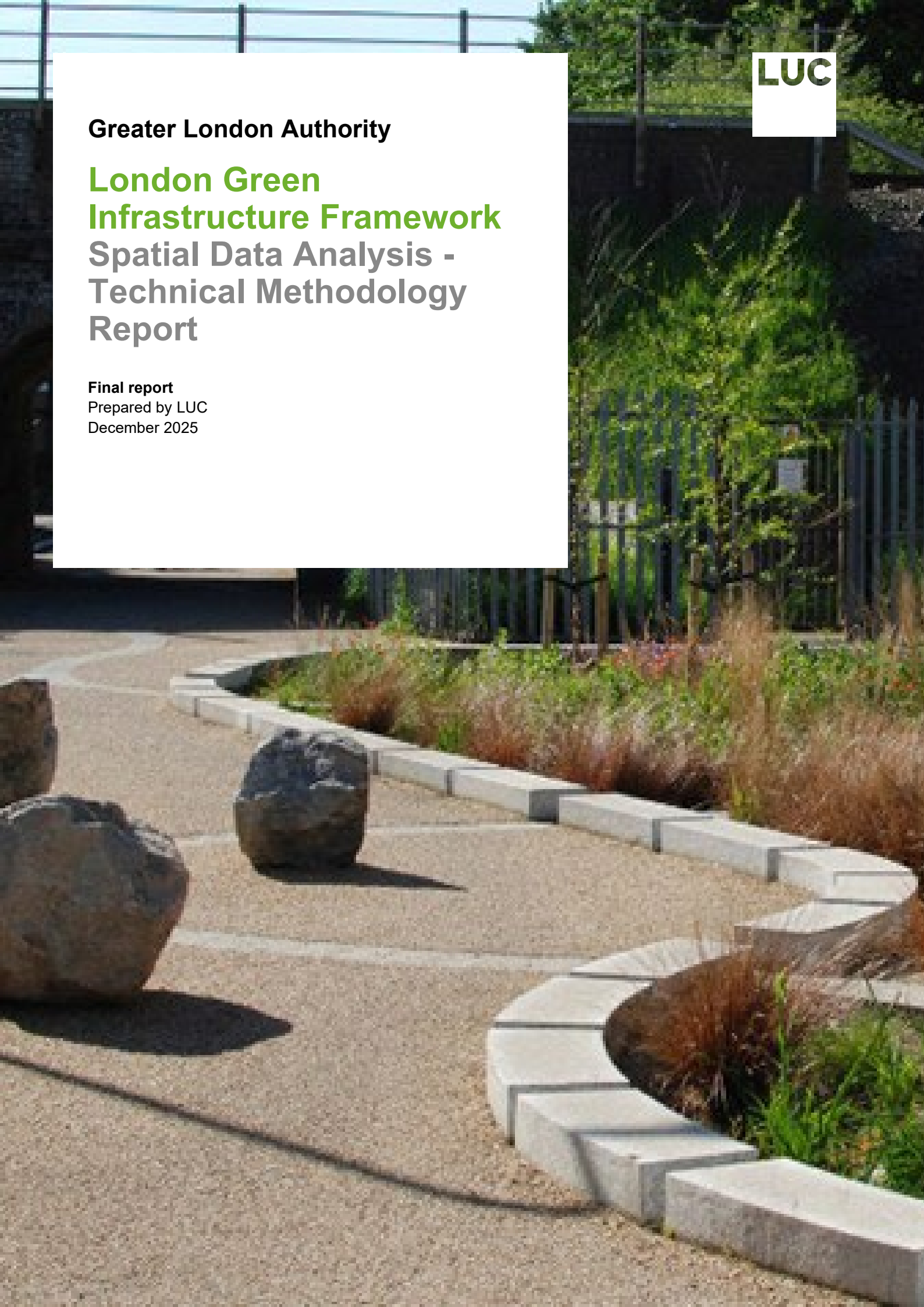

Greater London Authority

London Green Infrastructure Framework

Spatial Data Analysis - Technical Methodology Report

Final report
Prepared by LUC
December 2025

Greater London Authority

London Green Infrastructure Framework
Spatial Data Analysis - Technical Methodology Report

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Contents

Chapter 1
Introduction

This opening chapter introduces the scope of the London Green Infrastructure Framework (LGIF), including an overview of the approach to its development.

Purpose of the LGIF

1.1 The LGIF will provide a strategic-level spatial evidence base for London. The interactive public-facing online map will provide the latest London-wide spatial data, and help the Greater London Authority (GLA), London boroughs and other GI providers plan for and prioritise the siting of GI interventions that support key objectives and achieve multiple benefits. The tool will help decision makers prioritise strategic locations and suitable types of intervention for investment in GI protection, enhancement and creation across London. The tool aims to replace the All-London Green Grid (ALGG) Supplementary Planning Guidance (SPG)[1] and GI Focus Map[2], whilst also complementing the emerging London Local Nature Recovery Strategy (LNRS)[3].

1.2 The LGIF will comprise the following elements:

- The spatial data analysis explained in this **Technical Methodology** report and the outputs presented in the LGIF - Spatial Data Analysis - **Background and Findings Report**.
- An interactive public-facing online map that presents the spatial data analysis, showing areas with highest need for strategic GI, alongside relevant contextual datasets. This online map will enable users to interrogate the data to support GI decision making in London, at a range of scales.
- Supporting guidance explaining how to use the interactive online map and interpret the information it presents in order to guide future GI investment.

1.3 The development of the LGIF has been informed by insight from a range of internal and external stakeholders, responsible for the planning, delivery and management of GI across London.

Phased approach to the development of the LGIF

1.4 LUC was commissioned to support the GLA in the development of the LGIF, through the key phases outlined below:

Phase 1: Spatial data analysis

1.5 Working iteratively and involving extensive liaison with the GLA's GI and Geographic Information System (GIS) Teams, this phase included carrying out London-wide multi-criteria spatial data analysis, structured via a series of Strategic Objectives. The analysis of this spatial data identified areas of greatest need for GI, compared with areas where existing GI provision is lower or higher.

[1] Mayor of London (2012) Green Infrastructure and Open Environments: All London Green Grid Supplementary Planning Guidance
[2] Greater London Authority (updated 2023) Green Infrastructure Focus Map (Green Infrastructure Focus | Mayor of London)
[3] Greater London Authority (emerging) London Local Nature Recovery Strategy

Phase 2: Technical specification for the interactive web-based map

1.6 This stage involved the development of the technical brief for the creation and functionality of the LGIF web map, which will host the spatial data analysis produced in Phase 1.

Phase 3: Advisory role for the production of the web-based map

1.7 Undertaken in collaboration with GLA GIS team, Phase 3 will include the provision of support to inform the web-map build and user testing. User responses will be sought in the form of feedback surveys and targeted survey questions to elicit useful feedback. A user guide for the web-map will also be developed.

Phased approach to spatial data analysis

1.8 LUC and the GLA GI team have taken a phased approach to the LGIF spatial data analysis, involving seven key steps as outlined below and summarised in **Figure 1.1**.

Step 1: Identify key Strategic Objectives within the London context

1.9 As described in **Chapter 2**, this step involved identifying the key spatial Strategic Objectives and Inequalities in London that GI could help to alleviate.

Step 2: Identify and categorise relevant datasets as indicators for each Strategic Objective identified in Step 1

1.10 For each Strategic Objective, relevant datasets have been explored to use as indicators of the need for GI (e.g. areas at risk of flooding for the flood control Strategic Objective) and indicators of existing relevant GI provision (e.g. green cover across London has been used for many of the Strategic Objectives). The datasets that have been selected are discussed in **Chapter 3** along with the justification for their selection. Similarly, other datasets that were considered and rejected are discussed in **Appendix D**, with an explanation for their rejection.

Step 3: Define thresholds for each Strategic Objective indicator and GI provision indicator

1.11 For each Strategic Objective indicator dataset, thresholds have been defined to help identify areas with higher, medium or lower levels of need for GI, and higher, medium or lower levels of existing GI coverage. Where possible, thresholds have been based on national or London Plan policy targets or legal standards that exist, and the thresholds and justification for their use is described in **Chapter 3.** It should be noted that the use of the terms ‘higher’, ‘medium’ and ‘lower’ need or provision is relative for each Strategic Objective rather than absolute.

Step 4: Areas of greatest need (individual Strategic Objectives)

1.12 For each Strategic Objective, the indicators of need and provision have been mapped using a hexagon grid, and then combined using bivariate analysis to identify where there are areas of:

- Higher need (for a Strategic Objective) and lower relevant existing GI provision
- Lower need and higher existing GI provision
- Higher need and higher existing provision and
- Lower need and lower provision.

1.13 This helps to understand where different types of GI interventions are most needed across London to contribute to each Strategic Objective, and how these relate to gaps in the existing GI network.

Step 5: Areas with multiple needs/GI benefits (multi-criteria analysis)

1.14 This step combined the Strategic Objectives using multi-criteria analysis has helped to identify geographically specific areas across London where different types of GI intervention could address multiple needs / deliver multi-functional benefits. The multi-criteria maps and interpretation of the areas with multiple

needs and appropriate types of GI interventions are provided within the LGIF - Spatial Data Analysis - **Background and Findings Report**.

Figure 1.1 Phased approach to spatial data analysis

Step 1 **Identify key Strategic Objectives within the London context**	Step 2 **Categorise relevant datasets for each Strategic Objective identified in Step 1**	Step 3 **Define thresholds for each Strategic Objective indicator and GI provision indicator**	Step 4 **Compare levels of need and provision for each Strategic Objective** For each Strategic Objective identified in Step 1, plot GI need and GI provision on a bivariate map to identify areas of greatest need	Step 5 **Areas with multiple needs / GI benefits (multi-criteria analysis)** Combine the bivariate analysis for each Strategic Objective and factor in Social and Health Inequalities using multi-criteria analysis
Identify the key environmental and / or social issues in London which GI could help alleviate	Use relevant datasets to act as indicators to identify areas of GI need and provision	Help identify areas with high, medium and low levels of need and extents of existing GI coverage	Help understand where different GI interventions are most required across London and how these relate to gaps in the existing GI network	Consider all the Strategic Objectives in combination to identify the areas where multiple benefits from GI interventions could be achieved

Structure of this document

1.15 The report is structured as follows:

Chapter 1: Introduction

1.16 Outlines the scope of the LGIF, including an overview of the approach to its development.

Chapter 2: Step 1: Definition of Strategic Objectives

1.17 Establishes the principal drivers for GI within the London context, structured as a series of Strategic Objectives.

Chapter 3: Steps 2 and 3: Data sources and thresholds

1.18 Identifies the datasets used as indicators of need or GI provision within each Strategic Objective, as well as thresholds used to identify areas of high, medium or low need / provision.

Chapter 4: Steps 4 and 5: Approach to spatial data analysis

1.19 Outlines the process used in the LGIF spatial data analysis.

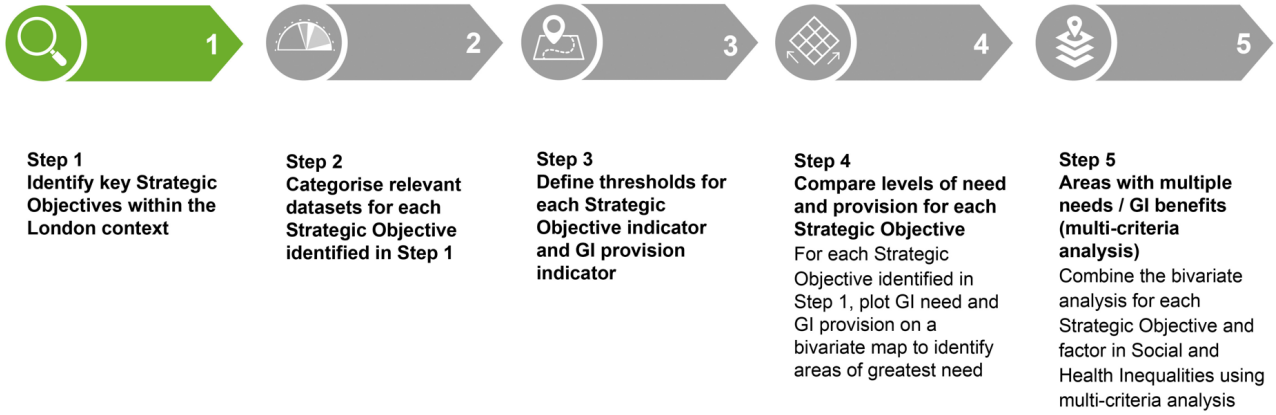
Appendices

1.20 The report is also supported by the following appendices:

- Appendix A: Glossary;
- Appendix B: Explanation of the thresholds defined based on data distribution or based on existing classifications;
- Appendix C: GIS processing methodology to translate the datasets to hex scale; and
- Appendix D: Datasets considered but not used in the analysis.

Chapter 2
Step 1 - Definition of Strategic Objectives

This chapter describes the process of identifying the key Strategic Objectives which GI can help to achieve across London.



Approach to structuring the data analysis

2.1 Owing to its multifunctionality, the benefits of high-quality GI are numerous and far reaching. LUC's Research and Analysis for the Scoping of a London GI Framework (2024) report recommended the adoption of GI themes to organise and group relevant spatial datasets to inform the spatial analysis for the LGIF. Natural England's five 'Benefit Principles' were recommended as a suggested starting point to structure the data analysis, to ensure alignment with national best-practice.

2.2 The Natural England national GI Framework outlines 15 principles to promote the successful delivery of GI. These 15 principles are comprised of the following:

- Five 'Benefit Principles';
- Five 'Descriptive Principles'; and
- Five 'Process Principles'.

2.3 The five 'Benefit Principles' summarise the role GI can play in the creation of high quality, attractive, nature rich and climate resilient places, providing a setting for healthy, active day-to-day living. These are described below:

Nature rich beautiful places

2.4 GI supports nature to recover and thrive. This includes conserving and enhancing natural beauty, wildlife and habitats, geology and soils, whilst also promoting our cultural and personal connections with nature. This principle aims to enhance ecological connectivity through the built environment whilst connecting people to nature.

Active and healthy places

2.5 Green neighbourhoods, green / blue spaces and green routes support active lifestyles, community cohesion and nature connections that benefit physical and mental health and wellbeing. GI also helps to mitigate health risks such as urban heat stress, noise pollution, flooding and poor air quality. To achieve 'active and healthy places' GI should maximise health and wellbeing outcomes and address deficiencies in access to green and blue spaces, whilst also delivering indirect environmental benefits.

Thriving and prospering communities

2.6 GI helps to create and support prospering communities by creating high quality environments which are attractive to businesses and investors, supporting the local economy / regeneration.

Improved water management

2.7 GI reduces flood risk and helps to maintain the natural water cycle and sustainable drainage at local and catchment scales, reducing pressures on the water environment as well as delivering amenity, biodiversity and economic benefits. This principle aims to encourage the use of Sustainable Drainage Systems (SuDS) to address the impacts of climate change.

Resilient and climate positive places

2.8 GI promotes climate resilience and climate change adaptation to help meet zero carbon and air quality targets. To achieve 'resilient and climate positive places', GI should be adapted to climate change to ensure long-term resilience.

Identification of Strategic Objectives for the LGIF

2.9 While the five Natural England GI 'benefit principles' provide a good description of the multiple benefits that GI can help to deliver, as discussed at the external stakeholder workshops in October 2024, they were considered too broad to use as an approach to structuring the spatial data analysis for the LGIF. Within each of the five principles, there are many themes covered, some of which overlap. For example, addressing flood risk is a key theme in the 'Improved water management' principle, but could also be considered under the 'Resilient and climate positive places' principle. Therefore, there would be potential for double handling and double-counting of data within the spatial data analysis, or confusion for users of the LGIF, and it was concluded that having single themes covered by each strategic objective would make the spatial data analysis easier to carry out, update and interpret. Finally, it was agreed that the set of Strategic Objectives for the LGIF needed to be relevant to the London context and address GLA/Mayoral priorities (for example, addressing social and health inequalities and ensuring healthy waterways).

2.10 Key strategic needs and objectives which GI can help to address and mitigate within the London context were proposed by LUC as part of a collaborative approach with the GLA. This process was also informed by feedback received during the external stakeholder workshops in October 2024 and a workshop with the GLA's LGIF internal coordination group in December 2024. Some needs identified were considered to be out of scope for the LGIF, because they were either a locally specific issue, would be unable to be analysed at the strategic London-wide scale, or were more of a cross-cutting issue already covered by other Strategic Objectives. These included:

- Mitigation of recreational impact on sensitive sites (e.g. for Epping Forest Special Area of Conservation).
- Heritage conservation.
- Improved climate resilience.
- Improved carbon storage.

2.11 The following strategic needs were agreed to be the focus for the development of the spatial analysis for the LGIF, listed in no particular order:

- Deficiencies in access to green and blue space;
- Greener active travel networks;
- Flood risk;
- Heat risk;
- Water pollution;
- Air pollution;
- Noise pollution;
- Greener high streets / town centres;
- Health inequalities;
- Social inequalities; and
- Nature recovery.

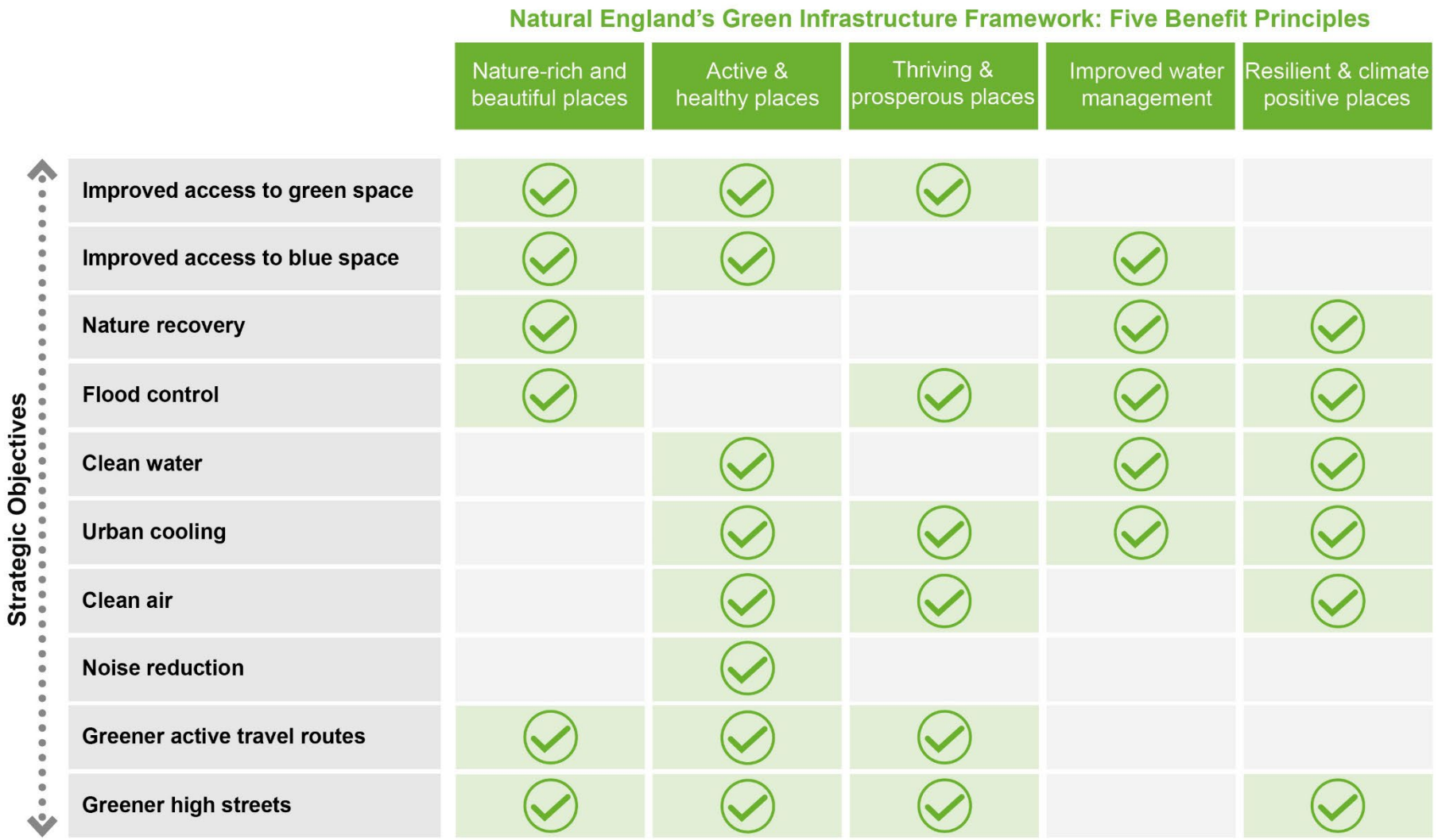
Final set of Strategic Objectives and the differentiation of Inequalities

2.12 The list of strategic needs was re-framed as 10 ‘Strategic Objectives’ for the LGIF, and two Inequalities as shown in **Figure 2.1**. The 10 Strategic Objectives represent functions that GI can deliver, while the two Inequalities provide data that helps to prioritise between areas of functional need based on demographic variations across London.

2.13 Although the five ‘Benefit Principles’ were not directly used to structure the LGIF spatial data analysis, **Figure 2.2** shows how the LGIF Strategic Objectives relate to the five ‘Benefit Principles’ included within Natural England’s GI Framework.

Figure 2.1: LGIF Strategic Objectives and Inequalities

Figure 2.2: Alignment of the LGIF Strategic Objectives with the Five 'Benefit Principles'



Chapter 3
Steps 2 and 3 - Data sources and thresholds

This chapter describes the datasets that have been considered for use in the spatial data analysis, including justifications for their inclusion or exclusion. The thresholds used to identify areas with high, medium or low levels of GI need and provision for each indicator dataset are explained.

Step 1
Identify key Strategic Objectives within the London context

Step 2
Categorise relevant datasets for each Strategic Objective identified in Step 1

Step 3
Define thresholds for each Strategic Objective indicator and GI provision indicator

Step 4
Compare levels of need and provision for each Strategic Objective
For each Strategic Objective identified in Step 1, plot GI need and GI provision on a bivariate map to identify areas of greatest need

Step 5
Areas with multiple needs / GI benefits (multi-criteria analysis)
Combine the bivariate analysis for each Strategic Objective and factor in Social and Health Inequalities using multi-criteria analysis

Approach to the selection of indicator datasets and thresholds for Strategic Objectives and Inequalities

3.1 For each Strategic Objective, numerous potential datasets were identified by the GLA and LUC, and then collated and reviewed by LUC through extensive collaboration with the GLA GI team. This process was also informed by stakeholder engagement, as explained in Chapter 2 of the LGIF - Spatial Data Analysis - **Background and Findings Report**.

3.2 For each Strategic Objective, datasets were selected on the basis that they provided good indicators of a particular need that effective GI can contribute towards, or indicators of existing GI provision. Datasets were selected based on the following criteria:

- Have full coverage across Greater London
- Have been consistently developed across all London Boroughs
- Be as granular as possible
- Have an update cycle in place or be as up to date as possible.

3.3 In general, the selected datasets were obtained from national or London-based datasets, including the London Datastore and GiGL. Some datasets detailed in the sections below have been made available by the GLA during this project as part of ongoing studies and may be subject to change as those studies are

finalised. In addition, other relevant datasets might become available in the future, and known studies/datasets are highlighted within the Strategic Objective and Inequality sections below.

3.4 **Table 3.1** below summarises the indicators of need and provision used for each Strategic Objective and Inequality. A detailed list including sources, is available in each Strategic Objective or Inequalities section below Table 3.1. (Hyperlinks are provided in the first column in Table 3.1 so readers can jump to the relevant section.)

3.5 The datasets that were reviewed during the data collection phase but were excluded from the analysis, including the rationale for exclusion, are detailed in **Appendix D**.

3.6 In some cases, multiple indicators of need or provision were selected for a Strategic Objective or Inequality. This was either due to the type and number of relevant datasets available and/or more than one factor or group contributing to the need or provision, e.g. for Flood Control, there are different areas at risk of flooding depending on the type of flooding, which can be fluvial (from rivers) or surface water flooding, with different corresponding spatial datasets available. Where multiple indicators were selected, further explanation is provided in the sections below. The multiple indicators were combined to provide an overall need or overall provision layer for the relevant Strategic Objective or Inequality. The tables in the sections below also provide details on how the overall need / provision was derived.

3.7 For each indicator dataset, thresholds have been defined to help identify areas with high, medium or low relative levels of need that GI could help to address, and high, medium or low relative levels of existing GI coverage across London. The results of applying these thresholds to the indicator datasets were mapped at the hexagon scale, which is described in the 'Scale of spatial data analysis' section in **Chapter 4**. Where possible, thresholds have been based on national or GLA policy targets or legal standards that exist, and the thresholds and justification for their use is described in each table in the sections in this chapter. If no policy or legal targets/standards exist, then thresholds have been applied using a proportionate split of data based on the spatial distribution across hexes, catchments or boroughs.

3.8 The selection of data sources and the processing of the data to measure need and provision for each Strategic Objective was undertaken through a deliberately iterative process. All the datasets were brought into Geographical Information System (GIS) software Esri ArcGIS Pro version 3.4 where they were processed at the hex scale to be scored using thresholds described in each Strategic Objective or Inequality section below. The detailed GIS methodology is available in **Appendix C**.

3.9 The GIS processed data was then transferred to an Excel spreadsheet where formula were used to assign low, medium or high scores for need or provision as per the threshold rules described in **Tables 3.2** to **3.13** below. The results were loaded into an interactive ArcGIS Online web application where they were sense checked collaboratively with the GLA GI team, and the data processing cycle repeated to obtain results that made sense for the London context. Changes made during this iterative process included refining the threshold levels and testing results using different datasets.

3.10 The output maps for each indicator of need / provision at the hex level are presented in Chapter 5 of the LGIF - Spatial Data Analysis - **Background and Findings Report**. Maps are presented showing the datasets used for each indicator of need or provision along with how that translates into areas of high, medium and low need or provision by hex.

Table 3.1 Summary of indicators of need and provision for all Strategic Objectives / Inequalities

Strategic Objective	Indicators of need	Indicators of provision
Strategic Objective 1: Improved access to green space	■ Areas of deficiency (AoD) in access to Public Open Space: district parks and local parks ■ AoD in access to nature ■ Area of private gardens per capita	■ Green Cover

Strategic Objective	Indicators of need	Indicators of provision
Strategic Objective 2: Improved access to blue space	■ Accessible waterside	■ Blue Cover
Strategic Objective 3: Nature recovery	■ London LNRS Potential measures	■ London LNRS Areas of particular importance for biodiversity (APIB)
Strategic Objective 4: Flood	■ Fluvial Flood Zones ■ London Surface Water Strategy priority areas and sub-catchments	■ Green Cover ■ Blue Cover
Strategic Objective 5: Clean water	■ River quality by river catchments ■ Misconnection (pollution) points by river catchments ■ Road run-off pollution by river catchments	■ Green riparian buffers based on Green and Blue Cover
Strategic Objective 6: Urban cooling	■ Major Summer Heat Spots	■ Green Cover ■ Tree Canopy Cover ■ Blue Cover
Strategic Objective 7: Clean air	■ NO2 concentration ■ PM 2.5 concentration	■ Green Cover ■ Tree Canopy Cover
Strategic Objective 8: Noise reduction	■ Rail noise and residential addresses ■ Road noise and residential addresses	■ Tree Canopy Cover
Strategic Objective 9: Greener active travel routes	■ Cycle network: National Cycle Network and London Cycle Network ■ Strategic Walking Analysis: Total walking potential density and Pedestrian density	■ Green Cover
Strategic Objective 10: Greener high streets	■ High street and town centre footfall	■ Green Cover within high streets and town centre ■ Tree Canopy Cover within high streets and town centres ■ AoD for local small pocket local parks
Inequalities: Health inequalities	■ IMD Health Deprivation and Disability Domain	N/A
Inequalities: Social inequalities	■ Population density ■ % of people under the age of 5 ■ % of people over the age of 75 ■ % of people note proficient in English ■ % of people in social housing ■ % of people identifying as Black, Asian or Minority Ethnic (BAME) ■ % of people considered income deprived	N/A

Strategic Objective 1: Improved access to green space

3.11 As described in **Chapter 2**, access to green space as part of a strong GI network provides opportunities for physical activity as part of more active lifestyles and social interaction. In a number of studies, access to green space has been associated with improved relaxation, increased functioning of the immune system and better sleep patterns[4]. The indicators of need and provision have been identified to consider these benefits.

Datasets and thresholds used for indicators of need and provision

3.12 The datasets used as indicators of need or provision, as well as the thresholds applied to identify areas with high, medium or low levels of need for GI or existing GI coverage for this Strategic Objective are described below in **Table 3.2.**

3.13 Four indicators of need were chosen, as they show areas of London where Londoners do not currently have close (i.e. walking distance) access to small to medium public open spaces (local and district parks), nature sites or private gardens. Therefore, they are less able to access the health and wellbeing benefits green space provides. The GiGL datasets for Areas of Deficiency were used because they have been developed specifically in relation to London using the access to open space and nature standards within the London Plan. There is no London-specific dataset for the amount of private gardens per person in London, therefore the Natural England national dataset was used.

3.14 One indicator of existing GI provision was selected; the GLA's Green Cover dataset, as it is the most up to date for London, and shows the provision of green space irrespective of which type of green space it is, i.e. a park, front or back garden, street tree, grass verge etc. Using the green cover dataset was found through testing (e.g. of public open space datasets) to provide a more nuanced picture of areas that have low access to publicly accessible green space, but may still have quite a lot of green cover, e.g. due to street trees or a private garden nearby.

3.15 It should be noted that the quality of green spaces has not been able to be taken into account within this Strategic Objective (or elsewhere in the spatial data analysis for the LGIF) because there is a lack of consistency in approach to assessing quality and no consistent dataset for the whole of London.

Table 3.2 Strategic Objective 1: Improved access to green space - datasets and thresholds

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
Area of deficiency in access to Public Open Space (AoD POS): district parks	GiGL - 2024 Obtained based on data exchange agreement – GiGL copyright	Need	Score 1 (**high need**) where 1% or more of the hex is in AoD. Score 0 (**low need**) where less than 1% of the hex is in AoD. A minimum 1% overlap of Hex and AoD was applied when scoring to avoid counting very small overlaps as within AoD.	Threshold measures presence / absence of areas of deficiency (i.e., determines whether a location sits in an area of deficiency or not). Areas of deficiency are identified by GiGL with reference to their POS dataset and the POS definitions set out by Policy G4: Open Space of the London Plan[5].	Average all four need indicators (sum and divide by 4). Resulting values were reclassified to a three-point scale as follows: >=0 - <0.25 = low need >=0.25 - <=0.5 = medium need >0.5 = high need.
AoD POS: local parks	GiGL - 2024 Obtained based on data exchange agreement	Need	Score 1 (**high need**) where 1% or more of the hex is in AoD. Score 0 (**low need**) where less than 1% of the hex is in AoD.	Threshold measures presence / absence of areas of deficiency (i.e., determines whether a location sits in an area of deficiency or not). Areas of deficiency identified by GiGL in relation to their	

[4] Natural England (2023) GI Framework – Benefit / 'Why?' Principles (GI Why Principles)
[5] Mayor of London (2021) London Plan: The Spatial Development Strategy for Greater London

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
	– GiGL copyright		A minimum 1% overlap of Hex and AoD was applied when scoring to avoid counting very small overlaps as within AoD.	POS dataset and the categories of the London Plan.	
Area of deficiency in access to nature (SINCs – Sites of Importance for Nature Conservation)	GiGL - 2024 Obtained based on data exchange agreement – GiGL copyright	Need	Score 1 (**high need**) where 1% or more of the hex is in AoD. Score 0 (**low need**) where less than 1% of the hex is in AoD. A minimum 1% overlap of Hex and AoD was applied when scoring to avoid counting very small overlaps as within AoD.	Threshold measures presence / absence of areas of deficiency (i.e. determines whether a location sits in an area of deficiency or not).	
Area (m^2) of private garden per 1,000 people by Lower Super Output Area (LSOA)	Natural England - 2024[6] Open Government Licence v3.0	Need	Score 1 (**high need**) where Hexes are located in 0 - <=41,725 m^2 of private gardens per 1,000 people. Score 0.5 (**medium need**) where Hexes are located in >41,725 – <112,982 m^2 of private gardens per 1,000 people. Score 0 (**low need**) where Hexes are located in >= 112,982 m^2 of private gardens per 1,000 people. LSOAs have no data over the Thames. Hexes overlapping with these areas were assigned 'N/A'.	Thresholds based on categorisation defined by Natural England in the Natural England GI Framework[7]. The Natural England categorisation was refined to match the London context. See **Appendix B** for more details.	
Green Cover	GLA - 2024[8] Licence: Other (Not Open)	Provision	Score 1 (**high provision**) where >=50% of hex is green cover. Score 0.5 (**medium provision**) where <50% and >=25% of hex is green cover. Score 0 (**low provision**) where <25% of hex is green cover.	Score of 1 achieved where areas are characterised by a minimum of 50% coverage, in accordance with London Environment Strategy (LES) target for London to have at least 50% green cover in 2050.	N/A – single provision indicator

[6] https://www.data.gov.uk/dataset/f335ab3a-f670-467f-bedd-80bdd8f1ace6/green-and-blue-infrastructure-england
[7] https://designatedsites.naturalengland.org.uk/GreenInfrastructure/Home.aspx
[8] https://data.london.gov.uk/dataset/green-cover-2024

Strategic Objective 2: Improved access to blue space

3.16 As described in **Chapter 2,** blue spaces support active lifestyles, community cohesion and nature connections that benefit physical and mental health and wellbeing, and quality of life. The recreational benefits of blue infrastructure are also important. The indicators of need and provision have been identified to consider these benefits.

Datasets and thresholds used for indicators of need and provision

3.17 The datasets used as indicators of need or provision, as well as the thresholds applied to identify areas with high, medium or low levels of need or existing coverage for this Strategic Objective are described in **Table 3.3**.

3.18 Buffers of 800m (corresponding to a 10-minute walk) from existing blue cover based on the GLA Blue Cover dataset were used as indicators of need for this Strategic Objective. The Natural England Accessible Waterside dataset was overlaid with the GLA blue cover dataset to distinguish between accessible and inaccessible waterways as it shows which parts of the rivers and waterbodies across London are publicly accessible. The 800m buffers help to identify areas of London devoid of access to blue space, or with blue space that is not currently publicly accessible. In those areas, Londoners may be less able to benefit from the positive effects of being in, on or near to water. **Appendix C** provides details on how the indicator of need was created in GIS.

3.19 One indicator of existing blue space provision was selected: an 800m buffer around the GLA's Blue Cover dataset. This dataset indicates a 10-minute walking distance from blue space, irrespective of how accessible it is. It is also the most up to date indicator of existing blue infrastructure across London.

3.20 It is noted that the GLA has a new workstream looking at 'clean and healthy waterways' and new and different datasets may result from that work that could be relevant to this Strategic Objective in future.

Table 3.3 Strategic Objective 2: Improved access to blue space - datasets and thresholds

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
GLA Blue Cover Natural England Accessible Waterside 800m buffer around accessible/ inaccessible waterways	GLA - 2024 Licence: Other (Not Open) Natural England - 2024 Open Government Licence v3.0	Need	Score 1 (**high need**) where a hex is >1% in 800m buffer (10-minute walking distance) around inaccessible waterways or is not in any of the buffers (i.e. <1% overlap with accessible / inaccessible buffers) Score 0.5 (**medium need**) where a hex is between 1% and <50% within the 800m buffer for accessible waterways. Score 0 (**low need**) where a hex is >=50% in the 800m buffer for accessible waterways. If a hex overlaps with both accessible and inaccessible buffers, and none of the overlaps are >=50%, then the hex is scored based on the largest overlap. Thus, if	Accessible / inaccessible buffers around waterways developed following the method from Bloomberg Associates used for the Mayor's Clean and Healthy Waterways Plan (2025). Threshold developed to reflect the principles of the Natural England Close to Home Target[9].	N/A – single need indicator

[9] Green Infrastructure Standards for England Summary

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
			it overlaps more with the inaccessible waterways buffer, it is scored 1 (high need), and if it overlaps more with the accessible waterways buffer it gets assigned a score of 0.5 (medium need).		
800m buffer (10-minute walk) around GLA Blue Cover 2024	GLA - 2024 Licence: Other (Not Open)	Provision	Score 1 (**high provision**) where >=50% of hex is in the 800m buffer around blue cover. Score 0.5 (**medium provision**) where >=1% and <50% of hex is in the 800m buffer. Score 0 (**low provision**) where <1% of hex is in the 800m buffer.	Threshold defined using a proportionate split of data based on the spatial distribution of blue cover across hexes. See **Appendix B** for more details.	N/A – single provision indicator

Strategic Objective 3: Nature recovery

3.21 As described in **Chapter 2,** GI has the potential to support nature recovery through the creation of a diversity of habitats and ensuring habitats in London are larger, better quality, and linked to each other. There is also the recognition that environments rich in biodiversity help to enhance the public's personal and cultural connections with nature. Nature recovery priorities for London and measures to achieve these are set out in the London Local Nature Recovery Strategy (LNRS).

Datasets and thresholds used for indicators of need and provision

3.22 The datasets used as indicators of need or provision, as well as the thresholds applied to identify areas with high, medium or low levels of need for GI or existing GI coverage for this Strategic Objective are described in **Table 3.4.**

3.23 Given the extensive work undertaken by the GLA to develop the LNRS, the indicators of need and provision for this strategic objective have been derived directly from the LNRS mapping. **Note: Due to the timing of public consultation on the LNRS, the first round of analysis (pre December 2025 updates to this report) relating to this Strategic Objective was based on a draft iteration of the LNRS data. The final version of the LNRS was released in December 2025 and the results are available on the LGIF web map.**

3.24 The LNRS Potential Measures dataset was used for the indicator of need, as it comprises locations in London where potential nature recovery measures have been identified that could deliver the priorities of the LNRS.

3.25 The London Areas of Particular Importance for Biodiversity (APIB) dataset was used for the indicator of provision, as it includes national nature conservation sites (e.g. SSSI, SPAs, SCAs, etc.), local nature reserves, local wildlife sites (in London these sites are called Sites of Importance for Nature Conservation - SINCs), proposed SINCs and the Ancient Woodland Inventory.

Table 3.4 Strategic Objective 3: Nature recovery - datasets and thresholds

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
London LNRS Potential measures	GiGL 2025 LNRS (December 2025) Obtained based on data exchange agreement – GiGL copyright	Need	Score 1 (**high need**) where >=25% of hex overlap with potential measures. Score 0.5 (**medium need**) where 1-25% of hex overlap with potential measures. Score 0 (**low provision**) where <1% of hex overlap with potential measures.	Thresholds were defined in agreement with the GLA LNRS team and attempt to highlight hexes that are within Potential Measure areas as 'high' need for nature recovery, partially within Potential Measures as 'medium' and not within Potential Measures as 'low' need.	N/A – single need indicator
London LNRS Areas of particular importance for biodiversity (APIB)	GiGL 2025 LNRS (December 2025) Obtained based on data exchange agreement – GiGL copyright	Provision	Score 1 (**high provision**) where >=25% of hex overlap with APIB. Score 0.5 (**medium provision**) where 1-25% of hex overlap with APIB. Score 0 (**low provision**) where <1% of hex overlap with APIB.	Thresholds were defined in agreement with the GLA LNRS team and attempt to distinguish between hexes that have a relatively high proportion of APIBs within them as 'high' provision of designated nature areas, hexes that have a smaller proportion of APIBs within them as 'medium' provision and hexes with no (or very small areas of) APIBs within them as 'low' provision.	N/A – single provision indicator

Strategic Objective 4: Flood control

3.26 As described in **Chapter 2**, GI can reduce flood risk and contribute to positive water management. Planned and delivered correctly, GI can greatly reduce the speed and volume of water reaching drains, sewers and watercourses across London. The indicators of need and provision have been identified to consider these benefits.

Datasets and thresholds used for indicators of need and provision

3.27 The datasets used as indicators of need or provision, as well as the thresholds applied to identify areas with high, medium or low levels of need for GI or existing GI coverage for this Strategic Objective are described below in **Table 3.5.**

3.28 Two indicators of need were selected, as they show areas of London where different types of flooding are most likely to occur (fluvial flooding and surface water flooding). While it is noted that the areas where the flooding occurs are not the only areas where GI solutions could help to alleviate flooding, for example, woodland planting, gully blocking or creating storage areas in upstream catchments will help to intercept rain fall, reducing and slowing down flood water, a dataset to identify upstream areas of need was not able to be obtained in the timeframe of the spatial data analysis. However, as noted in **Appendix D**, the Thames Regional Flood and Coastal Committee's Natural Flood Management opportunity and priority map could be a potential indicator of need dataset in the future.

3.29 Two indicators of existing GI provision were chosen; the GLA's Green Cover and Blue Cover datasets, as these are the most up to date for London, and highlight areas across London that can help with rainfall and surface water interception, infiltration and storage. While some data is being collected by the GLA on the location of sustainable drainage systems (SuDS) that have been delivered, it is not comprehensive enough

at this stage to provide an accurate picture of where there is high, medium or low provision of SuDS across London.

Table 3.5 Strategic Objective 4: Flood control - datasets and thresholds

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
Fluvial Flood Zones 2 and 3	Environment Agency 2024[10] Open Government Licence	Need	The zones with 'tidal only' sources were removed from the datasets to only keep fluvial flood zones, because GI cannot address tidal flood risk. Score 1 (**high need**) where hexes overlap >=25% with flood zone 3 only or where hexes overlap >=25% with both zones 2 and 3 Score 0.5 **(medium need)** where hexes overlap >=25% with flood zone 2 only Score 0 (**low need**) where hexes overlap <25% with flood zones 2 and 3	Thresholds based on EA categorisation of flood risk in the Flood Map for Planning - Flood Zones[10]. Flood zone 3 covers areas at the highest risk of flooding (a 1% (1 in 100) or greater annual probability of flooding from rivers). Flood zone 2 has between 0.1% - 1% (1 in 100 to 1 in 1000) annual probability of flooding from rivers, while flood zone 1 is lowest risk with a less than 0.1% (1 in 1000) annual probability of flooding. Thresholds defined to ensure hexes mostly within flood zone 3 are high need, mostly within flood zone 2 are medium need and hexes not in flood zones 2 or 3 are low need.	Average the two need indicators (sum and divide by 2). Resulting values were reclassified to a three-point scale as follows: >=0 - <0.25 = low need >=0.25 - <=0.5 = medium need >0.5 = high need.
London Surface Water Strategy (LSWS) – priority areas and sub-catchments	GLA – 2025[11] Licence: Other (Not Open – at the time of analysis)	Need	The percentage of priority areas for each LSWS sub-catchment was calculated. The LSWS sub-catchments were developed using the hex grid, so each hex was able to be assigned to a single LSWS sub-catchment. Hexes not covered by any LSWS sub-catchments are scored 0 (low need) because these correspond to areas less susceptible to rainfall than the London average. Score 1 (**high need**) where hexes are assigned to a sub-catchment with >30% priority area cover Score 0.5 (**medium need**) where hexes are assigned to a sub-catchment with priority area cover between 5 – 30%	Threshold defined using a split of data based on the spatial distribution of priority areas across sub-catchments, as well as based on discussions with GLA water experts. See **Appendix B** for more details.	

[10] Flood Map for Planning - Flood Zones
[11] London Surface Water Strategy

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
			Score 0 (**low need**) where hexes are assigned to a sub-catchment with <5% priority area cover		
Green Cover	GLA - 2024[8] Licence: Other (Not Open)	Provision	Score 1 (**high provision**) where >=50% of hex is green cover. Score 0.5 (**medium provision**) where <50% and >=25% of hex is green cover. Score 0 (**low provision**) where <25% of hex is green cover.	Score of 1 achieved where areas are characterised by a minimum of 50% coverage, in accordance with London Environment Strategy (LES) target for London to have at least 50% green cover in 2050.	Average the two provision indicators (sum and divide by 2). Resulting values were reclassified to a three-point scale as follows: >=0 - <0.25 = low provision >=0.25 - <=0.5 = medium provision >0.5 = high provision.
Blue Cover	GLA - 2024 Licence: Other (Not Open)	Provision	Score 1 (**high provision**) where >=50% of hex is blue cover. Score 0.5 (**medium provision**) where >=1% and <50% of hex is blue cover. Score 0 (**low provision**) where <1% of hex is blue cover.	Threshold defined using a split of data based on the spatial distribution of blue cover across hexes. See **Appendix B** for more details.	

Strategic Objective 5: Clean water

3.30 As described in **Chapter 2**, GI can play a role in improving water quality and natural filtration by introducing vegetation which can help trap, filter out or reduce contaminants released to the environment largely through surface water runoff. This is particularly the case in riparian margins adjacent to waterbodies. The indicators of need and provision have been identified to consider these benefits.

Datasets and thresholds used for indicators of need and provision

3.31 The datasets used as indicators of need or provision, as well as the thresholds applied to identify areas with high, medium or low levels of need for GI or existing GI coverage for this Strategic Objectives are described below in **Table 3.6.**

3.32 Three indicators of need were selected, as they show areas of London where different types of water pollution are already or likely to be more of a problem. The Environment Agency River Quality Status data shows those water bodies achieving 'good', 'moderate', 'poor' or 'bad' ecological water quality and thus indicates for the poor and bad quality rivers that pollution from direct (e.g. waste water treatment works discharges) and indirect sources (e.g. agricultural or road run-off) is already a significant issue. The GLA's River Health Map 'misconnection points' relate to polluted surface water outfalls based on data from the Environment Agency and local citizen scientist initiatives mapping. The GLA's River catchment high priority road emissions dataset categorises river catchments based on the length of 'high priority roads' which have been identified as the sections of London's strategic road network that are likely to contribute the most run-off pollution to rivers. Together, these datasets provide a more accurate reflection of the catchments across London that are experiencing the most water pollution.

3.33 Given the role that riparian vegetation can play in reducing pollution to rivers, the indicator of existing GI provision for this clean water Strategic Objective made use of the GLA's Green Cover and Blue Cover datasets. The Blue Cover dataset was buffered by 2.5m to create approximate riparian buffers along and around waterbodies. These buffers were overlaid with the Green Cover dataset to produce an indication of where riparian vegetation may already exist. It is noted that this is not as accurate as being able to identify different types and quality of riparian habitat, some of which will provide better pollution reduction than others (e.g. natural wetlands), however, a consistent, comprehensive dataset for London is not available.

3.34 It is also noted that the misconnection points data are 5 years old, and while more recent data may be being collected, it was not available in time for the LGIF spatial data analysis. The indicators of need for this Strategic Objective could be updated when any new data becomes available.

Table 3.6 Strategic Objective 5: Clean water - datasets and thresholds

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
River quality by river catchment	Environment Agency – WFD River Waterbody Catchments Cycle 2 2024[12]) Environment Agency – River quality status[13] Open Government Licence GLA – LSWS sub-catchments [11] Licence: Other (Not Open – at the time of the analysis)	Need	A water quality status was assigned to the WFD catchments (i.e. 'good', 'moderate', 'poor' or 'bad', based on the 2019 cycle 3 ecological classification). LSWS sub-catchments were used in Central London instead of EA WFD catchments to refine the analysis. Catchments with multiple water quality ratings were assigned the worst score. Hexes were assigned a catchment based on where they intersected. If a Hex overlaps with 2 catchments, it was assigned the largest overlapping catchment. Score 1 (**high need**) where hexes are attributed to catchments with water quality 'poor' or 'bad' score Score 0.5 (**medium need**) where hexes are attributed to catchments with water quality 'moderate' score Score 0 (**low need**) where hexes are attributed to catchments with water quality 'good'.	Thresholds based on ratings defined by the Environment Agency (bad / poor / moderate and good). Scoring done per catchment following recommendations from LGIF stakeholder engagements.	Average of the three need indicators (sum and divide by 3). Resulting values were reclassified to a three-point scale as follows: >=0 - <0.25 = low need >=0.25 - <=0.5 = medium need >0.5 = high need.
Misconnection points	GLA – River Health map pollution	Need	The misconnection points dated 2015-2020 were used because the	Threshold defined using a split of data based on the spatial distribution of	

[12] https://www.data.gov.uk/dataset/298258ee-c4a0-4505-a3b5-0e6585ecfdb2/wfd-river-waterbody-catchments-cycle-2
[13] https://experience.arcgis.com/experience/73ed24b6d30441648f24f043e75ebed2/page/Classification/

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
by river catchment	sources 2015-2020[14] Licence: Other (Not Open) Environment Agency – WFD River Waterbody Catchments Cycle 2 2024[12]) Open Government Licence		points show sources of pollution that were identified (although they are likely to have been fixed by now). A more recent dataset was being prepared at the time of the analysis however it was not provided in time for this project. Therefore the misconnection points (dated 2005-2010) were deemed too out of date and unlikely to reflect the reality on the ground and were not included in the analysis. The count of misconnection points by WFD catchment was used to score Hexes based on their assigned catchment (see above). Score 1 (**high need**) where hexes are assigned to a catchment with >5 points Score 0.5 (**medium need**) where hexes are assigned to a catchment with >=1 and <=5 points Score 0 (**low need**) where hexes are assigned to a catchment with 0 point.	misconnection points across river catchments, as well as following recommendations from GLA water experts. See **Appendix B** for more details.	
Road run-off pollution per river catchment	GLA – River catchment high priority road emissions analysis 2025 Licence: Other (Not Open) Environment Agency – WFD River Waterbody Catchments Cycle 2 2024[12])	Need	The length (km) of high priority roads (i.e. those with high potential for run-off pollution) by WFD catchment was used to score Hexes based on their assigned catchment. Score 1 (**high need**) where hexes are in a catchment with >10km of roads Score 0.5 (**medium need**) where hexes are in catchment with 2.01 – 10km of roads Score 0 (**low need**) where hexes are in	Threshold defined using a split of data based on the spatial distribution of length of high priority roads by river catchments, as well as following recommendations from GLA water experts. See **Appendix B** for more details.	

[14] https://apps.london.gov.uk/river-health/

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
	Open Government Licence		catchment with 0- 2km of roads Hexes that fall in 'n/a' areas score 0 (low need). 'n/a' areas are combined-sewer areas where the risk does not apply.		
Green riparian areas	GLA Green Cover 2024[8] and GLA Blue Cover 2024	Provision	The Blue Cover dataset was buffered by 2.5m to create riparian buffers. These buffers were overlaid with the Green Cover. Score 1 (**high provision**) where >=50% of the riparian buffer in a hex is also identified as green cover. Score 0.5 (**medium provision**) where <50% and >=25% of the riparian buffer in a hex is also identified as green cover. Score 0 (**low provision**) where <25% of the riparian buffer in a hex is also identified as green cover. Score 0 (**low provision**) where a hex does not contain any riparian buffer.	Buffer distances from the blue infrastructure network consistent with Forestry Commission Practice Guide1 that states: "Forest operations should not take place in buffer areas; the limited activities that are permitted for the different operations in this Guide are given in Table 1. The specified widths extend the legally required buffer zones of 1–2 m and 5 m for operations around watercourses and water supplies, respectively."	N/A – single provision indicator

Strategic Objective 6: Urban cooling

3.35 As described in **Chapter 2**, the delivery of GI can partially reduce the intensity of the urban heat island, promoting a resilient urban environment and contributing to climate change adaptation and mitigation. GI can also help to alleviate health risks such as urban heat stress. The indicators of need and provision have been identified to consider these benefits.

Datasets and thresholds used for indicators of need and provision

3.36 The datasets used as indicators of need or provision, as well as the thresholds applied to identify areas with high, medium or low levels of need for GI or existing GI coverage for this Strategic Objective are described below in **Table 3.7.**

3.37 One indicator of need was selected; Major summer heat spots 2020, as it shows the temperature variations across London and in particular those areas where the urban heat island effect is most strongly observed, due to those areas and land surfaces being more densely built up and covered by impermeable surfaces such as concrete, tarmac, bricks and stone.

3.38 Three indicators of provision were used; the GLA's Green Cover, Tree Cover and Blue Cover datasets. It was considered important to differentiate between general green cover which may include areas of grass

or shrubby vegetation, and tree canopy, due to the greater contribution larger trees can make to helping to reduce urban heat. In addition, the cooling effect of water bodies was also considered to be an important contributor to reducing the urban heat effect.

3.39 It is noted that if the GLA commissions updated analysis of urban heat temperatures, then this indicator of need may need to be updated.

Table 3.7 Strategic Objective 6: Urban cooling - datasets and thresholds

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
Major Summer Heat Spots using Landsat-8 Thermal Satellite data	GLA - 2020[15] Licence: Non-commercial licence Creative Commons	Need	Score 1 (**high need**) where the mean daytime land surface temperature is >34 and <=39 Degrees Celsius Score 0.5 (**medium need**) where the mean daytime land surface temperature is >31 and <=34 Degrees Celsius Score 0 (**low need**) where the mean daytime land surface temperature is >20 and <=31 Degrees Celsius When a Hex overlaps with different thresholds categories, it gets assigned the score corresponding to the largest overlap.	Thresholds defined as per the methodology from the data page on the London Datastore. See **Appendix B** for more details.	N/A – single need indicator
Green Cover	GLA - 2024[8] Licence: Other (Not Open)	Provision	Score 1 (**high provision**) where >=50% of hex is green cover. Score 0.5 (**medium provision**) where <50% and >=25% of hex is green cover. Score 0 (**low provision**) where <25% of hex is green cover.	Score of 1 achieved where areas are characterised by a minimum of 50% coverage, in accordance with Mayoral targets for London to become a zero-carbon city with at least 50% green cover by 2050.	Average three provision indicators (sum and divide by 3). Resulting values were reclassified to a three-point scale as follows: >=0 - <0.25 = low provision >=0.25 - <=0.5 = medium provision >0.5 = high provision.
Tree Canopy Cover	GLA – 2024[16] Licence: Other (Not Open)	Provision	Score 1 (**high provision**) where >23% of hex is tree canopy cover. Score 0.5 (**medium provision**) where <=23% and >15% of hex is tree canopy cover. Score 0 (**low provision**) where <=15% of hex is tree canopy cover.	The London Environment Strategy has a target of 10% increase in the overall amount of tree canopy (from a baseline of 21% across London in 2018), which would result in 23% canopy cover if all boroughs achieved the target. See **Appendix B** for more details.	

[15] https://data.london.gov.uk/dataset/major-summer-heatspots-using-landsat-8-thermal-satellite-data
[16] https://data.london.gov.uk/dataset/canopy-cover-2024

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
Blue Cover 2024	GLA - 2024 Licence: Other (Not Open)	Provision	Score 1 (**high provision**) where >=50% of hex is blue cover. Score 0.5 (**medium provision**) where >=1% and <50% of hex is blue cover. Score 0 (**low provision**) where <1% of hex is blue cover.	Threshold defined using a split of data based on the spatial distribution of blue cover across hexes.	

Strategic Objective 7: Clean air

3.40 As described in **Chapter 2**, GI can help to address some of the environmental causes of poor health, such as poor air quality, by filtering particulates in the air. The indicators of need and provision have been identified to consider these benefits.

Datasets and thresholds used for indicators of need and provision

3.41 The datasets used as indicators of need or provision, as well as the thresholds applied to identify areas with high, medium or low levels of need for GI or existing GI coverage for this Strategic Objective are described below in **Table 3.8.**

3.42 Two indicators of need were selected; NO_2 concentration and $PM_{2.5}$ concentration from the London Atmospheric Emissions Inventory 2019, as these are nationally recognised and monitored indicators of air quality. The 2025 forecast for these two pollutants were used, rather than the recorded concentrations in 2019, as these were considered by the GLA Air Quality team to be a more accurate reflection of the air quality picture across London.

3.43 Two indicators of provision were used; the GLA's Green Cover and Tree Cover datasets. It was considered important to differentiate between general green cover which may include areas of grass or shrubby vegetation, and tree canopy, due to the greater contribution larger trees and in particular street trees, can make to helping to reduce air pollution.

3.44 It is noted that a more accurate dataset for 2022 baseline pollutant concentrations will be released by the London Atmospheric Emissions Inventory soon, therefore this indicator of need may need to be updated.

Table 3.8 Strategic Objective 7: Clean air - datasets and thresholds

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
NO_2 concentration (2025 forecast)	GLA – London Atmospheric Emissions Inventory 2019[17] Licence: Not Specified	Need	Score 1 (**high need**) where hexes have an average of >=40 µg/m3 Score 0 (**low need**) where hexes have an average of <40 µg/m3	Thresholds follow European Union air quality standards[18].	The two need indicators were combined to obtain the overall need. A worst score rule was applied as described below to avoid scoring

[17] https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory--laei--2019
[18] EU air quality standards - European Commission

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
PM 2.5 concentration (2025 forecast)	GLA – London Atmospheric Emissions Inventory 2019[17] Licence: Not Specified	Need	Score 1 (**high need**) where hexes have an average of >=10 µg/m3 Score 0 (**low need**) where hexes have an average of <10 µg/m3	Thresholds follow World Health Organisation air quality standards[19].	hexes with low NO2 need but high PM2.5 as low. If NO2 **and** $PM_{2.5}$ are high, then the overall need is high If NO2 **or** $PM_{2.5}$ is high, then the overall need is high If NO2 **and** $PM_{2.5}$ are low, then the overall need is low
Green Cover	GLA - 2024[8] Licence: Other (Not Open)	Provision	Score 1 (**high provision**) where >=50% of hex is green cover. Score 0.5 (**medium provision**) where <50% and >=25% of hex is green cover. Score 0 (**low provision**) where <25% of hex is green cover.	Score of 1 achieved where areas are characterised by a minimum of 50% coverage, in accordance with London Environment Strategy (LES) target for London to have at least 50% green cover in 2050.	Average two provision indicators (sum and divide by 2). Resulting values were reclassified to a three-point scale as follows: >=0 - <0.25 = low provision >=0.25 - <=0.5 = medium provision >0.5 = high provision.
Tree Canopy Cover	GLA – 2024[16] Licence: Other (Not Open)	Provision	Score 1 (**high provision**) where >23% of hex is tree canopy cover. Score 0.5 (**medium provision**) where <=23% and >15% of hex is tree canopy cover. Score 0 (**low provision**) where <=15% of hex is tree canopy cover.	The London Environment Strategy has a target of 10% increase in the overall amount of tree canopy (from a baseline of 21% across London in 2018), which would result in 23% canopy cover if all boroughs achieved the target. See **Appendix B** for more details.	

Strategic Objective 8: Noise reduction

3.45 As described in **Chapter 2**, the appropriate siting of vegetation can help deliver indirect benefits such as noise mitigation. The indicators of need and provision have been identified to consider these benefits.

Datasets and thresholds used for indicators of need and provision

3.46 The datasets used as indicators of need or provision, as well as the thresholds applied to identify areas with high, medium or low levels of need for GI or existing GI coverage for this Strategic Objective are described below in **Table 3.9.**

3.47 Two indicators of need were selected; Road noise and Rail noise, combined with the number of residential addresses per hex. Road and rail noise levels are nationally recognised and monitored indicators of noise pollution. However, the number of residential addresses per hex was factored in as well in order to identify areas where people were more likely to be exposed to noise, as there were some areas of high road

[19] Air Quality Standards

or rail noise that were not close to where people live and therefore do not represent an area of need in the context of the LGIF.

3.48 One indicator of provision was used; the GLA's Tree Cover dataset. The presence of trees, and in particular street trees, can help to reduce noise pollution.

Table 3.9 Strategic Objective 8: Noise reduction - datasets and thresholds

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
Road noise combined with count of residential addresses per hex	DEFRA – Noise England Round 4 2022[20] Open Government Licence GLA – 2025 Licence: Other (Not Open)	Need	Score 1 (**high need**) where hexes contain > 0 residential addresses and where >50% of hex overlaps with noise areas that are >=55 decibels Score 0.5 (**medium need**) where hexes contain > 0 residential addresses and where >10% and <=50% of hex overlap with noise areas that are >=55 decibels Score 0 (**low need**) where hexes contain > 0 residential addresses and where <=10% of hex overlap with noise areas that are >=55 decibels Hexes with 0 residential addresses score 0 (**low need**), regardless of their overlap with high noise areas.	Thresholds follow recommendations from the World Health Organisation[21]. The inclusion of residential addresses count was agreed following discussions with the GLA GI team to score need based on where people are affected by the noise. See **Appendix B** for more details.	Average two need indicators (sum and divide by 2). Resulting values were reclassified to a three-point scale as follows: >=0 - <0.25 = low need >=0.25 - <=0.5 = medium need >0.5 = high need.
Rail noise combined with count of residential addresses per hex	DEFRA – Noise England Round 4 2022[20] Open Government Licence GLA – 2025 Licence: Other (Not Open)	Need	Score 1 (**high need**) where hexes contain > 0 residential addresses and where >50% of hex overlaps with noise areas that are >=55 decibels Score 0.5 (**medium need**) where hexes contain > 0 residential addresses and where >10% and <=50% of hex overlap with noise areas that are >=55 decibels Score 0 (**low need**) where hexes contain > 0 residential addresses and where <=10% of hex overlap with noise areas that are >=55 decibels Hexes with 0 residential addresses score 0 (**low need**), regardless of their overlap with high noise areas.	Thresholds follow recommendations from the World Health Organisation. The inclusion of residential addresses count was agreed following discussions with the GLA GI team to score need based on where people are affected by the noise. See **Appendix B** for more details.	

[20] https://www.data.gov.uk/dataset/38b1444f-47a0-42ca-a358-0d145fcf7d5c/road-noise-all-metrics-england-round-4
[21] Guidance on environmental noise

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
Tree Canopy Cover	GLA – 2024[16] Licence: Other (Not Open)	Provision	Score 1 (**high provision**) where >23% of hex is tree canopy cover. Score 0.5 (**medium provision**) where <=23% and >15% of hex is tree canopy cover. Score 0 (**low provision**) where <=15% of hex is tree canopy cover.	The London Environment Strategy has a target of 10% increase in the overall amount of tree canopy (from a baseline of 21% across London in 2018), which would result in 23% canopy cover if all boroughs achieved the target. See **Appendix B** for more details.	N/A – single provision indicator

Strategic Objective 9: Greener active travel routes

3.49 As described in **Chapter 2,** the integration of cycling and walking networks within GI corridors can contribute to CO_2 reduction through the provision of active travel options that are more attractive to cyclists and pedestrians. The indicators of need and provision have been identified to consider these benefits.

Datasets and thresholds used for indicators of need and provision

3.50 The datasets used as indicators of need or provision, as well as the thresholds applied to identify areas with high, medium or low levels of need for GI or existing GI coverage for this Strategic Objective are described below in **Table 3.10.**

3.51 Two indicators of need were selected; the National Cycle Network and London Cycle Network combined to show where cycle routes exist in London, and Total walking potential density and pedestrian density from the Strategic Walking Analysis by Transport for London. Although the Strategic Walking Analysis report is from 2017, it provides a more accurate reflection of where more everyday trips made on foot occur than the datasets that show walking routes (such as Public Rights of Way Network and the Walk London Network) as these are focussed more on recreational routes rather than walking routes people would take on a daily basis e.g. to work or shop. For the cycle network, the cycle routes were buffered by 5 metres and intersected with the GLA Green Cover 2024, to reflect the presence of vegetation / green corridors bordering existing active travel networks, and therefore determine areas of need where cycle routes are not already within green spaces and/or tree lined.

3.52 One indicator of provision was used; the GLA's Green Cover dataset, as this provides a good indication of areas where cycling and walking might be more or less in need of greening.

Table 3.10 Strategic Objective 9: Greener active travel routes - datasets and thresholds

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
Cycle network: National Cycle Network and London Cycle Network combined	Sustrans[22] TfL planning data[23] Both open data	Need	The cycle network was buffered by 5 metres and intersected with the GLA Green Cover 2024, to account for green edges of the network. If <1% of a hex overlaps with the cycling network, score 0 (**low need**). If >1% Hex overlaps with the cycling network, and >=50%	Threshold defined to reflect the presence of vegetation / green corridors bordering existing active travel networks. Existing networks are defined as low need where characterised by a minimum of 50% coverage of green cover, in accordance with Mayoral targets for	Average two need indicators (sum and divide by 2). Resulting values were reclassified to a three-point scale as follows: >=0 - <0.25 = low need

[22] https://www.sustrans.org.uk/national-cycle-network/
[23] https://planning.data.tfl.gov.uk/

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
			of the network in the Hex is green, score 0 (**low need**). If >1% Hex overlaps with the cycling network, and the network in the Hex is between 5% and 49% green, score 0.5 (**medium need**). If >1% Hex overlaps with the cycling network, and <=5% of the network in the Hex is green, score 1 (**high need**)	London to become a zero-carbon city with at least 50% green cover by 2050.	>=0.25 - <=0.5 = medium need >0.5 = high need.
Strategic Walking Analysis (SWA) - Total walking potential density and pedestrian density	TfL 2017[24] – Strategic Walking Analysis Obtained based on data exchange agreement – TfL copyright	Need	Each dataset was scored as per the thresholds below, and the need indicator was obtained by averaging both. Walking potential: Score 1 (**high need**): Hex with >16 m walked/m^2 Score 0.5 (**medium need**): Hex between 2-16 m walked/m^2 Score 0 (**low need**): Hex <=2m walked/m^2 Pedestrian density: Score 1 (**high need**): Hex with >50 m walked/m^2 Score 0.5 (**medium need**): Hex between 10-50 m walked/m^2 Score 0 (**low need**): Hex <=10m walked/m^2	Thresholds defined using the categories presented in the SWA report. The SWA framework proposes to focus on areas where both pedestrian density and walking potential are high to identify key areas for walking.	
Green Cover	GLA - 2024[8] Licence: Other (Not Open)	Provision	Score 1 (**high provision**) where >=50% of hex is in green cover. Score 0.5 (**medium provision**) where <50% and >=25% of hex is in green cover. Score 0 (**low provision**) where <25% of hex is in green cover.	Score of 1 achieved where areas are characterised by a minimum of 50% coverage, in accordance with London Environment Strategy (LES) target for London to have at least 50% green cover in 2050.	N/A – single provision indicator

Strategic Objective 10: Greener high streets

3.53 As described in **Chapter 2**, GI can help to promote prospering communities through the creation of high quality environments which are attractive to businesses and investors, create green jobs, and help to support the local economy and regeneration. The indicators of need and provision have been identified to consider these benefits.

[24] https://content.tfl.gov.uk/strategic-walking-analysis.pdf

Datasets and thresholds used for indicators of need and provision

3.54 The datasets used as indicators of need or provision, as well as the thresholds applied to identify areas with high, medium or low levels of need for GI or existing GI coverage for this Strategic Objective are described in **Table 3.11.**

3.55 One indicator of need was selected; Average count of visitors, residents and workers in high streets and town centres, as this helped to identify high streets and town centres with higher footfall than others. Greening of these high streets and town centres could help to attract more visitors and longer stays in the area, thereby indirectly supporting the local economy.

3.56 Three indicators of provision were used; High streets/town centres with Green Cover, High streets/town centres with Tree Canopy Cover, and High streets/town centres with access to local parks. These three indicators help to identify those high streets and town centres that already have a lot of green infrastructure within them or a local park nearby, all of which are likely to attract more visitors and longer stays in the area.

Table 3.11 Strategic Objective 10: Greener high streets - datasets and thresholds

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
Average count of visitors, residents and workers in high streets (HS) and town centres (TC)	GLA 2025 Footfall Licence: Other (Not Open) GLA 2025 High Streets[25] and Town Centres[26] Open Government Licence	Need	Each footfall dataset was scored as per the thresholds below, and the need indicator was obtained by averaging the three scores. <u>Workers:</u> Score **1 (high need)** where hexes contain HS/TC with an average count of workers >407.5 Score 0.5 (**medium need**) where hexes contain HS/TC with an average count of workers 152-407.5 Score 0 (**low need**) where hexes contain HS/TC with an average count of workers <=152 <u>Residents:</u> Score **1 (high need)** where hexes contain HS/TC with an average count of residents >1155 Score 0.5 (**medium need**) where hexes contain HS/TC with an average count of residents 731-1155 Score 0 (**low need**) where hexes contain HS/TC with an average count of residents <=731 <u>Visitors:</u> Score **1 (high need)** where hexes contain HS/TC with	Threshold defined using a split of data based on the spatial distribution of the three footfall variables in hexes located in high street and town centres. See **Appendix B** for more details.	N/A – single need indicator

[25] https://data.london.gov.uk/dataset/gla-high-street-boundaries
[26] https://data.london.gov.uk/dataset/town_centre_boundaries

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
			an average count of visitors >749.6 Score 0.5 (**medium need**) where hexes contain HS/TC with an average count of visitors 327-749.6 Score 0 (**low need**) where hexes contain HS/TC with an average count of visitors <=327 All Hexes that do not contain HS/TC are not applicable to this Strategic Objective and score 0.		
High streets / town centres within Green Cover	GLA - 2024[8] Licence: Other (Not Open) GLA 2025 High Streets[25] and Town Centres[26] Open Government Licence	Provision	Hexes with >=1% overlap with HS/TC were scored as follows: Score 1 (**high provision**) where >=50% of the area of HS/TC in a hex is green. Score 0.5 (**medium provision**) where <50% and >=25% of the area of HS/TC in a hex is green. Score 0 (**low provision**) where <25% of the area of HS/TC in a hex is green. All hexes with less than 1% overlap with HS/TC score 0 (**low provision**).	Score of 1 achieved where areas are characterised by a minimum of 50% coverage, in accordance with London Environment Strategy (LES) target for London to have at least 50% green cover in 2050.	Average three provision indicators (sum and divide by 3). Resulting values were reclassified to a three-point scale as follows: >=0 - <0.25 = low provision >=0.25 - <=0.5 = medium provision >0.5 = high provision.
High streets / town centres within Tree Canopy Cover	GLA – 2024[16] Licence: Other (Not Open) GLA 2025 High Streets[25] and Town Centres[26] Open Government Licence	Provision	Hexes with >=1% overlap with HS/TC were scored as follows: Score 1 (**high provision**) where >=23% of the area of HS/TC in a hex is tree canopy cover Score 0.5 (**medium provision**) where <23% and >=15% of the area of HS/TC in a hex is tree canopy cover Hexes overlapping HS/TC with <15% tree canopy cover score 0 (**low provision**) All hexes with less than 1% overlap with HS/TC score 0 (**low provision**).	The London Environment Strategy has a target of 10% increase in the overall amount of tree canopy (from a baseline of 21% across London in 2018), which would result in 23% canopy cover if all boroughs achieved the target. See **Appendix B** for more details.	
AoD for public open space	GiGL - 2024 Obtained based on data	Provision	Hexes with >=1% overlap with HS/TC were scored as follows:	Threshold measures presence / absence of areas of deficiency (i.e. determines whether a location sits in an area of deficiency or not, and	

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
(local parks)	exchange agreement – GiGL copyright		Score 1 (**high provision**) where HS/TC in a hex is <1% in AoD Score 0 (**low provision)** where HS/TC in a hex is 1% or more in AoD A minimum 1% overlap of HS/TC in hex and AoD was applied when scoring to avoid counting very small overlaps as within AoD. All hexes with less than 1% overlap with HS/TC score 0 (**low provision**).	therefore has access to a local park or not).	

Inequalities: Health inequalities

Datasets and thresholds used for indicators of need

3.57 As described in **Chapter 2**, GI can help to maximise health and well-being outcomes by providing opportunities for more active and healthy lives. GI can also contribute to health by helping to address or mitigate some of the environmental causes of poor health. The indicators of need have been identified to consider these benefits.

3.58 The datasets used as indicators of need, as well as the thresholds applied to identify areas with high, medium and low levels of health inequalities are described in **Table 3.12.**

3.59 One indicator of need was selected; the Health Deprivation and Disability Domain from the government's Indices of Deprivation. The Indices of Deprivation provide a set of relative measures of deprivation for small geographical areas (Lower-layer Super Output Areas, LSOAs) across England, based on seven different domains of deprivation, of which Health and Disability is one. The Health Deprivation and Disability Domain measures the risk of premature death and the impairment of quality of life through poor physical or mental health, based on four indicators:

- Years of potential life lost
- Comparative illness and disability ratio
- Acute morbidity
- Mood and anxiety disorders

3.60 In the absence of other comprehensive health data being collected for Londoners at the LSOA scale, the national indices of deprivation dataset was considered to be a good general indicator of areas within London with higher or lower levels of health inequality.

3.61 While access to green and blue space and nature is known to have beneficial effects on physical and mental health, the provision of existing GI has already been considered for this benefit within Strategic Objectives 1, 2 and 9. Similarly, the provision of GI to help reduce air, noise and water pollution, urban temperatures and flooding could also have indirect benefits for health, but has already been considered within Strategic Objectives 4, 5, 6, 7 and 8. Therefore, it was decided not to include indicators of provision for Health Inequalities within the LGIF spatial data analysis.

Table 3.12 Health inequalities - datasets and thresholds

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
IMD – Health Deprivation and Disability Domain by LSOA	MHCLG – 2019[27] Open Government Licence	Need	Score 1 (**high need**) where hexes intersect with a IMD decile between 1 and 3 (most deprived LSOAs) Score 0.5 (**medium need**) where hexes intersect with a IMD decile between 4 and 6 score 0.5 (medium need) Score 0 (**low need**) where hexes intersect with a IMD decile between 7 and 10 (least deprived LSOAs) Hexes that overlap with more than 1 LSOA were scored based on the decile from the largest overlap. LSOAs have no data over the Thames. Hexes overlapping with these areas were assigned 'N/A' and scored 0.	IMD data categorised into 10 deciles. Deciles 1 to 3 indicate the most deprived areas so are categorised as high need. Deciles 4 to 6 indicate medium need. Deciles 7 to 10 (least deprived) indicate low need.	N/A – single need indicator

Inequalities: Social inequalities

3.62 As described in **Chapter 2,** GI provision can help tackle social deprivation and inequalities, providing attractive social spaces to alleviate isolation. The indicators of need have been identified to consider where these benefits could be most helpful.

Datasets and thresholds used for indicators of need

3.63 The datasets used as indicators of need as well as the thresholds applied to identify areas with high, medium and low levels of social inequalities are described in **Table 3.13.**

3.64 A number of indicators of need were selected, as they represent different population groups that may be more likely to experience inequalities within London, and areas where there is a higher population density. Often, areas with higher population density can coincide with areas of higher deprivation and inequality. The different population groups included in the indicators of need, are the same groups as used in the GLA's Climate Risk Maps, as they were identified as being more vulnerable to climate impacts, such as high temperatures and heatwaves and flooding, which are also factors that GI can help to address. A range of characteristics increase their vulnerability depending on the population group, but include being socially isolated, being in ill-health (older people) or more affected by hot weather (older and younger people), having lower personal mobility, living in certain types of housing, having low income or unable to read, write, and/or speak English.

3.65 While the provision of GI to help reduce air, noise and water pollution, urban temperatures and flooding could also have indirect benefits for population groups that might be experiencing social inequality in London, this has already been considered within Strategic Objectives 4, 5, 6, 7 and 8. Similarly, access to green space can have beneficial effects on physical and mental health as well as more opportunities for

[27] English indices of deprivation 2019: technical report - GOV.UK

social interactions with others in the local community, the provision of existing GI has already been considered within Strategic Objectives 1, 2 and 9. Finally, making town centres and high streets greener through planting of street trees, shrubs and ornamental planting or amenity spaces can make them more attractive and more likely to provide opportunities for social interactions, however this GI provision has already been considered within Strategic Objective 10. Therefore, it was decided not to include indicators of provision for Social Inequalities within the LGIF spatial data analysis.

Table 3.13 Social inequalities - datasets and thresholds

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
Count of residential addresses per hex as a proxy for population density	GLA – 2025 Licence: Other (Not Open)	Need	Score 1 (**high need**) where hexes have >=709 residential addresses Score 0.5 (**medium need**) where hexes have <709 and >265 residential addresses Score 0 (**low need**) where hexes have <=265 residential addresses.	Threshold defined using a split of data based on the spatial distribution of the count of residential addresses in Hexes. Other options for thresholds were assessed using the London Plan; however it was agreed with the GLA GI team to use the thresholds defined based on the data distribution as it gives a better representation of housing density in the London context. See **Appendix B** for more details.	Average seven need indicators (sum and divide by 7). Resulting values were reclassified to a three-point scale as follows: >=0 - <0.25 = low need >=0.25 - <=0.5 = medium need >0.5 = high need.
% of people under the age of 5	ONS – 2021[28] Open Government Licence	Need	Score 1 (**high need**) where hexes intersect with a LSOA with >=7.2 % people Score 0.5 (**medium need**) where hexes intersect with a LSOA with <7.2% and >5.2% people Score 0 (**low need)** where hexes intersect with a LSOA with <=5.2% people. Hexes that overlap with more than 1 LSOA were scored based on the largest overlap. LSOAs have no data over the Thames. Hexes overlapping with these areas were assigned 'N/A' and scored 0.	Thresholds based on categorisation defined on the GLA Climate Risk Map[29].	
% of people over the age of 75	ONS – 2021[28] Open Government Licence	Need	Score 1 (**high need**) where hexes intersect with a LSOA with >=7.4 % people Score 0.5 (**medium need**) where hexes intersect with a LSOA with <7.4% and >4% people		

[28] https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/
[29] https://cityhall.maps.arcgis.com/apps/instant/media/index.html?appid=59236d2e842c4a3ba6480d9dac585d1e

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
			Score 0 (**low need)** where hexes intersect with a LSOA with <=4% people. Hexes that overlap with more than 1 LSOA were scored based on the largest overlap. LSOAs have no data over the Thames. Hexes overlapping with these areas were assigned 'N/A' and scored 0.		
% of people not proficient in English	ONS – 2021[30] Open Government Licence	Need	Score 1 (**high need**) where hexes intersect with a LSOA with >=7.8 % people Score 0.5 (**medium need**) where hexes intersect with a LSOA with <7.8% and >2.4% people Score 0 (**low need**) where hexes intersect with a LSOA with <=2.4% people. Hexes that overlap with more than 1 LSOA were scored based on the largest overlap. LSOAs have no data over the Thames. Hexes overlapping with these areas were assigned 'N/A' and scored 0.		
% of people in social housing	ONS – 2021[31] Open Government Licence	Need	Score 1 (**high need**) where hexes intersect with a LSOA with >=39% people Score 0.5 (**medium need**) where hexes intersect with a LSOA with <39% and >12% people Score 0 (**low need**) where hexes intersect with a LSOA with <=12% people Hexes that overlap with more than 1 LSOA were scored based on the largest overlap. LSOAs have no data over the Thames. Hexes overlapping with these areas were assigned 'N/A' and scored 0.		

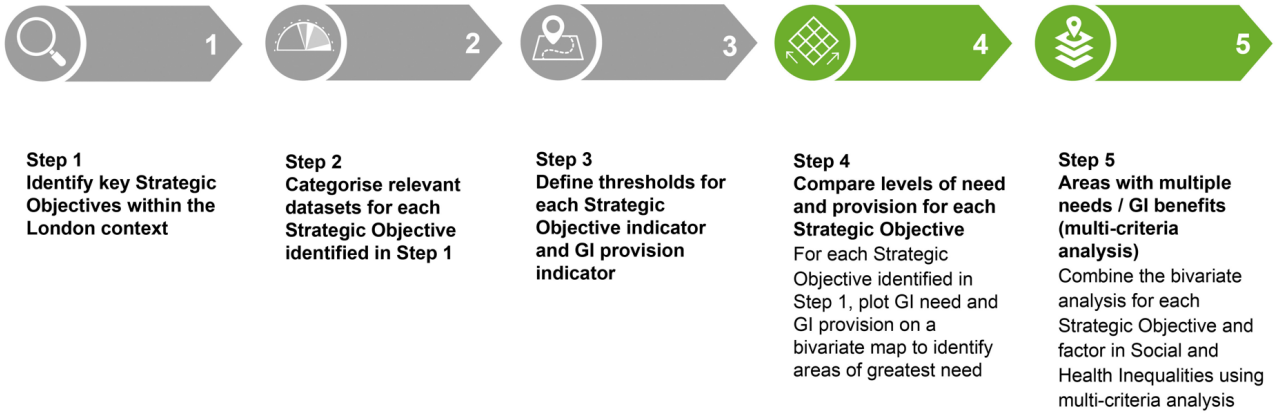
[30] https://www.ons.gov.uk/datasets/TS029/editions/2021/versions/2
[31] https://www.ons.gov.uk/datasets/TS054/editions/2021/versions/4

Dataset	Source	Indicator type	Thresholds	Thresholds rationale	Overall need/provision
% of people identifying as BAME	ONS – 2021[32] Open Government Licence	Need	Score 1 (**high need**) where hexes intersect with a LSOA with >=62 % people Score 0.5 (**medium need**) where hexes intersect with a LSOA with <62% and >37% people Score 0 (**low need**) where hexes intersect with a LSOA with <=37% people Hexes that overlap with more than 1 LSOA were scored based on the largest overlap. LSOAs have no data over the Thames. Hexes overlapping with these areas were assigned 'N/A' and scored 0.		
% of people considered income deprived	ONS – 2021[28] , MHCLG 2019[27] Open Government Licence	Need	Score 1 (**high need**) where hexes intersect with a LSOA with >=20 % people Score 0.5 (**medium need**) where hexes intersect with a LSOA with <20% and >10% people Score 0 (**low need**) where hexes intersect with a LSOA with <=10% people Hexes that overlap with more than 1 LSOA were scored based on the largest overlap. LSOAs have no data over the Thames. Hexes overlapping with these areas were assigned 'N/A' and scored 0.		

[32] https://www.ons.gov.uk/peoplepopulationandcommunity/culturalidentity/

Chapter 4
Steps 4 and 5 - Approach to spatial data analysis

This chapter describes the approach taken to the spatial data analysis. First, step 4 compared the indicator of need against the indicators of existing GI provision for each Strategic Objective using bivariate analysis. Then, step 5 combined all the Strategic Objectives and Inequalities using the multi-criteria analysis.



Evaluation of different spatial data analysis approaches

4.1 In the initial stage of developing the approach to spatial data analysis for the LGIF, LUC considered three different types of spatial data analysis:

- Accessibility analysis (i.e. proximity to points of interest);
- Multi-criteria analysis; and
- Bivariate analysis.

4.2 **Table 4.1** provides a summary of the differences between these three spatial data analysis approaches that were considered for use in the LGIF. The final row in the table highlights what analysis each approach is best used for, which helped to show how relevant each approach was for the LGIF. Given the multiple types of need for GI across London, and the multiple types of GI that already exist, using just the accessibility analysis was not suitable, as it only enables the spatial influence of a single variable to be considered (e.g. access to open space). Bivariate analysis allows comparison of two spatial variables to understand the relationship between them, such as the need for GI versus existing GI provision, while multi-criteria analysis is a more complex analysis where many spatial variables are compared to identify overlapping areas of opportunity/need/constraint. The approach that LUC used involved some bivariate analysis (in Step 4, to compare areas of high, medium or low need for GI, against areas of high, medium or low existing GI

provision for each of the Strategic Needs identified in Chapter 3), and multi-criteria analysis (in Step 5 to identify areas where multiple needs could be addressed and benefits achieved with GI interventions).

Table 4.1 Comparison of different spatial data analysis methods that could be used for the LGIF

Type of analysis	Accessibility analysis	Multi-criteria analysis	Bi-variate analysis
Overview	Using either straight line buffers or a network of roads or paths to determine the distance to points of interest.	Combining multiple variables to help make decisions and prioritise areas of interest.	Comparing two variables to understand the relationship between them.
Example	Natural England GI Framework – Access to Greenspace mapping[33]: draws buffers of different distances around existing green spaces to show areas with walking distance access to different sized green spaces.	South Hampshire GBI Strategic Opportunities Mapping[34]: overlaying various GIS layers to define five broad opportunity zone maps. GIS layers included need and constraints data.	Brighton analysis of overall GI need and deficiency[35]: overlapping of GI deficiency and need area to create a bi-variate map. Note that although the resulting map is bi-variate, the deficiency and need variables were created using a multi-criteria approach.
Data considerations	Network analysis requires a comprehensive network dataset to be compiled. This is time-intensive, and small errors in this data can have a large impact on the output.	Requires multiple datasets. The output will be at the resolution of the lowest resolution dataset.	Requires only two datasets. The output will be at the resolution of the lowest resolution dataset.
Analysis considerations	The spatial representation of points of access has considerable influence on the output. For example, the difference between treating the entire perimeter of a park as an entrance, compared to specific entrance points.	The variables that contribute to the analysis must be carefully considered so as not to introduce bias. For example, including multiple variables that represent the same thing (e.g. overlapping biodiversity designations such as SSSI and SAC) in different ways can create an implicit bias.	This analysis assumes no pre-existing relationship between the variables. If the two variables are not independent, this analysis may mask a third variable that is actually responsible for the relationship.
Extent	Limited only by the spatial extent of the input variable (e.g. borough level open space data versus London-wide).	Can only be run where all variables spatially overlap.	Can only be run where both variables spatially overlap.
Clarity	Provides simple outputs that are intuitive to understand.	Produces complex outputs that may require supplementary explanation in order for users to fully understand.	Outputs show direct, straightforward relationships that are easy to understand.

[33] https://designatedsites.naturalengland.org.uk/GreenInfrastructure/MappingAnalysis.aspx
[34] https://www.push.gov.uk/wp-content/uploads/2023/10/Strategic-Green-and-Blue-Infrustructure-Opportunities-in-South-Hampshire-Part-2-Sept-2023.pdf
[35] https://www.brighton-hove.gov.uk/sites/default/files/2024-05/12621%20Brighton%20%26%20Hove%20GI%20Study%20-%20FINAL%20REPORT.pdf

Type of analysis	Accessibility analysis	Multi-criteria analysis	Bi-variate analysis
Weighting	Done either by varying the distance used (e.g. 400m to open space versus 1km), or the cost-distance of a section of a network.	Weighting can be used to reflect the relative importance of each variable to the overall output. This can be subjective, and the values used can dramatically change the output. It is therefore important to get views of different stakeholders to help inform weighting.	Not used – the two variables are treated equally.
Best used for	Understanding the spatial influence of a single variable (e.g. access to open space).	Complex analysis where many variables are compared to identify overlapping areas of opportunity/need/constraint etc. (e.g. GI assets, areas of flood risk, poor air quality, lack of canopy cover).	Comparing two variables with a clear output in mind. For example, GI need versus GI provision. However, it should be noted that the two variables may comprise multiple indicators/datasets, therefore, this is also a form of multi-criteria analysis.

Scale of spatial data analysis

4.3 A lot of comments made during the stakeholder engagement raised the issue of scale at which the LGIF will be able to be viewed. LUC explored whether the smallest unit the spatial data analysis should be undertaken at should be either the Lower Super Output Area (LSOA) or using hexagons of an agreed equal area. **Table 4.2** outlines the pros and cons of using LSOAs or hexagon grid in the LGIF spatial data analysis. Further explanation about outputs areas and hexagon grids is provided below.

ONS Output Areas

4.4 Output Areas (OAs) are the lowest level of geographical area for census statistics and were first created following the 2001 Census. They are made up of between 40 and 250 households and have a usually resident population between 100 and 625 persons. There are some exceptions where OAs may have more than 625 people, for example, where there is a large prison. Lower layer Super Output Areas are made up of groups of OAs, usually four or five. They comprise between 400 and 1,200 households and have a usually resident population between 1,000 and 3,000 persons.[36]

Hexagon grids

4.5 The aggregation of point data to regularly shaped grids is used for many reasons in spatial data analysis such as normalising geography for mapping or to mitigate the issues of using irregularly shaped polygons created arbitrarily (such as borough boundaries). Regularly shaped grids can only be comprised of equilateral triangles, squares, or hexagons, as these three polygon shapes are the only three that can tessellate (repeating the same shape over and over again, edge to edge, to cover an area without gaps or overlaps) to create an evenly spaced grid.[37] Hexagons are favoured over squares or triangles because they reduce sampling bias due to edge effects of the grid shape, this is related to the low perimeter-to-area ratio of the shape of the hexagon (closest to a circle). The circularity of a hexagon grid also allows it to represent curves in the patterns of data more naturally than square grids and so hexagons are better when analysis includes aspects of connectivity or movement paths (e.g. waterbodies, roads, cycle paths).

4.6 After reviewing availability and scale of relevant datasets and carrying out some initial spatial data analysis at the LSOA level, it was agreed with the GLA to carry out the analysis on the hexagon grid basis. This was because a lot of London-wide data is already available at the hexagon grid[38] scale (the hexagons are 10.6 ha). Moreover, as detailed in Table 1.1, LSOA level datasets have the potential to introduce bias

[36] https://www.ons.gov.uk/methodology/geography/ukgeographies/censusgeographies/census2021geographies
[37] https://pro.arcgis.com/en/pro-app/latest/tool-reference/spatial-statistics/h-whyhexagons.htm
[38] Hex grid downloadable following the Hex350_grid_GLA.zip download link in: https://data.london.gov.uk/dataset/green-infrastructure-focus-map

into the analysis due to their varying sizes (e.g. larger LSOAs may contain more green spaces and therefore score higher for GI provision than a smaller LSOA) and larger LSOAs can result in a loss of spatial resolution (i.e. a user might not be able to get any finer-grained data than the LSOA level.

Table 4.2 Comparison of pros and cons of using LSOAs or hexagon grid in the LGIF spatial data analysis

Hexagon grids	LSOAs
Pros	**Pros**
Equal size removes any bias to do with area, eliminating the distortions introduced by irregular sized areas.	Easy to interpret as they follow geographic features and administrative boundaries.
Size can be adjusted prior to analysis, and through testing, to allow for a resolution that best suits the study.	Can easily be combined to form boroughs or other larger administrative units.
Cons	**Cons**
Some data will need to be interpolated to fit the hexagon grid. For example, data aggregated at borough or MSOA scales will require redistribution across hexagons. This process often involves assumptions (e.g., uniform distribution or weighting), especially for hexagons that cross boundaries.	Bias due to varying sizes as, for example, larger LSOAs may include more features purely because of their size, rather than reflecting true density or distribution patterns.
Hexagons do not align to natural or administrative boundaries, which may make them harder for some users to interpret, especially if they are interested in a particular administrative area.	Loss of spatial resolution in larger LSOAs, which may be able to contain several hexagons.
Population-related biases: Because hexagons are equal in area but vary in population density, datasets correlated with population may introduce bias.	Cross-LSOA and cross-borough boundary information will not be represented.

Step 4: Bivariate analysis

4.7 The bivariate analysis of need versus provision for each Strategic Objective shows direct, straightforward relationships between need for the functions GI can perform and existing GI provision at the hex level. As explained in **Tables 3.2-3.13** in Chapter 3, values of 0, 0.5 or 50, and 1 or 100 (representing low, medium or high need/provision) were generated for each hex by applying thresholds to the relevant datasets for each indicator (or group of indicators) of need or provision.

4.8 **Figure 4.1** shows an example of the values generated for six hexes in relation to the indicators of need and provision for Strategic Objective 8: Noise reduction. The numerical values in columns B, D, F and I are translated into text descriptions in the adjacent columns. Column F shows the 'overall need' obtained by taking the average of the two indicators of need (Road and Rail noise). As there is only one indicator of GI provision for this Strategic Objective, the value in column I is the 'overall provision' value. Column K provides the text description of the bivariate result for each hex for Strategic Objective 8: Noise reduction.

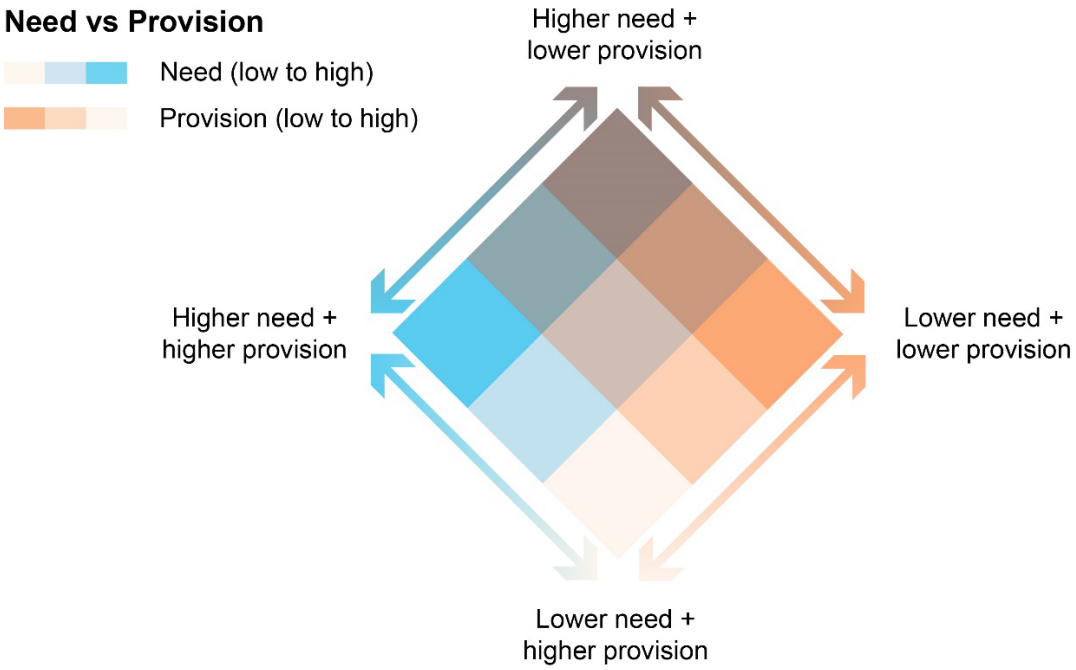
Figure 4.1 Values obtained for the indicators of need and provision for Strategic Objective 8: Noise reduction and the bivariate result

A	B	C	D	E	F	G	H	I	J	K
Hex_ID	N_Road	N_Road_txt	N_Rail	N_Rail_txt	N_overall_step	N_Noise_Overall	N_Noise_Overall_txt	P_TreeCover	P_TreeCover_t	Noise_bivariate
11661232	0.5	Medium need	0.5	Medium need	1	0.5	Medium need	100.0	High provision	Medium need / High provision
11661234	1.0	High need	0.5	Medium need	1	1	High need	100.0	High provision	High need / High provision
11661236	0.0	Low need	0.0	Low need	0	0	Low need	0.0	Low provision	Low need / Low provision
11661238	0.5	Medium need	0.0	Low need	0	0.5	Medium need	0.0	Low provision	Medium need / Low provision
11661240	1.0	High need	0.0	Low need	1	0.5	Medium need	50.0	Medium provision	Medium need / Medium provision
11661242	0.5	Medium need	1.0	High need	1	1	High need	0.0	Low provision	High need / Low provision

4.9 For each Strategic Objective, the bivariate result for each hex was obtained by plotting in ArcGIS Pro v3.4 the 'overall need' value and 'overall provision' values using the 'bivariate colours' symbology. The first

field for the symbology was set to the need value and the second field to the provision value. The orientation was set to 'high values', and the 'label corners' option was selected. This enabled the relationship between need and provision for each hex to be plotted on maps, using the legend shown in **1.1**, which has been referred to in the LGIF analysis as the 'bivariate diamond'. The bivariate diamond helps to distinguish on maps between areas of higher need for the function that GI can offer but lower GI provision, lower need but high existing GI provision, or high need with high provision and low need with low provision.

Figure 4.2 The bivariate diamond showing the relationship between need and provision

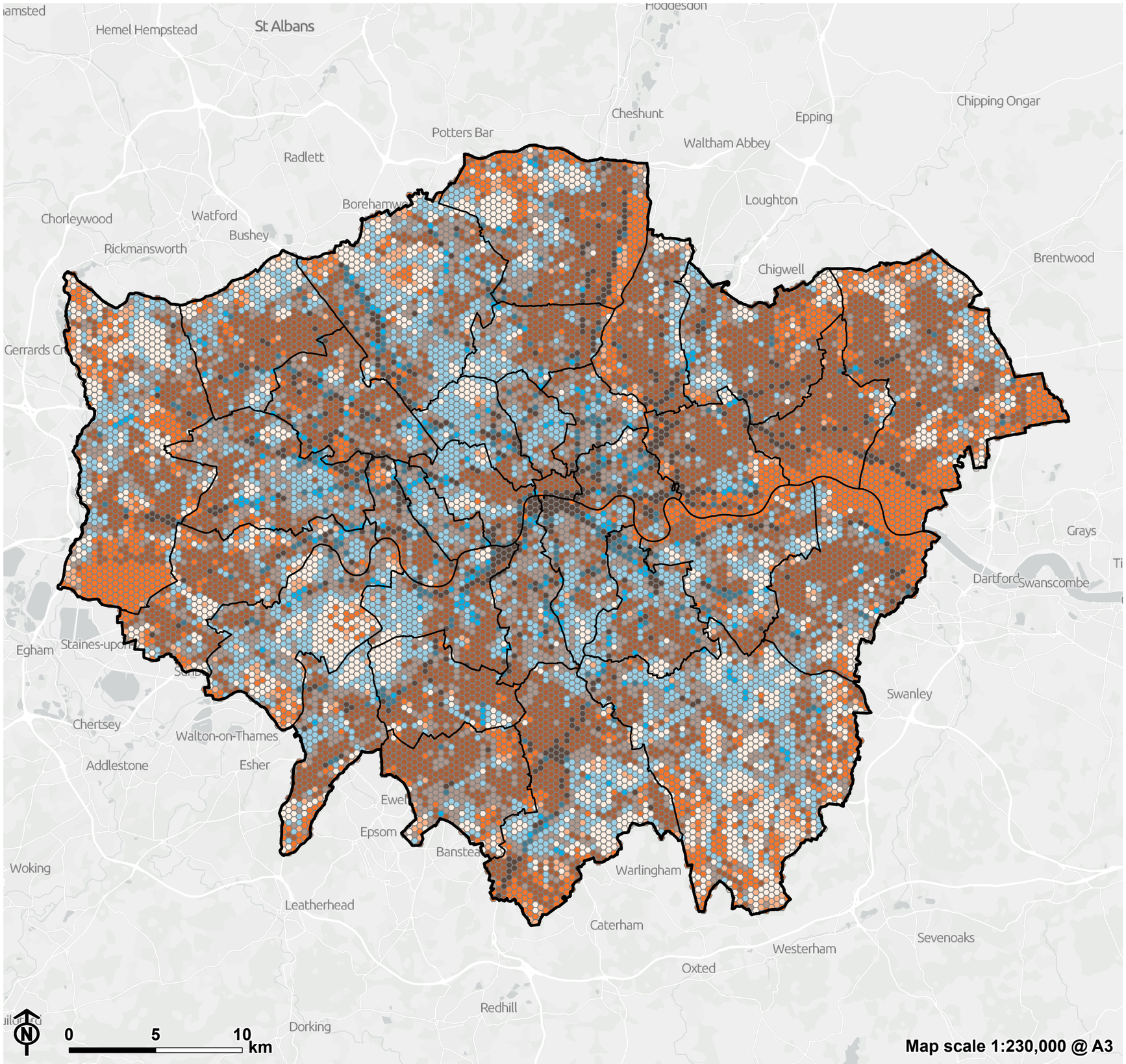


4.10 The map outputs of the bivariate analysis for each Strategic Objective are shown in Chapter 5 of the LGIF - Spatial Data Analysis - **Background and Findings Report**. However, by way of example, **Figure 4.3** below shows the bivariate analysis map for Strategic Objective 8: Noise reduction.

4.11 The outputs from Step 4 for the Health and Social Inequalities are maps showing just overall levels of need, without the inclusion of indicators of current GI provision as indicators of provision were not identified for these two Inequalities, as explained in **Chapter 3**. Therefore, bivariate analysis was not necessary, and the maps show just three categories need (high, medium or low). Again, to illustrate, **Figure 4.4** shows the overall need map for Social Inequalities.

LUC

Figure 4.3: Bivariate analysis map for Strategic Objective 8: Noise reduction



Greater London Authority boundary

Borough boundary

Need versus provision

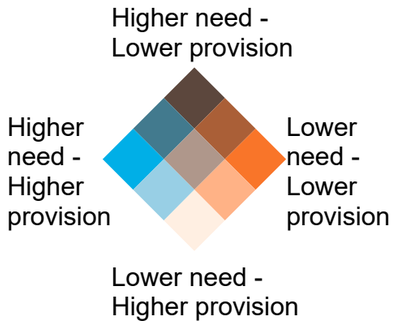


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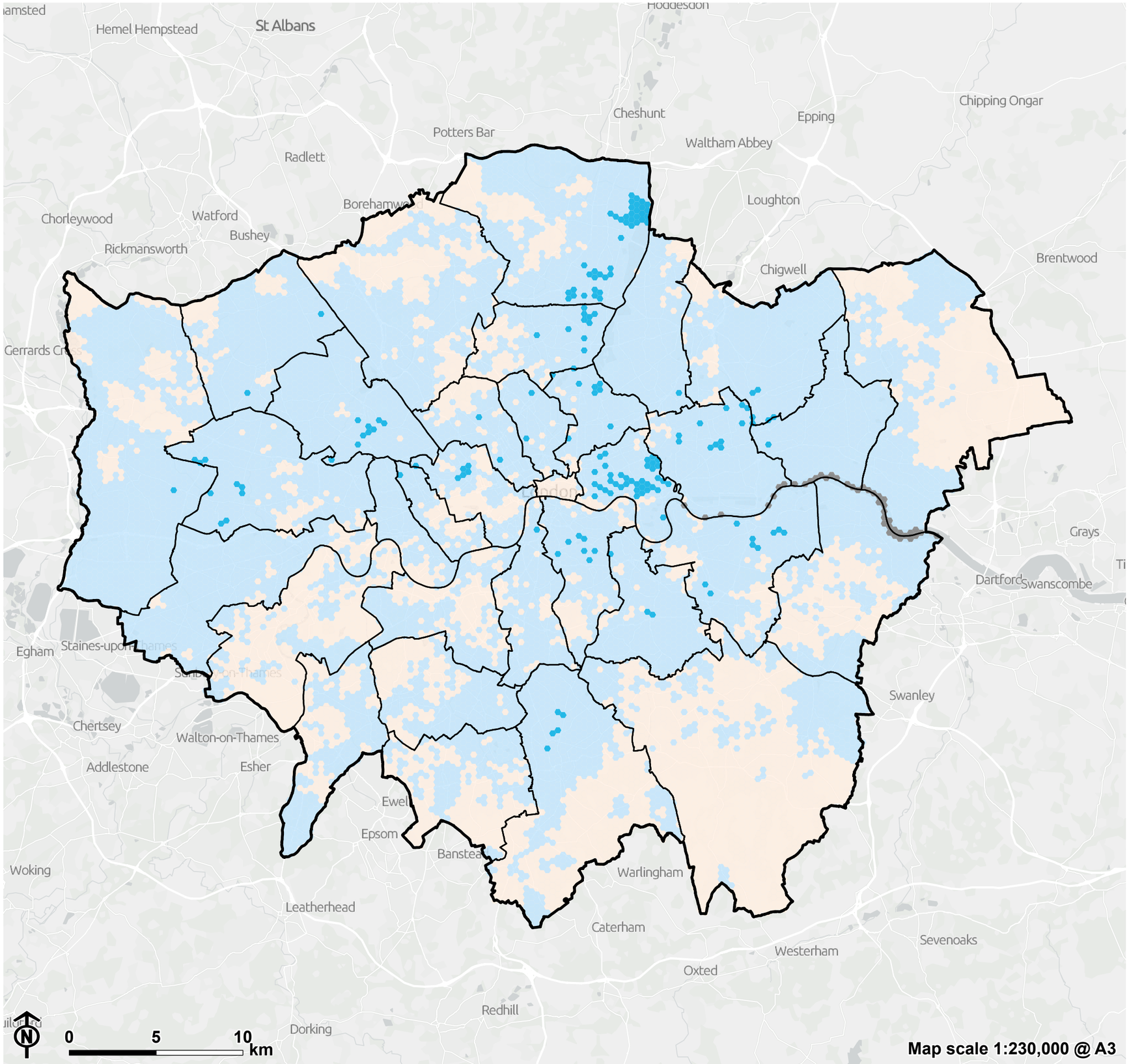
Figure 4.4 Overall need map for Social Inequalities



Greater London Authority boundary
Borough boundary

Overall need

- High need
- Low need
- Medium need
- N/A

Step 5: Multi-criteria analysis

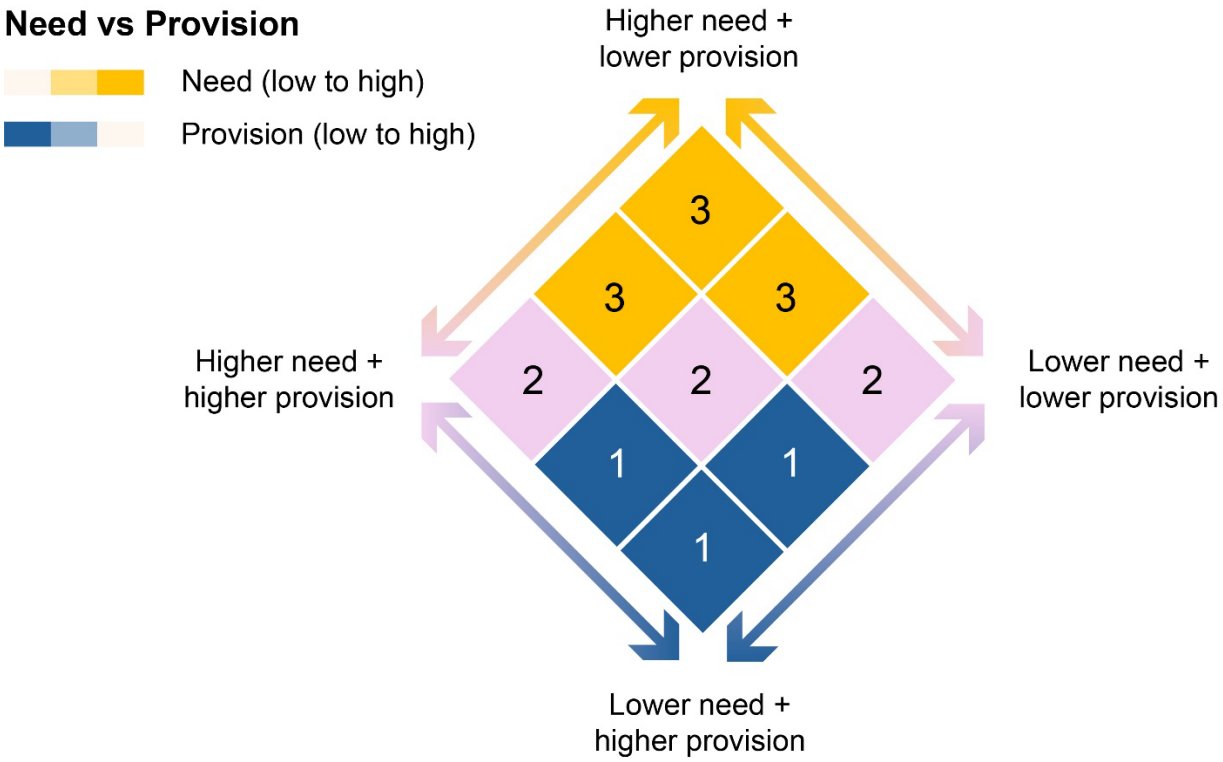
Scoring hexes for the multi-criteria analysis

4.12 This section describes the process followed in Step 5 to produce the multi-criteria analysis (MCA). As described above, the results from Step 4 are a bivariate analysis for each Strategic Objective, resulting in nine potential different categories (shown on the 'bivariate diamond') for each hex. The MCA combines all of the Strategic Objectives into a single map showing overall GI need and provision taking all the Strategic Objectives into account.

4.13 To produce the MCA, the 'bivariate diamond' categories from the bivariate analysis results were grouped as shown using the colour codes on **Figure 4.5.**

- The 'top' of the bivariate diamond results (orange diamonds) correspond to **higher need / lower provision**; **medium need / lower provision** and **higher need / medium provision**, and are all scored **3** for the MCA, because they represent the areas with higher need for GI and lower existing GI provision.
- The 'middle' of the bivariate results (pink diamonds) correspond to **higher need / higher provision**; **medium need / medium provision** and **lower need / lower provision** and are all scored **2** for the MCA, as they represent areas with need for GI but with corresponding levels of existing GI provision.
- The 'bottom' of the bivariate results (blue diamonds in the figure below) correspond **to medium need / higher provision**; **lower need / higher provision** and **lower need / medium provision** and are all scored **1** for the MCA, as they represent areas with lower need for GI and higher levels of existing GI provision.

Figure 4.5 Converting the bivariate diamond categories to numerical scores for the MCA



4.14 As also explained above, the outputs from Step 4 for the Health and Social Inequalities are maps just showing overall levels of need, without the inclusion of indicators of current GI provision. Therefore, the following scores for the Health and Social Inequalities were used for the MCA:

- **Higher need** hexes are scored **3** for the MCA;
- **Medium need** hexes are scored **2;** and
- **Lower need** hexes are scored **1**.

Mapping the multi-criteria analysis using a numerical scale

4.15 The MCA scores assigned to each hex based on the bivariate analysis for the Strategic Objectives or overall need map for Health and Social Inequalities were then summed across all the Strategic Objectives, resulting in a total MCA value. This was done in Excel, as illustrated on **Figure 4.6**, which shows for five hexes:

- The overall need value for Social Inequalities (columns BK and BL) and the corresponding MCA value (column BM);
- The overall need value for Strategic Objective 3: Nature recovery (columns BO and BP);
- The overall provision value for Strategic Objective 3: Nature recovery (columns BQ and BR);
- The corresponding MCA value for Strategic Objective 3: Nature recovery (column BS); and
- The total MCA value (column BU, which is the sum of the individual MCA values for Strategic Objectives 1-10 plus Social and Health Inequalities).

Figure 4.6 Multi-criteria analysis in Excel using numerical values

A	BK	BL	BM	BO	BP	BQ	BR	BS	BU
Hex_ID	N_Social_Overa	N_Social_Overa	Social_Multivari	N_Nature_Overa	N_Nature_Overa	P_Nature_Overal	P_Nature_Overa	Nature_Multivar	A_Total_All_Equ
10631211	0.5	Medium need	2	1	High need	100	High provision	1	21
10641210	0.5	Medium need	2	1	High need	100	High provision	1	17
10641212	0.5	Medium need	2	1	High need	100	High provision	1	16
10641214	0.5	Medium need	2	1	High need	100	High provision	1	16
10641216	0.5	Medium need	2	1	High need	100	High provision	1	15

4.16 The total equal weighting MCA values in column BU range from:

- 12 for hexes scoring 1 for all Strategic Objectives/Health and Social Inequalities; to
- 36 for hexes scoring 3 for all Strategic Objectives/Health and Social Inequalities. However, no hexes scored 3 for all 12 Strategic Objectives/Health and Social Inequalities at once, hence the top value reached was 35 in the equal weighting MCA analysis.

4.17 Different MCA scenarios were explored to see how focusing on one particular Strategic Objective or combination of Strategic Objectives and Inequalities might influence the LGIF map outputs. These scenarios are detailed in Chapter 6 of the LGIF - Spatial Data Analysis - **Background and Findings Report**.

4.18 The scenario based on combining all Strategic Objectives with equal weighting, excluding Health and Social Inequalities, and then hexes with medium or high need for Health Inequalities and/or Social Inequalities multiplied by 1.1 and 1.3 respectively was found to be the most appropriate to use for the LGIF output. This is because it takes all the Strategic Objectives that GI can help to address into account equally, but also amplifies the values for those areas where there is medium or high need to improve social and/or health inequalities. In this way, it helps to identify areas where multiple needs for GI could be addressed while also meeting some of the highest health and social needs in London. The MCA values for the preferred LGIF output range from:

- 10 for hexes scoring 1 for the 10 Strategic Objectives, and which are low need for Health and Social Inequalities.
- 39 for hexes scoring 3 for most of the 10 Strategic Objectives and which are also medium or high need for Health and/or Social Inequalities

4.19 Figure 4.7 shows the results of the MCA based on the numerical scale when all 10 Strategic Objectives are combined and hexes with medium or high need for health and social inequalities are factored in. **Note: This figure pre-dates the December 2025 updates to this report and thus reflects an older version of LNRS data (January 2025) and a now superseded approach to analysing 'improved access to blue**

space'. Yellow hexes show the areas in London with the highest overall need across all ten Strategic Objectives and medium to low levels of existing GI provision, and purple hexes show those areas with the lowest overall need and medium to high existing provision. This version of the combined objectives was not taken forward in the LGIF web map.

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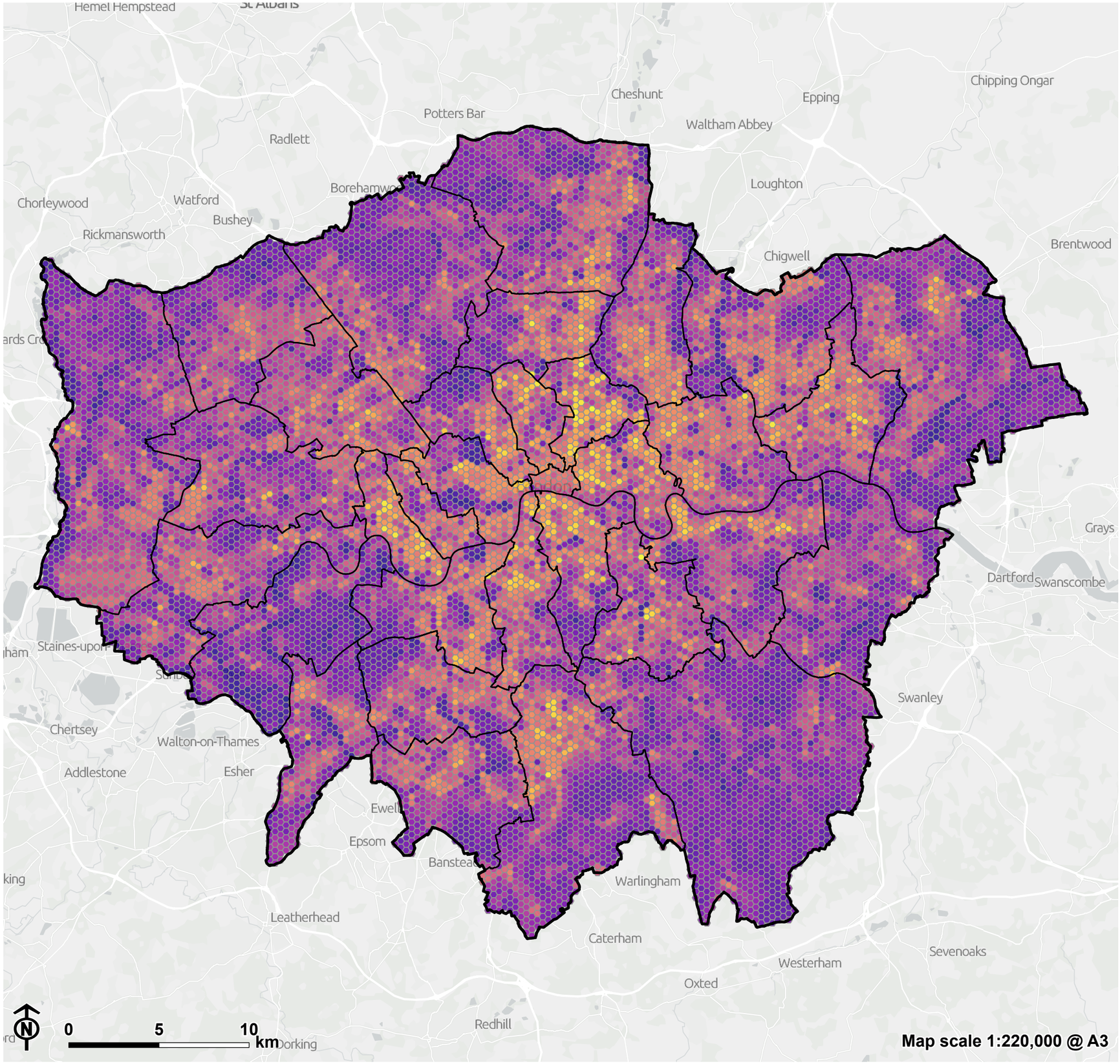
Figue 4.7: Multi-criteria results using numerical scale - all strategic objectives combined and health and social inequalities factored in



Greater London Authority boundary

Borough boundary

Multi-criteria results

10 - lowest overall need

39 - highest overall need

Mapping the multi-criteria analysis using the bivariate diamond categories

4.20 An alternative way of presenting the results of the MCA, is to use the 'bivariate diamond' categories to show hexes which are higher need/lower provision, lower need/lower provision, lower need / higher provision higher need / higher provision etc., as illustrated in **Figure 4.10**. **Note: This figure pre-dates the December 2025 updates to this report and thus reflects an older version of LNRS data (January 2025) and a now superseded approach to analysing 'improved access to blue space'.** This way of presenting the combined objectives was taken forward in the LGIF webmap. The process followed to obtain the bivariate diamond categories for the MCA (using the same scenario as above, i.e. when all 10 Strategic Objectives are combined and hexes with medium or high need for health and social inequalities are factored in) is described below.

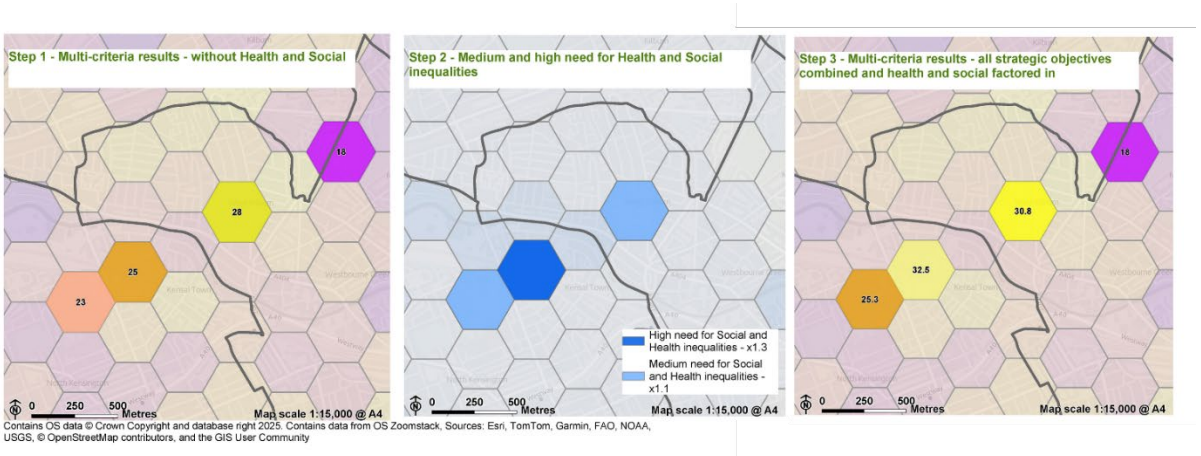
4.21 The overall need scores, which were obtained from combining multiple indicators of need for each Strategic Objective as described in Chapter 3, were summed for all hexes to obtain a 'total need' value in Excel.

4.22 This 'total need' value for each hex (excluding health and social inequalities) was then multiplied by either:

- 1.3 for hexes that scored high need for social or health inequalities; or
- 1.1 for hexes that scored medium need for social or health inequalities
- If a hex scored medium need for one of the inequalities and high for the other one, it was multiplied by 1.3 (classified as high need for social/health inequalities).

4.23 The effect of Scenario 2a on the numerical values for a sample of hexes is illustrated in **Figure 4.8**. The figure shows a sample of hexes in London. In Step 1 on the left, four hexes are highlighted with a range of multi-criteria analysis results for all ten Strategic Objectives combined equally, between 18 in the purple hex (lower overall need) and 28 in the yellow hex (higher overall need). Step 2 shows that three of those four hexes were also scored medium or high need for Social and/or Health Inequalities, shown in the mid blue and darker blue. In Step 3, the numerical multi-criteria analysis results from Step 1 were multiplied by 1.1 (if a mid-blue hex) and 1.3 (if a dark blue hex), giving the final numerical values for each of the four hexes. Step 3 shows that the purple hex with an overall need value of 18 is unchanged because it is not in an area of medium or high Health and/or Social Inequalities, whereas the three other hexes have higher need values once health and social inequalities have been factored in.

Figure 4.8 Illustration of the effect of the multiplication factor in Scenario 2a



4.24 This total need value with health and social inequalities factored in for each hex was then converted back to a three point scale by classifying the values into three equal intervals categories corresponding to low, medium, high need, listed as letters in Excel (L, M, H).

4.25 The overall provision scores obtained for each Strategic Objective as described in Chapter 3 were summed in Excel for all hexes to obtain a 'total provision' number. This number was then converted into letters (L, M, H) by re-scaling the values into three equal intervals categories representing low, medium and high provision.

4.26 Finally, the 'total need' letters and 'total provision' letters were concatenated (joined together in Excel) to obtain the overall bivariate diamond category for each hex (e.g. HM, ML, HL etc.). **Figure 4.9** provides an example of what the MCA using the bivariate diamond categories looks like in Excel, for five hexes:

- Columns BD and BE indicate whether a hex scored high or medium for health or social inequalities.
- Column BF is the total need value for the 10 Strategic Objectives combined.
- Column BG is the total need with the health/social inequalities factored in.
- Column BH shows the total need converted to L, M, H letters.
- Column BK shows the conversion of the total provision value to L, M or H.
- Column BM shows the overall MCA result for each hex in terms of low, medium or high need *vs* low, medium or high provision. The first letter indicates the level of need, the second letter the level of provision.

Figure 4.9 Calculating 'the four corners of the diamond' based on total need and total provision across all Strategic Objectives and factoring in health and social inequalities

A	BD	BE	BF	BG	BH	BK	BM
Hex_ID	H_S_High_Hexes	H_S_Medium_Hexes	Total_Need_wo_HS	Total_Need_MCA_2a	Total_Need_MCA_2a_HS_factored_i	Total_Provision_ca	MCA_2a_r1
10631211	0	50	3	3.3	L	M	LM
10641210	0	50	3	3.3	L	H	LH
10641212	0	50	3	3.3	L	H	LH
10641214	0	50	2.5	2.75	L	H	LH
10641216	0	50	2.5	2.75	L	H	LH

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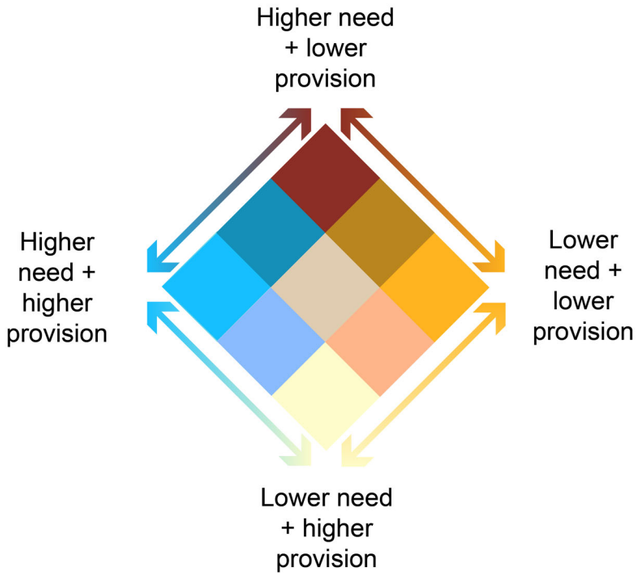
Figure 4.10: Multi-criteria analysis using bivariate diamond categories - all strategic objectives combined and health and social inequalities factored in

Greater London Authority boundary

Borough boundary



Overall bivariate - all strategic objectives combined and health and social factored in

- Higher need - Lower provision
- High need - Medium provision
- Higher need - Higher provision
- Medium need - Lower provision
- Medium need - Medium provision
- Medium need - Higher provision
- Lower need - Lower provision
- Lower need - Medium provision
- Lower need - Higher provision

0 5 10 km

Map scale 1:220,000 @ A3

Appendix A
Glossary

Accessible waterside

Dataset produced by Natural England as part of the GI Framework. The data identifies edges of rivers or water bodies that include the presence of a Public Right of Way (PRoW) or that are adjacent to accessible green infrastructure, indicating publicly accessible blue infrastructure.

Area of deficiency in access to nature

Areas where people have to walk more than one kilometre to reach a publicly accessible metropolitan or borough Site of Importance for Nature (SINC).

Areas of deficiency in access to public open space

Areas lacking in sufficient publicly accessible open space, as defined by a set of standards in Policy G4 Open space of the London Plan[5].

Areas of particular importance for biodiversity (APIBs)

This is an output from the London Local Nature Recovery Strategy (LNRS) mapping showing areas particularly important for biodiversity across London (including areas high in species richness, threatened species / biomes and habitats).

Bivariate analysis

A spatial data analysis method that allows the comparison of two variables to understand the relationship between them.

Biodiversity

The variety of plants and animals and other living things in a particular area or region. It encompasses habitat diversity, species diversity and genetic diversity. Biodiversity has value in its own right and has social and economic value for human society.

Blue space / blue cover

Areas covered by water including the River Thames and other rivers, canals, reservoirs, lakes and ponds.

Boroughs

The London boroughs are 32 of the 33 local authority districts within the Greater London administrative area (the 33rd is the City of London).

Flood zones

Dataset produced by the Environment Agency, showing the extent of land currently at risk of flooding from rivers and the sea, ignoring the benefits of defences.

Footfall

Number of people spending a defined amount of time in a particular space.

GiGL

Greenspace Information for Greater London – London's environmental records centre.

GIS

Geographic Information System

Green infrastructure

As defined within the London Plan[5], green infrastructure comprises the network of parks, rivers, water spaces and green spaces, plus the green elements of the built environment, such as street trees, green roofs and sustainable drainage systems, all of which provide a wide range of benefits and services.

Green roofs

Planting on roofs or walls to provide climate change, amenity, food growing and recreational benefits.

Green space / green cover

All vegetated open space of public value (whether publicly or privately owned), including parks, woodlands, nature reserves, gardens and sports fields, which offer opportunities for sport and recreation, wildlife conservation and other benefits such as storing flood water, and can provide an important visual amenity in the urban landscape.

Health inequalities

Health inequalities are systematic, avoidable and unfair differences in mental and/or physical health between groups of people. These differences affect how long people live in good health and are mostly a result of differences in people's homes, education and childhood experiences, their environments, their income, jobs and employment prospects, their access to good public services and their everyday opportunities to live healthier lives.

Hex grid

Hexagon grid applied across London, used to unify various datasets by rescaling them to the same grid. All the analysis described in this report were produced using the hex grid. The hex grid used in this study includes 15,042 hexagons that cover the extent of the Greater London Authority area. Each hex measures 350m across and is orientated so that the flat sides at top and bottom are horizontal.

Imperviousness

Impermeable barrier between the above-ground environment and the soil below. These surfaces prevent rainwater from penetrating the ground, leading to negative outcomes such as increasing surface runoff and the risk of flooding.

Landsat-8 Therma satellite

Earth observation satellite used for land use planning and monitoring on regional to local scales, support of disaster response and evaluations and water use monitoring. It includes a thermal infrared sensor which measures land surface temperature.

LNRS

Local Nature Recovery Strategy - new system of spatial strategies for nature, introduced in the Environment Act 2021.

LSOA

Lower layer Super Output Areas are geographical areas used for census statistics. They are made up of usually four or five Output Areas (OAs). They comprise between 400 and 1,200 households and have usually resident population between 1,000 and 3,000 persons.

LSWS Priority areas

Locations in London defined by the London Surface Water Strategy (LSWS) to which rainfall flows and eventually collects, resulting in flooding. Also referred to as 'wet spots' in previous versions of the analysis.

Misconnection points

Pollution points where rainwater runoff flows into a river. When pollution is observed at these points, it indicates that properties nearby are misconnected and draining int the water course.

Multi-criteria analysis

A spatial data analysis method that allows to combine multiple variables to help make decisions and prioritise areas of interest.

Natural England GI Framework

Best practice national guidance following a commitment in the Government's 25 Year Environment Plan to support the greening of towns and cities and connections with the surrounding landscape as part of the Nature Recovery Network. The Natural England GI Framework comprises the following elements:

- Green Infrastructure Principles;
- Green Infrastructure Standards;
- Green Infrastructure Mapping:
- Green Infrastructure Planning and Design Guide; and
- Green Infrastructure Process Guide and Journeys.

NO_2

Nitrogen dioxide (NO2) is an air pollutant generated mainly through the burning of fossil fuels.

$PM_{2.5}$

Fine particulate matter, which are fine inhalable particles consisting of a wide variety of chemical compounds and materials which are not a gas.

Provision

Term used in this project to relate to existing green infrastructure. It is defined on a three-point scale of low, medium or high.

Riparian

An area situated on the banks of a river.

River catchment

Catchments are an area of land from which all surface run-off flows through a series of streams, rivers, and sometimes lakes to a particular point in the water course such as a river confluence. The Environment Agency Water Framework Directive River Waterbody Catchments Cycle 2 dataset, which maps 62 catchments across London was used in the analysis described in this report.

Site of Importance for Nature Conservation (SINC)

Areas of land chosen to represent the best wildlife habitats in London and areas of land where people can experience nature close to where they live and work. Sites are classified into Sites of Metropolitan, Borough and Local Importance depending on their relative value.

Strategic Need

Term used in this project to relate to local needs which GI can help to address and mitigate within the London context.

Strategic Objective

Key themes defined in London defined in this project that could be alleviated using green infrastructure.

Sustainable drainage systems

Use of sustainable drainage techniques and the management of surface water run-off from buildings and hardstanding in a way that reduces the total volume, flow and rate of surface water that runs directly into drains and sewers.

Tree canopy cover

Dataset produced in 2024 by the GLA based on data primarily from 2022, which is a subset from the Green Cover 2024 dataset. The canopy cover was produced using a machine learning computer modelling technique to make judgement about what is tree canopy or other green cover (vegetation that is not trees).

Thresholds

Numerical values defined to classify a dataset into multiple categories.

Urban heat island

The height of buildings and their arrangement means that while more heat is absorbed during the day, it takes longer to escape at night. As a result, the centre of London can be up to 10°C warmer than the rural areas around the city. The temperature difference is usually larger at night than during the day. The Urban Heat Island effect is noticeable during both the summer and winter months.

Walking potential

An estimate of the amount of existing trips that could reasonably be walked all the way, but currently are made by other modes.

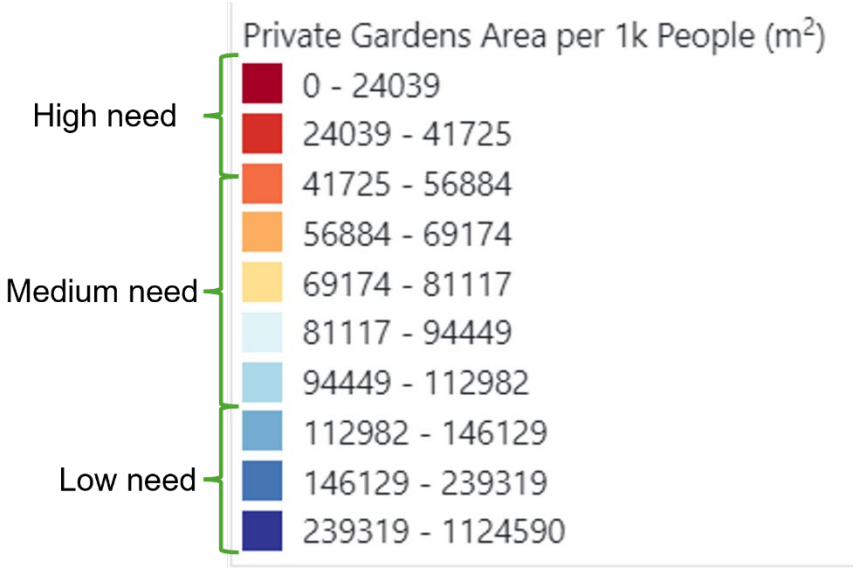
Appendix B

Explanation of thresholds defined based on data distribution or based on existing classifications

Area of private garden per 1,000 people by LSOA (Indicator of Need for Improving Access to Green Space)

B.1 The colour-coded bandings representing different levels of private garden area per 1,000 people (from low coloured dark red, to high coloured dark blue) defined by Natural England in the GI Framework [39] were used as a basis to define thresholds for this indicator of need. After sense checking the spread of these banding categories across London, the categories were grouped into low, medium and high need for the LGIF spatial data analysis as shown on **Figure B.1** to show a reasonable spread of levels of need in the London context.

Figure B.1 LGIF thresholds for low, medium, high need based on Natural England bandings for area of private garden per 1,000 people



Blue Cover 2024 (Indicator of Provision for Improving Access to Blue Space, Flood control and Urban cooling)

B.2 Different thresholds for defining high provision were tested using the GLA Blue Cover dataset to establish which percentage cover picked up most of the hexes within blue cover. The results were sense checked in GIS and it was found that using 50% as a threshold for hexes to score as high provision was the best at picking up the majority of hexes in blue cover as high provision, see **Figure B.2**.

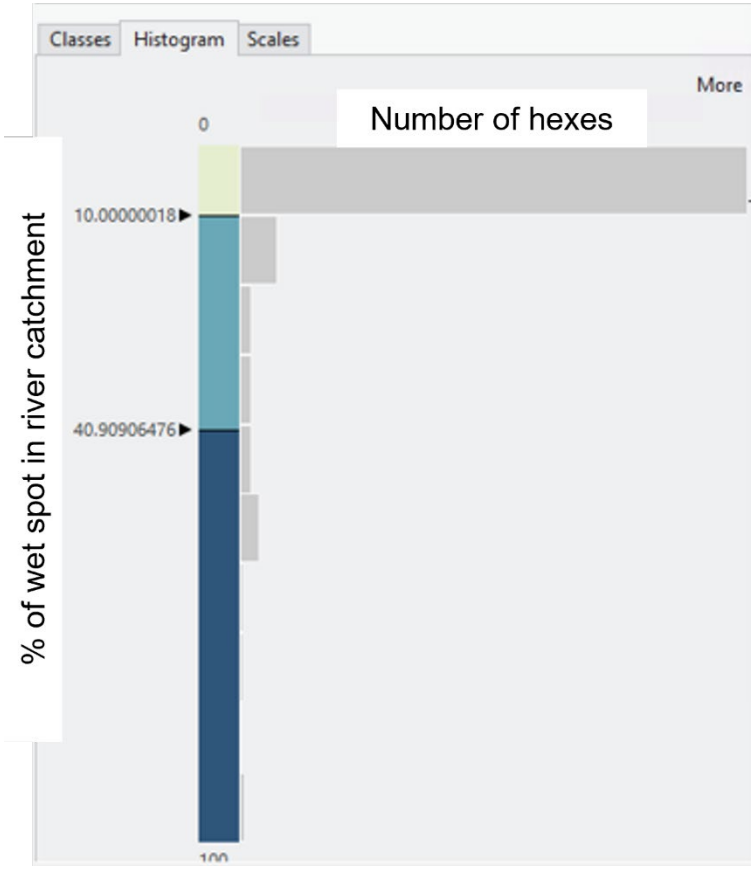
[39] See 'Private Gardens per Thousand People' layer in: Green Infrastructure Map

Figure B.2 : Example of Blue Cover dataset and coverage per hex that shows the underlying blue cover dataset and hexes, highlighting the difference between some hexes with 50% coverage and others with 90% coverage as threshold to score as high provision

London Surface Water Strategy priority areas and sub-catchments (Indicator of Need for Flood control)

B.3 The spatial distribution of the percentage coverage of priority areas per sub-catchment across hexes was used to define the thresholds to score this indicator of need. Priority areas are defined in the London Surface Water Strategy as the locations to which rainfall flows and eventually collects, resulting in flooding. The average percentage coverage of priority areas per sub-catchment was 9%. The histogram of the spatial distribution was drawn in GIS using natural breaks as shown in **Figure B.3**. It shows that most of the hexes within the sub-catchments are within sub-catchments with 0-10% priority areas. The hexes were scored using 10% and 40% as thresholds initially.

Figure B.3 Number and distribution of hexes based on % priority areas (also referred to as wet spots) per sub-catchment



B.4 After sense checking the results from this initial classification, it appeared that many hexes located in sub-catchments with a lot of priority areas, especially in Central London, were scored as low need, which was incorrect. The thresholds were therefore modified to 5% and 30% coverage to align better with the London context.

Misconnection points by river catchment (Indicator of Need for Clean water)

B.5 Misconnection points shown on the London River Health Map[40] relate to polluted surface water outfalls and are based on data from the Environment Agency and local citizen scientist initiatives mapping between 2005-2020. A surface water outfall is the point where rainwater runoff flows into a river. Where these are polluted it indicates that properties nearby are 'misconnected' and draining into the water course (instead of into a sewer). A count of misconnection points from the London River Health Map (just using those recorded from 2015-2020) was calculated for each river catchment as shown in **Table B.1** below. The thresholds to score this indicator of need were defined based on the distribution of these numbers of misconnection points across the catchments as shown in the final column in **Table B.1.** The resulting map showing the distribution of high, medium or low need scored hexes was reviewed by GLA water experts to ensure the areas identified in each level of need are reflective of the London water quality context.

Table B.1 Number of misconnection points found in each river catchment from 2015-2020

Count of misconnection points	Number of catchments	Need score
0	36	Low
1	8	Medium

[40] River Health Map

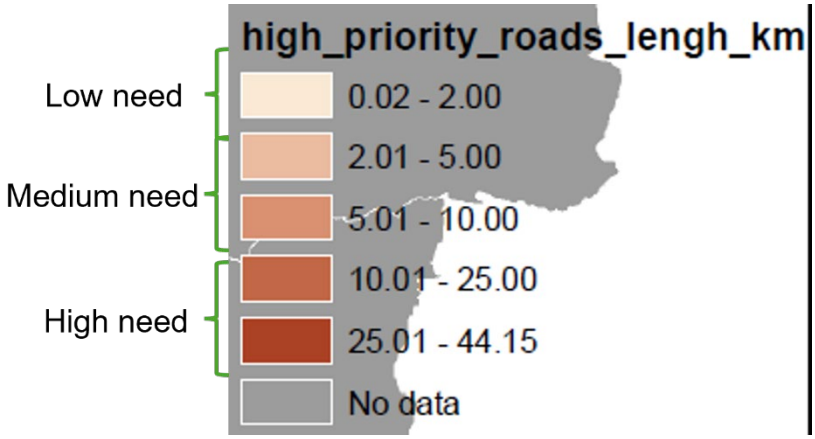
Count of misconnection points	Number of catchments	Need score
2	3	Medium
3	4	Medium
4	1	Medium
6	2	High
7	1	High
10	1	High
13	1	High
17	1	High

Road run-off pollution per river catchment (Indicator of Need for Clean water)

B.6 The Road Pollution Solutions Tool[41] is a decision tool for prioritising locations for road run-off treatment. It was created to help to identify the sections of London's strategic road network that are likely to contribute the most pollution to rivers. The tool is limited to outer London, because in outer London there is a separate surface water system. The methodology used to create the tool quantifies the mass of selected pollutants deposited on road surfaces, which can potentially enter rivers through road stormwater runoff; not taking into account the size of the waterway it is entering, and the dilution that might be applied. It gives roads an 'Integrated Pollutant Classification' as high priority, medium priority, lower priority and lowest priority based on modelling of different pollutants and the extent to which they exceed predicted total concentrations.

B.7 The thresholds used in the LGIF spatial data analysis for this indicator of need were defined based on the map provided alongside the dataset by the GLA, which symbolised the river catchments based on the length (km) of high priority roads as shown in **Figure B.4**. Various combinations of the length of high priority roads were tested to score the hexes that fall in each river catchment (i.e. 0 – 5 km for low need *as well as* 0 – 2 km was tested, and >25km for high need *vs* >10km). After sense checking of the resulting maps, the thresholds for low, medium and high based on the different lengths of roads as shown in Figure C.4 were found to align best with the raw data.

Figure B.4 : Symbolisation of the river catchments based on length (km) of high priority roads and corresponding LGIF thresholds used for defining low, medium and high need

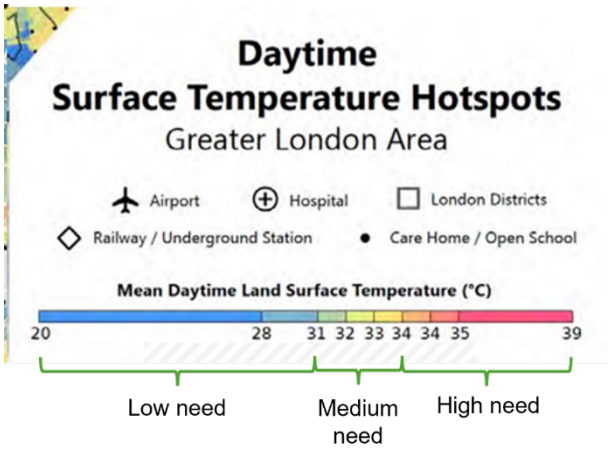


[41] Road Pollution Solutions Tool

Major Summer Heat Spots using Landsat-8 Thermal Satellite data (Indicator of Need for Urban cooling)

B.8 The thresholds to define low, medium or high need (heat risk) were identified in relation to the land surface temperature data (degrees Celsius) in the Major Summer Heat Spots dataset, using the colour coding of temperatures within the methodology available on the data page on the London datastore[42]. **Figure B.5** below shows which temperatures were included in low, medium or high need. The scored hexes were then sense checked against known areas of London that would be deemed at low or high heat risk. For instance, hexes over Heathrow Airport and in the inner parts of London more exposed to urban heat effects come up as high need for this indicator using that classification.

Figure B.5 Mean Daytime Land Surface Temperatures included in low, medium and high need



Tree Canopy Cover 2024 (Indicator of Provision for Urban cooling, Clean air, Noise reduction and Greener high streets)

B.9 The high threshold to score this indicator of provision was defined based on the London Environment Strategy[43] which has a target of 10% increase in tree cover across London. As the baseline tree canopy cover in 2018 was 21% across London, an increase of 10% would equate to 2.1%, which would result in 23% canopy cover across London if all boroughs were able to achieve the target. Therefore, a threshold of >23% coverage was used to score hexes for high provision. Tree Canopy Cover 2024 statistics by boroughs were reviewed (available in the London's Green Cover online map[44]). An initial threshold for low provision at <=13% tree canopy cover was used and the resulting map sense checked. It was found that this threshold left out some areas of London which have low tree canopy cover. There are four boroughs with an average of 15% tree canopy cover, therefore this was used as the threshold value to score low provision (hexes with <=15% tree canopy cover score low for provision).

Footfall in high streets and town centres (Indicator of Need for Greener high streets)

B.10 The footfall dataset provided by the GLA includes three variables mapped on the hex grid, which are:

- Worker count: the number of workers who spent more than 10 minutes in a hex over a daytime three-hour window. A person's work location is based on where they have spent most of their working hours based on the latest available calendar month.

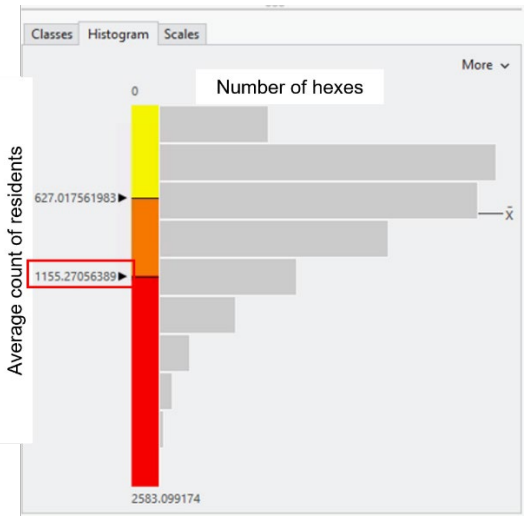
[42] Major Summer Heat Spots using Landsat-8 Thermal Satellite data - London Datastore
[43] London Environment Strategy
[44] London's Green Cover online map

- Resident count: the number of residents who spent more than 10 minutes in a hex over a daytime three-hour window. A person's residential location is where they have spent most of their evening and night time in the latest month.
- Visitor count: the number of non-residents and non-workers who spent more than 10 minutes in a hex over a daytime three-hour window

B.11 It was decided to include all three variables in this need indicator based on a review of the dataset and discussions with the GLA GI team, as footfall along a high street or within a town centre will comprise all three types of people: workers, residents and visitors. To define thresholds of low, medium and high need for each variable, the spatial distribution of the average count per hex was reviewed for hexes within high streets and town centres. The average count of workers was 152, average count of residents was 731 and average count of visitors was 327. These average values were used as lower thresholds to define low need. Histograms of the spatial distribution of each variable was drawn in GIS using natural breaks as shown in **Figure B.6** below. The value on each histogram that corresponds to where most of the hexes are located was used as the threshold to define the high need (circled on the histograms in **Figure B.6**). The resulting maps were sense checked with the GLA GI team to ensure they gave a fair representation of the footfall activity across high streets and town centres in London. The footfall need indicator was obtained by averaging the workers, residents and visitors scores for each hex.

Figure B.6 Histograms showing spatial distribution of average counts of workers (B.6a), residents (B.6b) and visitors (B.6c) footfall in each hex

B.6a



B.6b

B.6c

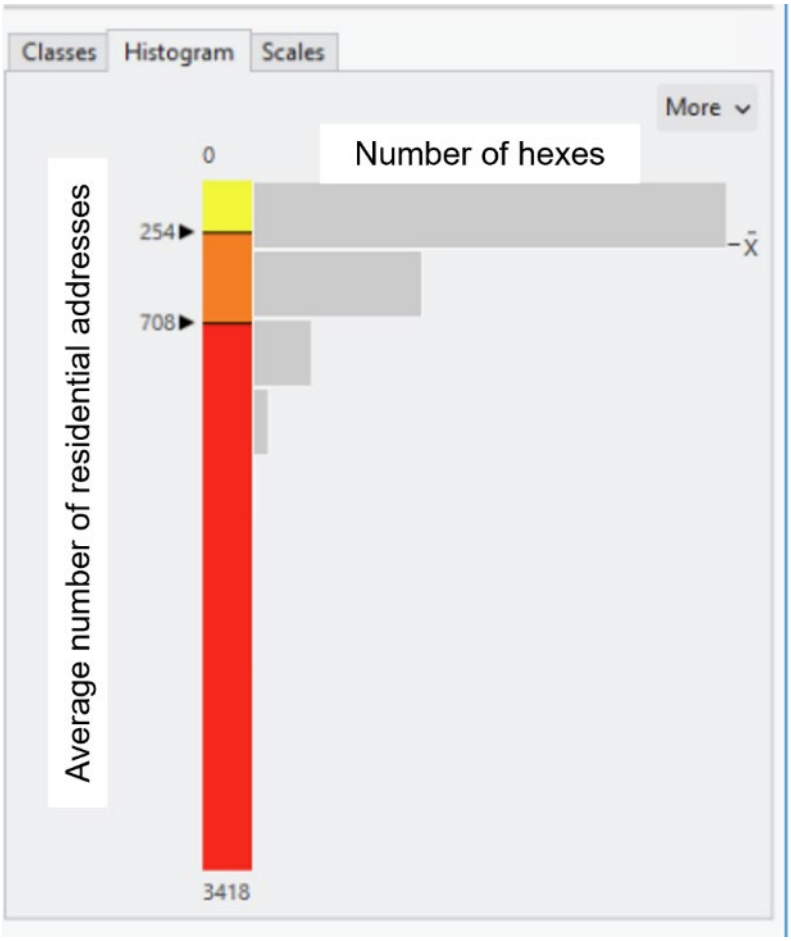
Count of residential addresses per hex (used in the Indicator of Need for Noise reduction and Social inequalities)

B.12 The count of residential addresses per hex dataset was provided by the GLA GIS team. This dataset was combined with the road and rail noise datasets to determine indicators of need for the Noise reduction strategic objective, as it was necessary to identify where people would be affected by noise, not just where the noise pollution is occurring.

B.13 The count of residential addresses per hex was also used as a proxy for population density across London as one of the indicators of need for Social inequalities.

B.14 To define thresholds of low, medium and high need for this indicator of need, the spatial distribution of the average count of residential addresses per hex was reviewed. The average count of addresses per hex across London was 265. This average value was used as the lower threshold to define low need. The histogram of the spatial distribution shown in **Figure B.7** was drawn in GIS using natural breaks. The value on the histogram that corresponds to where most of the hexes are located (709) was used as the threshold to define the high need. The resulting map was sense checked with the GLA GI team to ensure it gave a fair representation of population density across London.

Figure B.7 : Histogram showing spatial distribution of average number of residential addresses per hex



Appendix C

GIS processing methodology to translate the datasets to the hex scale

This appendix details the GIS steps undertaken to process the datasets described in Chapter 3 to bring them to the hex scale.

Table C1: GIS steps undertaken in ArcGIS Pro v3.4 to bring the datasets to the hex scale and score them for need or provision

Strategic Objective(s) / Inequality	Dataset	GIS method
1 – Improved access to green space	Area of deficiency in access to Public Open Space (AoD POS): ■ district parks ■ local parks	■ Intersect AoD POS layers with the hex grid ■ Export the intersect results (m2 of AoD POS per hex) to Excel to score each hex based on the threshold described in Table 3.2. This was done by calculating the percentage coverage (intersect / total hex area * 100) to establish if a hex is at least 1% AoD POS.
1 – Improved access to green space	Area of deficiency in access to nature	■ Intersect Area of deficiency in access to nature layer with the hex grid ■ Export the intersect results (m2 of AoD per hex) to Excel to score each hex based on the threshold described in Table 3.2. This was done by calculating the percentage coverage (intersect / total hex area * 100) to establish if a hex is at least 1% AoD in access to nature.
1 – Improved access to green space	Area (m^2) of private garden per 1,000 people by LSOA	■ Clip the 'Map6_LSOA_statistics' from NE to the GLA boundary ■ Create a new attribute and assign the need score as described in Table 3.2 based on the 'GardenSpace_m_per1000Pop' attribute ■ Intersect with the hex grid to assign a LSOA score per hex

Strategic Objective(s) / Inequality	Dataset	GIS method
		■ Export the intersect results (m2 of LSOA and associated score per hex) to Excel. Calculate the LSOA coverage per hex (intersect / total hex area *100). If a hex overlaps with more than 1 LSOA, assign the garden score from the largest overlap.
■ 1 – Improved access to green space ■ 4 – Flood control ■ 6 – Urban cooling ■ 7 – Clean air ■ 9 – Greener active routes	Green Cover	■ Dissolve the Green Cover layer and intersect with the hex grid ■ Export the intersect results (m2 of green cover per hex) to Excel to score each hex based on the threshold described in Table 3.2. This was done by calculating the percentage coverage (intersect / total hex area * 100) to establish the green cover for each hex.
2 – Improved access to blue space	Accessible/ inaccessible 800m buffer (10-minute walk) around waterways	■ Features tagged 'drain', 'settling pond', 'open water tank', 'buried open water tank' and features <9,000m^2 are removed from the GLA Blue Cover dataset ■ Clip the 'Accessible waterside' layer from NE to the GLA boundary and dissolve all polylines ■ Buffer the filtered Blue cover by 15m, and intersect the Accessible waterside prepared above with the 15m buffer. Keep the Accessible waterside within 15m of waterways and remove the rest. ■ Create an 800m buffer around the accessible waterside kept in the step above. This creates a proxy for public access to waterways (i.e. accessible buffer). ■ Create an 800m buffer around the filtered Blue cover dataset, providing a 10-minute walking distance from a waterway, regardless of its accessibility. ■ Subtract the 800m accessible buffer from the 800m buffer of all waterways. This provides an 800m buffer for inaccessible waterways. ■ Intersect the 800m buffer around accessible and inaccessible waterways with the hex grid (m2 of buffer per hex) and export to Excel to calculate the percentage coverage of the buffers per hex (intersect / total hex area * 100) to score each hex based on the thresholds described in Table 3.3.
2 – Improved access to blue space	800m buffer (10-minute walk) around Blue cover	■ Create an 800m buffer around the filtered (see filtering rule from the dataset above) Blue cover dataset, providing a 10-minute walking distance from a waterway, regardless of its accessibility.
■ 4 – Flood control ■ 6 – Urban cooling	Blue Cover 2024	■ Dissolve the Blue Cover layer and intersect with the hex grid

Strategic Objective(s) / Inequality	Dataset	GIS method
		■ Export the intersect results (m2 of blue cover per hex) to Excel to score each hex based on the threshold described in Table 3.3. This was done by calculating the percentage coverage (intersect / total hex area * 100) to establish the blue cover for each hex.
3 - Nature recovery	London LNRS Potential measures	■ Dissolve the Potential measures layer and intersect with the hex grid ■ Export the intersect results (m2 of potential measures per hex) to Excel to score each hex based on the threshold described in Table 3.3. This was done by calculating the percentage coverage (intersect / total hex area * 100) to establish the potential measures for each hex.
3 - Nature recovery	London LNRS Areas of particular importance for biodiversity (APIB)	■ Dissolve the APIB layer and intersect with the hex grid ■ Export the intersect results (m2 of APIB per hex) to Excel to score each hex based on the threshold described in Table 3.3. This was done by calculating the percentage coverage (intersect / total hex area * 100) to establish the APIB for each hex.
4 - Flood control	Fluvial Flood Zones 2 and 3	■ Clip the flood zones 2 and 3 layers to the GLA boundary ■ Select by attributes to remove 'tidal only' flood zones sources and keep the flood zones with either fluvial or multiple sources in the analysis ■ Dissolve both layers and intersect each with the hex grid ■ Export the intersect results (m2 of flood zone 2 and m2 of flood zone 3 per hex) to Excel to score each hex based on the thresholds described in Table 3.5. This was done by calculating the percentage coverage (intersect / total hex area * 100) to establish the flood zone 2 and 3 coverage for each hex.
4 - Flood control	London Surface Water Strategy (LSWS) – priority areas and sub-catchments	■ Intersect the LSWS priority sub-catchment layer with the hex grid and export to a table to assign a sub-catchment to each hex ■ Calculate the area of each priority area and export to Excel to calculate the percentage overlap of priority area per sub-catchment ■ Score each hex based on its assigned sub-catchment and the percentage of priority area per sub-catchment based on the threshold described in Table 3.5 ■ Hexes that are not covered by a sub-catchment are scored 0 (low need).
5 – Clean water	River quality by river catchment	■ Join the river quality CSV (2029, cycle 3, ecological classification) with the river shapefile using the water body ID attribute. Clip to the GLA boundary and dissolve by quality status ■ Intersect the quality status dataset prepared in the step above with the WFD catchment shapefile to assign a quality score per catchment as per the threshold described in Table 3.6. When there are

Strategic Objective(s) / Inequality	Dataset	GIS method
		different water quality status present in one catchment, the score matching the worst quality was assigned. ■ Assign a unique ID to each WFD catchment and intersect with the hex grid. Export the intersect results to Excel to assign each hex to a catchment with the matching water quality score. If a hex overlaps with multiple catchments, it is assigned the largest overlap catchment. ■ Remove the WFD catchment covering Central London from the analysis and select the LSWS sub-catchments that overlap with this WFD catchment to use in the analysis instead. ■ Run the same steps than above to assign a water quality score to each LSWS sub-catchment in Central London and assign each hex in Central London with a sub-catchment. ■ Combine the Central London results with the WFD catchment results in Excel to obtain the need score for this indicator.
5 – Clean water	Misconnection points by river catchment	■ Select the points for 2015-2020 from the data spreadsheet and run through a batch grid convert tool to convert the coordinates to British National Grid ■ Run the summarise tool to extract the count of points for each WFD catchment ■ Use the hexes assigned to WFD catchment as described in the 'River quality by river catchment' method above to score them based on the number of points in the river catchment following the threshold described in Table 3.6.
5 – Clean water	Road run-off pollution per river catchment	■ Join the road run-off CSV with the WFD river catchment and export resulting table to Excel ■ Use the hexes assigned to WFD catchment as described in the 'River quality by river catchment' method above to score them based on their corresponding catchment road length catchment following the threshold described in Table 3.6.
5 – Clean water	Green riparian areas	■ Buffer the merged and dissolved Blue Cover dataset by 2.5 metres. Erase the Blue Cover layer from the buffer. ■ Intersect the buffer with the merged and dissolved Green Cover. ■ Intersect the output from the previous step with the hex grid. ■ Export the intersect results (m2 of green riparian buffer per hex) to Excel to score each hex based on the threshold described in Table 3.6. This was done by calculating the percentage coverage (intersect / total hex area * 100) to establish the green riparian buffer for each hex.
6 – Urban cooling	Major Summer Heat Spots using Landsat-8 Thermal Satellite data	■ Classify the 'avgSLT' attribute from the dataset to need scores as per the threshold rules from Table 3.7

Strategic Objective(s) / Inequality	Dataset	GIS method
		■ Dissolve the dataset using the new score attribute and intersect with the hex grid ■ Export the intersect results (m2 of score based on temperature per hex) to Excel to calculate the percentage coverage (intersect / total hex area * 100). If a hex overlaps with more than one score, it gets assigned the score of the largest overlap.
■ 6 – Urban cooling ■ 7 – Clean air ■ 8 – Noise reduction	Tree Canopy Cover	■ Dissolve the Tree Cover layer and intersect with the hex grid ■ Export the intersect results (m2 of tree canopy cover per hex) to Excel to score each hex based on the threshold described in Table 3.7Table 3.2. This was done by calculating the percentage coverage (intersect / total hex area * 100) to establish the tree canopy cover for each hex.
7 – Clean air	NO_2 concentration 2025 forecast	■ Run the zonal statistics as a table tool using the hex grid as zone data, with the zone field set to 'hex_id', statistic type: mean (average), ignore no data in calculations ■ Export the resulting table to Excel to score each hex based on the threshold described in Table 3.8.
7 – Clean air	$PM_{2.5}$ concentration 2025 forecast	■ Run the zonal statistics as a table tool using the hex grid as zone data, with the zone field set to 'hex_id', statistic type: mean (average), ignore no data in calculations ■ Export the resulting table to Excel to score each hex based on the threshold described in Table 3.8.
8 – Noise reduction	Road noise combined with count of residential addresses per hex	■ Reclassify the Lden raster using the 55dB threshold: <55dB to NoData, >=55 to 1 ■ Convert the reclassified raster to polygon, selecting 'create multipart features' option ■ Intersect with the hex grid and export the intersects results (m2 of areas with noise >=55dB per hex) to Excel to calculate the percentage coverage (intersect / total hex area * 100). ■ Extract the list of hexes with 0 residential addresses to Excel ■ Score hexes with 0 residential addresses as 0 (low need) and the remaining of the hexes based on the coverage results as per the threshold described in Table 3.9.
8 – Noise reduction	Rail noise combined with count of residential addresses per hex	■ Reclassify the Lden raster using the 55dB threshold: <55dB to NoData, >=55 to 1 ■ Convert the reclassified raster to polygon, selecting 'create multipart features' option ■ Intersect with the hex grid and export the intersects results (m2 of areas with noise >=55dB per hex) to Excel to calculate the percentage coverage (intersect / total hex area * 100). ■ Extract the list of hexes with 0 residential addresses to Excel ■ Score hexes with 0 residential addresses as 0 (low need) and the remaining of the hexes based on the coverage results as per the threshold described in Table 3.9.

Strategic Objective(s) / Inequality	Dataset	GIS method
9 – Greener active travel routes	Cycle network: National Cycle Network and London Cycle Network combined	■ Merge the NCN and London Cycle Network and dissolve. Buffer by 5 metres. ■ Intersect the buffer with the hex grid and export the intersect results (m2 of network per hex) to Excel to calculate the percentage coverage (intersect / total hex area * 100). If a hex overlaps <1% with the cycling network, it gets scored 0 (low need) as described in Table 3.10. ■ Intersect the buffer with the merged and dissolved Green Cover to obtain the green network data. ■ Intersect the green network with the hex grid and export the intersect results (m2 of green network per hex) to Excel. Calculate the % of the network that is green within each hex using: m2 of green network per hex / m2 of network per hex * 100. Score the remaining hexes with >=1% of cycling network as per the threshold described in Table 3.10.
9 – Greener active travel routes	Strategic Walking Analysis (SWA) - Total walking potential density and pedestrian density	■ Extract both datasets to Excel (already provided at the hex level) ■ Score hexes for both datasets using the thresholds described in Table 3.10 ■ Average the score of both dataset (sum and divide by 2) and categorise to low, medium or high need as follows: ■ If <0.25: score 0 ■ If >=0.25 and <=0.5: score 0.5 ■ If >0.5: score 1
10 - Greener high streets	Average count of visitors, resident and workers in high streets (HS) and town centres (TC)	■ Clip the hex grid to the high streets and town centres boundaries and export to Excel to use as a list of hexes within HS/TC ■ Extract the three footfall variables to Excel (already provided at the hex level) ■ Score hexes in HS/TC against the three footfall variables using the thresholds described in Table 3.11 ■ Average the score of the three variable (sum and divide by 3) and categorise to low, medium or high need as follows: ■ If <0.25: score 0 ■ If >=0.25 and <=0.5: score 0.5 ■ If >0.5: score 1
10 - Greener high streets	Hight streets / town centres within Green Cover	■ Merge and dissolve the town centres and high streets datasets and intersect with the hex grid. Export the intersect results (m2 of HS/TC per hex) to Excel to calculate the percentage coverage of

Strategic Objective(s) / Inequality	Dataset	GIS method
		HS/TC per hex (intersect / total hex area * 100). If a hex overlaps <1% with a HS/TC, it gets scored 0 (low provision) as described in Table 3.11. ■ Intersect the merged and dissolved HS/TC with the merged and dissolve Green Cover layer to obtain the HS/TC within green cover ■ Intersect with the hex grid (m2 of green HS/TC per hex) and export to Excel. Calculate the % of the HS/TC that is green within each hex using: m2 of green HS/TC per hex / m2 of HS/TC per hex *100. Score the remaining hexes with >=1% of HS/TC as per the thresholds described in Table 3.11.
10 - Greener high streets	Hight streets / town centres within Tree Canopy Cover	■ Merge and dissolve the town centres and high streets datasets and intersect with the hex grid. Export the intersect results (m2 of HS/TC per hex) to Excel to calculate the percentage coverage of HS/TC per hex (intersect / total hex area * 100). If a hex overlaps <1% with a HS/TC, it gets scored 0 (low provision) as described in Table 3.11. ■ Intersect the merged and dissolved HS/TC with the merged and dissolve Tree Canopy Cover layer to obtain the HS/TC within tree canopy cover ■ Intersect with the hex grid (m2 of tree cover HS/TC per hex) and export to Excel. Calculate the % of the HS/TC that is tree cover within each hex using: m2 of tree cover HS/TC per hex / m2 of HS/TC per hex *100. Score the remaining hexes with >=1% of HS/TC as per the thresholds described in Table 3.11.
10 - Greener high streets	AoD for public open space local parks	■ Clip the AoD POS for local parks intersected per hex (output from SO1) to the merged and dissolved HS/TC. Dissolve the output on the hex_id attribute and export to Excel (m2 AoD per hex) ■ Merge and dissolve the town centres and high streets datasets and intersect with the hex grid. Export the intersect results (m2 of HS/TC per hex) to Excel to calculate the percentage coverage of HS/TC per hex (intersect / total hex area * 100). If a hex overlaps <1% with a HS/TC, it gets scored 0 (low provision) as described in Table 3.11. ■ Calculate the % of the HS/TC that is in AoD within each hex using: m2 AoD per hex / m2 of HS/TC per hex *100. Score the remaining hexes with >=1% of HS/TC as per the thresholds described in Table 3.11.
Health inequalities	IMD – Health Deprivation and Disability Domain by LSOA	■ Clip the IMD dataset to the GLA boundary and intersect with the hex grid ■ Export the intersect results (m2 of LSOA and associated IMD decile per hex) to Excel. Calculate the LSOA coverage per hex (intersect / total hex area *100). If a hex overlaps with more than 1 LSOA, assign the IMD decile from the largest overlap

Strategic Objective(s) / Inequality	Dataset	GIS method
		■ Score the hexes based on their intersecting IMD decile as per the thresholds described in Table 3.12.
Social inequalities	Count of residential addresses per hex as a proxy for population density	■ Join the Count of residential addresses per hex CSV to the hex grid and export to Excel ■ Score hexes in Excel based on their residential addresses count as per the thresholds described in Table 3.13.
Social inequalities	% of people under the age of 5	■ Create new attributes in the social inequalities per LSOA dataset ('under5', 'over75', etc) and score based on the relevant % of people as per the thresholds described in Table 3.13 ■ Intersect with the hex grid (m2 of LSOA per hex) and export to Excel. Calculate the LSOA coverage per hex (intersect / total hex area *100). If a hex overlaps with more than 1 LSOA, assign the score from the largest overlap.
Social inequalities	% of people over the age of 75	
Social inequalities	% of people not proficient in English	
Social inequalities	% of people in social housing	
Social inequalities	% of people identifying as BAME	
Social inequalities	% of people considered income deprived	

Appendix D

Datasets considered and discounted for the analysis

Table D1: Datasets that were discounted and justification for exclusion

Strategic Objective (s)/Inequality	Dataset	Source	Indicator type	Rationale for exclusion
1 – Improved access to green space	AoD for public open space regional parks	GiGL - 2024 Obtained based on data exchange agreement – GiGL copyright	Need	This dataset was included in the first iteration of the Strategic Objective. After sense-checking of the results by the GLA GI team, this indicator was removed from the analysis, as it tended to mask local variations in provision across London due to the large catchment areas attributed to larger typologies of open space. It was felt that indicators of access to open space close to home rather than longer distances better conveyed the intention of this Strategic Objective.
1 – Improved access to green space	AoD for public open space metropolitan parks	GiGL - 2024 Obtained based on data exchange agreement – GiGL copyright	Need	This dataset was included in the first iteration of the Strategic Objective. After sense-checking of the results by the GLA GI team, this indicator was removed from the analysis, as it tended to mask local variations in provision across London due to the large catchment areas attributed to larger typologies of open space. It was felt that indicators of access to open space close to home rather than longer distances better conveyed the intention of this Strategic Objective.
1 – Improved access to green space	Area of accessible GI (m2) per 1,000 people by LSOA	Natural England - 2024[45] Open Government Licence v3.0	Need	This dataset largely duplicates the GiGL AoD datasets. It was agreed to use the GiGL AoD datasets as they are specifically produced for London, and therefore more relevant for the LGIF than the national Natural England dataset.

[45] https://www.data.gov.uk/dataset/f335ab3a-f670-467f-bedd-80bdd8f1ace6/green-and-blue-infrastructure-england

Strategic Objective (s)/Inequality	Dataset	Source	Indicator type	Rationale for exclusion
1 – Improved access to green space	Nature close to home (under 16) by MSOA	Natural England - 2024[45] Open Government Licence v3.0	Need	GiGL AoD data to take precedence. It was agreed to use the GiGL AoD datasets as they are specifically produced for London, and therefore more relevant for the LGIF than the national Natural England dataset.
1 – Improved access to green space	Nature close to home (65 plus) by MSOA	Natural England - 2024[45] Open Government Licence v3.0	Need	GiGL AoD data to take precedence. It was agreed to use the GiGL AoD datasets as they are specifically produced for London, and therefore more relevant for the LGIF than the national Natural England dataset.
1 – Improved access to green space	All GI assets that are thought to be publicly accessible	Natural England - 2024[45] Open Government Licence v3.0	Need	Potential for duplication with the GLA green cover dataset.
1 – Improved access to green space	Accessible woodland	Natural England - 2024[45] Open Government Licence v3.0	Provision	Potential for duplication with GiGL Public Open Space. NE Accessible woodland covered by GiGL Public Open Space dataset.
1 – Improved access to green space	Public Open Space (POS)	GiGL - 2024 Obtained based on data exchange agreement – GiGL copyright	Provision	This dataset was included in the first iteration of the Strategic Objective, which focused on both green and blue infrastructure. In addition to including some blue infrastructure, which was ultimately considered under a separate Strategic Objective (Improved access to blue space) the Areas of Deficiency in access to public open space datasets essentially highlighted the inverse of the public open spaces dataset, therefore it did not produce a very meaningful result through the bivariate analysis, when trying to compare areas of higher/lower need with areas of higher/lower provision as they cancelled each other out to an extent. After testing of the GLA's Green Cover dataset, it was agreed with the GLA GI team that using green cover as an indicator of provision gives a more useful insight into areas of need versus provision for this Strategic Objective. Therefore, the POS dataset was excluded from the indicators of provision.
■ 2 – Improved access to blue space ■ 5- Clean water	Blue Infrastructure Network	Natural England - 2024[45]	Provision	This dataset was included in the first iteration of the Strategic Objective, which focused on both green and blue infrastructure. The GLA Blue Cover became available in February 2025, providing a more up to date and London specific dataset of blue infrastructure.

Strategic Objective (s)/Inequality	Dataset	Source	Indicator type	Rationale for exclusion
■ 6 – Urban cooling		Open Government Licence v3.0		
4 – Flood control	Natural Flood Management (NFM)	Thames Regional Flood and Coastal Committee (Thames RFCC)	Need	NFM Priority mapping data would be important to use as a need indicator as it identifies the catchments where NFM measures would be most suitable and benefit more properties are at risk of flooding. However, the NFM priority map ranking waterbody catchments by the amount of NFM opportunities and associated benefits they would provide, was not able to be obtained from the TRFCC datasets provided within the timeframe of the LGIF analysis.
4 – Flood control	Critical Drainage Areas	GLA – 2024 Licence: Other (Not Open)	Need	This dataset was excluded following feedback from GLA water specialists because Critical Drainage Areas (CDAs) is a localised dataset, whereas the LGIF analysis were done at a more strategic scale. CDAs are also not consistently produced across London so comparing them across the whole study area would not be appropriate.
4 – Flood control	Risk of flooding from surface water 1 in 30 year risk / 1 in 100 year risk	Environment Agency 2024[46] Open Government Licence	Need	This dataset was excluded following feedback from GLA water specialists because it is based on different models between Boroughs. GLA specialists' recommendation was to use LSWS data instead because it was developed using a consistent model across the whole of London.
4 – Flood control	Imperviousness density	Copernicus - 2018[47] Open data	Provision	This dataset was excluded due to its age and the fact that there is no update cycle for it anymore. The data is an almost exact inverse of the GLA Green Cover dataset (as it shows the most pervious land cover in the areas of the Green Cover dataset picks up, and the least pervious land cover in the areas not shown in the Green Cover dataset because they are covered in concrete buildings and other impervious surfaces). Therefore, it would have resulted in the same areas of high, medium and low provision as the Green Cover dataset, which has been used as an indicator of provision for this Strategic Objective and is more recent (2024 modelling based on 2022 imagery).
4 – Flood control	Existing SuDS sites in SuDS retrofit map	GLA – 2024[48] Licence: Other (Not Open)	Provision	This dataset was excluded due to its potential to skew the representation of levels of GI provision (in the form of sustainable drainage systems (SuDS). The GLA advised that while the map is frequently updated, it still only shows a very small proportion of SuDS that have been delivered across London, and it only shows SuDS delivered as part of retrofit projects, not those delivered within new development.

[46] Risk of Flooding from Surface Water
[47] Imperviousness Density 2018 (raster 10 m and 100 m), Europe, 3-yearly — Copernicus Land Monitoring Service
[48] London Retrofit SuDS Map

Strategic Objective (s)/Inequality	Dataset	Source	Indicator type	Rationale for exclusion
■ 4 – Flood control ■ 6 – Urban cooling	Green roofs	GLA - 2019[49]	Provision	The possibility to include this dataset as an indicator of provision was discussed with the GLA GI team and it was decided not to include due to its age and coverage limitations (it only covers the Central Activities Zone and is not updated).
6 – Urban cooling	Mean surface temperature by LSOA	Arup – 2022[50] Open Government Licence v3.0	Need	Since this dataset is the most recent available and is used in the GLA's Climate Risk Mapping, the possibility to include it as an indicator of need was discussed with the GLA GI team. It was decided not to include it due to it being only available at LSOA level. The results over a few LSOAs were investigated, and it was found that it does not reflect what is happening on the ground as well as the Major Summer Heat Spots using Landsat-8 Thermal Satellite data. The dataset ranges from 17 – 28 degrees Celsius and it masks out some important heat variation due to the aggregation by LSOA. For instance, the LSOA that includes Heathrow Airport comes up at 18.7 degrees Celsius. If Hexes were scored based on this value and the data distribution, the hexes over Heathrow Airport would end up scored as low need, resulting in inaccurate results.
6 – Urban cooling	Heat Risk layer – output from the Climate Risk Map	GLA - 2024[50] Open Government Licence v3.0	Need	Potential for duplication because the determination of heat risk was obtained by a multi-criteria analysis combining temperatures with other data such as groups of population under 5, over 75 years etc., which are considered separately in other Strategic Objectives in the LGIF analysis.
6 – Urban cooling	Urban Heat Island	GLA - 2016[51] Open Government Licence v3.0	Need	Excluded due to its age. More recent data was used as need indicator.
6 – Urban cooling	Urban Heat Management by LSOA	Natural England - 2024[45] Open Government Licence v3.0	Need	The possibility to include this dataset as an indicator of provision was discussed with the GLA GI team and it was decided to use the GLA dataset instead due to the Natural England one being only available at LSOA level.

[49] https://data.london.gov.uk/dataset/green-roofs
[50] https://cityhall.maps.arcgis.com/apps/instant/media/index.html?appid=59236d2e842c4a3ba6480d9dac585d1e
[51] https://data.london.gov.uk/dataset/london-s-urban-heat-island

Strategic Objective (s)/Inequality	Dataset	Source	Indicator type	Rationale for exclusion
7 – Clean air	NO_2 2019 concentration	GLA – London Atmospheric Emissions Inventory 2019[52] Licence: Not Specified	Need	This dataset was included in the first iteration of the Strategic Objective, however following recommendations from GLA Air Quality team the 2025 forecast was used in the analysis. A more accurate dataset for 2022 baseline concentrations will be released soon.
7 – Clean air	$PM_{2.5}$ 2019 concentration	GLA – London Atmospheric Emissions Inventory 2019[52] Licence: Not Specified	Need	This dataset was included in the first iteration of the Strategic Objective, however following recommendations from GLA Air Quality team the 2025 forecast was used in the analysis. A more accurate dataset for 2022 baseline concentrations will be released soon.
9 – Greener active travel routes	Walk London Network	TfL[53]	Need	Not included as it is focussed on recreational walking routes rather than active travel.
10 – Greener high streets	Pedestrian activity - derived from the London Travel Demand Survey (LTDS)	TfL - 2024[54] Open Government Licence	Need	The dataset was considered as an indicator of need; however, it is not spatially detailed enough as it only provides aggregated results at the Greater / Inner / Outer London levels.
10 – Greener high streets	IMD – Income Deprivation in town centres / high street boundaries	MHCLG – 2919[55] Open Government Licence	Need	This dataset was included in the first iteration of the Strategic Objective. Following review of the initial analysis with the GLA GI team, it was decided to exclude the IMD data from this Strategic Objective because it is included in the Social Inequalities measure and therefore would duplicate this data. It was agreed that footfall data would be more appropriate to measure the need.
10 – Greener high streets	IMD – Employment Deprivation in town centres / high street boundaries	MHCLG – 2919[55] Open Government Licence	Need	This dataset was included in the first iteration of the Strategic Objective. Following review of the initial analysis with the GLA GI team, it was decided to exclude the IMD data from this Strategic Objective because it is included in the Social Inequalities measure and therefore would duplicate this data. It was agreed that footfall data would be more appropriate to measure the need.

[52] https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory--laei--2019
[53] https://tfl.gov.uk/modes/walking/top-walking-routes
[54] https://tfl.gov.uk/campaign/consultations-and-surveys
[55] https://www.gov.uk/government/publications/english-indices-of-deprivation-2019-technical-report

Strategic Objective (s)/Inequality	Dataset	Source	Indicator type	Rationale for exclusion
10 – Greener high streets	Central Activity Zones (CAZ)	GLA - 2024[56] Open Government Licence	Provision	This dataset was included in the first iteration of the Strategic Objective. Following review of the initial provision based on the CAZ it was agreed with the GLA GI team that the high street boundaries should be used instead because they are more detailed and cover outer London as well.
10 – Greener high streets	Greenness Index	Natural England - 2024[45] Open Government Licence v3.0	Provision	GLA Green Cover data to take precedence, as it is a London-specific dataset.
Health inequalities	Office for Health Improvement and Disparities Fingertips tool	Department for Health and Social Care [57] Open Government Licence	Need	The public health profiles in the Fingertips tool provide collections of indicators covering a large range of public health topics. These profiles were considered as an indicator of need; however, as the data is only available at London borough level, it was agreed with the GLA GI team that the IMD determinant of health would be better to use as it is available at the finer-grained LSOA level.
Social inequalities	IMD – Living Environment Deprivation	MHCLG – 2919[55] Open Government Licence	Need	The indicators fall into two sub-domains. The 'indoors' living environment measures the quality of housing, while the 'outdoors' living environment contains measures of air quality and road traffic accidents. The datasets was excluded from the analysis due to the 'outdoors' domain duplication with other Strategic Objectives. The 'indoor' domain is not relevant to GI.
Social inequalities	Double Disadvantage Study	Joseph Rowntree Foundation[58]	Need	This study and tool were reviewed and discussed with the GLA GI team but considered to be too detailed and potentially duplicating some of the indicators of need already included in the LGIF.
Social inequalities	Civic Strength Tool	GLA[59]	Need	This study and tool were reviewed and discussed with the GLA GI team but considered to be too detailed and potentially duplicating some of the indicators of need already included in the LGIF.

[56] https://data.london.gov.uk/dataset/central_activities_zone
[57] https://fingertips.phe.org.uk/
[58] https://www.jrf.org.uk/neighbourhoods-and-communities/focusing-on-doubly-disadvantaged-neighbourhoods
[59] The London Civic Strength Tool | London City Hall