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# Mapping Green Dublin: Strategic Pathways to Community-led Greening

Authors: Alma Clavin, Niamh Moore-Cherry and Gerald Mills

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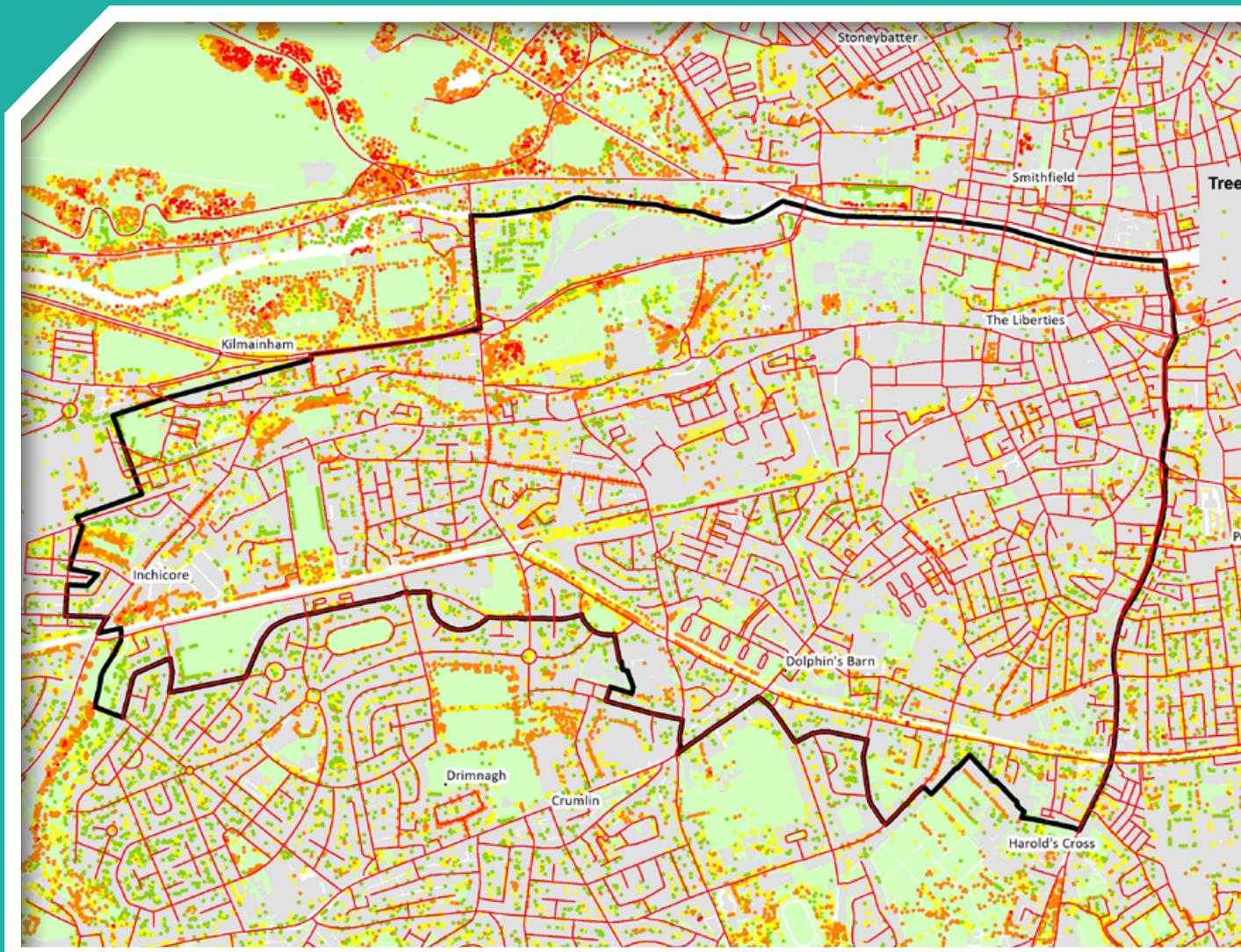
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- Office of Evidence and Assessment
- Office of Radiation Protection and Environmental Monitoring
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Mapping Green Dublin: Strategic Pathways to Community-led Greening

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EPA Research Report

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by

School of Geography, University College Dublin

Authors:

Alma Clavin, Niamh Moore-Cherry and Gerald Mills

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DISCLAIMER

Project Partners

UCD School of Geography
Newman Building
University College Dublin
Belfield
Dublin 4
Ireland
Tel: +353 1 716 8179
Email: geography@ucd.ie

Common Ground
St Vincent Street West
Inchicore
Dublin 8
Ireland
Tel.: +353 1 707 8766
Email: info@commonground.ie

Seoidín O'Sullivan
St Vincent Street West
Inchicore
Dublin 8
Ireland
Tel.: +353 1 707 8766
Email: iseoidin@gmail.com

Connect the Dots
The Tara Building
Tara Street
Dublin 2
Ireland
Tel.: +353 89 228 8108
Email: connectthedotsdublin@gmail.com

Contents

List of Figures

List of Tables

Executive Summary

Mapping Green Dublin (MGD) is a collaborative action research project that has developed and adopted a novel co-creation approach, which involves engaging with a local community to enhance the green infrastructure of an inner-city neighbourhood. In this study, we focused our co-creation approach on an area of Dublin that corresponds loosely with the postcode area of Dublin 8, which occupies the east–west area extending along the Liffey from the Liberties in the city centre to Inchicore. MGD was undertaken in three distinct stages, each with its own distinct methodology:

1. **Mapping trees.** This involved digitising Dublin's urban "forest", assessing its geographical distribution and evaluating the associated ecosystem services. This work was completed for the entire Dublin City Council (DCC) area, with a focus on the Dublin 8 study area.

2. **Co-creation.** This involved participatory mapping techniques, critical art engagement practices and online survey questionnaires to gather community greening recommendations.

3. **Action.** This involved using design thinking methods to develop an urban prototyping workshop with members of the community in the area. Qualitative interview techniques were deployed to elicit a policy/practitioner response to the community recommendations co-developed in stage 2.

There are more than 300,000 trees in the DCC area, most of which are between 5 m and 15 m tall. About 40% of these are found in public parks and along roads. The remainder are found in small private gardens and larger private spaces. The distribution of trees is extremely variable. For every person in the DCC area, there are 0.55 trees and 37 m^2 of green area. Excluding the parts of the city that have few residents, the ratios are highest in the suburbs and lowest in the city centre. On average, there are 13.5 m^2 of green area and 0.41 trees per person in residential neighbourhoods, and there are 9.9 m^2 of green area and 0.22 trees per person in the Dublin 8 study area specifically. The ratios of tree cover are highest where there is least traffic and lowest where there is most traffic.

This geographical information was used in MGD to support co-creation using community collaboration, arts practice and knowledge-sharing. The project proposes particular methods of co-creation for community engagement that highlight the greening issues that most affect wellbeing and quality of life. A transition from a technocratic, expert-led approach to co-creation changes the roles of the expert, the researcher and local communities. The implications of this shift for built environment policymakers and practitioners are enormous, creating new domains of collective creativity and capacity that could support a transformation towards more sustainable ways of living in the future. Based on an integration of community and policy/practitioner recommendations, a definitive set of actions are proposed to realise the potential of the community greening strategy and move towards a more just and inclusive approach to green infrastructure development.

The results of the MGD project have significant potential to support radical change in green infrastructure development, planning and practice across a number of domains. In particular, the development of a scientific evidence base that is shared equally with policymakers and the community provides an opportunity to develop more inclusive planning practices and enable more effective community participation. The co-creation approach adopted provides a model for other cities and communities to develop more socially and environmentally just green infrastructure and counter some of the recent criticisms of urban greening as a driver of gentrification. Finally, the co-creation approach and re-grounding has produced a set of actions that may be key to enabling a radical transformation of the greening agenda in Dublin, with major implications for biodiversity, climate change, more sustainable urban development and a more just transition that recognises the interconnectedness of urban vulnerabilities, greening and wellbeing. The work has culminated in a community greening strategy document, which has been made available on the MGD project website (www.mappinggreendublin.com).

1   Introduction

This report describes Mapping Green Dublin (MGD), a collaborative action research project led by the University College Dublin (UCD) School of Geography, in partnership with arts organisation Common Ground, artist Seoidín O'Sullivan and event facilitator Connect the Dots. MGD is based on the recognition of the value of lived experience in maximising community health and wellbeing. It has developed a new approach to greening strategy-making that is grounded in the community, collaboration and broader ideas of social and environmental justice. The MGD team worked with non-academic partners, local residents and other stakeholders to identify their greening needs and co-create a community greening strategy, which is a key output of this project.

The EU defines green infrastructure (GI) as a

> strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services such as water purification, air quality, space for recreation and climate mitigation and adaptation. This network of green (land) and blue (water) spaces can improve environmental conditions and therefore citizens' health and quality of life. (European Commission, 2021)

A number of recent reports commissioned by the Environmental Protection Agency (EPA) and the Health Service Executive have examined greenspaces as health-enabling environments (Carlin *et al*., 2020; Scott *et al*., 2020). Empirical evidence shows strong links between access and exposure to nature and health outcomes (Foley *et al*., 2016), with an increasing number of visits to nature leading to more positive health outcomes (Ahrens *et al*., 2019). To ensure that greening strategies optimise the benefits for end users, they must be fit for purpose and achieve the goals and meet the needs of a wide range of stakeholders.

The alternative approach to green strategy-making that MGD proposes begins by drawing on and responding to grassroots concerns and aspirations, and engages with policymakers to explore how community visions can inform and be supported by more formal policies and plans. The project exemplifies how communities can engage with scientific data and develop both local and strategic recommendations and projects towards action. Through co-creation approaches, the project has opened a critical space within the urban greening discourse to reconfigure perspectives not only on the provision and quality of urban trees and greenspaces, but also on the associated dimensions of environmental and social justice (such as housing, walkability and access to nature), as well as associated impacts on wellbeing and on youth and community development resourcing and involvement.

GI includes private gardens, public parks, a variety of other spaces (e.g. school playgrounds, club pitches and golf courses) and trees. The types of ecosystem services provided by GI include soil, water and air management and biodiversity, but the magnitude of these services depends on the extent of GI and its spatial and compositional structure. Spatial structure refers to the geographical layout of GI and its correspondence with other natural features (such as rivers), and compositional structure refers to vegetative composition (species variety, health and maturity). In cities, trees provide an essential component of GI, as they are often inserted into the paved landscape and provide a link between the sealed soil layer and the atmosphere. In this respect, they can be placed strategically to provide specific functions to mitigate emissions associated with traffic and to provide corridors to link greenspaces in the city. Apart from their biophysical contributions, road tree plantings may be a valuable community asset that can add economic and aesthetic value to neighbourhoods.

1.1   Objectives

The aim of MGD was to develop a co-creation approach to enhance the GI of an inner-city

neighbourhood in Dublin that has a deficit of greenspaces. The four objectives of MGD were to:

1. identify the current extent of GI within Dublin city;

2. present this information to the communities within the chosen study area;

3. work with these communities to explore greening strengths, deficits and opportunities for appropriate future greening;

4. present community greening recommendations to local policymakers/practitioners to identify action points for future greening policy and practice.

In this study, we focused our co-creation approach on an area of Dublin that corresponds loosely with the postcode area of Dublin 8, which occupies the east–west area extending along the Liffey from the Liberties in the city centre to Inchicore. Throughout this report, Dublin 8 (D8) is used to describe the spatial focus of MGD.

2   The Policy Context

The planning and design of GI is the accepted mode of delivering a strategic greening plan for a city. GI is based on the principle that "protecting and enhancing nature and natural processes […] are consciously integrated into spatial planning and territorial development" (European Commission, 2013). Accordingly, the Green Infrastructure Strategy defines GI as "a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services" in both rural and urban settings (EC, 2013). Much of the impetus behind the development of GI has been its contribution to tackling climate change and supporting biodiversity. The London GI plan (The All London Green Grid)[1] is a well-cited example of a comprehensive plan for greening a city. Although Dublin does not currently have a city-wide greening strategy, it has developed a number of local greening strategies [e.g. The Liberties Greening Strategy (2015–2021/2), the Stoneybatter Greening Strategy (2020) and the North East Inner City Greening Strategy (2018)], all of which are led by Dublin City Council (DCC). Figure 2.1 shows two examples of recent greening developments in Pimlico, Dublin. Urban greening or the development of GI is informed by and embedded within policies and plans at a range of spatial scales, each of which is necessary to understand the context for neighbourhood greening and the gap that exists in terms of community-led strategy making.

2.1   The National Policy Context

A GI approach includes not only protecting but also enhancing, restoring, creating and designing new ecological networks characterised by multifunctionality and connectivity (Lennon and Scott, 2014). This approach to the planning of greenspace treats GI assets as a fundamental biophysical infrastructure that must be considered in any urban (re)development alongside issues of spatial interconnectivity, multifunctionality and interdisciplinary collaboration

Figure 2.1. Examples of GI in Dublin. Credit: G. Mills.

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1   https://www.london.gov.uk/what-we-do/environment/parks-green-spaces-and-biodiversity/all-london-green-grid#acc-i-45470 (accessed 1 December 2021).

(Lennon *et al*., 2016). In Ireland, there is limited formal policy recognition of the importance of GI or clear guidance for strategy development. For example, the *Climate Action Plan 2019: To Tackle Climate Breakdown* (DECC, 2019) makes no reference to the potential contribution of GI as a component of mitigation and/or adaptation policy. The more recent *National Energy and Climate Plan, 2021–2030* (DECC, 2020) makes one reference to GI (p. 104) in a discussion on biodiversity and natural capital accounting, linked perhaps to the acknowledgement in the *National Biodiversity Action Plan 2017–2021* (DCHG, 2017) of its importance.

The National Planning Framework (DHPLG, 2018), adopted in February 2018, does make significant reference in principle to the importance of GI, particularly in urban areas. The document outlines the general principles and framework within which the entire planning system and investment decision-making will be realigned. The core concepts relate to achieving regional balance, optimising investment through concentration in a smaller number of growth centres, achieving compact growth within urban centres and achieving alignment with capital investment and infrastructure delivery. Critically, the regional scale is identified as being a crucial driver to achieve the range of national strategic objectives identified, which marks a significant shift in thinking. Within this document, GI planning is advocated as a way to protect and value "our important and vulnerable habitats, landscapes, natural heritage and green spaces" (DHPLG, 2018, p. 117) and "to enhance the resilience of human and natural systems in the face of climate change, such as creation of green spaces and parks to enable better management of urban micro-climates" (DHPLG, 2018, p. 120). Two national planning objectives (NPOs) are relevant here:

- NPO 58: integrated planning for GI and ecosystem services will be incorporated into the preparation of statutory land use plans.
- NPO 62: the value of greenbelts and greenspaces at a regional and city scales will be identified and strengthened, to enable enhanced connectivity to wider strategic networks, prevent coalescence of settlements and to allow for the long-term strategic expansion of urban areas.

There is a call for GI planning to inform the preparation of regional and metropolitan strategies and city and county development plans (DHPLG, 2018, p. 125), but there has been no clear statement of how this is to be delivered in practice.

At the national level there is a policy vacuum in relation to GI planning, strategy-making and action. Leadership in this arena has been devolved to the regional and local scales, with GI cutting across, and being relevant to, a range of regional, local and neighbourhood plans, strategies and policies. Figure 2.2 illustrates this complex landscape within which "urban greening" is situated and illustrates the difficulties faced by community-led greening initiatives to find visibility and voice.

2.2   The Regional Scale

The National Planning Framework identifies the regional level as critical to mediate between the overarching principles of the national plan and the realities of implementation and alignment at the local level. In January 2015, three new regional assemblies were established, and each of them was tasked with developing Regional Spatial and Economic Strategies (RSESs) as a priority. The RSESs are required under the Planning and Development Act 2000 (as amended) to address employment, retail, housing, transport, water services, energy and communications, waste management, education, health, sports and community facilities, environment and heritage, landscape, sustainable development and climate change. For successful implementation, the RSESs require interaction with and between national sectoral plans. In the five cities (Dublin, Cork, Limerick, Galway and Waterford), metropolitan area spatial plans have been produced to aid collaboration across boundaries.

The 2019–2023 Eastern and Midland Regional Assembly RSES sets out 16 regional strategic outcomes (RSOs), which are aligned with international, EU and national policy and in turn set the framework for city and county development plans and local area plans (LAPs). The strategy can assist local authorities in aligning with EU priorities to leverage funding and partnership opportunities (EMRA, 2019, p. 24), one of which is enhanced GI. The RSES sees GI not only as having intrinsic benefits but also as part of climate
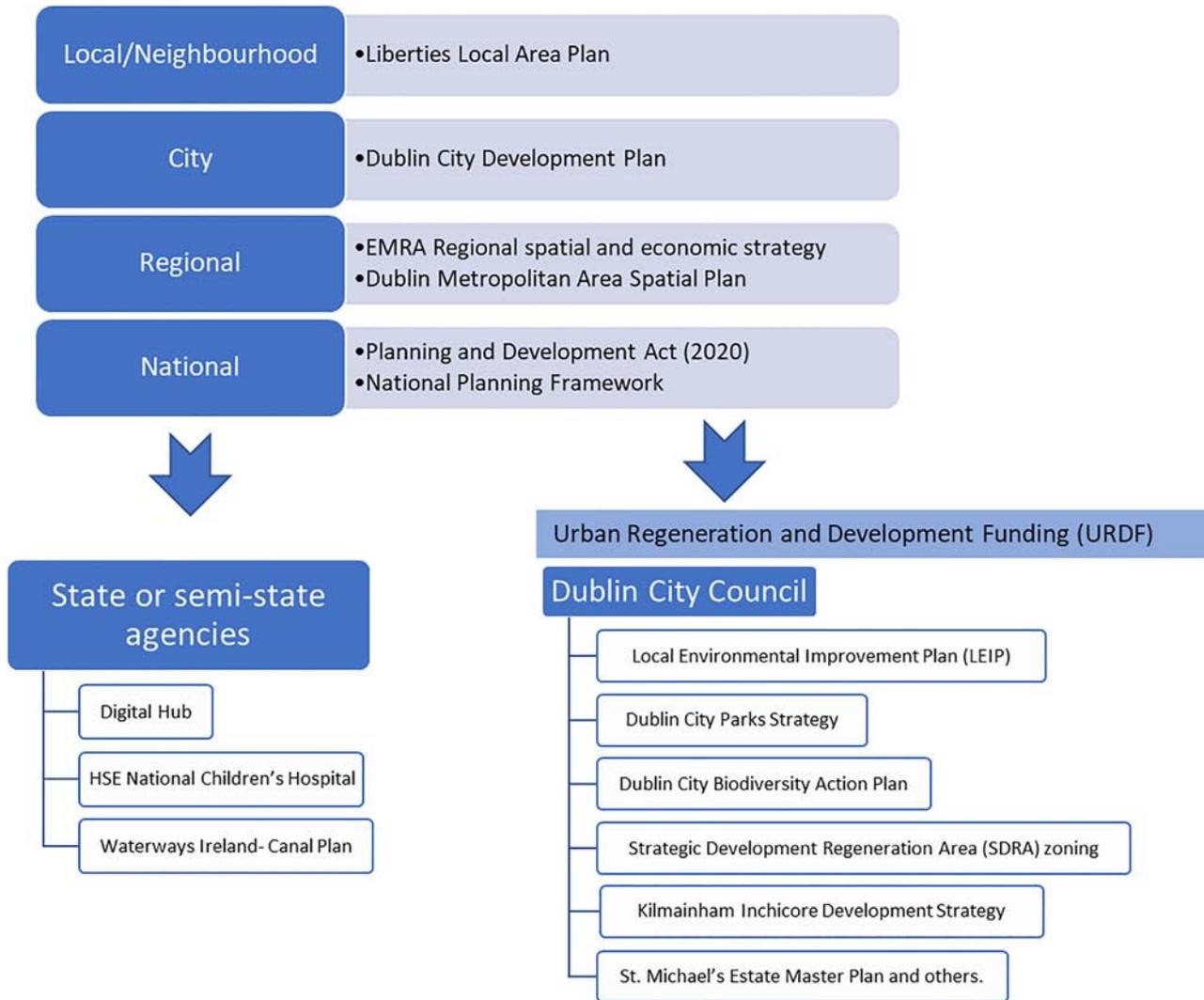
Figure 2.2. Planning context of greening in Dublin city. EMRA, Eastern and Midland Regional Assembly.

change adaption through the creation of a greenway[2] (and blueway) network in the region.

Embedded in the RSES is the Dublin Metropolitan Area Spatial Plan. This plan covers the area broadly comprising the four local authorities within County Dublin and parts of three other local authority areas. The Metropolitan Area Strategic Plan aspires to enhance the provision of regional parks and strategic GI and develop an integrated network of greenways/blueways along the canals, rivers and coast. Six greenways are proposed, including the

Grand Canal Greenway in Dublin, and there is recognised potential for strategic radial routes to link into other greenways, such as those proposed and under development along the rivers Tolka, Santry, Poddle and Camac, the last of which flows through the D8 study area. The identification and mapping of existing GI assets is identified as an important task to support management and for the further development of strategic connections (EMRA, 2019, p. 118). The EU-funded EnRoute project (https://oppla.eu/ casestudy/19264), of which the Eastern and Midland Regional Assembly was a partner, produced a

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2   Greenways are high-quality cycleways that are generally segregated from traffic and are often routed through parks and areas of high amenity value, such as coastal, canal and riverside routes. Where greenways pass through a designated environmental area, careful environmental assessment, routing and design will be required to avoid significant impacts on habitats and species (EMRA, 2019, p. 109).

common set of indicators to monitor GI and support a GI policy for the Dublin region. The mapping undertaken (EMRA, 2019, p. 119) demonstrates significant areas of green deprivation, particularly within inner-city Dublin, broadly defined as the area between the Royal and Grand Canals. The RSES sets out guiding principles for GI policy and development based on a range of EU and national environmental policies, plans and directives. These are technical in nature, governed through structures privileging technical working groups and senior officials, and, although there is acknowledgement of the important of GI for health, there is no indication of how civil society can inform or help drive this agenda.

2.3   The Dublin City Context

Within Dublin city, the *Dublin City Council Development Plan 2016–2022* (DCC, 2016a), which is currently under review and revision, is the main statutory document relevant to greening policy and practice. Part of the current review is to align it more closely with the RSES objectives for the region. The current city development plan commits to "actively promot[ing] a green infrastructure strategy which draws on the Council's sustainability principles" (DCC, 2016a, p. 164). The core theme on open space and recreation focuses on GI explicitly, although the theme cuts across many other areas, including sustainable housing and climate change. The plan recognises the role that GI can play in supporting community voluntary actions but does not articulate a vision for community engagement in developing the policies and objectives. Objective GI015 aspires "to engage with and involve corporate volunteers, landowners and relevant agencies to support their communities in the development and delivery of green infrastructure programmes" (DCC, 2016a, p. 167), but the mechanisms for effectively engaging civil society partners are not explicit.

Districts that are designated as Strategic Development and Regeneration Areas (SDRAs) have specific importance for GI development. These areas are considered to have substantial development capacity, and a series of detailed guiding principles incorporating urban design and GI guidance have been set out for each of them. There are 18 SDRAs in the Dublin City Development Plan 2016–2022 and "it is anticipated that…SDRAs, will drive the delivery

of sustainable, dynamic urban centres" (DCC, 2016a, p. 53) through individual masterplans that will provide the design detail for the provision of greenspace. Although the masterplan as a planning tool has been criticised within built environment practice (UN-Habitat, 2009; Bullivant, 2012, 2014) because of its traditional top-down and technically driven approach, the masterplan is the dominant tool in planning large urban sites. As detailed later in the report, significant planning is currently under way on a number of sites within our study area and one-third of all designated SDRAs in Dublin city are located within Dublin 8.

As well as the development plan, SDRA objectives and site-specific masterplans, other plans and strategies have a role to play in supporting and advocating for GI. Of note are the *Dublin City Council Parks Strategy 2019–2022* (DCC, 2019) and the *Dublin City Council Tree Strategy 2016–2020* (DCC, 2016b). The Parks Strategy makes clear links between urban greening and the quality of urban life and notes the contribution that GI can make to climate change adaptation and mitigation, as well as to recreation, health, tourism and social cohesion. Reference is made to community engagement in Chapter 3, but this is focused on two aspects: (1) perceptions of parks and their use gleaned from a questionnaire survey to inform the strategy and (2) community volunteering in parks. The strategy proposes to "support and promote volunteering to realise public goodwill and enhance engagement with the community in their local environment" and to do this by studying "the feasibility of establishing a Dublin Parks Volunteer Programme" (DCC, 2019, p. 37). Although recognising the potential of civil society, in the form of volunteers, to contribute to GI maintenance, the strategy has a limited view of the role that community can play in developing strategy and informing specific interventions.

2.4   Neighbourhood Planning

At the level below the city development plan, LAPs set out the strategy and context for sustainable urban development for sub-areas within the city. They take a more fine-grained approach to delivering the core strategy for the city at the neighbourhood level. The Liberties Local Area Plan, which covers the eastern end of our study area, was established in 2009 and expired in May 2020. The strategy noted that most greenspace within the area was private

or semi-private and comprised institutional lands, derelict sites, apartment blocks or private gardens. Public open space was generally of low quality. A more recent analysis suggests that accessible, high-quality greenspace is provided at a rate of $0.7\,m^2$ per person in the Liberties, in stark contrast to an average of $49\,m^2$ per person in the wider Dublin area (DCC, 2015). The publication of the *Liberties Greening Strategy 2015* (DCC, 2015) was a key step in addressing this deficit and has led to some significant achievements, such as the development of Weaver Park. However, the overall impact of the strategy has been patchy, and it is currently under review. This provides an opportunity to harness the aspirations of the regional, metropolitan and city strategic objectives at the local level.

As noted earlier, SDRA zoning in the city can substantially contribute to greenspace development given the detailed guiding principles incorporating urban design and GI guidance set out for each of them. Currently, there are six areas with SDRA designation in Dublin 8: St Teresa's Gardens, St Michael's Estate, Dolphin House, the Liberties (including the Digital Hub), St James's medical campus and Heuston station (including parts of Kilmainham). The framework conditions are therefore in place to dramatically transform urban greening and develop GI, but the governance mechanisms are fragmented and hinder progress. The responsibility for greening and GI is spread across multiple local authority departments and units, and there is thus limited ownership of this agenda. This lacuna is not unique to Dublin and is recognised internationally. Lennon *et al.* (2016) argue that GI offers an opportunity to work at a variety of scales – regional and metropolitan to local – and collaboratively across disciplines, but the practice of GI at the local neighbourhood scale is underdeveloped.

2.5 A Case for Community Greening in Dublin 8

The development of a local or neighbourhood greening strategy requires collaborative learning (Goldstein, 2009) and experimentation (Ahern, 2011), wherein social–ecological systems are seen to be co-produced and co-evolve with locally grounded scientific administrative knowledge (Evans, 2011). The fragmented scales of urban planning and policy

implementation in Dublin and the ad hoc nature of local development planning point to weak relationships at the local scale, which is the optimum nexus for planning, greening and community wellbeing. This weakness is compounded by a layering of social, environmental and economic vulnerabilities. Rather than simply focusing on increased zoning and the provision of greenspace in Dublin, the planning and design of greening needs to be perceived as an entire ecology of social inclusivity (Wilson *et al.*, 2008; Bullivant, 2014), requiring situational research and local praxis.

In the Dublin 8 context, the added pressure of living in what is perceived to be an overdeveloped area with profound and rapid large-scale transformations under way has left residents feeling powerless and voiceless (SICCDA, 2019). Moreover, the impact of the COVID-19 pandemic on the wellbeing and quality of life of urban dwellers has thrown into sharp contrast the variable access to good-quality greenspace within neighbourhoods across the city and raised community demands in relation to access to nature and greenspace for all, especially closest to where people live. Although there have been many strategies, plans and policies, there is limited evidence of their efficacy; communities are now demanding a new approach to shaping their living environments. This approach fits with national policies on the Just Transition (McCabe, 2020; NESC, 2020), as the economy and society adjust to climate change; specifically, it "embodies a commitment to a participative process of in-depth exploration with stakeholders and those experiencing the transition and change first-hand" (NESC, 2020). Urban communities are increasingly aware of environmental burdens and their uneven distribution in the city, and of the need to adopt new approaches that incorporate new voices to ensure that future planning is more inclusive and responsive to their needs.

Across Europe, there is an emerging interest in community-based coalitions for socially and environmentally just greening (see https://urban-arena. eu). There is also a keen interest in citizen science and engaging communities and civil society groups in co-creating and using scientific evidence to shape planning, policy and practice. The European Green Deal (2019) advocates for the adoption of a natural capital accounting[3] approach as a way to protect and

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3 https://ec.europa.eu/environment/nature/capital_accounting/index_en.htm (accessed 7 September 2021).

conserve natural capital and promote societal health and wellbeing. The interim report of the EPA INCASE project[4] acknowledges the value of this approach in understanding and addressing environmental pressures and impacts. If appropriately collated and communicated, there is significant potential for local community coalitions to harness this evidence base to advocate for more just GI planning and implementation.

The MGD project has aspired to do just that. The policy vacuum and fragmentation of GI governance at the local level has created a space for alternative approaches to be developed and tested within the context of significant development pressure and also transformational opportunity. The project has developed a model for community engagement on urban greening that begins with the experience of living in a particular context. It provides a template for including community perspectives in local greening practices and develops a new approach to greening policy development and praxis that begins at the grassroots and provides communities with access to the same evidence base as officials and technical groups. An urban prototyping toolkit has been developed to support communities in developing their greening ideas and articulating them to local officials.

More locally, the community greening strategy and recommendations developed as part of the project provide a ready-made and grounded input into the new government-funded Kilmainham Inchicore Development Framework, DCC's Biodiversity and Climate Action Plans and the future masterplans (e.g. for housing complexes or the canal area) for the area.

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4   https://www.incaseproject.com (accessed 7 September 2021).

3   Methodology

Mapping Green Dublin was undertaken in three distinct stages (Figure 3.1), each with its own distinct methodology:

- **Stage 1 – Mapping trees.** This was mostly completed by September 2020 and involved the use of a geographical information system (GIS) to digitise the urban "forest" and assess its ecosystem services. This work was completed for the entire DCC area, with a focus on the D8 study area. The primary motivation was to provide the evidence needed to support the co-creation of a greening strategy.
- **Stage 2 – Co-creation.** This involved participatory mapping techniques, critical art engagement practices and online survey questionnaires to gather community greening recommendations.
- **Stage 3 – Action.** This involved using design thinking methods to develop an urban prototyping workshop with members of the community in the area. Qualitative interview techniques were deployed to elicit a policy/practitioner response to the community recommendations co-developed in stage 2.

3.1   Stage 1 – Mapping Trees

Information on green cover is available for cities in Europe, including Dublin, at Urban Atlas (https://land.copernicus.eu/local/urban-atlas). These data show relatively large open green areas (minimum mapping unit of 500 m², with a minimum mapping width of 10 m) across the metropolitan area. These data are suitable for large-scale urban planning but are of limited value at neighbourhood scales, where much of the green cover exists in the form of small parks, private gardens and cemeteries, for example. Moreover, there is no detailed mapping of trees, which form an important component of the GI in urban areas especially. MGD undertook the task of mapping the trees in the DCC area to complement existing information on public green areas. These data were needed to evaluate the relative provision of GI in different neighbourhoods and provide a context for assessing the D8 study area. A variety of datasets were employed to map the GI across the DCC area, analyse geographical patterns and identify areas of deficit, and evaluate ecosystem services (Table 3.1). These datasets can be categorised into those directly associated with GI (green cover and trees) and those that provide physical (e.g. rivers and road networks), environmental (e.g. traffic) and sociodemographic (e.g. 2016 household and workplace censuses) contexts.

The basic land cover of the DCC area is shown in Figure 3.2. This geography shows the locations of green areas across the city alongside built cover and the road network. The built area includes private gardens of dwellings.
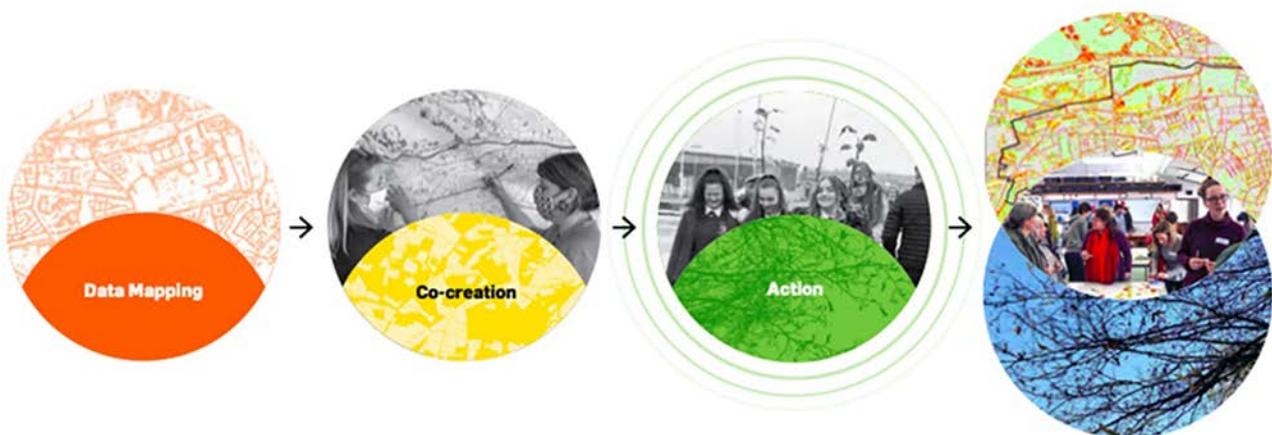
Figure 3.1. The three project stages: mapping of data, co-creation and action.

Table 3.1. A list of the main sources of information used in the MGD project

Data	Source	Content
Prime2 OSi dataset (https://osi.ie/)	Ordnance Survey Ireland	Vector data: roads, building footprints, parks, water
2016 household and workplace census	Central Statistics Office	Residential population data for small areas and work population for workplace zones
Dublin City traffic	Traffic department SCATS system	Traffic count by hour along sections of the road network
Aerial image	BlueSky (July 2018)	High-resolution data (12 cm; red, green, blue and near-infrared)
Digital elevation model	BlueSky (July 2018)	High-resolution Lidar data (1 m)
Tree information	Fieldwork and crowd-sourced data	Tree dimensions (height and diameter at breast height) and species

Lidar, light detection and ranging; OSi, Ordnance Survey Ireland; SCATS, Sydney Coordinated Adaptive Traffic System.
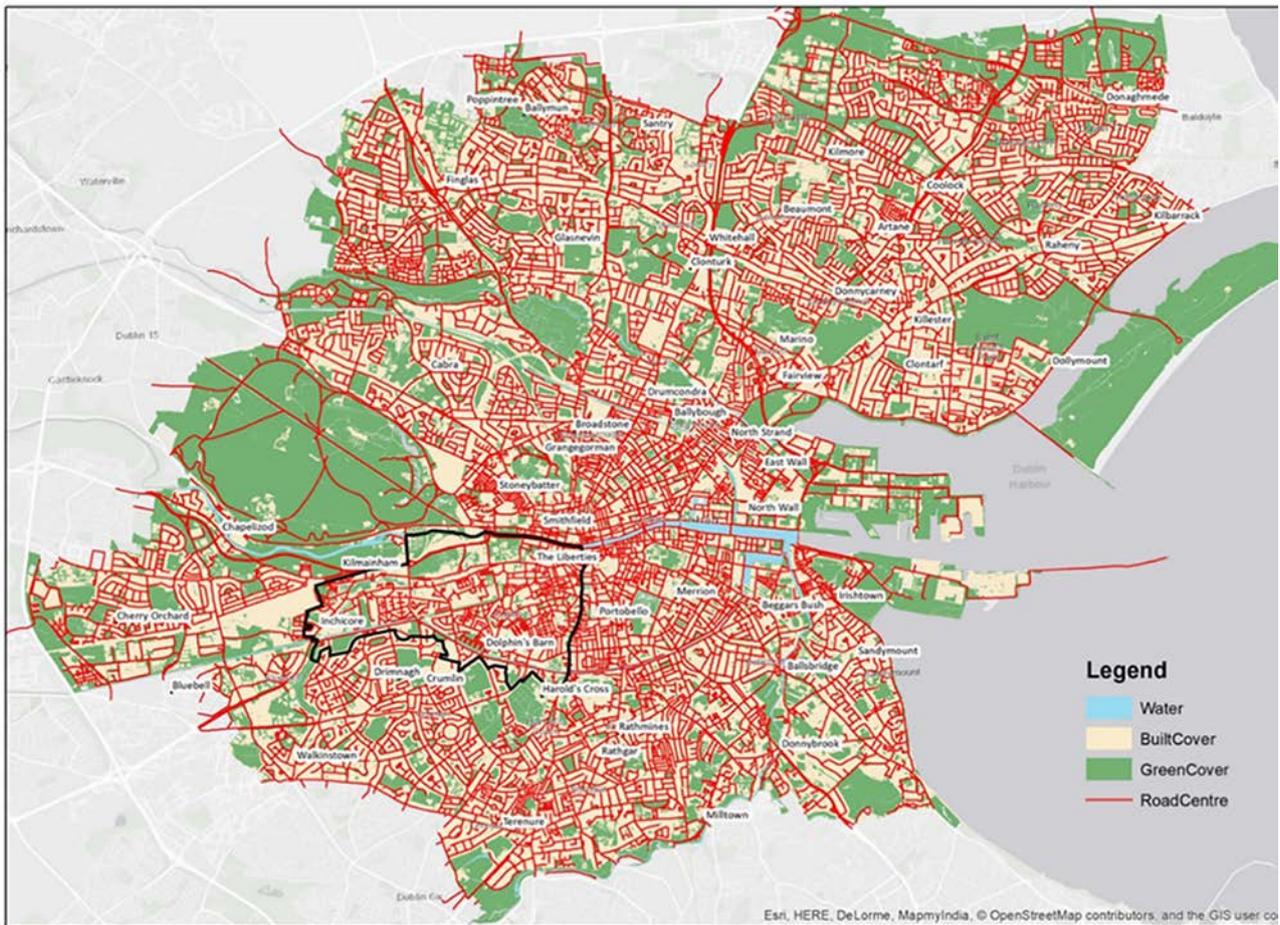
Figure 3.2. The DCC area. The black line outlines the D8 study area. The landcover information is from the Ordnance Survey Prime2 dataset and the background map is provided by OpenStreetMap under the Open Database Licence (CC BY-SA 2.0; https://creativecommons.org/licenses/by-sa/2.0/).

The trees in the DCC area were digitised from a detailed aerial image obtained in July 2018, when the trees were in leaf and individual tree canopies were readily identifiable. The location of each tree was digitised using ArcView GIS, based on the centre of the tree canopy. This process took 6 months, and several volunteer students participated. The locations of trees were superimposed on a digital elevation model (DEM), and the estimated height of tree canopies was extracted. This attribute is a valuable indicator of tree size and maturity when combined with information on tree species. This estimate will contain

some error given the resolution of the DEM (1 m) and placement of the canopy centre; however, error is likely to be largest for the smallest tree canopies.

Further information on trees was obtained from two sources:

1. Tine Ningal and Cathal Cullivan, at UCD, recorded the height of trees, the diameter at breast height (DBH) and species for a sample of trees planted next to roads (street trees) as part of fieldwork.

2. Information on trees provided by users of CURIO, a mobile phone application (app), allowed citizens to report on tree attributes, including the species.

Each tree was assigned a unique identification code that was used to link these locations to attributes gathered by individuals as part of fieldwork (e.g. Ningal *et al*., 2010) or using the CURIO app. The tree location and height data are publicly available at Zenodo,[5] a data-sharing website.

3.1.1 *The locations and distribution of trees*

A critical part of the MGD project was the generation of GI information that supported the co-creation process. Much of this was provided in the form of maps and tables that showed the uneven distribution of trees and parks across the city and which compared the study area (D8) with the surrounding city. Initially, simple counts of trees by height were calculated for public parks, along roads, within private domestic gardens and within large private spaces (school grounds, golf courses, etc.). Subsequently, tree coverage and open greenspaces across the urban landscape were evaluated and compared with the distribution of daytime and night-time population. To evaluate the services provided by trees, the carbon storage of the urban forest was compared with estimated emissions from traffic.

These analyses required a common geographical framework that would allow us to collate spatial information obtained for different features. For example, census information on household and workplace population (referred to as night-time and daytime populations) was available for small

areas and workplace zones, respectively.[6] Traffic data were available for road networks. The geographical frame that was created consisted of a grid of cells (200 × 200 m or 4 hectares) superimposed on the DCC area:

- Area-based data (e.g. household and workplace census data and green cover) were split according to grid-cell membership, and the cell values for population were calculated based on the fractional contribution of the census areas.
- Line-based data (traffic and road data) were split into sections based on membership of each cell. The traffic count for each cell was calculated from the traffic counts for each road segment in that cell.
- Point-based data (tree locations and heights) were counted based on cell membership.

Adopting a common geographical frame allowed all these data to be mapped and compared at the same scale.

3.1.2 *Ecosystem services*

Trees provide a great variety of ecosystem services in terms of biodiversity, rainfall management and air quality improvement. To evaluate these contributions, information on tree species, dimensions and health are needed. The species indicates the growth rate of the plant, its canopy architecture and height at maturity. As the tree grows, its canopy size increases (more leaf area), it stores more carbon in its trunk, branches and roots, and it sequesters more carbon on an annual basis. The DBH of the tree trunk is conventionally used as a measure of the maturity of the tree and the amount of carbon dioxide (CO_2) that is sequestered by, and stored within, the tree. Trees also exchange other gases such as nitrogen oxides; these are present in excess concentrations in the urban atmosphere as a pollutant and are mainly sourced from vehicles. In addition, the canopy slows the passage of air and traps airborne particulate matter on the leaf surfaces. Trees can also contribute to local air quality, as they may emit volatile organic compounds (VOCs) that contribute to the formation of ozone. The leaf area

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5 https://zenodo.org/record/3813792#.YDYdFej7SUk (accessed 7 September 2021).

6 Small areas are areas of population generally comprising between 80 and 120 dwellings. Workplace zones have a range of between 100 and 400 workers and each zone contains a minimum of three workplaces.

index (LAI) is the ratio of the plant area of the canopy to the total surface area of the leaves. The LAI of trees is an important measure of their capacity to modify the atmosphere.

In the context of cities, the diversity of species, the variety of ages and the density and layout of trees are important. Trees placed alongside roads have a particular significance, as they are generally exposed to harsh conditions associated with limited access to soil nutrients and water, excessive air pollution and physical damage. For this reason, street trees are selected for their resilience and because they have limited species diversity; London plane, lime and maple are common street trees. By comparison, trees in parks exhibit greater diversity and, at the same age, are more likely to be larger and healthier than an equivalent tree planted on a street.

Many of the physical descriptors of trees (DBH, LAI, crown height, etc.) that are linked to environmental attributes (such as pollution removal or rainfall interception) are specific to the type of tree species. Arboriculture studies have developed allometric equations that establish relationships between these measures, such as between DBH and volume (McPherson *et al.*, 2016). The i-Tree Eco[7] software can use data collected in the field from trees throughout a study area; the software can also use local hourly air pollution and meteorological data to quantify forest structure, environmental effects and value to communities. To use this software, we need, at a minimum, tree species and DBH information, which is available here for a small sample of trees.

In this report, we use information from this sample to extrapolate to the DCC urban forest based on the relationship between canopy height and DBH. This relationship is applied to each of the trees in the forest database, but the analysis is carried out using the cell-based geography for DCC. These data are used to estimate CO_2 storage in the tree stock and provide an assessment of the ecosystem services provided. The cell-based traffic data are used to estimate CO_2 emissions across DCC and evaluate the geographical disparity between sources and sinks of CO_2 and their correspondence with the population. Finally, a more detailed analysis of the tree services within the D8 study area is generated using i-Tree Eco V6.

To support the co-creation phase of the project, the basic mapping of Dublin's urban forest was completed prior to the community engagement. These data were presented in the form of maps and tables to illustrate the uneven distribution of GI across the city and specifically to show the GI available in the D8 study area. This work was presented in the context of population density and traffic, which were used in combination to illustrate the intensity of urbanisation across the city. Some of the more detailed work on ecosystem services presented in this report was completed during and after the co-creation phase of the MGD project.

3.2 Stage 2 – Choice of Study Area and Co-creation Methodologies

3.2.1 *Identification of study area*

From September 2019 to July 2020, the team worked to co-create a greening plan with the communities of Dublin 8. First, the area under study needed to be defined to identify which groups to work with. The study area needed to be manageable for the timeframe of the research project and contain a threshold of civic society and community groups to work with. The study area covers Kilmainham, Inchicore, Rialto, Dolphin's Barn and the Liberties (Figure 3.3). Project partner Common Ground has a long relationship with the communities in this area. A map depicting the type of stakeholders originally identified by the project partner is also included.

While there are significant large-scale greenspaces across Dublin, such as Phoenix Park, St Stephen's Green and Merrion Square, the geography of greenspace is highly uneven. Trees, greenspace and associated amenities are unequally distributed, and there is a particular lack of green amenity within the area encompassed by the two canals. Attempts have been made to address this unevenness within the study area, for example through *The Liberties Greening Strategy 2015* (DCC, 2015). In other parts of Dublin 8, particularly in the villages of Kilmainham and Inchicore, a report commissioned by the Department of Housing, Planning and Local Government (Nolan, 2019) highlights local concerns about the visible appearance of the area, the lack of greenspace,

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7   https://www.itreetools.org/tools/i-tree-eco (accessed 7 September 2021).
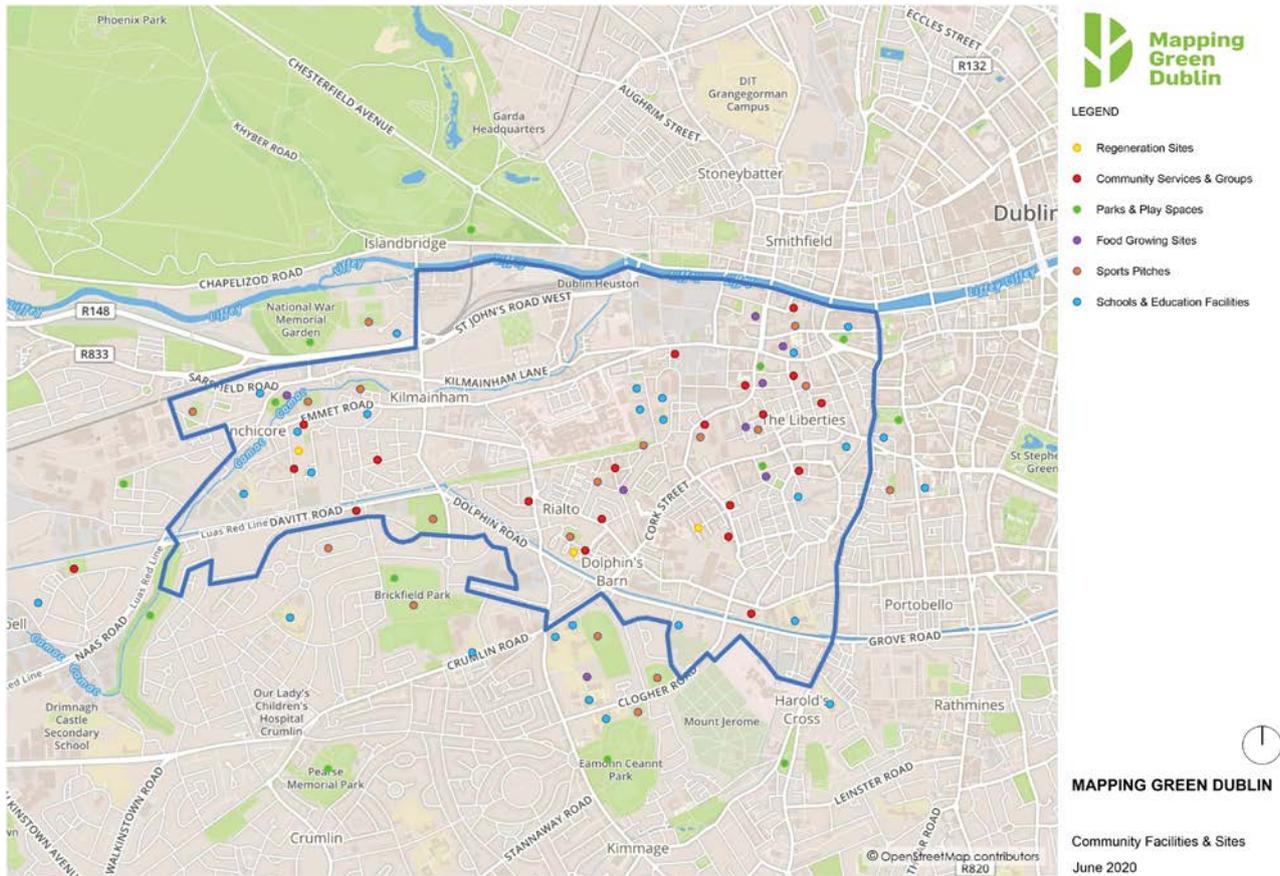
Figure 3.3. Initial mapping of community groups, organisations and associated spaces in the study area.

persistent intergenerational social problems and a sense of being left behind in terms of social and environmental infrastructure.

Although a range of excellent individual plans and people work on aspects of greening across the city council, its area offices and other agencies, implementation is difficult because of the lack of an identifiable office or unit responsible for coordinating greening in all of its elements. This also makes it exceptionally difficult for communities – particularly vulnerable communities – to engage with greening at the local level and to navigate the necessary institutional structures required to ensure that their voices and experiences are heard. The technocratic nature of the development plan-making process, land use zoning approaches and site-based design of the urban built environment complicate the transition to a holistic approach to greening, which needs to be considered by those responsible for housing, transport and crime. All these affect how greenspaces are provided and used and the impact they have on community health and wellbeing.

3.2.2   *Co-creation methods*

In developing an engagement strategy for community-led grassroots greening, varied and contested aspects of civic engagement are considered. Critiques of contemporary participatory methodologies (Cooke and Kothari, 2001) and academic insights into the depoliticisation of state-led community engagement practices (Fawcett and Marsh, 2014; Flinders and Wood, 2014) point towards a need for deep and more inclusive community engagement.

Co-creation has become increasingly popular in recent years as a concept, method and policy tool (Steinhaus *et al*., 2018). Co-creation has the potential to remove the boundaries between experts and citizens and to reconfigure participatory placemaking (Ermacora and Bullivant, 2016). At the same time, co-creation has been increasingly questioned in terms of enabling co-option by the state and cultural imperialism (Harvath and Carpenter, 2020).

MGD, while primarily about urban greening, provides a model for more bottom-up acquisition and sharing

of knowledge. The co-creation stage of the process (stage 2) involved presenting data that were mapped and analysed in stage 1 of the process; listening to the greening needs and desires of communities in the study area and expanding our knowledge of the strengths, deficits and opportunities as prompted by the map data; and, finally, re-grounding the project through the creation of a Dublin 8 community greening forum.

Mapping and re-mapping

Engagement with the tree and greenspace data for the entire city and more focused analysis on the study area provide both a greening context and recognition of the greening inequalities that exist. These maps were made available online and presented at community events. During the engagement process, further mapping needs were identified (e.g. pollution/traffic maps, maps of tree species and carbon sequestration, maps of public land and access, maps of vacant spaces) as the community became more engaged with the environmental issues and the relative impoverishment of GI in their neighbourhood. In this way, the mapping process was iterative in nature, mapping community assets and those aspects of the environment that concerned them and re-mapping these with the help of the community. Citizen science, specifically using the digital CURIO tree app,[8] was critical to empowering the community to learn about and contribute to knowledge-building about private and public trees.

Deep dialogue and mapping

Deep mapping workshops teased out various pathways to greening in the area at a variety of scales, first in the form of focus groups with those organisations and individuals already involved in local greening and social inclusion, and then opening the space out to all greenspace users in the area. Participants in the focus groups included local residents, such as residents of high-rise social housing complexes and members of residents' associations; people involved in local greening projects and art projects; members of the Men's Sheds Association, DCC business improvement districts and local sports clubs; and local environmental activists. The focus

group activity employed a "deep dialogue" and mapping approach in which site-specific, structural and strategic aspects of planning and greening were discussed, along with the mapping of greening strengths and deficits in the area. The focus group activities raised a number of issues that assisted in planning the exercises for the main community event, expanding themes while at the same time supporting the community to articulate their local greening needs.

On 7 March 2020, all users of greenspace in the D8 study area (i.e. those who lived or worked in or moved through the area) were invited to engage in a 1-day event at Inchicore Community College, located in the heart of the D8 study area. This **Pathway to Greening** event included an arts workshop for families and children, focusing on their favourite trees in Dublin 8, and an open mapping workshop adapting participatory workshop techniques (Chambers, 2002, 2006), where individuals and groups mapped the greening strengths, opportunities and deficits in the area. Finally, participants engaged in a "lunch dialogue," as part of which the experience of communal dining was combined with structured, facilitated conversation. These workshops created an opportunity to map out desires for, and expectations of, a community greening strategy: how this could be achieved, at what scale and what stakeholders needed to be involved (Figure 3.4).

The maps produced during the workshop were posted on social media to elicit further responses from those who were unable to attend the event on 7 March. This online (Typeform) survey was open from March to November 2020 and received 170 responses. The questions posed were those examined during the workshop:

- What works well in terms of greening in the area (greening strengths)?
- What has potential (greening opportunities)?
- What is not working so well (greening deficits)?

Mapping the hyperlocal

In the weeks following the March event, the government response to the COVID-19 pandemic resulted in a number of restrictions on face-to-face meetings and travel that affected the progress of MGD.

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8   https://www.curio.xyz/about (accessed 8 September 2021).

Figure 3.4. An open mapping session and lunch dialogue session at the 7 March 2020 launch event. Credit: Jason Sheridan.

Three sub-projects were developed to respond to the COVID-19 pandemic and the impact that restrictions had on how people used and experienced nature and greenspace in the area.

First, the PLOTS project was developed by Seoidín O'Sullivan to understand how people use their neighbourhood space. In late March, the government issued a "stay-at-home" order restricting movement to within 2 km. MGD took the opportunity to explore residents' use of their neighbourhood by mapping the movement routes (walk/run/cycle) of 15 people in their immediate locality (#2kmfromhome); plots were constructed digitally (using MyMaps) or by hand. This microgeographical mapping exercise linked people to their immediate environment, encouraging all users to consider the quality of their neighbourhood. Geographically localised analysis of people's experience of greenspace has been particularly relevant in high-density locations under COVID-19 restrictions. Recent research on how one's immediate environment has an impact on mental health (Houlden *et al*., 2019) has become more important in the context of the temporary 2 km (and subsequent 5 km) mobility restrictions implemented in spring/summer 2020 and again in winter/spring 2021 as a COVID-19 containment measure.

Second, a river access project (Camac go-along) was also developed to map the Camac river, an important greenway/blueway within the area, using an ArcMap story map approach,[9] which merges visual and textual information. This project was created by Ronan Foley, a health geographer at Maynooth University, and Seoidín O'Sullivan to tease out the issues of place experience and access. Seven individuals participated. This work complemented PLOTS by considering access to nearby nature and everyday microgeographies. Geographers of health and wellbeing draw from environmental psychology to consider additional microspatial elements of place fascination, attention restoration and nature connection. That work also considers more closely how such health-enabling or therapeutic spaces are produced and experienced, both actively and passively.

Third, interviews were also undertaken with members of four community and youth groups associated with housing complexes in the area (Oliver Bond, Dolphin House, St Michael's Estate – Core Youth, Fatima/Herberton) to examine how some of the most vulnerable in the area were experiencing COVID-19 and the associated restrictions, generally and in terms

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9   https://storymaps.arcgis.com/ (accessed 8 September 2021).

of their access to appropriate recreational spaces. The aims of these interviews were to:

- gather insights into how the individuals and groups they work with were affected by COVID-19 and associated lockdowns;
- identify how the future planning and design of open space and may respond to these COVID-19 pressures.

In addition, an open online COVID-19 impact survey was sent out via Twitter, which had 90 respondents. The survey was carried out in two stages; questions were posed first in March–July 2020 to capture the first wave of lockdown in Dublin (February–May 2020) and again in July–October 2020 to capture the second wave of lockdown (September–November 2020). Two open-ended questions were added to the main online community survey: (1) Has the way in which you use and experience greenspace changed during this period; if so, can you explain how? and (2) Are there greenspaces in your neighbourhood that you have recently discovered or rediscovered?

These various and scalar local knowledges were mapped to inform a deeper, multi-layered greening plan with strategic, appropriate and relevant objectives emerging. The recommendations that were gathered during stage 2 of the project were displayed online (www.mappinggreendublin.com) and posted online on Twitter (@DublinGreening) to prompt further responses through the online survey.

3.3   Stage 3 – Strategic Actions for Greening

During stage 3 of the project, the research was re-grounded with a group of interested individuals, with sites and ideas in mind for enhanced greening. Individuals interested in participating in a community-based coalition to become more active in driving greening projects in the area were identified and supported by the project team.

3.3.1   *A community greening forum*

The ways in which data and associated civic engagement can culminate in greening actions on the ground is of paramount importance in effecting

real change. Internationally, many high-profile parks and green public attractions have been critiqued for their inequality of access and gentrification effects (Anguelovski *et al*., 2019; Anguelovski, 2020). Actions emerging from civic engagement, whether tangible or intangible, smart/high-tech innovative nature-based solutions or lower tech community gardening initiatives, are more impactful when they originate from the community and/or can be evaluated for their social impact. The development of a community greening forum is one way to ensure that any greening plans are locally relevant, respond appropriately to the community's needs and are grounded in community action and empowerment.

During the 7 March 2020 community launch event, interested individuals signed up to be part of the Dublin 8 Greening Forum. Of the 35 who initially expressed interest, 12 became actively engaged in generating ideas for improving the GI within the study area. The forum has maintained discussions during the COVID-19 restrictions using email and the communication platform Slack.[10] An urban prototyping workshop, designed to develop these blossoming greening ideas into practical action, was run in August 2020 (Figure 3.5).

3.3.2   *Urban prototyping*

The prototyping workshop was created to support members of the community Greening Forum with specific projects in mind to develop their ideas and leverage relationships with other stakeholders to convert their project into actions. Exercises carried out during the workshop were borrowed from a range of design and community activist workshops and applied to a commonly used design thinking process. The full process is explained in an online guide produced for the MGD project (Schiffer and Clavin, 2020). The guide describes a series of sequential exercises and includes instructions for carrying them out and a list of the materials needed. The guide concludes with practical tips for setting up and running similar workshops. The document is open access and can be freely used by other communities.

A prototype is a physical object that looks and feels close to "the real thing". In contrast, prototyping suggests a process and specifically the testing and

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10 https://slack.com/intl/en-ie/ (accessed 8 September 2021).
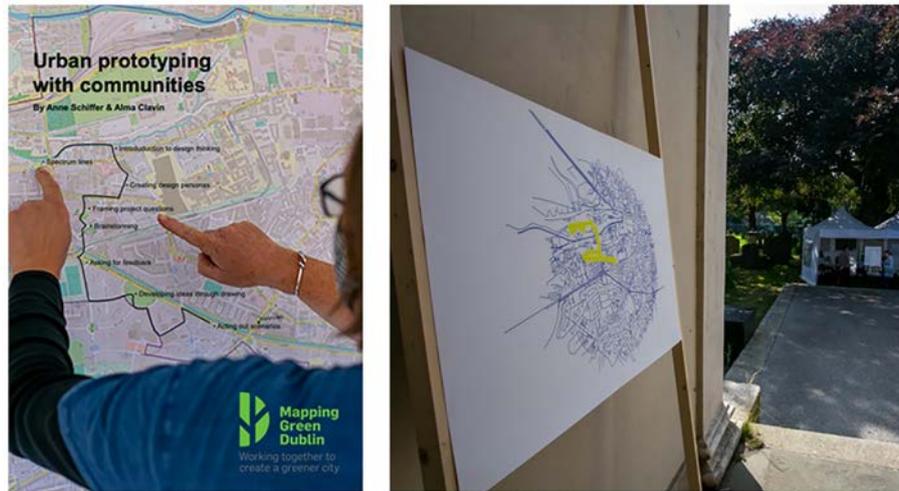
Figure 3.5. The urban prototyping tool was put into practice at an event that took place in August 2020 at Goldenbridge cemetery. Credit: Jason Sheridan.

refinement of ideas. In our study context, urban prototyping involved the framing, brainstorming, drawing out, designing, testing and refining of ideas relating to the urban environment, in this case local greening projects. Members of the Greening Forum developed greening ideas anew or further developed and refined pre-existing ideas and projects with support from landscape architects, architects, an ecologist and a city planner. The process was facilitated by the MGD project team.

3.3.3 Interviews with policymakers and practitioners

Although MGD began with a grassroots approach, the policy, planning and real-estate contexts are critical to realising community ambitions and projects. Online interviews were carried out with 13 policymakers and practitioners whose organisations work within the Dublin 8 area. Individuals/small groups from the following organisations participated:

- state/semi-state organisations – DCC (Departments of Planning, and Parks and Biodiversity; South-Central area), Waterways Ireland, the Digital Hub and National Children's Hospital;
- national non-governmental organisations – Irish Wildlife Trust and Mental Health Ireland;
- the community development and youth sector – Dolphin House, the Robert Emmett Centre, Fatima Groups United and Core Youth (St Michael's Estate).

During these semi-structured interviews, the community recommendations developed during the co-creation phase were presented for response. The set of community recommendations and associated maps, plus a set of policy/practitioner recommendations, were analysed qualitatively to culminate in a set of actions. These actions will be critical not only to deliver the community greening strategy, but also to realise the potential for wider GI development in the study area and wider city.

4 Findings and Outcomes

The main output from the MGD project is the greening strategy itself; however, each stage of the research process resulted in a set of maps and associated findings. All maps and tools are available online on the MGD website. Specific outcomes and outputs relating to the three stages of the project area are detailed below.

4.1 Stage 1 – Data Mapping

4.1.1 Dublin's urban forest

There are approximately 300,000 trees in the DCC area, with a clear concentration along some streets, in a few neighbourhoods and in public parks, especially in Phoenix Park. Figure 4.1 shows the distribution of trees by height categories across the DCC area. The pattern shows that the tallest trees (and by implication the most mature) are located in parks and in some neighbourhoods. Much of the suburban landscape has small tree plantings, indicating their relative immaturity. There are relatively few large and very large trees in the city centre.

The spatial concentration in tree cover is more apparent in Figure 4.2, which shows relative tree density (trees per hectare) in six categories, from low to high, according to the deviation from the mean of 25 trees ha^{-1}. The low and very low values are found where the landscape is mostly paved or where there is an extensive area of grass. The paved area is associated with the built-up area (see Figure 3.2), which extends from the eastern port areas, through the city centre towards warehouse areas in Cherry Orchard. Large and open grass-covered areas with few trees are found in Phoenix Park and Bull Island. The neighbourhoods of highest tree density are in Donnybrook and Clontarf near the coast and around Phoenix Park. South Circular Road and Griffith Avenue are easily identified from the linear patterns, as is the clustering along the edges of Phoenix Park and suburban parks, such as St Anne's Park and Bushy Park.

4.1.2 Locations of trees

Table 4.1 shows the distribution of trees by estimated height categories. Most of the trees are between 5 and 15 m tall (57%) and 10% are taller. The very largest trees (> 25 m) represent about 0.5% of trees in the DCC area.

Trees close to roads and parks accounted for 19.3% and 22.7% of trees, respectively, but nearly half are located in private gardens. The trees in parks are the largest in the city and those in gardens tend to be the smallest, overall. These results indicate that the owners of private gardens have an important role to play in managing the ecosystem services provided by trees in Dublin.

Figure 4.3 shows the population distribution(s) across the city; in 2016, over 550,000 people resided and over 700,000 people worked in the DCC area. The patterns show parts of the city that are mostly residential, parts that are mostly workplaces, parts that are mixed and parts that have low population density. The last includes the port areas and Phoenix Park. The D8 study area is a mixed-use area that has a significant population throughout the day and night.

Table 4.2 shows the population statistics for DCC as a whole, for populated DCC, for populated DCC outside Dublin 8 and for the D8 study area. D8, given its city centre location, has a higher population density than most of the DCC area, with values of about 9000 persons per km^2 during the day/night. Tables 4.2 and 4.3 list the "green share", that is the green area and tree population per capita, in the different geographies. The figures show the important role played by the larger parks in the city. Both the green area per person and the number of trees per person are considerably lower in populated areas of DCC than in DCC as a whole. For example, the green area falls from almost 37 m^2 per resident and 30 m^2 per worker in DCC as a whole to 14 m^2 per resident and 12 m^2 per worker in populated DCC, while the number of trees per person falls from 0.55 and 0.43 for residents and workers, respectively, to 0.41 per resident and 0.37 per worker.
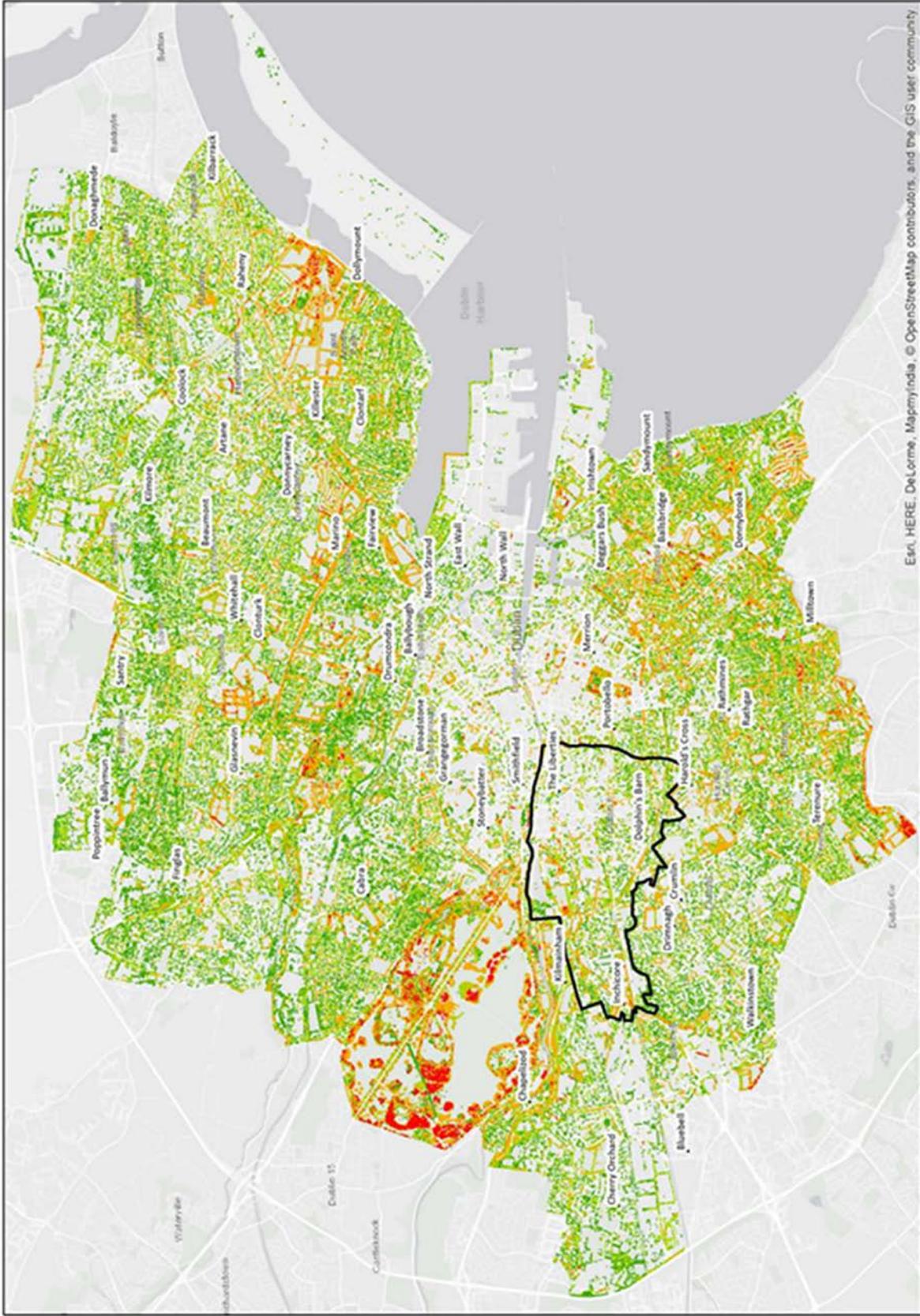
Figure 4.1. The distribution of trees in DCC by increasing height: low (green), medium (orange) and tall (red). Based on OpenStreetMap under the Open Database Licence (CC BY-SA 2.0; https://creativecommons.org/licenses/by-sa/2.0/).
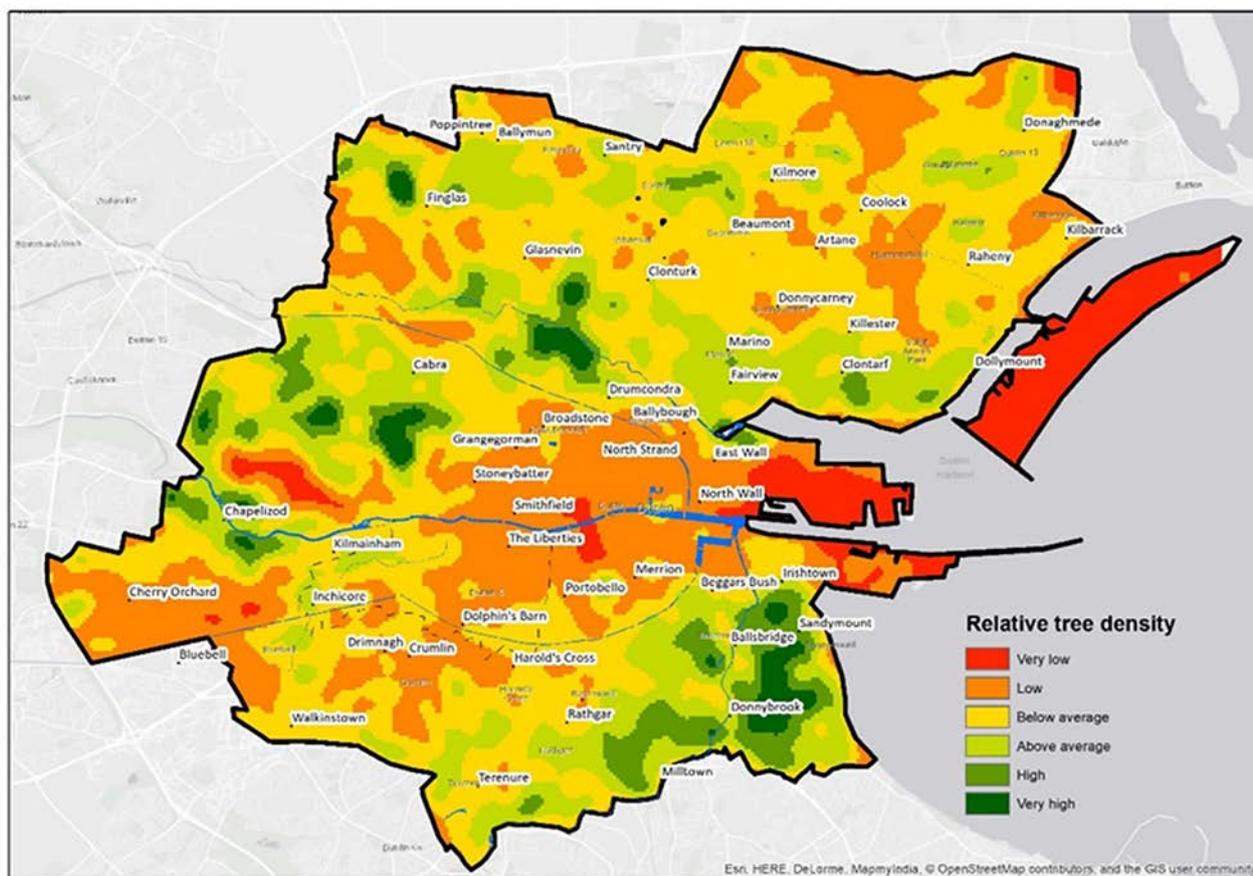
Figure 4.2. Trees per square km categorised by deviation from the mean. Based on OpenStreetMap under the Open Database Licence (CC BY-SA 2.0; https://creativecommons.org/licenses/by-sa/2.0/).

Table 4.1. Estimated distribution of trees by type of location and by size

Location	Total number of trees (%)	Percentage of trees by estimated height			
		< 5 m	5–15 m	15–25 m	> 25 m
Road	58,725 (19.3)	24.28	70.25	5.45	0.01
Park	69,092 (22.7)	18.20	55.36	24.17	2.27
Garden	99,403 (32.7)	49.78	47.84	2.36	0.02
Other	76,834 (25.3)	27.52	62.11	10.22	0.15
All	304,054 (100.0)	32.05	57.48	9.90	0.56

The D8 study area has about 10 m^2 of greenspace and 0.22 trees per person – in other words, about 4 m^2 less green area and half the number of trees available for residents/workers elsewhere in the city. These differences are a result of both the higher population density and the higher proportion of built-up space found in the city. Even within the D8 study area, there is considerable variation across the neighbourhood in terms of population, green cover and trees. In a densely occupied urban area where there is limited available space, the green share can be improved

by planting more street trees or by seeking novel greening solutions (e.g. green walls/roofs).

4.1.3 Ecosystem services

As previously discussed in this report, trees provide a host of environmental services, but a detailed assessment of these services requires information on the species and dimensions of individual trees. Unfortunately, there is little public information on the make-up of trees in the DCC area, apart from those in
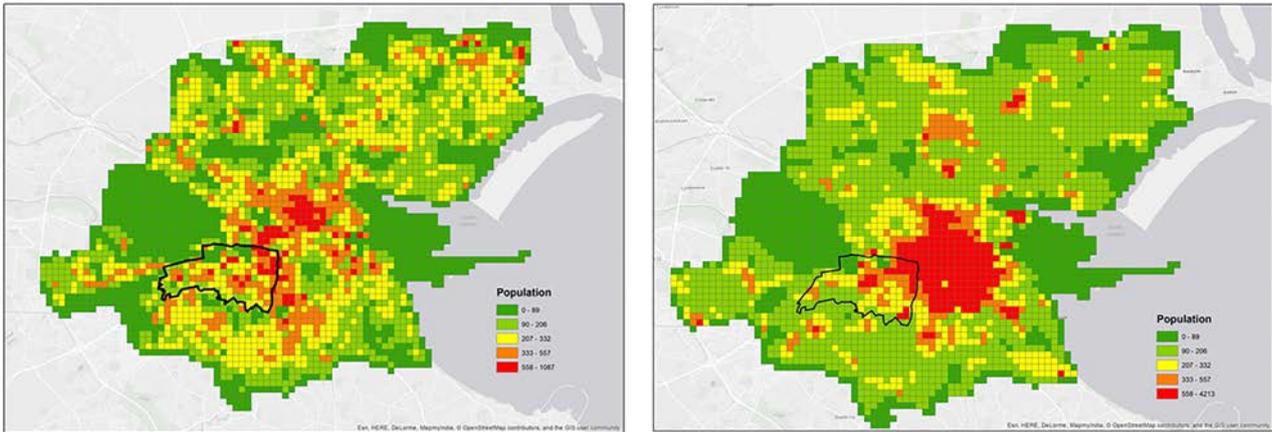
Figure 4.3. The distribution of population across DCC based on the 2016 household (left) and workplace (right) censuses (CSO, 2017). Based on OpenStreetMap under the Open Database Licence (CC BY-SA 2.0; https://creativecommons.org/licenses/by-sa/2.0/).

Table 4.2. Residential populations and green share

Location	Area (km²)	Household census 2016[a]			
		Population	Density per km²	Green area (m² per capita)	Tree (per capita)
DCC (whole)	122.76	554,554	4517	36.73	0.55
DCC (populated)[b]	80.20	520,217	6486	13.52	0.41
DCC (populated outside D8)	74.00	464,806	6281	13.95	0.43
D8	6.20	55,411	8937	9.89	0.22

[a]**CSO (2017).**
[b]**Areas with a residential population of >100.**

Table 4.3. Workplace populations and green share

Location	Area (km²)	Workplace census 2016[a]			
		Population	Density per km²	Green area (m² per capita)	Tree (per capita)
DCC (whole)	122.76	702,120	5719	29.01	0.43
DCC (populated)[b]	80.2	583,699	7278	12.05	0.37
DCC (populated outside D8)	74	527,362	7127	12.29	0.38
D8	6.2	56,337	9087	9.73	0.22

[a]**CSO (2017).**
[b]**Areas with a residential population of >100.**

some city parks (e.g. Xie, 2018) and on some street trees (e.g. Ningal *et al*., 2010). MGD has been working with DCC to add species information to the MGD tree database using the CURIO app, which allows individuals to enter information on individual trees. CURIO uses the MGD database so that individual trees can be identified and additional information, such as species type, health and dimensions, can be added. However, apart from species, other information is not usually collected. The data acquired by this citizen science project up to December 2020 have been included in the ecosystem analysis that follows.

Here we divide the analysis into two parts:

1. a general examination of the DCC urban forest based on the carbon stored in the tree stock;

2. specific examination of the urban forest in the D8 area based on a sample of trees.

In this work, we make use of available data obtained from field work and additional information from the CURIO app.

General examination of the DCC urban forest

A good measure of the overall service provided by the urban forest is the carbon uptake and storage, which is a function of the species composition and maturity of trees. The DBH of a tree is a critical parameter in estimating the CO_2 stored by a tree. McPherson *et al*. (2016) provide a compendium of information from multiple studies on allometric equations for a great variety of tree species. For general broadleaf trees (DBH of 5–135 cm), the volume (V in m^3) of wood is given by:

$$V = 0.0002835 DBH^{2.310647} \qquad (4.1)$$

This can be converted into carbon stored based on the wood density (ρ in $kg\,m^{-3}$):

$$C = \frac{V\rho}{2} \qquad (4.2)$$

Wood density varies by species, but typical values are between $400\,kg\,m^{-3}$ and $550\,kg\,m^{-3}$. Finally, C is converted to CO_2 using a multiplying coefficient (3.67).

In this work, we have measured DBH and height for a sample of trees and extrapolated to the entire forest of 300,000 trees from this sample. In making this inference, we are making several assumptions: that the sample is broadly representative of trees in Dublin, that the results from the sample can be extrapolated to the forest, that the heights of trees estimated using the DEM are accurate, and that the volume and carbon stored in each tree can be estimated from equations 4.1 and 4.2 with $\rho = 500\,kg\,m^{-3}$. The sample tree database was created by Ningal (2012) for Dublin city centre and by Cullivan (2020) for the D8 study area. The combined database comprises 2418 trees, mostly street trees. The measured variables in this sample are tree species type, canopy height and DBH; Table 4.4 provides a breakdown of the tree types that are broadly representative of trees in Dublin.

For the sample of 2418 trees, a statistical relationship between the measured height, H (m), and DBH (cm) values for the sample was generated (equation 4.3):

$$DBH = 1.108 H^{1.473} \qquad (4.3)$$

This relationship statistically explains 69.3% of the observed variation (Figure 4.4).

Applying these assumptions to the DCC area indicates that the tree stock stores 608,277 tonnes

Table 4.4. Sample of trees in DCC categorised by species type

Tree	Count	Per cent
London plane	689	28.5
Common lime	677	28.0
Norway maple	202	8.4
European hornbeam	153	6.3
Other (40 species)	697	28.8
Sample size	2418	100.0

of CO_2 (tCO_2). The value of $1\,tCO_2$ is currently €20, indicating that the carbon value of the trees is more than €12 million. It is acknowledged that this value will change in line with carbon pricing, which is expected to be €80 tCO_2^{-1} by 2030.

One of the main justifications for developing and maintaining the urban forest is to manage air quality. Common urban air pollutants are associated with the combustion of fossil fuels, which results in emissions of carbon monoxide, nitrogen oxides and particulates. Although CO_2 is not a pollutant with direct public health consequences, it is emitted along with these pollutants and is a driver of anthropogenic climate change. Emitted CO_2 is sourced from industry (including energy production), buildings and transport; emitted CO_2 sourced from transport is of particular concern, as emissions are linked to mobile (rather than stationary) sources and arise from linear sources (i.e. traffic along streets). For comparison, we compare estimated carbon emissions from traffic against carbon stored in trees across DCC. The annual emission in each grid cell was estimated simply as:

$$CO_2 = V * L * \alpha \qquad (4.4)$$

where V is the number of vehicles, L is the length of the road (km) and α is an emission factor ($CO_2\,km^{-1}$). The emission factor is variable and depends on the nature of the vehicle (engine size and efficiency); here we have selected $\alpha = CO_2\,km^{-1}$. This factor was selected so that the total emissions match the estimated DCC transport emissions of 697,747 tCO_2 equivalents (Codema, 2018). The results should be seen as indicative rather than definitive, as the types of vehicles (e.g. buses, heavy goods vehicles and private cars) and the associated fuel consumption will vary by road type across the city. Here, we use the emission distributions simply to map the "gap" between the sources and sinks. Figure 4.5 shows that

$$y = 1.1081x^{1.473}$$
$$R^2 = 0.6929$$
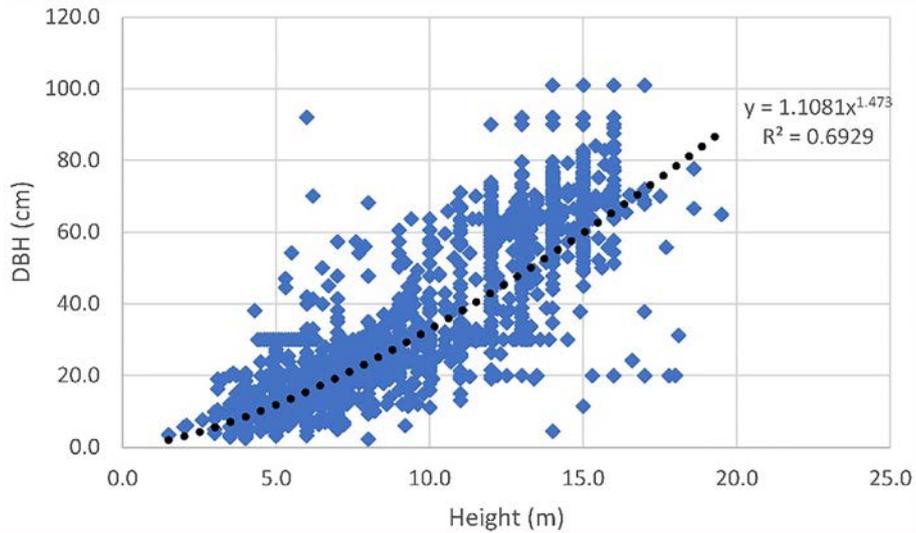
**Figure 4.4. Scattergram and statistical relationship between tree DBH and height.**
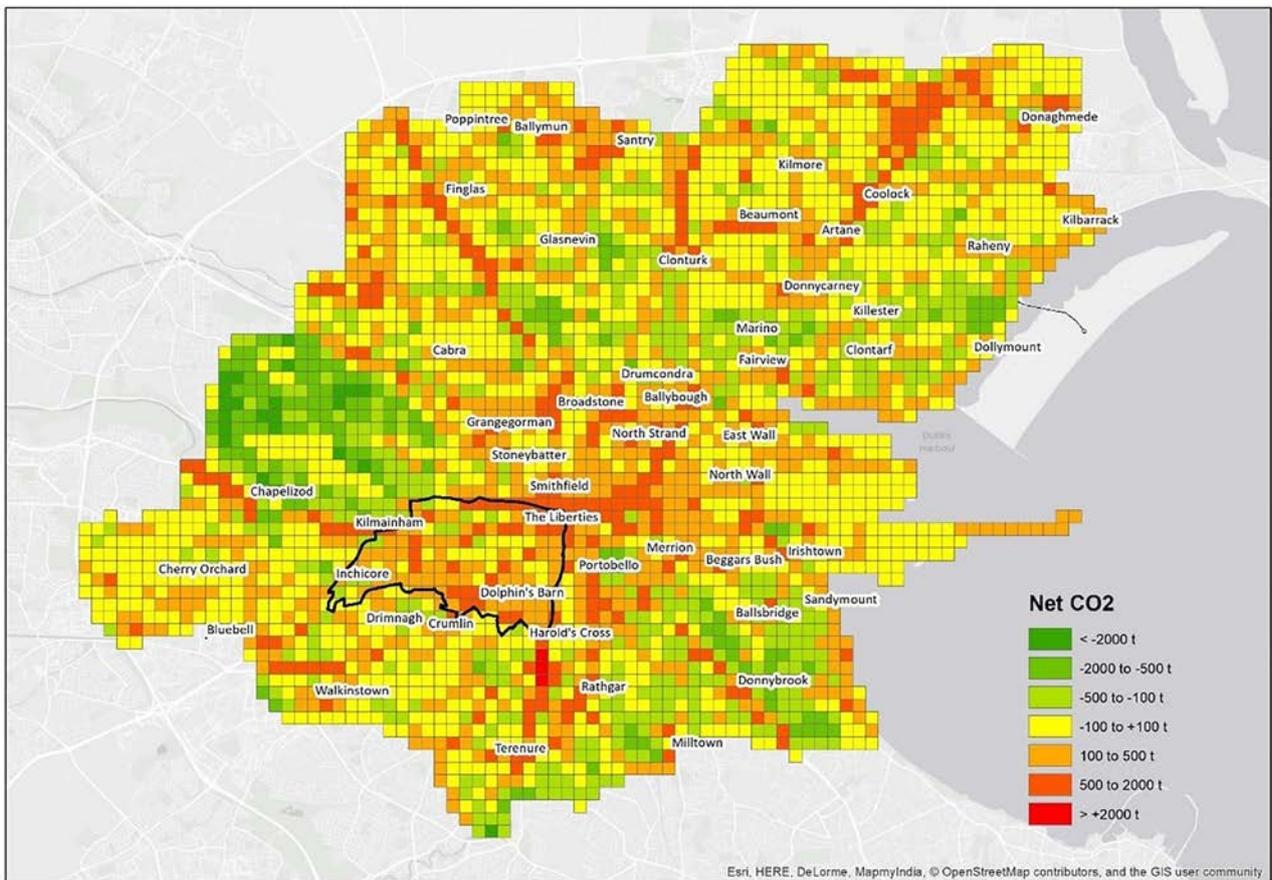

Figure 4.5. Estimates of net CO$_2$ across DCC. Positive values indicate that annual transport emissions exceed storage in the tree stock and negative values indicate that storage is higher than emissions. Based on OpenStreetMap under the Open Database Licence (CC BY-SA 2.0; https://creativecommons. org/licenses/by-sa/2.0/).

carbon storage and emissions are highly concentrated in the mature parks and neighbourhoods and along heavily trafficked roads, respectively. The sources and sinks emission are distinct; moreover, the total amount of CO_2 storage in the DCC urban forest, which represents decades of growth, is less than 90% of annual transport CO_2 emissions.

Table 4.5 compares the D8 study area with the DCC area as a whole, with the populated part of the DCC area and with the populated part outside D8. The importance of the mature trees in large parks can be seen in the carbon storage, which drops from 4955 to 3398 $tCO_2 \, km^{-1}$, when the mostly unpopulated areas are excluded; conversely, the emission intensity increases from 5633 to 6486 $tCO_2 \, km^{-1}$. The data for the D8 study area indicate relatively low storage and high emissions compared with other neighbourhoods.

In the D8 study area, there are approximately 14,000 trees, and species data are available for 7635 of them from three sources: (1) PhD research by Ningal (2012), (2) MSc research by Cullivan (2020) and (3) citizen data acquired from the CURIO app. Figure 4.6 shows the distribution of trees by species in the D8 area, and Table 4.6 lists the most common types.

The more detailed data (species and estimated DBH) available in D8 permit a more complete evaluation of the ecosystem services provided; i-Tree Eco software[11] was used to assess these services (Table 4.7) and information from Dublin Airport weather station was used to measure the ambient conditions for these trees.

The canopy tree cover for D8 is estimated at 609,000 m^2, which is equivalent to 9.8% of the study area. The leaf area is about four times the canopy plan area and is indicative of the ability of the tree stock to intercept rainfall and take in pollutants and CO_2. i-Tree Eco estimates that the trees in D8 remove 1.57 t of pollutants per year and offset 8836 m^3 of rainfall, or about 1.4% of annual rainfall. The CO_2 stored in the tree stock is estimated at 20,221 t with an annual sequestration of 589 $t \, y^{-1}$. To put these numbers in perspective, in 2015 the estimated CO_2 equivalent emissions per capita amounted to 13 t, about 65% of which was CO_2. This equals 8.45 tCO_2 per capita. The annual sequestration by trees in D8 accounts for the emissions of about 70 persons and the total CO_2 in storage represents the annual emissions of just 2393 persons (or 4.3% of the population). Clearly, the tree stock cannot sequester and store all CO_2 emitted.

The final column in Table 4.7 applies the findings for D8 to the entire DCC area based simply on the ratio of the tree populations. For comparison, the estimated CO_2 sequestered by this method for DCC is 444,865 t while the estimate based on tree heights was 608,277 t (Table 4.7. These results are comparable, as the estimated value for D8 (3036 $t \, km^{-2}$ in Table 4.5) is consistent with the i-Tree Eco results. These results confirm the importance of mature trees in large parks and some neighbourhoods in providing ecosystem services for the DCC area. The D8 results are comparable to those reported in other published work (Mills *et al.*, 2016; Brennan *et al.*, 2017).

4.2 Stage 2 – Co-creation

Outcomes and outputs are the results of the three phases of structured co-creation (Figure 4.7).

Table 4.5. Estimated CO_2 stored in the DCC tree stock compared with that emitted by traffic annually

Location	Area (km²)	Trees		Traffic	
		tCO₂	tCO₂ km⁻²	tCO₂	tCO₂ km⁻²
DCC (whole)	122.76	608,277	4955	691,536	5633
DCC (populated)[a]	80.2	272,557	3398	520,144	6486
DCC (populated outside D8)[b]	74	253,735	3429	458,273	6193
D8	6.2	18,822	3036	42,759	6897

[a]**Areas with a residential population of >100.**
[b]**Based on the 2016 household census (CSO, 2017).**

11 https://www.itreetools.org/tools/i-tree-eco (accessed 8 September 2021).
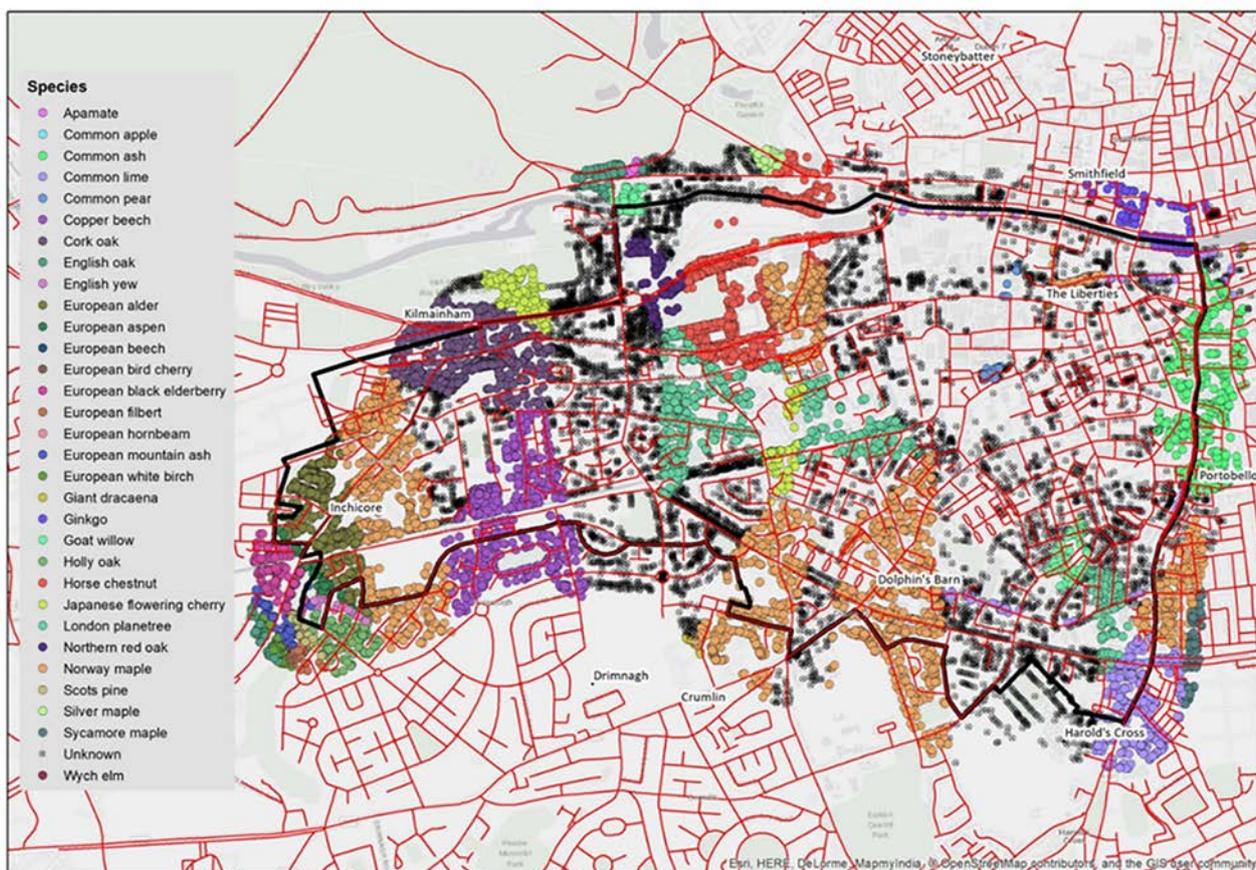
Figure 4.6. The distribution of trees by species in the D8 study area. Based on OpenStreetMap under the Open Database Licence (CC BY-SA 2.0; https://creativecommons.org/licenses/by-sa/2.0/).

Table 4.6. The list of tree species in the D8 study area

Tree	Number	Percentage of all trees (%)	Percentage of trees of known species (%)[a]
Norway maple	2129	15.4	27.9
Cork oak	789	5.7	10.3
London plane	748	5.4	9.8
Horse chestnut	588	4.3	7.7
Copper beech	561	4.1	7.3
European alder	511	3.7	6.7
Common ash	425	3.1	5.6
Common lime	386	2.8	5.1
Japanese flowering cherry	280	2.0	3.7
European black elderberry	144	1.0	1.9
English oak	132	1.0	1.7
Other[b]	942	6.4	12.3
Unknown	6162	44.7	
Total	13,797	100	

[a]**This is based on the known tree species (i.e. 13,797– 6162).**

[b]**Other identified species in the study area include holly oak, northern red oak, goat willow, ginkgo, European mountain ash, sycamore maple, European aspen, Scots pine, European white birch, common pear, silver maple, European filbert, apamate, English yew and European bird cherry.**

Table 4.7. i-Tree Eco results based on a sample and for the D8 study area

Property	Sample	D8	DCC
Tree cover (m^2)	337,000	608,980	1,339,764
Leaf area (m^2)	1,630,000	2,945,528	64,801,627
Pollution removal (t y^{-1})	0.870	1.572	34,587
Carbon storage (t)	3049	5510	121,215
CO$_2$ storage (t)	11,190	20,221	444,865
Carbon sequestration (t y^{-1})	89	160	3526
CO$_2$ sequestration (t y^{-1})	326	589	12,960
Avoided runoff (m^3 y^{-1})	4613	8336	183,393
Number of trees	7635	13,797	304,054

Note: the final column assigns the values for D8 to the DCC tree population.

Present data   Listen and Expand   Re-ground
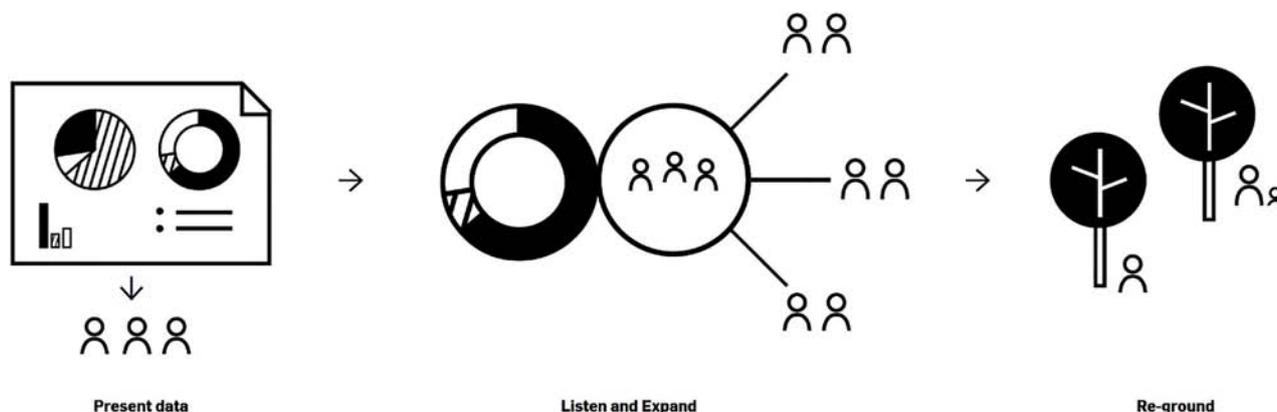
Figure 4.7. The three phases of the co-creation process. Credit: MGD team.

4.2.1   Data presentation

The evidence base developed in phase 1 of the project was presented at two focus group events with local residents and individuals working in the area in November/December 2019 and at an open community launch event held at Inchicore College of Further Education on 7 March 2020.

4.2.2   Listening and expanding – focus groups

During the focus groups (listening phase), a range of greening deficits was identified. Figure 4.8 shows clearly defined areas for improvement that match with areas believed to have strong greening/ecological value for the community as identified by focus group participants. Specific issues and concerns relating to greening and associated knowledge deficits are outlined below.

The type and form of greening

The focus groups were concerned that, in the absence of a plan for future greening, it would be difficult to achieve linear/connected greening; a plan for a linear park, is currently under consultation. Overall, there is a deficit of greening types and there is a view that greening types are pitted against each other, e.g. sports amenity versus other greening interventions. There is a concern that there are not enough opportunities to be in nature and this includes trees and canopy cover, as prompted by the maps presented to the group.

Recognition of city-wide urban development pressures

The development of GI was linked by participants to other strategic infrastructural developments that are taking place in Dublin; the creation of the 5G network and the BusConnects initiative were identified. In 2019, Dublin communities rallied against a new strategic bus network that was to see over 1000 street trees removed in the city and a widening of urban centres. Communities Not Corridors was a city-wide campaign to replicate the city-wide BusConnects initiative. The benefits of GI in the area to reduce paving, enhance cooling effects and opportunities to green the
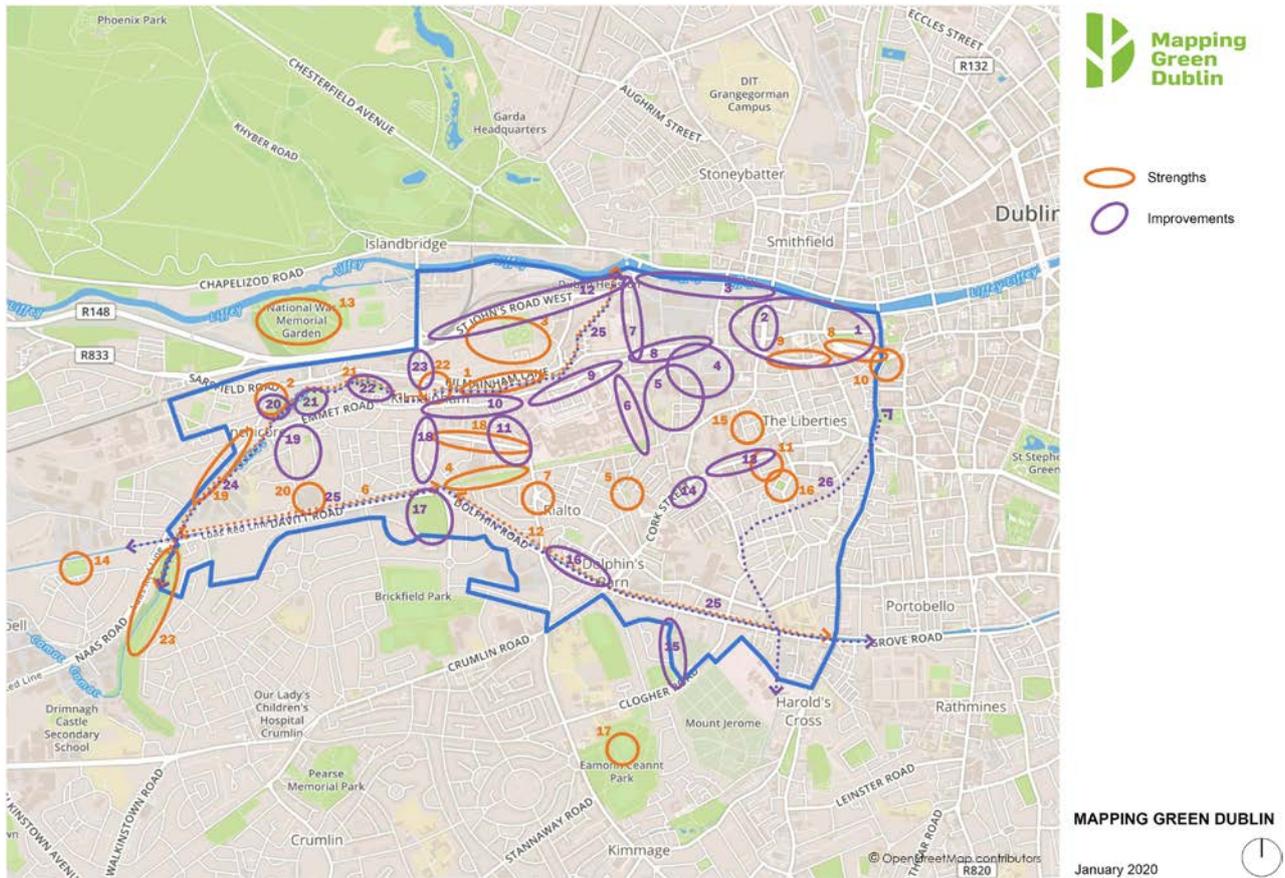
**Figure 4.8. Map of areas of strengths (orange) and weaknesses (purple) across the D8 study site. Based on OpenStreetMap under the Open Database Licence (CC BY-SA 2.0; https://creativecommons.org/ licenses/by-sa/2.0/).**

housing estates in Dublin 8, and connect greenspaces and blue spaces are both opportunities and concerns in equal measure. A higher density built environment was predicted by participants and the pressure to increase the number of apartment blocks and student accommodation was recognised. There is pressure on parking in the area, particularly with the development of large sites such as Player Wills, where 1600 new apartments are being built on a former factory site.

Issues of quality and maintenance

The focus group expressed the view that current greening was uninspiring from an aesthetic perspective and articulated concerns that further development will remove what are currently "wilder" spaces. The spraying of weed killer (glyphosate) around the Irish Museum of Modern Art (IMMA) and the Liberties, and its potential effect on residents and those who regularly use the area, was mentioned. At the same time, there were conflicting views around what are seen as "neglected" and "unmaintained"

spaces and sites in the areas. The precise locations of any GI actions were unclear, leading to the questions "where can we green/plant?" and "what are the greenspaces in the area?" A map of green public land was not available to the group.

Participants saw vacant sites as "wasteland" but also identified them as having potential. Street trees are a political topic in Dublin currently, partly because of the BusConnects scheme, which seeks to widen some roads and remove trees in some neighbourhoods, and partly because of the media coverage of safety issues associated with pavement upheaval caused by tree roots. Focus group participants were also aware of the health and safety issues around people tripping over roots and slipping on leaves, and that residents of the area view tree leaves as litter. There were further concerns around saving trees that people have fought for (e.g. Grattan Crescent) and the replacement of trees that have been removed. A number of participants wanted to see more trees along the Luas line and the canal and particularly in the housing complexes (e.g. Dolphin's Barn).

Air quality and tree cover

The focus group participants indicated that air quality is a significant concern for residents of Dublin 8. A reduction in traffic and increase in tree and canopy cover were suggested as ways to ameliorate polluted environments. Participants were aware of the levels of pollution in their environment compared with other parts of the city. This, in combination with the recognition that the area has a low level of tree cover (as researched in stage 1), provides members of the community with some of the knowledge and tools they need to go forward with a greening plan for their area.

Knowledge deficits

Participants were aware of their own knowledge deficits regarding the development of a community-led greening strategy. The questions posed included the following. What are the categories of greening? What are the other (planning/design) infrastructures? How do greening plans affect each other/people?

The current greenspaces were seen as spatially fragmented and as not linked to wider community benefits. The focus group expressed concerns and uncertainty about the pace of developments in the area. The questions posed included the following. Who is carrying out the current development at the canal? Who runs the Diageo site? Will there be greening as part of the development that we can link up to? Residents did not know whom to contact for street tree advice and wanted advice on how to plant trees. The D8 area has a history of community gardening and, although a precarious activity, the residents respond to change and have continued this community activity through various iterations of plans and economic uncertainty and upheaval. Participants felt that there is a lack of understanding (by authorities) of how greenspaces create local special community spaces.

Sociocultural context

Discussion explored some of the social vulnerabilities within Dublin 8. The crime levels in the area were seen to have direct relevance to greening. Those working directly in planting community spaces had seen some of their plants stolen and dug up. Some areas were seen to be dangerous, and trees are places where people can potentially hide for cover if there is an

intention to cause harm. The participants noted an often negative perception of the area from within the D8 community itself and that there is also a changing population dynamic, with older and newer residents often wanting different things.

Governance and policy

Again, the democratic deficit (Norris, 2011) and lack of knowledge around greening planning, policy and associated practices in the area was prevalent in the focus group discussions. The following questions posed by participants shine some light on this "black box" of greening plans and policymaking in D8:

- Who is greening for?
- Where are the public greenspaces?
- How do the public access greenspace decision-making?
- Can greening be enforced/encouraged?
- Who has the statutory responsibility?
- Who will pay for GI?
- How can we enhance what we already have?

Participants were concerned about the lack of engagement with ordinary people to become more aware of ecology and biodiversity. There was seen to be a lack of consultation around trees in particular. The action gap between community sentiment and policy is caused by many things, including a perception of:

- no creative thinking;
- lack of policy push;
- lack of green plan for all;
- poor leadership;
- need for communication buy-in and ownership;
- lack of resources/funding.

These concerns for current greening practice were incorporated into the development of a renewed greening practice. The focus group work informed the planning and preparation for the second event – the community launch event.

4.2.3 Listening and expanding – community launch event

The community launch event was attended by over 80 people and the results were uploaded to the MGD website.[12] Nine maps were created from the

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12 www.mappinggreendublin.com (accessed 8 September 2021).

Pathway to Greening open workshop on 7 March 2020. This all-day open mapping workshop was attended by registered attendees and was also open to unregistered attendees who dropped in on the day itself. While studying large maps detailing roads, landmarks and all the trees in the area, participants used stickers to indicate areas of strength (green), potential (yellow) and deficit (red) within the study area, for up to nine dimensions of greening (trees; greenspace; biodiversity; play; sport; seating; walking; cycling; cars/pollution). Participants were also given the opportunity to write details on an A5 card. A total of 155 comments were received and mapped geographically (Figure 4.9). Half of this total comprised comments on trees, greenspace and walking. The Grand Canal was identified as an area of deficit, potential and strength, reflecting the value of this resource for local people and how it can become a rich green opportunity for the future. The map shows a greater number of types of comments in the west of the study area. It could be argued that this is likely to be because the workshop location was in Inchicore

(Inchicore College of Further Education) and because of the presence of the project partner (Common Ground) in Inchicore. This imbalance was addressed in the subsequent phases of the co-creation stage.

Maps developed during the participatory mapping event were also made available on the website and on social media and were used to elicit further response using an online survey (*n* = 170). Nine interconnected dimensions of greening were identified and synthesised under three main axes:

- green environment (trees; greenspace; biodiversity);
- green amenity (play; sports; seating/benches);
- green mobility (walking; cycling; pollution).

A comprehensive set of recommendations (*n* = 160) was compiled from contributions made during the focus group event, individual comments made at the community launch and lunch dialogue workshop, and the comments received from the online community survey. All comments and recommendations were
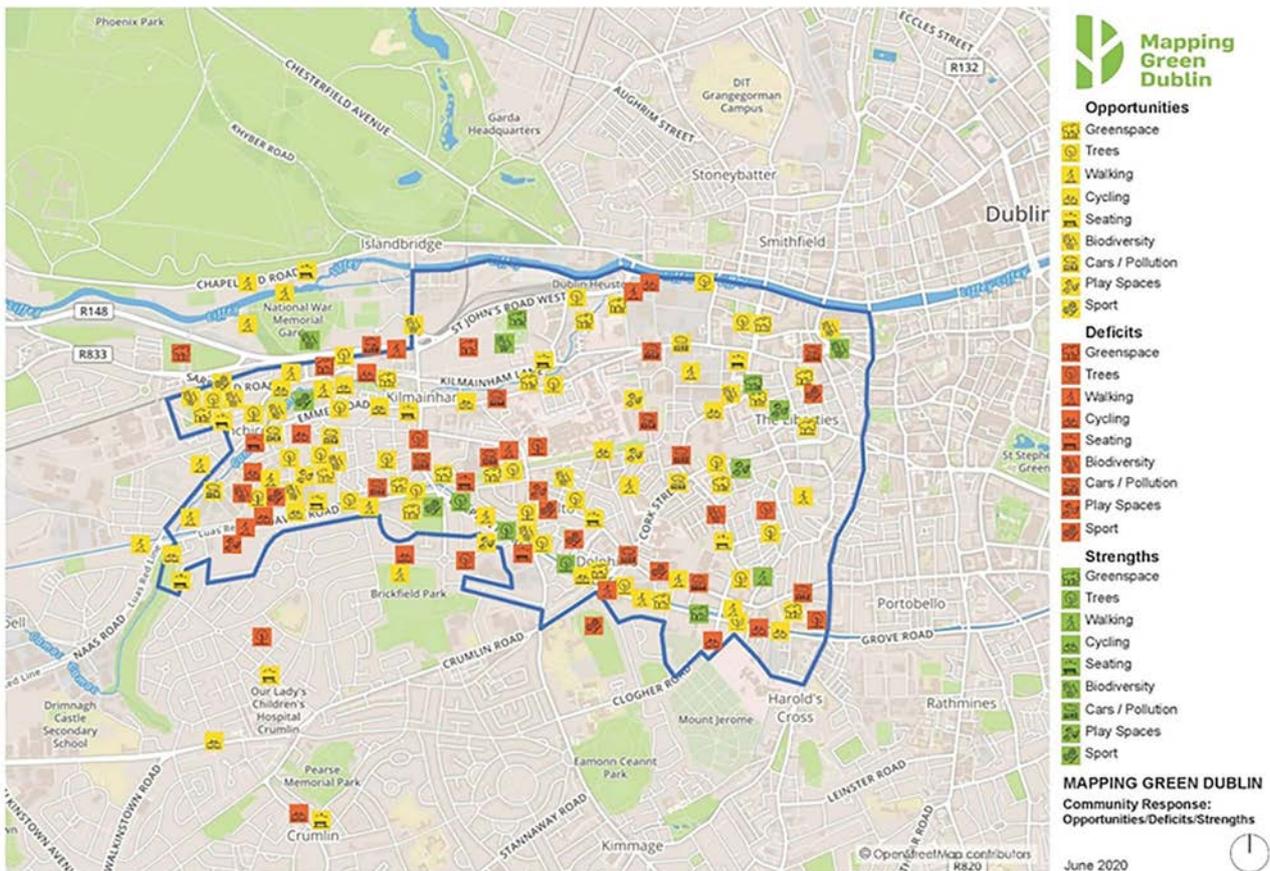

Figure 4.9. Synthesis of responses gathered during the open mapping workshop. Based on OpenStreetMap under the Open Database Licence (CC BY-SA 2.0; https://creativecommons.org/licenses/by-sa/2.0/).

Table 4.8. Summary of the comments from the Pathway to Greening event

Theme	Comment summary
Green environment	
Connectivity and access	Improve the connectivity, accessibility and quality of existing greenspaces
	Protect green and blue corridors and identify new potential corridors
	Enhance data on the volume, location and accessibility of current greenspace
Governance	Support the development of greening partnerships between the public sector, private landowners and civil society groups
	Clarify and streamline the governance and regulation of greening and GI
	Provide access to resources, financial and other, to enable community-based greening initiatives
Safety and security	Enhance youth involvement in greening to build positive engagement with the wider environment
	Challenge perceptions of the area through greening initiatives
	Enhance climate-proofing and security by planting more trees, communicate information on seed procurement and species and integrate green and blue infrastructure
Care and maintenance	Empower the community through training and education to play a greater role in green caring
	Recognise the importance of wilding, biodiversity and plant management and create a programme of maintenance
	Review tree planting and felling and develop a strategic and coherent tree management approach
Health and wellbeing	Learn from the experiences of other projects and cities
	Enhance the planting of trees and other greenspaces, particularly in the highest density areas, through innovation (e.g. green roofs)
	Connect blue/green corridors as urban sanctuaries and places to reconnect with nature and other people
Development pressures	Identify and map particular hotspots for development and require a greening response within planning proposals
	Create multifunctional greenspaces and creatively adapt existing land (e.g. green roundabouts)
	Use nature-based solutions to support more sustainable development
Green amenity	
Connectivity and access	Enhance permeability and build connectivity for ease of everyday movement
	Improve access to, and inclusive use of, existing GI
	Activate underutilised green-blue infrastructure (Grand Canal and Camac)
Governance	Recognise the role of different stakeholders and interests within the area (e.g. children, sports clubs)
	Identify and connect existing green groups
	Support existing community-based greening projects
Safety and security	Improve the public realm to enhance the perception and reality of security
	More effective policing to address anti-social behaviour in collaboration with local communities
	Undertake a "safety review" in the design, development and ongoing maintenance of greenspaces
Care and maintenance	Provide more public services and amenities in public spaces (e.g. bins)
	Upgrade and enhance existing public space and amenity
	Support community volunteer efforts at enhancing the public realm (bulb planting, litter picks)
Health and wellbeing	Build physical connectivity to support social connectivity
	Introduce infrastructure to support being in nature (seating, skate park, sports grounds, pocket parks)
	Maximise the opportunity for large-scale regeneration to diversify greenspaces and how they are used
Development pressures	Recognise the importance of the quality, not just quantity, of greenspaces
	Retain a diversity of greenspaces that are multifunctional and intergenerational
	Conceptualise greenspaces not just as corridors but as places to "be"
Green mobility	
Connectivity and access	Work with national and local stakeholders on realising a local cycling and walking plan
	Create green mobility corridors and better harness existing green–blue corridors
	Enhance permeability and build connectivity for ease of pedestrian and cycling movement

Table 4.8. Continued

Theme	Comment summary
Governance	Use and collaboratively generate new data to enhance awareness of transport-based pollution
	Build collaborative, cross-departmental approaches
	Harness the knowledge and skills of local people in a structured way
Safety and security	Improve the public realm to enhance the perception and reality of security
	Put in place more effective policing to address anti-social behaviour
Care and maintenance	Improve public services and amenities in public spaces (e.g. bins)
	Develop a regular maintenance programme for green and blue spaces and communicate it to local stakeholders
Health and wellbeing	Promote walking routes and enhance walking infrastructure
	Develop deterrents for car-based mobility
	Promote green prescriptions and a focus on the quality of the everyday living environment
Development pressures	Develop integrated approaches to land management and development that foreground greening
	Adopt a more people-centred approach to development and future planning
	Review the impact of construction and parking on the local environment

divided into six themes: connectivity and access; governance; health and wellbeing; care and maintenance; safety and security; and development pressure. The themes are summarised in Table 4.8 under the headings of green environment, green amenity and green mobility.

Figure 4.10 illustrates the dominance of comments on health and wellbeing, governance and development pressures over those on care and maintenance, safety and security, and climate change.

Finally, three synthesis maps and charts (Figures 4.11–4.13) detail the geographical locations and nature of these recommendations.

Figure 4.10. Radar diagram showing proportionally the number of comments made per theme.

4.2.4   Mapping the hyperlocal

PLOTS

In July 2020, the PLOTS tool was created by artist Seoidín O'Sullivan to respond to the COVID-19 restrictions. This work examined individual microgeographies and the experience of local outdoor space during lockdown. An exhibition of this work was held in August 2020 at the Goldenbridge cemetery. In total, 16 PLOTS maps were created, and the PLOTS tool is available on the MGD website for future use. Individuals commented on the changing local environment during lockdown, noticing reduced pollution and also noticing the nature and greenspace "closest in" to their homes (Figure 4.14). Owing to the restricted spatial freedom of lockdown, individuals carved out new running and walking spaces to enhance their individual wellbeing.

Camac go-along

As part of the MGD, a "go-along" method was developed using the River Camac as a linear site of encounter. A tool to video the walk (Ubipix) and an accompanying survey tool encouraged participants to carry out a place introspection, one that leads to new attentiveness and connection to the things that make and keep us well. In one short half-day walk (15 August 2020), the method showed the power of an in situ encounter, providing rich material.
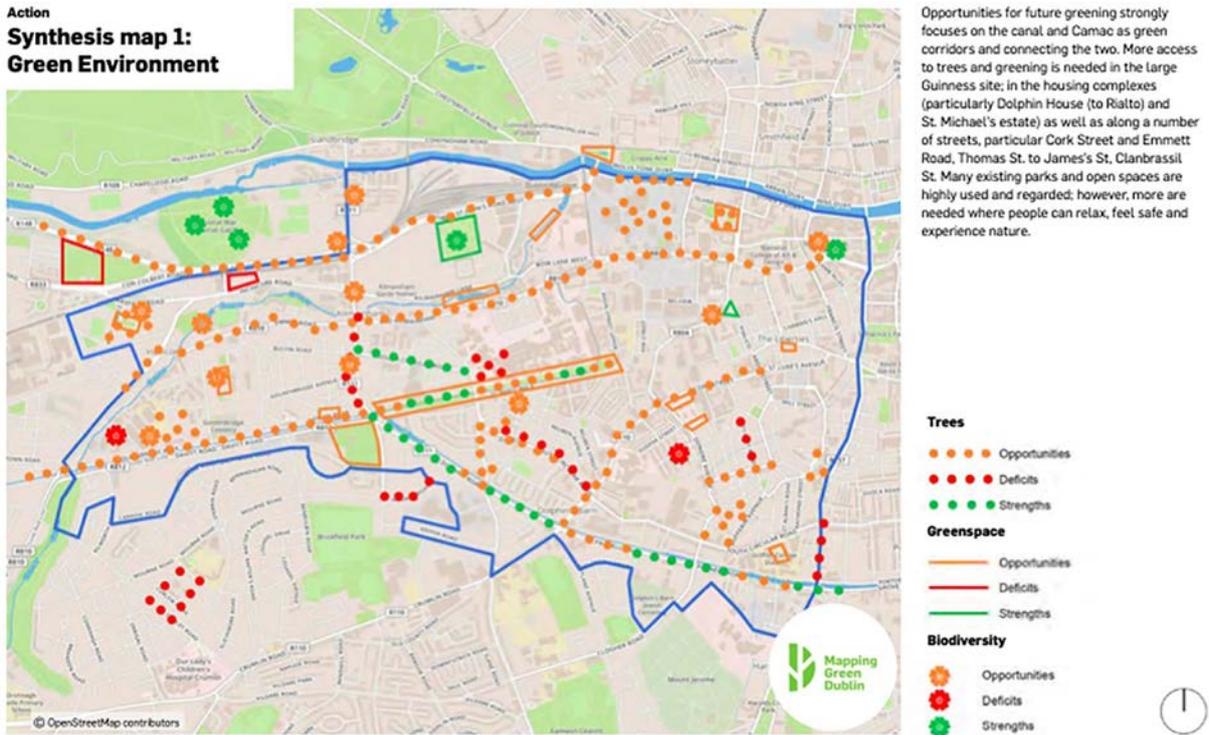
Figure 4.11. Summary map relating to green environment (trees, greenspace and biodiversity). Based on OpenStreetMap under the Open Database Licence (CC BY-SA 2.0; https://creativecommons.org/licenses/by-sa/2.0/).
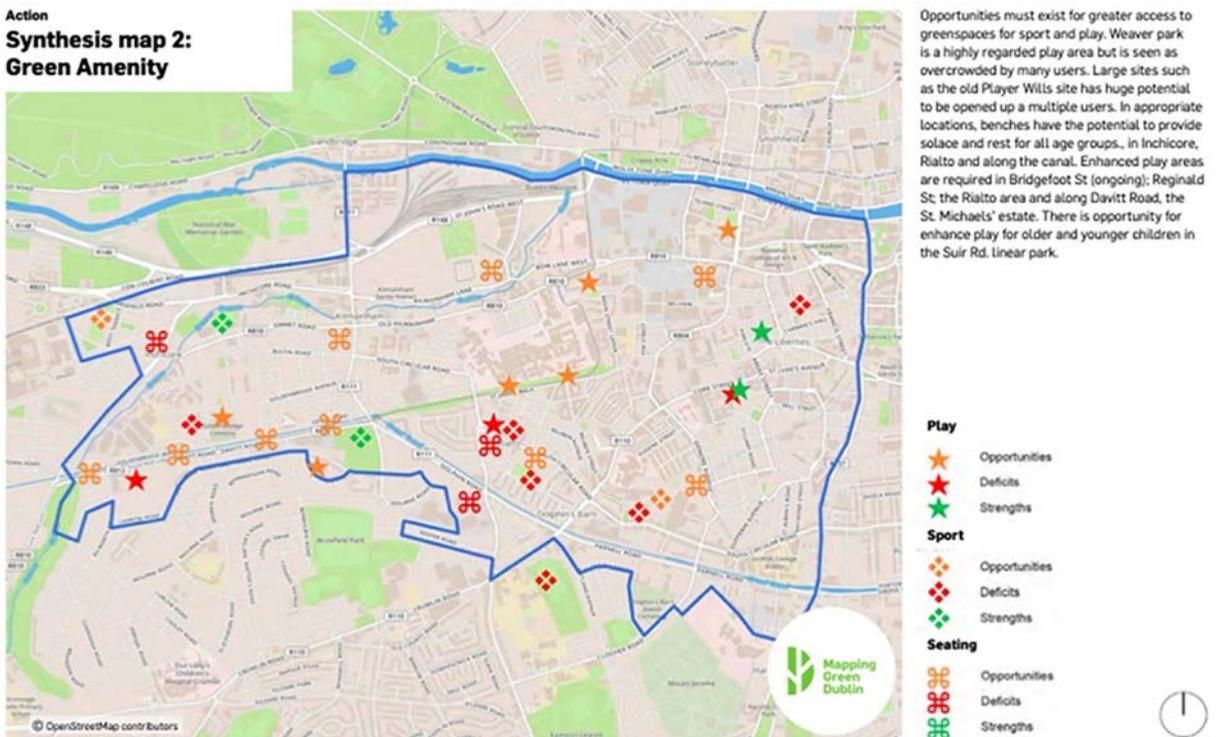
Figure 4.12. Summary map of all comments relating to green amenity (play, sport and seating). Based on OpenStreetMap under the Open Database Licence (CC BY-SA 2.0; https://creativecommons.org/licenses/by-sa/2.0/).
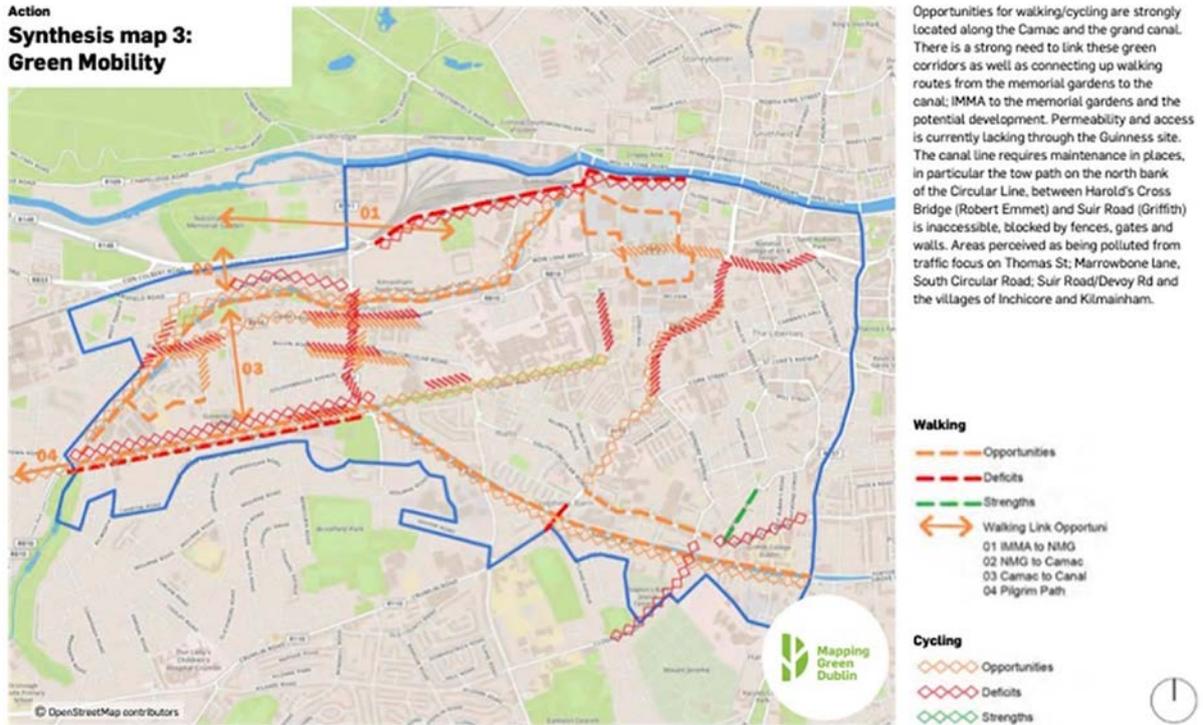
Figure 4.13. Summary map of all comments relating to green mobility (walking, cycling and pollution). Based on OpenStreetMap under the Open Database Licence (CC BY-SA 2.0; https://creativecommons. org/licenses/by-sa/2.0/).
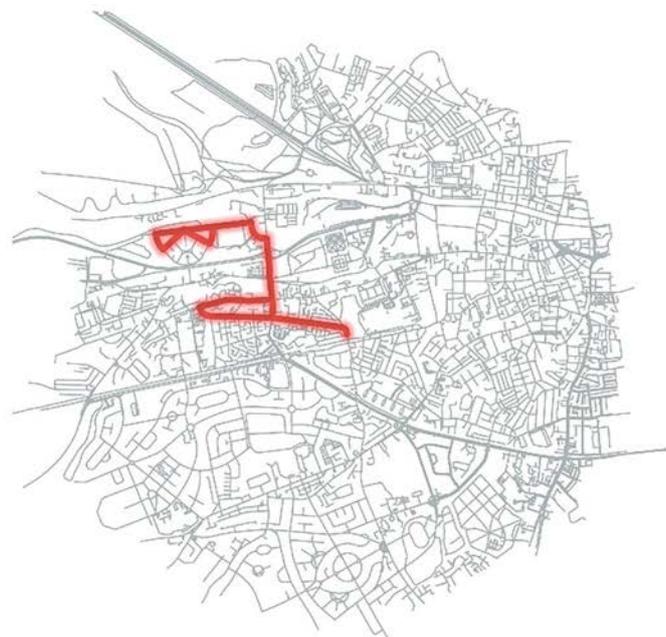
Figure 4.14. The PLOTS project examined the personal routes taken by individuals during lockdown in 2020; an exhibition was held at Goldenbridge cemetery on 15 August 2020. Credit: Seoidín O'Sullivan and Eoin O'Mahony.

Capturing shared local knowledge, on planning, culture, identity, restorative initiatives and sometimes even anger, was part of that method and helped establish a collective voice on the need for enhanced place care and new ways to recognise the value of open spaces in cities (Figure 4.15).

Interviews and COVID-19 impact survey

After qualitatively analysing the four in-depth interviews carried out with youth and community workers, all interviewees expressed concern that housing complexes have limited or no access to private open space.

> In Dolphin house, the 1950s housing blocks are without private external gardens or balconies. It is very difficult for the children to access somewhere safe to play. This was

> a real issue for families [during lockdown]. (HC2, Dolphin House)

The pandemic magnified a number of already existing social and infrastructural problems in what are, in parts, already under-resourced and overcrowded spaces. Children and youth and older people are particularly affected by any underprovision of greenspace in terms of both quantity and quality.

> For older people in the area, there is no greenspace…Younger people will go to the Phoenix Park but there is nowhere else really to go to except walk into town. Just walking around the place, you would not really be interacting with any greenspace. (HC4, Oliver Bond)

Representatives from the youth service identified a lack of funding and resources to create projects that
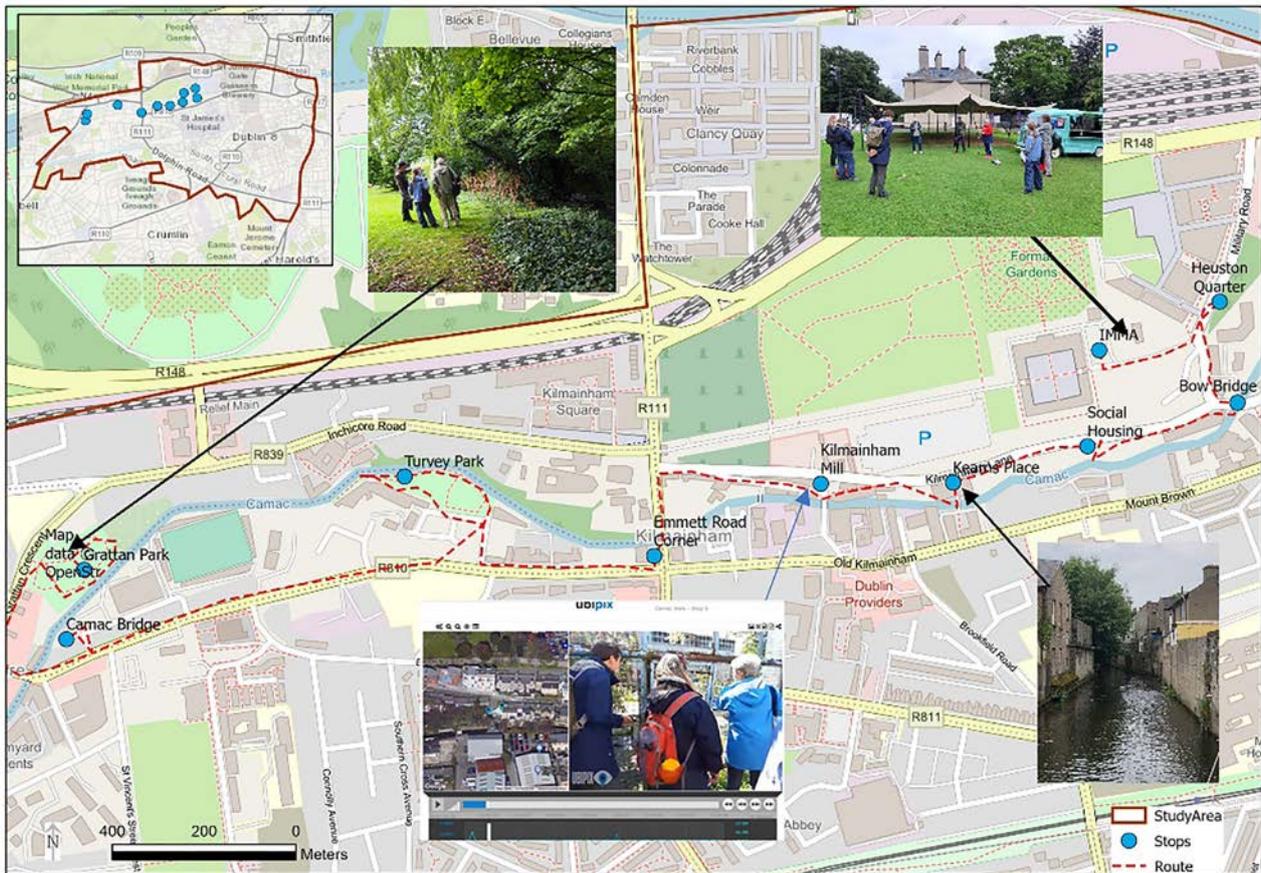
Figure 4.15. The Camac go-along, August 2020 (see https://storymaps.arcgis.com/stories/ 86034131772240048475e33778bbe544; accessed 14 October 2021). Credit: Foley and O'Sullivan.

nurture a sense of youth ownership of greenspaces and open spaces, in addition to the provision and ongoing maintenance of basic amenity spaces.

> I think they just want a chill-out area – a space to call their own … there is green spots at the back of the flats, but they're not used properly. They're not in a state to be used properly basically. (HC1, Core Youth)

An open online COVID-19 impact survey formed part of the main online MGD community survey, and there were 90 responses to the open questions on the impact of COVID-19. A number of participants stated that, during COVID-19 restrictions, they used greenspaces and open spaces more for jogging and walking than for stopping or sitting. People walked and cycled more often, and used and enjoyed the canal more often. Less traffic in the area (February–May 2020) meant that people enjoyed the area more. Some found the canal to be safer with more people, but others felt it was overcrowded. Others recognised, for the first time, how precious local nature is and identified a lack of connectivity between greenspaces. Others noticed a marked difference in the provision and quality of greenspace in the area.

> I've realised there are huge disparities between different sections of Dublin 8. Some are lush green oasis, some are boring concrete roads. (CI123)

There is a clear need for spaces that enable people to meet safely outdoors in a socially distanced manner. Others wish to sit outside to read, relax and be in nature, to "get out of the house" CI21.

> The greenspace that is available is too small for the amount of people in our community. No way to keep 2 metres. CI43

Many respondents discovered new small spaces in their neighbourhoods and used local spaces, such as the IMMA (when open), the War Memorial Gardens and Kilmainham Hospital, more often:

> I have discovered the waterfall behind the Black Horse Pub, which is beautiful. I can

> hear the waterfall because there is less noise from traffic on Tyrconnell Road. (CI18)

> We also walk or cycle along the canal most days, something we always did but not so regularly. We go to new places that we didn't used to go to – for example, the small tracks on the canal bank instead of the towpaths, or beyond Blackhorse as far as Ballyfermot along the canal. (CI16)

Many sought out local greenspaces to relieve the stresses of lockdown. While some respondents felt that Weaver Park was overcrowded and small, others sought refuge there and along the canal:

> The canal has always been important to me, but during the early stages of lockdown it became my only wild space to stretch my legs and my mind. (CI49)

The Grand Canal was seen as a vital resource but there was recognition of the need for further path and tree maintenance.

4.2.5 Reground

To ensure project longevity and a focus on action, a community Greening Forum was established and has become a pivotal output of the MGD project. This forum became an open and active core of 13 individuals who want to be involved in, and drive, future greening projects in the area and have a keen interest in ensuring that the community recommendations are implemented in practice. They are developing their own projects, some further on than others, that provide the focus for action (stage 3).

4.3 Stage 3 – Action

4.3.1 Urban prototyping: the projects

Ten projects were developed by members of the community Greening Forum (Table 4.9). A number of these (e.g. Funafloat and Pocket Forest) were already in the early stages of conceptualisation, and other projects emerged from the workshop itself. There are three project categories: intergenerational

Table 4.9. Projects initiated and developed within the Greening Forum

Project type	Project
Intergenerational greenspaces	Community garden, Inchicore
	Turvey Park development
	Greenspace improvement on Devoy Road
	Intergenerational private gardens
	The D8 bench project
Canal and walkway activities	Funafloat – water-based activity for young people along the Grand Canal
	Grand Canal Towpath from Sally's Bridge to Drimnagh Luas stop
	A pilgrim path – Camino, a walkway in Dublin 8
Small projects with a big impact	Parklets
	Pocket Forests

greenspaces, canal and walkway activities, and small projects with big impacts.

In summary, these projects advocate a focus on both public and private spaces, greater youth involvement, creation of intergenerational spaces, working with local schools and local organisations/enterprises and state bodies. A number of these projects are now under way; these include improvements to Turvey Park, the establishment of Pocket Forests as a social enterprise, and the planning and design of a canal project (Funafloat). These projects need further support from stakeholders such as DCC and Waterways Ireland to make progress.

4.3.2 *Recommendations from policymakers and practitioners*

Community recommendations as outlined above and the Greening Forum projects were introduced to 13 key policymakers and practitioners involved in the active use or planning of trees and greenspace within the area, with a view to identifying pathways to greening action and change. A summary of their responses to the community recommendations are presented in Table 4.10. The comprehensive summary of recommendations is available on the MGD project website.

Table 4.10. A summary of responses for policy development and practitioners

Theme	Policy/practitioner responses to community recommendations
Connectivity and access	Have green city idea as a guiding principle for planning and development
	Take a "landscape-based" approach to natural infrastructure connectivity
	Strengthen and build on physical, organisational, psychological and social connectivity at a range of scales, from home and neighbourhood to city areas
	Ensure greening projects are inclusive and widen accessibility
Governance	Through structured collaboration address the policy vacuum in relation to greening in this area
	Streamline the range of stakeholders/agencies engaging in greening/natural infrastructure to create coherence
	Enhance and support the role of civil society groups in leading greening
Safety and security	Recognise the complex relationships between community security and greenspaces to develop a common vision/approach
	Address anti-social behaviour, particularly along the canal, through public realm enhancement and light-touch policing
Care and maintenance	Develop a planned, visible and strategic maintenance programme for all natural infrastructure in the area
	Make collaboration, education and training central to effective care
	Identify and undertake a high-quality audit on existing greenspaces and the expertise needed to sustain and enhance these
Health and wellbeing	Have "nature-connectedness" as an enabler for mental health and wellbeing
	Empower and enable children and young people to take ownership of their area
	Enhance ecological literacy to give voice to community needs and desires
Development pressures	Implement multifunctionality as a core principle in planning new developments and greenspaces
	Ensure a more proactive land management, informed by data, in support of greening and the capture of land value uplift
	Give greater consideration to the relationship between gentrification, displacement and community gain

4.3.3   *Pathways to change*

Eight cross-cutting themes were identified from policy/practitioner responses to illuminate pathways to change and meaningful action on greening.

Communications

An online, easily accessible, up-to-date programme of tree maintenance (including reasons for tree removal) would greatly enhance communications around what is perceived as ad hoc tree felling. This could include an explanation of the "right tree in the right place" concept and detailing difficulties concerning the impact of underground services on street trees. Enhanced public understanding of civic structures and how decisions are made is required to articulate why certain places may have green amenity provision and others do not. A three-dimensional visualisation of a greener Dublin 8 that shows green walls and roofs and vertical stacking of greening features would aid communication and support innovative engagement.

Constructive collaboration

A platform for constructive collaboration between landowning stakeholders (involving local community groups) would lend itself to improved connectivity and access to greenspace for local people, and the sharing of ideas around greening in high-density areas. Collaborative working groups would also contribute to resolving particular maintenance issues (e.g. managing invasive species and the use of glyphosate weedkiller) and produce a common approach to health and safety for trees and greenspaces across all properties. In working with community groups and organisations, "greenwashing" (i.e. claims of greening that are false) should be avoided to ensure long-term engagement and commitment.

Community and social infrastructure

A greening strategy should include schools, hospitals, housing complexes and community organisations in the area. There is a community benefit policy/practice vacuum that can be maximised, especially in terms of green employment; green maintenance could be linked to local green social enterprises. For housing complexes in particular, funding for local youth and community work to develop greening projects would maintain and enhance social ties. Co-designing and giving ownership of space to young people, along with light policing and improved public lighting, are ways to reduce anti-social behaviour.

Ecological literacy

An agreed cross-sectoral health and safety plan will contribute towards enhancing more biodiverse green areas. Training is needed to maintain these spaces. There are historical reasons for the lack of greening in housing complexes. A renewed vision for engagement and greening in the shared spaces within housing complexes would enhance individual and community wellbeing. In communicating the benefits of trees and greenspace, an emphasis not only on time spent in nature, but also on nature connectedness, may improve understanding of the quality of the nature experience and the associated features of soil, nature sounds and access to biodiverse places.

Leadership

Political support and leadership are required to harness the current cultural shift in greening and climate action. A Dublin city-wide focus on liveability (quality of urban life) with greening at its core is required for a transformative greening impact. Local elected representatives are voicing this green agenda, which is one way to link local community greening action and national government; however, a space for dialogue between green non-governmental organisations, civil society and public bodies needs to be created to capture the rich expertise that these groups bring to the greening agenda. The work of the C40 cities[13] group and the greening agenda advocated by Parisian leaders are exemplars in this area.

Resources

More green jobs (e.g. trained arborists and horticulturalists) are needed to survey and protect existing trees, especially mature trees, throughout the area. Further resourcing for youth and community groups is needed to maintain and enhance social ties, particularly through sport and multifunctional

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13 https://www.c40.org/ (accessed 8 September 2021).

greenspace for active and passive activities, and also for projects along the canal to engage differently with this space. Training for local green social enterprises on funding, costings and organisational structure, along with engaging with the larger developments and landholders (in the form of community benefit) in the area, would enhance their function.

Multifunctionality

Given the development legacy in the area, new innovations in nature-based solutions (such as green walls and roofs) and innovations in food growing could be more effectively created and rolled out with training. Resources could be combined and maximised through collaborative inclusive working groups. Any new spaces developed should have multiple functions and intergenerational relevance, for example parks, sports pitches and play spaces. Multifunctionality

as an ecological design principle is one way of communicating the multiple benefits of nature, and this can be practised in the design of buildings and greenspaces.

Planning

Landscape-led planning at all nested scales of design and development would be the main driver and tool for enhanced green connectivity. The streamlining of plans that have a "greening" dimension would avoid policy/plan gaps and confusions. Post-plan evaluations would acknowledge how and why certain projects did not go ahead. There is a need for a greater understanding of planning tools to capture land value change during the rezoning process (with resulting speculative development) along with research to better understand the impacts of gentrification in the area.

5 Key Messages for Policymakers and the Public

The MGD project has significant potential to support radical change in GI development, planning and practice across a number of domains. In particular, the development of a scientific evidence base that is shared equally with policymakers and the community provides an opportunity to develop more inclusive planning practices and enable more effective community participation. The co-creation approach adopted provides a model for other cities and communities to develop more socially and environmentally just GI and counter some of the recent criticisms of urban greening as a driver of gentrification. Finally, the co-creation approach and re-grounding has produced a set of actions that may be key in enabling a radical transformation of the greening agenda in Dublin, with major implications for biodiversity, more sustainable urban development and a more just transition that recognises the interconnectedness of urban vulnerabilities, greening and wellbeing.

5.1 Learning from the Scientific Evidence Base

There are more than 300,000 trees in the DCC area, most of which are between 5 and 15 m tall. About 40% of these are found in public parks and along roads. The remainder are found in small private gardens and larger private spaces.

- *Private gardens can play a greater role in enhancing the GI of the city. Tree management at a city scale requires co-operation among stakeholders in the private/public realms.*

The distribution of trees is extremely variable. For every person in the DCC area, there are about 0.55 trees and 37 m^2 of green area. Excluding the parts of the city that have few residents, the ratios are highest in the suburbs and lowest in the city centre. On average, there are 13.5 m^2 of green area and 0.41 trees per person in residential neighbourhoods, and for the D8 study area the values are 9.9 m^2 green area and 0.22 trees.

- *City centre neighbourhoods have the highest population densities in terms of residents and workers and the lowest amount of greenspace (and trees) per person. Where space is limited, opportunities for greening along roadways should be encouraged.*

One indicator of the multiple ecosystem benefits provided by trees is the CO_2 captured and stored in the tree stock. The DCC area's urban forest stores 608,277 t of CO_2 (or 4955 tCO_2 km^{-2}), and this has a value of €12 million at current carbon prices (€20 per tCO_2). These benefits are unevenly distributed over the DCC area and are mainly concentrated in the large parks. The trees in D8 store approximately 3036 tCO_2 km^{-2}, compared with the average of 3398 tCO_2 km^{-2} for DCC neighbourhoods.

- *City centre neighbourhoods are distinguished by the relative fewness of trees (per capita and per unit area).*

One measure of the impact of the city on the environment is the equivalent carbon emissions generated by transport, which is focused along heavily trafficked roads. It is estimated that annual emissions from this sector amount to 691,536 tCO_2, more than that stored in the entire tree stock. A comparison of emissions and storage shows that the sources and sinks occupy different parts of the DCC area. Traffic in the D8 study area generates 6897 tCO_2 km^{-2}, compared with an average value for DCC neighbourhoods of 6486 tCO_2 km^{-2}.

- *City centre neighbourhoods are a focus of transport-based emissions that far exceed the capacity of the tree ecosystem services. Tree planting should be considered alongside traffic reduction measures to create a healthier environment.*

The tree canopy in D8 covers 609,000 m^2, equivalent to 9.8% of the study area. A sample survey of the tree population found that 11 species make up the majority and that Norway maple is the dominant species.

5.2 Recognising the Potential of a Deep Mapping and Co-creation Approach

In this project, the MGD partners have made a concerted attempt to engage in deeper dialogue and deeper mapping (Brodenhamer *et al*., 2015; Roberts, 2016) to unearth local concerns, histories and vulnerabilities associated with greening. Greening does not happen in a vacuum but within particular contexts. Focusing on community collaboration, arts practice and knowledge-sharing, this work proposes particular methods of co-creation for community engagement that highlight the greening issues that most affect wellbeing and quality of life. A transition from a technocratic expert-led approach to co-creation changes the roles of the expert, the researcher and local communities. The implications of this shift for built environment policymakers and practitioners are enormous, creating new domains of collective creativity and capacity, which could support a transformation towards more sustainable ways of living in the future.

The co-production of new knowledges during this co-creation process is an important component of the research. Co-production of knowledge is held up as an ideal for the development of inclusive policy and practice (Campbell and Vanderhoven, 2016) and is increasingly applied to the development of policy for the delivery of public goods linked to health, education and community services (e.g. Alford, 2009; Donetto *et al*., 2015). However, few examples currently exist of the successful translation and practice of the principles of co-creation and co-production into an active policy environment. The MGD project therefore provides a much-needed exemplar.

5.3 Recommendations/Actions for Policymakers

Based on an integration of community and policy/practitioner recommendations, a definitive set of actions are proposed to realise the potential of the community greening strategy and move towards a more just and inclusive approach to GI development. These require engagement with diverse partners and stakeholders at a range of scales, from the metropolitan level to the neighbourhood level.

1. **Coordinate all plans and green strategies across Dublin.** Spatial, temporal and cross-sectoral coordination is required and could be facilitated through landscape-led planning and a director for greening for the wider metropolitan area to provide strategic direction that is then championed at a local level by greening forums.

2. **Assess the impact of urban development policies, plans, regulations and practices on the GI and its social, economic and physical contribution to sustainability.** Strengthen the formal links across Dublin's climate, biodiversity, transport and neighbourhood plans and ensure that all policy and plan development is cognisant of the potential of GI development. Ongoing monitoring is required, as is a mechanism for accountability.

3. **Employ greenspace indicators to support ongoing monitoring and evaluation** by the public and private sectors and civil society groups. Through a shared and reflexive approach, the types of GI indicators developed through the EU-funded EnRoute project (https://oppla.eu/casestudy/19264) could be expanded and made publicly available. Additional indicators might include the number of trees per person, the quantity of greenspace per person at different spatial scales and the ratio of greenspace in new developments. These indicators could be connected to existing smart city initiatives and platforms and coordinated at the regional level.

4. **Improve greenspace quality and provision**, especially in large housing complexes currently undergoing development. The multidisciplinary approach adopted for the Emmet Road development is supporting communities to articulate their greening needs and provides a potential model for other large-scale regeneration schemes. Target ratios for greenspace provision in new developments could be considered, and this would also foster creative thinking.

5. **Identify key development hotspots** throughout Dublin 8 and collaboratively develop and implement pilot small-scale, community benefit projects to act as a model for other areas. We should build on pre-existing data and evidence to identify where small-scale or infill projects can

be supported at minimal cost but with significant potential to act as urban acupuncture.

6. **Develop a consistent, coherent and shared natural infrastructure vision and narrative for Dublin 8.** Constructive and structured collaboration is required to merge planning of blue infrastructure and GI (and the wider colour palette of nature) and realise its full and connected potential. Identifying a lead group or organisation with broad-based legitimacy would be critical.

7. **Develop a community safety and wellbeing plan** to balance physical safety, mental wellbeing and access to nature. This should be a shared programme for health, safety and community risk management across agencies, including DCC, semi-state bodies, community development and grassroots groups.

8. **Create community projects along the canal.** Engage all groups, including local youth, and create a sense of ownership, improving access and water activation. In partnership with state agencies, community youth workers, community Gardaí and wider civil society groups, there is significant untapped potential to transform the relationship with the canal and environs. Waterways Ireland could play a lead role in facilitating this engagement.

9. **Build a culture of collaboration.** Establish inclusive, diverse and collaborative working groups to share and develop greening ideas. Collaboration is required between major landholders; between major landholders and communities; between civic society organisations; and between major landowners and communities. The MGD co-creation model and urban prototyping techniques form ready-made methodologies that could help to establish and build trust.

10. **Sustain the Dublin 8 neighbourhood Greening Forum as a key enabler of community-led greening.** Greening Forum members have different types of expertise and needs. Future work involves building capacity of early individual projects, providing guidance on social economy structures and providing advice on funding, costings, etc., for those projects that are already established. Greening forum activity can be integrated into different spaces and streets. The support of locally based partners with community development expertise and organisations with access to broader policymakers and funding, for example the DCC biodiversity officer, will be necessary to provide access to training, financial and organisational advice, and coordination.

11. **Further research.** There is a growing body of literature on the environmental, social, economic and health benefits of urban greening that requires place-based studies to provide supporting evidence and enable contextual decision-making. Research on the value of small and diverse greenspaces within high-density urban areas and the role of communities in their design is largely absent. This research illustrates the potential of small-scale, green urban acupuncture to enhance the lived experience of high-density neighbourhoods. How this might be mainstreamed and the appropriate governance and resourcing frameworks could be the subject of further examination. A high-quality green urban environment has the potential to play a role in alternative medical therapies, and the potential role of trees and greenspace in supporting social prescribing in Ireland is worthy of significant attention.

The MGD project has developed a very significant scientific evidence base for both formal planning and community-based interventions and empowered the Dublin 8 community to articulate its specific needs. The findings have been developed into a community greening strategy entitled *Mapping Green Dublin: Strategic Pathways to Community-led Greening*, which has been published on the project website (www.mappinggreendublin.com). The project has developed a robust, radical and alternative methodology to support community-led greening that can be applied in other contexts. It has also left a legacy in the community through specific greening projects and the establishment of a community Greening Forum that will be supported by the local authority biodiversity office into the future.

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Abbreviations

App	Application
D8	Dublin 8
DBH	Diameter at breast height
DCC	Dublin City Council
DEM	Digital elevation model
EPA	Environmental Protection Agency
GI	Green infrastructure
GIS	Geographical information system
LAI	Leaf area index
LAP	Local area plan
MGD	Mapping Green Dublin
NPO	National planning objective
RSES	Regional Spatial and Economic Strategy
SDRA	Strategic development and regeneration area
UCD	University College Dublin

AN GHNÍOMHAIREACHT UM CHAOMHNÚ COMHSHAOIL
Tá an Ghníomhaireacht um Chaomhnú Comhshaoil (GCC) freagrach as an gcomhshaol a chaomhnú agus a fheabhsú mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaol 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: *Soláthraímid sonraí, faisnéis agus measúnú comhshaoil atá ar ardchaighdeán, spriocdhírithe agus tráthúil chun bonn eolais a chur faoin gcinnteoireacht ar gach leibhéal.*

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

Ár bhFreagrachtaí

Ceadúnú
Déanaimid na gníomhaíochtaí seo a leanas a rialú ionas nach ndéanann siad dochar do shláinte an phobail ná don chomhshaol:
- saoráidí dramhaíola *(m.sh. láithreáin líonta talún, loisceoirí, stáisiúin aistrithe dramhaíola)*;
- gníomhaíochtaí tionsclaíocha 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 tionsclaíocha)*;
- áiseanna móra stórála peitril;
- 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 phoiblí, 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 dhíriú ar chiontóirí, agus trí mhaoirsiú a dhéanamh ar leasúchán.
- Cur i bhfeidhm rialachán ar nós na Rialachán um Dhramhthrealamh Leictreach agus Leictreonach (DTLL), um Shrian ar Shubstaintí Guaiseacha agus na Rialacháin um rialú ar shubstaintí a ídíonn an ciseal ózóin.
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaol.

Bainistíocht Uisce
- Monatóireacht agus tuairisciú a dhéanamh ar cháilíocht aibhneacha, lochanna, uiscí idirchriosacha agus cósta na hÉireann, agus screamhuiscí; leibhéil 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 gComhshaol
- 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 Chomhshaol 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-ocsaíde carbóin is mó in Éirinn.

Taighde agus Forbairt Comhshaoil
- Taighde comhshaoil a chistiú chun brúnna a shainaithint, bonn eolais a chur faoi bheartais, agus réitigh a sholáthar i réimsí na haeráide, an uisce agus na hinbhuanaitheachta.

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

Cosaint Raideolaíoch
- Monatóireacht a dhéanamh ar leibhéil radaíochta, measúnacht a dhéanamh ar nochtadh mhuintir na hÉireann don radaíocht ianúcháin.
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as taismí núicléacha.
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíocha.
- 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 gcomhshaol ar a bhfuil fáil éasca a chur ar fáil chun rannpháirtíocht an phobail a spreagadh sa chinnteoireacht i ndáil leis an gcomhshaol *(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 ghníomhaíocht á bainistiú ag Bord lánaimseartha, 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
- Oifig um Chosaint Radaíochta agus Monatóireachta Comhshaoil
- 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 imní agus le comhairle a chur ar an mBord.

Mapping Green Dublin: Strategic Pathways to Community-led Greening

epaResearch

Authors: Alma Clavin, Niamh Moore-Cherry and Gerald Mills

Identifying Pressures

Urbanised landscapes are associated with low vegetation cover in the form of greenspaces and trees, which can regulate some of the negative aspects of urban environments, such as poor air and water quality and low biodiversity. The lack of vegetation cover is especially acute in densely occupied city centres, where much of the landscape is paved or built on. Enhancing the urban green infrastructure is an important means of improving the environment for those that work and reside in cities. The project Mapping Green Dublin examined the variable green cover in the Dublin City Council area and focused specifically on the uneven distribution of trees. A survey of all the trees in the city was completed and their environmental value was estimated. Maps of tree cover were compared with population and traffic information to identify those places with significant environmental deficiencies for further examination. Following the mapping exercise, the focus of Mapping Green Dublin moved to a neighbourhood in the south-west inner city area (Dublin 8) to address the green deficiency using a co-creation approach.

Informing Policy

It is Dublin City Council policy to enhance the green infrastructure of the city. This policy needs to be based on evidence and supported by local communities. Mapping Green Dublin has generated data on the city's trees, which are publicly available, and established a working relationship with the local community to develop a greening strategy for the Dublin 8 study area. Actions identified were formulated following intensive collaboration organised around workshops, interactive mapping and web-based discussions. Each of these engagements was supported by scientific data, which allowed citizens to become actively involved in designing plans to improve the green infrastructure of their neighbourhood. The results of this study were presented to Dublin City Council and will contribute to the city's next development plan.

Developing Solutions

The competing demands on space in urban environments present challenges for urban greening. Dublin's inner city is experiencing significant development pressure as available plots are converted into high-rise apartment blocks with limited private open space. Tree planting, alongside opportunities for creating small-scale accessible and high-quality greenspaces, can address many environmental issues in crowded urban spaces. Community involvement can provide important insights into local needs and opportunities for urban greening that have widespread support. Mapping Green Dublin established a process for effective engagement with neighbourhoods that allows residents to be participants in the design of their own spaces.

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