, 2004; Walker <i>et al.</i> , 2012
Habitat provision	Establishing suitable areas and environmental conditions for individual organisms and ecological communities to thrive	Andrés-Orive and Dios-Lema, 2012; Beatley, 2010; CGIF, 2011; Erickson, 2006; Hostetler <i>et al.</i> , 2011; Mell, 2013; Naumann <i>et al.</i> , 2011; NE, 2009; Pankhurst, 2012; Rouse and Bunster-Ossa, 2013; Sandström, 2008; Selman, 2012; TEP, 2011; Williamson, 2003
Ecological connectivity	Creating functionally contiguous land and water habitats that facilitate multi-scalar connectedness of ecological processes (e.g. species dispersal, nutrient transfer and hydro-ecological flow)	Allen, 2012; Benedict and McMahon, 2006; Conservation Fund, 2007; Comhar, 2010a; Davies <i>et al.</i> , 2006; Flink <i>et al.</i> , 1993; Francis and Chadwick, 2013; Hamilton and Selman, 2005; Hasse, 2010; Hellmund and Smith, 2006; Jongman and Pungetti, 2004b; Kambites and Owen, 2006; Leitao <i>et al.</i> , 2006; Silva <i>et al.</i> , 2010; Sylwester, 2009; Walmsley, 2006
Landscape conservation and management	Managing ecological processes, land uses and social–ecological interactions that define and associate a mosaic of areas across a broad scale. It involves balancing habitat provision and ecological connectivity (see above), with sustainable social and economic patterns of use	Allen, 2012; Boothby, 2000; Borgstrom <i>et al.</i> , 2006; de Groot <i>et al.</i> , 2010a; Landscape Institute, 2013; Mell, 2010; Plieninger and Bieling, 2012; Rouse and Bunster-Ossa, 2013; Selman, 2006, 2012
Health, well-being and community development	Promoting positive individual and communal physical, psychological and social conditions; this entails fulfilling and enhancing a range of different needs, including basic requirements, (food and energy); developmental necessities (outdoor education and community development opportunities); and growth facilitation (contact with nature)	CABE, 2009; Coucher <i>et al.</i> , 2007; Dunn, 2010; EC, 2012; EKN, 2012; Entrix, 2010; Landscape Institute, 2012; Maas <i>et al.</i> , 2009; Ong and Peterson, 2011; Scottish Government, 2011, 2012; Shackell and Walker, 2012; Takano <i>et al.</i> , 2002; Tzoulas <i>et al.</i> , 2007; van den Berg <i>et al.</i> , 2010; Ward Thompson, 2011
Recreational space (provision and access)	Providing ease of access to a variety of different types of recreational space, including formal public gardens; natural and semi-natural spaces (woodlands, meadows, remediated quarries); outdoor sports facilities (playing fields, walking tracks); and community gardens/allotments	Braioni <i>et al.</i> , 2012; Byrne and Sipe, 2010; Caspersen and Olafsson, 2010; Erickson, 2006; Fábos, 2004; Gobster and Westphal, 2004; Hellmund and Smith, 2006; Hine <i>et al.</i> , 2008; Jaakkola, 2012; Lindsey <i>et al.</i> , 2001; Little, 1990; NE, 2010; Primdhal <i>et al.</i> , 2009; van der Valk and van Dijk, 2009
Sustainable transport (route provision and access)	Ensuring access for all to infrastructure that responds to current need and accommodates future demand, yet does not endanger public health or ecological integrity	Ahern, 1995; Benedict and McMahon, 2006; Erickson, 2006; Fábos, 2004; Flink <i>et al.</i> , 1993; Girling and Kellett, 2005; Jaakkola, 2012; Kambites and Owen, 2006; Little, 1990; Pankhurst, 2012; Rouse and Bunster-Ossa, 2013; Walmsley, 2006
Climate change (mitigation and adaptation)	Facilitating forms of planning and designing that achieves a desired state by remaining responsive to both short and longer term changes in environmental conditions	Foster <i>et al.</i> , 2011; Fryd <i>et al.</i> , 2011; Gill <i>et al.</i> , 2007; Gill <i>et al.</i> , 2009; Kazmierczak <i>et al.</i> , 2010; Lerner and Allen, 2012; NWCCP, 2011
Economic development	Supporting sustained and sustainable forms of growth that improve standards of living	AGMA, 2011; CNT and AR, 2010; Ecotec, 2008; LCRP, 2010; LPI, 2012; RICS, 2011; Vandermeulen <i>et al.</i> , 2011

of jurisdictions, there is a notable focus of work on ecologically focused practices within the European Union (EC, 2007b; Karhu, 2011). A significant proportion of this literature addresses the co-ordination of national and international initiatives to address

ecosystems fragmentation (Bonnin *et al.*, 2007; Silva *et al.*, 2010), although recent years have witnessed a growing desire for a parallel focus on more localised ecological networks in urban environments (Francis and Chadwick, 2013; James *et al.*, 2009; Niemelä *et*

al., 2011; Pickett *et al.*, 2004; Pickett *et al.*, 2008). This work seeks to demonstrate the scientific procedures and planning practices required to deliver effective ecological connectivity (Jongman and Pungetti, 2004b). Although often facilitating an array of functions, it is cautioned that a GI approach that prioritises biodiversity conservation over other objectives risks generating institutional and political friction, as GI's core principle of multifunctionality can be eclipsed and difficulties may arise when attempting to balance anthropocentric utility with ecological protection (Roe and Mell, 2013); however, in some cases, legal requirements, such as those under the Birds and Habitats Directives, may limit the discretion available in decision-making.

Also notable with respect to many GI practice examples is a focus on human well-being. Such work often concerns the assessment and advocacy of recreational space provision and the creation of cycle/pedestrian networks (Bird, 2004; Butler, 2012; Erickson, 2006; Maas *et al.*, 2009; NE, 2009; Takano *et al.*, 2002; Tzoulas *et al.*, 2007; van den Berg *et al.*, 2010; Ward Thompson, 2011). These studies emphasise the physical health benefits that accrue from ease of access to natural or semi-natural spaces, with some contending that such access also provides psychological benefits (Coucher *et al.*, 2007; Tsunetsugu *et al.*, 2013). Furthermore, recent years have witnessed the emergence of studies that seek to evaluate the benefits of ecosystems services to local economic development and advocate a GI planning approach as a means to ensure sustained local and regional economic growth (LCRP, 2010; RICS, 2011). While such studies often have a quantitative emphasis (Ecotec, 2008; LPI, 2012; Vandermeulen *et al.*, 2011), others also advance qualitatively focused arguments for adopting a GI planning approach (AGMA, 2011).

2.5 Procedures for Green Infrastructure Planning

Reference to practice can help set benchmarks and through frequent citation generate "common knowledge" (Horwood, 2011) of progressive thinking. However, practice examples often represent isolated cases "privileged by combinations of ownership, location and subsidy" (Hebbert, 2009, 363). Moving GI beyond such exemplary but exceptional instances of "common knowledge" and institutionalising it as common practice requires attention as to how practitioners and the public

engage with planning processes. Consequently, it is vital to consider what implications a GI approach holds for the procedures of spatial planning. Such implications are identified and discussed below as issues concerning the requirement for greater integration and the need to conceive GI as a proactive planning approach to enhancing ecosystems services.

2.5.1 Integration

The core GI principles of connectivity and multifunctionality call on planners to concurrently achieve seemingly disparate goals within the development plan process such as flood control, recreational space provision and habitat conservation (EC, 2012; Novotny *et al.*, 2010). For this reason, GI planning necessitates a spectrum of experience drawn from an array of theories, practices and opinions (Benedict and McMahon, 2006, 40). Hence, a GI approach "requires a co-ordinated approach from a multidisciplinary, cross-organisational, cross-boundary team of partners" (TCPA, 2012, 10). It is in this sense that GI planning encourages a departure from traditional modes of organisational activity wherein multidisciplinary communication is hampered by rigid professional delineations buttressed by a legacy of inflexible bureaucratic structures. As noted by Kambites and Owen (2006, 490), "The 'silo mentality' whereby different departments of a local authority work separately from each other – and occasionally in conflict with each other – is inimical to the nature of green infrastructure planning." Moving beyond this silo mentality demands long-term commitment and a willingness to listen to the opinions of others whose views may not always correspond with one's own (Forester, 1999). While the format of such collaboration will likely differ between organisations and be tailored to the local institutional, socio-economic and environmental landscape, such efforts are likely to yield greatest profit when a framework for interdisciplinary engagement exists (Huitema *et al.*, 2009). With reference to learning from practice, Rouse and Bunster-Ossa (2013) show how a structured approach to creating partnerships between an array of professional actors with different disciplinary backgrounds was critical to the formulation and delivery of the GreenPlan for Philadelphia. Similarly, Medearis and Daesking (2012) demonstrate how co-ordinating the efforts of a multidisciplinary team was key to the planning, design and development of the environmentally sensitive Rieselfeld area in Freiburg, Germany.

In addition to such horizontal integration, a GI approach advances vertical integration between different levels of the planning hierarchy and across spatial scales (Allen, 2012; McDonald *et al.*, 2005). As materials, nutrients and species rarely respect administrative boundaries, it is incumbent that broad national, and where appropriate international, frameworks are formulated to facilitate the co-ordinated delivery of GI networks (Jongman *et al.*, 2004). Of particular concern is the need to generate coherent frameworks that help avoid potential mismatches between objectives at different spatial or institutional scales (Roe and Mell, 2013). Such frameworks provide the strategic spatial and land use direction shaping the production of more localised GI initiatives at regional and local levels of the planning hierarchy (CABE, 2009). The benefit of cross-scale co-ordination is demonstrated in practice by Primdahl *et al.* (2009). In their analysis of varying administrative approaches to planning each of Copenhagen's five green wedges, these authors show how different levels of co-ordination resulted in different degrees of success in the delivery of multifunctional spaces that provide an array of benefits to local residents. In particular, they note that the lack of a harmonised approach between certain local authorities resulted in greater fragmentation and the provision of relatively limited recreational infrastructure in comparison to green wedges where a more strategic approach was adopted.

This integrative approach also entails end-user participation in the formulation, implementation and maintenance of GI assets and functions. Various practice-based case studies have demonstrated that cross-sectional community involvement in the decisions affecting their locality is essential to the success of GI initiatives (CGIF, 2011; Mayer *et al.*, 2012; The Scottish Government, 2011; Williamson, 2003). For example, Erickson (2006) identifies the involvement of multiple community groups and non-governmental organisations (NGOs) in the development and instigation of GI initiatives as crucial to the realisation of the Chicago Wilderness project. Likewise, Rouse and Bunster-Ossa (2013) demonstrate how community involvement was key to the formulation of plans for a regional park in Birmingham, Alabama. Nevertheless, Kambites and Owen (2006, 492) caution against the twin "dangers of consulting only the 'usual suspects' and consulting in order to get acceptance of already formulated plans". To counter these pitfalls, it is important that public participation be commenced at the inception stages of GI

proposals (The Scottish Government, 2011). Moreover, Erickson (2006) notes the importance of empowering local communities to take ownership of GI planning by facilitating them as leaders in the initiation and development of GI projects.

2.5.2 Proactivity

A GI approach is a proactive approach. Therefore, "green infrastructure should be planned and protected before development" (Benedict and McMahon, 2006, 41). In this way, the provision of a strategy to improve the connectivity of GI assets and enhance GI functions should structure spatial planning activity. Informing such strategies should be "robust scientific knowledge gained from a number of fields including landscape ecology, land use planning theory and practice, and landscape psychology" (Roe and Mell, 2013, 653). Using such "sound evidence" (TCPA and WT, 2012, 10), efforts should be made to produce comprehensive maps of GI assets from which to formulate both holistic spatial planning frameworks and site-specific initiatives (Casperson and Olafsson, 2010; Comhar, 2010a; Weber *et al.*, 2006), complying with legislative requirements to employ scientific, objective evidence in environmental assessment. Nevertheless, Kambites and Owen (2006, 488) advise that if such a cartographic exercise "is not set within an effective planning process, the mapping of green infrastructure, albeit a vital component of the process, remains little more than a technical exercise". Accordingly, mapping GI assets is a means to an end rather than an end in itself. In this sense, maps form tools that aid rather than replace critical engagement with a GI planning approach.

Ahern (1995, 2007) offers some assistance here by proposing a four-fold typology of spatial strategies that practitioners may employ when involved in GI planning activities (see Table 2.3). These strategies focus on protective, defensive, offensive and opportunistic approaches to spatial planning. Each requires close attention to multifaceted vertical and horizontal integration, land use zoning, the formulation of issue-specific policies and the designation of site-specific objectives. When taken in combination, these strategies can inform different types of planning interventions in different locations at different times. In reflecting the GI principle of context sensitivity, these alternate approaches can be deployed in accordance with their appropriateness to the social and environmental circumstances

Table 2.3. Typology of spatial strategies for GI planning

Principles	Procedures			Practice examples
	Background requirements	Spatial strategies	Summary of spatial strategy	
Connectivity (spatial, scalar, institutional); multifunctionality; context sensitivity; collaboration; prioritise GI	Integration (functional, spatial, scalar, institutional); partnerships (interdisciplinary working, end-user participation); proactivity	Protective	Taking preventative measures to preserve GI assets and functions before they are threatened by erosion or changed by development	Creating national parks and nature conservation sites; flood plain identification; greenbelt, wedge, corridor designation
		Defensive	Taking measures to defend GI assets and functions that are already suffering attrition or deterioration from development pressure	Creating buffer zones; environmental impact mitigation; formulating green space access standards
		Offensive	Taking remedial or restorative actions to repair, restore or replace GI assets and functions	Creating new GI cores and corridors; ecological restoration; "daylighting" culverted watercourses; environmental adaptation initiatives; enhancing and/or providing access to existing green spaces
		Opportunistic	Recognising the potential for landscape elements to be managed or structured differently to enhance the assets and functions of a GI network	Biodiversity enhancement initiatives; sustainable drainage schemes; greenways projects; urban greening initiatives; initiating GI plan production

Adapted from Ahern (1995, 2007).

at hand. In confirming the assertions of Braat and de Groot (2012), sensitive application of these strategies may thereby provide ways to enhance the structures (assets) and functions that provide ecosystems services benefits, rather than simply mitigating the pressures upon such services. Consequently, the strategies can be employed to help translate the principles of a GI approach into planning procedures by learning from and informing practice on how ecosystems services may be enhanced via spatial planning.

2.6 Take-away for Practice

- Traditional land use planning addresses conservation through an "islands of protection" approach with site-based approaches to protecting and enhancing habitats and species.
- A GI approach to conservation focuses on multi-functional objectives and protecting, enhancing, restoring and creating new ecological networks.
- The benefits of a GI approach are two-fold:
 - enabling planning authorities to meet a wide range of objectives in an integrated manner focused on ecologically sound development outcomes, including: drainage management; habitat provision; ecological connectivity; landscape conservation and management; health, well-being and community development; recreation space; sustainable transport; climate change (mitigation and adaptation); and economic development;
 - enabling local authorities to meet their environmental obligations under European and national legislation, including: SEAs, EIAs; AA, Birds and Habitats Directives and related regulations, Nature Reserves, and Natural Heritage Areas and Proposed Natural Heritage Areas.
- GI provides an enabling and holistic framework for planning authorities, placing GI in a similar position to traditional physical grey infrastructure in terms of requiring investment.

3 GI Planning in Ireland: Emergence and State-of-the-art

3.1 Introduction

This chapter seeks to provide a concise, yet comprehensive study of Irish national, regional and local level spatial planning policy concerning GI. It does so by first identifying the immediate policy precursors to a specific GI planning approach. The report then traces the emergence, evolution and institutionalisation of GI planning approaches throughout various arenas of planning governance. An analysis of recent trends in GI planning initiatives is provided. The chapter furnishes a useful baseline resource for the development of future practice regarding the integration of the ecosystems services paradigm into Irish spatial planning activity using the GI concept.

3.2 The Emergence of GI

3.2.1 *The policy backdrop to GI planning approaches (2002–2007)*

3.2.1.1 *National initiatives*

The first formal reference to GI in an Irish policy context was in 2002, with the production of a study on ecological network¹ (Tubridy and O Riain, 2002). Commissioned by the EPA, the specified purpose of this study was to inform the then upcoming NSS (DEHLG, 2002b). The study equated GI with ecological networks and metaphorically explained these by reference to more familiar forms of “grey infrastructure”. The study argued that the fragmentation of habitats was the primary issue threatening Ireland’s biodiversity. Ecological networks were presented as a solution to this problem by creating a series of “corridors” and habitat “stepping stones” linking habitat “core areas” (Tubridy and O Riain, 2002, vii). The study concluded that the map-based formulation of

a national ecological network would help to ensure the conservation of Ireland’s biodiversity by reversing the trend towards habitat fragmentation.

However, when the NSS 2002–2020 was adopted in November 2002, it made no specific reference to the value of the ecological network (GI) approach or its relevance to strategic planning. Instead, the NSS advocated the development of a “Green Structure” through regional and county level plans and strategies. Rather than emphasising a concern for the conservation of biodiversity via an ecological network (i.e. GI) planning approach, the NSS “Green Structure” approach to planning seeks to balance polycentric urban development with a co-ordinated strategy for the containment of urban sprawl.

During April 2002, the first NBP (DAHGI, 2002a) was published. Although the plan made reference to the potential use of biodiversity action planning methodologies, there was no reference to an ecological networks/GI approach to planning. Likewise, no reference to ecological networks/GI planning was made in the Guidelines for the Production of Local Biodiversity Action Plans (DEHLG, 2002a). These guidelines were prepared and published to provide instruction to local authorities when producing Biodiversity Action Plans in response to the provisions of the NBP. Similarly, the National Heritage Plan (DAHGI, 2002b), also published in April 2002, made no reference to ecological networks/GI planning.

This pattern continued over the following 2 years (2005–2007) with the publication of a number of national plans and strategies by central governmental departments. These included among others, the National Countryside Recreational Strategy (DCRGA, 2006), the National Rural Development Strategy 2007–2013 (DAF, 2006) and the National Climate Change Strategy 2007–2012 (DEHLG, 2007). Whilst many of these documents discussed items of potential pertinence to subsequent conceptions of GI, none made reference to the concept. However, it is noted that a draft document produced and tabled by the then Comhar Sustainable Development Council (SDC) at a GI workshop 4 years later (8 February 2010) referenced the recreationally orientated greenways approach advocated in the

1 Defined by Tubridy and O Riain (2002) as “a network of sites. Its constituents are: ‘core areas’ of high biodiversity value and ‘corridors’ or ‘stepping stones’, which are linkages between them. In contrast to species or site-based conservation, the ecological network approach promotes management of ‘linkages’ between areas of high biodiversity value, between areas of high and low biodiversity value, between areas used by species for different functions, and between local populations of species. ‘Corridors’ or linking areas can support species migration, dispersal or daily movements.”

National Countryside Recreational Strategy (DCRGA, 2006) as a composite element of GI.

3.2.1.2 Regional and local initiatives

Giving regional effect to the NSS (DEHLG, 2002b), the Regional Planning Guidelines for the Greater Dublin Area 2004–2016 (DRA and MERA, 2004) were published in July 2004. Reflecting the Green Structure approach advocated by the NSS (see above), these guidelines promote the implementation of green belts with a focus on the delineation, containment and servicing of urban areas. The role of these green belts was primarily viewed as catering for the recreational and visual amenity of the built environment in addition to the maintenance of peri-urban agricultural land uses. No mention was made of the potential function of green belts in the conservation of biodiversity. Extending this focus, the guidelines infer ecological benefits from public open space provision (DRA and MERA, 2004, 162). This represents the first evidence of a nascent shift in emphasis away from the emphasis on ecological issues in planning for biodiversity towards a multifunctional perspective on natural and semi-natural green spaces.²

In September 2004, South Dublin County Council adopted its County Development Plan for the period 2004–2010 (South Dublin County Council, 2004). The Natural Heritage section of this plan focused primarily on the protection of conservation designated sites, in parallel with some attentiveness to recreational access provision. In particular, the plan outlined an intention to deliver “a Green Structure Plan for the county to identify green linkages and to allow for the intensification of use of existing and proposed amenity networks” (South Dublin County Council, 2004, 32). It is noted here that the term “Green Structure” differs from that outlined in the NSS in which it is primarily equated with a co-ordinated approach to the management of urban generated land use pressures. Additionally, the term “green linkages” differs from that of the EPA’s National Ecological Networks, which focused on the provision of habitat connectivity. Rather, in the case of the South

Dublin plan, such terms are related to the increased use of current and proposed green linkages for amenity purposes.

A few months later, in January 2005, Galway City Council adopted its development plan for the 2005–2011 period (Galway City Council, 2005). The recreation amenities provision policies of this plan were not included in an individual or community chapter, as was the normal format for such documents at the time, but rather were grouped with policies on biodiversity conservation in a chapter entitled “Natural heritage, recreation and amenity”. Tacitly suggesting that the existing integration of natural and semi-natural areas for recreational use was poor (Galway City Council, 2005), the plan sought to facilitate better integration by building on a framework presented in the previous Galway City Development Plan (1999–2005) for the establishment of a green network. The 2005–2011 City Development Plan outlined how such a network offered the means by which to combine and co-ordinate the protection of natural heritage areas and facilitate the provision of open space for recreational purposes. One of the primary methods advocated for realising the green network was the creation of greenways. These were defined as “pedestrian and cycle ways separated from road traffic” (Galway City Council, 2005). This presentation of the Council’s green network greenways approach as a means for the provision of transport, recreational and habitat connectivity echoes the language, if not necessarily the content, of both the Green Structure Plan of the South Dublin County Development Plan 2004–2010 and the ecological networks/GI approach of the 2002 EPA National Ecological Networks study. However, in contrast to the EPA study, this evolving approach increasingly sought to accommodate the multifunctional potential of green spaces.

Adopted 2 months after the Galway City Development Plan, the Dublin City Development Plan 2005–2011 (Dublin City Council, 2005) echoes this shift towards a more multifunctional perspective on public open space. Indeed, Chapter 11 of the plan entitled “Recreational amenity and open space” envisaged that open space would furnish “... green chains or networks, which allow for walking and cycling and facilitate biodiversity” (Dublin City Council, 2005, 84). Policies contained in this plan are indicative of an inchoate change in how biodiversity conservation was beginning to be conceived at this time. This change comprised an interpretation of biodiversity as something which, like recreational amenities,

² In referencing the requirements of the NBP (DAHGI, 2002a), these guidelines briefly state that planning authorities should identify “wildlife corridors, which are important for the migration and dispersal of wildlife, and areas of degraded habitat with potential for restoration and enhancement” (DRA & MERA, 2004).

can be enhanced via proactive planning, rather than simply protected by reactive designations.³

Although proximate to the Dublin City Development Plan (Dublin City Council, 2005) in both time of adoption and administrative area, the Fingal County Development Plan 2005–2011 (Fingal County Council, 2005a), adopted in June 2005, made little mention of biodiversity protection in its chapter on Open Space and Recreation. Rather, such references were largely confined to Chapter 8 of the plan entitled “Heritage and conservation”. In proposing to protect and enhance its non-designated conservation habitats, the Council promoted the creation of a countywide ecological network comprising core areas linked by corridors and stepping stones (Fingal County Council, 2005a, 150). The Council’s Heritage Plan (Fingal County Council, 2005b), adopted in July 2005, further promoted this ecological networks approach.

By 2008, the desire to promote multifunctional green space planning was further consolidated in planning guidance documentation. In January of that year, Galway City Council published a non-statutory planning guidance document, entitled *Galway City Recreational and Amenity Needs Study* (Galway City Council, 2008). This document extended the green network “concept advocated in the Galway City Development Plan 2005–2011 by enthusiastically promoting the development of such a network that “... allows for nature protection and for the enhancement and expansion of passive and active recreation opportunities in tandem with the expansion of the city” (Galway City Council, 2008, 6). While noting that recreational land uses are not always commensurate with ecological protection, the study proclaims that “Recreation and amenity can help to bring about positive environmental impacts to an area of high biodiversity if carefully designed and managed. Areas at risk of decline or under threat can be restored and protected whilst allowing access for use by the community” (Galway City Council, 2008, 16).

3 This assumption was outlined and given statutory footing in policies RO1 to RO12 of the plan where it was respectively stated: Policy RO1: It is the policy of Dublin City Council to continue to manage and protect public open spaces to meet the social, recreational, conservational and ecological needs of the city... (Dublin City Council, 2005). Policy RO12: It is the policy of Dublin City Council to endeavour to make provision for habitat creation and maintenance and facilitate biodiversity by encouraging the development of linear parks, nature trails, wildlife corridors and urban woodlands (Dublin City Council, 2005).

3.3 The Emergence of Specific GI Approaches (2008)

3.3.1 Ecosystem services perspectives

By early 2008, the recalibration of discourses on ecological/green networks from nature conservation by the protective designation of sites towards conservation by proactive planning of networks was furthered through an emerging focus on ecosystems services. The first formal recognition of this in a planning context appears in the Dublin City Council Biodiversity Action Plan 2008–2012 adopted in February 2008.⁴ This plan echoed the 2002 EPA National Ecological Networks study in noting habitat fragmentation as a major threat to biodiversity and the consequent requirement for physical links between habitats. However, rather than prioritising the conservation of biodiversity for its intrinsic value as the 2002 EPA study had done, this plan outlines the importance of biodiversity and the consequent rationale for its protection, by accentuating the benefits to “our well-being” (Dublin City Council, 2008, 9) of the ecosystem services delivered to society by biodiversity. This conceptual realignment is outlined in the plan’s introduction where under the heading Why is Biodiversity Important, it states,

... loss of biodiversity at the ecosystem, species and gene level is an issue of serious concern not only because of the ethical issues raised but also due to the decline in ecosystem services which natural systems provide. These services include production of food, fuel, fibre, medicines, regulation of water, air, climate, maintenance of soil fertility, cycling and nutrients.

Dublin City Council (2008)

Although an ethical dimension is presented, biodiversity conservation is primarily addressed as a service provider and regulator for the benefit of society. Elaborating this ecosystems services perspective was a document produced in May 2008 by the Department of the Environment, Heritage and Local Government entitled *The Economic and Social Aspects of Biodiversity: Benefits and Costs of Biodiversity in Ireland* (DEHLG, 2008). Referencing various sources and employing a

4 This was produced in response to the requirements of the NBP 2002–2006.

monetary calculation of the value of ecosystems services to society, this document cogently asserts that:

The incentive to protect biodiversity does not simply arise from a benevolence towards the natural world. Rather, a high level of biodiversity also ensures that we are supplied with the “ecosystem services” that are essential to the sustainability of our standard of living and to our survival.

DEHLG (2008)

This document proposes a cost–benefit analysis of the economic value of ecosystem services. These more recent planning discourses not only imply a concentration on the necessity of biodiversity for the maintenance of society, but also align arguments for the protection of biodiversity with facilitating economic development.

3.3.2 *The emergence of green infrastructure*

In 2007, University College Dublin and Natura Ecological Consultants Ltd combined efforts with Dublin City Council, Dún Laoghaire Rathdown County Council and Fingal County Council to produce the Green City Guidelines (Urban Forum, 2008). These were published in 2008 and propose a multifunctional perspective on green space provision. This interpretation is articulated beneath the rubric of GI when, in quoting Girling and Kellett (2005), the guidelines declare that:

Urban green space includes everything in cities that has vegetation. Collectively it is sometimes referred to as “Green infrastructure”, encompassing the entire working landscape in cities that serve roles such as improving air quality, flood protection and pollution control.

University College Dublin et al., (2008)

This marks the first mention of GI in an Irish planning document since the EPA National Ecological Networks study in 2002. As detailed earlier, the EPA study equated GI with the concept of an ecological network in which biodiversity protection was prioritised on the basis of the intrinsic value of nature. However, these guidelines reflect the post-2002 evolution of networked concepts of green space governance by repositioning policy approaches to ecosystems from reactive protection by site designation to proactively planning for their enhancement as something of multifunctional value in facilitating urban development in a manner that

ensures “our standard of living” (DEHLG, 2008, 5) and well-being (Dublin City Council, 2008, 9).

In November 2008, Fingal County Council, one of the authors of the Green City Guidelines, in association with the Irish Planning and Irish Landscape Institutes, and the Institute of Ecological and Environmental Management, organised an international conference on GI in Malahide, Co. Fingal. This high profile conference was addressed by the Minister for Environment, Heritage and Local Government along with national and international speakers from various universities, central and local government, state agencies and NGOs. Presentations consisted of a wide range of internationally sourced examples of GI planning and a number of talks on Ireland’s requirements under the European Union Habitats (EC, 1992) and Water Framework Directives (EC, 2000). These latter presentations cursorily referenced the term GI, focusing primarily on meeting commitments specified by the provisions of international agreements and European legislation. However, three presentations specifically regarding GI planning in Ireland were provided. Two of these were by officers of Fingal County Council, while the third was delivered by the Head of Policy and Research at the Heritage Council.⁵ Both presentations from Fingal County Council stressed the utility of GI in assisting management of urban growth pressures within the county. One such presentation illustrated the multifunctionality inherent to the GI concept by offering examples of GI strategies initiated by the Council wherein details on flood plain management, habitat conservation, as well as passive and active recreation land uses were furnished (Logan, 2008). The presentation provided by the Heritage Council promoted a recreational and mobility focused perspective on GI but concurrently noted the possible uses of GI in climate change mitigation, the protection of landscape distinctiveness, ecosystems services, providing attractive places to live and work, reversing habitat fragmentation and helping to meet Ireland’s legislative requirements under European Union Directives. With a particular

⁵ The Heritage Council was established under the Heritage Act of 1995, although it had existed in various guises prior to this. Since 1995, the Heritage Council as a state aid-granted body has overseen the production of over 60 publications covering a cross-section of heritage policy, the development of a Heritage Officer network throughout most counties in Ireland, the allocation of over 18 million euros in grant aid to hundreds of projects throughout the country, and it also provides policy advice to the Minister.

focus on “greenways” as facilitating access to the countryside and heritage sites, in addition to their use for awareness raising of heritage management systems, the Heritage Council’s approach echoed the “green network” approach previously advocated by Galway City Council (see section 3.2.1.2 of this report) in promoting the integration of ecology with recreational land uses.

3.4 State-of-the-art

3.4.1 Expounding and institutionalising GI planning approaches (2009–2011)

3.4.1.1 Valuing nature

In March 2009, Dr Gerry Clabby, Heritage Officer in Fingal County Council and a presenter at the GI conference a few months previously, published a guest commentary⁶ on the Comhar SDC web page entitled “Green infrastructure: critical infrastructure for a smart economy” (Clabby, 2009). Here Dr Clabby compared GI to conventional understandings of the term “infrastructure” before outlining numerous international examples of how the networks of green spaces he described as GI are managed. Summarising the societal benefits of GI, Dr Clabby noted its importance in the mitigation of urban heat island effects; recreation and mental health amenities provision; flood risk management; compliance with EU legislative requirements; increasing land values; attracting tourist and business interests; and in the facilitation of national economic recovery. Dr Clabby’s exposition illustrated in real and tangible terms a broadening conception of the multifunctional potential of green spaces intrinsic to a GI planning approach. Extending this comprehension, Dr Clabby’s focus on GI as facilitating economic recovery during a period of international financial crisis suggests an increasing perception of GI planning as a means to transform traditional views of conservation initiatives as growth inhibiting. Rather, Dr Clabby’s exposition demonstrated

an alternate perspective, wherein a GI planning approach emphasises the potential for ecosystems conservation to work with, as opposed to against, economic development. As noted in his commentary:

Land use planning is one of the key areas where we need to successfully integrate environmental considerations if we are to move towards a “Smart Economy”. A key to achieving this is finding ways in which we can align environmental and economic goals in the planning system. Green infrastructure planning provides a practical way in which to do this.

Clabby (2009)

Outlining how GI can achieve such economic goals, Dr Clabby declared that:

It (GI) recognises the fundamental contribution that green space makes to our quality of life, and then aims to plan for its protection, provision and management in a comprehensive way in tandem with plans for growth and development.

Clabby (2009) (emphasis in original)

In this sense, GI is expressed as a means to facilitate co-ordinated growth and development in a manner that enhances our quality of life. Echoing the green network approach advocated a year previously (Galway City Council, 2008), GI is here presented as a planning mechanism centred on reconciling the desire to enable development as well as protect the environment.

In September 2009, the Draft South Dublin Development Plan 2010–2016 (South Dublin County Council, 2009) was placed on public consultation display, and was subsequently adopted in October 2010 (SDCC, 2010). Whereas the previous development plan for the area (2005–2010) promoted a “Green Structure” that conceived a networked approach as primarily providing recreational amenities (see section 3.2.1.2), this plan, adopted 5 years later, equates linked and interconnected open space provision as catering both for recreational needs and the provision of valuable wildlife corridors. Furthermore, such provision is seen as forming “a significant green infrastructure in the County” (South Dublin County Council, 2010, 95). Therefore, GI as a networked approach to planning is once again represented as a network of multifunctional land uses serving recreational needs and biodiversity

⁶ Comhar SDC was the Irish “Sustainable Development Council”. Prior to its dissolution in 2011, Comhar SDC commentaries were published on a fortnightly or monthly basis. They provided a platform for those who were allied to Comhar SDC to express their views on various aspects of sustainable development outside the formal confines of official documentation. As such, they provided a useful insight into the thinking underlying the rationale ostensibly proffered in Comhar SDC’s formal publications. Dr Clabby was on the steering committee of Comhar SDC’s Green Infrastructure working group.

conservation. Echoing the approach adopted by the Galway City Development Plan 2005–2011 and the Galway City Recreational and Amenity Needs Study 2008 (see section 3.2.1.2), the South Dublin County Council plan conceived that these “green networks” will

... function as long distance walking and cycling routes as well as ecological corridors such as canals. Green networks are vital to the maintenance and facilitation of ecological corridors such as those found along major transport routes. Their main function is to link parks and other “green” infrastructure.

South Dublin County Council (2010, 96)

The suggestion here is that the function of green networks “is to link parks” for recreational and biodiversity uses, whereas GI is perceived as something broader than these links. As such, it is implied that GI subsumes recreational amenities and ecological corridors, but also includes additional land uses. Although never specified, these other land uses appear to embrace the plan’s array of networked planning approaches, each with functional priorities but all preceded by the prefix “green”. These approaches include a “green routes network” comprising “... the creation of a network of cycling and walking routes throughout the County” (South Dublin County Council, 2010, 98), in addition to “the creation of a Green Structure in accordance with the National Spatial Strategy” (South Dublin County Council, 2010, 246) and the designation of “green belt” areas “to protect the special amenity value of the countryside” (South Dublin County Council, 2010, 257). Furthermore, Section 4.3 of the plan states that the Council’s aim for “Landscape, Natural Heritage and Amenities” is that this “well defined and linked” (South Dublin County Council, 2010, 246) approach necessitates the development of

... a strategy for the creation of a green infrastructure for the County, promoting a balance between the protection of areas of high amenity, the facilitation of recreational use, and the provision of a network of sustainable wildlife corridors throughout the County.

South Dublin County Council (2010)

“Areas of high amenity” are here considered in terms of landscape aesthetics and referenced to a citation from Section 10 of the Planning and Development Act

2000–2007 (Oireachtas, 2000) regarding the onus on local authorities to “... include objectives relating to the preservation of the character of the landscape ...” (South Dublin County Council, 2010, 246).

Therefore, the South Dublin County Council plan seeks to include “the protection of areas of high amenity” with the existing pairing of recreational and ecological conservation land uses within its GI approach. The meaning of such GI is defined in plan as:

... a strategically planned and delivered network of high quality green spaces and other environmental features. It should be designed and managed as a multifunctional resource capable of delivering a wide range of environmental and quality of life benefits for local communities. Green infrastructure includes parks, open spaces, playing fields, woodlands and allotments and private gardens.

South Dublin County Council (2010)

This exposition of GI suggests a representation similar to that advocated almost 2 years previously by Galway City Council in its green network approach (see section 3.2.1.2). Thus, GI as a multifunctional resource is articulated in terms of its value as something which can be planned, designed and managed so that it is capable of delivering benefits to society. Additionally, the composite elements of GI are expanded from those of public open spaces to “allotments and private gardens”.

In December 2009, 3 months following the placing of the Draft South Dublin County Development Plan 2010–2016 on public consultation display, Dublin City Council also placed its Draft Dublin City Development Plan 2011–2017 (Dublin City Council, 2009) on public consultation display. This plan was subsequently adopted in November 2010 (Dublin City Council, 2010). Whereas the previous Dublin City Development Plan 2005–2010 had promoted a networked planning approach that aligned the provision of recreational amenities with habitat conservation (see section 3.2.1.2), it had not specified this as GI per se. In contrast, the Dublin City Development Plan 2011–2017 is unambiguous in its promotion of GI and declares that:

A key priority of this Development Plan is to reinforce the importance of green infrastructure, recreation and biodiversity as a vital component of a compact city. The introduction of a green

infrastructure strategy reflects an integrated approach to the city's open space, recreational, landscape and biodiversity assets.

Dublin City Council (2010)

As with the approach of the South Dublin County Development Plan 2010–2016 adopted just 2 months earlier, this statement announces Dublin City Council's intention to integrate recreational amenity provision, landscape protection and habitat conservation within a multifaceted GI approach to the planning, design and management of the city's open spaces. Moreover, the provisions of the Dublin City Development Plan 2011–2017 expand the functions of GI from that expounded by South Dublin Council to include the delivery of additional services to urban residents. This is undertaken by extending the multifunctionality potential of ecosystems services, outlined in the Dublin City Council Biodiversity Action Plan 2008–2012, and broadening the interpretation of GI to include a multitude of additional land uses. Specifically, the plan outlines how sustainable urban drainage systems (SuDS) "forms an integral part of green infrastructure" (Dublin City Council, 2010, 76), while Section 6.4.1 of the plan expands the interpretation of GI to include archaeological and heritage sites, coastal areas, brownfield sites, as well as drainage and flood management.

In early February 2010, Comhar SDC organised a workshop on GI in which it presented for discussion the draft conclusions and case studies from a GI study commissioned in August 2009 (Comhar, 2010b). Addressing an invited audience of professionals and identified stakeholders, the consultancy team employed by Comhar SDC to produce the study presented a quantitative data-based cartographic methodology for the planning and design of GI. Examples of maps produced using this method were displayed and discussed. Responses from the floor were requested and received. Advocating GI as an answer to many problems where the variously promoted solutions did not enjoy universal ascription,⁷ the workshop was significant in developing cartographic and map-based approaches to furthering the

⁷ GI was expressed as supporting landscape characterisation and protection; endorsing the objectives of the EU Water Framework and Flood Risk Directives; improving the quality of the rural environment and diversifying rural economies; and attracting tourists.

GI concept. As an additional element to GI discussions, this approach furnished a methodological template previously largely absent from GI planning and emphasised the centrality of mapping quantitative data.

The Draft Galway City Development Plan 2011–2017 (Galway City Council, 2010), published in the same month (February 2010), and formally adopted 12 months later in February 2011 (Galway City Council, 2011), outlines an intention to maintain the green network planning approach advocated in its previous plan (see section 3.2.1.2). Equating its green network with GI, the plan stresses the many advantages of this approach by declaring:

The development of "green infrastructure" and the availability of recreation opportunities, facilities and natural amenities are important quality-of-life factors for the location of inward investment and for individuals choosing a place to live.

Galway City Council (2011, 44)

As pronounced by Dr Clabby in his Comhar SDC commentary issued in March 2009 (see above), the plan seeks to overturn traditional assumptions that nature conservation inhibits economic development by emphasising that a GI planning approach facilitates economic growth.

Maintaining this perspective, the director of Comhar SDC presented an economics-focused argument for the introduction of GI planning at the Irish Planning Institute's Annual Conference in April 2010. During this conference, which was organised around the theme of "Planning for a smarter Ireland", numerous talks were presented on how to plan for national, regional and local economic regeneration. Comhar SDC's presentation at the conference used references from its "Towards a Green New Deal" document (Comhar, 2009) to frame GI as part of a multifaceted environmentally sensitive approach that can help reverse the costly loss of ecosystems services. This endorsement of a cost-benefit argument for the adoption of GI planning was sustained by Comhar SDC in its presentation at the Parks Professional Network Seminar Day in June 2010, when it was announced that the estimated worth to Ireland of the ecosystems services delivered by GI was €2.6 billion (Comhar, 2010c).

3.4.1.2 From policy theory to policy practice

In the same month as the Irish Planning Institute's Annual Conference (April 2010), Fingal County Council issued for public consultation display its Draft County Development Plan 2011–2017 (Fingal County Council, 2010). This was subsequently adopted a year later in April 2011 (Fingal County Council, 2011). The plan includes three detailed GI maps in addition to the zoning, transport, architectural and archaeological maps normally associated with such documents. Chapter 3 of this plan is entitled "Green infrastructure". The location of the GI chapter immediately before the conventional "Physical infrastructure" chapter signals an interpretation of GI as a strategically important concept binding together the various economic, physical, environmental and social objectives of the plan. The Fingal County Council plan identifies numerous environmental challenges requiring redress and presents GI as a means by which to meet all of these in providing

... space for nature (or biodiversity) and the natural systems which regulate temperature, reduce storm flows, provide us with clean water and air, and a multitude of other benefits or ecosystem services free of charge. High-quality accessible parks, open spaces and greenways provide health benefits for all ... By providing a high-quality environment in which to live and to work green infrastructure helps to attract and to hold on to the high-value industries, entrepreneurs and workers needed to underpin the knowledge economy. In addition it is increasingly being recognised that green infrastructure is a vital component in building resilient communities capable of adapting to the consequences of climate change.

Fingal County Council (2011)

These qualities of GI are also reflected in the Draft Kildare County Development Plan 2011–2017 (Kildare County Council, 2010), which was issued for public consultation in April 2010, the same month as the Draft Fingal County Development Plan 2011–2017. It was subsequently adopted in May 2011 (Kildare County Council, 2011). Emulating South Dublin County's perspectives on the possibilities of "designing" GI, the Kildare County Development Plan employs the term GI to describe multiple "green space" typologies, which form a:

... strategically planned and delivered network ... designed and managed as a multifunctional resource capable of delivering a wide range of environmental and quality of life benefits for local communities.

Kildare County Council (2011)

In spring 2010, the Draft Regional Planning Guidelines for the Greater Dublin Area 2010–2022 were issued for public consultation. Whereas the previous guidelines for the region aligned urban generated recreational demands and the conservation of biodiversity in its provision of planning guidance regarding open space (see section 3.2.1.2), it did not specifically reference GI. In contrast, these new guidelines devoted considerable attention to GI planning. Specifically, the guidelines maintained the wide-ranging interpretation of GI advocated in both the Fingal and Kildare County Development Plans. They also reflected a parallel advocacy of GI's multifunctionality, particularly in stressing its ability to facilitate the delivery of ecosystems services. However, unlike previous discussions on GI planning in Ireland, the guidelines advanced an understanding of GI as extending beyond urban and peri-urban locations to include the wider rural environment. The promotion of GI in these guidelines is significant for GI planning in Ireland, as following the inception of the Planning and Development (Amendment) Act 2010 (Oireachtas, 2010) in August 2010, all new plans are required to be consistent, as far as practicable,⁸ with policy provisions issued in strategies at higher tiers in the planning policy hierarchy. Thus, all policy provisions within the seven local planning authority areas comprising the Greater Dublin Area would, from August 2010, have to be consistent with the policy provisions of these Regional Planning Guidelines. Against this legislative background, all local authorities within the Greater Dublin Area would have to include policies harmonising with the particular perspective of GI promoted in these guidelines. The adoption of the guidelines in June 2010

⁸ Before the enactment of this legislation, planning policies were only required "to have regard to" policy provisions issued at higher tiers of the planning policy hierarchy. Planning Authorities must now ensure that their development objectives are consistent, as far as practicable, with national and regional strategies (Section 7 of Part 2 of Statutory Instrument No. 30 of 2010: Amendment of Section 10 of the Principal Act).

is the first formal representation of GI in the planning policy hierarchy, as all other GI-advocating plans were still in draft (public consultation) format at this time.

While having evolved to encompass multiple functions, there persisted a discourse of ecosystems valuation underpinning the rationale for the promotion of a GI approach to planning. This was demonstrated in August 2010, when Comhar SDC (2010a) published the finalised version of the GI study it had commissioned 12 months earlier (see section 3.4.1.1). In an extension of a document published almost 2 years earlier on the “The Economic and Social Aspects of Biodiversity” (DEHLG, 2008), the study largely represents biodiversity’s value in terms of its fiscally framed ecosystems services potential. This is reflected in the study’s numerous references to the consideration of biodiversity beneath the ambit of GI, which in turn is promoted as a means by which to efficiently deliver policy goals. Indeed, the study notes that:

An ongoing study on The Economics of Ecosystems and Biodiversity (TEEB) ... provides evidence that investment in green infrastructure offers cost-effective opportunities to meet policy goals. The study shows that it is cheaper to make such investment than restoring damaged ecosystems and that the social benefits that accrue from appropriate investment are of a significantly higher magnitude than the costs.

Comhar (2010a)

This concentration on an economic calculation of GI’s value may be explained by Comhar SDC’s assessment of a survey undertaken as part of the study of selected local authority staff. Interpreting the results of this survey, the study concludes that:

There is general dissatisfaction with the mechanisms currently available to input information on biodiversity to spatial plans. Respondents, to whom the concept was introduced directly for the first time, considered that the concept of green infrastructure and mechanism of green infrastructure planning will be more attractive than ecological networks because of the clearer focus on benefits to people.

Comhar (2010a, 22)

Thus, in promoting GI as a holistic planning approach for the provision of multifunctional spaces, this study suggests the need to fashion GI as a planning mechanism underpinned by a sound economic rationale (Comhar, 2010a, 23).

Echoing this appraisal was the long-awaited review and update of the NBP (DEHLG, 2010) published in draft consultation format the following month (September 2010). Although this draft plan appeared to support Comhar SDC’s position on the economic assessment of ecosystems services as a means to highlight their value to society (DEHLG, 2010, 20), it adopted a more restricted perspective on the functions of GI, harmonising more with the assertions on GI expressed by the 2008 Green City Guidelines (see section 3.3.2) than with the 2010 Comhar SDC report. Specifically, the draft plan fostered a wholly urban-based interpretation of GI’s applicability that diverges with the contention by both Comhar SDC (2010a) and the Regional Planning Guidelines (DRA and MERA, 2010) that a GI approach is equally pertinent to rural environments.

3.4.1.3 Institutionalisation

By mid 2010, the GI planning policy concept appeared to be in wide circulation among a community of planning practitioners and allied professionals, with its representation evident in both regional and local level planning policy guidance. Indeed, the regional representation of the concept was further consolidated when in July 2010 the Regional Planning Authority for the South-East Region adopted its planning guidelines, which make reference, albeit in a limited way, to GI in the context of policy direction on open space provision and biodiversity protection (SERA, 2010). Furthermore, GI was given prominence by Fáilte Ireland⁹ (Fáilte Ireland, 2010) in a published document describing how to maximise the tourist potential of historic towns. In addition, the inclusion of a limited reference to GI in the Wicklow County Development Plan 2010–2016 (Wicklow County Council, 2010) and mention in a document produced by the Heritage Council (Heritage Council, 2010) regarding the formulation of a National Landscape Strategy for Ireland, demonstrate the term’s growing popularity within the planning policy community.

⁹ Ireland’s National Tourism Development Authority.

By autumn 2010, both Clare and Waterford County Councils published proposed amendments to their respective draft county development plans for the period 2011–2017. Both plans were later adopted in January (Clare County Council, 2011) and February 2011 (Waterford County Council, 2011), respectively. While the draft public consultation display of these plans had not included reference to GI, these proposed amendments sought to introduce mention of GI planning. In both cases, reference to a GI approach is included in the adopted plans. Although such references are limited in scope and specificity, they indicate the movement of the GI discourse beyond urban areas into the policy discourses circulating within more rural planning authorities.

November 2010 witnessed the publication of a document by the Urban Forum¹⁰ and the Institute of Ecology and Environmental Management (UF and IEEM, 2010) entitled *Green Infrastructure: A Quality Of Life Issue*. Prepared by a multidisciplinary team, this document represents the fruit of activities between a number of professional bodies that commenced networking at the Malahide Green Infrastructure Conference in November 2008 (see section 3.3.2). Maintaining a focus on the multifunctional potential of land use, this document asserts that:

The green infrastructure concept involves the planning, management and engineering of green spaces and ecosystems in order to provide specific benefits to society.

UF and IEEM (2010, 1)

In the same month, Kilkenny City and County Councils in association with the Heritage Council produced a habitat survey for Kilkenny City (Kilkenny County Council, 2010b). This survey, which relied heavily on the presentation of mapped data, included a section on GI. In the survey, the councils outline their conception of GI as multi-functional and providing a number of ecosystem services (Kilkenny County Council, 2010b, 29). The document focuses primarily on habitat classification and management, thereby departing from

prevalent discourses on GI by adopting a perspective centred primarily around habitat conservation rather than the social uses of open spaces or the ecosystems services furnished by biodiversity. As such, this document indicates the persistence of an ecology-centred understanding of GI that maintains the concept as originally articulated in section 2.1.1 of the EPA study of 2002 (Tubridy and O Riain, 2002). This perspective on GI was subsequently given planning policy representation by the Kilkenny County Council by a limited reference in the local area plans for Gowran (Kilkenny County Council, 2010a), formally adopted in December 2010, and later in the Fidown (Kilkenny County Council, 2011a) and Piltown (Kilkenny County Council, 2011b) local area plans, both of which were formally adopted in January 2011.

The proliferation of interpretations and references to GI continued into 2011. One of the first among these was a proposed variation to the Dún Laoghaire Rathdown County Development Plan (Dún Laoghaire Rathdown County Council, 2011) issued for public consultation in January and subsequently adopted in September of 2011. This variation presented a recreation and amenity interpretation of GI in the context of a high density urban environment. The following month observed the issuing for public consultation of a draft Transport Strategy for the Great Dublin Area over the 2011–2030 period in which GI was represented in terms of facilities for non-motorised travel (NTA, 2011). Subsequent months saw reference made to GI within planning documentation with respect to flood risk management (SCC, 2011), long distance walking and cycle routes, as well as with regard to ecological corridors (ATC, 2011). GI was also referenced in connection with the assessment and protection of landscape character (DAHG, 2011).

In April 2011, Dublin City Council advertised its intention to produce a local area plan for the Clongriffin-Belmayne (North Fringe) area (Dublin City Council, 2011). Of note is the inclusion of a section titled “Green Infrastructure and Sustainability” in the Issues Paper produced by the Council for public consultation. In this document, the Council promoted a perspective on GI that specifies it as a network of green spaces which

... includes and integrates open spaces, green corridors for cycling and walking, areas of high biodiversity value and recreational areas.

Dublin City Council (2011, 18)

¹⁰ The Urban Forum is a joint initiative by the five institutes representing the built environment professions in Ireland: Royal Institute of Architects in Ireland, Society of Chartered Surveyors, Engineers Ireland, Irish Planning Institute and Irish Landscape Institute. The Urban Forum facilitates and promotes debate on issues pertaining to urban planning and urban design within Ireland.

An identical interpretation was offered in the Issues Paper for the proposed Naas Road Lands local area plan announced by the Council in June 2011, while the Issues Paper for the proposed George's Quay local area plan, released by the Council a month previously, implicitly underlined GI's role in flood risk management and climate change adaptation. In May 2011, a presentation on GI at the Irish Planning Institute's Annual National Conference was delivered by one of the authors of the Urban Forum and IEEM document entitled *Green Infrastructure: A Quality Of Life Issue* (UF and IEEM, 2010). Included among a schedule of lectures tackling conventional planning practice topics,¹¹ this presentation provided a national platform from which to proclaim the approach's benefits to an audience of public and private sector planning practitioners. Its endorsement by the Irish Planning Institute represented the Institute's positive assessment of GI's legitimacy as a planning approach and signified an official position that it should be widely disseminated.

In November 2011, the updated NBP (DAHG, 2011) was published. Although making limited reference to GI, and framed within a broader discussion of habitat conservation, this plan states:

Green infrastructure is a network of green spaces that help conserve natural ecosystems and provide benefits to human populations through water purification, flood control, carbon capture, food production and recreation. Such spaces include woodlands, coastlines, flood plains, hedgerows, city parks and street trees.

DAHG (2011, 41)

Although evolving from the urban-focused and valuation perspectives of GI asserted in the document's public consultation format, the adopted plan continues to resonate with prevailing interpretations of GI as a networked approach to nature conservation emphasising the society-servicing functions of ecosystems. Also of note is the document's alignment with general perceptions on the wide array of land uses and space typologies to which GI is applicable.

In addition to its representation within a plethora of nationally applicable statutory and non-statutory

planning documentation, the formal adoption of those local, city and county development plans that in their 2010 public consultation (draft) format had advocated GI gave the approach official planning recognition in several local planning authority areas and two regional council areas by the end of 2011.

3.4.2 An established but varying approach (2012 to the present)

Although GI has become an established policy discourse at regional and local levels of the planning hierarchy since the international GI Conference organised in 2008 by Fingal County Council in Malahide, Co. Fingal, GI-specific planning guidance at a national level is conspicuous by its absence. GI is currently most often employed at the local authority level. Here, development plans and local area plans are regularly used as the vehicle through which GI policy is formulated and projects developed. Nevertheless, there are variations in the interpretation and application of the GI concept between local authorities in Ireland. For example, some local authority plans demonstrate a prioritisation of GI for biodiversity protection, but seek to partially advance a more multifunctional approach to conservation by including recreational open space provision within policies concerning natural heritage management (Kildare County Council, 2012). However, many of the local authorities employing the GI concept exercise it as an extension rather than a transformation of traditional approaches to environmental conservation (Meath County Council, 2013; Monaghan County Council, 2013). In such instances, GI may be conceived as a rebranding of unifunctional ecological-networks akin to that advanced by the 2002 EPA-commissioned study (Tubridy and O Riain, 2002). By envisaging GI in a manner that confines it to biodiversity conservation, these interpretations risk eroding the multifunctional potential of the concept. Here, issues like flood management, accessible green space provision and non-motorised transport may be perceived in a disjointed fashion as a restricted GI approach is formulated to accord with existing administrative delineations. This phenomenon can be witnessed in the sustained configuration of development plans wherein natural heritage is confined to a distinct chapter within a plan that is frequently disengaged from other issue-specific policies, such as drainage and transport. In the absence of a section at the beginning of a plan to outline how a GI approach

¹¹ The main topics discussed at the conference were changes to planning legislation, quarries and natural resource planning and urban design.

affects subsequent chapters and policies (Fingal County Council, 2011a), maintaining the conventional structure of plans reinforces existing administrative compartmentalisation and reduces the transformative potential of the GI concept to facilitate the synergistic integration of land uses. To date, this phenomenon seems most pronounced in rural local authorities whose capacity to fully engage a proactive multifunctional GI planning approach may be hampered by resource constraints such as low staffing and restricted budgets due to public sector budgetary controls.

With higher staffing levels and institutional capacity, the urban authorities of the eastern regions have been able to embrace a more progressive GI planning approach. In particular, Dublin City Council and Fingal County Council have sought to advance an integrated perspective to land use governance concerning a spectrum of planning issues. For example, the Naas Road local area plan produced by Dublin City Council employs a GI approach

... to address legislative and policy requirements in an integrated way across a range of issues, including biodiversity, open space, flooding, surface water management (SuDS) and cultural heritage.

Dublin City Council (2013, 46)

This plan outlines a GI strategy that seeks “to create a linked network of strategic open spaces” (Dublin City Council, 2013, 47) focused on biodiversity, amenity, movement, water resources and a series of new connected routes. Adopting a proactive approach to the formulation and implementation of GI, the plan innovatively proposes to enhance the local environment and meet numerous policy objectives by using the development management system to sensitively re-expose those sections of the Camac (Cammock) River currently culverted on the site. The plan then proposes to use this open space asset as a spine linking a network of green routes and ecological corridors connecting every development parcel of the plan lands to the Grand Canal through an enhancement of Lansdowne Valley Park.

Similarly pioneering are the contiguously located local area plans for Baldoyle-Stapolin (Fingal County Council, 2013a) and Portmarnock South (Fingal County Council, 2013b) produced by Fingal County Council. These plans employ a GI approach to holistically frame and integrate policy initiatives concerning landscape,

biodiversity, sustainable urban drainage, archaeology and built heritage, as well as open space and recreation. Through a detailed and iterative environmental assessment process, both documents negotiate the development constraints posed by various conservation designations (Special Protected Areas, Special Areas of Control, Shellfish Waters) in a manner that sensitively accommodates both urban expansion and environmental protection. Included in the plans are new residential areas integrated with parkland, sustainable urban drainage schemes, non-motorised transport routes and spaces for urban farming that are specifically designed to assist community development. A key feature of these plans is how they work synergistically in facilitating high quality urban extensions to Baldoyle and Portmarnock, while concurrently protecting the ecological integrity of the Baldoyle Estuary. This example is considered in more detail in Chapter 4 in this report.

3.5 Discussion

This review of the emergence and state-of-the-art of GI planning in Ireland reveals a picture of the concept’s emergence and evolution from an ecologically centred networked approach to conservation into a perspective increasingly focused on multifunctionality. Such a reorientation has increasingly sought to emphasise and enhance the variety of ecosystem services GI supplies. This evolving interpretation of GI may be divided into three broad phases, namely: 2002–2007, 2008 and 2009 to the present, each of which is summarised below and in Table 7.1.

3.5.1 *First phase: 2002–2007 – networked approaches*

Between 2002 and 2007, the development of GI planning was characterised by a three-period chronological sequence in the realignment of networked approaches to green space policy. This succession commenced with the appearance in 2002 of an ecological network approach that prioritised the conservation of habitats. The popularity of this approach appears to have persisted until 2005 when it was overtaken by a green network concept which, with greater standing in statutory planning guidance, emphasised multifunctionality in the planning and management of natural heritage. The third period, between 2005 and 2008, not only continued the escalating focus on land use multifunctionality, but also extended the increasingly established

green network policy discourse to dissolve traditional perspectives on the incommensurability of ecological conservation and anthropocentric land use.

3.5.2 *Second phase: 2008 – GI's emergence*

By early 2008, new planning policy initiatives concerning green space management had sought to reconcile biodiversity conservation with recreational space provision. This was paralleled by the rising popularity of the ecosystems services paradigm which helped prompt new perspectives on conservation policy that increasingly viewed elements of the natural and semi-natural environment as ecological assets (DEHLG, 2008). The publication of the Green City Guidelines in September 2008 (Urban Forum, 2008) observed the reintroduction into planning debates of the term GI. The international GI Conference (Malahide, Co. Fingal) in November 2008 consolidated the reappearance of GI as an alternative and proactive policy approach to green space management focused on multifunctionality and spatial connectivity. This approach sought to challenge the prevailing concentration on reactive measures directed at a limited range of functions and conservation site designation.

3.5.3 *Third phase: 2009 to the present – institutionalisation and ongoing evolution*

The period from 2009 to the present has observed a considerable expansion in the spatial and functional applicability of a GI approach. Almost all spatial typographies, including brownfield sites (Dublin City Council, 2009) and cultural heritage locations (DRA and MERA,

2010), are now considered as potential elements of GI. Simultaneously, the functions of GI have been expanded to include economic development (Clabby, 2009; Comhar, 2010a,b). Reinforcing this association, 2010 witnessed increasing reference to GI as a means to enhance ecosystems services provision (Comhar, 2010b; DEHLG, 2010). This year also saw efforts to foster cartographic means for the formulation and implementation of GI planning. Furthermore, evident in late 2010 through to 2011 was the increasing prominence of professional institutes in advocating GI. By the winter of 2011, GI had achieved representation in guidance at national, regional and local levels, while also enjoying reference in many non-statutory planning policy documents. However, with the exception of Galway City Council, the most comprehensive representation of GI was in the Greater Dublin area, and more specifically within the local authorities comprising the Dublin metropolitan region.¹² This eastern and urban bias continued through 2012 into 2013. Although a number of rural local authorities now seek to promote GI (Meath County Council, 2013; Monaghan County Council, 2013), much of this represents an extension of traditional modes of ecological conservation via ecological networks, rather than a focus on enhancing the multifunctional potential of lands reflecting the planning context of the rural environment. Nevertheless, recent initiatives by both Dublin City Council and Fingal County Council exemplify proactive and pioneering GI approaches that sensitively cater for development and urban growth while concurrently enhancing ecological integrity.

¹² Dublin City Council, Dun Laoghaire-Rathdown County Council, South Dublin County Council, and Fingal County Council.

4 Planning for Natural Capital and Redefining Social–Ecological Relations: A Case Study of Fingal County Council

4.1 Introduction

The emergence of “social–ecological systems” thinking in spatial planning debates represents a recent turn in efforts to acknowledge the complexity of social and ecological interactions (Ahern *et al.*, 2014; Benson and Roe, 2007; Selman, 2012) and to reorient thinking towards a more holistic perspective on the fundamental entwining of social and natural environments (Davoudi *et al.*, 2012; Folke *et al.*, 2003; Folke *et al.*, 2010; Walker *et al.*, 2006). Thinking in terms of social–ecological systems signifies the potential to centralise in planning policy those social–ecological relationships that have occupied much landscape research. Planning theorists in particular have seen promise in this perspective and have recently focused attention on locating ways to enhance the resilience of such systems to a variety of environmental, political and institutional stressors (Wilkinson, 2012b). This has entailed a flurry of thinking on how the goals and objectives of planning can be adjusted to better account for social–ecological systems and how the resilience of such systems can be advanced (Cumming, 2011; Davoudi *et al.*, 2012; Scott, 2013). Nevertheless, there remains a paucity of examples to illustrate what planning for social–ecological resilience might look like in practice and what forms of planning activity are required for its realisation (Wagenaar and Wilkinson, 2013). In essence, therefore, there exists a gap in our understanding of how the holism of a landscape perspective may be effectively integrated into spatial planning practice.

This chapter seeks to address this knowledge gap by reflecting upon the development and institutionalisation of the GI approach in Fingal County Council as a means to critically evaluate if and how it promotes the centralisation of a socio-ecological landscape perspective in planning practice. The previous chapter identified Fingal County Council as an innovator in applying a GI approach and this chapter seeks to identify best practices that have the potential to be transferred to wider planning practice. This chapter examines both Fingal County Council planning guidance and in-depth qualitative interview material with nine local authority officers

conducted between December 2013 and March 2014. The interviewee selection process was based upon the level of involvement of the interviewees in the development of recent planning and design guidance that explicitly advanced the GI approach, including policy and development management planners, ecologists, landscape architects, drainage and transportation engineers, a heritage officer and those in local authority management positions. These interviews were used to explore if and how the officers of a local planning authority have sought to overcome the limitations of traditional planning approaches by innovatively employing the GI concept in developing policy and design ideas. This was undertaken by investigating the central processes and perspectives deployed to integrate a more holistic and contextually sensitive landscape perspective into spatial planning activities.

4.2 From Strategic Policy to Local Practice

Fingal County Council is broadly recognised as having pioneered the innovative deployment of GI planning for enhancing social–ecological resilience in Ireland (Lennon, 2013, 2014). It does so in an effort to reduce tensions between growth management and environmental protection. This entails a holistic perspective on planning that endeavours to augment the potential for social–ecological synergies that furnish quality of life enhancements while concurrently advancing ecological conservation. Such an approach also seeks to facilitate adaptation to both predictable change and unforeseen events. Thus, the GI approach advanced by Fingal County Council aims to promote an evolutionary perspective on planning for the resilience of social–ecological systems.

The area administered by Fingal County Council encompasses a transition of land uses from the urban-suburban continuum extending from north of Dublin City to a rural, coastal and agricultural landscape containing numerous European and national nature conservation sites designated under the provisions of the EU Birds and Habitats Directives.

Realising social–ecological resilience in this context is guided by a strategic approach to GI planning that advances a series of policy formulation principles. These are namely a collaborative approach, advancing a multifunctional perspective on land use planning, as well as promoting functional and spatial connectivity. The operationalisation of these principles are evident in innovative and interlinked local area plans for the contiguously located Baldoyle-Stapolin (Fingal County Council, 2013a) and Portmarnock South (Fingal County Council, 2013c) areas. These plans employ a GI approach to holistically frame and integrate policy initiatives concerning landscape aesthetics, biodiversity, sustainable urban drainage, archaeology and built heritage, as well as open space and recreation. Through a detailed and iterative environmental assessment process, both documents negotiate the development constraints posed by various conservation designations [Special Protection Area (SPA), Special Area of Conservation (SAC), Shellfish Waters] in a manner that sensitively accommodates both urban expansion and environmental protection. Included in the plans are new residential areas integrated with parkland, sustainable

urban drainage schemes, non-motorised transport routes and spaces for urban farming that are specifically designed to assist community development. A key feature of these plans is how they work synergistically in facilitating high quality urban extensions to the Baldoyle and Portmarnock urban areas while concurrently protecting the ecological integrity of the Baldoyle Estuary. Therefore, by examining how Fingal County Council has developed and deployed the aforementioned series of policy formulation principles in seeking to realise social–ecological resilience in both its strategic planning objectives and the production of these local area plans, it furnishes insight into how the employment of a GI approach in planning practice helps centralise a landscape perspective in land use governance and address a range of environmental obligations at the local authority level (Figures 4.1–4.3).

4.3 Collaborative Approach

Fingal County Council is a relatively new organisation, which was formed in 1994 when three new local authorities were created following the dissolution of Dublin



Figure 4.1. Local area plan for Portmarnock South – Green Infrastructure strategy (source: Fingal County Council, 2013c).



Figure 4.2. Linear park concept outlined in Portmarnock local area plan (source: Fingal County Council, 2013c).

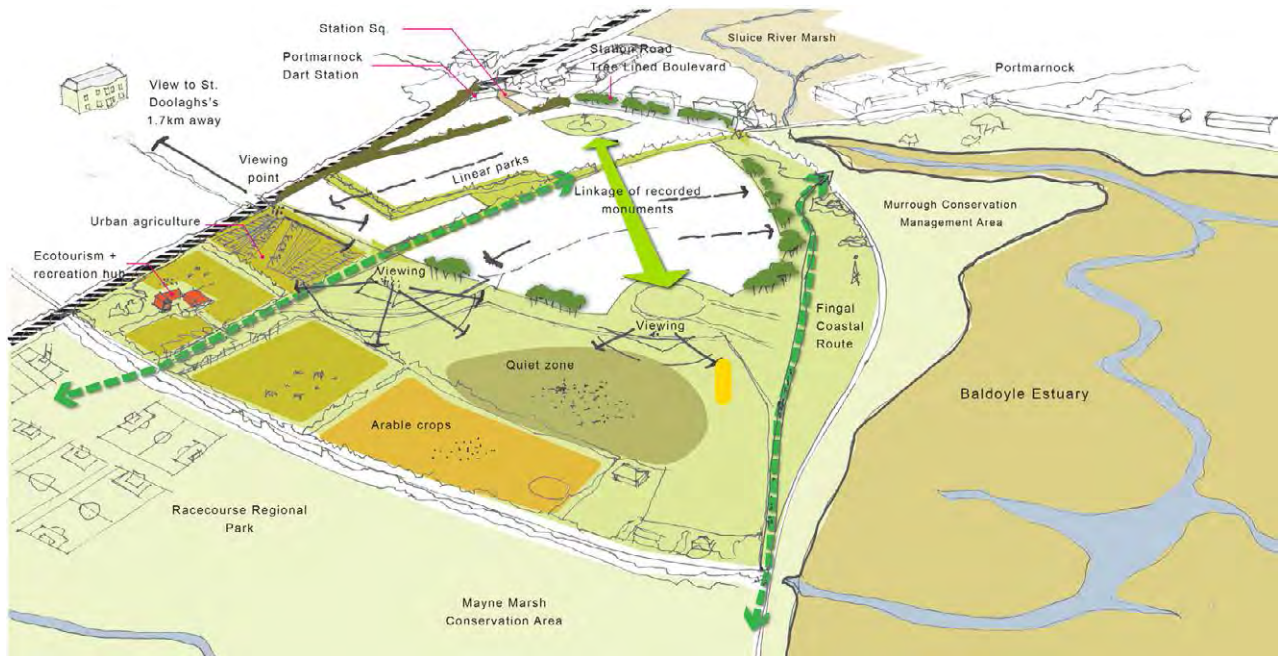


Figure 4.3. GI concepts outlined in introduction of Portmarnock local area plan (source: Fingal County Council, 2013c).

County Council (Oireachtas, 1993). Professional staff within the council who were interviewed indicated their belief that this comparative youth stimulates an organisational identity wherein functional roles have not yet become sedimented (Peters, 2005; Scott, 2008) and innovative possibilities are positively received. As noted by one interviewee, “Fingal does innovative things. We like new thinking. We like to be able to say that about ourselves” (Interviewee A8). Such a willingness to experiment has been identified by both Ahern (2011, 2013) and Evans (2011) as essential attributes in seeking to advance social–ecological resilience. Reinforcing

this identity as a dynamic local authority, Fingal County Council has undertaken a self-initiated reorganisation of its disciplinary divisions. This reorganisation was instigated with the intent of facilitating greater collaboration between the array of council professions deemed pertinent to land use planning activities. In essence, it was initiated to redress the silo mentality in traditional planning activities “whereby different departments of a local authority work separately from each other – and occasionally in conflict with each other” (Kambites and Owen, 2006, 490). A central element of this administrative reorganisation was the merging of

several previously discrete departments into a newly created Planning and Strategic Infrastructure division. This new division includes strategic planners, drainage engineers, traffic planners, parks professionals, the biodiversity officer and the heritage officer, formerly distributed in different departments. This root and branch administrative reorganisation facilitated communication and collaboration by professionals who previously had little contact beyond formal cross-departmental channels (Interviewees A5, A6 and A7). Positive working relationships soon emerged and synergies developed as ill-formed presumptions and mutual suspicions dissipated and co-operative planning efforts evolved. As noted by one interviewee:

I think planning and strategic infrastructure makes sense. Because in the past, like, we would have had the Planning Department planning for things, and other Departments then delivering major infrastructure, but now you have kind of those things being thought about in a more integrated way ... So the reorganisation helps, I suppose, in terms of making it more possible for people to come together, to talk together. So we're not as siloed as we were ... And now I think there is much more realisation that the silos are less fixed, and so people are much more willing to talk horizontally across the organisation.

Interviewee A8

The administrative reorganisation of Fingal County Council has advanced the potential of the local authority to plan in a more integrated way by facilitating collaborative effort by a spectrum of professionals drawn from an array of theoretical backgrounds, practices and opinions (Benedict and McMahon, 2006, 40). Such increased horizontal, cross-department communication and working arrangements have helped promote more comprehensive and efficient responses to a multitude of complex planning issues by enabling concerted action in achieving seemingly disparate goals such as flood control and habitat conservation (EC, 2012; Fingal County Council, 2011b; Novotny *et al.*, 2010). GI has facilitated this by presenting a "centring concept" that various professions can "buy into" (Interviewee A8) in forging interdisciplinary collaborative working arrangements.

In reflecting on the production of Baldoyle-Stapolin and Portmarnock South local area plans, those involved in

overseeing policy formulation stress the role of the GI concept in focusing a diversity of practice backgrounds on potential synergies (Interviewees A1, A2, A3 and A4). In this way, GI helped stimulate collaborative engagement between professionals and between the council and other agencies. As noted by one planner involved in the plan production process:

Whether that is with your other Departments, or whether it was the other agencies, it's all about collaboration.

Interviewee A4

This collaborative approach is reflected in the way the plans seek a multifunctional perspective on spatial planning, wherein each parcel of land is seen to offer the potential to serve a combination of functions, such as biodiversity conservation and flood risk management or recreation and drainage.

Moreover, the drive for innovative collaboration advanced by Fingal County Council in the development of these local area plans also involved working with local community groups through meetings and plebiscites over issues of recreational need and access (Interviewee A5), as well as in monitoring the effectiveness of policy implementation. An illustrative example of such broader collaboration is the efforts of Fingal County Council to cultivate a partnership with local nature conservation NGOs to inform policy formulation and monitor its performance. As conveyed by one interviewee involved in such collaborative initiatives:

We do a lot of work with the local NGOs because they have a lot of local knowledge ... they're looking at the site for years. While a consultant comes in 1 or 2 days, makes an assessment, (and says) there's nothing there. Well they (NGOs) can say no, wait a minute; last winter there was loads of them, loads of these birds or animals and plants, whatever, they're just not here this year for whatever reason and it's more to kind of capture that and I think it requires basically a lot more interaction between nature conservation groups and the local authority.

Interviewee A2

This approach enables local authorities to tap into valuable local knowledge as a complement to meeting

statutory obligations to make use of scientific evidence in plan-making and decision-making.

4.4 Multifunctionality

The significance of land use multifunctionality in the GI policy advanced by Fingal County Council is illustrated by the central aim of the council's GI approach outlined in its development plan:

Create an integrated and coherent green infrastructure for the County which will protect and enhance biodiversity, provide for accessible parks and open space, maintain and enhance landscape character including historic landscape character, protect and enhance architectural and archaeological heritage and provide for sustainable water management by requiring the retention of substantial networks of green space in urban, urban fringe and adjacent countryside areas to serve the needs of communities now and in the future including the need to adapt to climate change.

Fingal County Council (2010, 89)

This strategic level policy direction formed a departure point in the policy formulation process for the Baldoyle-Stapolin and Portmarnock South local area plans. Here, local level policy reflects the recalibration of planning practice from traditional approaches that foster single function land uses towards a multifunctional approach that facilitates social-ecological integration. This was conveyed in the reflections of one planner involved in producing these plans when noting:

What I think we're doing then is we're trying to provide this framework, which can be bought into by all the different parties, and which can help sustain our biodiversity, which can help make places better. It gives (us) our open spaces, our movement and all the rest. All those things that we want ... So whereas before, while we might have been trying to do it, we didn't have this big overview, we did it a little, we wanted our park and maybe we had our habitat conservation there. And we had a cycle path over there, but we didn't put it all into that frame. So, that I suppose is maybe how I'd see it, as kind of changing the traditional.

Interviewee A1

In comparison with conventionally produced local area plans in Ireland, these plans are unusually detailed in the provision of design guidance. It was felt that this was necessary to ensure that the proper implementation of the relatively novel GI concept was being advocated (Interviewee A6). Consequently, the plans detail mowing regimes, direction on how SuDS should be incorporated into the design of public areas, and guidance on public lighting to limit interference with nocturnal animals.

This multifunctional perspective on land use planning also extends into the policy construction phases of the local area plans. Here, Fingal County Council seeks to promote the use of development sites through the temporary use of undeveloped areas for social and ecological enhancement. As recounted by a council officer involved in the production of these plans:

What we were suggesting to the developers (is) that they make all of the land accessible, except for the area that was the subject of the current phase of development, as opposed to putting up hoardings and fences. And what you do then is you cut your paths through it for cycling and walking, and then the rest of it you turn over to something like wild flower meadows or short rotation biomass, or something like that ... and using the model like short rotation woodland or wild flower meadow, you can say to a farmer "you've got to cut these paths 17 times a year, and for that we'll allow you to take the hay off that area". Or we say "fence off, you know with stock proof fencing, Phase B, and the Council will graze it with an attractive set of rare breeds, or something like that". So you can create something that is attractive, sustainable, and easy to manage, as an interim to the final development of the site.

Interviewee A6

4.5 Connectivity

The collaborative approach that facilitates multifunctional synergies has also facilitated more attention to spatial and functional connectivity between land uses in local policy formulation and implementation. Prior to the advocacy of a GI planning approach, Fingal County Council had advanced habitat connectivity

through ecological networks (Fingal County Council, 2005b). Such networks render otherwise fragmented ecosystems biologically coherent by facilitating species movement and genetic exchange (Opdam *et al.*, 2006). Although promoting spatial and scalar integration, these networks focused primarily on ecological connectivity. Consequently, this entirely ecological focus failed to fully reflect the social dynamics intrinsic to social–ecological systems thinking. However, following greater acquaintance with GI theory and the consequent advocacy of a holistic approach to planning, Fingal County Council has sought to advance a more functionally integrated network of key sites that meet several social objectives while concurrently maintaining ecosystems integrity. This GI network is given graphic representation in a series of planning maps accompanying the County Development Plan that identify key sites of conservation and amenity value linked via a series of multipurpose corridors. A key aspect of planning this GI network has been the use of spatial data analysis in identifying opportunities for enhanced connectivity. Using such evidence, efforts are made to produce comprehensive maps of GI assets from which to formulate site-specific initiatives that consolidate the broader GI network. However, Kambites and Owen (2006) advise that if such cartographic exercises are “not set within an effective planning process, the mapping of green infrastructure, albeit a vital component of the process, remains little more than a technical exercise”. Accordingly, Fingal County Council officers expressed an understanding that mapping GI assets is a means to an end rather than an end in itself. In this sense, the maps employed to assist planning policy formulation form tools that aid rather than replace critical engagement with a GI planning approach. Engaging with this approach ultimately requires promoting synergistic social–ecological integration by focusing on how the multifunctional potential of GI networks can be sensitively realised while meeting the local authority’s environmental obligations around European protected sites and networks, and environmental assessments. As noted by one interviewee when reflecting on Fingal County Council’s GI planning approach:

It’s (GI) basically trying to link up your key ecological features which are amenity features, your water features and the likes of that ...

... most of the important major conservation in the county is within this network so if you’re going to do any development near it, whether

it’s amenity or whether it is roads or water or housing, these are the key features that need to be protected and it’s more to see how can we work with you to incorporate that. If you build a housing estate and the river runs through that, how can we design the flood plain at the river in such a way that it will actually suit everybody. So it is still an amenity space, but wildlife can live there too ... it’s trying to combine those different things.

Interviewee A2

This approach is reflected within the Baldoyle-Stapolin and Portmarnock South local area plans. Here connectivity is promoted both within the plan lands and with contiguous land uses. Such a perspective is given prominence in the overarching GI strategy for the Baldoyle-Stapolin local area plan (LAP) which states:

This LAP seeks to create a green infrastructure network of high quality amenity and other green spaces that permeate through the plan lands while incorporating and protecting the natural heritage and biodiversity value of the lands.

Fingal County Council (2013a, 18)

Illustrated in this strategic objective is a desire to integrate both the biological focus of ecological networks with the social concerns of greenways to deliver multifunctional connectivity (Austin, 2014). In this sense, Fingal County Council has sought to employ a broad-based collaborative approach to facilitate multifunctionality and connectivity across the urban–rural interface in a sensitive ecological context where there is significant pressure for urban expansion. The council has endeavoured to do so by using a GI planning approach to centralise the holistic perspective of landscape research that promotes social–ecological resilience by acknowledging the mutually constitutive nature of ecosystems health and human well-being.

4.6 Discussion

Fingal County Council has been at the fore in Ireland in seeking to advance the GI planning approach. At the heart of the Fingal County Council’s activities is a drive to enhance collaborative working arrangements to encourage a more responsive and effective holistic approach to the complexities of planning for

social–ecological resilience. This chapter’s review of Fingal County Council’s efforts to promote such a perspective illustrates how the theory of GI has been used as a “centring concept” (Interviewee A8) that stimulates interdisciplinary working to enable the formulation of an “organisational strategy that provides a framework for planning conservation and development” (Benedict and McMahon, 2006). With a focus on improving the multifunctional potential of connected local and landscape scale environmental assets, such a GI approach supplies “the ‘umbrella’ for disciplines to unite” (Wright, 2011, 1011) and consequently promotes “increased dialogue between planners, developers, and policy-makers” (Mell, 2010, 241).

However, this should be used with a cautious awareness that the history of planning is littered with the carcasses of failed blueprints (Ostrom *et al.*, 2007) that proposed a universally applicable solution to delivering on the promise of sustainability (Owens and Cowell, 2011). Indeed, a continuing dispute on how planning should seek to advance more sustainable forms of governance indicates ongoing failure in the search for a single means to resolve persistent divergence between environmental protection, economic development and social equity (Allmendinger, 2009). Thus, rather than claiming that GI furnishes a panacea for the multitude

of problematic issues encountered in planning practice, this chapter demonstrates that progressing a landscape perspective in planning necessitates an openness to new ideas and new ways of working wherein cognizance of knowledge limitations promotes “learning to manage by managing to learn” (Bormann *et al.*, 1994). Key to this is overcoming the “silo approach to planning” through “a transformation of the structural context and factors that determine the frame of reference” for planning activity (Pahl-Wostl, 2009, 359). Accordingly, integrating a more landscape-informed holistic perspective on social–ecological resilience requires the “recognition that multiple sources and types of knowledge are relevant to problem solving” (Armitage *et al.*, 2008, 96). This emphasis on inclusivity resonates with other moves in planning theory that seek to ground planning in a more collaborative ethos (Agger and Löfgren, 2008; Healey, 2003; Innes and Booher, 2010) as a means to resolve conflict through co-operation and the accommodation of difference (Forester, 1999; Umemoto and Igarashi, 2009). In this sense, a planning perspective better attuned to landscape research requires collaborative learning (Goldstein, 2009) and experimentation (Ahern, 2011), wherein social–ecological systems are seen to be co-produced and co-evolve with forms of locally grounded scientific–administrative knowledge (Evans, 2011).

5 Green Infrastructure, Urban Design and Flood Risk Management¹³

5.1 Introduction

Although much of the GI literature emphasises biodiversity gains, effective GI planning is characterised by a multidimensional approach that seeks to address a range of policy objectives – from addressing ecological obligations to promoting recreation and well-being. Within the context of multifunctional objectives, this chapter focuses on the potential role of GI measures within flood risk management. Specifically, the chapter examines flood risk at the urban scale where the potential of spatial planning is greatest in terms of incorporating GI measures into a full spectrum of flood risk responses.

The causes of flooding are complex, requiring multidimensional management approaches. For example, White (2013) outlines the nature of flood risk to include not only fluvial, tidal and coastal flooding, but also exposure to flood risk from surface water including urban runoff and local drainage failure. In summary, the sources of flood risk may arise from natural and infrastructural sources as follows (OPW, 2012):

- natural sources:
 - rivers (fluvial);
 - sea (coastal and tidal);
 - groundwater;
 - rainfall (pluvial);
 - tsunami;
- infrastructural sources:
 - urban storm-water drainage systems (due to undercapacity);
 - reservoirs (due to breach of walls);
 - water supply systems (due to burst water mains);
 - ESB infrastructure (hydropower dams);
 - Waterways Ireland infrastructure (embanked canals).

This chapter will focus on reducing flood risk from intense rainfall and urban storm-water. In this context, the chapter will review approaches aimed at

incorporating GI measures into spatial planning at the urban scale to reduce urban runoff and to maximise water storage potential to reduce pressure on urban drainage systems. It should be noted that GI measures can also be utilised in the context of coastal or fluvial flooding (for example through the use of wetlands); however, these measures are often external to the plan area or may be beyond the remit of the spatial planning system (e.g. where limited space may be available). The chapter therefore seeks to further advance the thrust of the 2009 publication *The Planning System and Flood Risk Management: Guidelines for Flood Risk Management* (DEHLG and OPW, 2009) in promoting the role of spatial planning within a multidimensional approach to managing flood risk.

5.2 A Paradigm Shift in Flood Risk Management

International literature on flooding has, until recent years, tended to focus upon structural measures to reduce the probability of flooding. Of particular note is how a legacy of past, hard engineering interventions that sought to channel runoff into and through piped systems often fails in the face of exceptional rainfall. Moreover, as Harries and Penning-Rowsell (2010) identify, institutional cultures and public perceptions that were formed when structural, engineered approaches were the norm tend to hamper the ability of government policies to implement a broader range of adaptation measures. However, the potential costs of flooding have driven a renewed interest in flood risk management around the globe. For example, a recent study published in *Nature Climate Change* (Jongman *et al.*, 2014) suggests that the costs of flooding throughout Europe (to homes, businesses, infrastructure, etc.) are likely to rise from an annual cost of €4.5 billion at present to €23 billion per year to 2050 under anticipated climate change impacts and current trends in socio-economic development. Both the scale of vulnerability and the complexity of flooding causes undermine the efficacy of traditional “keep flood water out” approaches, suggesting that a range of measures are needed to address risk, including structural and nature-based approaches.

¹³ We wish to acknowledge the additional input of Eoin O’Neill in developing this chapter.

As a result, in Ireland, as in many countries, flood risk management is currently undergoing a paradigm shift as it moves beyond a one-dimensional “keep flood water out” approach, towards a more strategic, holistic and long-term approach characterised by both mitigating flood risk and adaptation, or increasing resilience to flooding events, as well as preventing flood risk through sustainable development. The benefits (damages avoided) of this approach may be very large. Again, taking account of anticipated climate change impacts and current trends in socio-economic development, Feyen and Watkiss (2011) suggest the annual benefits of adaptation to river flooding across Europe will increase from about €1.3 billion today to €8.3 billion in the 2020s, and maybe up to €50 billion by the 2080s. Consequently, policy emphasis on adaptation and achieving greater resilience to flooding is reflected in the enactment of EU legislation in the form of the Floods Directive (2007/60/EC) (EC, 2007). Within this context, GI has the potential to contribute to a whole-catchment framework to risk management and to work alongside structural approaches, particularly to encourage more ecologically sensitive development and enhanced drainage management to create more resilient places.

The costly and, at times, irreparable damage left in the wake of traditional urban drainage systems being overwhelmed or failing highlights the lack of critical attention to resilience in approaches to urban flood risk management. Here, resilience denotes a heuristic approach to conceptualising change management. The term has an inherent normative dimension that seeks to shift thinking towards design approaches that are more responsive to disturbance (Barr and Devine-Wright, 2012; Plieninger and Bieling, 2012). Much contemporary debate concerning the use of the concept centres on the distinction between equilibrium and evolutionary interpretations of resilience (Scott, 2013). The former understanding has its roots in disaster management and concerns a survival discourse that focuses on the ability of a system to bounce back towards business as usual following a catastrophe (Shaw and Maythorne, 2013). In contrast, evolutionary resilience challenges the desire for a single-state equilibrium or a return to normal. Instead, it emphasises an ongoing evolutionary change process (Scott, 2013). This interpretation focuses on resilience as enabling transformation so that disturbance delivers the spur for re-invention and thereby ensures strength through continuing reflection (Erixon *et al.*, 2013). Therefore, evolutionary resilience

entails a more radical and optimistic perspective that embraces the opportunity to bounce forward (Shaw and Maythorne, 2013). It seeks to supplant a desire for stability with the acceptance of inevitable change so that conventional modes of thought are inverted by “assuming change and explaining stability, instead of assuming stability and explaining change” (Folke *et al.*, 2003, 352).

This chapter seeks to outline the benefit of advancing evolutionary resilience in urban design for flood risk management operationalised through a GI approach. It identifies and critically examines three alternative approaches and associated design philosophies in response to the problem of urban flooding. The chapter first traces the reasons why these three approaches have emerged and discusses the attributes of each. It then examines the potential of the GI approach as a means to realise evolutionary resilience in designing urban environments for enhanced drainage management. The closing section contrasts the three alternative approaches to flood risk management and identifies some implications of advancing the GI concept in urban design activities.

5.3 Designing for Flood Risk Management

Designing for flood risk management in an urban storm water drainage context is a complex endeavour often involving many variables, uncertainty and a multitude of agents. Nevertheless, it is possible to identify three broad approaches and the design philosophies associated with each. These approaches are characterised by different functional objectives: persistence, adaptation and transformation.

5.3.1 Persistence

Recent urban development has often been produced without much consideration for flood risk (White, 2008). Where regard was paid to urban drainage, this most frequently involved the construction of expensive hard solutions such as piped drains and the underground piping of historic drainage channels. Consequently, the accumulated legacy of design interventions has often interrupted natural drainage processes by removing vegetation, paving extensive areas with artificial impermeable surfaces, eliminating natural water storage capacity and disrupting flow paths (O'Neill, 2013). The

consequence has been a divorcing of urban areas and their populations from environmental constraints (White, 2008) and, compounded by the trust people place in technical experts and structural solutions (Terpstra, 2011), an embedding of urban areas with vulnerability to flood risk. Such traditional approaches to flood risk management persist. In essence, these approaches are characterised by a design philosophy focused on controlling flows and mastering the perceived capriciousness of nature and are typified by modes of intervention wherein the functional objective is exclusively directed at flood control. Exemplifying this established pattern of operation is the situation that persists in many municipal authorities where engineering staff work in a disciplinary silo (Kambites and Owen, 2006), directing policy concerning flood risk management and perpetuating design approaches that demonstrate persistence with hard solutions to urban drainage and flood problems. However, increasingly best practice seeks to promote a more integrated range of context-appropriate flood risk management measures, whereby traditional structural-based approaches are complemented by a full spectrum of risk management measures. This perspective concerns a greater focus on adapting urban environments to manage urban rainfall and runoff at source.

5.3.2 Adaptation

The turn to adapting urban environments for flood risk management reflects broader societal concerns with the inevitability of some degree of climate change. It is a design response to a predicted increase in the frequency and severity of flooding events (Bulkeley, 2013). This perspective seeks to complement rather than challenge traditional hard approaches focused on flood defence through recalibrating design to facilitate a more flood-adapted urban environment. In this sense, urban design initiatives focused on adaptation signal a desire to promote a bounce-back form of resilience. Such an approach is characterised by a design philosophy concerned with accommodating the unavailability of flooding events through modifications to architectural detailing and design of the public realm. For example, this approach is evident in raised plinths to flood proof new developments, the allocation of attenuation areas in car parks and sequential methods of land use allocation that aim to steer developments away from identified flood plains (Roaf *et al.*, 2009; Smith, 2009), as emphasised in *The Planning System and Flood*

Risk Management Guidelines for Planning Authorities (2009). As a departure from traditional governance approaches, a focus on adaptation encompasses a broader skill set and therefore involves the co-operation of a variety of construction-related disciplines. In the case of municipal authorities, this is reflected in efforts to promote greater co-operation between engineers, architects, urban designers, emergence planners and landscape architects in responding to these challenges.

However, there is an increasing focus on moving beyond urban design adaptation. Such interest echoes wider concern with the appropriateness of current approaches to flood risk management and calls for a more profound re-evaluation of how flooding issues are considered in urban environments. For example, the European Union's Floods Directive advocates soft solutions that make space for water (Merz *et al.*, 2010). Accordingly, authors such as White (2008), Yu *et al.* (2008), and Berke *et al.* (2009) have sought to encourage the integration of urban design and flood risk management. In a sense, what these authors are calling for is a transformation in how flood risk is addressed in the urban environment.

5.3.3 Transformation

Similar to the adaptation perspective, those advocating transformative approaches to flood risk management view a measure of climate change as inevitable. However, calls for a transformation in urban design involve moving beyond a focus on construction-based interventions or simple sequential land use modes of governance aimed at flood risk defence and/or accommodation. Instead, it entails a holistic reassessment of the relationship between the built and non-built components of urban environments (O'Neill and Scott, 2011). In this way, a transformation requires the urban environment to be seen as a hydrological unit embedded within a larger, or series of larger, hydrological units,¹⁴ rather than as a collection of various built elements adversely affected by flooding. This approach advances a design philosophy focused on bio-mimicry and working with water rather than concentrating solely on controlling or avoiding it (Grant, 2012; Novotny *et al.*, 2010), reducing the hydrological impact of the built environ-

¹⁴ Such larger hydrological units are most commonly referred to as "river basins" in the British Isles or "watersheds" in North America.

ment and thereby transforming the urban footprint of the city (O'Neill, 2013). In this sense, a transformative perspective seeks to orientate urban design towards an evolutionary form of resilience thinking. In desiring greater holism in the consideration of flooding, such an approach necessitates broadening the skill base of those involved in flood risk management beyond disciplines primarily concerned with construction. Hence, it involves new working arrangements with an array of professionals who are not normally associated with flooding-related design issues, such as ecologists, recreation and transport planners, as well as more conventional participants such as engineers, architects, urban designers, emergency planners and landscape architects. Furthermore, a transformative and holistic approach to flooding would require full collaboration in interdisciplinary partnerships, as opposed to co-operation between different disciplines that remain largely isolated beyond the requirements of occasional association during flood risk design exercises (Lennon, 2014). This begs the question as to what form such a transformation in urban design could take. A reply to this may be found in the increasing popularity of the GI approach to planning, design and management.

5.4 The Green Infrastructure Approach to Flood Risk Management

As outlined in Chapter 2 in this report, a key ecosystem services benefit is the retention of water so that drainage into watercourses is more protracted and the peaks in flow associated with flood events are avoided. A GI approach seeks to realise such benefits by giving greater consideration to multifunctionality in the design process. In this context, GI potentially provides a holistic approach towards addressing source-pathway-receptor models applied in contemporary flood risk assessment (FRA) (TCPA, 2007; DEHLG and OPW, 2009), particularly in providing a design response focused on the receptors of flooding (people and assets) and the pathways by which flood water reaches these receptors (e.g. river channels, drainage systems, etc.), by enabling water retention in the built environment through ecologically sensitive development patterns.

Attention to enhancing the multifunctional potential of sites is a key attribute differentiating the GI design philosophy from more conventional approaches focused solely on flood defence or accommodation. Referencing

the multiple environmental, economic and community benefits that accrue from such a transformative perspective, Rouse and Bunster-Ossa (2013, 19) assert that “these benefits derive from the multiple and overlapping functions provided across different systems – hydrology, transportation, energy, economy, and so on – that can intersect in green infrastructure”. Indeed, advocates of a GI design approach contend that the multifunctional potential of the wider urban environment can be maximised by combining the need for temporary flood storage with other ongoing functional, recreational and ecological uses (White, 2008).

The city of Portland, Oregon in the north-western United States of America presents an example of how a GI design approach to flood risk management can provide an array of benefits for the local community at the site and neighbourhood scales. Prompted by an excessive burden on the city's drainage system, resulting in an average of 50 combined sewer overflows (approximately 6 billion gallons) to the Willamette River in 1990, Hoyer *et al.* (2011) note how Portland's municipal authority has employed a suite of GI design initiative to alleviate the pressure on the sewer system and reduce adverse impacts to urban watercourses. Such measures have included financial incentives for downpipe disconnection (with stormwater redirected to lawns, gardens, and infiltration into the ground), the construction of green roofs that enhance local biodiversity, and the provision of a green space recreational network that simultaneously serves to slow rainwater runoff into the Willamette River. These ongoing GI initiatives comprised part of a 20-year plan known as the Combined Sewer Overflow (CSO) Abatement Programme that provided for low-cost and small-scale GI cornerstone projects, in combination with high-cost grey infrastructure big pipe projects (City of Portland, 2011). The cumulative effect of numerous local small-scale GI measures (e.g. 56,000 downpipe disconnections, 2800 infiltration sumps and sedimentation manholes, and the green streets programme) has helped to reactivate the local hydrological cycle, thereby easing pressure on the city's combined sewer system by over 2.1 billion gallons annually and consequently reducing flood events generated by undercapacity in the urban drainage system. Furthermore, these GI initiatives helped reduce CSO discharges by about 35% and reduce CSO discharges to the Willamette River to an average of four overflows each winter and one every third summer (City of Portland, 2011, 2012). Importantly, this

has been achieved without compromising on aesthetic appeal. This contrasts with what some consider as the objectionable appearance of many flood defence interventions associated with traditional hard engineering approaches to flood risk management, such as flood barriers (Entrix, 2010). Indeed, soft design initiatives undertaken by municipal authorities to reduce the proportion of impervious surfaces in the urban area have improved the appearance and experience of the urban landscape. Such initiatives include roadside tree planting, increasing the number of publicly accessible green spaces and the construction of attractive swales and rain gardens in residential streets that are specifically designed to supplement a decentralised approach to drainage management, enhance streetscape appearance and boost local biodiversity (Hoyer *et al.*, 2011; Figure 5.1). Erickson (2006) examines similar multifunctional and local level drainage initiatives in Vancouver, Canada. Here, the municipal authority has promoted a Green Streets programme that offers local residents the opportunity to engage in urban gardening by sponsoring a roadside enhancement project. This project augments the proportion of permeable surface areas within the city while concurrently supporting community development by encouraging a sense of ownership and pride in a neighbourhood's public realm through helping to dissolve firm delineations between public and private spaces.

Guildford in England offers an example of how a GI approach can be applied at the masterplanning scale. In this case, about 67 hectares of the settlement is situated within floodplain of the River Wey, which floods once in every 100 years and contains approximately 620 vulnerable properties (GBC and Environmental Agency, 2009). Moreover, almost 47 hectares of this area would normally be defined as a floodplain with a probability of flooding of once in 20 years or greater. In the absence of a feasible hard engineering option, the challenge for Guildford has been to identify a solution to the problem of flood risk by “using redevelopment opportunities to provide increased safety, additional floodwater storage, and improved floodwater flows, whilst making space for water and the enjoyment of the River Wey” (GBC and Environmental Agency, 2009, 2). To achieve this, the municipal authority stipulates a policy whereby as local redevelopment opportunities arise, effort is directed at reducing the probability of flooding by ensuring that new building footprints are set back from the River Wey to allow greater space for floodwater. Furthermore, the municipal authority seeks to restore flood plains and flood flow paths where feasible so that natural water storage capacity is increased in the urban landscape (O'Neill, 2013).

At the city-wide scale, guidance on how a GI design approach may be advanced is provided by points-based



Figure 5.1. Social housing scheme in Sydney with multifunctional green space (which serves as storm water sink) (source: Mark Scott).

planning regulations in Berlin (Kazmierczak and Carter, 2010), Malmö (Kruuse, 2011) and Seattle (Beatley, 2010). The objective of such schemes is to increase the area and quality of permeable surface area in a move towards achieving water infiltration rates experienced in natural ground cover. This is promoted through increased planting to deliver a combination of reduced water runoff rates, enhanced biodiversity and an improved aesthetic experience of urban spaces. These schemes enable designers to flexibly integrate landscaping elements into developments by allowing them to propose designs that respond to the particular opportunities and constraints of a specific site (Figure 5.2). The Biotope Area Factor (Berlin) and Green Factor (Malmö and Seattle) operate by allocating different scores to different design elements. The developer must ensure that the proposed design exceeds a certain minimum threshold to proceed with construction on site. The scoring mechanisms include a variety of functions and are weighted according to relative functional desirability. Prominent in these scoring mechanisms are issues concerning drainage management, ecological enhancement, recreational space provision and aesthetic benefit. In Berlin, focus is placed on the use of planting schemes in private properties to increase on-site water retention. In Malmö, greater emphasis has been placed on

improving user experience of semi-private residential courtyards through constructing new water retention areas that provide ecologically rich habitats and offer recreational opportunities for local residents. These private and semi-private space issues are also addressed in the Seattle Green Factor scheme, although here considerable stress has also been given to public spaces. In this scheme, applicants to the municipal authority are permitted to include landscape-enhancing elements in public areas adjacent to the development site. This has increased the permeable surface cover in public areas by incentivising developers to improve the quality of the public realm through investing in the streetscape. As noted by Rouse and Bunster-Ossa (2013, 78), “where bare, five-by-five-foot tree pits used to be the norm, planting strips now tend to be larger and include under-story planting”. In this sense, city-wide GI initiatives can have a direct positive impact on urban design at a range of scales and cater for a variety of functions. These different approaches also reflect different design traditions, property rights and regulatory approaches, and environmental contexts. However, the key principle is transferable across these contexts: the enhancement, creation and the integration of multifunctional green networks and spaces into ecologically sensitive urban development.



Figure 5.2. Green roofs in new residential areas in Ostfildern (located in the urban periphery of Stuttgart) (photo: Karen Foley).

5.5 Discussion

The persistence of traditional approaches to flood risk management is evident in much urban design activity, reflecting complex risks, varying sources of flooding and, often, space constraints within urban contexts. This design philosophy is manifested in projects that seek to resist, disrupt and dominate the natural hydrological cycle. Where appropriate, GI planning can provide a complementary suite of measures that meet additional objectives (e.g. biodiversity gain). In this context, best practice flood risk management increasingly seeks to incorporate nature-based solutions within an urban design context aimed at water storage and retention at the urban scale. To complement traditional approaches at the urban scale, this chapter calls for a further advancement in how the issue of flood risk management is incorporated into the design of urban areas. As argued by Carmona (2014), the emergence of more ecologically focused urbanisms (e.g. sustainable urbanism, landscape urbanism, ecological urbanism) “seek to neatly package favoured physical forms with prescribed social and/or ecological content and philosophical meaning, but often end up in circular debates about aesthetics” (Carmona, 2014, 4–5). However, this chapter argues for a transformative understanding of the role in urban design of place-resilience. This involves attention to the multifunctional potential of sites and seeks to engender an evolutionary resilience that facilitates ongoing reflection on how to deliver more sustainable urban forms. The attributes characterising this progression from resistance to bounce-back and evolutionary resilience are illustrated in Table 5.1.

This chapter advances the GI approach as a means for realising evolutionary resilience in urban flood risk management. The chapter does not oppose the application of traditional or adaptation focused approaches to flooding, as these are likely to be the most appropriate modes of action in certain circumstances. However,

the chapter does challenge the dominance of traditional hard solutions to issues of flood risk management, while concurrently suggesting that an adaptation focused approach is often limited in both scope and ambition. Thus, in seeking to complement these two approaches, this chapter advances an alternative design perspective that advocates working with as opposed to dominating or adapting to nature. Such an approach necessitates a broader skill set than that which is currently deployed in addressing urban flooding issues. For example, a challenge arising is to advance urban design that works with nature by creating a more permeable landscape which provides for water absorption and storage; habitat connectivity; recreational access; and the requirements of emergency response (clear safety evacuation routes). Consequently, it requires greater collaboration between an array of different specialisms. However, it is contended that the hard work of producing these new interdisciplinary working arrangements will ultimately result in an aesthetically and functionally enhanced urban public realm.

In a northern European context, anticipated climate change will increase flooding risk with increased frequency of precipitation events. Within this context, a tension potentially arises between GI measures to adapt to climate change and policies designed to mitigate climate change. For example, over the last two decades, urban planning orthodoxy has promoted compact urban form and higher densities to reduce energy consumption and the ecological footprint of cities (Howley *et al.*, 2009). However, as McEvoy *et al.* (2006) outline, efforts at increasing density often pose problems for urban drainage systems, while brownfield sites targeted for development may actually serve more important functions in terms of water retention, recreational use and urban cooling. At the same time, a GI approach may undermine compact city policies through a greater emphasis on multifunctional green space provision and

Table 5.1. Attributes of the resistance and resilience concepts

Attributes of the resistance and resilience concepts				
Guiding concept	Approaches to flood risk management	Design philosophy	Functional objectives	Urban design example
Resistance	Persistence	Dominate nature	Prevent flooding	Piped urban drainage systems
Resilience (bounce-back)	Adaptation	Accommodate flooding	Reduce vulnerability to inevitable flooding	Raised plinths, impermeable attenuation areas
Resilience (evolutionary)	Transformation	Biomimicry and working with nature (GI)	Multifunctionality, responsiveness, flexibility	Rain gardens, green roofs

less intensive urban development patterns. Within the context of mitigation/adaptation tensions, the role of urban design is to reconcile these competing demands within the design process. For example, a GI approach may suggest promoting higher density development

within key nodes or public transport corridors (reducing the need for car travel) intermeshed with multifunctional green corridors, or promoting green roofs and green walls to promote water retention within densely developed areas.

6 Developing Green Infrastructure Thinking: Devising and Applying an Interactive Group-based Methodology for Practitioners

6.1 Introduction

As outlined by Fish (2011), conserving ecosystem services is now a key normative goal of environmental decision-making. However, devising means to ensure the integrity and longevity of the natural processes and ecosystems underpinning society has often been fraught with confusion on how to act and where to focus attention (Owens and Cowell, 2011) and there is limited understanding of the implications in terms of decision-making tools or styles of decision-taking. Within this context, in the last 20 years the EA has been researched and promoted widely to convey that nature needs “to be protected not only for itself, but because it is essential for human life and society” (Granjou *et al.*, 2013, 10). Considered by some as “the last best hope for making conservation mainstream – attractive and commonplace” (Daily *et al.*, 2009), operationalising the concept in day-to-day decision-making has, nevertheless, proved a challenge, perhaps nowhere more so than in spatial planning for complex urban systems (de Groot *et al.*, 2010a; Geneletti, 2012) faced with the task of operationalising ecologically sustainable urban regions as a means to reconcile urban development with the biosphere (Wilkinson *et al.*, 2013). However, more limited attention has been paid to decision-making processes or tools to enhance green infrastructure within spatial plans and policy guidance (Lennon and Scott, 2014). Successfully embedding a GI approach into spatial planning practice requires new modes of decision-making as ecological principles become more central; new institutional arrangements and modes of interdisciplinary working; and a shared understanding of what constitutes an ecosystem service.

This chapter addresses these deficits by reporting on the development and application of an interactive group-based methodology (applied in national, regional and local arenas) to enhance GI thinking and interdisciplinary collaboration. Traditionally, planning authorities in Ireland (in a similar way to other countries) have considered nature conservation in terms of the protection of isolated sites underpinned by reactive approaches

involving site-specific conservation designations, often in response to European directives. However, in recent years, the GI concept has gained some traction in Irish planning debates, with an increasing number of local authorities including GI as a topic within development plans (see Chapter 3 of this report). However, progress has been limited by the dominance of conventional land use regulatory tools and approaches that are spatially segregated and by institutional thinking that is hampered by traditional administrative delineations within the local authority system (Lennon, 2014).

To address these challenges, a group-based methodology was devised as a game-based approach to encourage GI thinking and collaborative problem-solving in complex social-ecological contexts among planners and policy actors. Since the 1990s, collaborative and deliberative approaches have dominated planning debates (see for example: Healey, 1992, 1997, 2008; Innes, 1996, 1998; Booher, 2008), which emphasise a discursive and interactive process as a means of identifying priorities and developing strategies for collective action, stressing the importance of reasoned dialogue among participants to overcome the deficits of other policy process models. In this chapter, we seek to develop a specific deliberative toolkit to promote GI thinking that complements these wider theoretical debates. The deliberative toolkit has been devised to facilitate ideas from strategic to micro GI interventions at a range of spatial scales (e.g. from the creation of ecological networks to green roofs), including problem formulation and solution search. Therefore, the approach developed recognises the interconnected nature of GI and aims to enable a reframing of land use and conservation issues that are solvable and technically feasible from a GI perspective.

Accordingly, this chapter is structured as follows: the next section discusses interactive methodologies and group processes to aid decision-making in complex contexts, providing a rationale for adopting a game-based approach (in this case, developing a board game called GI Quest) to break down professional silos and

to encourage new modes of interdisciplinary thinking. This is followed by an outline of the research approach and a discussion on the application of the game-based approach in four professional stakeholder workshops. The chapter concludes by reflecting on the process of embedding an EA into traditional planning concerns and progress in developing new modes of thinking and working to underpin GI practice.

6.2 Theoretical Approach

An extensive literature exists on group-based methodologies to encourage deliberation on environmental and wider planning issues (for extensive reviews see Bryson and Anderson, 2000; Murray, 2010; Weisbord, and Janoff, 2000). In relation to environmental problem-solving, Fish *et al.* (2011) identify commonly used deliberative techniques, including citizen juries (Murray, 2008), deliberative opinion polls (Albeson *et al.*, 2003), participatory modelling (Hare *et al.*, 2003), deliberative monetary valuation (e.g. Spash, 2007), and deliberative multi-criteria analysis (Munaretto *et al.*, 2014). While these techniques are often designed to enhance citizen engagement, the core principle underpinning these approaches is the emphasis on the potential of participant interaction to generate novel insights and solutions based on a new, shared understanding of problems/issues as participants exchange views, consider evidence, reflect, negotiate and persuade. In recent years, there has been much focus on the use of scenarios and role-playing in the arena of land use change and planning. Game usage offers complementary methodologies for tackling, for example, conflicting land use in rural environments (Sausse *et al.*, 2013), for participatory modelling in developing cultures (Campo *et al.*, 2010) and for engaging citizen participation in urban planning (Poplin, 2012). Indeed, Bishop (2011) has speculated that a “new breed of game-oriented researchers within landscape-focused multidisciplinary teams may be about to emerge” (p. 390). Drawing on this, the research team developed and applied a game-based approach among selected policy actors, based on a board game (GI Quest) to simulate GI planning dilemmas with the specific aim of breaking down institutional and disciplinary barriers among policy stakeholders who hold key information or are necessary for successfully implementing GI.

There are a number of advantages to designing an interactive problem-solving approach focused on a

board game. Research has demonstrated that games in general, and board games in particular, help neutralise tension and supply the opportunity for dynamic participation in interdisciplinary settings (Clark *et al.*, 2003; Crookall, 2010; Eisenack, 2013). Research has also demonstrated that a game-based approach to interdisciplinary learning stimulates interest in novel ideas (Garris *et al.*, 2002; Petranek, 1994). Games provide an especially valuable heuristic approach in seeking to foster the interdisciplinary synergies necessary to effectively tackle the complex social-ecological dynamics that challenge those engaged in land use planning. For example, with specific reference to the benefit of games as simulation tools for solving complex planning issues, Klabbers offers the following illustration:

Physical laws, which describe and explain hydrodynamics, are well known ... This does not necessarily imply that authorities know how to handle flooding ... Needed are methods to simulate flooding in a certain populated area and to offer the actors involved workable response repertoires to prevent or mitigate the damage to people, infrastructure and ecosystems, taking into account the multiple agencies involved ... designing a game on flooding will certainly take into account knowledge about hydrodynamics. However, it would be simplistic to think that flooding results from these natural laws. Human settlements, their community practice and infrastructure, and level of industrialisation in relation to their surrounding ecosystems impact on the risk of flooding. Games depend on smart designs that link human action with the available (natural) resources, legislation (rules), and infrastructure.

Klabbers (2009)

Thus, to serve as an effect heuristic to facilitate problem-solving in complex social-ecological contexts, a game must not only simulate the complexity of a situation, but also offer the potential for its resolution. A carefully designed game can achieve this by supporting the “world-building activities” (Goffman, 2013) wherein upon “entering a game, and assuming the role of a player, people temporarily enact a world, which is a class of its own. Interactively they shape a narrative and write local history” (Klabbers, 2009). This game world thereby possesses multiple possibilities in

which it is feasible to suspend the segregating effects of disciplinary-aligned departmental structures and the sense of mutual suspicion that such an arrangement supports. Therefore, through smart design, a well-conceived gaming approach may be employed to stimulate new and positive perceptions of the potential for interdisciplinary collaboration within a planning authority. Such a design approach draws upon and resonates with the ontological and epistemological perspectives of symbolic interactionism (Atkinson and Housley, 2003; Charon, 2009).

First developed by Herbert Blumer in 1937 (Blumer, 1937), this sociological perspective quickly enjoyed popularity among many North American sociologists but was only fully elaborated when Blumer published a detailed exposition of his thinking in 1969 (Blumer, 1969). Strongly referencing the influence of his teacher George Herbert Mead, as well as pragmatist philosophers such as John Dewey and William James, Blumer stipulated three premises grounding this school of thought. These are (1) social action is based on the meanings we attribute to them; (2) these meanings are derived from social interaction; and (3) both these meanings and the forms of social interaction from which they are derived are in turn modified in the course of social interaction (Manning, 1992, 19). Therefore, rather than existing in a self-reinforcing cycle of meaning-making and interaction, symbolic interactionists hold that the meanings of social action and the forms of interaction through which such meanings are produced exist in a constantly expanding process of evolution. As a consequence, both meanings and the forms of interaction that produce them can be recreated, reframed and reconfigured. This suggests that there is a significant possibility that simulation gaming exercises can be used to aid in recalibrating the format and meaning-making attributes of interdisciplinary work. Ensuring that this possibility is realised entails close attention to what Erving Goffman (1983) described as the “interaction order” in the design and deployment of a game so as to maximise its effectiveness in disseminating novel ideas and stimulating new forms of positive interdisciplinary interaction.

For Goffman, social interaction “transpires in social situations, that is, environments in which two or more individuals are physically in one another’s response presence” (Goffman, 1983, 2), a phenomenon he most frequently referred to as “co-presence” (Goffman, 1963b, 2005, 2009). In such situations, “mutual monitoring occurs” (Goffman, 1963a, 18) that both enables

and constrains the attributes of social interaction. This attention to the “socially situated” nature of “our human condition” (Goffman, 1983, 2) reflects a focus on how context both influences and is influenced by the form and content of social interaction. In this view “the self is therefore not the ontological starting point for a theory of social order. For Goffman it is an end product” (Warfield-Rawls, 1987, 139). By focusing on the way agents negotiate co-presence, Goffman’s sociology is characterised by an analysis of how both the relationships and meanings produced in interactions build upon a commitment to coherent communication and what are perceived as appropriate forms of action in the presentation of self in different contexts. Therefore, “meaning is, according to this view, a constitutive production in and through group performance” (Warfield-Rawls, 1987, 141). Grounded in this perspective, Goffman’s “interaction order” comprises layers of contextual analysis that facilitate an understanding of how context may influence the form and content of social interaction (Goffman, 1963a). Attending to these layers thereby provides a useful means to structure the formulation of an interactive problem-solving exercise designed to encourage interdisciplinary collaboration. The broadest scale of this typology is the “social occasion”. This is “whatever it is that has brought together this particular group of people to this particular time and place” (Smith, 2006, 37). Within such social occasions, there may be located “social gatherings” wherein two or more people find themselves in each other’s co-presence. The interactive format of participants within a social gathering is influenced by that gathering’s “situational proprieties” (Goffman, 1963a, 24). These are the set of social conventions and expectations for appropriate interaction within the context of a particular social gathering. For example, the expectations regarding suitable conduct in a formal planning meeting between planning authority officials is likely to differ from the expectations of how those same officials should interact with their friends at an evening meal. Goffman observes how in social gatherings, the situational properties that influence the format of social interactions are affected by the interpretive shortcuts people deploy in seeking to establish the forms of communicative action appropriate to the context in which they find themselves. As he notes:

The characterisation that one individual can make of another by virtue of being able directly to observe and hear that other is organised around two fundamental forms of identification:

the categoric kind involving placing the other in one or more social categories, and the individual kind, whereby the subject under observation is locked to a uniquely distinguishing identity through appearance, tone of voice, mention of name or other person-differentiating device.

Goffman (1983)

It follows that the “smart design” (Klabbers, 2009) of a game with the aim of seeking the dissolution of mutual suspicion between professionals from different local authority departments should endeavour to reduce the employment of “categoric” interpretive shortcuts that may mobilise negative perceptions concerning those from different disciplines: the obstinate engineer, the intractable parks officer, the incorrigible planner, etc. Instead, such a game should engender situational proprieties conducive to interdisciplinary collaboration by stimulating individual interpretive shortcuts that encourage open and constructive dialogue between individuals with expertise rather than solely between representatives of professions who are likely to be apprehensive of each other. Realising this objective in a way that concurrently disseminates the novel, holistic mode of planning advanced by the GI approach entails close consideration in game design to the interpretive perspectives that participants may bring with them and how these perspectives may be modified by the forms of positive social interactions cultivated through the heuristic potential of the game. Goffman supplies a means for conceiving how the modification of such perspectives may be achieved through his theory of “frame analysis” (Goffman, 1974). In this, he proposes that “primary frameworks” are the grounding perspective guiding the interpretation of action in a given context. These primary frameworks are embedded within a culture of everyday activity that influences how they are deployed. For example, within a local authority, the primary framework of drainage engineers in their daily work routine may result in presumptions concerning the unreasonableness (or otherwise) of officers from the parks department when they are debating a contentious proposal to construct a flood management scheme in a popular public park. Goffman theorises that it is possible to transform such primary frameworks through a process of “keying” whereby the meaning of the primary framework is transformed into something which is based on it, but is independent (Smith, 2006,

57). This potential of keying to modify the “organisation of experience” (Goffman, 1974, 11) is significant for the formulation of a game designed to facilitate new modes of interpretation and interaction. Specifically, Goffman described how keying can serve to generate new frames of interpretation, “wherein the here and now is transformed into a simulation of a real situation in the future” and may be accompanied by a sense that “the frame is what it purports to be” (Manning, 1992).

Therefore, by attending to the role of keying and social proprieties in the smart design of a game, it is possible to promote the interdisciplinary collaborative synergies intrinsic to the GI approach while simultaneously disseminating the concept in a manner that encourages its deployment in tackling the complexities of entangled social–ecological planning issues. The next section details how such theoretical insights were employed by the Eco-Plan research team in the careful design of a workshop specifically designed to dissipate tensions between different disciplines, encourage co-operative problem-solving and disseminate the GI approach as a solution to an array of complex planning issues in a resource constrained institutional environment.

6.3 Methodology: Workshop Design and Application

From the outset, it was necessary to accurately inform the construction of a case-specific game to be tested in a series of workshops. The design of these workshops was informed by two preceding stages in the research. The first stage of the research process was documentary analysis, which occurred between July and October 2013. It entailed the scrutiny of 153 Irish policy documents identified as relevant to the study and assembled as an archive (Foucault, 1972). This archive included plans, strategies and studies produced by a spectrum of national, regional and local governmental authorities, quasi-autonomous non-governmental organisations and NGOs. The contents of the archive spanned the period from January 2002 to November 2013 at which point it was considered that sufficient information had been collated and analysed to facilitate progression to the next stage of the research process. In particular, the examination of documentary material conducted in Stage 1 enabled the confident determination of which planning authorities were leaders in both advocating and implementing the GI approach. Two local planning authorities were identified: Fingal County Council and

Dublin City Council, Ireland. This procedure allowed the research team to locate a series of potential interviewees whom it was considered beneficial to consult in seeking to understand the processes that facilitated the emergence, integration and operationalisation of the GI approach in each of the identified planning authorities.

The second stage in developing the workshop methodology involved undertaking a series of interviews conducted between December 2013 and March 2014. A total of 17 people were interviewed. Fifteen of these were local authority officials and two were consultants who had recently worked closely with these authorities in formulating local area plans that promoted a GI approach through both land use policy and design specification. The interviewee selection process was based upon the level of involvement of the interviewees in the development of recent planning and design guidance that explicitly advanced the GI approach. This selection process was also grounded in a desire to represent a broad array of disciplinary perspectives in order to explore potential variations of opinion between different disciplines regarding the benefits of the GI approach. Those interviewed included policy and development management planners, ecologists, landscape architects, drainage and transportation engineers, a heritage officer,¹⁵ urban designers and those in local authority management positions. The insight provided by this interviewing process enabled the research team to formulate an innovative and interactive tool for the dissemination and integration of the GI approach within the Irish planning system.

Both research stages then fed into the concept design for the workshop, which was developed between February and March 2014. Prototypes of the interactive problem-solving elements were trialled in February 2014 with a mixed cohort of planning, environmental policy and landscape architecture graduate students. This allowed the research team to test the heuristic potential of the workshop design and reconfigure any elements they felt required additional attention before deployment with practitioners. The development of the workshop was not finalised until all interviews were completed in early March 2014. This ensured that

the research team remained sensitive to any issues raised in the interviews and were able to integrate these into the formulation of the workshop design. As this report seeks to outline and discuss the interactive problem-solving methods deployed in these practitioner workshops, greater detail concerning the workshop design is provided in the sections 5.1–5.5 below.

Four practitioner workshops were conducted between mid-March and August 2014. As described below, the workshops were conducted with selected groups that represented a range of practitioners drawn from an array of organisations. Depending on the workshop, participants possessed different degrees of familiarity with the GI approach. This enabled the research team to explore the benefits and constraints of the workshop format within a number of different contexts, and thereby garner knowledge on how the elements of the workshop should and could be recalibrated to reflect the needs, aspirations and comparative knowledge of the different participant groups involved. On average, the workshops lasted approximately 3 hours and 30 minutes,¹⁶ inclusive of a 10 minute break for refreshments. A total of 62 participants attended the workshops. These included planners, engineers, landscape architects, ecologists and heritage officers.

The first workshop was conducted at a biodiversity training day organised by the Eastern River Basin District. This was a large workshop of 27 practitioners attended by a mixed cohort consisting mainly of planners, engineers and ecologists primarily drawn from local authorities. Most of those attending had not previously encountered the GI approach. This training day was chosen for a workshop as it was considered that it offered an opportunity to maximise the dissemination impact of the presented material resulting from the unusual assembly of relevant practitioners from across a number of local authorities. The second workshop was conducted with a specifically selected cohort of eight senior practitioners, drawn from a number of pertinent national organisations such as the Department of the Environment, Community and Local Government, the EPA, the National Parks and Wildlife Service of the Department of Arts, Heritage and Gaeltacht, and the Office of Public Works (responsible for flood risk

15 Working on a broad definition of “heritage”, these officers help co-ordinate and provide input to numerous council activities ranging from natural environmental issues through to landscape and archaeology, as well as built and cultural heritage matters. Their activities frequently interact with the local planning policy development process.

16 The workshop at the Eastern River Basin District Training Day was approximately 2 hours and 30 minutes. This shorter workshop resulted from a scheduling overrun in a full day of various training events of which this workshop was one event among many.

management). This high level workshop also included representatives from two local authorities and a senior representative from the Irish Landscape Institute, which represents landscape architects in Ireland. While all participants had familiarity with the GI approach, the degree of knowledge varied; however, participants had substantial knowledge of and expertise in potential GI benefits relating to their particular discipline (e.g. nature conservation or flood risk management) while also having a high level of appreciation of GI benefits for other policy areas. This workshop was organised to maximise the dissemination of the GI approach among a cohort of practitioners in influential positions in key organisations both within and allied to the planning system. The third workshop was conducted with a mixed group of 15 practitioners from Louth County Council. Participants at this workshop were mainly drawn from the planning and engineering departments of the council. Louth County Council had not yet formally advocated the GI approach in its planning guidance. Although a limited number of members from the planning department were interested in integrating a GI approach into the county's forthcoming development plan, most of those attending the workshop had not previously encountered the GI concept, presenting a well-timed opportunity to both disseminate the GI approach and stimulate interdisciplinary co-operative working with a cohort of practitioners unfamiliar with GI thinking. The fourth workshop was conducted with Dublin City Council. This workshop was attended by 12 practitioners drawn from the drainage engineering, traffic, planning, and parks departments. All participants had some knowledge regarding the GI approach, although familiarity with the approach varied. As discussed in greater detail below, Dublin City Council is a leader in the promotion of GI thinking and application in Ireland through its formal endorsement of the GI approach in a number of local area plans. Nevertheless, the interview stage of the research process identified interdepartmental tensions as a potential barrier to the continued operationalisation of the GI approach within the planning and design activities of the council. Thus, the research team sought to conduct a workshop with this local authority as a means to both assist the council in fostering greater inter-departmental co-operation and as a way to explore the effectiveness of the workshop as a tool for cultivating interdisciplinary collaboration. Audio recording and detailed notes were made by the research team at the workshops. The tracings made by participants as part of the process were also collected

and scrutinised following each workshop. In addition, anonymous feedback sheets were distributed and later examined to supply participants with an opportunity to provide a critique of the workshop.

6.4 The Collaborative Challenge

The documentary analysis identified Fingal County Council (see Chapter 3 of this report) as the initiating source and one of the principal advocates behind GI's ascension to prominence in green space planning policy formulation in Ireland. At the forefront of such advocacy activity has been the framing of much policy by the GI approach within the council's development plan (see Chapter 4 of this report). The Fingal County Council development plan (Fingal County Council, 2011b) includes three detailed GI maps in addition to the zoning, transport, architectural and archaeological maps normally associated with such documents. Chapter 3 of the development plan is entitled "Green infrastructure". As discussed earlier in this report, the location of the GI chapter immediately before the subsequent conventional "Physical infrastructure" chapter signals an interpretation of GI as a strategically important concept binding together the various economic, physical, environmental and social objectives of the plan. Several of the Fingal County Council staff interviewed indicated that the process involved in its production was vital to advancing the GI concept. This is reflected in the assertion of one interviewee who was deeply involved in producing the document:

It's not just having it (GI) in the development plan, it's the build-up to the development plan, because in terms of formulating your development plan, it (GI) didn't actually just come from the planning department here, there would have been inter-departmental working groups developing the strands of it. So behind the green infrastructure you would have had the parks people, the biodiversity people, and the engineers, the water service engineers, and so the strategy came out of that group. So by the time it came to the development plan draft, there was buy-in from the departments, so you weren't fighting between the departments.

Interviewee A4

Identified here is the essential role played by inter-departmental collaboration in advancing the GI concept

through facilitating buy-in by professionals from different disciplinary backgrounds. Buttressing this process was a reorganisation of council departments. This was initiated to promote better efficiencies through removing staff from “their little silos” (Interviewee A5). In this sense, the reorganisation was instigated so as to dissolve sedimented administrative arrangements that promoted disciplinary and functional fragmentation into discrete departments (Scott, 2008). This is indicated in the comments of one interviewee who in reflecting on the emergence and formal advocacy of GI by the council noted:

We did have a Roads Department, a Water Department, a Planning Department, a Parks Department. There has been quite a breakdown now of that departmental structure and a reorganisation into another structure, and I suppose that has meant quite a lot of movement of staff out of where they would have been and into other places ... I suppose particularly this department, it is Planning and Strategic Infrastructure, I think it has definitely helped that we have engineers and planners working together, I think that is a good thing, definitely that has been helpful ... we're all on the same team now, we're all kind of together. You meet planners, I mean, meet, sit for coffee with engineers, you know. In the past the Roads Department and the Water Department was in Blanchardstown (another council premises), and the Planning Department was here. People didn't see each other that often. Now people are sitting beside each other, and just that level of interaction makes for a difference.

Interviewee A8

Here the interviewee suggests that the reconfiguration of departments within the council was important for the successful promotion and integration of the GI approach within council activities by stimulating new professional and personal relationships between staff that enable informal communication and a better sense of working together on the same team. This opinion is not simply that of one interviewee who experienced marginal change in this reorganisation, but rather is supported by the reflections of all those interviewed, including that of an engineer for whom the departmental reconfiguration meant a move between council premises:

There is (sic) a logic to the previous system, but there is also a logic, probably a better logic to the current system. So the fact that I am now in the same department as the planners, and the fact that there is a planner sitting opposite me, it probably means that we are sort of casually chatting on a more regular basis, rather than the situation that was previously ... I mean, instead of writing off reports and getting maybe an email back, now you can just pop down and have a word.

Interviewee A7

Therefore, the reorganisation that facilitated more informal working relationships within Fingal County Council has provided the administrative context that assists collaborative working and the exchange of expertise by helping to erode the bureaucratic barriers inhibiting co-operative problem-solving between professionals from different disciplinary backgrounds. This greater degree of interdisciplinary dialogue has both stimulated and supported a more holistic perspective on planning that resonates with the GI approach. This phenomenon is noted by one interviewee when contrasting previous modes of operation with the current, more collaborative approach:

We would have had the historic or traditional situation where our parks people would never have wanted SuDS¹⁷ (or) any sort of water issues in the open space. So that would've meant if there had to be, it would've meant underground retention basins ... obviously they don't want to go out and have flooding on the open space every day. But if it happens once every 5 years, or every now and then, that might be okay. So we can start to manage in the (sic) more holistic way.

Interviewee A8

Here, it is suggested that the new mode of collaborative working prompted by departmental reconfiguration has helped to defuse former tensions between different professional disciplines and aided the attrition of

¹⁷ These systems seek to mimic natural drainage processes that reduce the adverse effects of pulse water release by facilitating infiltration, evapo-transpiration and storm water detention.

suspicion regarding the objectives of those formally located in different disciplinary-aligned departments. The importance allocated to interdisciplinary dialogue in facilitating the multifunctional synergies advanced by the GI concept also featured prominently in interviews conducted with staff from Dublin City Council. As with Fingal County Council, Dublin City Council has been at the fore in seeking to integrate and promote a GI planning approach. This is evident in a number of local area plans recently produced by the council wherein the GI concept is employed to underpin guidance on spatial connectivity and land use multifunctionality (Dublin City Council, 2012a, 2012b, 2013). However, unlike Fingal County Council, the organisational arrangements of Dublin City Council have not been reconfigured. Rather, all interviewees from Dublin City Council felt that the council still suffered from a problem of mini silos (Interviewee B3) in which roles are delineated by a fragmented array of departments based on disciplinary affiliation, such as drainage engineering, traffic planning, and parks management, rather than on the most effective and efficient means to deliver specified objectives. This departmental fragmentation is seen to foster ignorance regarding the concerns of other professionals within the council and thereby generate inter-departmental tensions (Interviewee B2). Where success has been realised in promoting the interdisciplinary collaboration seen as necessary for multifunctional GI planning, this has been achieved through concerted efforts on the part of planning officers to foster inter-departmental co-operation in the formulation of planning guidance. As noted by one interviewee:

By planning (Planning Department) taking the lead, it is possible to bring people around the table. What is, I think, unusual here is that we have managed. I'm not really sure exactly how! But I think that we have managed to enable this kind of discussion, and it has found a commonality and an understanding that is now emerging as accepted practice in the authority (Dublin City Council).

Interviewee B5

This focus on interdisciplinary collaboration as a prerequisite for the successful integration of GI into local authority activities is reflected in the advice of one interviewee to other local authorities seeking to advance the GI concept in their activities:

I do think the main thing is to get an inter-departmental group set up at a very early stage. That would be my advice for any local authority. Because the expertise is in every local authority, but it is whether they talk or not is the problem ... It can be done, it just means getting different departments to sit down and agree ... It just means sitting down with all the different departments and actually trying to get them to talk to each other.

Interviewee B4

Against this backdrop, all Dublin City Council interviewees indicated that enhancing inter-departmental communication and fostering new collaborative working arrangements would facilitate a more holistic approach to planning and further the integration of GI thinking within the council's activities. As noted by one interviewee:

A lot of it is just about getting people who are too stuck in their own particular disciplines, kind of getting them out of those, and actually talking to other people and finding the best solution rather than the best solution that one department can come up with.

Interviewee B6

However, a challenge repeatedly identified by these local authority officers is how to facilitate the open discussion and collaborative working necessary to advance GI planning in an institutional environment wherein "one of the main impediments (is) the way the council is structured, especially because it is such a large organisation, we generally just stick to our own departments and do our own thing" (Interviewee B6). Therefore, the remainder of this paper outlines how the authors responded to this challenge by developing an innovative means to both disseminate the GI concept and encourage co-operative working arrangements between a spectrum of different disciplines. Informed by the analysis of practitioner interviews, the approach formulated promotes interactive and collaborative problem-solving. Key to this approach was an effort to defuse potential tensions between different departmental officers and dispel potential negative suspicions regarding the objectives of others. This was achieved by fostering an entertaining learning environment centred on a board game that functions as an engaging heuristic.

6.5 The GI Quest Workshop

A workshop provides a social occasion that facilitates the assembly of practitioners from a range of backgrounds who may not normally come into contact or may even choose to avoid each other. It supplies a useful arena when seeking to cultivate interdisciplinary collaboration simply by bringing together such a group. Moreover, the conventional expectations of a workshop as a learning environment support the objectives to convey the benefits of the GI approach and disseminate the concept among a cohort of professionals who administer or regularly interact with the planning system. In seeking to cultivate a learning environment where those attending the workshop could feel free to explore new concepts and working arrangements, a neutral (non-departmental) venue was used, either on the local authority premises, or at a location unfamiliar to all attendees. The workshop was organised in a series of related phases designed to foster increasing interdisciplinary interaction, learning and reflection.

6.5.1 Phase 1: introducing GI

On entering the venue, participants were allowed to select their own seating. In general, people well-known to each other either by way of shared departmental affiliation or previous working relationships sat together. The assembled attendees were then introduced to the project team who produced the workshop and would be facilitating the event.¹⁸ Following these preliminaries, a 20-minute PowerPoint presentation was delivered. This presentation outlined the rationale and principles of the GI approach, as well as discussing an array of internationally sourced best-practice examples to illustrate the successful deployment of the approach in solving complex social–ecological planning issues.

6.5.2 Phase 2: ice-breaking and asset identification

This phase of the workshop was approximately 40 minutes in duration. It commenced immediately

following Phase 1 and the participants were separated into clusters of four or five and physically segregated into a series of small working teams. Each team was allocated a separate table located at a distance from other teams in the room. A facilitator sat at each of the tables, primarily to record social interactions rather than to provide additional direction, as to furnish too much guidance would erode the prospect for self-initiated co-operative problem-solving. Separating the group into a number of small teams generated a series of social gatherings. Importantly, participant inclinations towards habitual departmental groupings were countered by requesting engineers to sit with planners, who in turn were required to share a co-present space with parks officers and ecologists. The conditions for interdisciplinary interaction were thereby generated through the spatial arrangement of participants who did not generally have existing working relationships. The participants were then asked to introduce themselves to each other and subsequently to the wider group of workshop participants.

Located on each table was an A1 size aerial photo of a coastal town, a series of coloured markers and tracing paper. The participants were informed that the town indicated in the photo was the fictional settlement of Ballystewart. The players were also informed that the fictional local authority for Ballystewart intended to formulate a local area plan for the town that would employ the GI approach to inform the planning and design of both strategic policies and specific proposals. The participants were then provided with further context information in the form of a number of A4 sheets of texts and illustrations. These sheets outlined local landscape characteristics such as the location of flood plains, nature conservation sites and protected views. Also provided was information concerning local political and planning aspirations for a number of urban extensions to the town. The participants were then tasked with examining the aerial photo and context information supplied to identify GI assets and explore potential opportunities for enhancing green space connectivity and multifunctionality by employing the GI approach. Using the tracing paper and coloured markers, each team was requested to record in tracings, sketches and summary text their collaboratively derived planning and design objectives for consolidating and enhancing the area's existing GI. Participants were also tasked with providing some outline ideas on how to manage the aspirations for urban expansion.

¹⁸ The facilitating team comprised one ecologist; one landscape architect; and two planners. An architect substituted for the ecologist at the workshop with the Eastern River Basin District. All facilitators were experienced practitioners but working in an academic environment at the time the workshops were held.

There was initial hesitation in each of the workshops as participants came to terms with their task and became familiar with each other. In general, the participants first carefully studied the context information before turning their attention to the aerial photo. There was a tendency towards preliminary polite discussion on what the potential GI assets may be. A trend also evident in this phase of the workshop was for different professionals to draw upon their different training and experience in co-operatively identifying these assets and suggesting a means for their enhancement. In particular, landscape architects initially led in sketching and tracing ideas, while drainage engineers contributed knowledge regarding potential hydrological issues. Similarly, when ecologists were present, there was greater consideration shown to ecological issues. Planners across the four workshops most often focused on recreational access issues and on politely co-ordinating the analytical process to reflect both the context information supplied and the objective to promote urban expansion. Discernible over the 40 minutes of this phase was a transition from initial formal social proprieties to good-humoured informal discussion between different professionals. This most commonly occurred through the nascent blurring of category-specific and individual interpretive shortcuts as a more relaxed form of social interaction emerged when participants broke the ice by moving from detached analysis to interactive creative activity. The moment when this arose most frequently occurred when team members picked up the markers and began to use the tracing paper. This is illustrated by the following, broadly representative passage of interaction that captures the moment of transition from detached analysis to drawing on the tracing paper:

Policy planner: Maybe we should draw them (GI assets) in?

Landscape architect: Shall we trace everything that is not developed? And then we can ascribe values to them?

Community planner: And there are some nice green stepping stone areas that could provide ...

Policy planner: There's the architect. Do the job! (Jovially referring to the landscape architect on the team.)

Landscape architect: This is bad! (Picking up a marker, beginning to trace and laughing)

Policy planner: Keep to the discipline, you know. (Laughing)

All: Laughing

Table A; Workshop 4

The interactive nature of the exercise helped alter the social proprieties "of this social gathering by stimulating physical involvement in a process that allows participants to draw upon disciplinary divisions and different skills in a good-humoured and co-operative manner. In the following exchange from a different workshop, the participants (who had not previously worked together) began rather nervously and it is noticeable how each participant draws from within their own disciplinary expertise as a basis for working collaboratively and integrating the issues at hand – ecologists begin with ecosystem services, the planner outlines scalar issues, and the flood risk engineer highlights the need to map water retention areas:

Ecologist 1: Will we map GI assets first?

Planner: Are you the artist? (Laughs)

Ecologist 1: No, not really. (All laughing) Will we map GI in general or maybe ecosystem services and functions? Or map designated areas?

Ecologist 2: I think we should map GI spaces in general.

Planner: What do you mean?

Ecologist 2: Well, any spaces that have a recreation, access function.

Ecologist 1: I think we need to come up with an agreement what we mean by GI and ecosystem services.

Planner: And what scale are we talking about?

Ecologist 1: Maybe we should start with services?

Engineer: Well, we could easily map water retention areas ...

Table B; Workshop 2

Interestingly, these disciplinary boundaries were maintained and respected throughout the workshop, marked by a willingness to draw on each other's expertise

for problem-solving, enabling this group to maximise the multifunctional potential of proposed solutions. For example, the extract below outlines a proposal to develop a linking greenway through the town with ecological/biodiversity, hydrological, quality of life, recreational and mobility functions:

Planner: Should we have a green corridor running through town?

Ecologist 2: Yeah, the different GI areas need connectivity. And then a greenway can create a buffer to those (pointing at map) protected sand dunes.

Planner: I think the local authority could try to purchase this demesne land and house. That would create an attraction at one end of our greenway to encourage more walking and recreation.

Ecologist 1: Could we then link the greenway to this cutaway bog?

Engineer: That could become a wetland park and retain water in this area.

Ecologist 1: We should commission a study to see how much water it could hold. There was that study by the university ...

Ecologist 2: I think a greenway connecting these sites and running through the town would make a huge difference.

Table B; Workshop 2

This method of encouraging positive collaboration by blurring category-specific and individual interpretive shortcuts was extended in the subsequent phase of the workshop through playing the GI Quest board game.

6.5.3 Phase 3: game play

This phase of the workshop occupied approximately 1 hour and built upon the nascent interdisciplinary collaboration of the preceding phase. By now the participants had familiarised themselves with the context and formulated a series of planning and design ideas. The workshop facilitators now distributed a series of colour coded cards, a dice and some place markers. The attention of the participants was then directed to the series of coloured blocks bordering the aerial photograph and informed that each block corresponded

to a different set of cards (see Figures 6.1 and 6.2). These cards addressed a variety of themes, namely ecology, hydrology, sustainable mobility, cultural heritage, recreation and wildcard – the latter theme addressing miscellaneous issues such as unforeseen political interference and lottery bursaries. Associated with the cards was a series of posters erected around the room that addressed issues specifically referenced on the cards, such as protected views, flooding zones and the location of sites designated for ecological conservation.

Participants were instructed to rest their place marker on the block identified as “Start” and roll the dice to commence their passage along the coloured boxes. The roll of the dice ensured a random outcome as different teams landed on different coloured boxes and thereby drew different corresponding colour-coded cards.¹⁹ Each card presented the team with a new challenge that they had to collaboratively negotiate by revising the outline plans and designs they formulated in Phase 2 of the workshop. The cards were designed to simulate issues that may emerge in devising a site masterplan or local area plan. For example, drawing an ecology card may specify that a recent ecological assessment had identified the presence of an internationally protected animal within a certain area with consequent implications concerning development limitations and conservation requirements.

The board game facilitated the keying of multiple interpretive frameworks that enhanced the heuristic potential of the exercise through the simulation of difficult issues commonly encountered in the formulation of planning policies. Specifically, participants interpreted the primary framework as comprising a professional workshop for the dissemination of a new planning and design concept. However, by playing the GI Quest game, the interpretive experience was keyed in a way that blurred the boundaries between playful interaction and the serious challenges posed by co-operative working in complex social–ecological environments. This process not only involved collaborative working and learning, but also persuasion and encouragement of others to shift from traditional solutions. In the following example, both of the participants with an ecology background pressed for a GI approach to address

¹⁹ The cards were shuffled prior to game play to further ensure that a random and broad selection of issues emerged in the course of this phase of the workshop.



Figure 6.1. GI Quest game board.



Figure 6.2. Interactive problem-solving and collaborative learning.

coastal flooding issues. The flood risk engineer outlined traditional engineering solutions, while using his expertise to expose weaknesses in alternative proposals. However, through further discussion and in response to alternative flooding scenarios, the flood risk engineer and ecologists identified a range of GI measures to complement the need for traditional flood defences. These included an earth embankment, an innovative offshore GI solution and a proposal for sand dune enhancement:

Ecologist 2: What could we suggest?
Something not physical ...

Ecologist 2: Could we abandon buildings in this part of town?

Engineer: In this part, there is very little you can do except build a wall.

Planner: Yes, people get very emotive about protecting property, especially with a school nearby.

Engineer: With coastal flooding (in an urban area), there are very few options.

Ecologist 2: What about a set-back or an area of wetlands? A salt marsh?

Engineer: No, there is no room. You cannot store it (flood water). With fluvial flooding you can try to make room for attenuation, but with coastal flooding, there is an infinite volume of water.

Ecologist 2: But we need to try some GI solutions.

Engineer: Well, we could try an earth embankment in this part (pointing to map) rather than a wall. Yes, that could work. There is space for an embankment and it could be a GI asset, which could be landscaped.

Ecologist 2: With trees?

Engineer: No, this would weaken the structure of the embankment. Perhaps you could also try some softer solutions offshore. I have seen some good examples elsewhere of artificial reefs that function well. They really assist well with reducing wave energy and help with biodiversity as well.

Ecologist 1: We could also remove this road, which would allow the dune system to do what it's meant to do. If you stop using this road and clearing the sand away, you would allow the dune system to grow.

Engineer: Yes, sand dunes are a good flood defence.

Table B; Workshop 2

In seeking to augment the heuristic potential of the exercise, the game cards were designed to encourage participants to consider the potential for enhancing spatial connectivity and the multifunctional potential of sites. This process stimulated reflection on both what the GI approach entailed and on how it could be operationalised through the planning system. Representative of this process was the response of one team to combine the recreational routes (looped walks) they had devised in response to an issue that emerged in a sustainable mobility card with the requirement to promote the ecological connectivity of nature conservation sites

that subsequently emerged as an issue in an ecology card:

Planner: So when development comes up you're going to keep that corridor (drawing on the tracing paper). So you know, when you talk about that finger thing; here it seems to be circular (referring to the Copenhagen Region Green Fingers Plan discussed by the facilitating team in the introductory section in Phase 1).

Energy engineer: You could also tie in your looped walks into the green corridor, into the ecological corridor, the ecological network.

Planner: Yeah, and this could be mobility, the pedestrian thing could follow this line (drawing on the tracing paper) ... so that would be cycling, recreational, green. Flooding?

Environmental engineer: The flooding is down here already (pointing at the aerial photo in the centre of the game board).

Planner: Yeah, and there's the coast. Oh! We did not get the river, that would be a good connection ... (drawing connections on the tracing paper).

Environmental engineer: So you identify a corridor around there that you say there is a link (sweeping a hand across the team's sketch for a combined ecological and recreational network). And we want to protect that. And any development along there we want promoted as green.

Planner: And get your mobility in that too.

Environmental engineer: So we want as much green; so it's the percentage of green.

Planner: It's your green corridor.

Energy engineer: And your linkages through that.

Table A; Workshop 3

Several game cards were also formulated that required participants to reflect upon their understanding of GI by obliging them to develop a communication strategy outlining the benefits of the approach to elected politicians and the broader public. This prompted participants to

reflectively construct an argument to explain and justify why the GI approach should be advanced in the planning system. Therefore, in addition to stimulating discussion on how to operationalise a GI planning approach, the game also prompted reflection on why the approach should be advanced. This reflective element of the game play was illustrated in the generally representative thinking of one participant, who, when during a discussion about how to respond to a card requiring a communication strategy, asserted:

I think it all has to be based around a narrative of possibility and quality of life. It can't be about why you can't do things. It has to be about why you can do things. And instead of seeing the ecology and the flooding as problems, you have to see them as opportunities to focus the development of the town in a way that actually makes sense for everybody in the longer term. So you'd want to be reminding them (local politicians) of how much flooding costs the town, but then telling them that you have the answer. It's a cost-benefit strategy!

Table A; Workshop 2

The game thereby provided an opportunity for a range of professionals from different disciplines to collaboratively formulate and rehearse arguments that could be taken away from the workshop and later deployed in their workplace when seeking to advance the GI approach. Thus, this continuous blurring of interpretive frameworks between entertaining interaction and the real-life planning problems confronting both planners and allied disciplines helped to generate new meaning through social interaction. In particular, it enabled those participating in the exercise to identify the merits of the GI approach and the mutual benefits that accrue from the collaborative working relationships necessary to operationalise it. On occasion, groups shifted from discussing the hypothetical problems of the game to grounding the dialogue in real-life application, indicating the potential of breaking down internal institutional barriers for GI problem-solving and the current inadequacies of cross-departmental interaction. For example, a group comprising local authority engineers and planners discussed integrated constructed wetlands in response to the game. The dialogue initially focused on the engineers explaining the purpose and benefits of this approach over other non-GI solutions and also micro-level design considerations. Without prompting,

Planner 1 shifted the focus of the discussion from the game to the current development plan formulation:

Planner 1: Is this something we could do more in (Town X) and (Town Y)?

Engineer 1: We could not use it for (Town Y) because of the topography, but we could use it in (Town X).

Planner 2: We should specify this for the local area plan for (Town X). And require the master plan (currently being prepared by two developers for a large residential development) to include this.

Table C; Workshop 3

6.5.4 Phase 4: assessment challenge

The participants finished their passage around the coloured boxes by landing on the large red circular shape identified as "GI" (see Figure 6.1). The facilitators then presented each team with details concerning a planning application for a complex mixed-use residential, hotel and golf course development located adjacent to a nature conservation area and partially situated within an identified flood plain. Each team was tasked to once again pool their respective expertise in assessing the merits of this proposal against the GI-informed design and planning concepts they had formulated so far. This phase of the workshop lasted about 30 minutes and was formulated as a heuristic to simulate the potential application of a GI approach in a development management context. As such, this phase of the workshop involved a transition from simulating policy development towards simulating policy implementation.

Working co-operatively, each team in each of the workshops quickly began to assess the proposal against the analysis of GI assets conducted in Phase 2 as well as against the policies and designs they had formulated in response to issues that emerged during the game play of Phase 3. This contrasted with the early caution exhibited in the initial minutes of Phase 2 and indicates the evolution of the gathering's social proprieties from hesitant and formal interaction to confident and comfortable collaborative working. In making their assessment, participants generally drew heavily upon their previous tracings. This entailed a form of sieve mapping whereby maps produced on the tracing paper of GI assets and proposed designs were overlaid and

employed to locate the proposal within the wider GI planning framework that the team had earlier devised. This was subsequently used to inform the assessment of each of the elements of the proposed development. To some teams, this meant refusing or relocating certain elements of the proposal. An interesting feature to emerge in all the workshops was the view that appropriate modification of the proposal would enable it to serve as an opportunity to enhance the GI potential of the area. Here, members of each team worked co-operatively in contributing their respective expertise in suggesting alterations to the proposal that would render it suitable to deliver a range of functional benefits and enhance connectivity. These included, but were not limited to, using the hotel element of the proposal as a means to enhance the attractiveness of a cycle network and designing the golf course to consolidate the ecological integrity of the adjacent nature conservation site while concurrently facilitating flood water attenuation. At the end of this phase, a facilitator asked each team to outline the decision they had reached and justify the reasoning underpinning this assessment. A brief discussion of each team's analysis then ensued, with particular attention allocated to how the principles of the GI approach influenced the decision that was reached.

6.5.5 Phase 5: debriefing

The workshop concluded with an open discussion lasting about 40 minutes that provided a forum for participants to reflect-on-action what had been learned through reflection-in-action (Schön, 1991). In this phase of the workshop, participants were invited to relate and identify the potential benefits and constraints of the GI approach to their own experiences. Participants were also asked to consider the possible barriers to operationalising the GI approach in their work and to offer suggestions on how such barriers could be overcome. In complementing the workshop format, a common response to this question was that involving a greater number of professionals from a greater variety of disciplines in the workshop would help disseminate and integrate the GI approach in the planning system. Many participants felt that it was particularly important that senior management from their organisation be exposed to the GI concept. Another recurring response was that establishing inter-departmental GI working groups involving senior staff in the different departments of local authorities would be a useful means to co-ordinate the integration of the GI approach within the planning

system. In addition, those from a planning background frequently identified the need for national legislation obliging the integration of a GI approach into planning policy formulation and a requirement for the provision of associated planning guidance on developing GI policies and proposals in a range of different types of environments.

The presumption of participants at all workshops as related to the facilitators was that the workshop would consist of a series of conventional presentations by the facilitating team. It was conjectured by several participants that such a workshop format would be unlikely to significantly alter participant's perception on the benefits of the GI approach. As such, it was held that a series of conventional presentations would have been unlikely to alter the primary framework employed to interpret this form of social occasion that was required to deliver transformative learning on GI to participants. This primary framework was, for the most part, grounded in participants' experiences of previously attended workshops. In contrast, many participants informed the facilitators that they had not previously completed a workshop where an interactive gaming format was used as a heuristic tool for co-operative learning. Indeed, the majority of participants at the workshops felt that "the game aspect of the workshop was very useful and encouraged participation as opposed to giving a lecture" (Anonymous feedback; Workshop 3). A substantial majority of those playing the game also indicated in their anonymous feedback comments that this was both a fun and effective means for acquiring new knowledge and promoting interdisciplinary collaboration. As expressed by one participant when reflecting on the game play of Phase 3:

... at that stage we had developed a GI map, and now had an opportunity to discuss (the) scenarios. This is where different experiences/backgrounds really came to the fore and led to good discussion.

Anonymous feedback; Workshop 4

This potential of the gaming approach to stimulate good discussion was evident in a clear trend in all the workshops towards more informal and jovial social interaction as category-specific interpretive shortcuts dissolved with the concurrent emergence of individual interpretive perspectives between co-present interactants. In this way, the social proprieties governing

the form and content of participant interaction were transformed from those rooted in a cautious approach to interdisciplinary working to those centred on a good-humoured, enjoyable and constructive approach to co-operative problem-solving.

6.6 Discussion

As summarised by Benedict and McMahon (2006, 15), the GI approach represents “a philosophy or organisational strategy that provides a framework for planning conservation and development”, essentially an ‘umbrella’ for disciplines to unite (Wright, 2011, 1011) for enhancing the multifunctional potential of connected local and landscape scale environmental assets. In doing so, it is contended that the GI approach offers an effective means to operationalise the ecosystems approach in spatial planning. However, such a GI approach moves planning beyond a simple recalibration of contemporary modes of thinking and doing. Rather, it involves a transformation in the ways spatial planning systems are structured and how practitioners conceive the world which they act in and upon. In this regard, GI has the potential to provide a key discursive storyline, acting as a powerful metaphor for an EA – in other words, it places GI in a similar position to traditional physical grey infrastructure in terms of requiring investment and provides a positive, proactive narrative rather than traditional “preserve and protect” conservation approaches.

While planners have a long tradition of working with cognate disciplines in managing the built environment, ecological imperatives are increasingly challenging planners to initiate or participate in new institutional arrangements or new working relationships to reconcile urban development with ecological limits and thresholds. In this context, the capacity to affect change in complex social–ecological systems may arise not from the agency of any specific actor or set of actors, but collectively through emerging networks and relationships, suggesting greater emphasis on interactive and collaborative problem-solving. Moreover, an EA to managing the built environment requires the embedding of new concepts (in this case GI) into planning practice at a range of spatial scales that potentially influence organisational behaviour and styles of decision-making.

This chapter outlined the design and application of a collaborative heuristic to enhance complex environmental

problem-solving through the creation and/or consolidation of policy networks for implementing a GI approach. While workshop participants were able to develop a shared understanding of ecological challenges and environmental risks, the emphasis within the methodology was on problem-solving. As Bryson (2004, 46) outlines:

In his classic work on policy analysis, the late Aaron Wildavsky (1979) argued that one of the keys to effective policy change was “creating problems that could be solved”. In other words, policy analysis is a kind of art in which problems must be solvable, at least tentatively or in principle, in order to be understood and addressed effectively.

While it is still too early to assess the impact on institutional behaviour and the contribution to a policy shift, a number of issues can be identified from the workshops that offer potential for solution search and problem-solving. Firstly, the game-based approach effectively broke down professional barriers by creating an informal learning arena, providing an enabling opportunity for participants to solve problems in an iterative, non-linear style to develop principles for action with transferability to ongoing plan formation. Secondly, the interactive approach assisted in shifting norms for interactions of those involved in tackling specific issues, creating a much more dynamic interaction than existing working relationships (this was particularly evident within local authorities). For example, while local authority parks departments have been traditionally viewed as focused on ornament and green space maintenance, through the workshop discussions, parks departments were often recast as key actors in addressing surface water flooding (parks for water attenuation or street-level rain gardens to capture surface water to reduce pressure on urban drainage) and enhancing biodiversity (through a shift from manicured green spaces to a greater emphasis on nature). Thirdly, these workshop outcomes were determined by interactions of participants, leading to an improved capacity for decision-making in the face of environmental dilemmas. In this context, achieving a deeper understanding of sustainability and learning capacities requires working across disciplinary boundaries to challenge existing assumptions (Krasny *et al.*, 2010), whether knowledge-based or in terms of perceived institutional roles.

7 Discussion

7.1 Introduction

Chapters 2 to 6 examined potential mechanisms for the Irish planning system to deliver ecologically sound outcomes through the application of an EA and the incorporation of GI into spatial plans. This report advocates that mobilising a GI approach has the potential to move the spatial planning system centre-stage in addressing the significant challenges of biodiversity loss and in climate change adaptation. This chapter provides a discussion of the research findings and also describes the contribution that GI makes to planning practice, before identifying key recommendations in the final chapter.

7.2 Discussion of Project Findings

In essence, the GI approach provides a framework for planning, conservation and development. It provides a focus for improving the multifunctional potential of connected local and landscape scale environmental assets. It provides a framework for disciplines to unite (Wright, 2011, 1011) and consequently promotes “increased dialogue between planners, developers, and policy-makers” (Mell, 2010, 241). A GI approach focuses on identifying and promoting positive synergies. It facilitates working on numerous schemes at various scales that reinforce their respective spatial and functional attributes in a variety of ways.

Establishing a holistic GI framework has the potential to generate long-term positive cumulative impacts that are mutually beneficial to both society and the environment. In doing so, it is contended that the GI approach offers an effective means to effectively integrate an EA into spatial planning. A GI approach involves a transformation in the ways spatial planning systems are structured and how practitioners conceive the world which they operate in and upon.

To embrace these challenges, this chapter advocates for an integration of an EA within spatial planning theory and practice. This involves:

- developing and refining ecological conservation to inform planning policies and processes;

- a re-focusing of spatial planning practice to place ecology, ecosystem services and environmental risks as central concerns of planning practice;
- expanding the core competencies of professional planners in relation to the practical application of a GI/ecosystems services approach;
- considering GI in a similar way to traditional physical grey infrastructure in terms of requiring investment and also considering a positive, proactive model rather than traditional “preserve and protect” conservation approach to its implementation.

GI planning is an evolving approach. Consequently, experimentation and continuous learning characterise GI planning activity. In this sense, Erickson (2006, 290) advocates a “strategy of taking small steps, building support, demonstrating successes, and then tackling more”. A responsive and collaborative approach to new knowledge must continue to be central to the GI approach. This report has attempted to demonstrate that there is a growing wealth of such knowledge regarding the theory and practice of GI planning.

7.2.1 *Green infrastructure principles for spatial planning*

Chapter 2 outlines a GI approach to spatial planning and urban/landscape design that moves beyond traditional site-based approaches of “protect and preserve” towards a more holistic approach that acknowledges the complexities of social–ecological interactions. This approach includes not only protecting but also managing, enhancing, restoring, creating and designing new ecological networks characterised by multifunctionality and connectivity. There is a diversity of interpretations as to what GI involves, but almost all understanding resonates with the regularly cited definition advanced by Benedict and McMahon (2006, 1) as “an interconnected network of natural areas and other open spaces that conserves natural ecosystem values and functions ... and provides a wide array of benefits and services for people and wildlife”. As a descriptive statement, this definition provides a useful focus upon which numerous social–ecological planning issues can converge. However, devising a means to disseminate

and integrate GI thinking among planning and allied practitioners demands attention to the principles upon which the approach is founded. These are as follows:

- GI assets as fundamental infrastructure. Planning for the conservation and enhancement of valuable ecological assets and functions should precede the allocation of lands for development (Landscape Institute, 2013; TCPA and WT, 2012). For example, a naturally occurring floodplain would amount to a valuable asset should it function in aiding flood water attenuation, facilitating the slow release of flood water and thereby preventing the inundation of residential properties. Furthermore, a floodplain may serve as a valuable ecological asset by providing wintering grounds for wildfowl, while simultaneously providing recreational and educational services during the summer months. In emphasising the merit of protecting GI assets and functions prior to other forms of development activity, GI is thereby regarded as fundamental infrastructure (Roe and Mell, 2013, 653), essential for the provision of a better environment for humans and non-humans alike (Grant, 2012).
- Spatial connectivity. The GI approach seeks to amalgamate the spatial concept of ecological networks developed in the field of landscape ecology (Forman and Godron, 1986) with the greenways concept derived in the more anthropocentric tradition of spatial planning (Hellmund and Smith, 2006). An ecological network is “a framework of ecological components, e.g. core areas, corridors and buffer zones, which provides the physical conditions necessary for ecosystems and species populations to survive in a human-dominated landscape” (Jongman and Pungetti, 2004). Greenways differ from ecological networks in their emphasis on human recreational access and mobility, as well as in their more linear format (Gobster and Westphal, 2004). By seeking to integrate the concept of ecological networks with greenway planning, the GI approach advances a form of spatial connectivity that both assists ecological conservation while simultaneously seeking to expand the purpose of the network to facilitate anthropocentric utility (Pankhurst, 2012).
- Multifunctionality. Benedict and McMahon identify a focus on multifunctionality as distinguishing the GI approach “from conventional approaches to land conservation and natural resources protection

because it looks at conservation in concert with land development and man-made infrastructure planning” (Benedict and McMahon, 2006, 2). Accordingly, those promoting a GI approach advance the idea of multifunctionality as “an integration and interaction between functions” (Roe and Mell, 2013, 655). In this context, the GI approach is interpreted as giving practice-based application to theorising on how planning may enhance mutually beneficial social–ecological interactions by orientating spatial planning towards a focus on improving positive synergies between physical, biological and social systems.

- Interdisciplinary collaboration. Collaborative working between a broad spectrum of different professional disciplines is needed to realise positive functional synergies in a spatially connected network (Barnhill and Sardon, 2012; Davies *et al.*, 2006; Mayer *et al.*, 2012; Scottish Government, 2012). Such a collaborative approach relates to the planning, design and implementation of a GI initiative (Austin, 2014; Erickson, 2006) and the creation of integrated spatial data relating to habitat mapping, green spaces mapping, wetlands mapping and ecological network mapping alongside land use zoning maps.

Therefore, successfully embedding a GI approach into spatial planning practice requires:

1. new methods of decision-making as ecological principles become more central;
2. new institutional arrangements and approaches to interdisciplinary working; and
3. an agreed understanding of what constitutes ecosystem services.

7.2.2 *Progress and prospects for embedding GI into Irish spatial planning practice*

7.2.2.1 *Progress to date*

Chapter 3 provides an overview of the progress to date in embedding the GI approach into spatial plans and practice within an Irish context. The chapter identifies three key phases within the Irish planning system.

- First phase: (2002 to 2007) – networked approaches. Between 2002 and 2007, the development of GI planning was characterised by a

“networked approaches to green space policy”. This included the emergence in 2002 of an ecological network approach that prioritised the conservation of habitats and green mapping exercises in some local authorities. The popularity of this approach appears to have persisted until 2005 when it was overtaken by a green network concept, which emphasised multifunctionality in the planning and management of natural heritage. The continued and increased focus on land use multifunctionality was discernible between 2005 and 2008, while the established green network policy discourse was extended to dissolve traditional perspectives on the incommensurability of ecological conservation and anthropocentric land use.

- Second phase: (2008–2009) – GI’s emergence. By early 2008, new planning policy initiatives concerning green space management had sought to integrate biodiversity conservation with recreational space provision. Coinciding with this was the rising popularity of the ecosystems services practice which helped promote and establish new perspectives on conservation policy that increasingly viewed elements of the natural and semi-natural environment as ecological assets (DEHLG, 2008).
- Third phase: 2010s to present – institutionalisation and ongoing evolution: The period from 2009 to the present has seen a considerable expansion in the spatial and functional applicability of a GI approach. Almost all spatial typographies, including some brownfield sites and cultural heritage locations, are now considered as potential elements of GI. Simultaneously, the functions of GI have been expanded to include economic development aligned with smart economy objectives. By the end of 2011, GI had achieved representation in guidance at national, regional and local levels, while also enjoying reference in many non-statutory planning policy documents. However, with the exception of Galway City Council, the most comprehensive representation of GI was in the Greater Dublin Area, and, more specifically, within the local authorities comprising the Dublin metropolitan region. This eastern and urban focus of GI practice continued through 2012 and into 2013. Although a number of rural local authorities now seek to promote GI (Meath County Council, 2013; Monaghan County Council, 2013), much of this represents an extension of traditional modes of ecological conservation via ecological

networks, rather than a focus on enhancing the multifunctional potential of lands. Nevertheless, recent initiatives by both Dublin City Council and Fingal County Council demonstrate proactive and pioneering GI approaches that sensitively cater for urban growth while concurrently enhancing ecological integrity. Moreover, this latter period has also seen an increasing awareness that a GI approach can help planning authorities meet a wide range of environmental obligations under a series of EU Directives including the SEA Directive, the Birds/Habitats Directives, and the Floods Directive.

The various phases in the evolution of GI into Irish spatial planning practice and the implications for integrating an ecosystems approach into spatial planning are outlined in Table 7.1.

In the context of promoting GI within the planning system, the county development plan has always been and continues to be the main policy document of the planning authority in which the planning objectives for the area are set out (Grist, 2003, 228). The Fingal County Council Development Plan (Fingal County Council, 2011b) supplies a good practice approach as to how this may be achieved. In this case, the county development plan includes three detailed GI maps in addition to the zoning, transport, architectural and archaeological maps normally associated with such documents. This gives prominence to the GI concept in the spatial illustration of council policy and provides a reference for those seeking to spatially locate specific information regarding GI assets. Moreover, Chapter 3 of this plan is entitled “Green infrastructure”. The insertion of the GI chapter immediately before the conventional “Physical infrastructure” chapter signals an interpretation of GI as a strategically important concept binding together the various economic, physical, environmental and social objectives of the plan. In essence, this GI chapter frames the reading of all subsequent policy by advancing a strategic approach to integrated multifunctional land use.

7.2.2.2 Limitations to embedding a GI approach

While the progress towards embedding a GI approach has been marked by examples of policy and institutional innovation, a number of limitations can also be identified in relation to policy implementation:

Table 7.1. Evolution of GI in Irish spatial planning practice

Timeframe	Green infrastructure as:	Key focus
Early 2000s	Ecological networks	Ecological corridors Linking habitats
	Green structure	Urban growth management Strategic greenbelts
Mid 2000s	Green linkages	Amenity purposes
	A green network or greenways	Protection of natural heritage areas Provision of green space for recreation
	Green chains or networks	Multifunctionality Proactive biodiversity enhancement
Late 2000s	Multifunctional networks, spatial connectivity	Network of multifunctional land uses serving social and ecological requirements Landscape scale perspective Multi-scalar
2010s	Essential infrastructure	Incorporating the above and promoting resilience and adaptation Incorporating the above and environmental risk management (e.g. flood risk)

- While there are pockets of innovative practice, the application of a more formal and proactive GI approach is largely limited to eastern local authorities and larger urban areas. This is perhaps to be expected as these local authorities have a critical mass of staff/resources for effective implementation, an institutional flexibility, and an ability to take risks and innovate, which have enabled some local authorities to proactively advance the GI concept. In this context, ensuring policy transfer and diffusion and institutional capacity building is a priority task. Further integration of GI with SEA/AA/FRA requirements offers a potential and significant opportunity to enhance practice, e.g. by mobilising the concept through SEA/AA Regional Fora.
- Further work is needed to promote the GI concept among Irish planning practitioners and local government managers as a means to satisfy multiple objectives.
- To date, policy innovation has emerged from the bottom up, with experimentation taking place within some local authorities. These innovative examples have, however, taken place in the absence of a national policy framework for GI implementation. While there may be a danger that overly prescriptive top-down guidance can at times limit bottom-up innovation or lead to a tick-box approach among local authorities, some top-down prompting in this case may lead to a wider diffusion of the GI approach – this is further discussed in the recommendations section below. The forthcoming National Planning Framework (DECLG, 2015) and new Regional Spatial and Economic Strategies represent significant potential opportunities to further mainstream GI into spatial planning.
- In our interviews with local authority officers, a challenge repeatedly identified is how to facilitate the open discussion and collaborative working necessary to advance GI planning in an institutional environment. This is in the context of roles being delineated by a fragmented array of departments based on disciplinary affiliation, such as drainage engineering, traffic planning, and parks management, rather than on the most effective and efficient means to deliver specified objectives. Hence, the issue of departmental silos hinders GI policy formulation and implementation as a result of embedded local authority administrative arrangements that separate rather than integrate professional expertise. Many local authorities have begun to address new ways of preparing plans since the coming into force of SEA regulations, establishing internal cross departmental teams to inform the plan making and SEA/AA/FRA processes.
- Progress to date with applying a GI approach in Ireland has focused on translating the concept into the development plan (both in terms of content and the preparation process and the associated SEA/FRA/AA) as a key mechanism for mainstreaming GI into the wider objectives of a local authority. In

contrast, there is an absence of specific GI toolkits to provide decision-making frameworks with the development management process (similar to the points system applied in Berlin and Seattle), site assessment toolkits, or specific design guidance to assist development management decision-making or to inform the developer-sector to support the wider legislative framework.

- There is currently little financial incentive for developers to propose innovative GI solutions to the contextual constraints associated with site development. This has the potential to limit the dissemination and adoption of the GI concept, as developers seek to maximise returns in an economic landscape wherein depressed (but growing) demand provides a deterrent to what may be perceived as speculative investment in novel design methods to enhance environmental quality.

7.2.3 Developing GI thinking in spatial planning practice

A key output of the Eco-Plan project has been the development of an interactive, collaborative learning toolkit to facilitate GI thinking among professional stakeholders called GI Quest. As outlined in Chapter 6, spatial planners increasingly view their role as one of co-ordinator, negotiator and integrator of the spatial dimensions of wider policy streams, including environmental protection, infrastructure delivery and land use governance.

While planners have traditionally developed working relationships with built environment professionals, ecological obligations are increasingly challenging planners to participate in new institutional relationships to build social–ecological resilience. The GI Quest toolkit was designed to stimulate collaborative and non-linear learning to develop a new shared understanding of problems and also to facilitate solution search and problem-solving. Three key insights were developed from this approach:

Firstly, a game-based approach effectively broke down professional barriers by creating an informal discussion arena, providing an enabling opportunity for participants to solve problems in an iterative style to develop principles for action with transferability to ongoing plan formation.

Secondly, the interactive and iterative approach assisted in shifting norms for interactions of those involved in tackling specific issues, creating a much more dynamic interaction than existing working relationships.

Thirdly, the workshop outcomes were determined by interactions of participants, leading to an improved capacity for decision-making in the face of environmental dilemmas.

In this context, achieving a deeper understanding of sustainability and learning capacities requires working across disciplinary boundaries to challenge existing assumptions, whether knowledge-based or in terms of perceived institutional roles.

8 Recommendations

8.1 Introduction

The focus of the Eco-Plan project is to outline appropriate ecosystems-based responses through effective institutional design, policy and practices that provide positive feedback loops to drivers, pressures, state and impacts.

This chapter develops a DPSIR framework (EEA, 2007), providing identification of the concepts of drivers, pressures, state, impact and response (the DPSIR approach) to reinforce the interplay between the environment, land use and socio-economic activities. It also seeks to encourage and support decision-making, by pointing to clear steps in a causal chain where the chain can be broken by policy action.

The DPSIR approach represents a systems analysis view: social and economic developments exert pressure on the environment and, as a consequence, the state of the environment changes (Table 8.1). This leads to impacts on, e.g. human health, ecosystems and materials that may elicit a societal response that feeds back on the driving forces, on the pressures or on the state or impacts directly, through adaptation or mitigation.

In this context, an appropriate policy response can de-lock unsustainable development trajectories or path dependencies towards path creation for resilient urban systems. This is represented in Figure 8.1.

It is not the intention to provide a prescriptive set of rules for implementing a GI approach in this section, but rather to offer a suite of research-based principles to inform policy-making, to explore alternative policy instruments and to identify areas of further research. The various recommendations are considered under three headings:

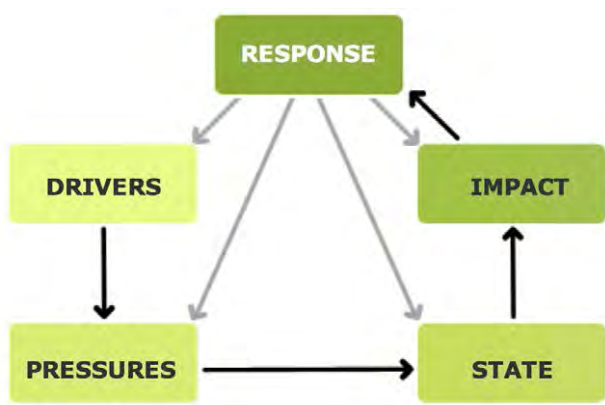
- embedding and consolidating an ecosystems approach in Irish spatial planning practice through GI;
- institutional and governance enhancements;
- capacity building requirements.

The recommendations (Eco-Plan R) are outlined in detail below and Table 8.2 summarises the key recommendations and the potential responsible actors and timetable.

8.2 Embedding and Consolidating an Ecosystems Approach in Irish Spatial Planning Practice through GI

8.2.1 The development plan

- Eco-Plan R1: to effectively implement GI initiatives, the GI concept should be robustly and systematically advanced through the development plan



Eco-Plan – developing a policy response for:

Embedding GI into spatial planning policy and practice

- Development plans
- Development management
- SEA/AA/FRA

Institutional enhancement

Capacity building

Figure 8.1. DPSIR Framework (Adapted from: EEA, 2007).

Table 8.1. Elaborating Drivers, Pressures, State, Response – illustrative examples of planning for complex social–ecological systems

Drivers	Societal: e.g. quality of life, well-being, place-making and sustainable communities Economic: e.g. construction, infrastructure, efficiencies within public policy delivery Environmental: e.g. natural capital protection and enhancement, environmental quality Policy: e.g. meeting EU environmental obligations, SEA/AA/FRA, protected sites, including Natura 2000 networks
Pressures	Climate change mitigation/adaptation response strategies Biodiversity loss/habitat and ecological network fragmentation Fragmented urban development Ecosystems and human health Flood risk and urban drainage capacity Population increases Development and further loss of green space
State	Urban areas as a social–ecological system The eco-environment Citizens' living conditions
Impact	Ecological integrity Urban resilience
Response (Eco-Plan Recommendations)	Embedding GI into development plan process and tools Collaborative and interactive policy-making SEA to integrate an ecosystems-based approach to GI Protect, enhance, restore, create natural capital Alternative development management assessment tools Developer and community incentives Site assessment and retrofit methods Design and management guidelines Institutional and governance enhancement and new working arrangements Capacity building

preparation process. GI should be positioned as a potential enabling framework for integrating environmental, economic and social objectives and supporting the delivery of and compliance with planning authorities' environmental obligations. This aligns with the Department of Environment, Community and Local Government's Planning Policy Statement (2015) and the key principles it outlines for underpinning the planning system.

- Eco-Plan R2: GI should be viewed as a potential enabling mechanism within spatial plans. GI should not be perceived as an additional obligation on planning authorities, but rather GI provides an integrative concept that enables a local authority to deliver planning objectives relating to: natural heritage; water resources; housing; transport; recreation; economic development; flood risk management; and climate change, while also meeting environmental obligations including SEA, AA and FRA.
- Eco-Plan R3: place GI in a similar position to physical grey infrastructure in terms of requiring investment, protection and management and as an enabler of wider planning and environmental objectives.
- Eco-Plan R4: replace traditional “preserve and protect” conservation and natural heritage measures in development plans with a proactive and comprehensive GI approach to underpin planning objectives to protect, enhance, restore and create natural capital and associated ecosystem services. This approach will also strengthen environmental obligations within the SEA, AA and FRA process.
- Eco-Plan R5: in the development plan review process, policy provisions should be strategically configured via a series of GI framing strategic

objectives. The context-specific details of such objectives could then be delivered through policies” in particular development plan chapters (e.g. transport, environment, infrastructure, heritage, recreation” etc.) and/or by policies in local area plans or masterplans.

- Eco-Plan R6: a collaborative approach should be fostered between planning authorities, key stakeholders and elected representatives. The GI Quest approach has been developed as a potential collaboration supporting toolkit. As part of the Eco-Plan project, a manual has been produced to provide planning authorities with a framework for collaborative GI planning available at <http://www.epa.ie/pubs/reports/research/biodiversity/research182.html> and www.ecoplanresearch.org along with the various toolkit elements.
- Eco-Plan R7: GI-specific plan performance assessment tools should be developed to facilitate the monitoring and evaluation by planning authorities of the challenges, benefits and progress of GI planning implementation. Where possible, this should be linked to SEA-related monitoring requirements – see below.
- Eco-Plan R8: the potential of interactive public engagement and stakeholder-based methodologies at local authority level should be explored to embed the GI concept into public consciousness and to communicate GI ideas to the wider public and key stakeholder groups. This may also include new visualisation technologies (e.g. smart phone apps) as a means of communicating GI planning outcomes to citizens and stakeholders.
- Eco-Plan R9: a GI approach should be evidence-based and meet statutory obligations to make use of scientific evidence in plan-making and decision-making.

8.2.2 *The Strategic Environmental Assessment process and Appropriate Assessment*

Virtually all spatial plans in the Irish system are subject to SEA or screening for SEA and there are significant opportunities for operationalising and integrating an ecosystems approach with GI thinking in the SEA process related to the statutory development plan process.

- Eco-Plan R10: GI methods should be explored as a means to realise the iterative potential of the SEA process to promote positive synergies and

promote long-term positive cumulative effects in the plan formulation process via: (a) the formulation of a holistic socio-ecological assessment matrix; (b) informing the formulation and assessment of feasible alternative scenarios and selection of preferred alternatives. In this way, GI planning becomes fully integrated in the plan making/SEA processes and will assist the fulfilment of its SEA obligations more effectively.

Furthermore, GI methods should also be applied to support the achievements of the Birds and Habitats Directives, specifically in meeting (Article 6.3 and 6.4) AA requirements and Article 10 of the Habitats Directive.

8.2.3 *Development management*

As outlined in the Development Management Planning Guidelines (DEHLG, 2007), the purpose of the planning system is to promote proper planning and sustainable development, rather than merely to control undesirable forms of development, i.e. an approach that is positive, responsive and promotes high standards. Development management is a key process in which to apply a GI approach as development is implemented “on the ground”. This will require embedding the potential of the development management process as a means to implement GI policy and to maximise the commitment to and investment in GI such as biodiversity “gains” from the development process.

- Eco-Plan R11: A range of decision support tools should be developed, piloted, tested and evaluated with the aim of providing a user-friendly and transparent model of decision-making for embedding and integrating GI considerations into development management. This approach is best developed at a county/city development plan and local area plan level.
- Eco-Plan R12: A series of exemplar design guidelines for development and management of GI should be developed with a target audience of local authority officers, private sector developers, public infrastructure providers, and built environment professions (architects, planners, civil engineers, landscape architects).

While developing design guidance for the complete range of GI features may be unrealistic (given the scope of potential actions), with a focus on the public

realm (green spaces, parks, streetscapes etc.) GI guidance may enable the integration of public realm design and improvement with infrastructural needs (e.g. water management) and biodiversity gains. Secondly, guidance should also be developed for the management of public GI assets, including the design of green spaces to capture a wide range of multifunctional objectives and to provide models to transfer to both the public and private sector.

- Eco-Plan R13: further research should be undertaken to investigate the role of incentives for developers that move beyond the minimum requirements for GI towards incentivising enhancement, restoration and creation of GI assets within the development process. This should include a focus on biodiversity gain that aims to move beyond simply mitigating significant biodiversity loss. In this context, research into developer interests and built environment professionals should be undertaken to test the acceptability of alternative development assessment tools and evaluate their likely influence on design, and also to test various incentives to maximise GI provision within the development process. This approach could also be applied within flood risk management scenarios.

8.3 Institutional Enhancement

This research suggests that overcoming departmental silos is a necessity to the full integration of a GI approach into planning practice. The silo mentality characterising much planning work fosters a limited understanding regarding the concerns of other professionals within a local authority and occasionally generates inter-departmental conflicts.

When success has been realised in promoting the interdisciplinary collaboration (seen as necessary for multifunctional GI planning), this has most often been achieved through the concerted efforts on the part of individual council officers to cultivate or champion inter-departmental co-operation in the formulation of planning guidance, rather than through regular processes of inter-department team working. The following are recommended:

- Eco-Plan R14: each planning authority should establish a cross-departmental GI steering group comprising a team of senior officers to collaborate on the formulation of broad goals, detailed policy

provisions and site specific objectives. This group may overlap with existing structures, such as SEA/AA/FRA teams that exist in some planning authorities at local/regional level.

- Eco-Plan R15: this GI steering group would be responsible for the co-ordination of GI policy implementation at local authority level and linking with SEA monitoring. The steering group should meet on a regular basis in order to facilitate the discussion on GI-related development management issues as they arise, for example in development management. Cross-departmental GI teams from adjoining planning authorities should meet a number of times per year to co-ordinate GI planning initiatives across administrative boundaries providing opportunities for a regional approach.

Many of those interviewed as part of this research perceived that the lack of direction on GI from central government and a legislative basis presents significant obstacles to the widespread implementation of a GI planning approach in Ireland. In cases where GI informed policies are advanced, these are currently implicit or marginal to the primary thrust of guidance. This impedes the co-ordinating potential of the GI concept to stimulate thinking and practice regarding multifunctional integrated land use planning.

- Eco-Plan R16: the GI approach should be explicitly promoted and advanced across a range of policy guidance at national level (e.g. planning, transport, water management, flood risk management, nature conservation).
- Eco-Plan R17: integrate GI with landscape planning and policy. For authorities dealing with extensive un-zoned agricultural lands, the potential of integrating a GI approach into the Landscape Character Assessment (LCA) process should be examined, particularly in relation to mapping GI assets and potential. The Draft LCA Guidelines should be reviewed to include a GI approach, while the further development and implementation of the National Landscape Strategy (2015) should also promote the use and benefits of GI.

8.4 Capacity Building Requirements

A key deficit at present in Ireland relates to the concentration of GI implementation within the larger (better resourced) local authorities. Therefore, there is a

significant opportunity to engage in a proactive process of enhanced information exchange to promote the GI concept and approach to a wide range of local and regional authorities. This process could include:

- Eco-Plan R18: Developing and piloting a CPD GI programme for local/regional authority officers in

association with third level institutes and professional institutes.

The GI Quest (outlined in Chapter 5) provides a potential CPD toolkit to engage with interdisciplinary teams of local authority officers – see GI planning manual

Table 8.2. Summary of Eco-Plan recommendations

Recommendation	Key stakeholders	Priority
<i>Embedding and consolidating a GI approach planning practice</i>		
R1: advance GI through the development plan process	Local planning authorities	1
R2: GI should be viewed as a potential enabling device within plan formulation	Local and regional assemblies	1
R3: place GI in a similar position to physical grey infrastructure	DECLG/regional assemblies/local planning authorities	1
R4: replace traditional “preserve and protect” conservation measures with a proactive GI approach to protect, enhance, restore and create natural capital	DECLG/regional assemblies/local planning authorities	1/2
R5: development plan review process to frame GI concepts across planning objectives	Local planning authorities	1
R6: formulate GI planning objectives using a collaborative framework e.g. GI Quest	Local planning authorities	1/2
R7: development plan performance assessment tools	Further research needed/local planning authorities	2/3
R8: to explore public engagement and stakeholder-based methods	DECLG/EPA regional assemblies/local planning authorities	3
R9: a GI approach must be evidence-based	Local planning authorities	1
R10: GI as a means to realise the iterative process in SEA	DECLG/regional assemblies/local planning authorities/ local planning authorities	1
R11: develop GI decision-support tools for development management	EPA/DECLG/regional assemblies/local planning authorities	2/3
R12: sponsor GI design guidelines to disseminate best practice	DECLG or DAHG	1/3
R13: explore role of developer incentives	EPA, DECLG	3
<i>Institutional enhancement</i>		
R14: establish GI cross-departmental steering groups in each local authority	Regional assemblies/local planning authorities	1
R15: GI steering group responsible for co-ordinating and monitoring policy implementation	Regional assemblies/local planning authorities	1
R16: to advance GI approach through national level policy guidance	DECLG/OPW	2
R17: integrate GI with national landscape policy and the LCA process	DECLG/DAHG; local planning authorities	2
<i>Capacity building requirements</i>		
R18: develop a GI CPD programme	IPI; RTPI; ILI; RIAI; universities	1
R19: build local government management and elected member buy-in	DECLG/regional assemblies/local authorities/Eco-Plan research team	1
R20: organise a national GI planning conference	DECLG/DAHG/OPW/regional assemblies/local authorities/Eco-Plan research team	1
R21: mainstream GI into professional planning education	Third level institutes	2

Priority: 1, immediate; 2, within 5 years; 3, more research needed within next 3–5 years.

IPI, Irish Planning Institute; OPW, Office for Public Works; RIAI, Royal Institute of Architects of Ireland, RTPI, Royal Town Planning Institute.

available at <http://www.epa.ie/pubs/reports/research/biodiversity/research182.html>.

- Eco-Plan R19: building local government buy-in for a GI approach. Chief executive officer and management level within local authorities should be targeted to build support for developing a GI approach as a means to enhance the local planning process while fulfilling various EU obligations, and also engaging with elected councillors to enhance capacity among elected representations for GI thinking.

In this latter context, the GI Quest approach can be modified to engage with local authority elected members. A further means of building local authority management and elected member buy-in may include facilitated best practice visits to leading national and European innovative local government actors to explore the implementation and multiple benefits of a GI approach.

The GI Conference held in Malahide in 2008 was identified in Chapter 3 as a pivotal moment in the dissemination of the GI concept among the planning and allied professions in Ireland. This event facilitated mutually beneficial knowledge exchange between Irish practitioners and an array of international researchers. The conference also facilitated discussions on experience between practitioners both regarding the transferability of project ideas and the means employed to overcome potential barriers to the realisation of GI initiatives, such as resource constraints.

- Eco-Plan R20: organise a national GI planning conference with the aims of taking stock on GI progress and practice in Ireland since the 2008 conference. This should focus on disseminating best national and international practices; evaluate prospects over the next 5–10 years, and build political support for the GI approach.
- Eco-Plan R21: mainstream GI approaches within professional planning education

Irish third level institutes' professional planning programmes should develop and incorporate GI-related modules. These should include a greater awareness of ecological processes; an understanding of the EA to policy-making; an appreciation of the role of GI within plan-making, development management and urban design; and the development of skills in interdisciplinary working and problem-solving (e.g. with civil engineers, landscape architects, ecologists).

8.5 Future Research Directions

While GI has emerged as a potential planning approach in Ireland in recent years, the Eco-Plan project provided a timely opportunity to reflect on progress to date, provide an assessment of the state-of-the-art for GI planning, and to develop a methodology to facilitate GI capacity building on a diverse range of professional stakeholders. Based on the research conducted as part of the Eco-Plan project, we conclude that there is an urgent need for follow-on research to further embed the GI approach in Irish spatial planning policy and practice. The following represent key knowledge deficits that future research should address:

- Research to explore the potential of interactive public engagement and stakeholder-based methodologies to further advance and embed GI approaches and concepts.
- Further attention should be paid to developing appropriate decision support exemplars based on good practice and input from planning officers, particularly relating to development management. This should involve testing/applying/sharing alternative tools for development management assessment to consider the potential for alternative outcomes to be achieved.
- An examination of site assessment methodologies to determine if GI could be retrofitted to facilitate GI implementation among private developers and public authorities (e.g. in the delivery of infrastructure). The purpose of site evaluation methodologies is to flag opportunities for retrofitting or design improvement to maximise ecosystem service delivery. A site evaluation toolkit could identify generic GI design and retrofit measures that can be applied at a site scale based on physical characteristics and ecosystem services performance assessed in the evaluation process.
- Further examination of the potential of integrating land use governance and water-based management systems should be explored. Specifically, research should explore the implications of river basin or river catchment approaches (e.g. espoused within Water Framework Directive and Floods Directive) for land-use governance and the potential of catchment-based approaches to overcome planning for natural capital across administrative boundaries.

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Abbreviations

AA	Appropriate Assessment
CBD	Convention on Biological Diversity
CPD	Continuing professional development
CSO	Combined sewer overflow
EA	Ecosystem approach
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
FRA	Flood Risk Assessment
GI	Green infrastructure
LAP	Local area plan
LCA	Landscape Character Assessment
NBP	National Biodiversity Plan
NGOs	Non-Governmental Organisations
NSS	National Spatial Strategy
SEA	Strategic Environmental Assessment
SuDS	Sustainable urban drainage systems
WP	Work package

Glossary

Amenity	A positive element or elements that contribute to the overall character or enjoyment of an area. For example, open land, trees, historic buildings and the inter-relationship between them; less tangible factors such as tranquillity.
Appropriate Assessment (AA)	AA is the requirement to consider the possible nature conservation implications of any plan or project on the Natura 2000 site network before any decision is made to allow that plan or project to proceed. Not only is every new plan or project captured by this requirement, but each plan or project, when being considered for approval at any stage, must take into consideration the possible effects it may have in combination with other plans and projects.
Birds Directive	This addresses the conservation of wild birds, creating a comprehensive scheme of protection for all wild bird species naturally occurring in the European Union. It was adopted unanimously by the Member States in 1979 as a response to increasing concern about the declines in Europe's wild bird populations resulting from pollution and loss of habitats, as well as unsustainable land use. It was also in recognition that wild birds, many of which are migratory, are a shared heritage of the Member States and that their effective conservation required international co-operation. The directive recognises that habitat loss and degradation are the most serious threats to the conservation of wild birds. It therefore places great emphasis on the protection of habitats for endangered, as well as migratory species, through designated Special Protected areas – see below.
Climate change adaptation	Adjustments to natural or human systems in response to actual or expected climatic factors or their effects, including from changes in rainfall and rising temperatures, which moderate harm or exploit beneficial opportunities.
Climate change mitigation	Action to reduce the impact of human activity on the climate system, primarily through reducing greenhouse gas emissions.
Development management	The process whereby a local planning authority receives and considers the merits of a planning application and whether it should be given permission having regard to the development plan and all other material considerations.
Development plan	The development plan is intended to provide the strategic framework and policy context for all local planning decisions. Planning legislation reinforces the role of the development plan as the primary strategic statement on land use planning at city, town and county levels, and provides a clearly defined context for development management.
Ecological network	These link sites of biodiversity importance.
Ecosystem approach (EA)	A strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. It is based on the application of appropriate scientific methodologies focused on levels of biological organisation that encompass the essential processes, functions and interactions among organisms and their environment.

Ecosystem services	Broadly conceived as “the benefits people obtain from ecosystems” (Millennium Ecosystems Assessment, 2005), namely: Supporting Services (services “necessary for the production of all other ecosystem services” e.g. nutrient cycling, water cycling, soil formation); Regulating Services (services “necessary for the production of all other ecosystem services” e.g. air quality regulation, climate regulation, water purification and waste treatment); Provisioning Services (the provision of “products obtained from ecosystems” e.g. food, fibre, fuel, pharmaceuticals, fresh water); and Cultural Services (the “nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences” e.g. recreation and tourism, aesthetic values, sense of place, cultural heritage values).
Environmental impact assessment (EIA)	EIA is a process that focuses on anticipating all environmental impacts of significance of a proposed development prior to consent being granted, and that specifies those measures that should be taken to eliminate or at least mitigate such impacts to an acceptable level.
European Landscape Convention (ELC)	Promotes the protection, management and planning of European landscapes and organises European co-operation on landscape issues. It includes outstanding, ordinary and degraded landscapes.
European site	These include Special Areas of Conservation and Special Protection Areas – see below.
Flood plain	Generally low-lying areas adjacent to a watercourse, tidal lengths of a river or the sea, where water flows in times of flood or would flow but for the presence of flood defences.
Flood risk assessment	An assessment of the likelihood of flooding in a particular area so that development needs and mitigation measures can be carefully considered.
Green infrastructure	A network of multi-functional green space, urban and rural, which is capable of delivering a wide range of environmental and quality of life benefits for local communities.
Green wedges	Green wedges comprise the open areas around and between parts of settlements, which maintain the distinction between the countryside and built up areas, prevent the coalescence (merging) of adjacent places and can also provide recreational opportunities.
Habitats Directive	The main aim of the Habitats Directive (adopted in 1992) is to promote the maintenance of biodiversity by requiring Member States to take measures to maintain or restore natural habitats and wild species listed on the Annexes to the Directive at a favourable conservation status, introducing robust protection for those habitats and species of European importance. In applying these measures, Member States are required to take account of economic, social and cultural requirements, as well as regional and local characteristics.
Landscape	An area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors.
Landscape character assessment	Inter-connected data and information on the appearance, natural resources, cultural importance and economic, ecological, social and cultural potential of a landscape unit.
Local biodiversity action plan	To provide a framework for the conservation of biodiversity at the local level and to co-ordinate existing and new initiatives for conserving and enhancing biological diversity.
Natura 2000 network	Network of sites designated pursuant of the Birds and Habitats Directives.

Natural heritage areas (NHA)	Statutory designation for wildlife protection in Ireland. Under the Wildlife Amendment Act (2000), NHAs are legally protected from damage from the date they are formally proposed for designation.
Nature-based solutions	Nature-based solutions are living solutions inspired by, continuously supported by and using nature, which are designed to address various societal challenges in a resource efficient and adaptable manner and to provide simultaneously economic, social and environmental benefits.
Open space	All open space of public value, including not just land, but also areas of water (such as rivers, canals, lakes and reservoirs) which offer important opportunities for sport and recreation and can act as a visual amenity.
Spatial planning	Spatial planning goes beyond traditional land use planning to bring together and integrate policies for the development and use of land with other policies and programmes which influence the nature of places and how they function.
Special Area of Conservation (SAC)	Areas given special protection under the European Union's Habitats Directive.
Special Protection Areas (SPA)	Areas identified as being of international importance for the breeding, feeding, wintering or the migration of rare and vulnerable species of birds found within European Union countries. They are European designated sites, classified under the Birds Directive.
Strategic Environmental Assessment (SEA)	A procedure that requires the formal environmental assessment of certain plans and programmes that are likely to have significant effects on the environment.
Urban Design	The art of making places. It involves the design of buildings, groups of buildings, spaces and landscapes, in villages, towns and cities, to create successful development.

Appendix 1

GI Weblinks

Global links

- Convention on Biological Diversity (local authorities)
- Greenroofs & Greenwalls
- ISOCARP Congress 2012 (portal to papers)
- Urban Habitats (free journal)

European Community links

- European Capitals of Biodiversity
- European Commission (GI pages)
- European Commission (LIFE Programme)
- Green & Blue Space
- Greenstructure & Urban Planning
- SURF Nature
- Sustainable Urban Fringes
- Urban Spaces
- URGE (urban green environment)

European Countries links

- CABE (UK: archived material)
- DAC & CITIES (Denmark)
- Ecosystems Knowledge Network
- Forestry Commission (UK)
- Plurel (Pan-European)
- GreenSpace (UK)
- Green Infrastructure North West (UK)
- GCV Green Network (UK)
- Natural England
- Online Green City (Pan-European)
- The Wildlife Trusts (UK)
- Town and Country Planning Association (UK)
- Trees & Design Action Group (UK)

North America links

- Centre for Green Infrastructure (USA)
- Ecosystems Valuation (USA)
- Green Infrastructure Ontario Coalition
- Green Infrastructure Resources (USA)
- Infrastructure Canada
- Project for Public Spaces (USA)
- S.W.I.M. Coalition (USA)
- The Conservation Fund (USA)
- The Trust for Public Land (USA)

Irish Best Practice

- Dublin City Development Plan (Dublin City Council)
- Naas Road Local Area Plan (Dublin City Council)
- George's Quay Local Area Plan (Dublin City Council)
- Liberties Local Area Plan (Dublin City Council)
- Clongriffin-Belmayne Local Area Plan (Dublin City Council)
- Fingal County Development Plan (Fingal County Council)
- Portmarnock South Local Area Plan (Fingal County Council)
- Baldoyle-Stapolin Local Area Plan (Fingal County Council)
- Barrysparks Local Area Plan (Fingal County Council)
- Ballyboghil Local Area Plan (Fingal County Council)
- Galway City Recreation and Amenity Needs Study (Galway City Council)
- Loughmacask Local Area Plan (Kilkenny Borough Council)
- Fortunestown Local Area Plan (South Dublin County Council)
- Newcastle Local Area Plan (South Dublin County Council)
- Towards a Liffey Valley Park (OPW & ERM)

Irish Research

- Green Infrastructure: A Quality of Life Issue (Urban Forum)
- Park Atlantic: Action Plan Main Report (Mid-Eastern Regional Authority)
- Green City Guidelines (Fingal County Council, Dun Laoghaire Rathdown County Council, UCD)
- Preliminary Study of the Needs Associated with a National Ecological Network (EPA, Tubridy, O'Rian)
- The Economic & Social Aspects of Biodiversity; Benefits & Costs of Biodiversity in Ireland (Department of Environment, Heritage and Local Government)
- Creating Green Infrastructure for Ireland (Comhar Sustainable Development Council)

AN GHNÍOMHAIREACHT UM CHAOMHNÚ COMHSHAOIL

Tá an Gníomhaireacht um Chaomhnú Comhshaoil (GCC) freagrach as an gcomhshaoil a chaomhnú agus a fheabhsú mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaoil a chosaint ó éifeachtaí díobhálacha na radaíochta agus an truaillithe.

Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

Rialú: Déanaimid córais éifeachtacha rialaithe agus comhlíonta comhshaoil a chur i bhfeidhm chun torthaí maithe comhshaoil a sholáthar agus chun díriú orthu siúd nach gcloíonn leis na córais sin.

Eolas: Soláthraimid sonraí, faisnéis agus measúnú comhshaoil atá ar ardchaighdeán, spriocdhírthe agus tráthúil chun bonn eolais a chur faoin gcinnteoireacht ar gach leibhéal.

Tacaíocht: Bimid ag saothrú i gcomhar le grúpaí eile chun tacú le comhshaoil atá glan, táirgiúil agus cosanta go maith, agus le hiompar a chuirfidh le comhshaoil inbhuanaithe.

Ár bhFreagrachtaí

Ceadúnú

Déanaimid na gníomhaíochtaí seo a leanas a rialú ionas nach ndéanann siad dochar do shláinte an phobail ná don chomhshaoil:

- saoráidí dramhaíola (*m.sh. láithreáin líonta talún, loisceoirí, stáisiúin aistriúcháin dramhaíola*);
- gníomhaíochtaí tionsclaíoch ar scála mór (*m.sh. déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta*);
- an diantalmhaíocht (*m.sh. muca, éanlaith*);
- úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe (OGM);
- foinsí radaíochta ianúcháin (*m.sh. trealamh x-gha agus radaiteiripe, foinsí tionsclaíochta*);
- áiseanna móra stórála peitрил;
- scardadh dramhuisce;
- gníomhaíochtaí dumpála ar farraige.

Forfheidhmiú Náisiúnta i leith Cúrsaí Comhshaoil

- Clár náisiúnta iniúchtaí agus cigireachtaí a dhéanamh gach bliain ar shaoráidí a bhfuil ceadúnas ón nGníomhaireacht acu.
- Maoirseacht a dhéanamh ar fhreagrachtaí cosanta comhshaoil na n-údarás áitiúil.
- Caighdeán an uisce óil, arna sholáthar ag soláthraithe uisce poiblí, a mhaoirsiú.
 - Obair le húdaráis áitiúla agus le gníomhaireachtaí eile chun dul i ngleic le coireanna comhshaoil trí chomhordú a dhéanamh ar líonra forfheidhmiúcháin náisiúnta, trí dhírú ar chiontóirí, agus trí mhaoirsiú a dhéanamh ar leasúcháin.
- Cur i bhfeidhm rialachán ar nós na Rialachán um Dhramhthrealamh Leictreach agus Leictreonach (DTLL), um Shrian ar Shubstaintí Guaiseacha agus na Rialachán um rialú ar shubstaintí a ídionn an ciseal ózóin.
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaoil.

Bainistíocht Uisce

- Monatóireacht agus tuairisciú a dhéanamh ar cháilíocht aibhneacha, lochanna, uisce idirchriosacha agus cósta na hÉireann, agus screamhuiscí; leibhéal uisce agus sruthanna aibhneacha a thomhas.
- Comhordú náisiúnta agus maoirsiú a dhéanamh ar an gCreat-Treoir Uisce.
- Monatóireacht agus tuairisciú a dhéanamh ar Cháilíocht an Uisce Snámha.

Monatóireacht, Anailís agus Tuairisciú ar an gComhshaoil

- Monatóireacht a dhéanamh ar cháilíocht an aeir agus Treoir an AE maidir le hAer Glan don Eoraip (CAFÉ) a chur chun feidhme.
- Tuairisciú neamhspleách le cabhrú le cinnteoireacht an rialtais náisiúnta agus na n-údarás áitiúil (*m.sh. tuairisciú tréimhsiúil ar staid Chomhshaoil na hÉireann agus Tuarascálacha ar Tháscairí*).

Rialú Astaíochtaí na nGás Ceaptha Teasa in Éirinn

- Fardail agus réamh-mheastacháin na hÉireann maidir le gáis cheaptha teasa a ullmhú.
- An Treoir maidir le Trádáil Astaíochtaí a chur chun feidhme i gcomhair breis agus 100 de na táirgeoirí dé-ocsaide carbóin is mó in Éirinn.

Taighde agus Forbairt Comhshaoil

- Taighde comhshaoil a chistiú chun brúnna a shainnaint, bonn eolais a chur faoi bheartais, agus réitigh a sholáthar i réimsí na haeraíde, an uisce agus na hinbhuanaitheachta.

Measúnacht Straitéiseach Timpeallachta

- Measúnacht a dhéanamh ar thionchar pleananna agus clár beartaithe ar an gcomhshaoil in Éirinn (*m.sh. mórphleananna forbartha*).

Cosaint Raideolaíoch

- Monatóireacht a dhéanamh ar leibhéal radaíochta, measúnacht a dhéanamh ar nochtadh mhuintir na hÉireann don radaíocht ianúcháin.
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as tairm núclicéacha.
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núclicéacha agus leis an tsábháilteacht raideolaíochta.
- Sainseirbhísí cosanta ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

Treoir, Faisnéis Inrochtana agus Oideachas

- Comhairle agus treoir a chur ar fáil d'earnáil na tionsclaíochta agus don phobal maidir le hábhair a bhaineann le caomhnú an chomhshaoil agus leis an gcosaint raideolaíoch.
- Faisnéis thráthúil ar an gcomhshaoil ar a bhfuil fáil éasca a chur ar fáil chun rannpháirtíocht an phobail a spreagadh sa chinnteoireacht i ndáil leis an gcomhshaoil (*m.sh. Timpeall an Tí, léarscáileanna radóin*).
- Comhairle a chur ar fáil don Rialtas maidir le hábhair a bhaineann leis an tsábháilteacht raideolaíoch agus le cúrsaí práinnfhreagartha.
- Plean Náisiúnta Bainistíochta Dramhaíola Guaisí a fhorbairt chun dramhaíl ghuaiseach a chosc agus a bhainistiú.

Múscailt Feasachta agus Athrú Iompraíochta

- Feasacht chomhshaoil níos fearr a ghiniúint agus dul i bhfeidhm ar athrú iompraíochta dearfach trí thacú le gnóthais, le pobail agus le teaghlaigh a bheith níos éifeachtúla ar acmhainní.
- Tástáil le haghaidh radóin a chur chun cinn i dtithe agus in ionaid oibre, agus gníomhartha leasúcháin a spreagadh nuair is gá.

Bainistíocht agus struchtúr na Gníomhaireachta um Chaomhnú Comhshaoil

Tá an gníomhaíocht á bainistiú ag Bord Iáinimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóirí. Déantar an obair ar fud cúig cinn d'Oifigí:

- An Oifig um Inmharthanacht Comhshaoil
- An Oifig Forfheidhmithe i leith cúrsaí Comhshaoil
- An Oifig um Fianaise is Measúnú
- An Oifig um Cosaint Raideolaíoch
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag comhaltaí air agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair inniúla agus le comhairle a chur ar an mBord.

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Identifying Pressures

Pressures placed on the planet by human activities pose some of the most complex and demanding challenges facing societies and policy-makers across the globe. Observed increases in storm intensity and the challenges faced in adapting to climate change and seeking to preserve the quality of our environment while advancing socio-economic development illustrates that Ireland too is subject to such global pressures and thereby shares in the responsibility to address them. In recent years, the Irish planning system has been reshaped in response to the challenges posed by these issues. There now exists enormous pressure on planners and allied professionals to respond to such pressing issues when formulating land use plans.

Informing Policy

This report outlines how the 'green infrastructure' (GI) concept can help planners and allied professionals respond to the challenges posed by these pressures when formulating spatial plans. The GI concept addresses multiple issues in an environmentally sensitive manner by promoting spatial connectivity and multifunctionality. This report outlines how employing the GI concept enables those working within the planning system to meet a diverse array of complicated objectives that often seem to conflict. It describes how this can be achieved by simply enhancing certain existing work practices to better facilitate a more context sensitive form of planning that supplies a range of mutually reinforcing social, economic and environmental benefits.

Developing Solutions

This report seeks to assist planners and allied professionals involved in the formulation of spatial plans by providing a knowledge base and guidance for integrating the GI concept into spatial planning practice. It forms part of a suite of GI-related resources produced and collated in this project. In particular, it provides the evidence base for, and accompanies a 'How To Guide' (EPA Research Report 182), which describes an interactive workshop that fosters novel perspectives on spatial policy formulation and new collaborative working arrangements between a range of professionals.

The materials and instructions for running this workshop are available from www.ecoplanresearch.org and <http://erc.epa.ie/safer>.

