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THE “UNDERSPACES” WITHIN THE CONTEMPORARY CITY

An analytical investigation of residual areas as
an opportunity for community enhancement
through spatial regeneration strategies.

by

Alessandra Di Cerbo

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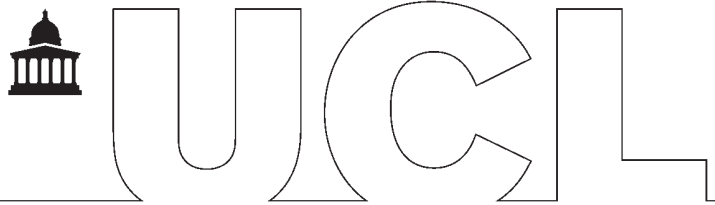
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ABSTRACT

Nowadays, we face a common urban phenomenon referring to seemingly unattractive and obsolete areas beneath elevated transport infrastructures, defined as “*residual urban spaces*” or “*flyovers*”. These places, created by past urban planning processes, are usually left in a state of decay representing a waste of precious land resources in dense cities like London. Flyovers physically divide communities and create spaces perceived as unsafe due to their deterioration, at the same time preventing equal usage by diverse groups of people, mainly at night. Therefore, an accurate analytical investigation is required to gain a deep understanding of these urban places, aiming to ultimately formulate appropriate requalification strategies for reclaiming public areas and reintegrating them into the broader urban network. This study aims to examine the morphological and topological features of neglected flyovers, defining a spatial and social classification framework to fill the void in the understanding of “*residual spaces*”. By analysing the three-dimensional impact of undesirable urban places on a neighbourhood scale, this research seeks to identify the current spatial, socio-economic and perceptual issues affecting those areas. The study starts with a historical investigation of the spatial configuration from the 1950s moving to the present transformation of the spatial structure. This investigation is then coupled with historical and present socio-economic analyses portraying the overall context in which residual spaces emerged. In the last section, feasible configurational improvements promoting spatial interconnections and community bonding measures are presented. Conventional morphological analysis alongside space syntax methods and data mapping on a GIS platform are used to measure building forms, fabrics, and functions through figure-ground and urban block analysis, deprivation, residential-retail densities and visual integration analysis. Furthermore, objective surveys are conducted to investigate the factors related to safety perception influencing the usage of these spaces by a diverse population. Findings suggest that areas adjacent to the Westway flyovers in London lack diversity in land usage and show inadequate socioeconomic service provisions, being surrounded by high deprivation rates. Additionally, patterns in urban morphology reveal community severance between the north and south of the Westway. By acting on enhancing spatial and social factors, as well as on functional and visual connections, multiple improvements could be reached. In conclusion, addressing undesirable urban spaces through analytical approaches and evidence-based reconfiguration design proposals, may contribute to creating more sustainable, resilient, and liveable cities.

Keywords: Residual spaces, elevated infrastructures, urban morphology, space syntax.

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INTRODUCTION I

Chapter 1

1. INTRODUCTION

The concept of **residual urban space** encompasses neglected places scattered throughout the urban fabric, involving complex spatial, socioeconomic, and environmental aspects. These overlooked areas are perceived as the outcome of countless planning processes that have governed urbanisation across time, thereby impacting the transformation and evolution of urban systems (Trancik, 1986). As a result, urban environments have witnessed the emergence of residual areas, also referred to as “*lost spaces*” or “*antispaces*” (Trancik, 1986, pp. 3-4), which are typically perceived as undesirable urban places. These areas tend to arise especially along or underneath highways, railway lines, and waterfronts, requiring the implementation of redesign strategies (op.cit., 1986).

In this regard, Villagomez (2010) states that “*cities have been – and always will be – dynamic entities*” (p. 95), that undergo continuous transformation. Similarly, Hillier (1996) acknowledges the “*multidimensional dynamics of cities*” (p. 136), emphasising their complex nature and their “*dynamic spatial processes*” (p. 305) involved in the development of urban environments. In certain instances, these processes give rise to what can be referred to as “*leftover spaces*” within the city fabric, manifesting in various forms and sizes. Regrettably, these spaces often go unnoticed, falling into a state of neglect or underutilisation (Khalil & Eissa, 2013).

Residual spaces, in contrast to meticulously planned and officially designated urban spaces, can be viewed as “*underused areas*” (Shukla & Deshmukh, 2021). Nevertheless, these spaces offer a unique opportunity to test innovative and unconventional urban concepts. Hence, regeneration measures addressed to these abandoned and undervalued places can be promoted to reclaim their potential by transforming them into opportunities for new and creative urban redevelopments. This approach enables rediscovering numerous hidden resources within our cities, leading to spatial and socioeconomic improvements for the communities residing in the nearby areas (Trancik, 1986).

The main objective of this research is to investigate the correlation between socio-spatial factors and the occurrence of residual sites in defined urban settings, specifically the *flyover* spaces underneath modern elevated infrastructures. In order to explore the concept of residual spaces, London has been selected as the main case study due to its distinct urban

characteristics resulting from the modernisation processes that have shaped several European and American cities over the past centuries. Indeed, the layered nature of London's physical environment is a consequence of advancements in mobility and communication concepts (Trancik, 1986). As a result, various forms of unused and fragmented spaces have arisen between, around, and under urban infrastructures, including railways, highways, and bridges (Wall, 2011). Specifically, the focus of this study has been on examining the spaces beneath one of London's significant highways, namely the *A40 Westway* (Figure 1). This elevated highway, extending over a distance of 4 kilometres, serves as an essential link between the city centre of London and the route to Oxford. However, its presence has crucial environmental implications for the surrounding area, leading to challenges such as community segregation, social isolation, and decline of traditional street life (Robertson, 2007).



Figure 1. Residual space underneath the Westway, London.

In other words, this study seeks to examine unattractive places, with a particular focus on neglected and unwelcoming flyovers, in order to comprehend, reuse, and enhance them. The research intends to explore the seemingly inert nature of residual spaces and delve into their role in dividing or connecting areas and communities, exploring their level of vacancy and residuality degree, as well as the potential for their reintegration into the surrounding urban network. The research also aims to understand how individuals perceive these undefined spaces through the use of subjective surveys (questionnaires), to rate the degree of perceived safety by people occupying the study areas. This contributes to assess how the utilisation of these spaces can overcome issues like land wastage (Khalil & Eissa, 2013).

The research will be mainly conducted using an evidence-based research approach based on *Space Syntax* concepts and techniques (Hillier & Hanson, 1984). *Space Syntax* embodies a theory and methodology centred on revealing aspects of a city's spatial structure which seem to be obscured by conventional analyses. In more detail, this theory intends to scrutinise the interplay between spatial configurations and human behaviour within the urban fabric. It underscores the significance of comprehending the intrinsic spatial structure properties of a place, which deeply influence its social and functional characteristics (Hillier & Hanson, 1984).

In conclusion, the overarching aim of this study is to identify and categorise residual areas within the urban system of London, with the ultimate goal of offering renewed and revitalised spaces to the city. In this regard, it is important to explore how the reuse of these so defined "*intermediate spaces*" can impact human interactions and behaviours (Groth & Corijn, 2005, p. 503). By strategically reinterpreting these overlooked areas, there is an opportunity to make our cities more liveable and functional, fostering a sense of cohesion and equity among communities inhabiting the surrounding areas. To achieve this goal, the research endeavours to provide regeneration design proposals and guidelines that can serve as catalysts for beneficial transformation and enhancement processes. These recommendations are intended to be applicable not only within the city of London but also potentially in urban environments worldwide.

1.1 BACKGROUND

Modern cities have undergone continuous development and evolution processes, particularly starting from the 19th century, when a strong emphasis was given to high-speed mobility and communication. This focus has resulted in the creation of public spaces primarily designed to serve these functions, giving rise to new urban forms and spatial configurations. Within this context, vacant and underused land, also defined as "*unshaped antispace*" (Trancik, 1986, p. 1) has emerged in most of today's urban environments representing spatial settings that lack a defined identity or purpose.

In the study by Shukla and Deshmukh (2021), it is noted that while new transport infrastructures may address traffic aspects and fulfil mobility requirements, the construction of flyovers can also give rise to problematic spaces within the existing urban fabric. In particular, these places are often perceived as wasteful and lacking functionality. Furthermore, as stated by the authors (op.cit.), flyovers have the potential to act as barriers, dividing communities and eroding the identity of a place.

The decision to focus on examining residual spaces beneath the A40 Westway (*Figures 2-3*), an elevated highway linking London with the western route of England, stems from the interest

to explore the nature of these residual areas situated beneath what is regarded as an “*icon of modernism*” and a symbol of the “*ever-increasing speed of everyday life*” (Robertson, 2007, p. 76).



Figure 2. 1973 Aerial view. Source: grasart.com. ©RBKC Local Studies and Archives.



Figure 3. Today's aerial view. Source: Matt Cardy/Getty Images.

While previous studies have primarily attempted to investigate the nature of neglected spaces generated by modern infrastructures, particularly from a subjective perspective, this research aims to bridge the gap, objectively and deeply understanding flyover spaces by adopting a more comprehensive, analytical, and multidimensional standpoint. In this regard, the study also seeks to tackle the challenges associated with the integration of modern motorways into the pre-existing urban fabrics, shedding light on a broader comprehension of the resulting residual spaces. Specifically, this research examines the areas underneath such transport infrastructures, aiming to uncover both the challenges and potentialities that similar places offer. The existing literature is marked by numerous descriptions that can be blurred or unclear, creating a confusing foundation for comprehending the concept of residuality. Additionally, previous academic discourse has attempted to describe residual places in a conventional manner, often relying on historical research and subjective observations. Nonetheless, these approaches seem to have frequently fallen short in considering a comprehensive picture, thus overlooking various factors that contribute to the emergence of neglected and unwelcoming spaces. Conversely, this study seeks to establish a structured analytical framework to investigate this topic, incorporating traditional methods as well as space syntax approaches. The ultimate goal is to recognise and categorise residual spaces in a more holistic manner, by taking into account their spatial, socio-economic, and perceptual factors.

1.2 RESEARCH QUESTIONS

This research is structured into three primary sections – *Past*, *Present*, and *Future* – which are interconnected through direct or mutual relationships (Figure 4). Each study section is dedicated to specific overarching research questions and sub-questions aimed at exploring the emergence of residual spaces beneath elevated transport infrastructures within the London’s urban setting and, more broadly, within cities worldwide. Additionally, the last section delves into the potential to strategically regenerate residual urban spaces. These inquiries are individually tackled in the four empirical chapters (Chapters 4,5,6,7), as illustrated in Figure 4.

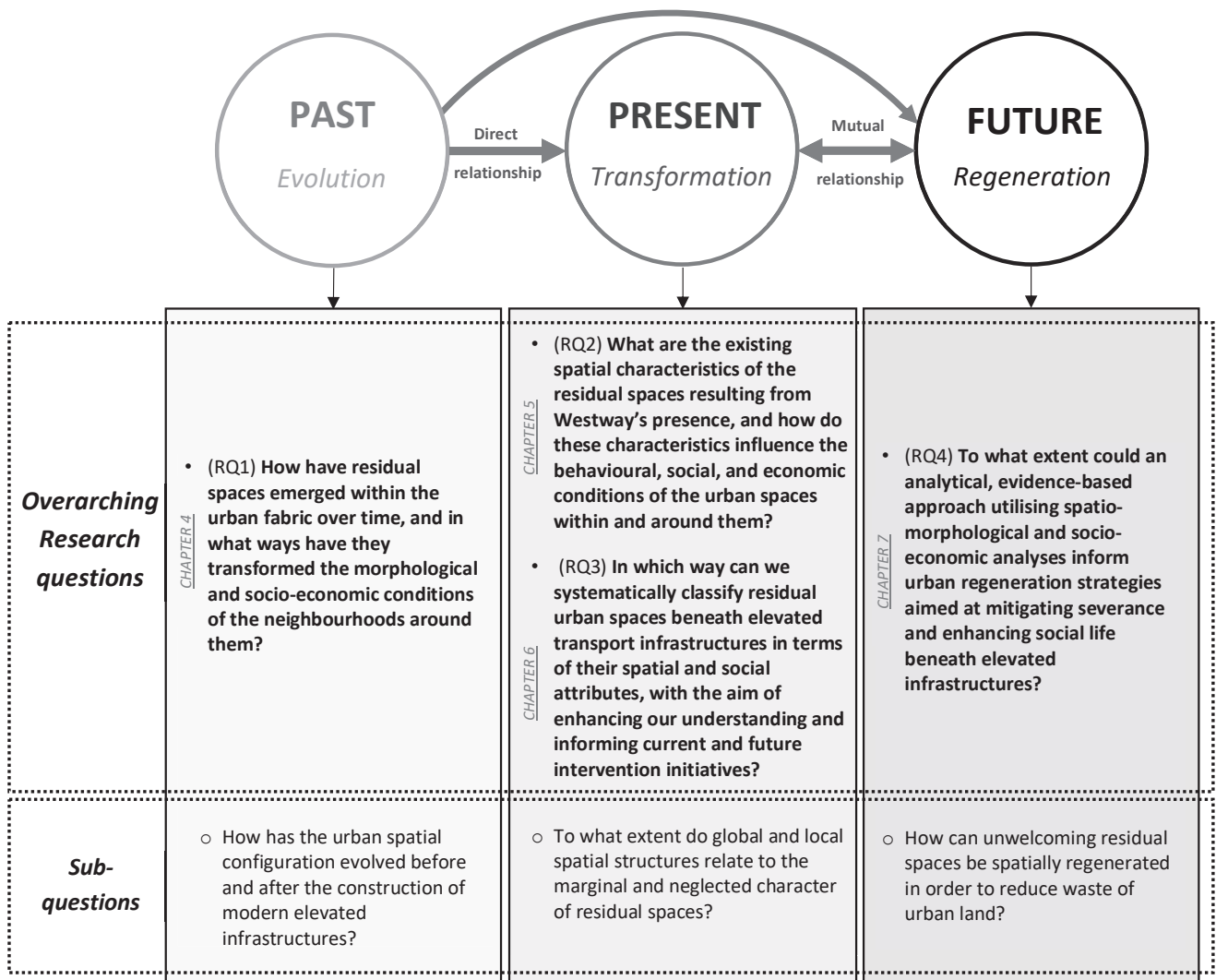


Figure 4. Overview of Research Questions for each study section.

PAST-Evolution

The first overarching question (RQ1) addressed in this research is:

- *How have residual spaces emerged within the urban fabric across time, and in what ways have they transformed the morphological and socio-economic conditions of the neighbourhoods around them?*

In order to answer this inquiry, it is essential to develop a conceptual framework for investigating the evolution of the spatial configuration of London before and after the construction of the Westway which occurred between 1964 and 1970 (Wall, 2011). Hence, creating a spatial model representing the configurational network before and after this period is necessary to properly comprehend how the London system has evolved over the years.

PRESENT-Transformation

The second part of this study focuses on the analysis of the transformations occurred in the current spatial and socio-economic context. Additionally, this section establishes a *Residuality Assessment Process* aiming to categorise residual areas. The inquired research questions (RQ2, RQ3) are the following:

- *What are the existing spatial characteristics of the residual spaces resulting from Westway's presence, and how do these characteristics influence the behavioural, social, and economic conditions of the urban spaces within and around them?*
- *In which way can we systematically classify residual urban spaces beneath elevated transport infrastructures in terms of their spatial and social attributes, with the aim of enhancing our understanding and informing current and future intervention initiatives?*

These questions will serve as the foundation for conducting the majority of conventional and Space Syntax analyses presented in Chapter 5. The assumptions connected to these enquiries posit that both the spatial and socio-economic conditions of the city affect the emergence of residual spaces within the London study site and, more broadly, in contemporary cities.

FUTURE-Regeneration

The final research question (RQ4), featured in the last *future* section of study, stands as follows:

- *To what extent could an analytical, evidence-based approach utilising spatio-morphological and socio-economic analyses inform urban regeneration strategies*

aimed at mitigating severance and enhancing social life beneath elevated infrastructures?

This enquiry is explored in Chapter 7, through an evaluation of potential design proposals aimed at spatially and socially enhancing residual spaces in London. One of the underlying hypotheses is that improvements in future spatial-visual, functional, and environmental conditions could lead to increased utilisation of residual areas beneath motorways, thereby alleviating severance or social inequality issues.

1.3 HYPOTHESES

This work is grounded on a comprehensive literature review, which provides evidence on how urbanisation and modernisation processes have contributed to the emergence of residual spaces (Gabbianelli, 2017). These transformations have led to urban expansion, dismissal of a multitude of areas within cities, and the establishment of spatial as well as social divisions in proximity of modern transport infrastructures (*Figure 6*, top). This in turn, has affected the quality of urban spaces, the social well-being of local communities, and their interaction patterns. However, theoretical perspectives suggest that these overlooked areas can be regenerated through spatial and social redevelopment interventions, counteracting the factors that led to the establishment of neglected and underutilised settings, thereby rediscovering the importance of the public environment as a social and physical space (Hillier & Hanson, 1984; Trancik, 1986)(*Figure 6*, bottom).

Building on these initial theoretical foundations, the study defined five hypotheses linked to the above-presented research questions, which are summarised as follows:

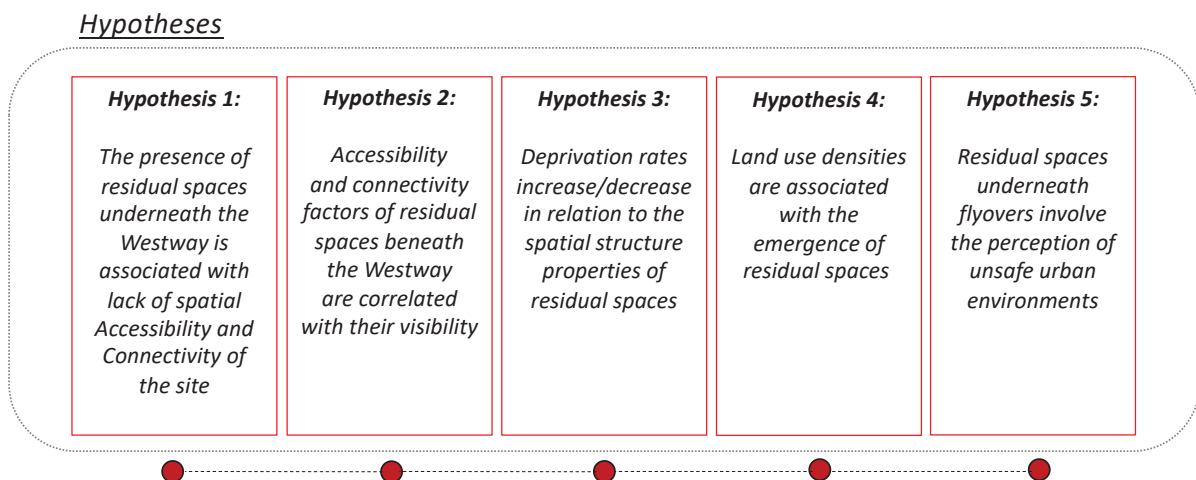


Figure 5. Key Hypotheses of the study.

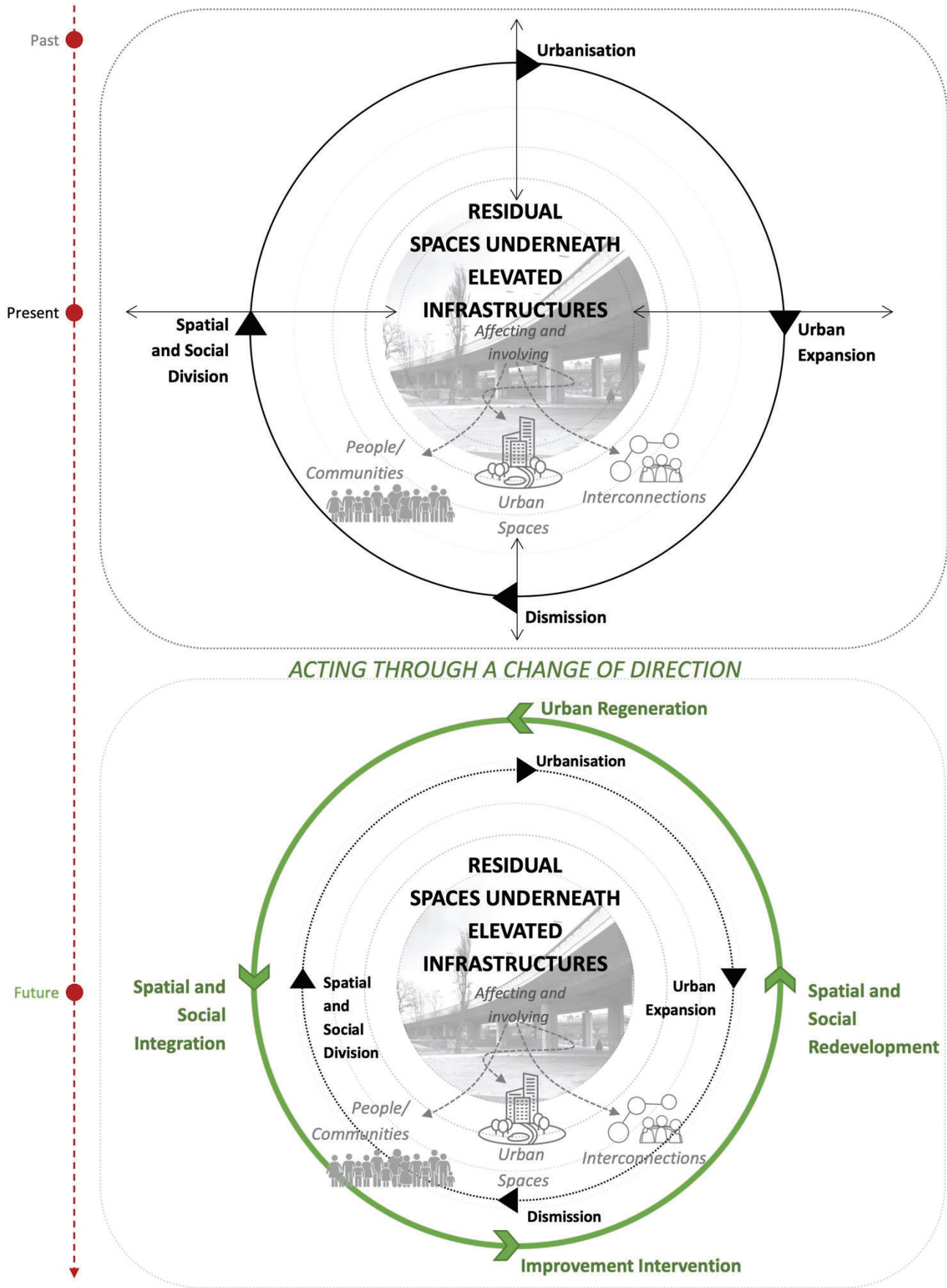


Figure 6. Interpretation of literature's hypothesis by author.

1.4 SIGNIFICANCE OF THE STUDY

This study attempts to fill the gap in the existing literature concerning the investigation of residual areas within modern urban environments. Prior research has explored the concept of neglected spaces and the challenges posed by “*leftover unstructured landscape*” in today’s cities (Trancik, 1986, p. 3). However, these studies have adopted a predominantly discursive and subjective examination approach, potentially resulting in a lack of comprehensive and accurate definitions of this urban phenomenon. Thus, this research seeks to offer a more analytical and objective system for addressing overlooked spaces minimising assumptions and biases, and scrutinising the urban space in direct connection with people and users (Karimi, 2012). An initial systematic methodology is presented for identifying or categorising residual spaces through an evidence-based approach. This offers a valuable opportunity to critically and broadly examine how certain physical spaces impact social structures, aligning with Hillier and Hanson’s theories (1984). Specifically, through the establishment of various parameters to categorise residual spaces, a more in-depth research framework is defined for exploring this topic. By dissecting spatio-configurational, socio-economic, and perceptual factors using a space syntax approach, a quantifiable degree of residuality can be attributed. The analysis outcomes could subsequently inform future regeneration plans to effectively reintegrate residual areas into the broader urban context. In this regard, the study could potentially offer contribution to design processes by enhancing our understanding of urban spaces and providing an efficient analytical framework to evaluate the impact of design changes on public spaces’ “residuality”.

1.5 DISSERTATION OVERVIEW

This paragraph offers a summary of the dissertation’s structure. **Chapter 1** introduces the main research topic by providing a contextual framework that includes the background, hypothesis, and research questions. In **Chapter 2**, a literature review explores the definition of key-concepts upon which this research is built. **Chapter 3** outlines the methodological framework employed throughout the study, describing the data sources and the objectives of each specific analysis. **Chapter 4** focuses on the “*PAST*” section where Space Syntax and socio-economic analyses are employed. **Chapter 5** regards the “*PRESENT*” study section including all the quantitative and qualitative analyses performed, along with their results. **Chapter 6** concerns the categorisation methodology of residual spaces. **Chapter 7** revolves around the “*FUTURE*” section displaying potential design proposals. Finally, **Chapter 8** discusses the achieved outcomes, defining an overarching conclusion on the investigated topic.

LITERATURE
REVIEW

II



Chapter 2

2. LITERATURE REVIEW

2.1 INTRODUCTION

This chapter outlines the main topics of this research, laying the theoretical ground for a better understanding of “residual spaces”. A wide context of literature, composing a *conceptual framework* which connects spatial and socio-economic factors, is used to scrutinise how residual spaces generally emerge within urban systems, and how their presence interconnect with adverse spatial, and social aspects such as segregation and inequality phenomena. Starting from the notion that the physical dimension of a city embodies a “*complex pattern of space*” where various social activities unfold (Hillier & Vaughan, 2007, p. 206), it becomes crucial to explore the residuality concept in association with its surrounding urban scene. This entails a comprehensive examination of its socio-spatial challenges and opportunities. In this regard, it is essential to acknowledge the potential of regeneration processes as proposed by numerous scholars, which can expand the realm of possibilities associated with neglected sites, offering fertile ground for human creativity (Villagomez, 2010).

The following literature review is divided into seven parts, each highlighting a specific and relevant aspect of the research. Section 2.2 explores the meaning of “*residual space*” as defined by different academics in the field, while the following section 2.3 discusses the concept of public spaces according to *Space Syntax* theories. Then, section 2.4 describes the impact of modern highways on the existing urban fabric and the consequent spatial and social transformations. Paragraph 2.5 examines *community severance* as an effect of the creation of transport infrastructures underneath where residual areas tend to emerge. Subsequently, section 2.6 discusses different forms of *inequalities* occurring in cities, with a specific emphasis on defined groups of people. Section 2.7 addresses potential regeneration plans for neglected urban areas. Finally, section 2.8 concludes the argumentation by summarising the key points drawn from literature that inform the study.

2.2 DEFINITION OF “RESIDUAL SPACES”

The definition of *residual urban space* comes from the combination of the Latin term “*residuus*”, which means “*residual*”, with the concept of “*urban space*” (Gabbianelli, 2017, p. 42). As a result, we obtain a compound term that refers to the tangible and intangible qualities of some specific portions of the urban fabric (Lauria & Vessella, 2021). More specifically, these

places are considered the result of numerous processes occurring within the complex and dynamic urban system (Roberts et al., 2016). They exhibit a deficiency in attributes and fail to provide the city's inhabitants with opportunities and amenities that other urban spaces can offer. Additionally, residual urban spaces can be defined differently in relation to their inner characteristics. Terms commonly used in literature are: "derelict lands", "dead zones", "wastelands", "in-between spaces", "terrain vague", "no-man's lands", "vacant lands", etc. (Barron & Mariani, 2013, p. 3; Lauria & Vessella, 2021, p. 27) (Figure 7).

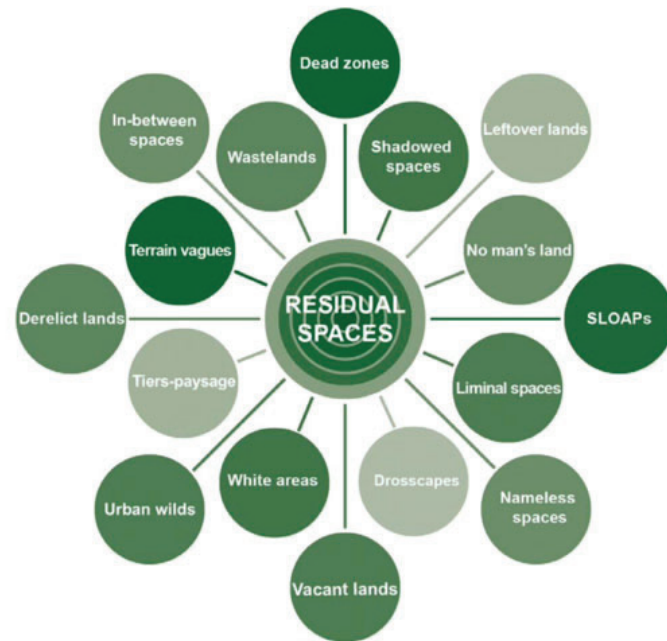


Figure 7. Terms used in literature to define residual spaces. Source: Lauria & Vessella, 2021, p.28.

Scholars have developed different terminologies to identify these overlooked places, primarily referring to their physical and usage qualities, as well as their aspect. According to Wall (2011), left-over spaces are disconnected from the surrounding urban network creating "unattractive isolated islands in the city" (p.147). This highlights the spatial inadequacies frequently found in these sites. For Lauria and Vessella (2021) "residual spaces are often the carpets under which the city hides the physical and existential dross it produces incessantly" (p. 30), referring to the complex nature of these often forgotten and underutilised places. Similarly, Gabbianelli (2017) defines them as "spatial pauses" (p.19) within the structured contemporary city, signifying more than simply physical settings, but also urban realities entailing emotional and perceptual engagement.

Additionally, Villagomez (2010) identifies eight different typologies of residual spaces resulting from urban actions (see Figure 8) occurring over time and forming disregarded urban areas which may vary in their size, shape and activities. Among the classified typologies, Villagomez

pinpoints the so-called “*spaces below*”, originated underneath large infrastructural elements such as highways overpasses and elevated railways. These places, are often left in a state of decay, resulting in the form of neglected spaces often used as storage or parking sites. However, Villagomez (op. cit., 2010) argues that by understanding the potential use of residual areas, one may delineate reintegration strategies, thereby converting them into welcoming, meaningful, and useful public areas that enhance the inclusivity and liveability of our cityscapes.

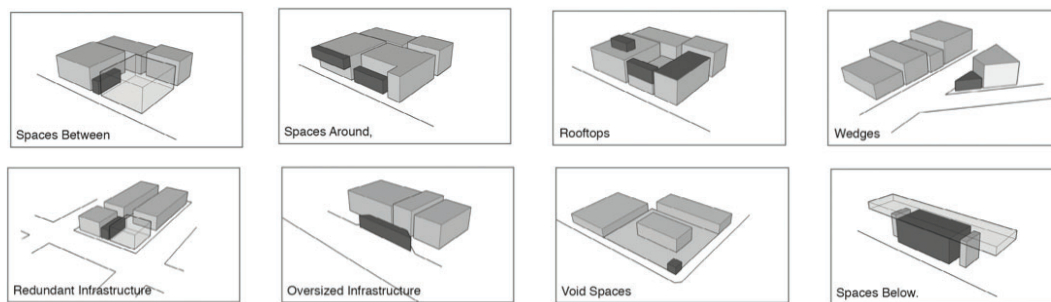


Figure 8. Typologies of urban residual spaces. Source: Villagomez, 2010, p. 84.

In this context, Trancik (1986) describes modern cities, primarily referring to American and European urban scenarios, as places where a vast amount of vacant and unused land has emerged over the last five decades. These areas, also defined as “*antispace*” (op. cit., 1986, p. 4), are scattered throughout the urban environment in the form of abandoned sites along freeway edges. These “*lost spaces*” (op. cit., 1986, p. 3) can be vacant military areas, train yards, or relocated industrial complexes, also referred to as “*residual areas*” (op. cit, 1986, p. 3). Additionally, according to Trancik (1986), they lack clear definition, measurable boundaries, and fail to effectively establish coherent connections between urban elements.

2.3 SPACE SYNTAX THEORIES ON PUBLIC SPACES

Hillier and Hanson (1984) state that most urban settlements seem to be made up of the aggregation of open public spaces, such as streets, alleys, squares, which create a continuous system. The configuration of these open space systems, define the individual experience of a specific settlement. Hence, this involves the consequent perception of individuals while being in a precise urban environment.

In this regard, Monokrousou and Giannapoulou (2016) argue that public spaces constitute an essential role in the structure of a city, providing a source for quality and sustainability of life. Hence, one of the biggest challenges for urban planners and designers has always been to create quality and sustainable urban environments, aiming to promote pedestrian movement

and limit the excessive use of automobiles. In this context, it is important to consider that pedestrian movement is deeply interconnected with the urban layout and that human behaviour is influenced by the structure of the urban tissue.

According to Space Syntax theory (Hillier & Hanson, 1984), the syntactic properties of the urban network contribute to interpret and predict densities of pedestrian movement as spatial configuration strongly correlates with pedestrian movement. Therefore, employing a space syntax approach may assist in assessing the accessibility of a particular location while also uncovering the impacts resulting from the arrangement of land uses and activities. Simultaneously, it reveals how pedestrian movement patterns and social structure directly influence spatial organisation.

Accordingly, Hillier et al. (1986) maintain that cities are often considered as a mechanism for generating social contact. However, modern cities are affected by transformation which sometimes seem to keep people apart instead of supporting human contact. In their study, the authors employed space syntax method to demonstrate that successfully designed urban environments have the potential to generate life encouraging social encounters and co-presence. This, in turn, leads to subsequent remarkable and beneficial social effects within public urban spaces.

2.4 ELEVATED HIGHWAYS AND URBAN TRANSFORMATION

Starting from the 1950s onwards, the progressive and technologically advanced approach along with the technically innovative methods of construction improved following modernist visions of the time (Robertson, 2007). According to Robertson (2007), this approach alongside the increasing idea of the urban environment as a site of auto-mobility, conducted to the construction of elevated urban highways which transformed the built environments, so reshaping their structure into modernist urban systems. The vision of urban mobility and the idea of urban highways have roots in America dating back to the twentieth century. A couple of decades later they landed in London. Here, a two-and-a-half-mile elevated highway known as the *Westway*, devised as one of the major connections in the city, opened in 1970. This motorway links the West End of central London to the A40 route west to Oxford, conceived back to the 1920s by one of the most important British planners of the twentieth century, Patrick Abercrombie. His 1943's London Plan proposed to erect the Westway as one of the radial roads connecting central London with Ringway 1 (Robertson, 2007) (*Figure 9*).

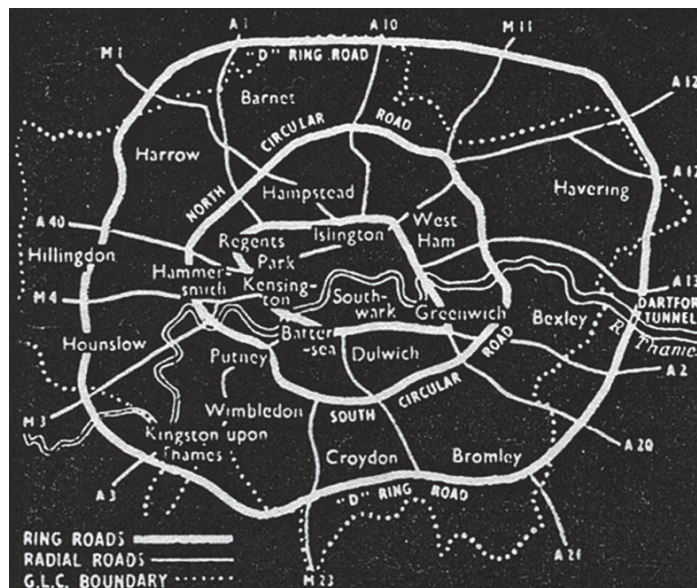


Figure 9. Orbital ringways and radial routes as planned by Abercrombie in 1943. (J.L. Blake, 'London's proposed motorways' *Building*, 11 Sept. 1970, p. 94.)

The Westway, was promoted as the “*Europe’s longest elevated highway*” (Robertson, 2007, p. 78). However, the nature of this modern architecture was criticised because of generating a loss of street life, problematics in segregation of communities, and social isolation (Robertson, 2007, p. 78).

2.5 COMMUNITY SEVERANCE IMPACT

After considering the contribution of various scholars in defining the meaning of residual areas, this section delves into the potential impact of overlooked urban spaces on the emergence of social segregation issues within local communities.

According to Vaughan et al. (2020), *community severance* is commonly connected to the presence of public roads or rail infrastructures, which may interfere with individuals’ ability to access goods, services, and social systems. Such physical barriers seem to reduce pedestrian activity as well as the pleasantness and safety perception of walking and cycling within these urban spaces. Additionally, Vaughan et al. (2020) state that similar city environments may increase injury risk and present adverse air and noise pollution conditions, leading to reduced physical mobility and social activity. This also includes affecting people’s aptitude to make social ties, reducing individuals’ physical movement and children’s play, and lowering the accessibility to goods and services (Vaughan et al., 2020).

Mindell and Kerlsen (2012) claim that there is empirical evidence demonstrating the adverse impact that *transport infrastructures* and their associated activity play on both physical and

social aspects. Roads spatially divide urban fabrics, often leading to pedestrians avoiding certain routes and services to be underutilised. Furthermore, the authors discuss that road transport often overlooks significant aspects such as social networks among local residents and the freedom of pedestrian mobility. Additionally, Mindell and Kerlsen (2012) state that it is important to take into account how people living on streets with major traffic and no trees, no pavement, or no shops, perceived their neighbourhood as less attractive and safe.

As Vaughan (2015) asserts, architecture and urban design play a crucial role in the establishment of segregation issues. Following relevant empirical studies, the author argues that a relation between urban form and severance seems to be acknowledged. Hence, certain spatial configurations might be associated with human co-presence and segregation aspects. In this regard, according to space syntax theory, space is not a neutral background for social and cultural processes, but rather is assumed to have an intrinsic social logic (Hillier & Hanson, 1984). As Hillier and Hanson (1984) maintain, the spatial configuration of buildings and cities directly influence social life and relations.

In this context, public spaces can be seen as key areas that should be designed to enable social interactions and connections among people, promoting movement and co-presence, rather than inhibiting such practices (Vaughan, 2015). To this end, the research has shown that there is a relationship between *physical segregation* and *social marginalisation*. Hence, everyday activities taking place in public areas embody a significant factor for reducing urban segregation. In conclusion, gaining an understanding of the factors contributing to socio-spatial division within urban settings can provide valuable insights for improving urban systems and shaping more welcoming and liveable public spaces for nearby communities.

2.6 INEQUALITIES WITHIN URBAN ENVIRONMENTS

This part of the literature seeks to shed light on how poorly or inadequately designed and maintained urban spaces may represent a source of social discrimination enforcing community division and social differentiation. A crucial factor in this study is represented by the *inequalities* that seem to be experienced by diverse groups in specific urban places. This aspect affects the way people perceive and experience urban settings, sometimes even jeopardising groups like feminine or children. For instance, similar inequalities may be recognised within what scholars define “*residual spaces*” (Gabbianelli, 2017, p. 11; Villagomez, 2010, p. 82).

In this regard, Bondi and Domosh (1998) describe how the presence or absence of certain individuals such as women on the streets, is often connected with the perception that female people have of the surrounding urban space and the way they experience the public environment they live in. Bondi and Domosh (1998) refer to the concept of “*gendered and*

classed” spaces (p. 279), where inequalities may persist over time affecting the way people use, perceive, and behave in public urban areas at specific times of the day. As a result, defined categories of people may feel their personal safety threatened by spatial design standards and maintenance deficiency. The authors argue that streets and public spaces should support egalitarianism instead of encouraging inequalities and marginalisation of individuals such as women, children, and old people. Finally, Bondi and Domosh (1998) claim that modern cities should reinforce attention to these themes, transform urban environments into more sensitive settings, and enhance more freedom and accessibility for all users.

Accordingly, Kern (2021) portrays how nowadays cities and urban spaces demarcate inequalities for various groups such as women, children, or even disabled people, challenging their way of fully inhabiting and making use of the built environment, which is supposedly shaped to welcome every single person. The author shows how urban settings may have a large impact on people’s daily social life due to white male-focused stereotypes characterising the public sphere. This could lead several individuals to experience a sense of *fear, inadequacy, hostility* and in some cases, even *harassment*. Hence, it is important to understand which are the factors causing such discrimination in order to improve our cities at different scales.

On this matter, Borden et al. (2002) argue that public spaces could demonstrate both physical and cultural barriers excluding certain groups from the public sphere, restricting their lives primarily to the domestic space. To this end, the authors assert that interventions addressed to public places are needed in order to claim spaces where the safety and accessibility all individuals would be environmentally supported.

2.7 RESIDUAL SPACES AND REGENERATION PLANS

The ongoing expansion of urban areas, both spatially and demographically, underscores the necessity of optimising the use of existing residual spaces, positively impacting the entire urban system and its communities . In this regard, urban regeneration processes can be considered as the response to the challenging circumstances occurring in a given urban organism, involving the improvement of physical, socio-economic, and environmental conditions (Roberts et al., 2016). Azhar and Gjerde (2016) state that *urban regeneration initiatives* can harness leftover spaces to enhance the overall quality of the urban landscape and generate meaningful environmental benefits. Accordingly, they (op. cit., 2016) focus on regeneration processes arguing that different forms of leftover spaces are spread around cities and each of them has the “*potential to become a stepping stone for nature to flourish*” (p. 2). This refers to the fact that even small alterations within the urban fabric may lead to noteworthy and sustainable transformations in a city.

As Della Spina et al. (2017) argue, the formulation of strategies centred on regenerating abandoned urban areas offers the prospect of creating new opportunities for the city. The evaluation of tactical and potential urban transformation scenarios as part of a decision-making strategy, needs to be properly considered within a comprehensive evaluation framework. This ensures that the impact of analyses and choices aligns with the improvement of a certain place. As the authors (2017) assert, contemporary circumstances necessitate adequate tools and strategies for evaluating transformation projects as an integral phase of problem-solving programs and interventions projects. This approach entails identifying a range of possible solutions and predicting the prospective effects across diverse development scenarios.

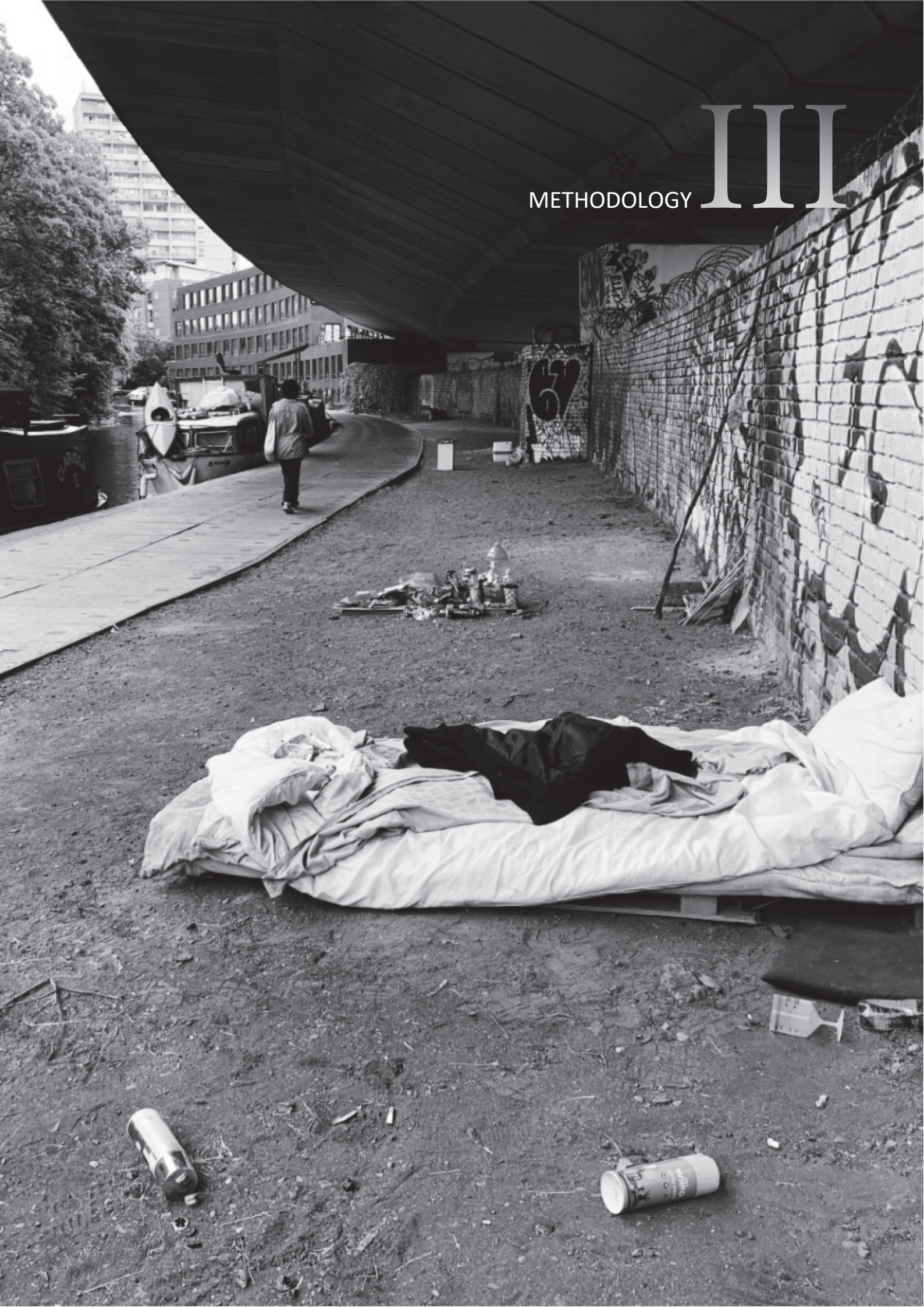
2.8 CONCLUSION

The concept of “Residual spaces” has been investigated by numerous scholars and associated with the rapid urbanisation and modernisation processes observed in recent centuries worldwide. In this regard, the intricate evolution of urban structures has led to the appearance of different typologies of neglected areas. For instance, according to the literature, highways and railways have contributed to the emergence of residual urban areas underneath their elevated sections. The research also suggests that these modern transportation infrastructures as well as the annexed overlooked spaces often act as a physical barrier that hinder *community bonding* actions. As a consequence, the adverse spatial and social conditions in cities like London generally lead to community segregation issues, exacerbate social inequalities among local communities, and disrupt human connections.

Additionally, scholars have argued that various factors generally contribute to adverse perceptions of certain urban environments such as residual places. For example, specific spatial configurations significantly influence the sense of safety when occupying these areas and consequently impact their usage patterns. Hence, inadequately planned urban systems, absence of economic activity, limited land-use diversity, lack of accessibility, and insufficient maintenance all appear contributing to the reduced consideration and undesirable perception of these spaces.

In summary, extensive literature published in recent decades has aimed to deepen our understanding of residual areas, leading to a diverse range of descriptions and recommendations intended to address the above mentioned spatial and social issues. Ultimately, the presented theoretical framework has suggested regeneration proposals and renewal guidelines, demonstrating the possibility of improving the current conditions of numerous residual areas within our urban environments.

METHODOLOGY III



Chapter 3

3. METHODOLOGY

3.1 INTRODUCTION

This research aims to define a better spatial, socio-economic, and perceptual understanding of the concept of “*residual space*”. This chapter describes the tools, methodology and components involved in the current study. The ultimate purpose of the structured analytical system is to identify relevant socio-spatial factors influencing the emergence of residual spaces in the contemporary city and, at the same time, examine the aspects contributing to the undesirable perception often associated with these areas. Moreover, urban regeneration strategies are discussed through the exploration of their potentials in instances of residual spaces. As a result, useful guidelines are drawn towards the mitigation of spatial isolation and social inequalities responsible for the exclusion of diverse individuals within unattractive residual environments.

The applied methodological framework sets the overall structure of this study. Quantitative analyses and qualitative observations are employed to evaluate in a comprehensive methodology both spatial and social factors involved in the assessment of residuality conditions. Specifically, this research project approaches the topic of *residual spaces* from two main perspectives. On one hand, it investigates more *quantitatively* the present and past spatial configuration of the London urban environment, assessing the evolution of the spatial structure occurred over time, which led to the establishment of overlooked flyover areas. On the other hand, it explores the *perceptual* dimension of residual spaces by estimating how people inhabit and experience these places through the collection of questionnaire’s responses.

3.2 METHODOLOGICAL FRAMEWORK

A methodological framework has been developed, as depicted in the *Figure 10*. This analytical structure defines the analyses, data sources, analysis units, and expected outputs for each of the identified research questions, providing an overview of the entire study process developed in the following chapters.

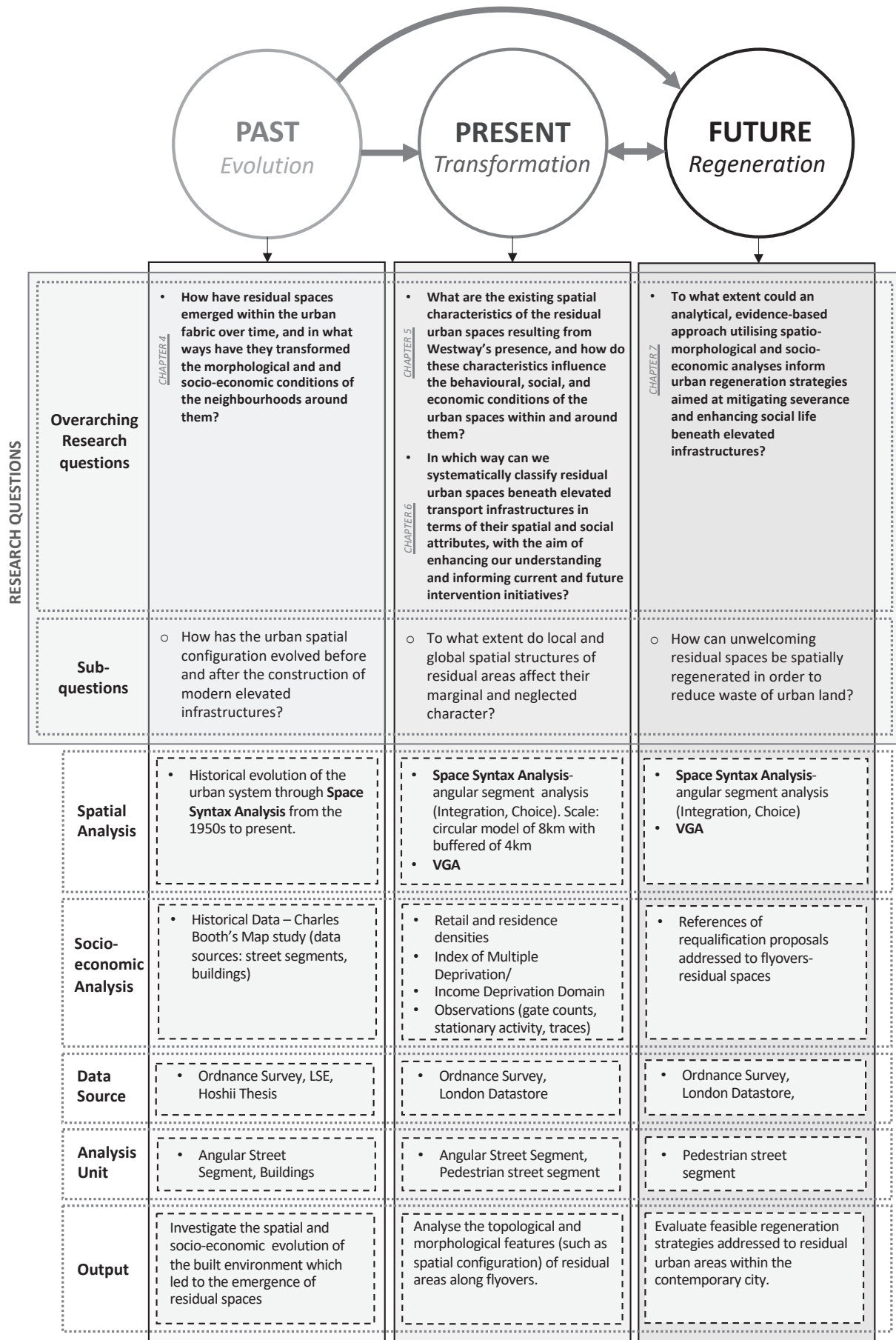


Figure 10. Methodological framework.

The above-mentioned analyses and methods composing the overall methodological framework of this study, are employed to address all the research questions. These enquires are closely linked to the hypotheses outlined in *Figure 11*, along with the corresponding analytical methods used to validate these assumptions.

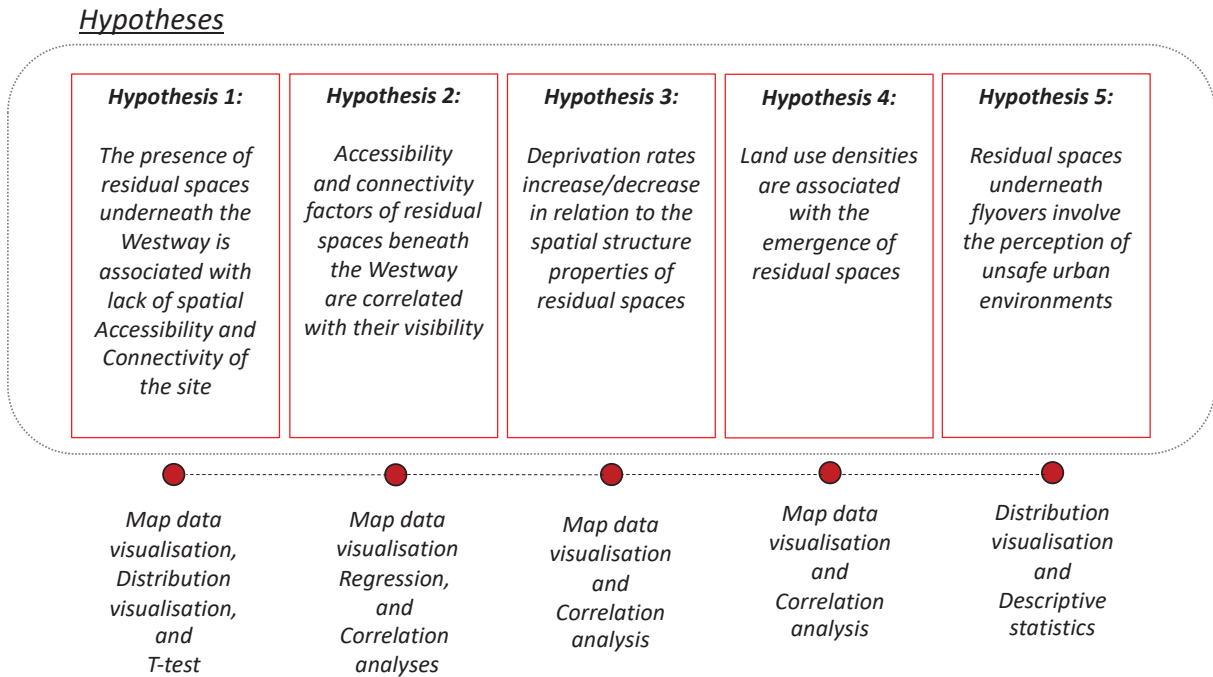


Figure 11. Hypotheses and methods.

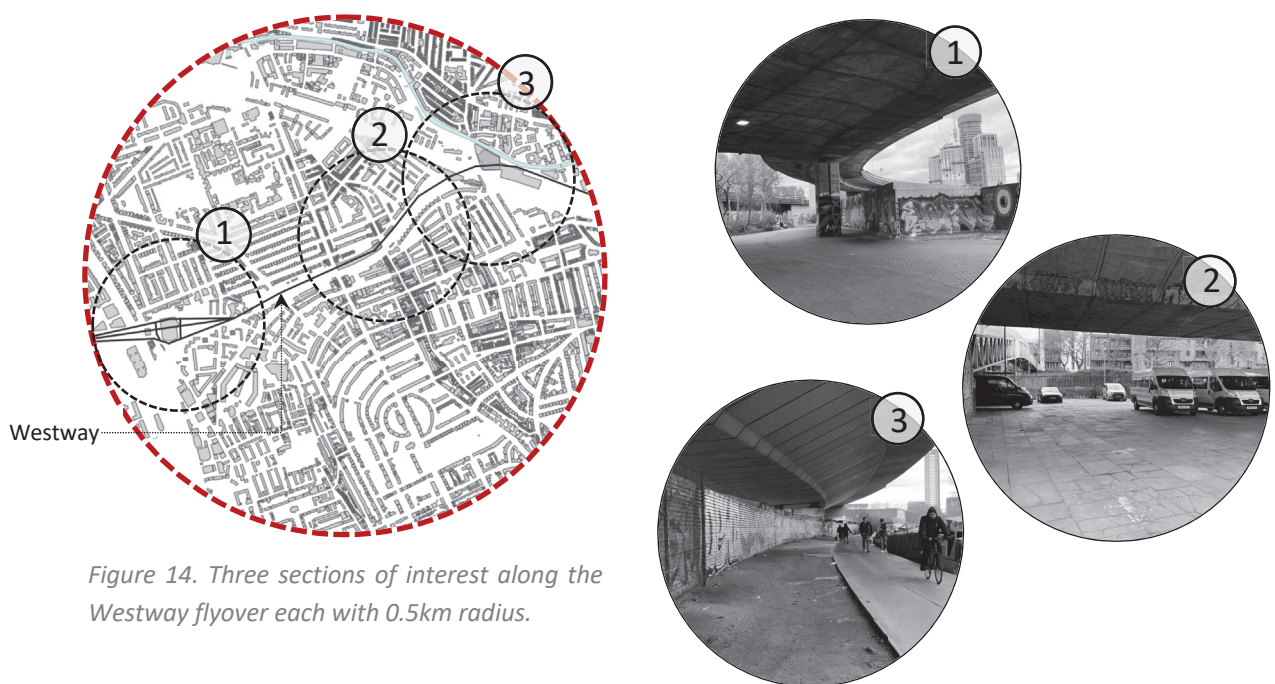
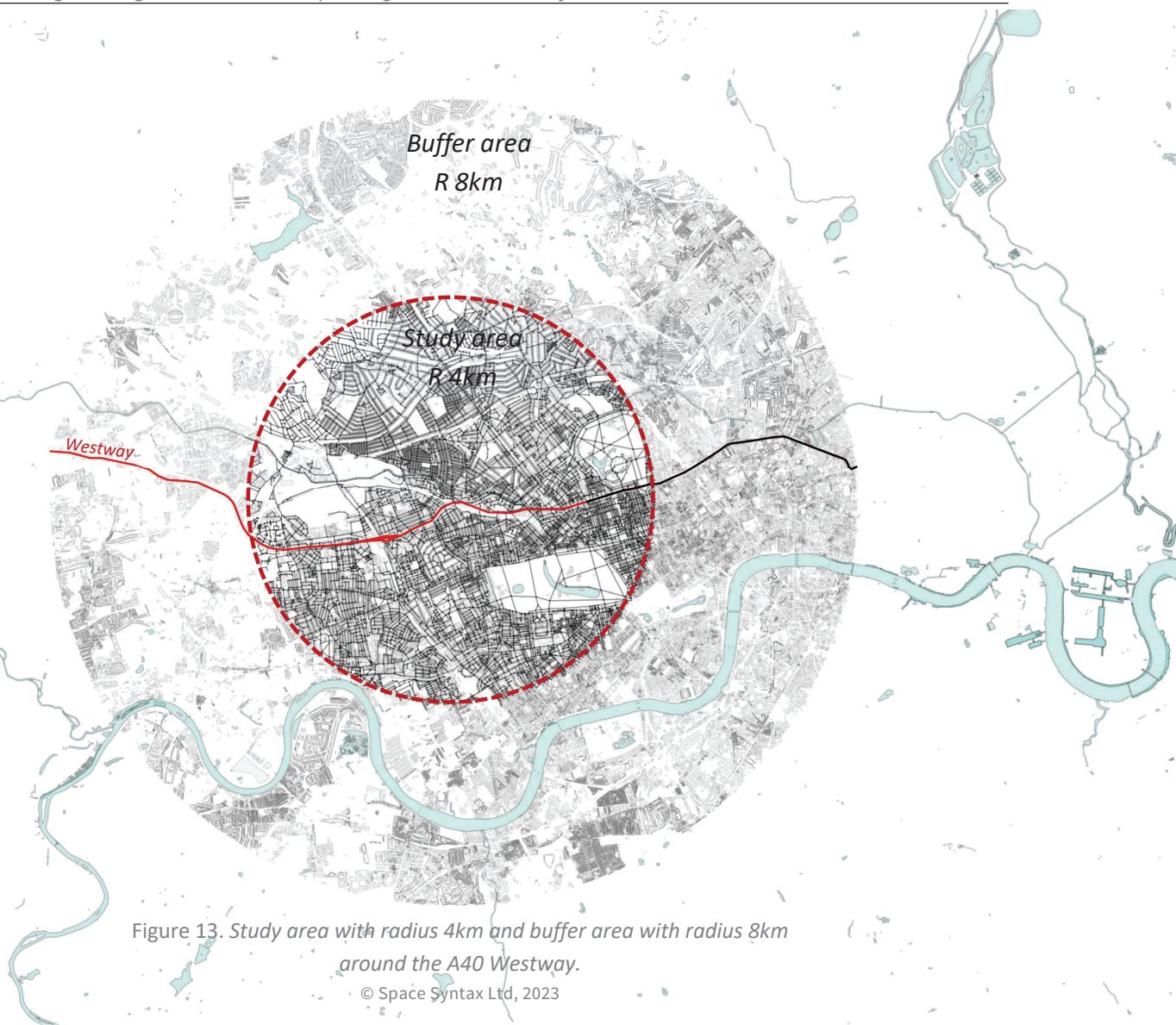
3.3 CASE SELECTION

The initial stage of the methodology involves defining the case study area by conducting a thorough evaluation of the concept of “residual space”. This process is accomplished by critically reviewing relevant literature and establishing connections with key features revealing residuality conditions within an urban system. Specifically, this phase delves into the interpretation of various scholars’ descriptions and narratives. As a result, this textual examination offers comprehensive insights into the nuances associated with the notion of “*residuality*”, used to identify and localise specific residual spaces in London.

Building upon this theoretical approach and the subsequent observational phase, the selection of the case study area was centred on neglected spaces situated underneath the *Westway*, which is a 4-kilometres elevated highway connecting the centre of London to the route leading to Oxford (Robertson, 2007). The research considers an area with a 4km radius, along with a buffer zone of 8km (*Figure 12*). Within this designated region, three distinct sections alongside the flyover region have been pinpointed (*Figure 14*). These spaces exhibit differences in terms of spatial configurations and socio-economic attributes, as will be further explored in subsequent sections. The aim of this work is to assess and compare all the relevant features of these three flyover sections through a more objective and quantitative approach, to acquire a comprehensive understanding of their intrinsic nature.



Figure 12. Localisation of study area within London.



3.4 OBJECTIVE DATA COLLECTION

3.4.1 Spatial Analysis

This part of the methodology evaluates the morphologic configuration and topological features of residual areas detected underneath the Westway in London, considering two main crucial time periods, namely 1950s and 2020s, before and after the construction of the motorway. This initial spatial investigation examines *how residual spaces have emerged within the urban fabric over time, and in what ways they have transformed the morphological and socio-economic conditions of the neighbourhoods around them*. At the same time, this phase enquires to *what extent the local spatial structure interplays with the global conformation, and how these factors affect the formation of residual spaces and their current usage*. Specifically, spatial network analysis are built upon *Space Syntax* theories and techniques, originally developed by Bill Hillier jointly with Julienne Hanson and the Space Syntax Lab at the Bartlett School of Architecture, UCL, in the late 1970s (Hillier & Hanson, 1984).

The analyses conducted include a first data mapping step on a QGIS platform and subsequent statistical evaluation on the SPSS software. *Angular segment analysis* which uses geometric distance such as angular distance, is chosen for this study. The vectorised road centre line representing the 1950s context is processed by the author through geo-referenced historical imagery acquired from *OS Mastermap*, which have been combined on QGIS and used for the construction of the historical spatial model. On the other hand, the 2020s segment model has been provided by the Space Syntax Lab and generated from the M25 road centre line map of London. Both models serve as the foundation for most of the examinations conducted in this study.

More in detail, the space syntax analysis examines two key properties of the spatial network, which are angular *Integration* and *Choice*. Integration, also known as “closeness centrality”, measures the potential *to-movement* of a space, indicating the depth value of a space from all other spaces, representing the potential of an area to become a destination within the spatial network (Hillier, 1996). Choice, or “betweenness centrality”, assesses the potential *through-movement*, reflecting how frequently certain paths are most likely to be chosen as part of a route between spaces (Hillier, 2012). These properties can be expressed, respectively, through *Connectivity* measuring “normalised angular integration” (NAIN), and through *Accessibility* measuring “normalised angular choice” (NACH) (Hillier et al., 2012; Van Nes & Yamu, 2021).

These measures are analysed at different radii – 400m, 800m, 1600, and 4000m for global scale, using the *Space Syntax toolkit*, which constitutes a QGIS plug-in capable of supporting the verification and study of the spatial network models. All the spatial data obtained through the analysis was normalised for ease of comprehension and to enable comparison of city’s

components, as supported by Hillier et al. (2012). The normalised angular integration and choice measures known as NAIN and NACH for a radius r , are the result of a normalisation procedure resulting from the following formulas (Hillier et al., 2012, p. 191; Yamu et al., 2021, p. 79):

- $NACH = \log(\text{Choice}(r)+1) / \log(\text{Total depth}(r)+3)$
- $NAIN = \text{Node Count}(r)^{1.2} / \text{Total depth}(r)+2$

The determination of metric radii has been selected in relation to real-life phenomena such as walking time distance (e.g. a 5-minute walk can be approximated with a metric radius of 400 metres, which is the radius chosen for the local scale). The rest of the radii, although used in the investigation process, has been intentionally left out of the presented analysis as their outcomes are not considered relevant for this specific research.

Additionally, a *pedestrian movement modelling* for each of the three chosen study areas has been created by the author in QGIS. This methodology considers the pedestrian movement model as an integral component of the research. In fact, it contributes to evaluate the spatial variables connected with the urban network structure, predicting the distribution of spatial movement of people in the city, based on its street network (Lerman et al., 2014). As for the vehicular segment model, the *Space Syntax methodology* (Hillier, 1996) is used to examine the pedestrian movement. More in detail, pedestrian movement analysis has been employed to provide insight into the spatial Connectivity and Accessibility of the three study areas, through normalised Integration and Choice measures considering, for each study area, a radius of 0.5km. Through the application of a space syntax approach, it becomes possible to assess the walkability of different areas gaining an understanding of how spaces are utilised in accordance with pedestrian flows. This valuable information sheds light on the dynamic interplay between the built environment and human behaviour, thereby aiding in the design of more pedestrian-friendly, accessible, and inclusive urban spaces.

In summary, the examination of spatial-configurational aspects enables the assessment of both vehicular and pedestrian movement patterns within residual urban spaces by applying topological-visual analysis of the built environment (Hillier et al., 1993).

3.4.2 Socio-economic Analysis

The defined methodology involves gaining socio-economic data from different databases, which is then pre-processed and organised before being imported into QGIS. These socio-economic datasets encompass Deprivation open data sourced from the *Department for Communities and Local Government* platform. More specifically, the *Index of Multiple Deprivation (IMD)* dataset is initially joined with the LSOA 2021 census boundaries. Later, the

values are distributed along the segment model (road centre line model) by applying the spatial join in QGIS between the segment model itself and the LSOA layer. The maps produced through this procedure visualise the data using a colour gradient, showing the spatial distribution of deprivation in connection to its geographic location. The same procedure is applied for diverse deprivation domains comprehended in the Index of Multiple Deprivation (IDM). Among them, the *Income deprivation domain* (IDD), measuring the level of economic disadvantage or lack of financial resources experienced by a given population.

Furthermore, the assessment of *socio-economic factors* encompasses an analysis of *retail and residence density*. This examination is conducted to gather relevant insights into how the presence or absence of land use differentiation in the areas surrounding the Westway influences the formation of residual spaces. In this regard, Hillier (1996) argues that in an urban environment the distribution of land uses, such as retail and residence, affects the configuration of urban forms. The author maintains that “*dense patterns of mixed use encounter*” usually lead to “*characterise the spatially successful city*” (Hillier, 1996, p. 6). Conversely, lack of mixed-use might result in the isolation and decline of a place, as estimated for some of the study areas.

3.4.3 Visual Analysis and Visual Correspondence Index

Syntactic methods are used to evaluate the spatial and visual relations that influence the vision and movement of individuals within the designated study areas. Specifically, *visual graph analysis* (VGA), described as a method to evaluate and represent two-dimensional inter-visibility relations in a specific built environment, is employed in the research. Specifically, the diagram values refer to a continuous space discretised into a defined grid. This graph representation visualises and assesses meaningful spatial features and visual relationships that affect movement and social engagement (Varoudis & Psarra, 2014).

Visual graph analysis is obtained using the *DepthmapX* software and subsequently importing the data into QGIS for visualisation purposes. This process also enables to detect patterns of visual connectivity assessing how visual aspects may influence people’s perception of residual areas, both on an eye and knee levels. This visual approach aids to identify trends, anomalies, or relationships that may not be directly apparent through other analytical techniques.

The research, also considers the correlation between visual integration values at knee-level and normalised connectivity values obtained from angular analyses on the pedestrian segment model. This association defines a *Visual Correspondence Index*, utilised as a parameter in the classification framework for residual spaces.

3.4.4 Environmental Condition Analysis

Environmental factors are examined, as they hold the potential to improve future urban conditions and contribute to the enhancement of the overall liveability of residual areas. According to some research conducted by London Air Quality Network (LAQN, 2023), air quality predictions show a significant improvement in the expected future emission of NO₂ by 2030 (Appendix 1). This factor, alongside the rapidly increasing advent and diffusion of electric vehicles, may result in a positive shift from a quite polluted urban environment beneath the currently high-trafficked motorways, to environmentally friendly areas. Consequently, the introduction of facilities such as communal or sport amenities, could ultimately shape welcoming spaces for the entire community.

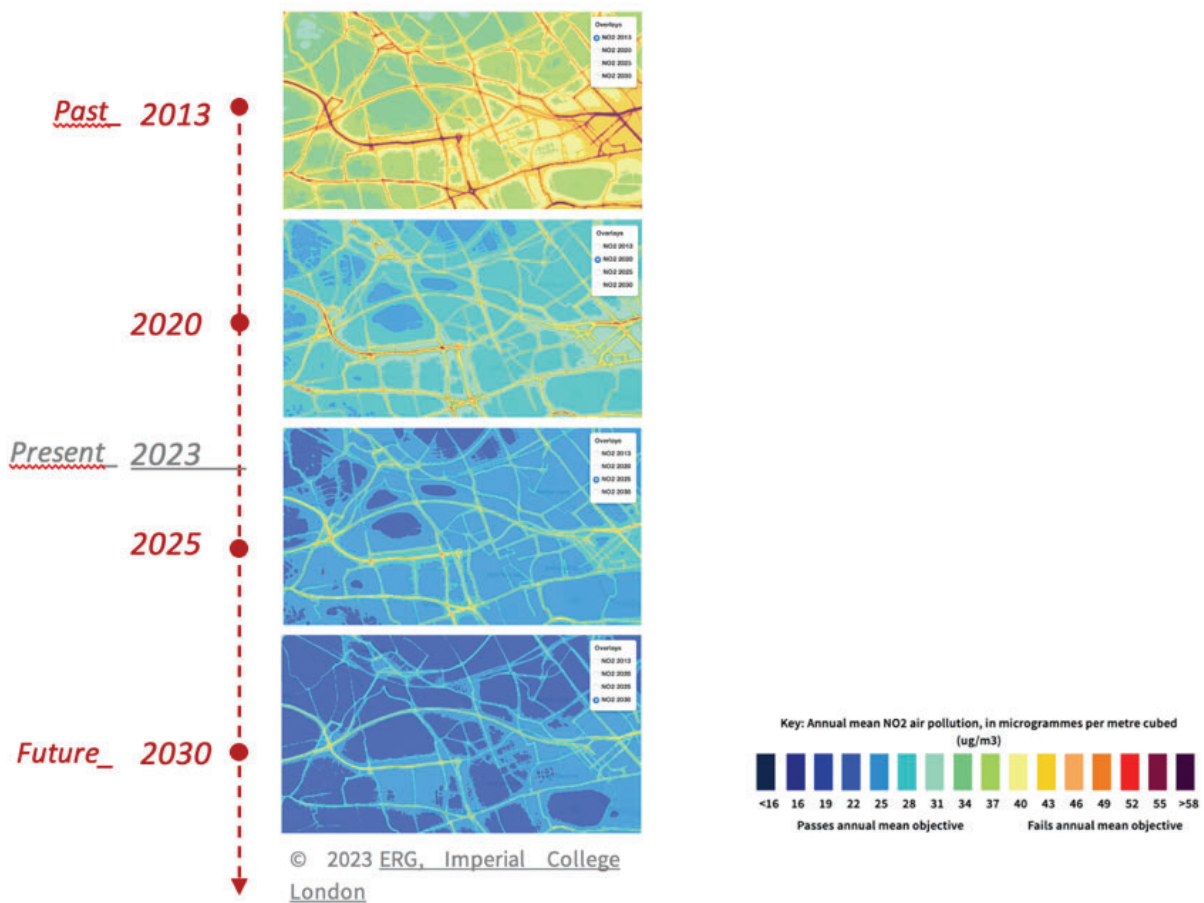


Figure 15. Modelled annual mean Nitrogen Dioxide (NO₂) air pollution for NO₂. Source: London Air. <https://www.londonair.org.uk/london/asp/futuremaps.asp>

3.4.5 Gate Count

The *gate count* is a technique from space syntax literature to examine pedestrian movement and flow within a specific spatial network throughout the day, over a designated period of time. This method involves counting pedestrians passing through defined entrances or “gates”, represented by imaginary screen lines across a street (Sharmin & Kamruzzaman, 2018). This research seeks to examine pedestrian movement in three selected residual areas underneath the Westway in London. Specifically, each site employs a different number of gates:

Area 1: 12 gates

Area 2: 11 gates

Area 3: 1 gate

The observation is conducted for a duration of 5 minutes at each gate. By quantifying pedestrian flows, this method assists in identifying key movement routes and patterns that reveal the current utilisation of residual spaces. The results are later compared with the acquired safety perceptual aspects for broader comprehension. This method also enables an evaluation of how changes in the spatial configuration and visual connectivity factors can influence pedestrian movement activity. Summarising, the gate count technique provides objective data to understand and guide the redesign of these neglected urban spaces, facilitating evidence-based decision-making.

3.4.6 Stationary activity and traces

This research incorporates stationary activity observations, which are regarded as an effective method for capturing and recording diverse stationary behaviours, including social interactions among individuals within a specific space (Yamu et al., 2021). The primary objective is to systematically observe and document the activities taking place in a stationary or fixed position within the designated residual areas. These observations are conducted for a brief period of 5 minutes, often referred to as “*snapshot*” (Yamu et al., 2021, p. 16), detailing the observed dynamics performed by people within residual settings. As a result, data regarding the quality, nature, and characteristics of the human activity within the observed stationary context can be gathered. This analysis is combined with traces observations which aim to provide a comprehensive overview of the movement patterns within the studied areas.

3.5 SURVEY DATA COLLECTION

To assess the subjective perception of people occupying public *residual urban spaces*, a structured questionnaire is defined for each of the three case studies. More in detail, the survey questions are carefully designed to capture the social dimension within flyover regions and to examine the safety perception and social interactions among these areas. By engaging participants in this process, relevant qualitative data are collected enabling a deeper understanding of perceptions within public residual spaces underneath modern infrastructures. This approach seeks to gather information concerning attitudes and feelings of a certain number of participants while traversing the identified spaces. Each questionnaire consists of 10 questions, designed to take approximately two minutes to be completed. All questions are structured in a manner that ensures the *anonymity* of participants. In this context, the total number of participants allocated for each of the three areas is 32, with a sample size division based on sex parameter, as outlined below:

- 16 men
- 16 women

In total, the survey involves interviews with a final sample size of 96 individuals across the three study areas. The framed questionnaire can be found in Appendix 4. Moreover, in accordance with the UCL Ethics Policy (2023), *ethical approval* was required for the implementation of this methodology due to the involvement of questionnaires investigating safety perceptions of participants. For this reason, the process falls under the category of sensitive research, therefore necessitating compliance with ethical standards in order to limit any potential ethical risks arising from the study. As a result, this enhances the quality and success of the research, ensuring protection of participants as well as of the researcher. The gathered data are then quantitatively analysed using statistical techniques, allowing for a systematic exploration of individuals perception while being in residual urban areas.

In this regard, the study by Lapham et al. (2016) support the notion that the utilisation of public places such as parks or other communal areas, is significantly influenced by the perception of safety. Accordingly, Jiang et al. (2018) provides both a theoretical foundation and empirical evidence about perceived safety in urban alleys, proposing design interventions based on the interpretation of people's feelings through a detailed survey. In light of this, safety perception emerges as a relevant factor in the investigation of neglected areas. Therefore, the *perceptual* dimension is integrated into the overall classification process as it may uncover the perceived sense of unsafe environments, which can conduct to social inequalities (*Figure 61*, p.89).

3.6 STATISTICAL ANALYSIS

Multiple datasets are first collected from different databases, processed in QGIS, and subsequently exported in CSV format for testing in *SPSS statistics* or *Python* software. This step facilitates the demonstration of the relationships between diverse aspects through statistical analysis.

Bivariate Correlation Analysis also known as the *Pearson Correlation*, is employed to determine if a significant relationship between sets of two variables exists, along with *Multivariate distribution Analysis* involving more than two variables. Specifically, Pearson's correlation coefficient, commonly referred to as *Pearson's "r"*, measures both the strength and direction of the linear relationship between two continuous variables. The value of this Pearson's *r* value can range from -1 to $+1$. In general, the closer the Pearson correlation value is to one of these two numbers, the stronger the linear relationship between the variables. Conversely, a value of 0 indicates no linear correlation between the variables (Obilor & Amadi, 2018). Moreover, a correlation is considered significant whether the *p-value* associated with the correlation coefficient (*Pearson Correlation value*) is below a predetermined threshold, typically 0.05 (and/or 0.01). If the *p-value* is less than 0.05 , it suggests that a meaningful relationship between the variables examined exists. In other words, the smaller the *p-value*, the more significant is the relationship (Obilor & Amadi, 2018).

The variables exhibiting the strongest correlations are subsequently selected for *Multiple Linear Regression Analysis*. In each model, an independent variable is identified, and multiple dependent variables are compared. Though the coefficient of determination (R^2), it is possible to denote the proportion of the variance in the dependent variable, that can be explained by the independent variables or predictors. This assessment provides an insight into the extent to which the identified independent variables are capable of predicting or explaining the dependent variable. Specifically, R^2 ranges from 0 to 1 (or 0% to 100%), where 0 means the independent variables cannot explain any of the variation in the dependent variable, whereas 1 indicates that the independent variables can explain all of the variation (Plonsky & Ghanbar, 2018).

3.7 ANALYSIS FRAMEWORK: INTEGRATED MODEL

Figure 16 depicts the array of analyses employed to address the main research questions across all three study sections: *PAST Evolution*, *PRESENT Transformation*, and *FUTURE Regeneration*. In this regard, the illustration below presents the overlay of historical as well as present analyses conducted to examine the evolution of the spatial configuration and socio-economic conditions within the study area. On top of this, an environmental analysis is superimposed predicting future atmospheric emissions affecting the potential condition of the site. The combination of all current, historical, and future spatial, socio-economic, and environmental analyses constitutes what is referred to as an integrated model.

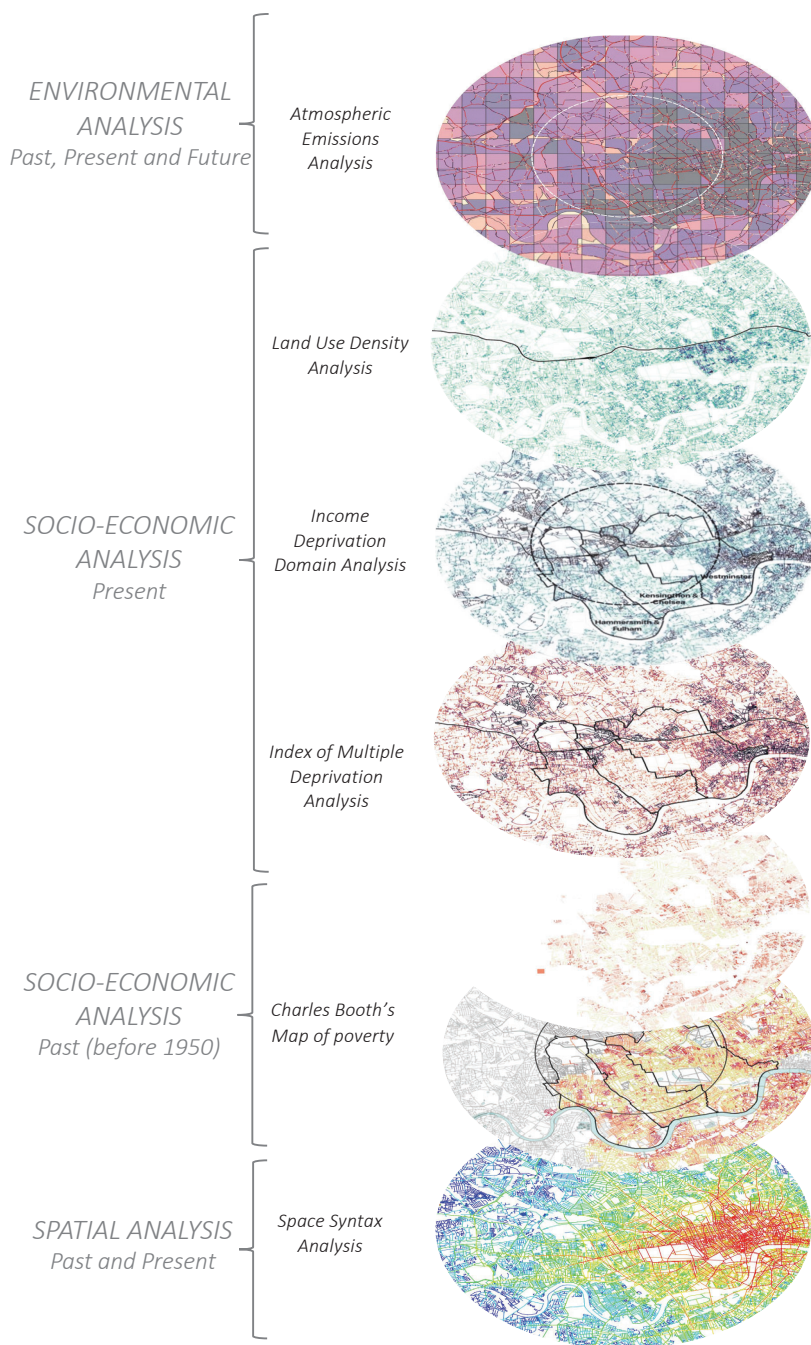


Figure 16. Integrated model.

LOOKING THROUGH THE SOCIO-MORPHOLOGICAL
EVOLUTION OF THE URBAN ENVIRONMENT
BEFORE THE WESTWAY CONSTRUCTION

IV



Chapter 4

4. LOOKING THROUGH THE HISTORICAL SOCIO-MORPHOLOGICAL EVOLUTION OF THE URBAN ENVIRONMENT BEFORE THE WESTWAY CONSTRUCTION

4.1 INTRODUCTION

The first phase of this research project delves into scrutinising the impact of the Westway's construction on London's urban environment. To comprehensively evaluate the development of the urban system and the appearance of residual spaces underneath the Westway across time, it is essential to gain an understanding of the socio-morphological evolution of the city. Through an examination of the historical character of the urban landscape, the study aims to assess the extent to which residual urban spaces have emerged within the city's spatial structure after the construction of the motorway between 1964 and 1970, symbolising innovation and high-speed transportation (Wall, 2011).

This chapter is structured into two primary sections. The first part entails a spatio-historical analysis of the city, with a specific emphasis on the street network during the 1950s, before the introduction of the motorway. The second section is centred on the socio-economic investigation of London, employing data from Charles Booth's map of poverty (London School of Economics & Political Science, 2016). Later, in Chapter 5, a comparison is presented between the city's spatial and socio-economic conditions before and after the Westway construction.

4.2 HISTORICAL PERSPECTIVE: RESIDUALITY AS AN OUTCOME OF URBANISATION

The historical map sources from the *Ordnance Survey* datastore (*Figure 17*) reveal that the spatial structure of London was originally well-interconnected, and the building pattering was compact throughout the entire 8km radius of the defined study area. However, following the construction of the motorway during the late 1960, as response to the increasing demand for fast-moving vehicles and high-speed connections (Wall, 2011), the site underwent spatial division with visible configurational consequences.

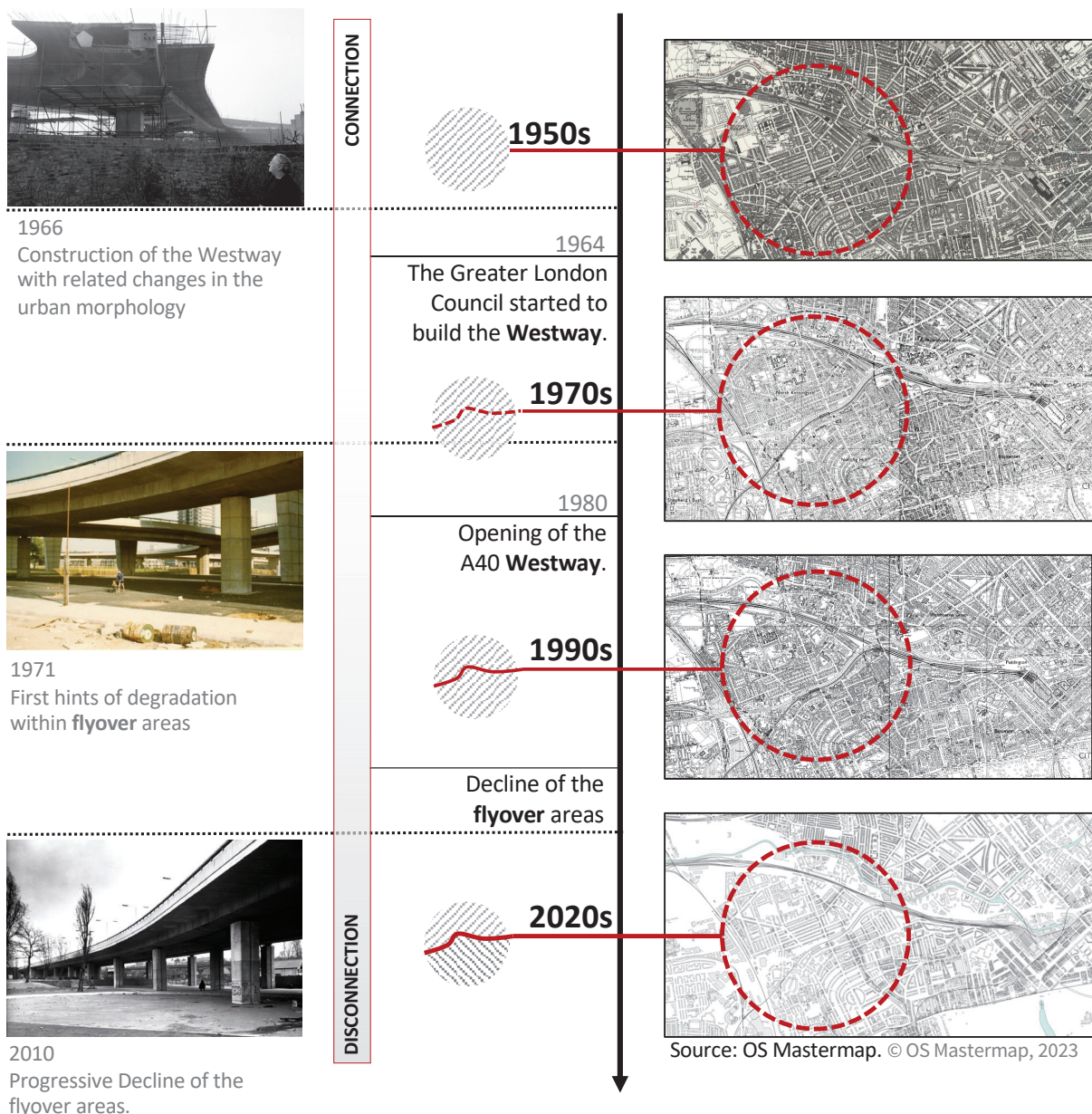


Figure 17. Historical evolution of the spatial system. From spatial connection to spatial disconnection.

In this regard, the analysis conducted by Hoshii (2021) further reveals the noteworthy implications that arose in terms of street networks and building footprint (Figure 18). The study indicates that the number of street segments in the chosen case areas near the East section of the Westway, increased over time. Accordingly, the spatial analysis conducted on the historical spatial model illustrated in Figure 19 (left) demonstrates that the total count of segments within the study area on the 1950s map amounts to 42,185. When this value is compared with the count of segments identified in the 2020s model (Figure 19, right), the number rises to 44,148. Despite it might seem that there has been relatively limited development in the street network, several streets that previously used to connect the northern and southern parts of

the neighbourhoods, were disrupted due to the construction of the elevated infrastructure. As a result, the Westway had a significant impact both on the street network and building composition of the area, resulting in evident disconnections between the north-south districts and local communities till present time.

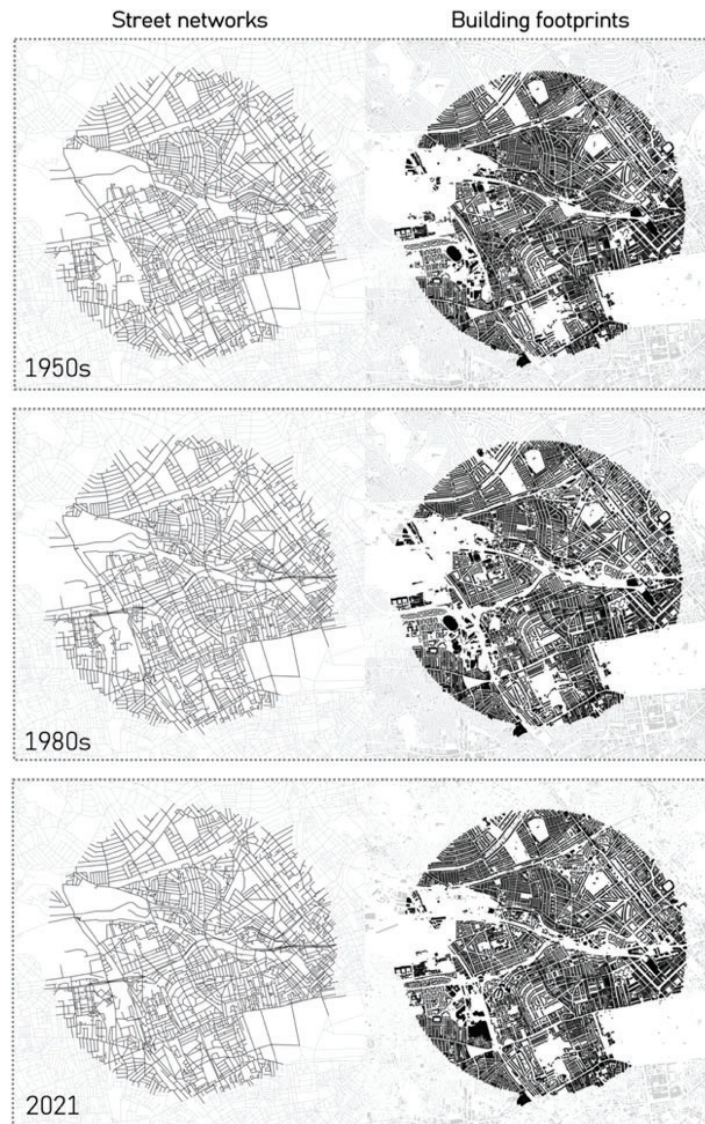


Figure 18. Historical street network and building footprint maps in 1950s, 1980s, and 2021. Source: Hoshii (2021).

To this end, Hillier argues (1989) that “*space is used sometimes to generate and sometimes to restrict the field of human beings*” (p. 6). Accordingly, the Westway seems to have contributed to the socio-spatial division and isolation of the urban system, generating not only spatial disruption but also social issues among resident communities. By reconsidering the intrinsic relationship between space and society, as maintained by Hillier and Hanson (1984), changing the urban’s grid spatial configuration of this area, numerous socio-economic consequences may have occurred. This, in turn, triggered interference in the natural pedestrian flow and resulted in the sites underneath the motorway to be underused across time. Gradually, the

cohesive urban system became fragmented and discontinuous, ultimately giving rise to challenging sites under the shadow of the Westway, often referred to as “*residual*” or “*left-over spaces*” (Wall, 2011, p. 148).

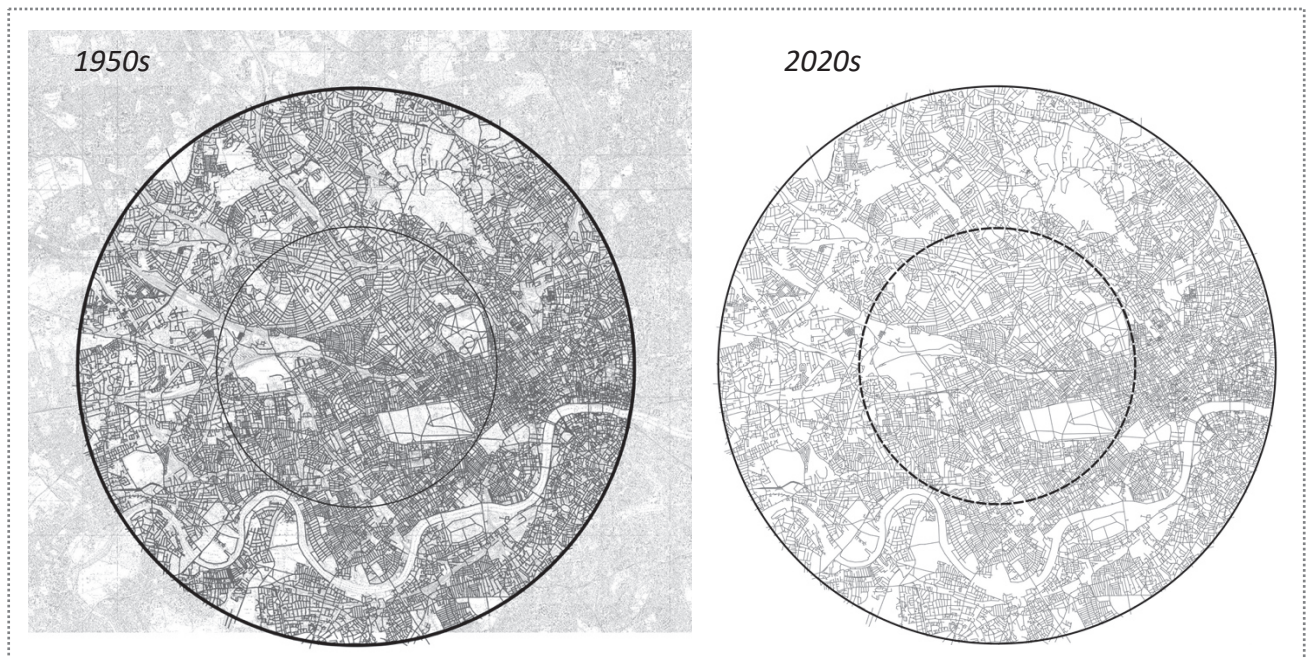


Figure 19. On the left: London spatial model 1950s created by author. Georeferenced images Source: Digimap. On the right: London spatial model 2020s. Source: Space Syntax Ltd.

4.3 PRE-WESTWAY URBAN MORPHOLOGY

4.3.1 Angular Segment Analysis: Integration and Choice – Road centre line (1950s Model)

The following set of segment maps representing the 1950’s spatial context displays the normalised centrality measures (*Integration* and *Choice*) resulting from the angular segment analysis of the constructed historical road centre line model. Specifically, the investigation encompasses various radii, providing an overview of the spatial properties prior to the construction of the Westway, later compared to the present spatial layout (Figure 24). The analysis (Figures 20-22-23) unveils that within the study area, both normalised angular *Integration* and *Choice* in the local 400m radius exhibit relatively low values. This scenario uncovers fragmented *Connectivity* and *Accessibility* patterns at local scale, in the historical as well as present spatial context. Conversely, a positive shift occurs when examining the global 4000m radius, resulting in heightened values for both *Integration* and *Choice* properties. The findings demonstrate a more connected and accessible scenario at global-scale within the 1950s spatial system, compared to the present configuration (Figure 23). Additionally, the examination shows a strong correlation between the local and the global spatial structures within the 1950s site, with an R^2 equal to 0.321 (Figure 21). This outcome displays that the

urban system was operating efficiently prior to the implementation of the elevated transportation infrastructure and the consequent emergence of residual spaces.

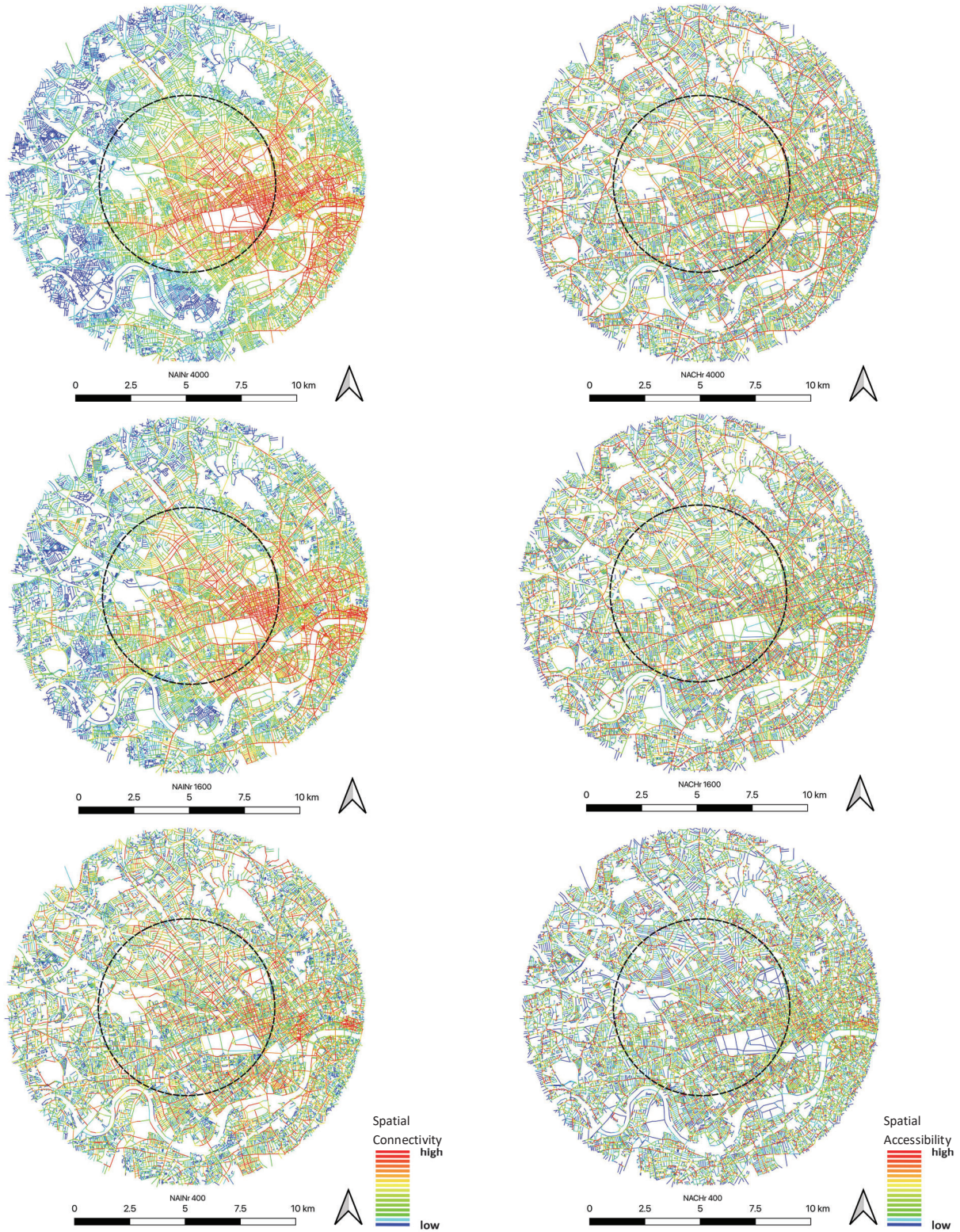


Figure 20. Street segment analysis: Integration and choice properties.

1950's model

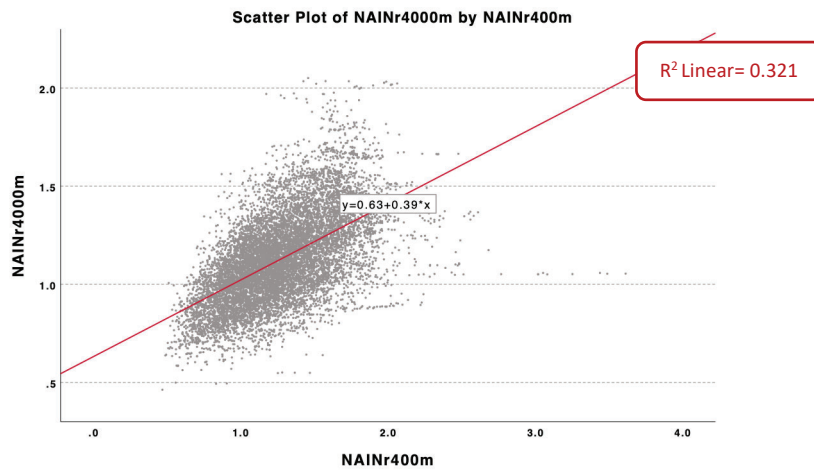


Figure 21. Local-global spatial structure correlation-1950

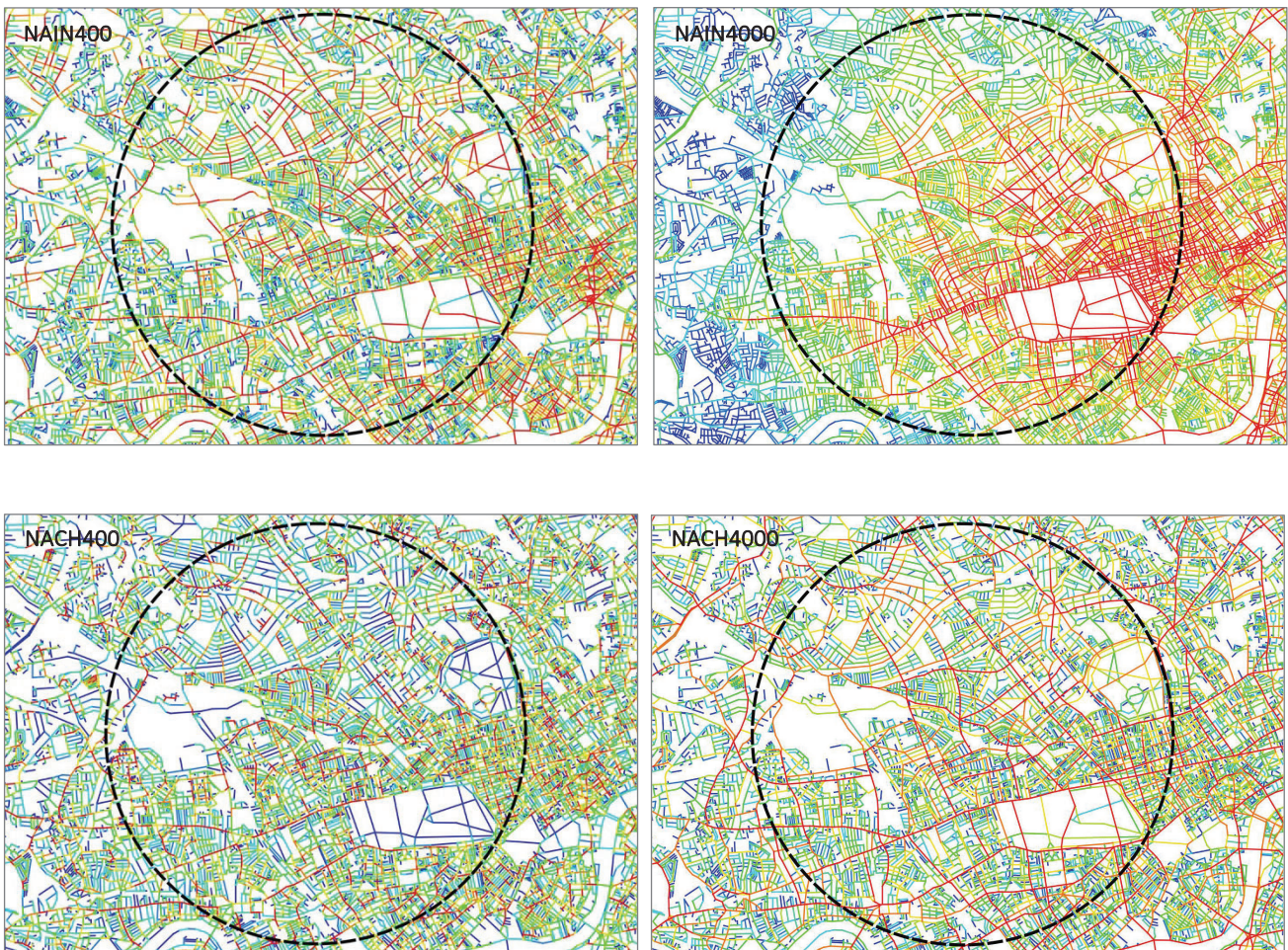
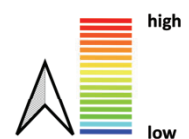


Figure 22. NAIN and NACH 400 and 4000-1950's model



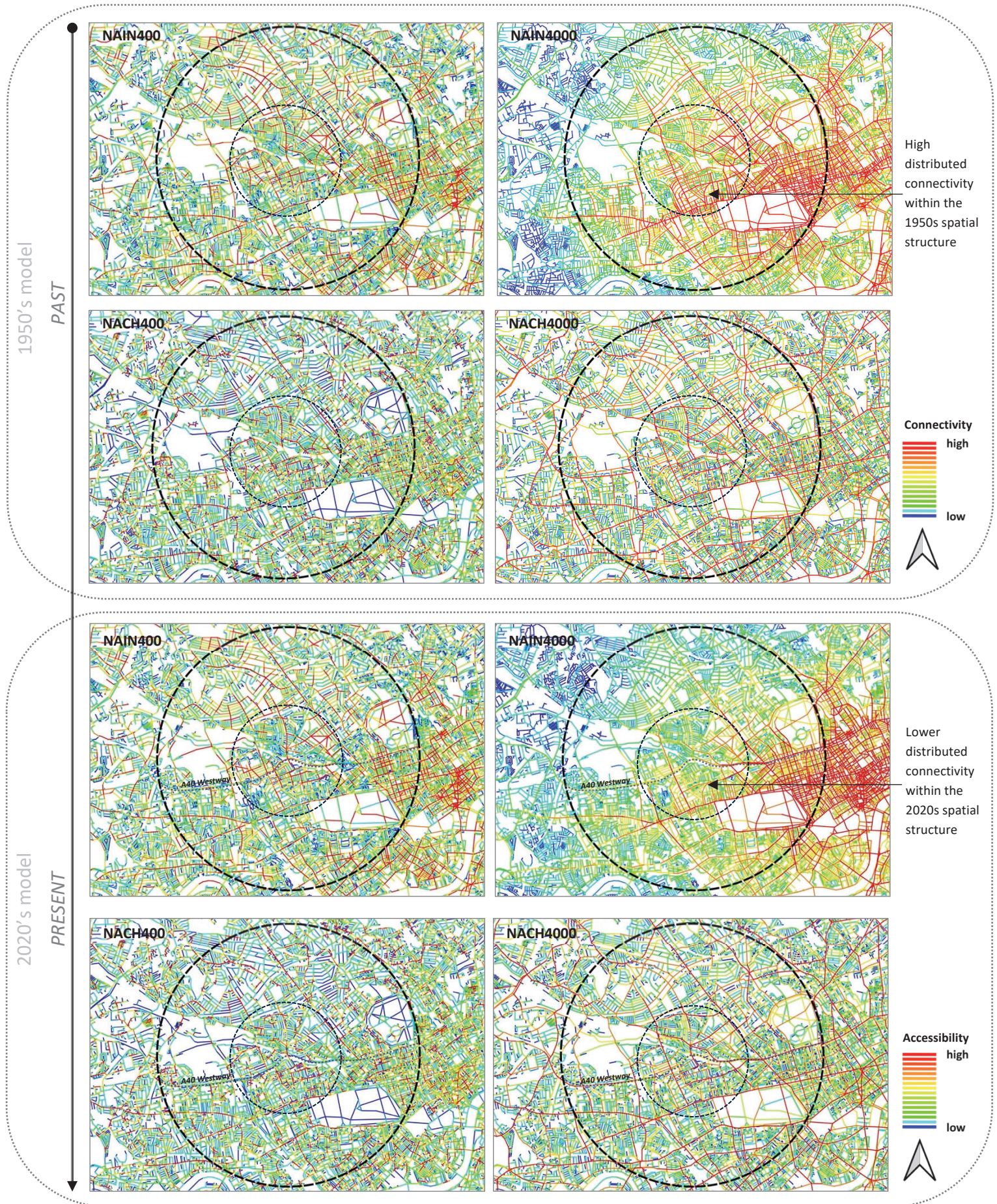


Figure 23. Set of local and global normalised angular measure: Integration and Choice.

4.4 A SOCIO-ECONOMIC OVERVIEW: SPATIAL DISTRIBUTION OF POVERTY BY CHARLES BOOTH'S MAPS

This section revolves around the historical socio-economic condition of the study area. Specifically, *Charles Booth's maps* from 1898-9 (London School of Economics & Political Science, 2016) serve as the primary reference to depict the spatial distribution of poverty and historical socio-economic conditions of London (*Figure 24*). The following analysis considers Booth's classification, which comprises seven ranks of poverty. These ranks have been distributed along both the road-centre-line segment model from the 1950s and the building forms for comprehensive investigation (*Figures 25-26*).



Figure 24. Charles Booth's *Descriptive Map of London Poverty, 1889*, sheets 4-7-8.

Source: <https://booth.lse.ac.uk/learn-more/download-maps>



Figure 25. Charles Booth map poverty values distributed along the street segment model.

As Vaughan (2007) points out, the distribution of poverty in the London context is closely tied to the spatial accessibility properties of the site. Looking at the selected case study, the persistence of poverty and the low-quality of life can be attributed to a combination of pre-existing spatial factors and economic aspects. Building upon the previous spatial analysis, it can be argued that looking at the historical road-centre-line segment model, the regions with the highest degree of angular *Integration* and *Choice* within the study area exhibit a lower degree of poverty, and vice versa (Figures 27-28). This pattern of spatial and socio-economic conditions is also investigated for the present time in Chapter 5, p.67 and compared with the results from the historical context. This comparison proves a certain correspondence between poverty in the past and the occurrence of Income Deprivation Domain in the current time.

“Charles Booth’s recognised that space can have an effect on social outcomes” Vaughan & Geddes, 2009, p.5

“Booth frequently noted in his writing that physical boundaries such as railways had the effect of isolating areas, walling off their inhabitants and isolating them from the life of the city”

Vaughan & Geddes, 2009, p.6

Charles Booth's Map of poverty (1898-9)
joined with road-centre-line segment model of 1950s





Figure 27. Normalised angular choice analysis (NACH 4000) from 1950's segment model overlapped to Charles Booth's Map of poverty.

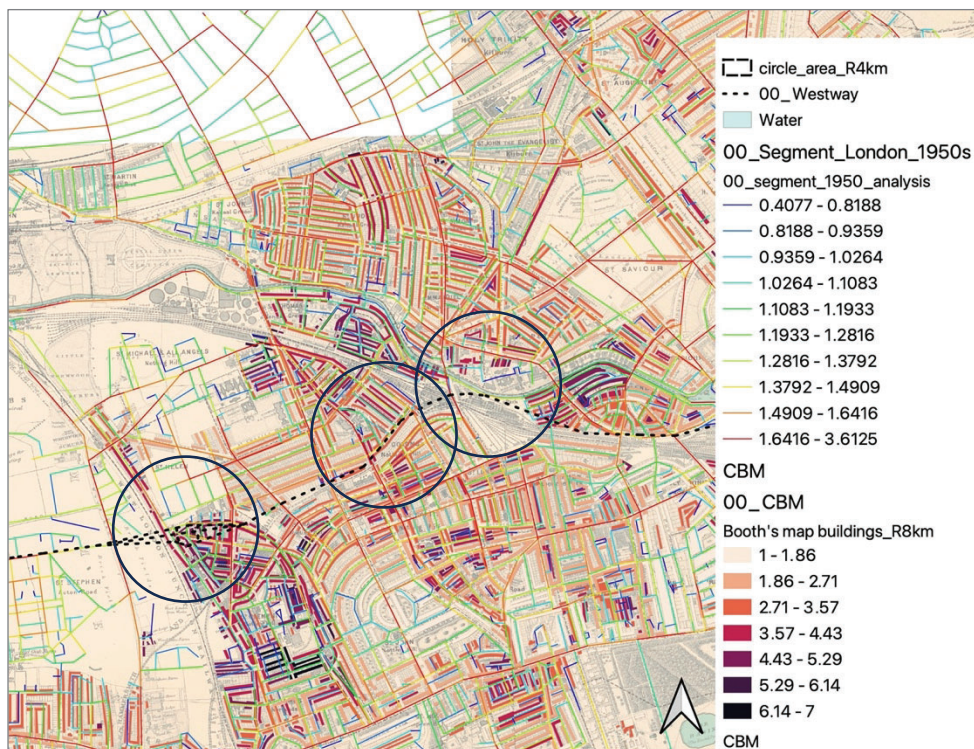


Figure 28. Normalised angular integration analysis (NAIN 4000) from 1950's segment model overlapped to Charles Booth's Map of poverty.

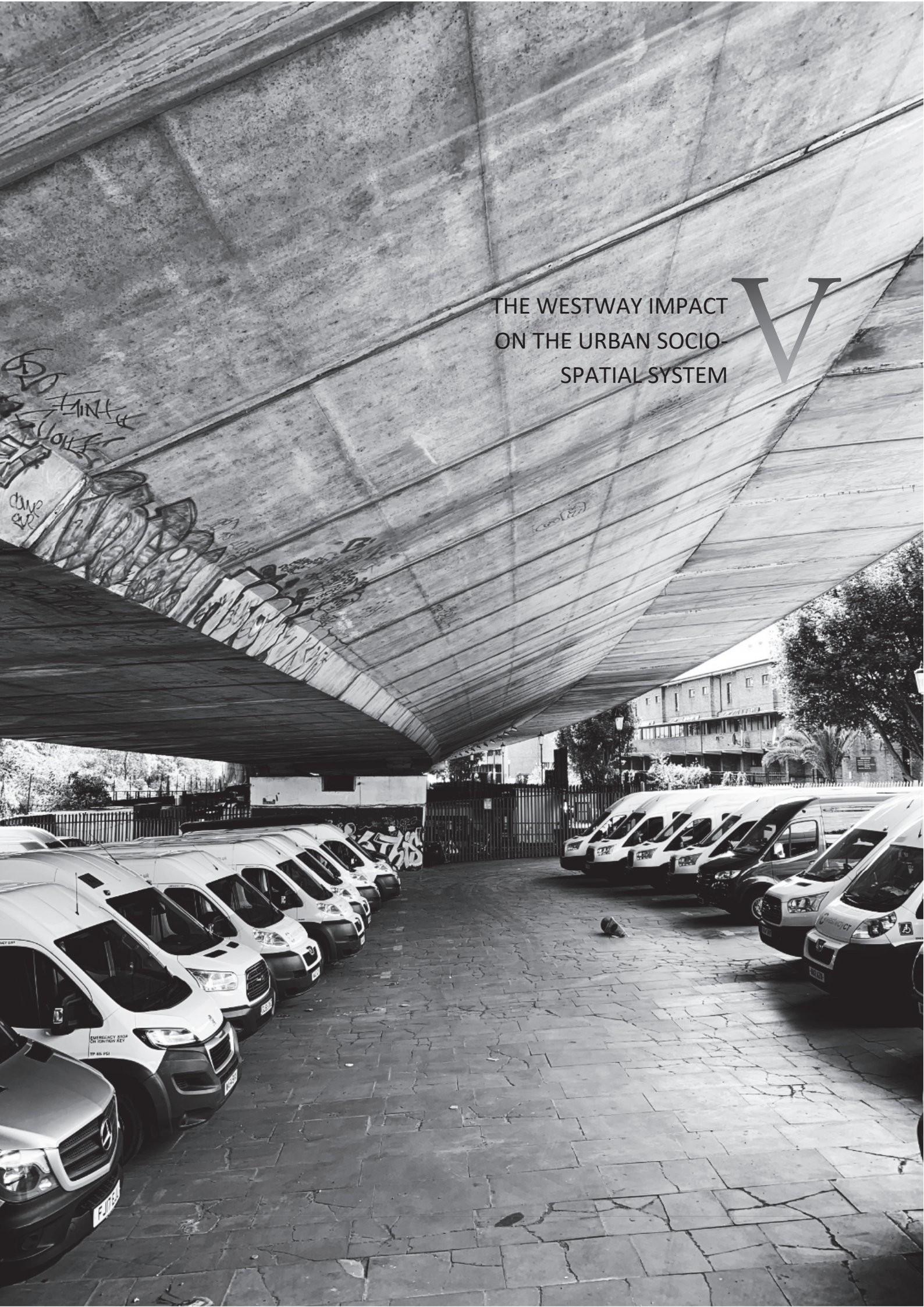
In summary, as the analyses reveal, the presence of poverty patterns within specific regions of the case-study area indicates that challenging socio-economic conditions were evident as early as the late 1880s, well before the construction of the modern motorway. However, the situation deteriorated after the introduction of the Westway along with the associated changes in the spatial structure.

4.5 CONCLUSION

The historical investigation underscores the interplay between spatial and socio-economic factors in the emergence of residual areas. This aspect aligns with the existing Space Syntax literature, which affirms that the configurational attributes of street sections, in terms of spatial relations, play a crucial role in shaping the socio-economic profile along the streets over time. Specifically, the conducted examination hints a correlation between adverse spatial configurational and socio-economic properties of the area, which worsened across time, leading to the appearance of undesirable spaces.

In conclusion, this study section portrays how the socio-spatial context of this particular area in London demonstrated complexities and problematics already in the past, which gradually exacerbated following the introduction of the Westway. As a result, this challenging context seems to have determined the surfacing of residual spaces within the urban setting, contributing to spatial and social division among communities and the establishment of inefficient urban land utilisation.

THE WESTWAY IMPACT
ON THE URBAN SOCIO-
SPATIAL SYSTEM



Chapter 5

5. THE WESTWAY IMPACT ON THE URBAN SOCIO-SPATIAL SYSTEM

5.1 INTRODUCTION

In this empirical study section, a multi-faceted approach is adopted to examine the current context in which residual spaces are identified. Firstly, the spatial system is analysed using Space Syntax methods to evaluate the impact of spatial connectivity and accessibility on both vehicular and pedestrian networks, specifically in relation to the surfacing of neglected urban areas underneath the London's Westway. Secondly, deprivation analyses are employed to probe the present socio-economic conditions within the study-site exploring their potential impact on the emergence of neglected urban spaces. Subsequently, an investigation of land use densities is employed to determine whether a lack of functional diversity might affect the area's condition and the prevalence of residual sites. Furthermore, visual graph analysis conducted from both eye and knee levels, seeks to uncover the role of visual relationships in the formation and decline of these areas, exploring whether this specific aspect may also contribute to heightened feelings of insecurity. The investigation is complemented by stationary activity and traces analyses, which assess the current usage patterns of the selected sites. Lastly, findings from qualitative questionnaires, are integrated into the research to inspect the perceptual dimensions of individuals occupying these overlooked places. The conclusions drawn from this examination are used to define the classification framework later presented in Chapter 6.

5.2 OBJECTIVE ANALYSIS

5.2.1 Angular Segment Analysis - Road centre line (2020s Model)

A set of segment maps on a road centre line model displaying *Normalised Integration* (or closeness centrality) and *Choice* (betweenness centrality) values, identifies relevant spatial patterns. The examination spans across a range of radii from R400 to R4000, portraying scenarios at various scales. The results highlight that the site's spatial system seems to function efficiently, as supported by the $R^2=0.322$ correlation value reflecting the alignment between

local and global spatial structures. Nonetheless, a more detailed investigation is required to comprehensively assess the area, examining the pedestrian network of the site.

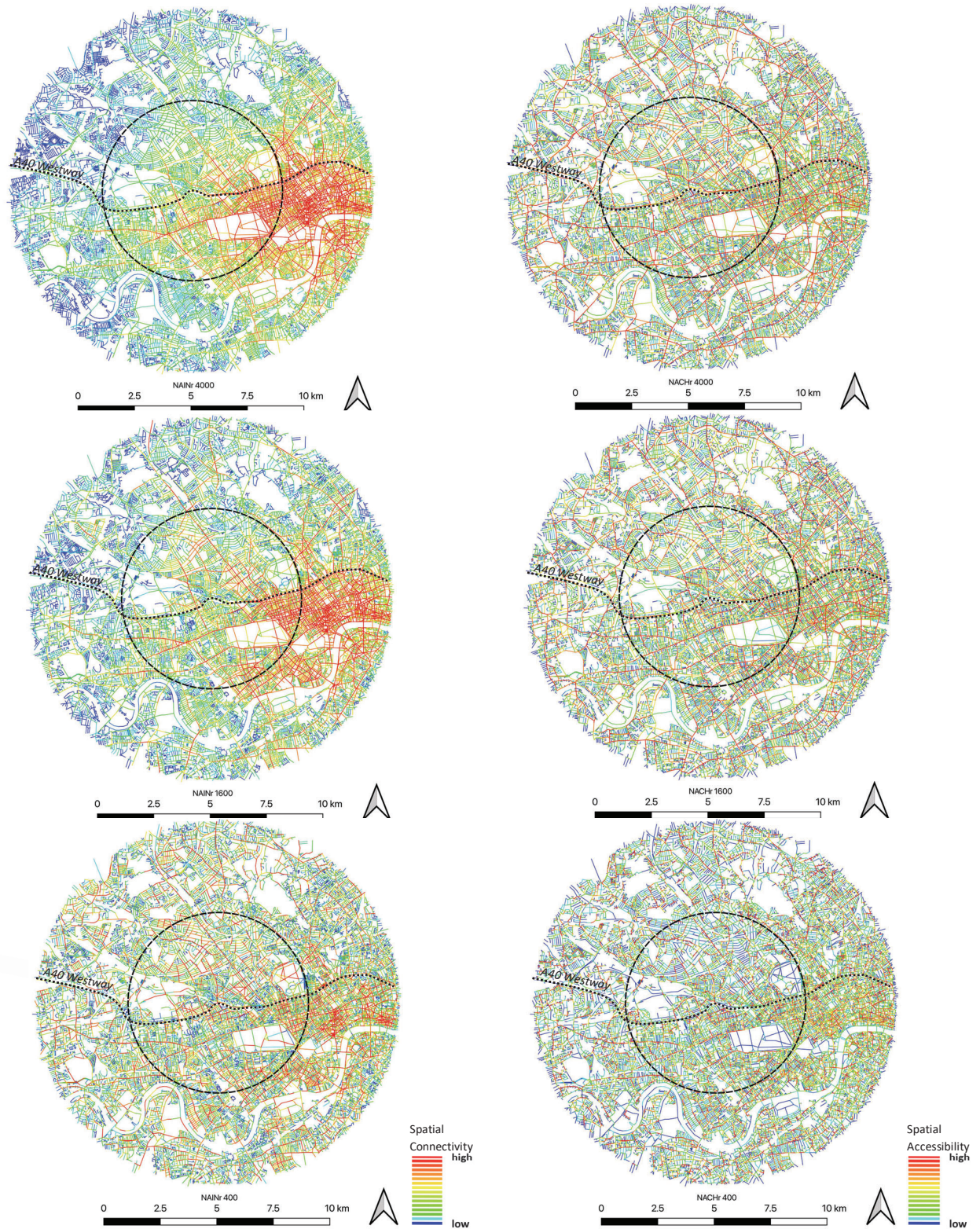


Figure 29. Angular Segment Analysis: Integration and Choice

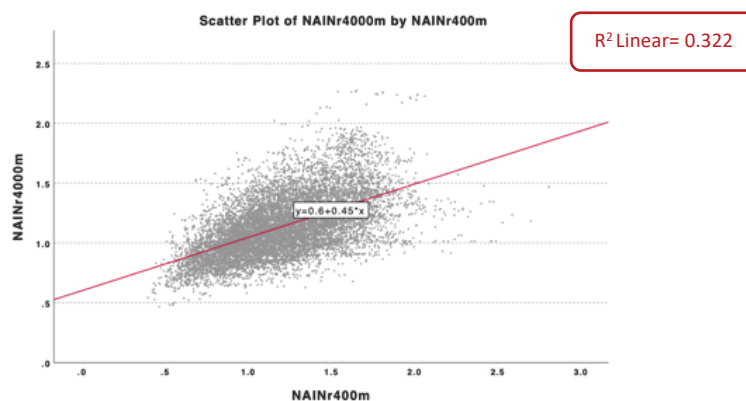


Figure 30. Local-Global spatial structure correlation.

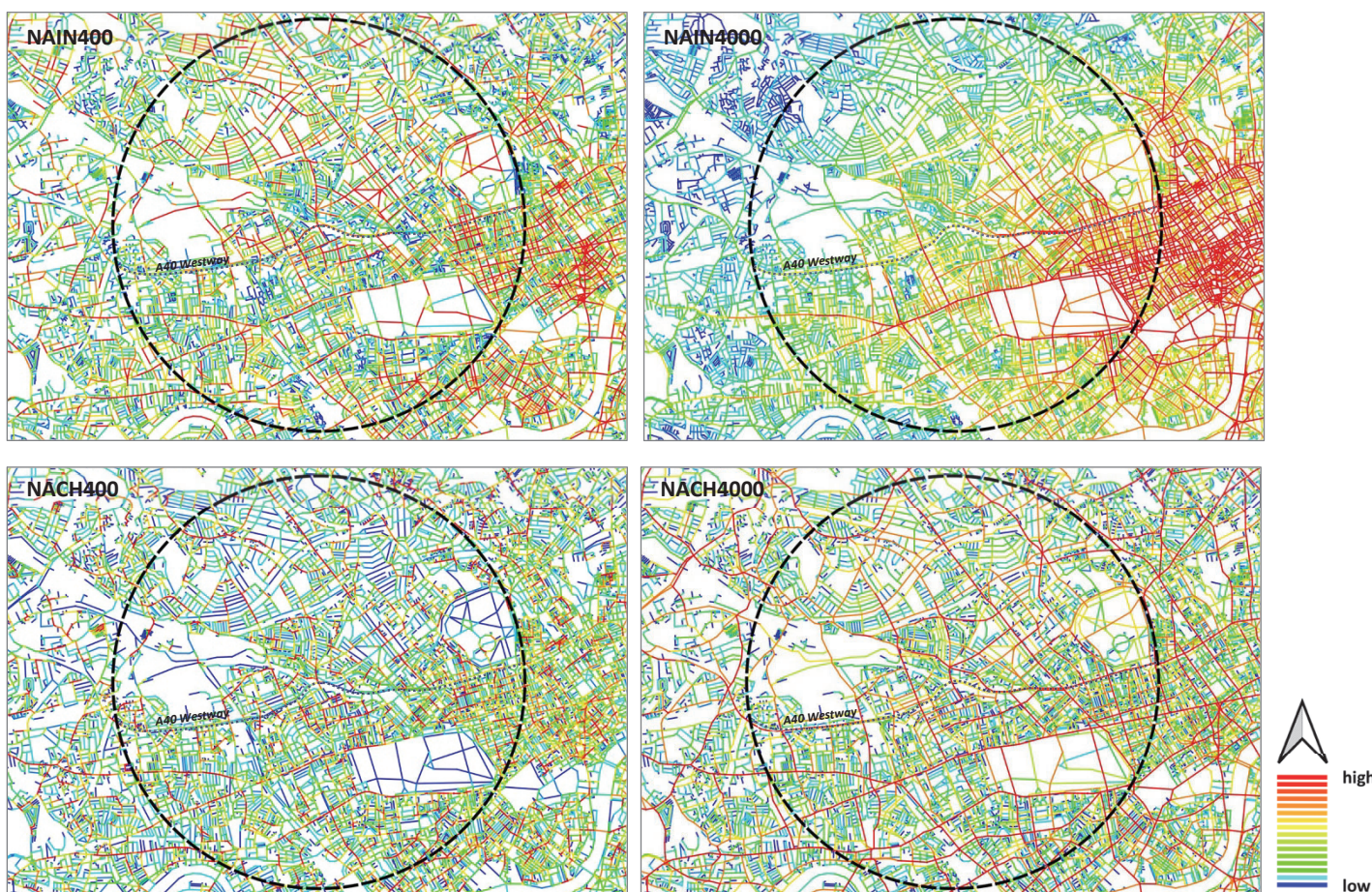


Figure 31. Spatial Structure Analysis at global and local radii.

In Figure 31, high global *Connectivity* (NAIN4000) and *Accessibility* (NACH4000) showcase that the area is effectively linked with the city’s core at vehicular level. Furthermore, NAIN400 analysis depicts favourable local *Connectivity* along the main North-South routes, yet highlighting generally less integrated sections of the network at local scale. Accordingly, *Choice* (NACH400) results in fragmented *Accessibility* within the local movement structure.

5.2.2 Angular Segment Analysis – Pedestrian model

The use of streets and public areas as social spaces is a key aspect for the successful operation of a city and has a beneficial impact on the social relationships within communities (Vaughan et al., 2020). Based on this principle, it becomes pertinent to assess potential people's movement and behavioural aspects of users at a pedestrian level while examining residual areas. Specifically, the study employs pedestrian segment analysis, evaluated at various metric radii. For the investigation, a total area with a 2km radius is considered, along with a radius of 0.5km for each individual area. The findings indicate that Area 2 exhibits the highest *Integration* and *Choice* values (Figures 32-33-34), and the highest local-global spatial structure correlation compared to the other regions (Figures 35-36). Remarkably, this site also displays the least presence of residual spaces and the lowest degree of residuality.



Figure 32. Angular Segment Analysis on pedestrian model



Figure 33. Set of normalised local-global Connectivity from angular segment pedestrian model.



Figure 34. Set of normalised local-global Accessibility from angular segment pedestrian model.

The variation in spatial *Connectivity* and *Accessibility* among the three areas influences the distribution of pedestrian movement flows, subsequently affecting the emergence and status of residual areas. Hence, configurational properties play a crucial role in the occurrence of overlooked spaces. Based on empirical analysis, there is correspondence between high prevalence of residual areas and lack of spatial *Connectivity* or *Accessibility*. This observation is somewhat validated through data visualisation primarily, and T-test secondly (Figures 37-38 and Appendix 2), suggesting that the spatial logic of the urban system encourages the distribution of residuality patterns in less connected and integrated areas, both on a vehicular and pedestrian level.

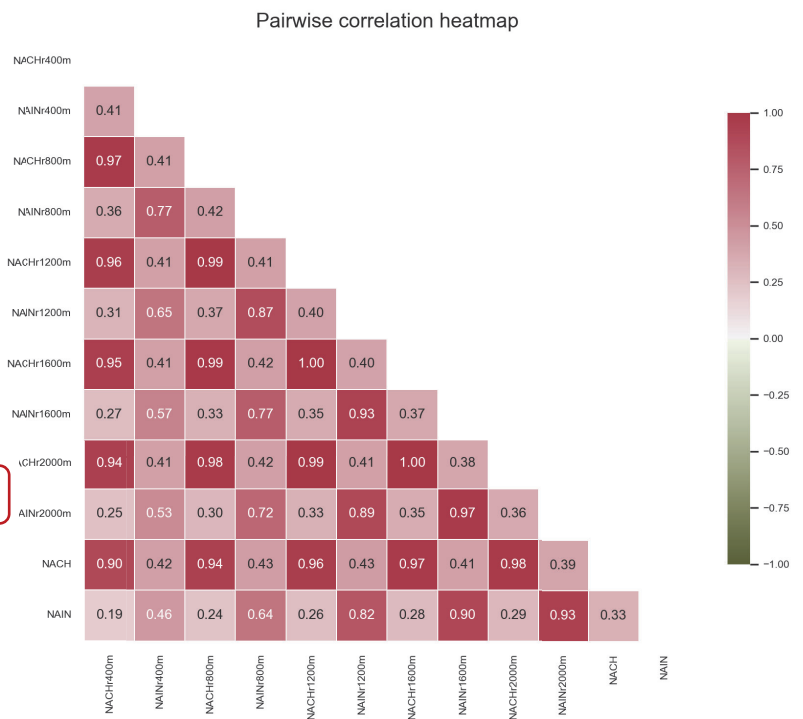
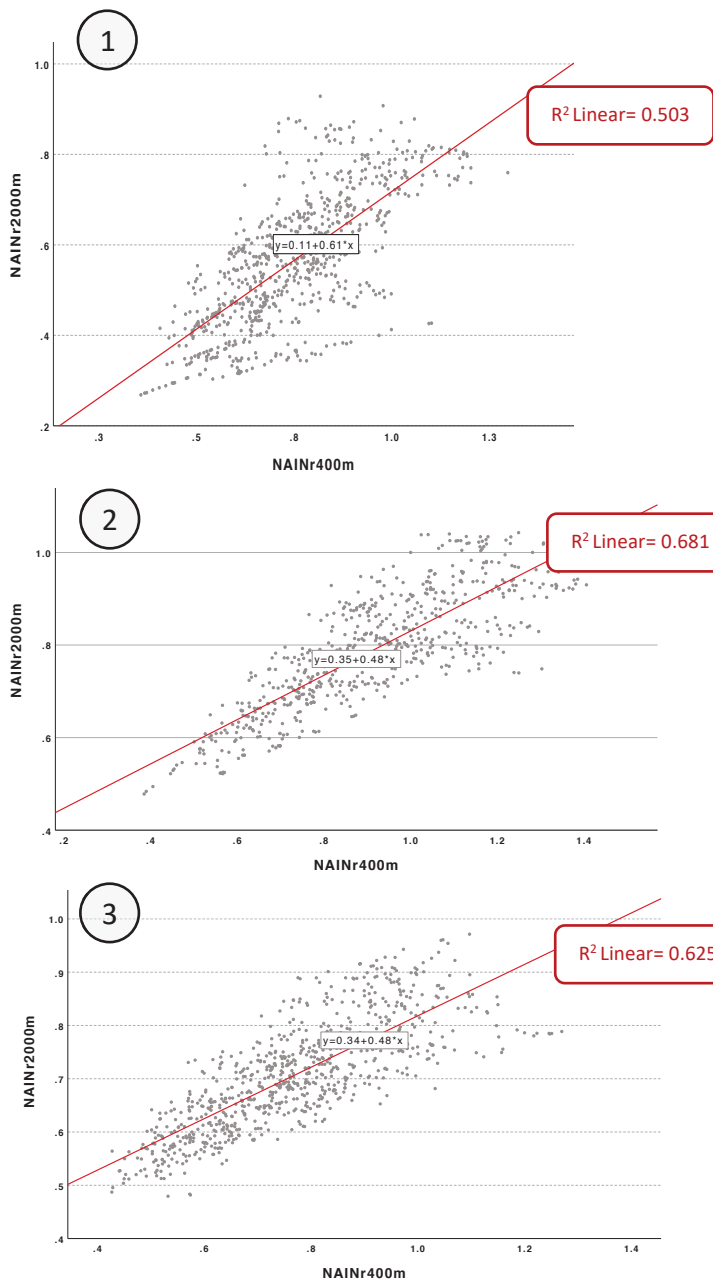
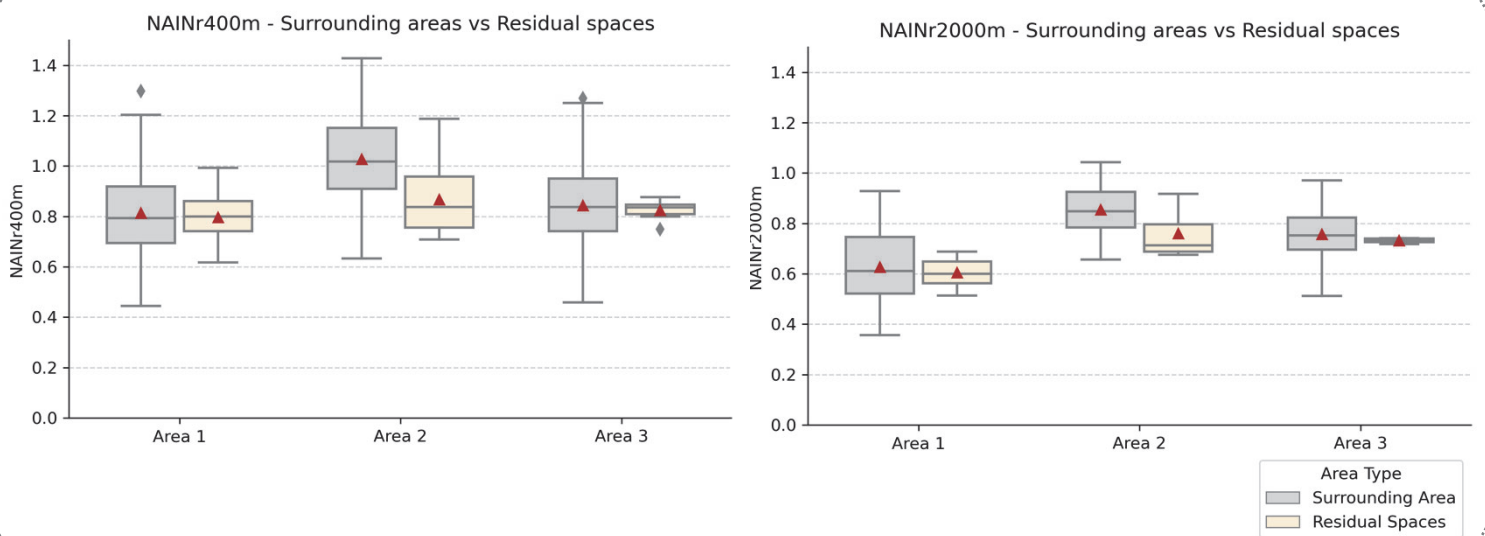


Figure 35. A Pairwise correlation of all normalised centrality measures among the three study areas, resulting from angular segment analysis on the pedestrian segment model representing the current spatial configuration of the site.

Figure 36. Local-global spatial structure correlations for each of the three areas.

This assumption is partially confirmed through a series of analyses and statistics, which also assess *Hypothesis 1* asserting that “The Presence of residual spaces underneath the Westway is associated with lack of spatial Accessibility and Connectivity of the site”. The outcomes indicate that in terms of *Connectivity* (NAIN), the values related to the identified residual areas are lower compared to the values pertaining to the surrounding regions, both on a local (400m) and global (2000m) scale. However, this scenario changes when examining *Accessibility* (NACH) as the values on the residual spaces’ segments of Area 1 and 2 at 400m appear higher than the values of the segments concerning the surrounding areas.

NAIN (Connectivity)



NACH (Accessibility)

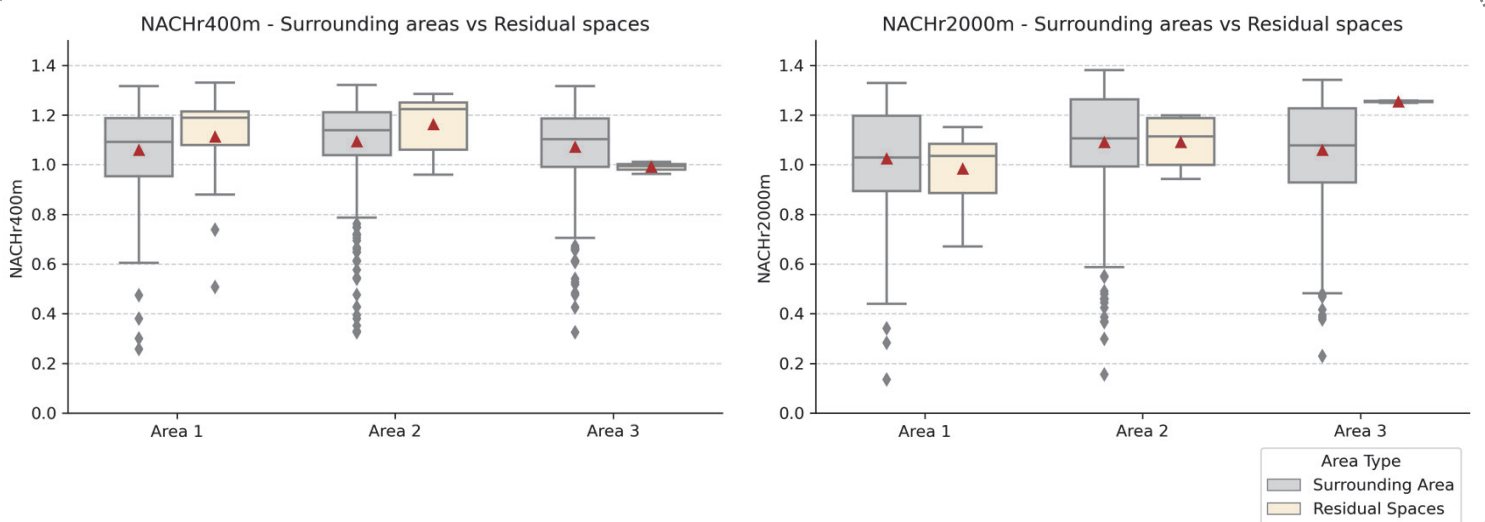
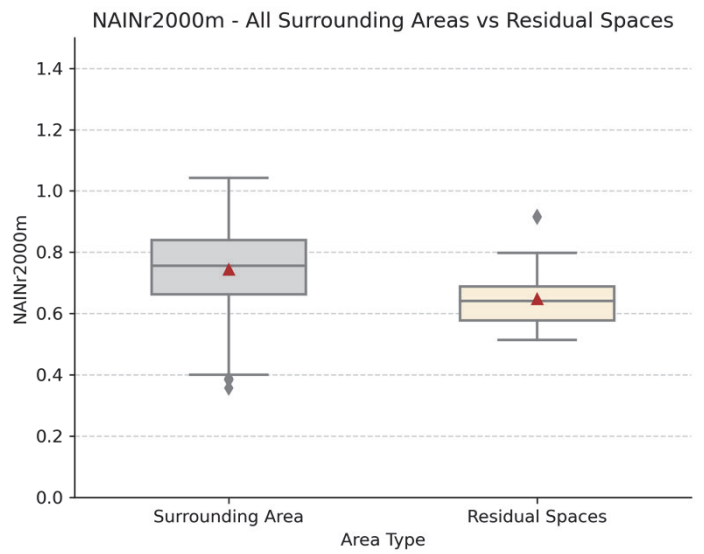
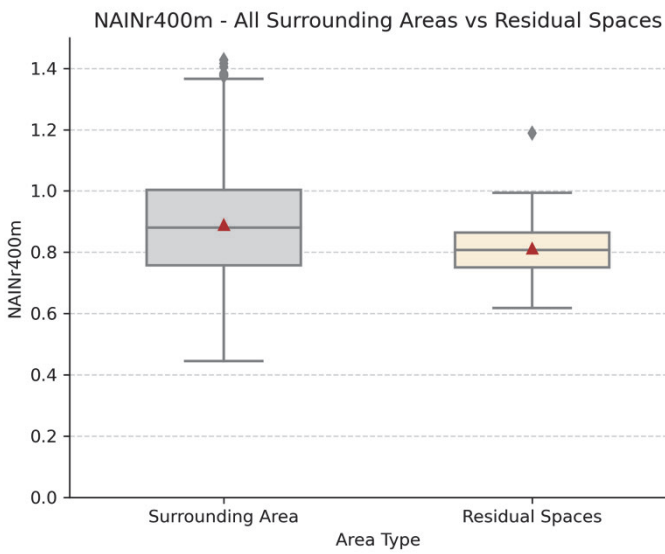


Figure 37. Visualisation data: NAIN and NACH Comparison - Residual spaces vs surrounding areas

Nevertheless, when considering the combined data from all three areas, a notable alignment with Hypothesis 1 becomes evident. Indeed, *Figure 38* demonstrates how the overall values of all residual spaces are lower than the values concerning the surrounding areas, thereby expressing a lack of *Integration* and *Choice*. As a result, the initial assumption regarding the correlation between spatial structure properties and the existence of residual areas is substantiated, particularly in terms of *Connectivity*.

NAIN-All areas' data combined



NACH- All areas' data combined

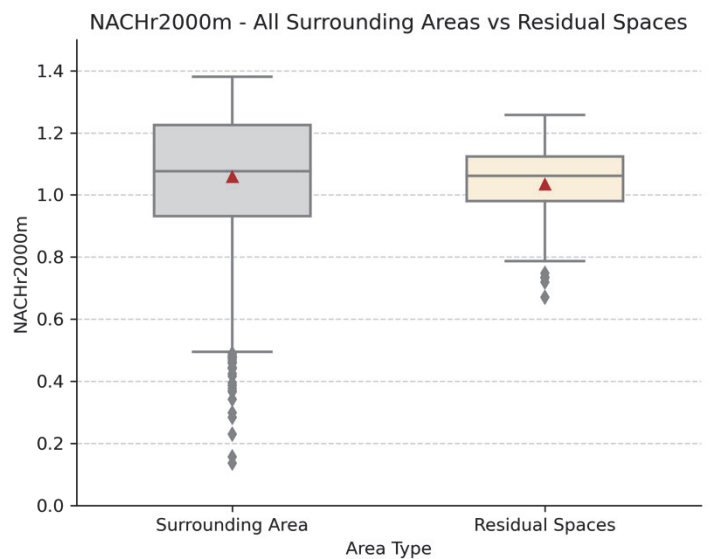
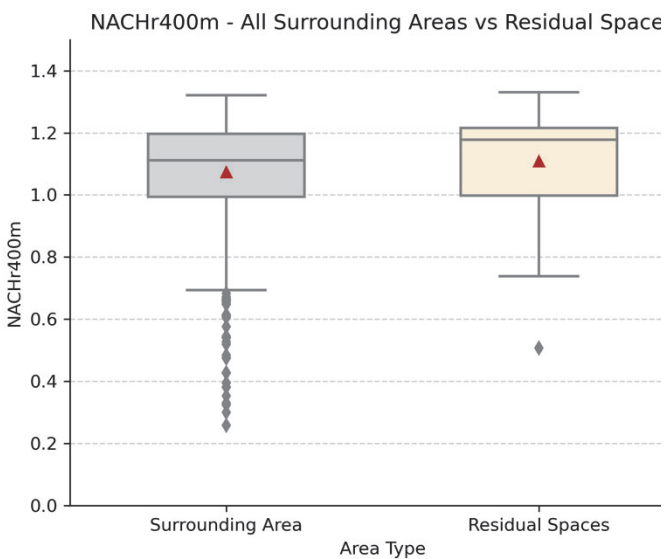


Figure 38. Combined NAIN and NACH for all three study areas.

5.2.3 Current Deprivation and Historical Poverty Analysis

The exploration of the socio-economic attributes of the study area, particularly evaluating the *Index of Multiple Deprivation* and the *Income Deprivation Domain*, denotes notable deprivation values in the neighbourhoods adjacent to the Westway at the present time (Figure 39). This aspect underscores the adverse effects stemming from the physical and social division caused by the motorway's construction, which impacted both the economy and society, thereby affecting residents' quality of life.

In this regard, if the present context is juxtaposed with Charles Booth's historical poverty assessment (Figures 40-41), it becomes evident that the motorway's influence extends beyond spatial alterations, as previously examined, and has also impacted the social dynamics of local communities. This observation is further supported by Table 1, revealing a significant correlation between the *Income Deprivation Domain* values from 2019 and the poverty values documented by Booth in 1898-9 within the study site. This finding aligns with the assertion by Vaughan et al. (2020) that physical barriers like roads contribute to social isolation and community severance, ultimately affecting the socio-economic circumstances and overall quality of life in a given area.

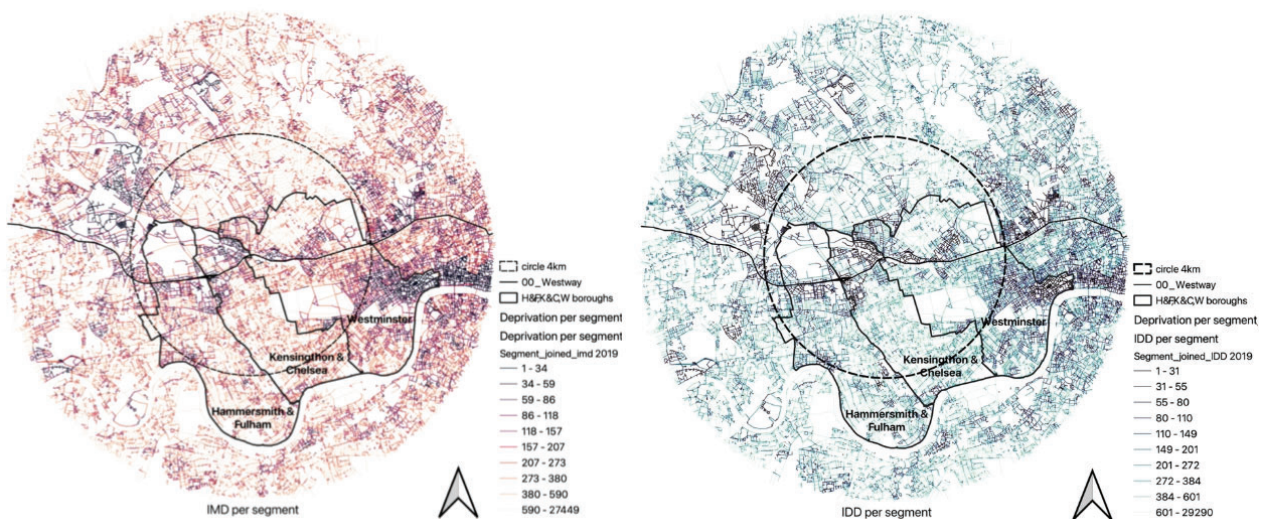


Figure 39. Index of Multiple Deprivation (IMD) and Income Deprivation Domain Analysis distributed along 2020's segment model.

Furthermore, the current heightened degree of deprivation, when compared to historical socio-economic conditions, seems to correspond with a more significant presence of residual spaces. This outcome supports Hypothesis 3, which posits a connection between deprivation rates and the existence of residual spaces. Certainly, this challenging context, characterised by

a lack of essential resources, opportunities, and favourable circumstances, appears to have contributed to the emergence and continued persistence of residual spaces underneath the elevated infrastructure over time.

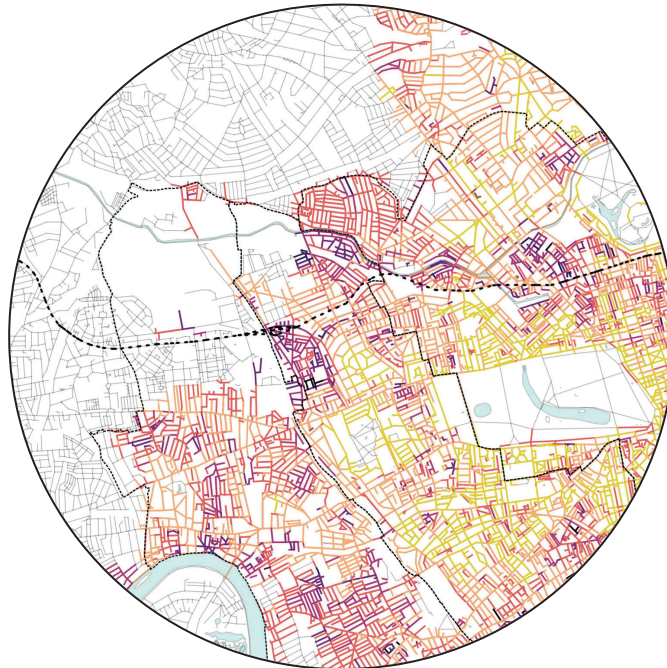


Figure 40. Poverty map from Charles Booth's classification (1898).



Figure 41. Income Deprivation Domain map (present).

Correlations

		LSOA_IMD19_r rank	LSOA_IDD19_r rank	Inverse_CBM_r rank_mean
LSOA_IMD19_rank	Pearson Correlation	1	.926**	.358**
	Sig. (2-tailed)		<.001	<.001
	N	40947	40947	40947
LSOA_IDD19_rank	Pearson Correlation	.926**	1	.343**
	Sig. (2-tailed)	<.001		<.001
	N	40947	40947	40947
Inverse_CBM_rank_mean	Pearson Correlation	.358**	.343**	1
	Sig. (2-tailed)	<.001	<.001	
	N	40947	40947	40947

Table 1. Correlation between Income Deprivation domain values (present) and Charles Booth's Map of poverty values (1898).

** . Correlation is significant at the 0.01 level (2-tailed).

Simple Boxplot of LSOA_IDD19_rank by CBM_rank_max

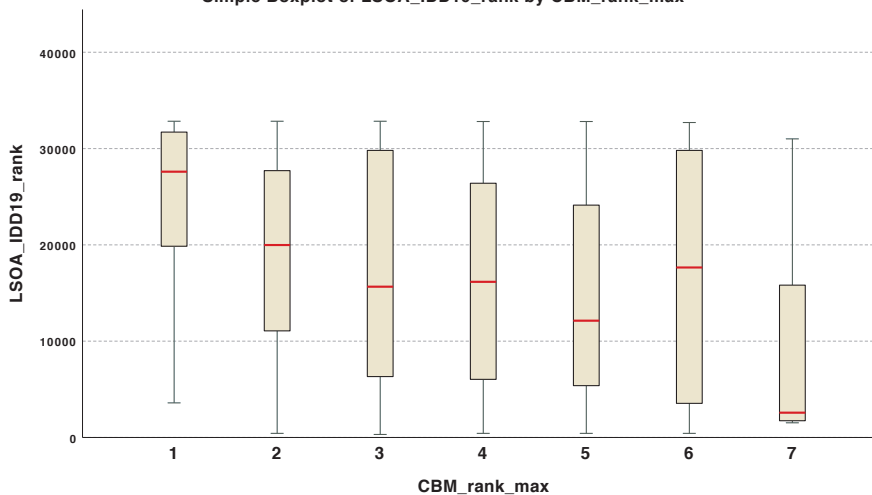


Figure 42. Boxplot of Income Deprivation Domain values (present) and Charles Booth's Map of poverty values (1898).

5.2.4 Land Use Densities Analysis

Land use densities analysis unveils a lack of variety and diversification within the study area (Figure 43). Specifically, high residential density per segment is detected within the total 8 km radius area under investigation. This prevalence of residential land use is particularly pronounced in regions near the Westway, where retail use remains relatively limited. However, a significant exception is visible in Area 2, located in proximity of Portobello Road market, a renowned touristic destination hosting one of the world’s most famous street markets. Within this region, the analysis exposes a higher retail density, signifying a shift from the predominantly residential pattern observed in the other two areas.

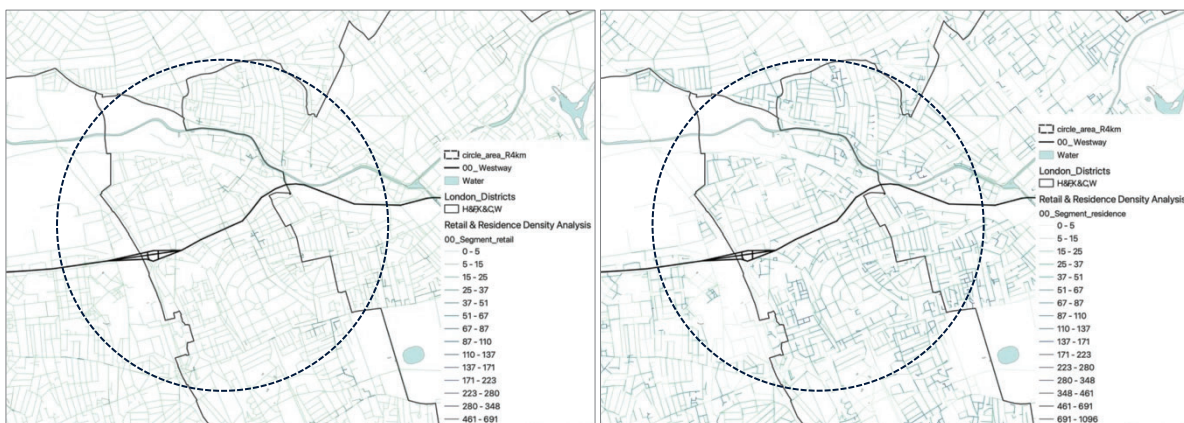
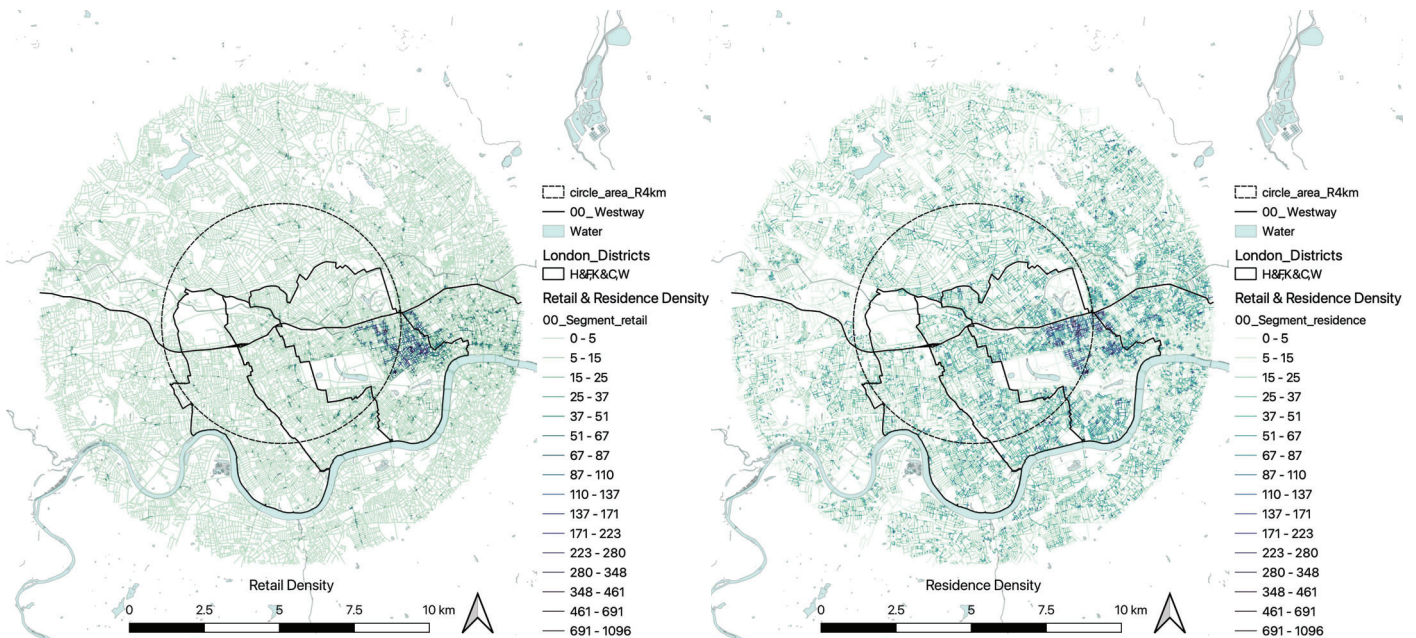


Figure 43. Retail and Residence density analyses per segment.

The results suggest that a higher diversity of land uses generally corresponds to a reduced presence of residual spaces. The lack of diversity in terms of land use can negatively impact the condition of the area, potentially leading to isolation and increased segregation issues. In support of this notion, Hillier (1996) argues that what he defines as a “*spatially successful city*” (op.cit, p.6) is often characterised by dense patterns of mixed use.

Additionally, as Jacobs (2020) highlights, by incorporating mixed-use functions, a certain sense of safety and community can be fostered. This aspect holds significant importance for the current research, as it suggests that any potential regeneration proposal for the study area would require careful consideration towards the integration of highly diversified land uses.

5.2.5 Visual Graph Analysis (VGA) and Visual Correspondence Index

An examination of visual integration at both eye and knee levels has provided valuable insights into the visual characteristics of the studied urban site. The outcomes reveal that all three areas exhibit a relatively high visual integration at eye level, as depicted in *Figure 44*. However, a drop in the values is scored at knee level, where limited visibility is documented within the sites due to numerous sections of the flyovers being physically and visually inaccessible or obstructed by physical structures such as buildings. Interestingly, these areas correspond to the locations where residual spaces have been identified. Hence, the observation reinforces the notion that lack of adequate visual factors is correlated with the presence of neglected urban spaces.

Moreover, as subsequent sections of this study will illustrate, visibility aspects appear to be deeply intertwined with individuals’ perception of safety. This consideration, combined with other aspects like inadequate lighting and insufficient maintenance, may result in an increased sense of insecurity, particularly at night.

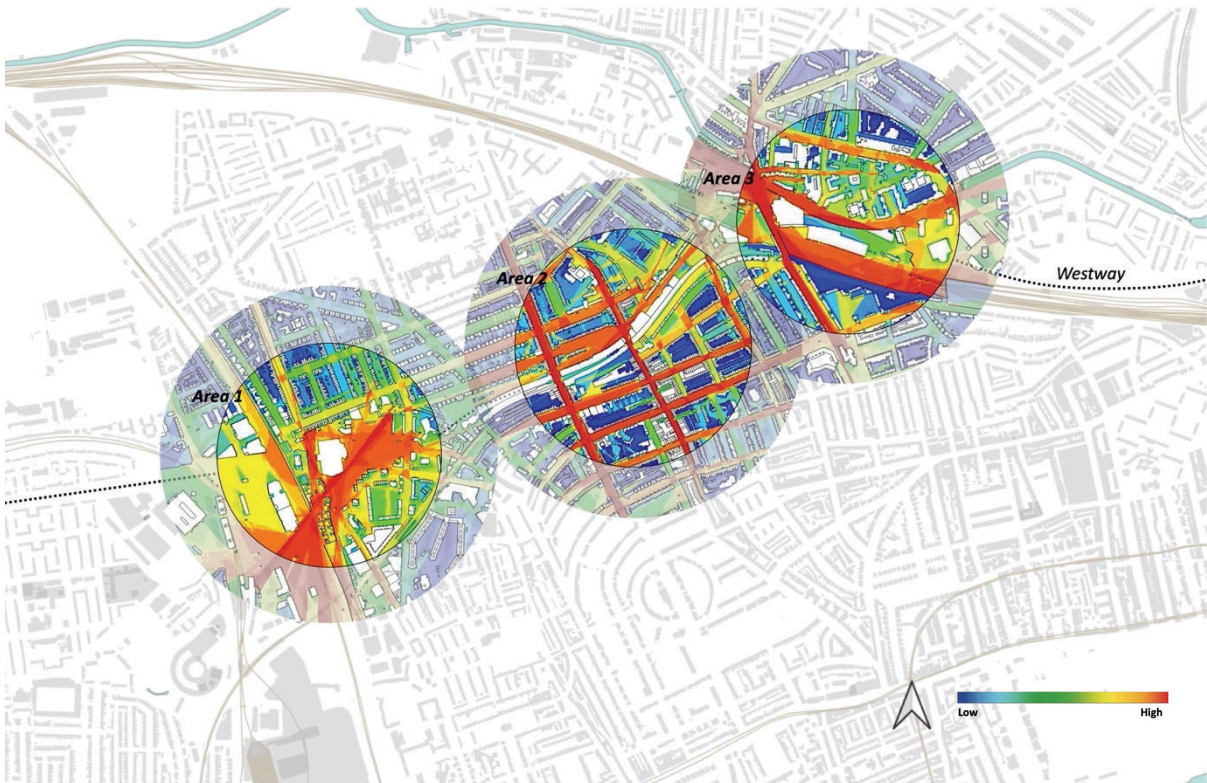


Figure 44. VGA analysis at an eye and knee levels.

Additionally, through the superimposition of knee-level visual integration analysis with normalised *Integration*, which expresses a site's level of spatial *Connectivity*, a deeper comprehension of the interplay between visual and spatial variables and their relationship with the existence of residual spaces can be attained (Figures 45-46). Specifically, the correlation of these values is referred to as the **Visual Correspondence Index** (Tables 2-3), serving as one of the metrics used for understanding and classifying residual spaces.

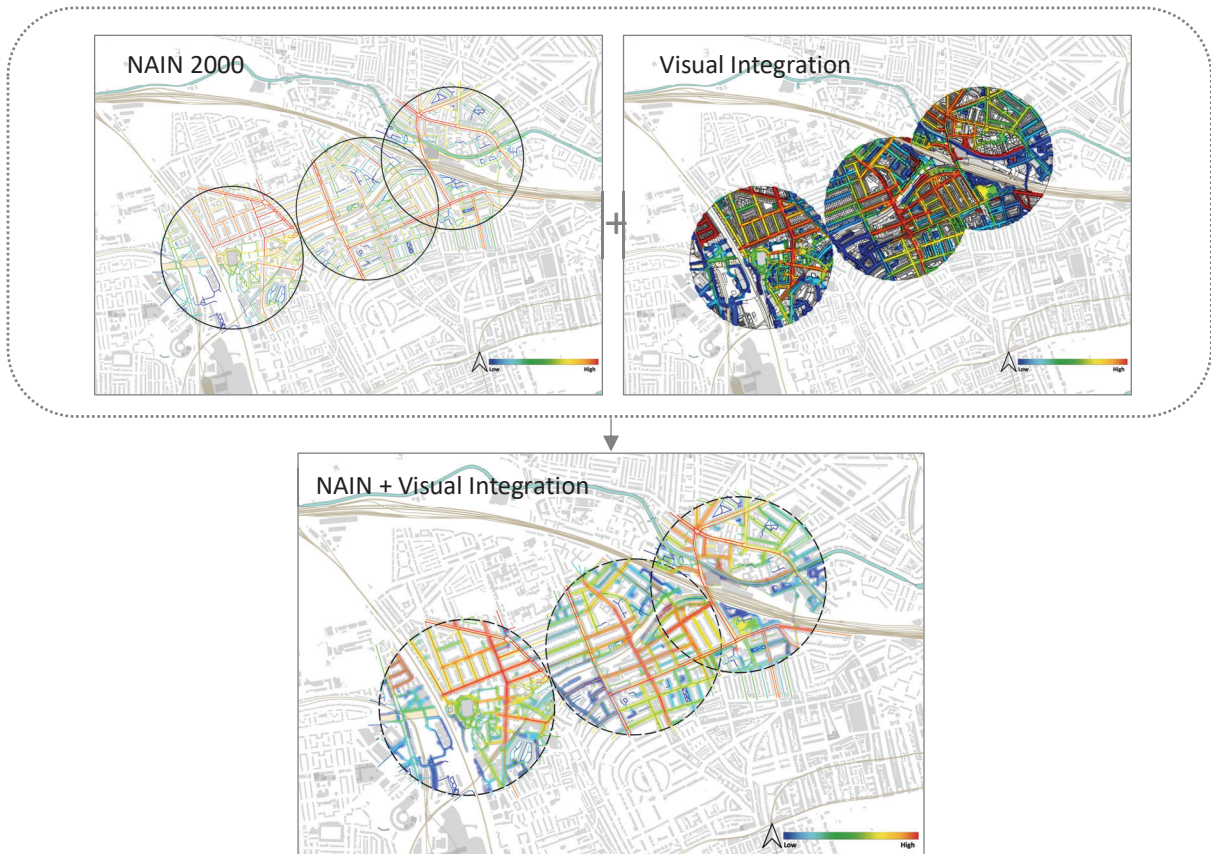


Figure 45. Superimposition of normalised *Integration* (NAIN2000) and Visual Integration analysis composing the Index of Visual Correspondence.

		Correlations									
		NACHr1200m	NACHr1600m	NACHr2000m	NACHr400m	NACHr800m	NAINr1200m	NAINr1600m	NAINr2000m	NAINr400m	NAINr800m
Visual_integration_mean	Pearson Correlation	.045	.049	.049	.019	.035	.374**	.376**	.368**	.277**	.326**
	Sig. (2-tailed)	.221	.187	.183	.615	.344	<.001	<.001	<.001	<.001	<.001
	N	735	735	735	735	735	735	735	735	735	735
Connectivity_max	Pearson Correlation	.197**	.200**	.200**	.122**	.182**	.487**	.486**	.495**	.437**	.477**
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
	N	735	735	735	735	735	735	735	735	735	735
Connectivity_mean	Pearson Correlation	.210**	.213**	.213**	.138**	.196**	.461**	.456**	.461**	.444**	.467**
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
	N	735	735	735	735	735	735	735	735	735	735

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Table 2. Correlation pertaining to Area 1, linking visual integration values on a knee level and accessibility values from pedestrian segment analysis.

By performing a correlation analysis between the mean values of the Visual Integration analysis at knee-level with normalised *Integration (NAIN) and Choice (NACH)*(Appendix 9), from the angular segment analysis of the pedestrian model, the outcomes indicate a substantial Pearson’s correlation coefficient between NAIN2000 and Visual Integration measures in Area1 ($R=0.368$, and correspondent $R^2=0.135$). This is the area in which the largest number of residual spaces, as well as the highest degree of residuality and severity level, have been identified. Lower positive correlation coefficients are found in Area 2 ($R=0.266$, $R^2=0.07$) and Area 3 ($R=0.185$, $R^2=0.03$) (see Table 3).

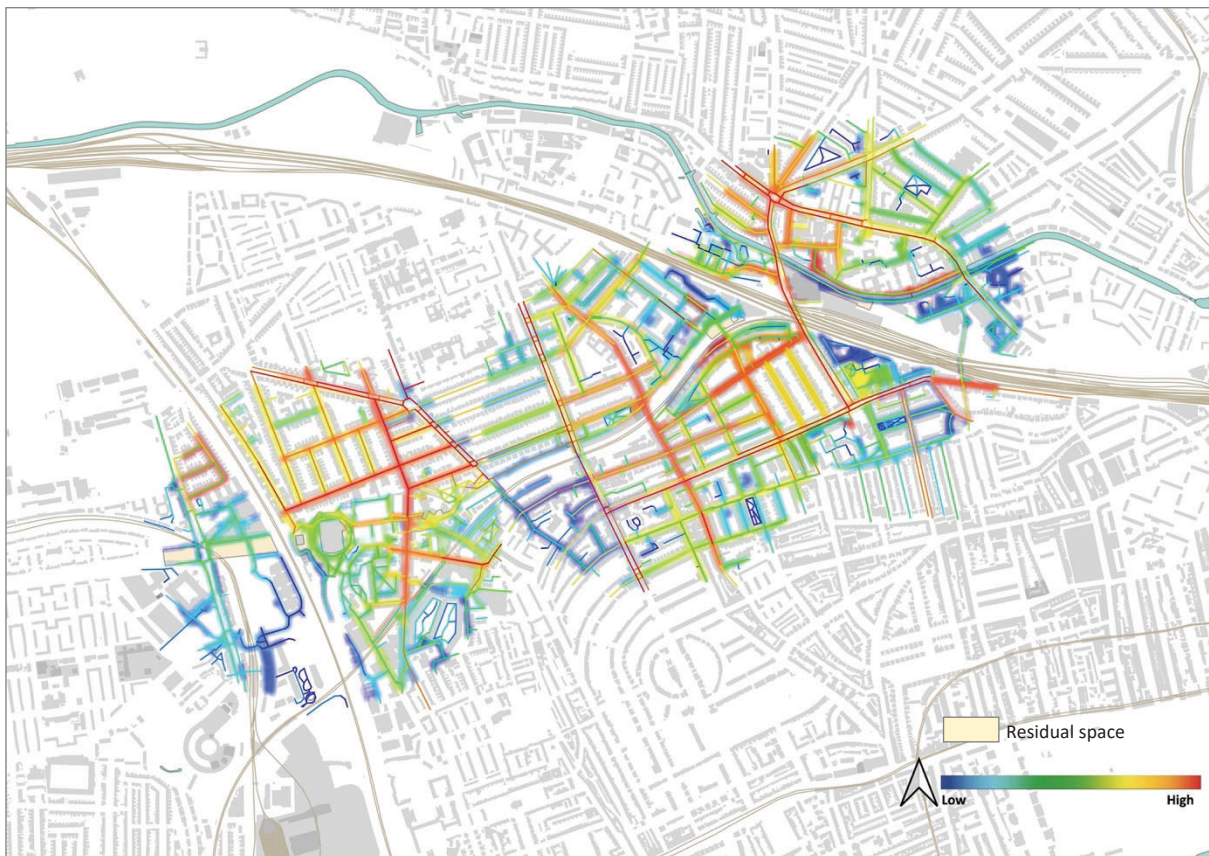


Figure 46. Map of Visual Integration at knee level + NAIN2000 angular analysis on pedestrian model, with identified residual spaces.

	Area 1	Area 2	Area 3
Pearson’s Correlation coefficient (R)	0.368	0.266	0.185
R² (Visual Correspondence Index)	0.135	0.07	0.03

Table 3. Pearson’s Correlation among NAIN2000 and Visual Integration at knee level for all three study areas.

5.2.6 Gate count observations

The conducted gate count observations showcase a predominance of male groups, which could signify a *gender inequality* dynamic in the usage of the selected residual spaces. This aspect aligns with the notion that the physical structure of a place may discourage women from occupying specific city's areas. For instance, factors like inadequate lighting, poor visibility and maintenance conditions seem to affect the way women perceive and experience these places, as shown in the questionnaire findings. Consequently, this prevents the usage of these public areas, mainly at night, with particular disadvantages for women as well as children. The study's findings also underscore a distinction user groups between *Area 1* and *Area 3*, when compared to *Area 2*. Notably, *Area 2*, which includes Portobello Road Market and its commercial activities, exhibits a higher presence of female individuals compared to the other two sites. This area is also where lower residuality levels are depicted.

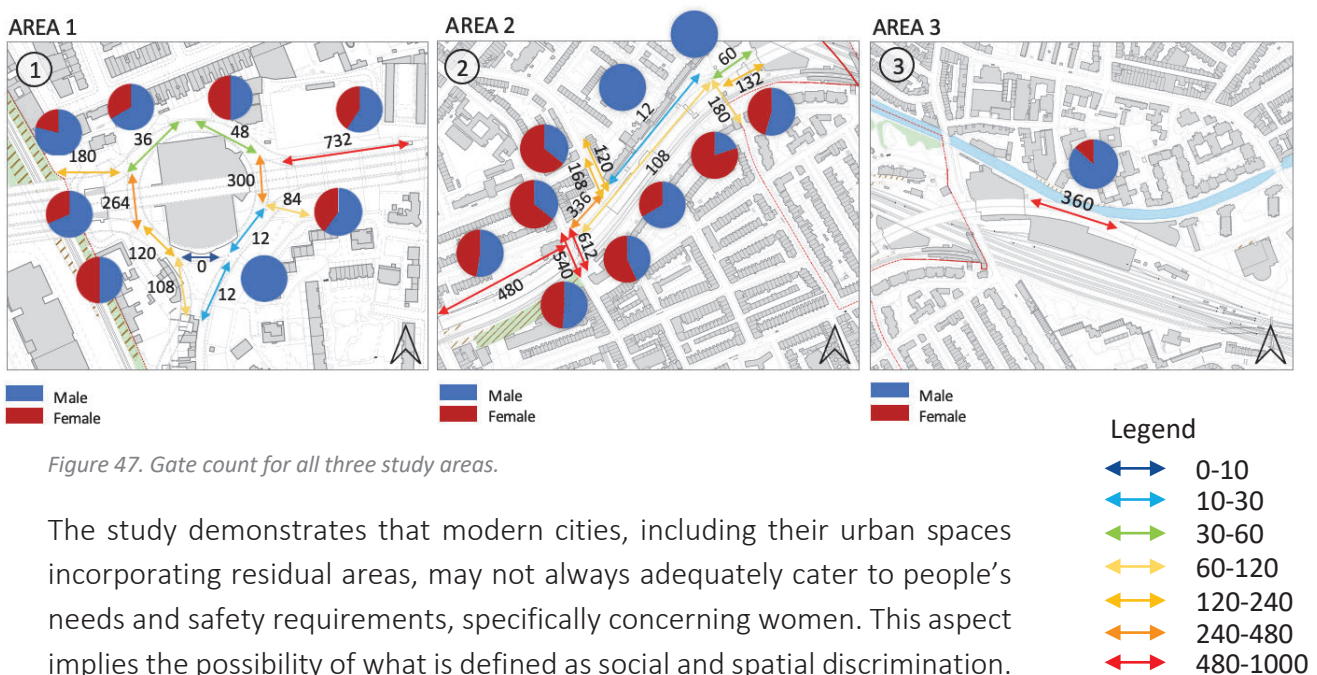


Figure 47. Gate count for all three study areas.

The study demonstrates that modern cities, including their urban spaces incorporating residual areas, may not always adequately cater to people's needs and safety requirements, specifically concerning women. This aspect implies the possibility of what is defined as social and spatial discrimination.

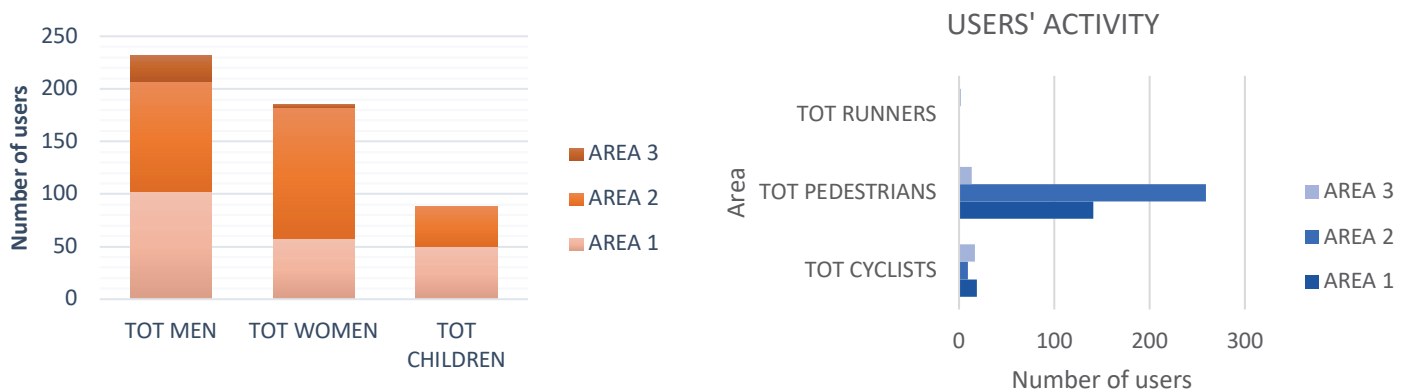


Figure 48. Statistics on gate count observations.

5.2.7 Stationary activity and traces

The stationary activity analysis, combined with the 5-minute trace observations, highlights that there is no relevant sedentary behavioural pattern within any of the three study areas. Conversely, walking and cycling emerge as the prevailing actions. These qualitative observations reveal that people predominantly occupy residual areas as passing corridors, opting against extended standing or sitting in these locations. The factors contributing to the emphasis on this aspect are not solely attributed to the spatial characteristics of this place, such as lack of visibility and at times restricted accessibility, but also encompasses factors like maintenance standards, the absence of urban furniture, and the insufficient presence of lighting. As a result, these elements collectively contribute to the perception of unsafety, thereby creating unwelcoming environments for individuals occupying these spaces. This perspective aligns with findings from the qualitative questionnaires discussed in the following paragraph.

Moreover, this analysis brings to light specific zones within Area 1 that seem to be avoided by most individuals. This particular space, identified as the back side of the sport centre, is notably less attractive and it exhibits low connectivity on both local and global scales when considering the pedestrian segment model. This aspect is paired with a lack of visual integration at a knee level. As a result, addressing these challenging conditions and enhancing the overall context necessitate a targeted strategic approach.

AREA 1

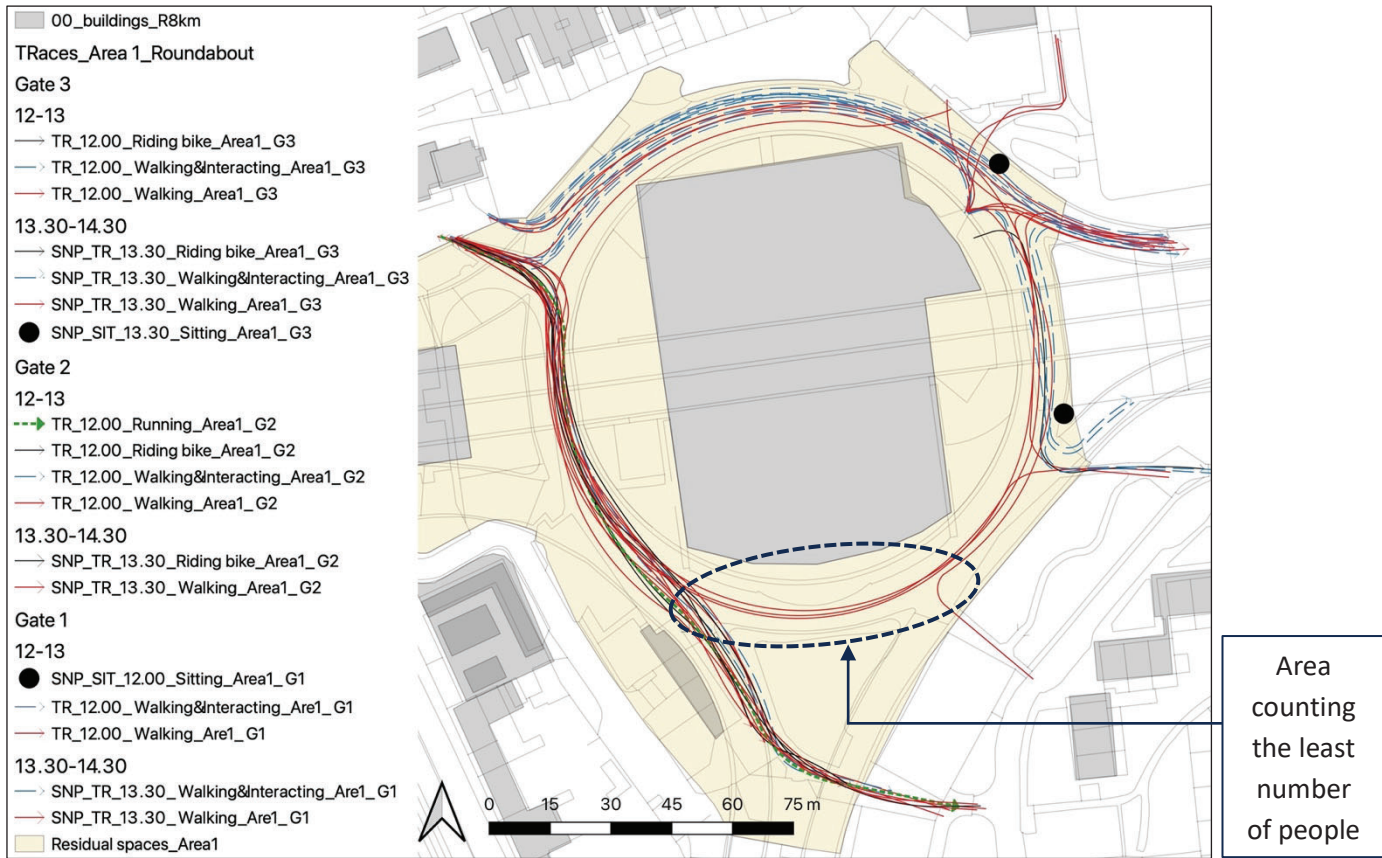


Figure 49. Area1 - Traces and snapshots analysis.

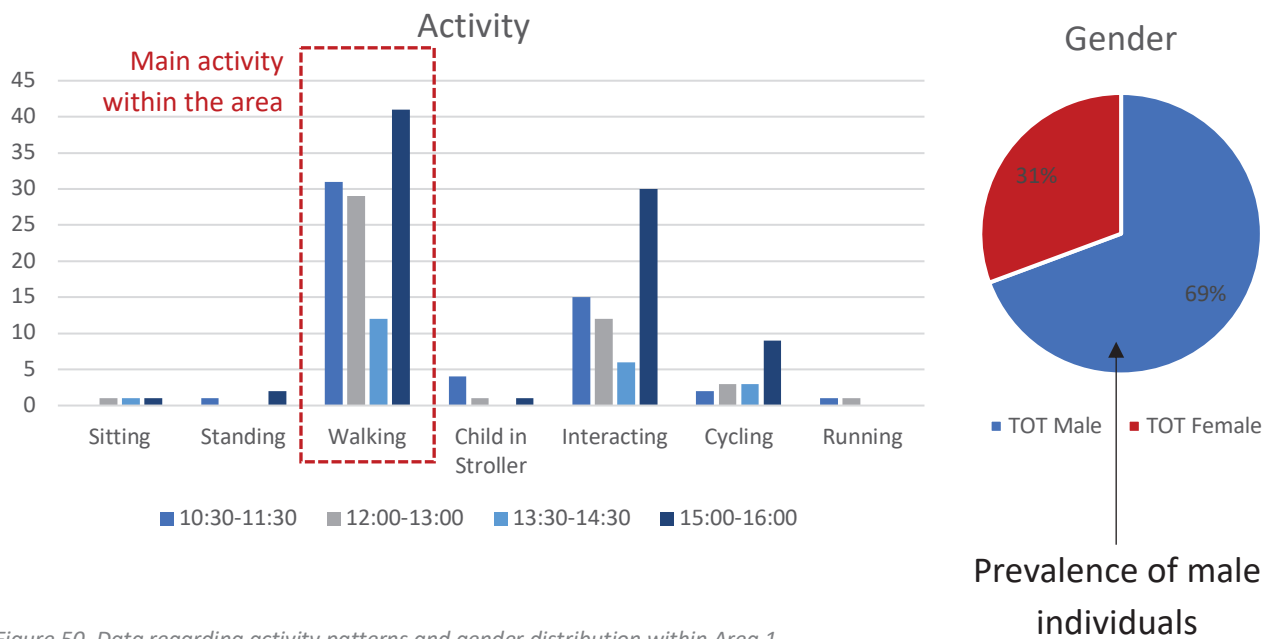


Figure 50. Data regarding activity patterns and gender distribution within Area 1.

AREA 2

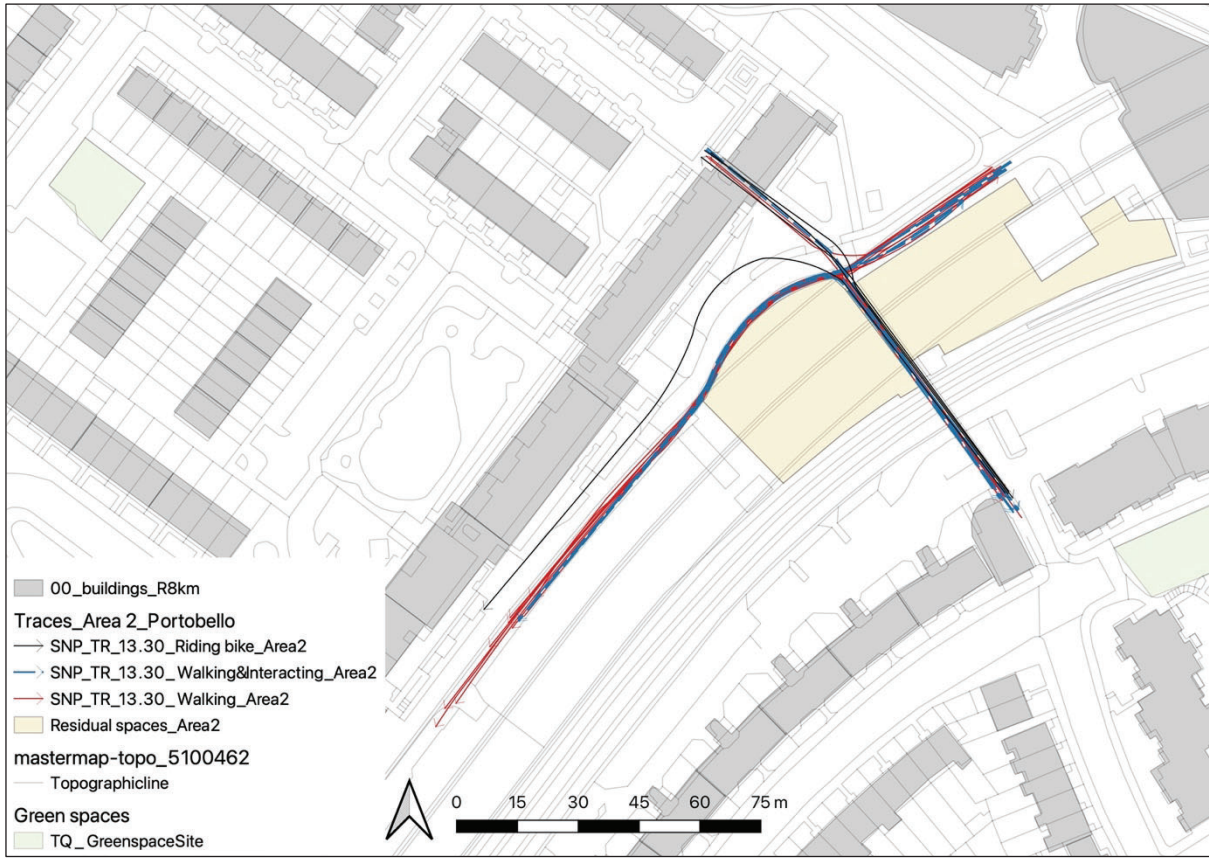


Figure 51. Area2 - Traces and snapshots analysis.

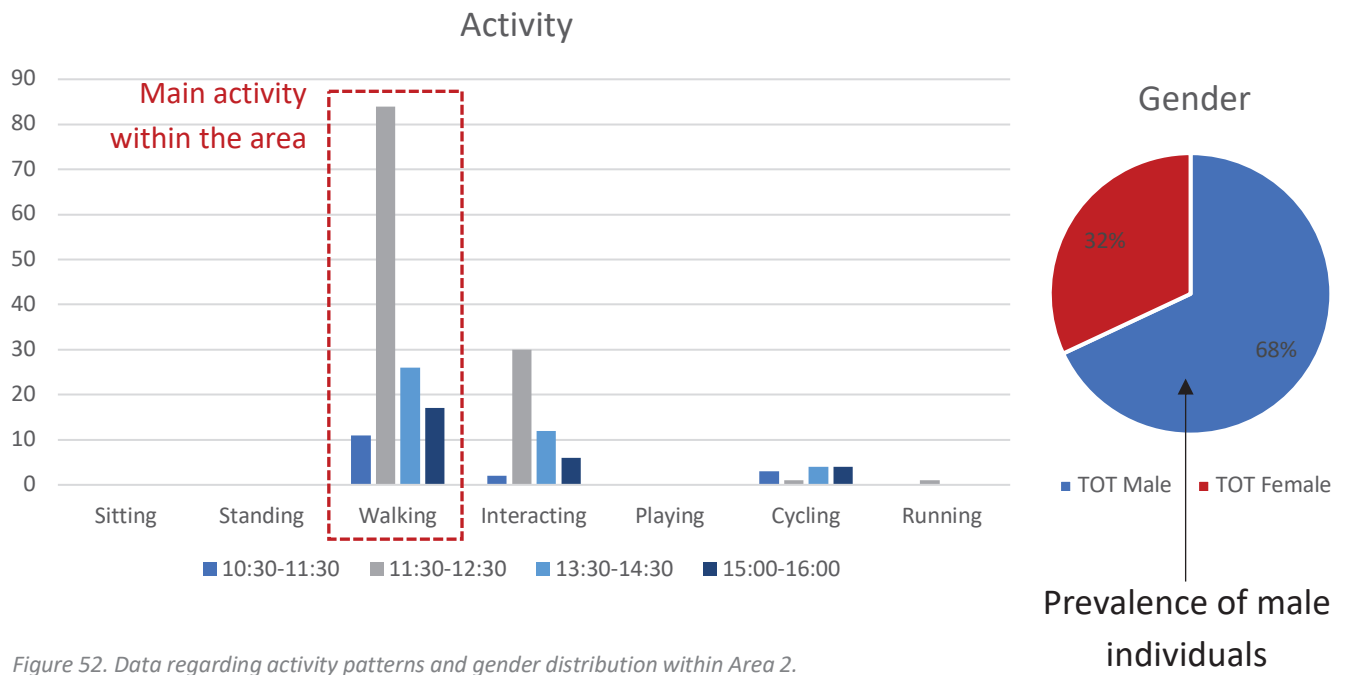


Figure 52. Data regarding activity patterns and gender distribution within Area 2.

AREA 3

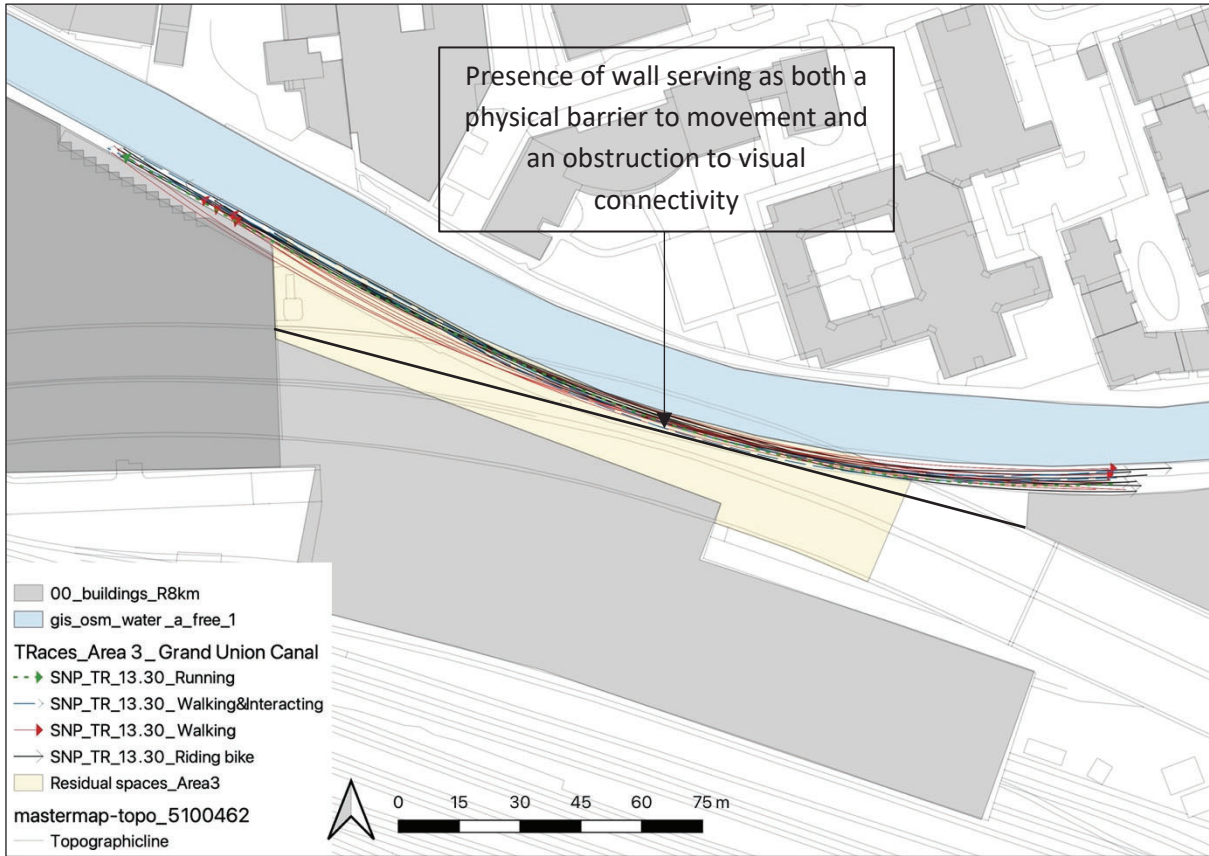


Figure 53. Area3 - Traces and snapshots analysis.

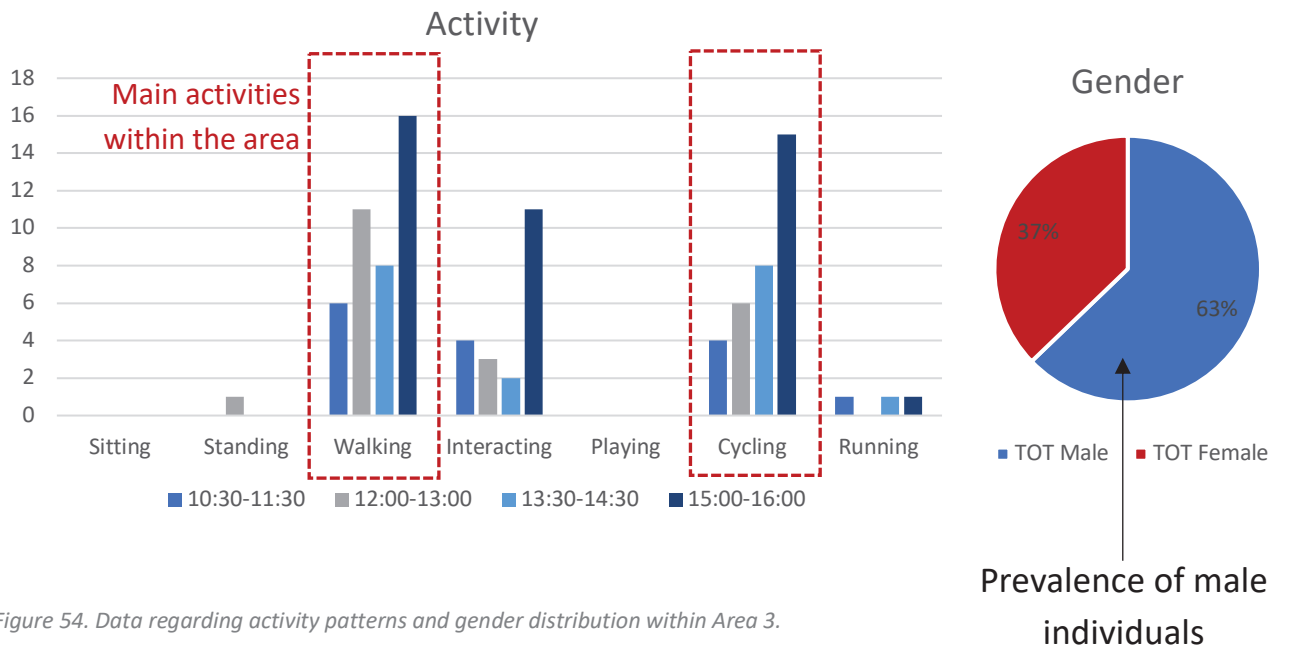


Figure 54. Data regarding activity patterns and gender distribution within Area 3.

5.3 STATISTICAL ANALYSIS

Bivariate correlation analysis is employed to uncover statistically significant relationships among a set of spatial and socio-economic variables within the flyover area beneath the motorway in London. The key finding of this *Pairwise correlation* analysis, based on *Pearson correlation*, and involving all normalised centrality measures extracted from angular segment analysis on the road-centre-line segment model, discloses a strong positive correlation between global and local spatial structure values. Conversely, Deprivation and spatial variables exhibit negative or non-significant correlations, indicating a limited relationship or interdependence among them. Nevertheless, a 0.24 correlation coefficient is yielded between *Retail density* and global normalised *Integration* (*NAIN4000* and *NAIN5000*) factors. Ultimately, a meaningful correlation emerges between House price values (refer to *Appendix 10* for this supplementary study section) and the *Domains of Deprivation* within the designated study site.

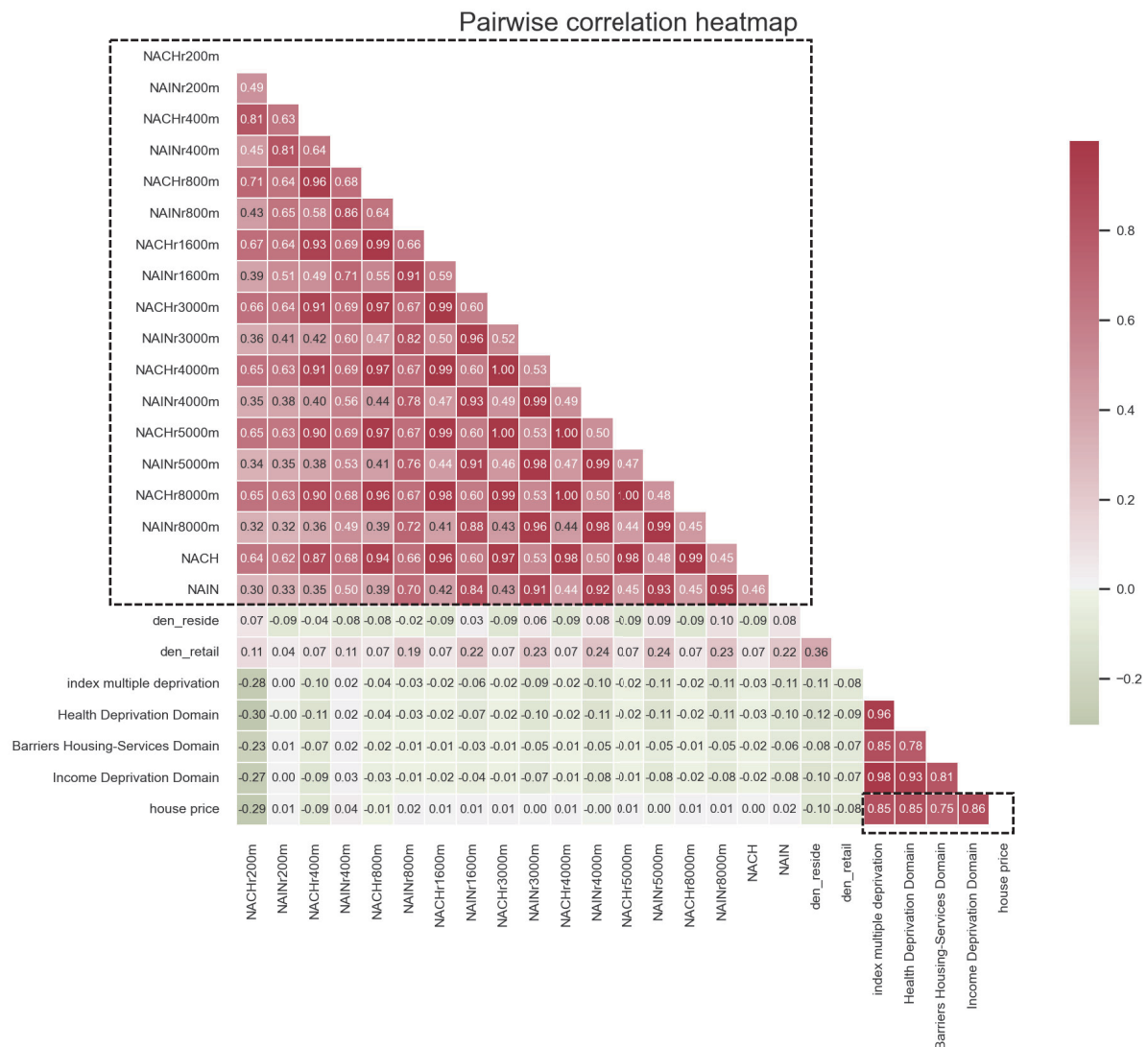


Figure 55. Pairwise Correlation Heatmap-Pearson Correlation across all normalised centrality measures resulting from angular segment analysis on the road-centre-line segment model.

5.4 SURVEY ANALYSIS

Questionnaire surveys are implemented as a systematic and structured method to gather data from a selected group of individuals. Participants are presented with a set of ten predefined questions (Appendix 4) to collect insights into their opinions and experiences regarding residual spaces beneath the elevated sections of the Westway. This approach allows for an exploration of participants’ perceptual considerations while occupying the identified sites, both during day-time and night-time. Specifically, the questionnaire investigates and validates **Hypothesis 5**, which posits that *residual areas involve the perception of unsafe urban environments*. The final goal is to explore the diverse variables implicated in the establishment of insecurity feelings within these areas, providing valuable perspectives for informed decision-making when contemplating potential regeneration proposals.

In summary, the results of the subjective questionnaire, involving a total of **96 participants**, reveal that across all three study areas, the majority of participants consider the urban environment as mostly safe during the daytime, with an average score of 7.4 on a scale from 1 (*least safe*) to 10 (*very safe*) (Table 4). However, a shift occurs for night time, as this rating drops to 4.6, indicating a predominant sense of unsafety according to both genders’ opinions. This trend is also evidenced by the statistic that 48.3% of individuals explicitly confirmed avoiding walking through these areas at night (Figures 57). The gathered data underscores a shared feeling of insecurity among both male and female individuals when traversing residual spaces after dark.

GRAND TOTAL (ALL THREE AREAS)	Female	Avg	7.396	Avg	4.486	Avg	5.941
		Count	48	Count	22	Count	70
		Std. Err	0.282	Std. Err	0.517	Std. Err	0.298
	Male	Avg	7.500	Avg	4.841	Avg	6.171
		Count	48	Count	27	Count	75
		Std. Err	0.249	Std. Err	0.410	Std. Err	0.263
	Total	Avg	7.448	Avg	4.667	Avg	6.058
		Count	96	Count	49	Count	145
		Std. Err	0.187	Std. Err	0.321	Std. Err	0.197
	<i>Daytime</i>			<i>Night-time</i>		<i>Day+Night</i>	

Table 4. Average of perceived safety among the three study areas.

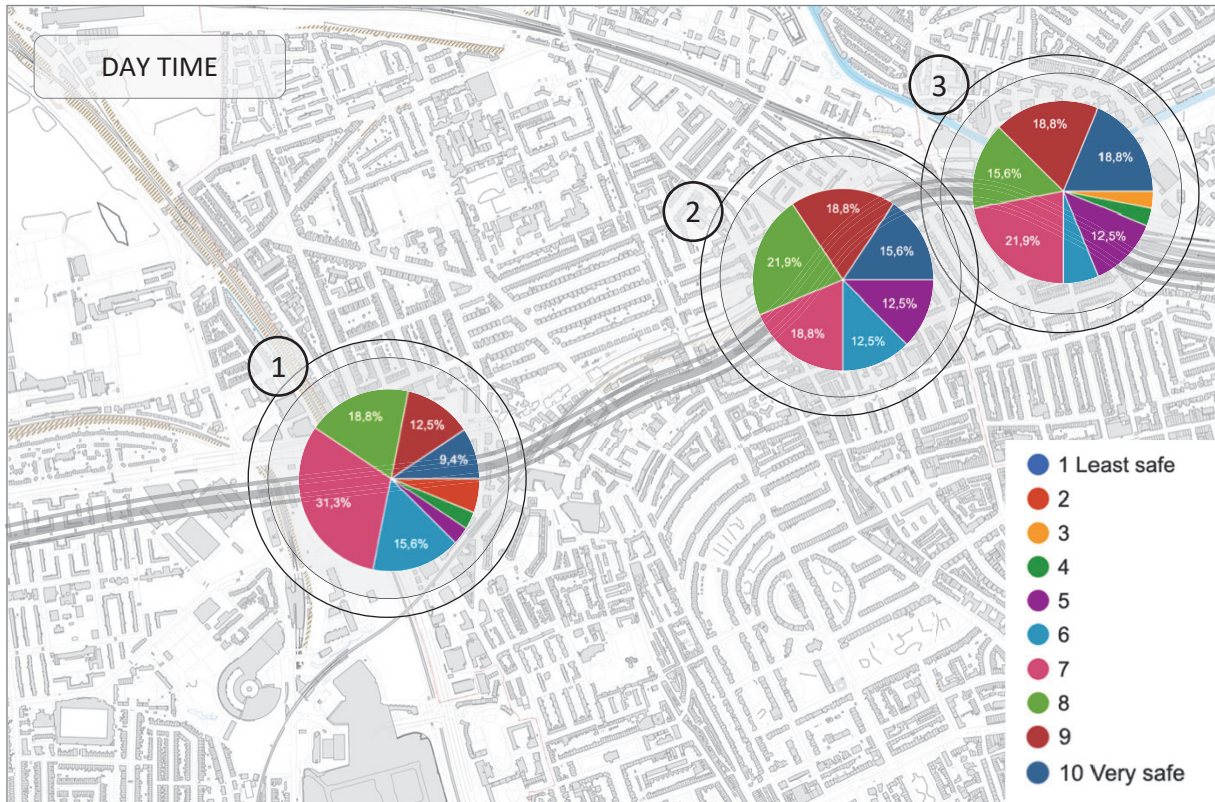


Figure 56. Visualisation data of safety perception daytime.

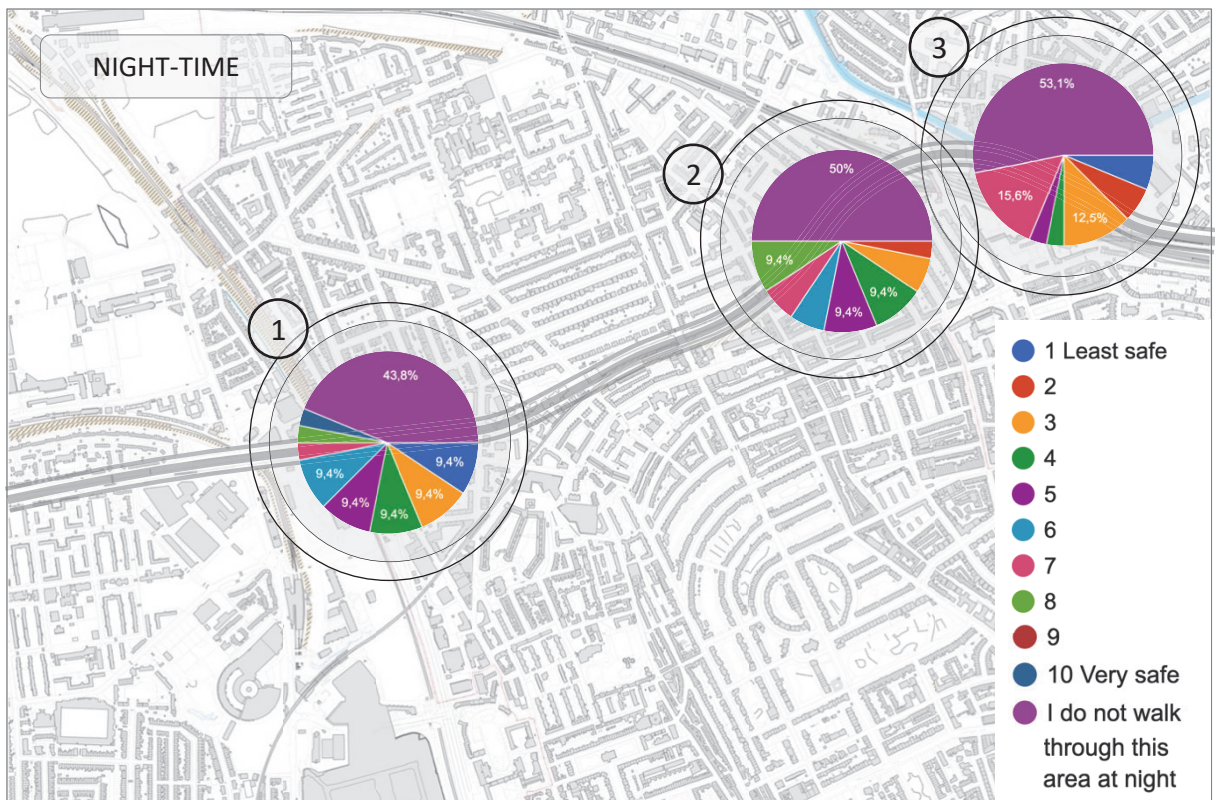


Figure 57. Visualisation data of safety perception night time.

The primary catalyst for this perception is the presence of inadequate urban lighting, as underlined by the outcomes of question 7. This factor, coupled with earlier findings from the stationary activity and traces analysis, emphasises that residual spaces stand apart from other urban areas within the city. In contrast, they are perceived as exceptions lacking attractiveness, liveability, and safety.

In this regard, it is important to highlight that the statistical data (Figure 58) indicates a higher degree of safety concerns among female participants when compared to men’s responses. This aspect highlights how women tend to be more influenced and susceptible to the impacts of such complex and challenging urban environments.

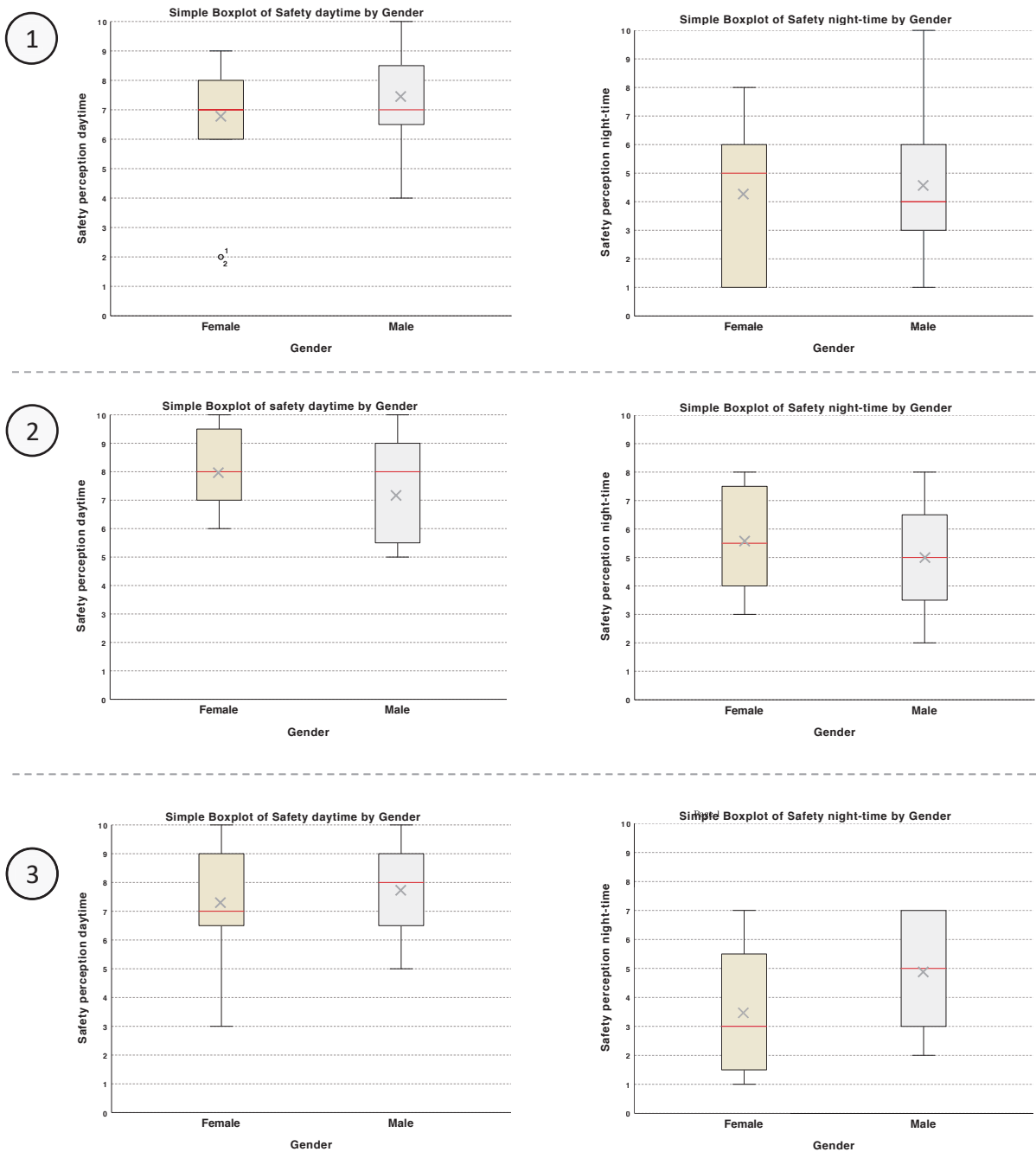


Figure 58. Box plots of safety perception among male and female participants within the three study areas.

**LACK OF SENSE
OF SAFETY AT
NIGHT**



INTERVIEW 1:

"I feel quite safe here during the day but I don't walk across this area when it's dark due to lack of lighting"

Woman carrying a stroller with a baby, encountered while walking in the flyover Area 1. Comment on the question regarding whether she felt comfortable walking through that space.

**LACK OF SENSE
OF SAFETY DUE
TO POOR
VISIBILITY**



INTERVIEW 2:

"Something that makes me feel less safe both day and night time, is the fact that I cannot see through the entire space. For example, I don't know if there are people around the corner."

Woman met while walking in the flyover Area 1. Comment on the question regarding whether she felt safe or unsafe while occupying that flyover space.

Additionally, the collected data shows that the majority of participants employ these sites primarily as passageway for walking (53.1% in Area 1, 31.3 % in Area 2, and 75% in Area 3) and functional activities (37.5%, 62.5%, and 37.5% respectively), which include commuting to their home or workplace. This observation reinforces the notion that people tend to avoid gathering or spending prolonged periods within these unwelcoming areas.

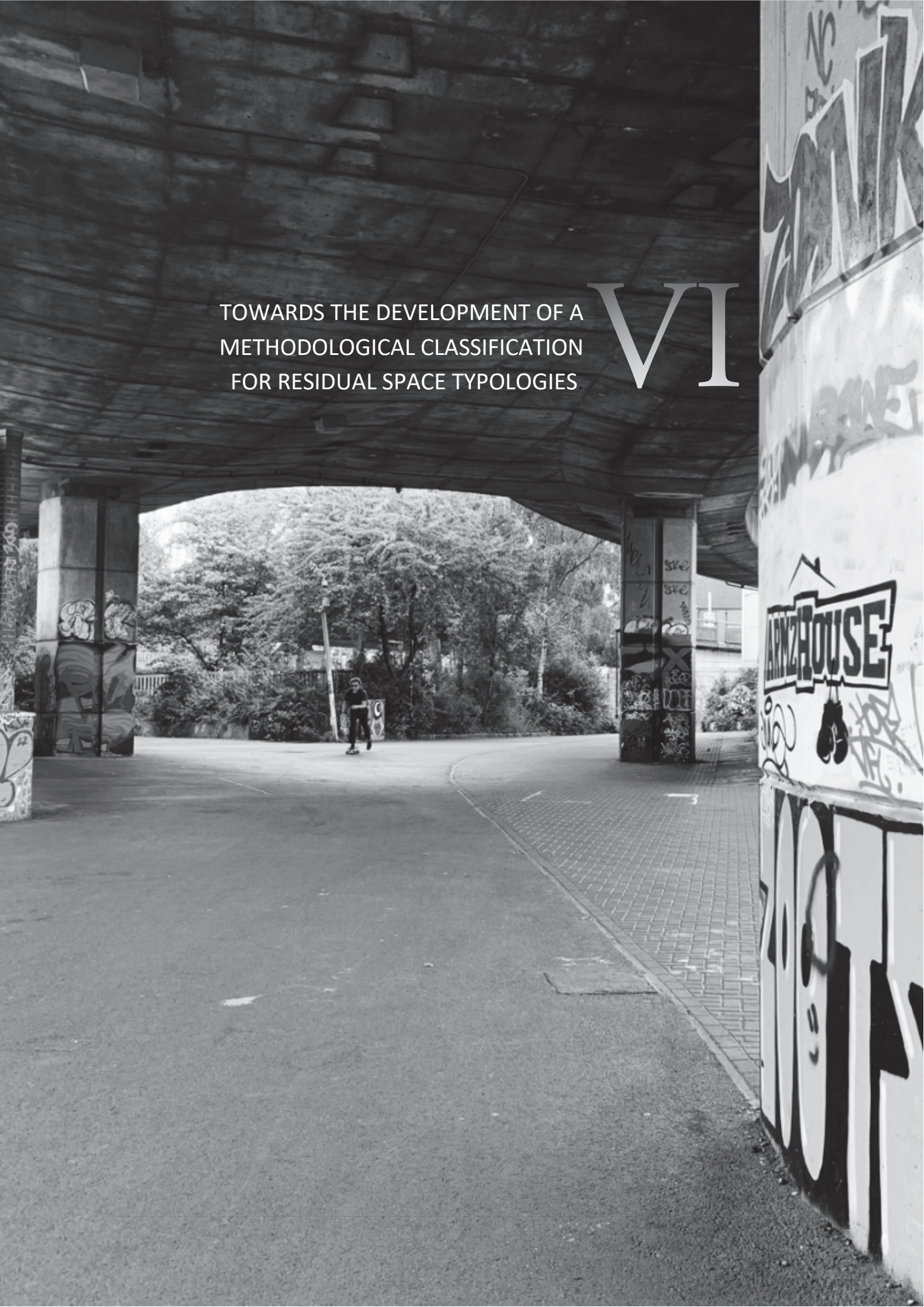
Ultimately, pertaining to potential enhancements for these study sites, a significant proportion of participants expressed the desire for improvements in lighting (59.52 % collectively across all three areas), in paved surfaces (24.96%), and the introduction of more green spaces (27.84%) (responses to question 10 in Appendix 4). These data will serve as a foundational framework for shaping the proposed design plan shown in Chapter 7, aimed at regenerating the identified residual areas.

5.5 CONCLUSION

This chapter addressed the overarching research question: ***What are the existing spatial characteristics of the residual spaces resulting from Westway's presence, and how do these characteristics influence the behavioural, social, and economic conditions of the urban spaces within and around them?*** Through a series of quantitative and qualitative analyses, along with on-site observations, the places underneath and around the Westway were comprehensively explored. The initial examination regarding the spatial structure unveiled that residual areas tend to be concentrated predominantly in regions showcasing limited connectivity. Additionally, the presence of adverse socio-economic challenges revealed a high concentration of deprivation affecting the flyover areas and their surroundings. This condition has exacerbated the marginalisation of economically disadvantaged regions and fostered social division among local communities. Furthermore, poor land use diversity and reduced visual relationships have influenced the low usage patterns of the examined areas, contributing to the establishment of a sense of unsafety within these disregarded places. Consequently, this has had a negative impact on the liveability and consideration of the same areas.

TOWARDS THE DEVELOPMENT OF A
METHODOLOGICAL CLASSIFICATION
FOR RESIDUAL SPACE TYPOLOGIES

VI



Chapter 6

6. TOWARDS THE DEVELOPMENT OF A METHODOLOGICAL CLASSIFICATION OF RESIDUAL SPACE TYPOLOGIES.

6.1 INTRODUCTION

Residual spaces, as advocated by numerous scholars, are dispersed throughout the urban fabric and demand a multidisciplinary approach for a comprehensive understanding. Previous studies have endeavoured to identify and characterise these areas (Lauria & Vessella, 2021; Villagomez, 2010). Nevertheless, the existing literature still lacks a systematic and objective categorisation system for assessing residual spaces. Therefore, this chapter aims to establish a structured methodological framework to comprehensively analyse residual spaces. Specifically, though the definition of a *Residuality Assessment Process*, the dynamic interplay of spatial, social, and perceptual factors influencing the adverse condition of neglected sites is assessed. The initial analytical phase involves the identification and mapping of residual areas beneath the Westway in London based on their attributes. Secondly, a classification procedure is introduced to scrutinise the current state of these informal public spaces, encompassing diverse analyses and data typologies used in the definition of an “*Index of residuality*”.

The pivotal question tackled in this chapter is: *In which way can we systematically classify residual urban spaces beneath elevated transport infrastructures in terms of their spatial and social attributes, with the aim of enhancing our understanding and informing current and future intervention initiatives?* This study section provides a research-driven and evidence-based answer to this inquiry, employing a structured analytical investigative approach.

6.2 MAPPING RESIDUAL SPACES

The first phase of the *Residuality Assessment Process* entails mapping all residual areas beneath the Westway, as depicted in *Figure 59*. These sites are mostly situated in proximity of spatially isolated areas characterised by a lack of land use diversity and visual connectivity.



Figure 59. Maps of residual spaces identified underneath three sections of the Westway.

6.3 CLASSIFICATION PROCEDURE: FROM RESIDUALITY FACTORS TO SPATIAL AND SOCIAL ISSUES

The presented classification system constitutes a methodological approach developed by combining research and literature review on the concept of “residuality”, coupled with extensive analyses and on-site observations (Figure 60).

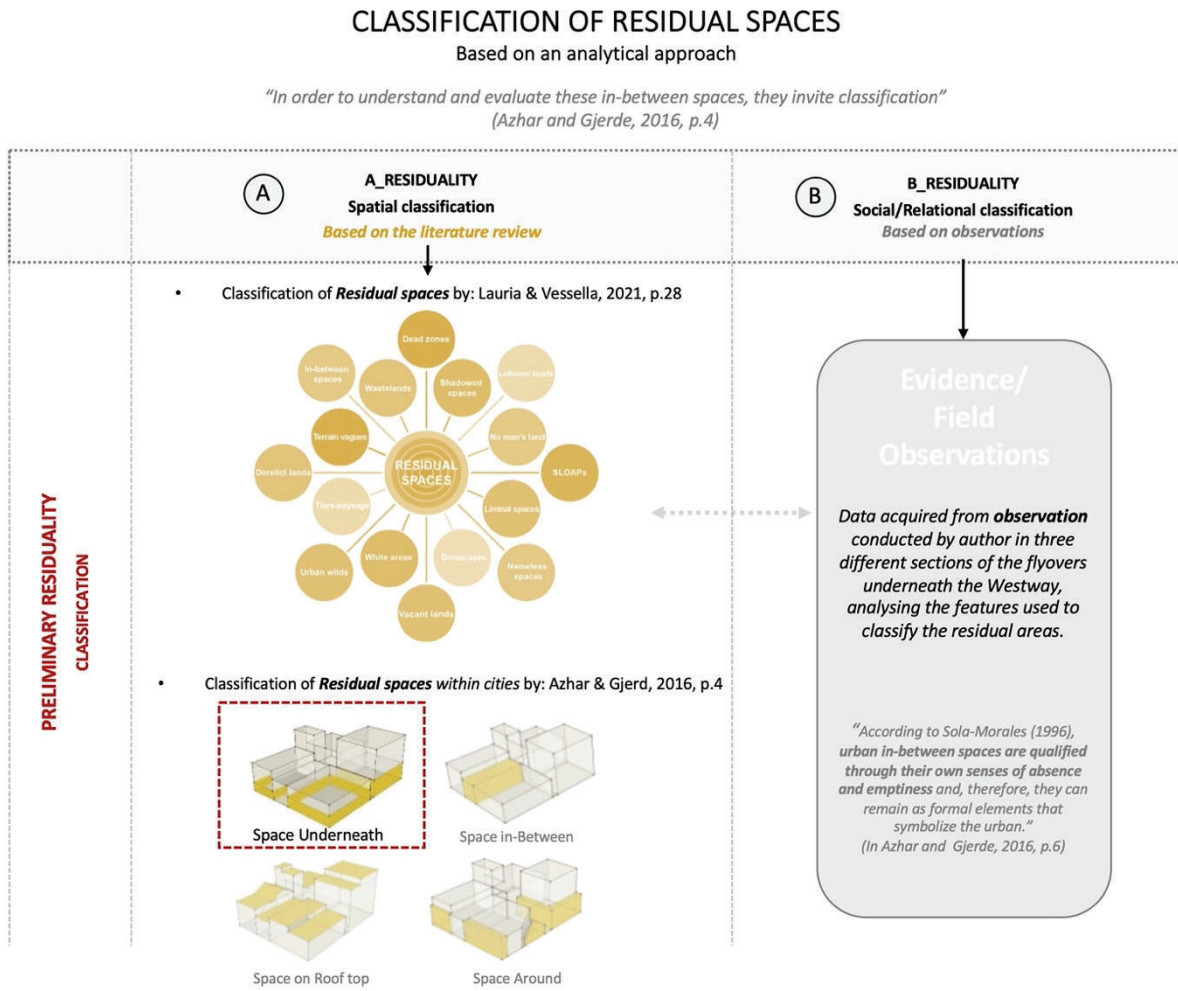


Figure 60. Preliminary step of Residuality Assessment Procedure.

The entire analytical process is structured into four distinct phases, or levels of knowledge, each designed to frame the categorisation procedure for identifying the residuality nature of a given urban area. The initial phase involves evaluating the *Expressions of residuality*, encompassing *Decay (physical and social)*, *Improper usage*, and *Absence of people/Emptiness* (Figure 61). This preliminary assessment relies on a subjective approach grounded on on-site survey and observational analysis, providing a first understanding of the overall conditions of the areas. Progressing to the second, third, and fourth stages, the research endeavours to identify intrinsic, use related, and semantic aspects through a series of quantitative spatial, socio-economic, perceptual, and visual graph analyses. The classification system’s final stage,

which entails outlining the resulting spatial and social issues stemming from the conducted examinations, ultimately seeks to categorise neglected urban spaces.

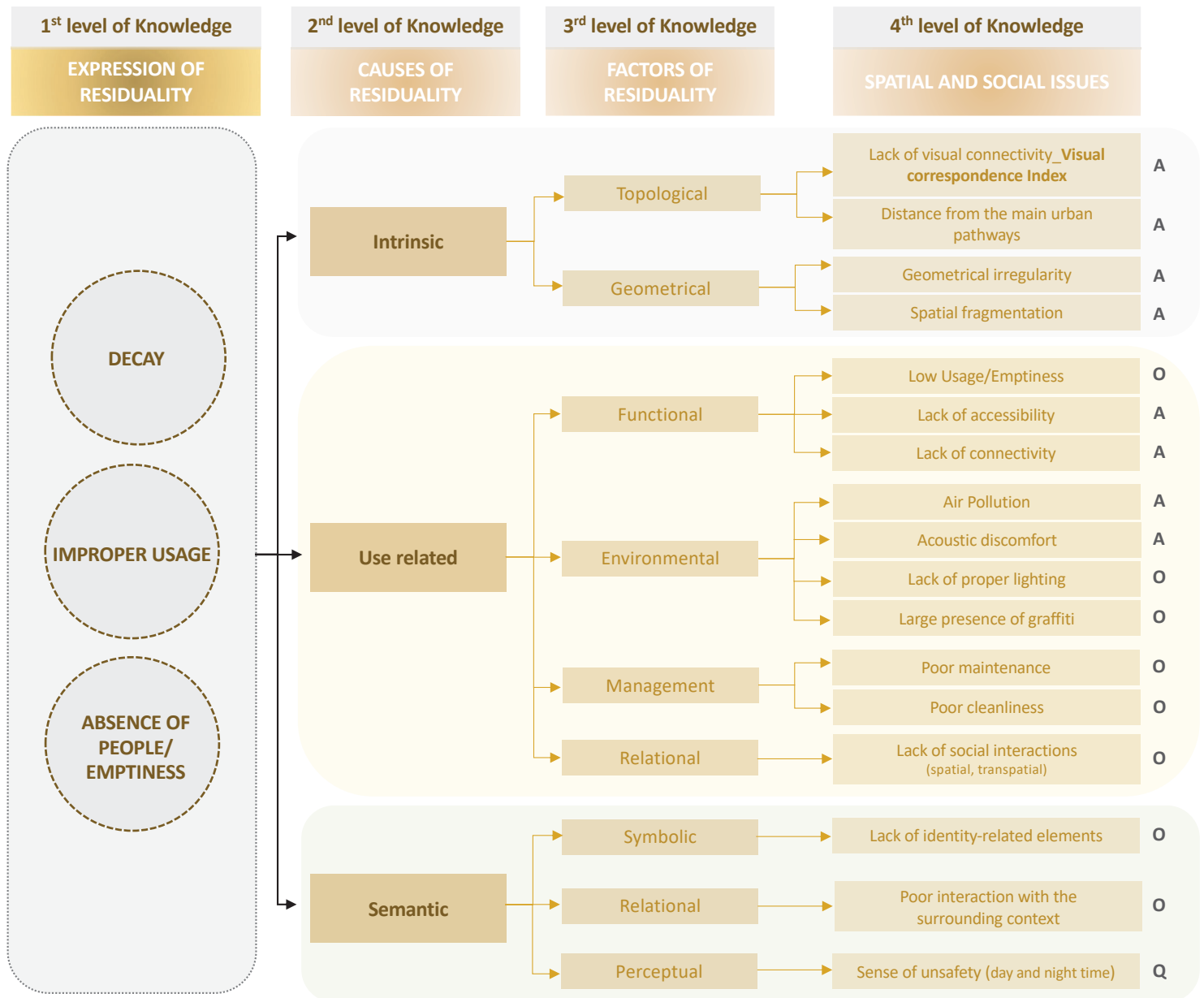


Figure 61. Classification methodology consisting of four main levels of knowledge.

Legend

- O** Field Observation
- A** Data Driven Analysis
- Q** Questionnaire

Note: A methodological system including provisional weight values assigned to each spatial and social factor, can be found in Appendix 8.

Afterwards, a proposed scale is organised into three main **Residuality degrees** or residuality tiers, by observing in each site the presence of instances of “Expressions of residuality”, as illustrated in Figure 62 (top). Each tier corresponds to the number of residuality expressions identified. A space is deemed to possess low residuality when only one of the three expressions occurs, medium when two are observed, and high when all three are detected. Additionally, a **Severity level** of residuality is calculated by referring to the count of spatial and social issues detected within the examined space (fourth level of knowledge), as explained in Figure 62 (bottom). The severity is also organised into three tiers, where a count up to five instances of spatial and social issues denotes the first level of severity, a count up to ten instances indicates the second level, and higher counts express the third and last level.

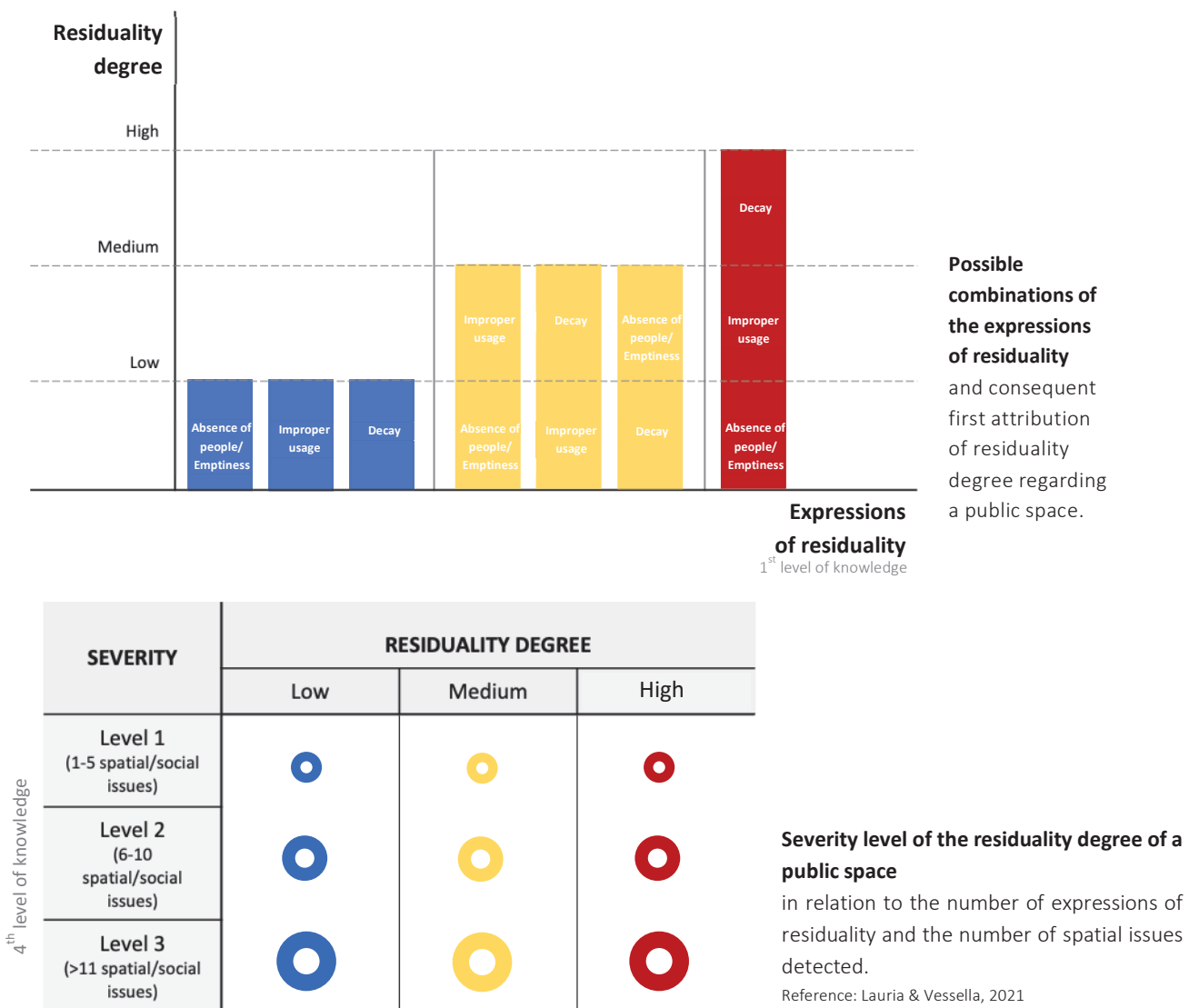


Figure 62. Classification system for assessing Residuality degree and Severity level of an urban area. The colours indicate the residuality degree from low to high. The size of the circle designates the severity level of residuality.

Figure 63 depicts how the classification symbol labels change in colour according to their residuality tier (blue for “Low”, yellow for “Medium”, red for “High”) and size according to their

severity level. These labellers are later used in maps to illustrate the resulting class of residual spaces (Figures 63-64).

6.4 AN INWARD INSIGHT ON RESIDUAL SPACES

The map displayed in Figure 63 presents the previously mapped residual spaces (showcased in Figure 59), categorised based on their residuality degree and severity level according to the classification tables provided in Figure 62. The outcomes underscore that spaces manifesting the highest residuality degree and severity level tend to cluster in regions where, according to prior analyses, there is generally low spatial connectivity and accessibility, lack of visual integration on a knee-level, poor land use diversity, and relatively minimal presence of people (particularly female individuals).

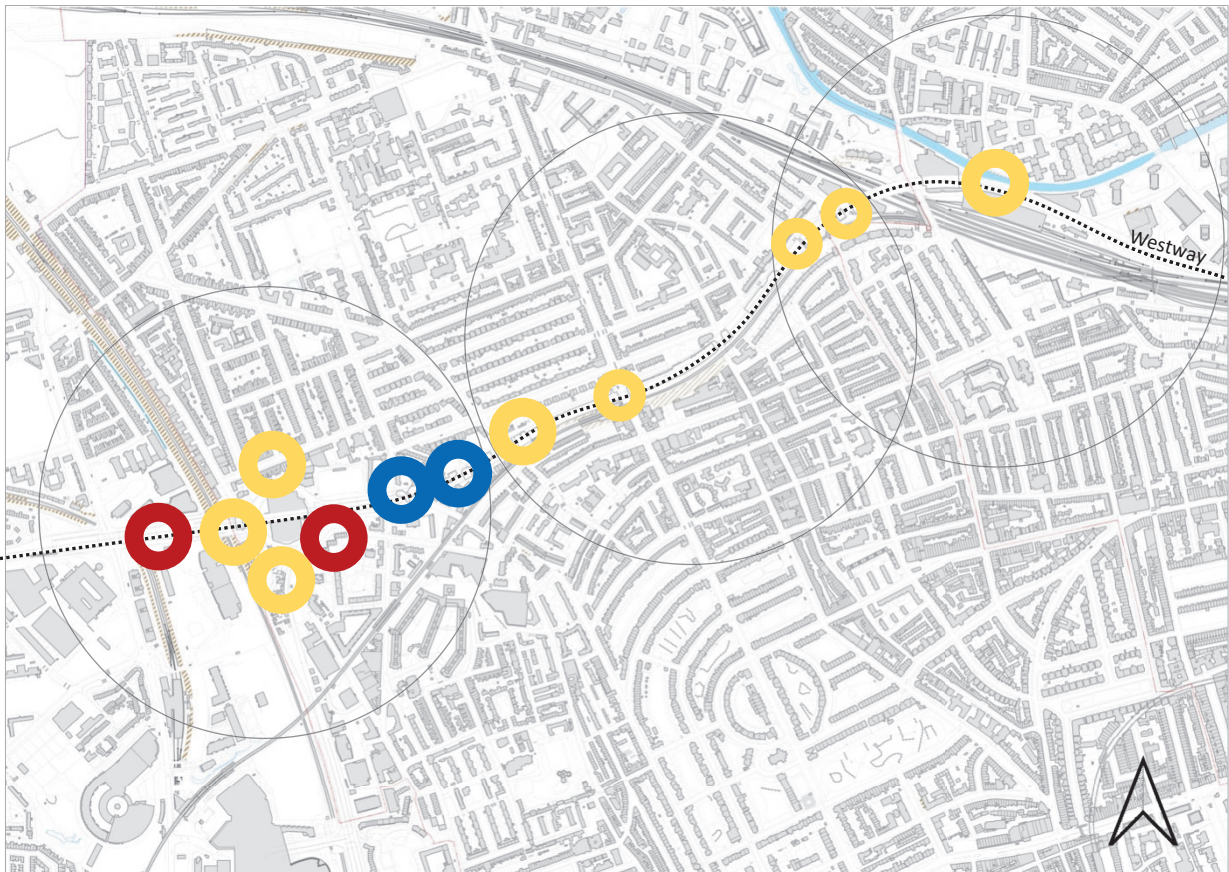


Figure 63. Map of residual spaces classified according to their residuality degree and severity. Source: author.

Legend

Residuality Degree

- Low
- Medium
- High

Severity Level

- Level 1
- Level 2
- Level 3

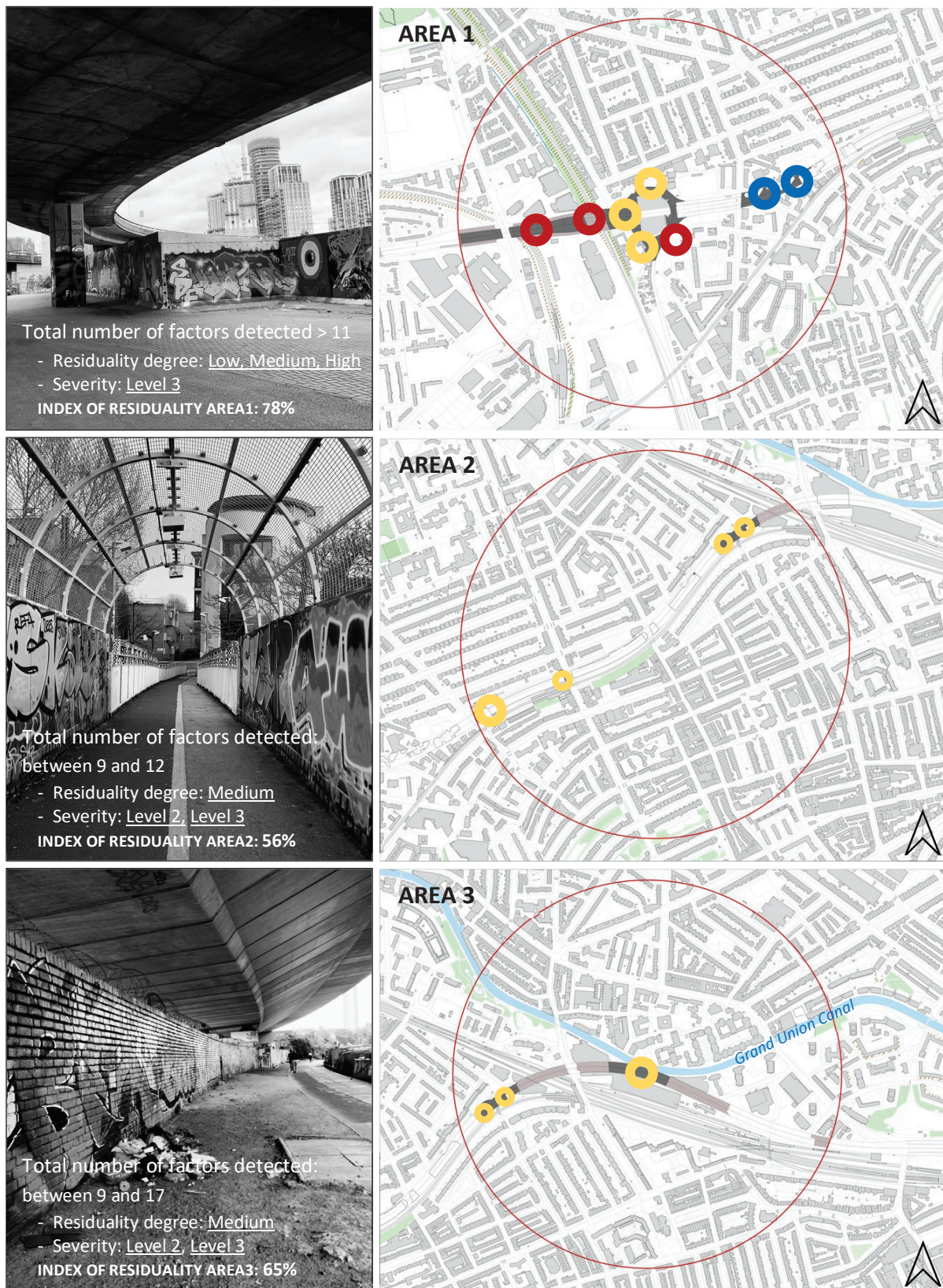


Figure 64. Mapping residual spaces across the three study areas.

The combination of all spatial and social factors identified in each area leads to the formulation of an *Index of Residuality*, with the intention of pinpointing the primary causes contributing to the emergence of informal residual settings. More specifically, the culmination of the process involves the conversion of all detected variables into a single cumulative average value, expressed as the “*Area Residuality Index*”. This unified value, which is later converted into percentage for easier comprehension, facilitates a more effective comparison of residuality measurements across diverse regions, allowing for a broader understanding of the urban space, and providing an efficient analytical system for assessing the current condition of an area. *Table 5* illustrates the initial procedure of identifying all the factors within Area 1, offering a representative instance of the methodology employed across all residual areas to eventually obtain the above-mentioned index, displayed in *Table 6*. The corresponding tables for Area 2 and 3 are provided in Appendix 6.

AREA	AREA 1 a	AREA 1 b	AREA 1 c	AREA 1 d	AREA 1 e	AREA 1 f	AREA 1 g	AREA 1 h
INTRINSIC								
Lack of visual connectivity_Visual correspondence Index	x	x	x	x	x	x	x	x
Distance from the main urban pathways		x			x	x		
Lack of local accessibility		x						
Lack of local connectivity			x	x	x	x		
Geometrical irregularity	x	x	x	x	x	x	x	x
Spatial fragmentation			x				x	x
USE RELATED								
Low usage/Emptiness	x	x	x	x	x	x	x	
Poor land use diversity	x	x	x	x		x		x
Air Pollution	x	x	x	x	x	x	x	x
Acoustic discomfort	x	x	x	x	x	x	x	x
Lack of lighting	x	x	x	x	x	x	x	x
Large presence of graffiti			x		x	x	x	x
Poor maintenance	x	x	x	x	x	x	x	x
Poor cleanliness	x	x	x		x	x	x	x
Lack of social interactions	x	x	x		x	x	x	x
SEMANTIC								
Lack of identity-related elements	x	x	x	x	x	x		
Poor interaction with surrounding	x	x	x	x	x	x	x	x
Unwelcomed and unsafe environment	x	x	x	x	x	x	x	x
TOT FACTORS	13	15	16	12	15	16	13	13
RESIDUALITY INDEX Percentage	72%	83%	89%	67%	83%	89%	72%	72%
Area Residuality Index (Mean)_Area 1	14.1 = 78%							

Table 5. Identification of intrinsic, use related, and semantic factors within Area 1, with corresponding measurement of the Area Residuality Index from the combination of all the factors.

	Area 1	Area 2	Area 3
Residuality Index per Area (Average across residual spaces within areas)	0.78	0.56	0.65
Residuality Index per Area % (Average across residual spaces within areas)	78%	56%	65%

Table 6. Residuality Index per Area across all three study sites.

However, it is crucial to underline that different factors might have varying impacts on the classification outcome and the resultant Index of Residuality. Therefore, a weighting system can be introduced and thoroughly developed in subsequent studies. An illustrative example of the potential weighting structure has been included in Appendix 8. Nonetheless, this represents a preliminary model, and future research is required to refine and validate the assigned weighting values. It is also important to note that the defined categorisation does not represent a fully inclusive and exhaustive analytical system, but rather a contribution towards the development of a broader picture, which could be implemented and expanded in future studies.

6.5 CONCLUSION

The established classification attempted to unpack the key factors that generally define the character and level of residuality within urban spaces through the identification of an *Area Residuality Index*. The categorisation method revealed that the majority of residual spaces along the Westway exhibit a medium or high degree of residuality, as in most cases the identified forms of residuality – *Decay (physical and social), Improper use, and Absence of people/Emptiness* – occurred in combination rather than singularly. Moreover, many of these spaces were classified as Level 2 or Level 3 in severity, indicating that numerous *spatial issues* (such as physical obsolescence, lack of maintenance, and physical incivilities like graffiti) along with *social issues* (in form of antisocial behaviours), were depicted in each of the three study sites. In summary, the analysis conducted using this analytical framework revealed a distinct interaction among all the expressions of residuality, which vary based on the spatial, visual, and perceptual characteristics of a given context.

In conclusion, this methodology established a structured *Residuality Assessment Process* with the purpose to have broader applicability across various urban scenarios worldwide. Through the employment of this analytical approach, the ultimate goal is to interpretate, categorise, and better comprehend residual areas on a citywide scale, in order to comprehensively formulate potential regeneration strategies.

UNLOCKING THE POTENTIAL OF
URBAN RESIDUAL SPACES:
STRATEGIES FOR REGENERATION

VII



Chapter 7

7. UNLOCKING THE POTENTIAL OF URBAN RESIDUAL SPACES: STRATEGIES FOR REGENERATION

7.1 INTRODUCTION

The previous spatial and socio-economic analysis discussed in Chapters 4 and 5, along with the subsequent classification of residual spaces in Chapter 6, played a crucial role in understanding the key spatial and socio-economic aspects of the study site. This analytical approach framed the structure for devising regeneration strategies by identifying the main strengths and challenges of the areas, with the aim to enhance their overall condition. As Hanson and Hillier states, public space has the potential to “*reassemble what society divides*” (1987, p. 265). For this reason, it is crucial to strategically design overlooked areas, transforming them into renewed and welcoming sites.

The objective of this chapter is to assess the possibilities of enhancing the identified residual areas by implementing regeneration strategies. This is accomplished through the application of an evidence-based, data-driven approach. The first section of the chapter outlines the site’s potential and challenges through a SWOT analysis. Subsequently, a design proposal specifically targeting Area 1, is presented. The suggested solution is supported by spatial and visual analysis, which seeks to improve the overall site’s condition.

7.2 ASSESSING THE URBAN SYSTEM’S STRENGTHS AND WEAKNESSES

In the quest to evaluate the influential factors affecting the success of urban spaces, it is fundamental to examine both the potential and challenges inherent in an urban system. Urban structures embrace complexities that require thoughtful consideration when defining strategic proposals aimed at improving the condition of problematic areas like residual spaces. The illustration presented in *Figure 65* provides a schematic depiction of key strengths, weaknesses, opportunities, and threats pertaining to the study area. These findings derived from the former analysis and observations conducted.

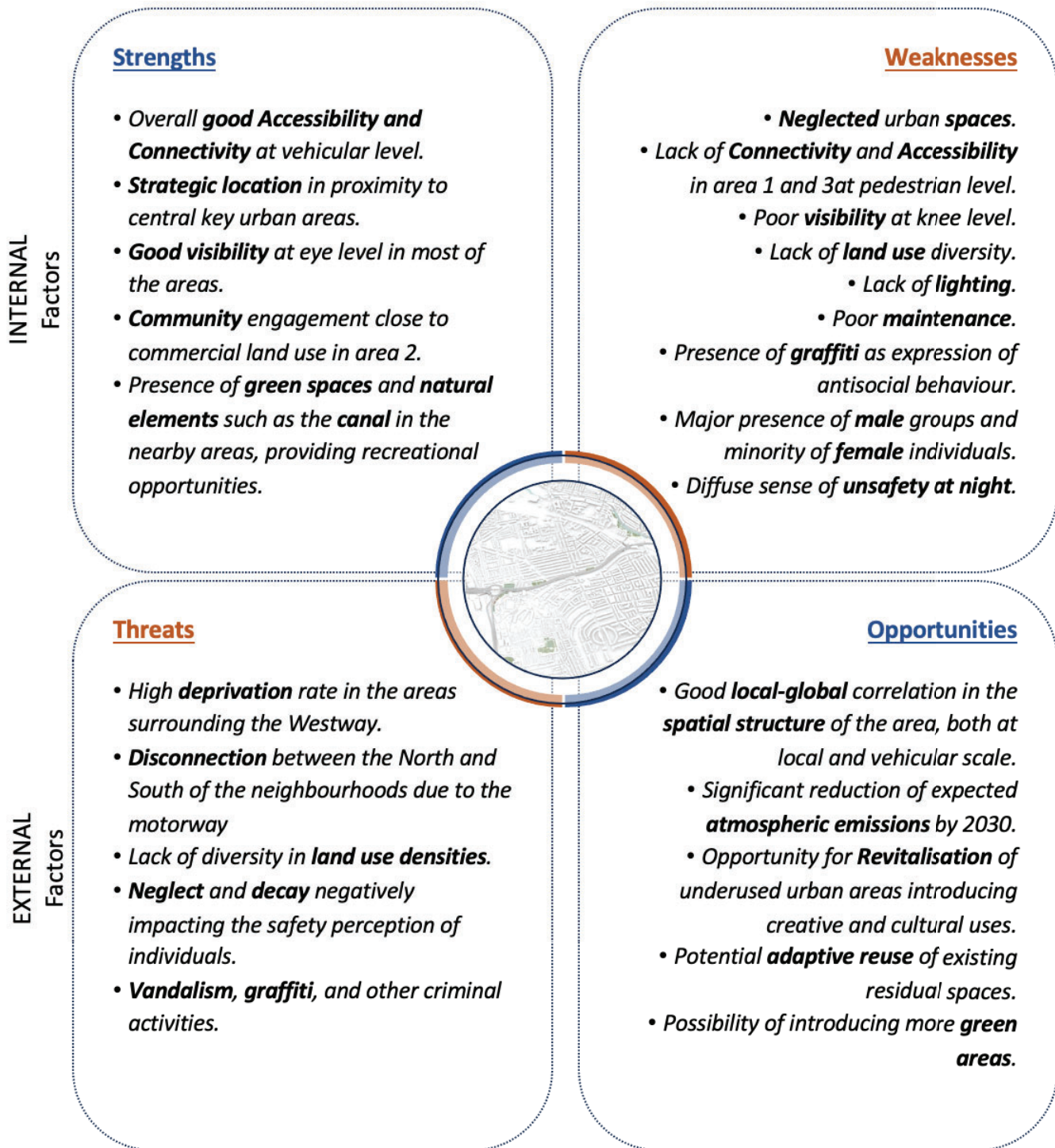


Figure 65. SWOT Analysis

In the subsequent illustration (Figure 66), the current status of the study area is showcased, serving as an introductory insight into the present contextual urban setting. Additionally, Figures 67-68 depict the identified weaknesses and strengths directly on the site-map.

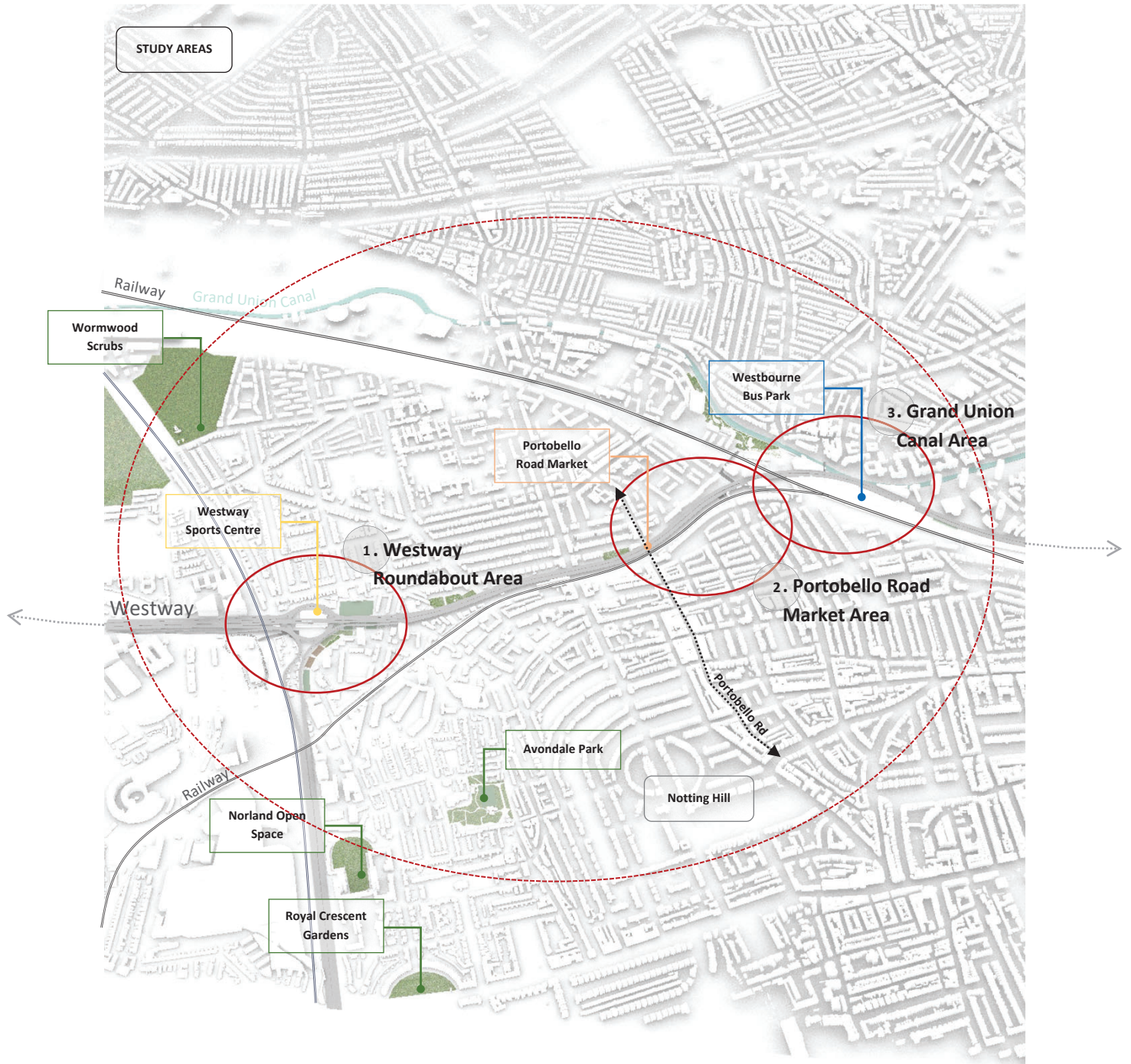


Figure 66. Illustration of current status of study area

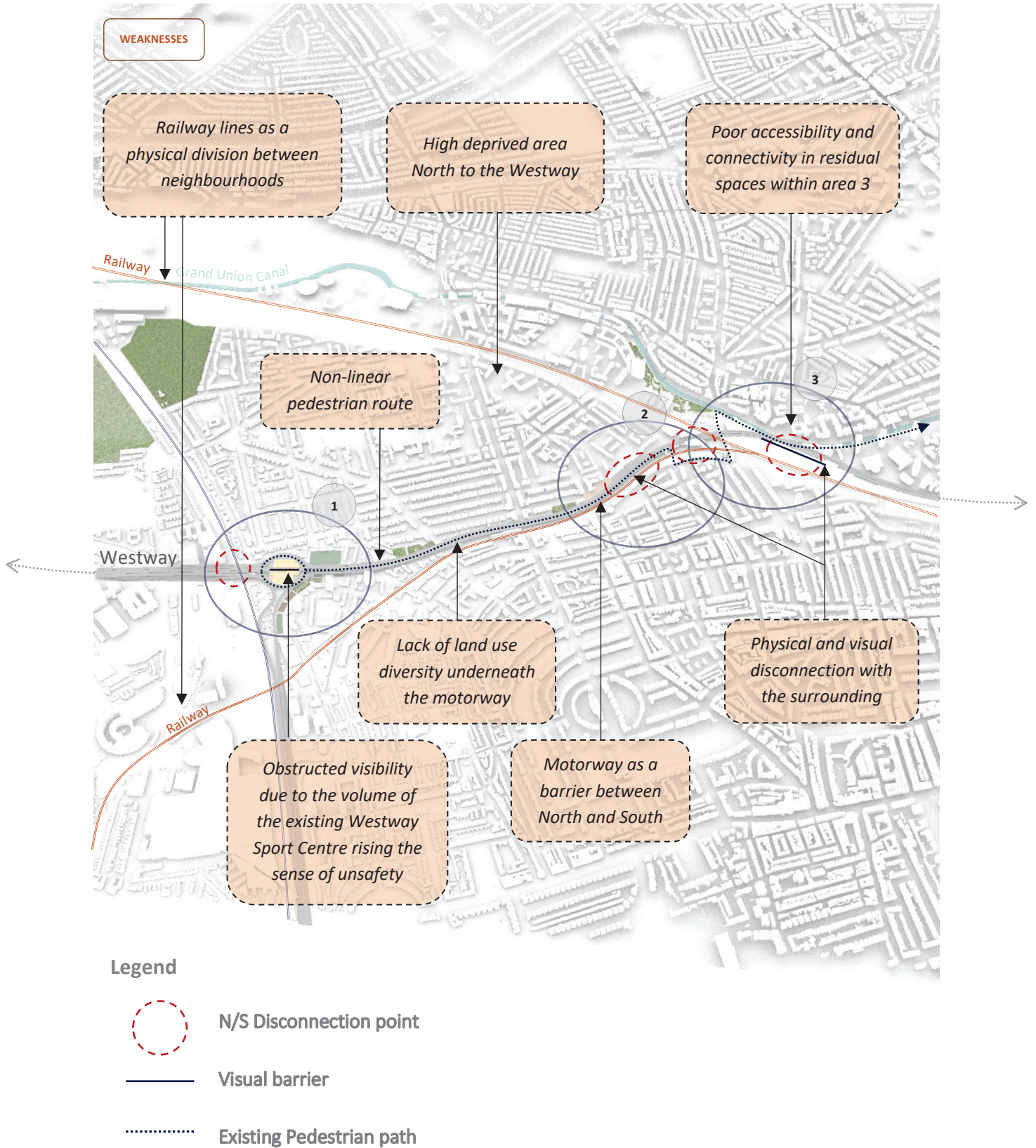


Figure 67. Weaknesses of the study area.

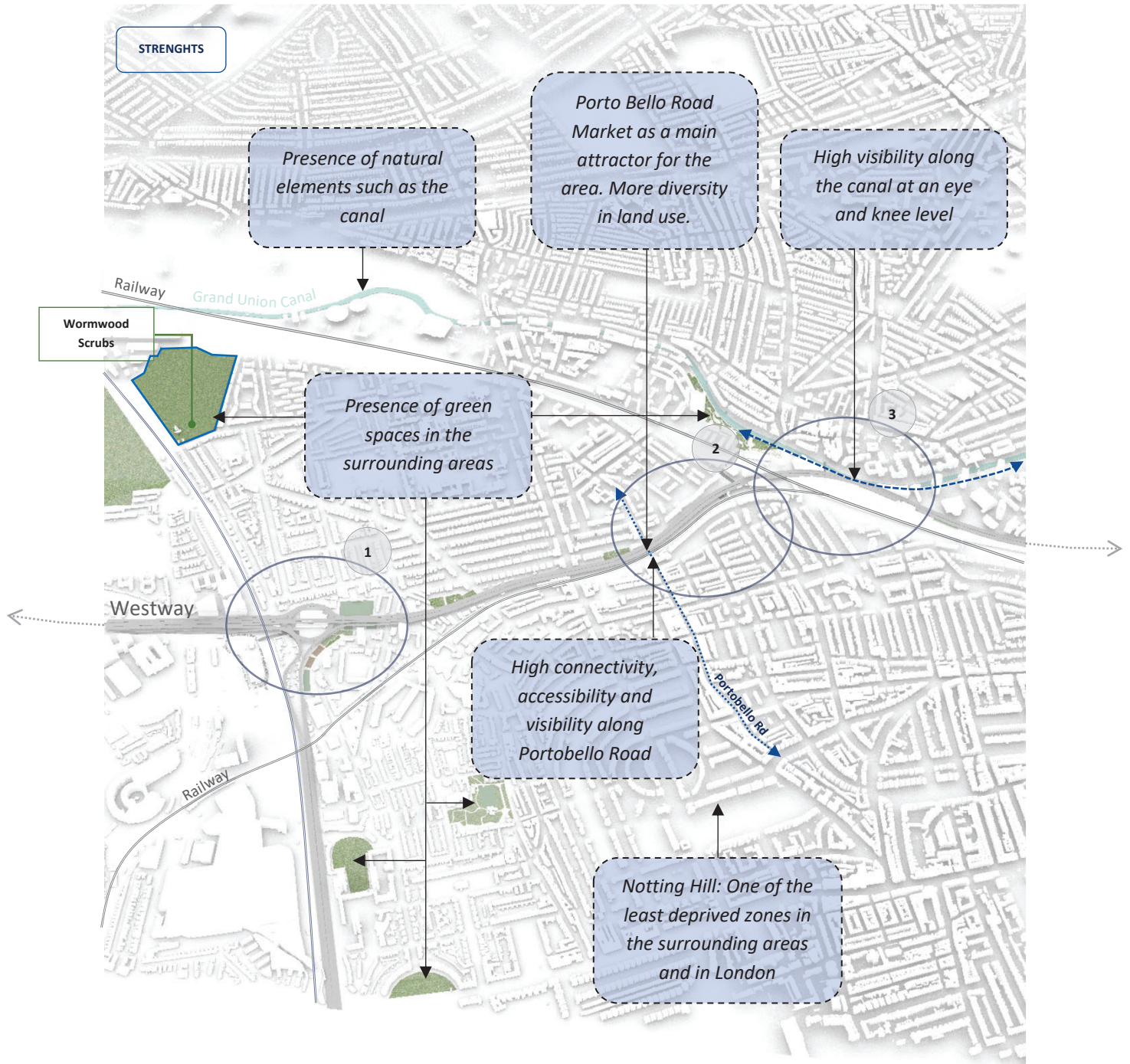


Figure 68. Strengths of the study area.

7.3 POTENTIAL EVIDENCE-BASED DESIGN PROPOSAL

A potential design proposal, grounded on an evidence-based approach, is defined for the neglected flyover study area, as illustrated in *Figure 69*. This strategic plan seeks to enhance pedestrian routes along the entire studied Westway section through a series of planned interventions. In this regard, new pathways are integrated into the existing main route establishing additional pedestrian and cyclist-friendly interconnections. This shapes a more continuous and active East-West route connecting the various sections of the flyover, while also facilitating links with the surrounding areas through North-South routes. The improved connectivity and accessibility within the study areas resulting from this design action are highlighted in *Figures 72-75*. Furthermore, the implementation of a wider range of land uses is intended to attract more locals and visitors, fostering a new life cycle of these areas, and ultimately promoting their integration into the broader urban system. Lastly, the increased lighting system enhances the sense of safety perceived by all individuals at night (*Figure 71*).

Summarising, the proposed design strategy encompasses the following key measures:

DESIGN
Measures

- Integration of new connections within the existing spatial configuration;
- More activated E/W pedestrian and cycling route;
- Enhancement of N/S pedestrian and cycling routes;
- Reconfiguration of existing sport centre building with consequent reduction of its volume;
- Introduction of land use diversity with the inclusion of new facilities (e.g. sport, community, retail, commercial) acting as attractors for locals and visitors;
- Enhancement of visual relationships;
- Increased lighting system;
- Strong sense of community, vibrancy and safety.

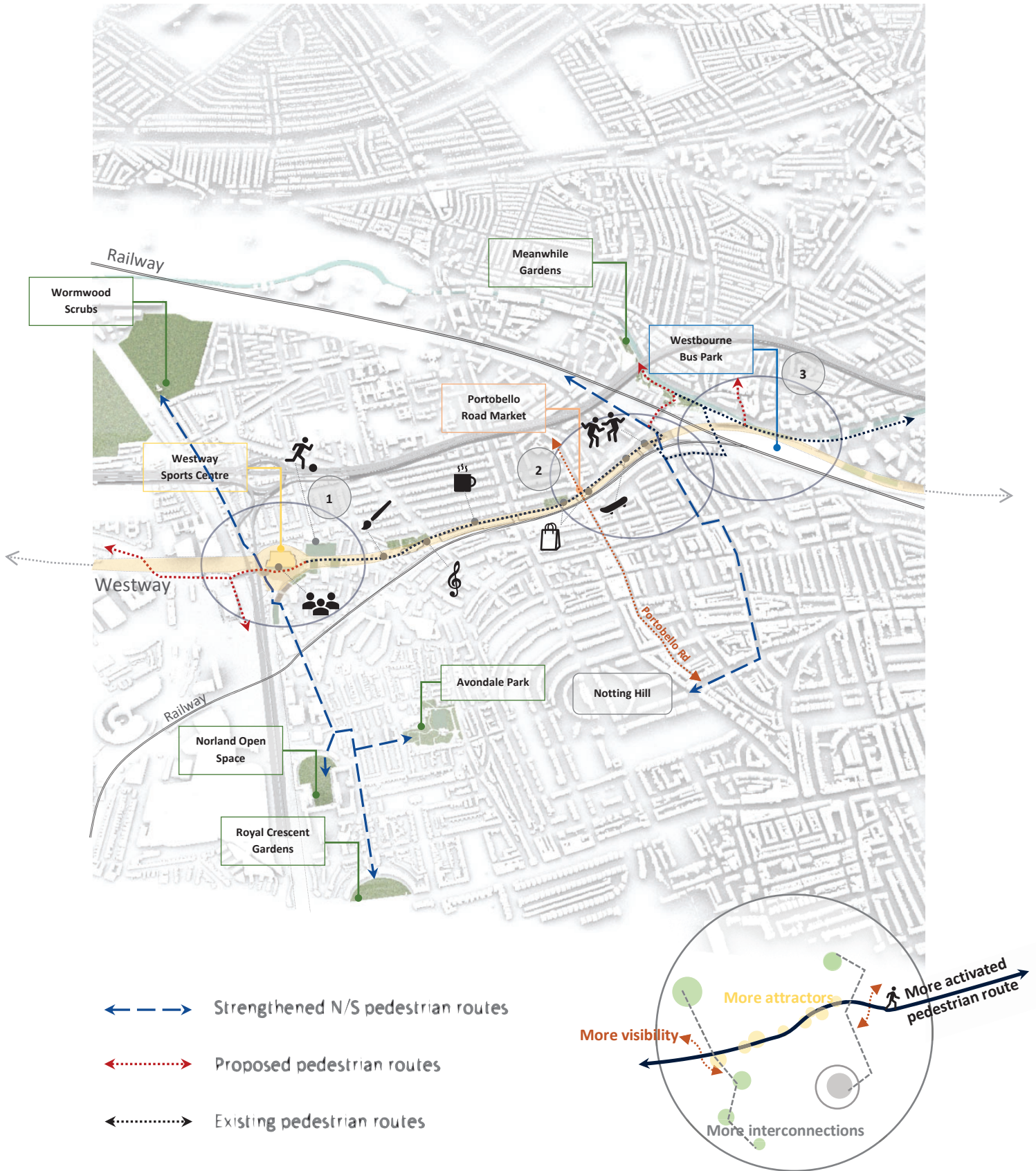


Figure 69. Design proposal concerning the flyover space underneath the Westway.

PROPOSAL AREA 1_Daytime



Figure 70. Proposal for Area 1-daytime scenario.

PROPOSAL AREA 1_Night time

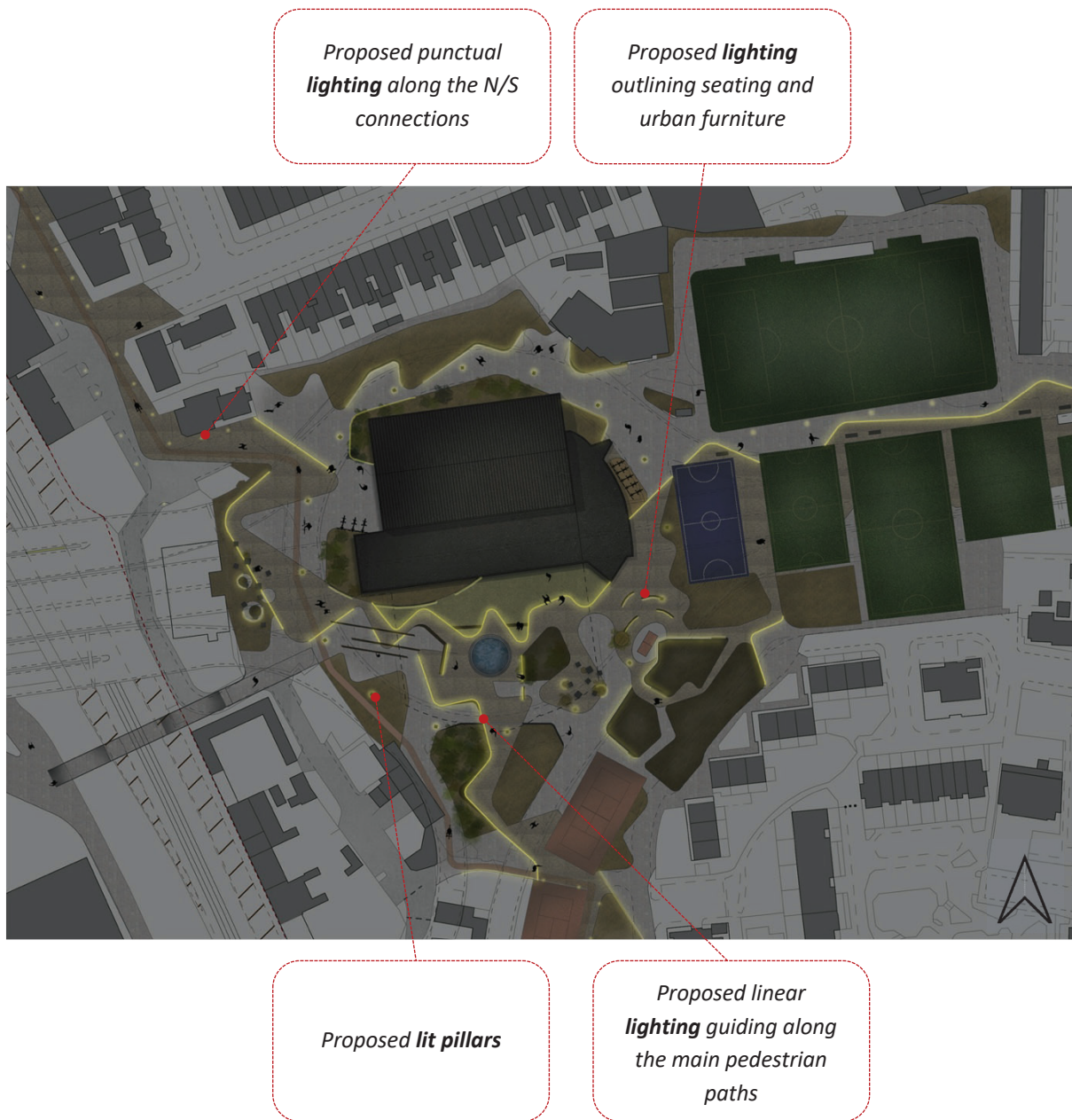


Figure 71. Proposal for Area 1-night time scenario.

7.4 EXPLORING STRATEGIC PLANS TOWARDS THE ENHANCEMENT OF RESIDUAL SPACES/ RECONNECTING THE CITY THROUGH REGENERATION PLANS

7.4.1 Angular Segment Analysis – Pedestrian model

To achieve a successful proposal, alterations have been enacted within the pedestrian spatial structure of the study area. Specifically, improvements in *Connectivity* and *Accessibility* within the proposed spatial layout are showcased in the following angular segment analyses (Figures 72-75). This aspect is further examined by the high values of local-global spatial correlation R^2 calculated for each of the three sites (Figure 77).

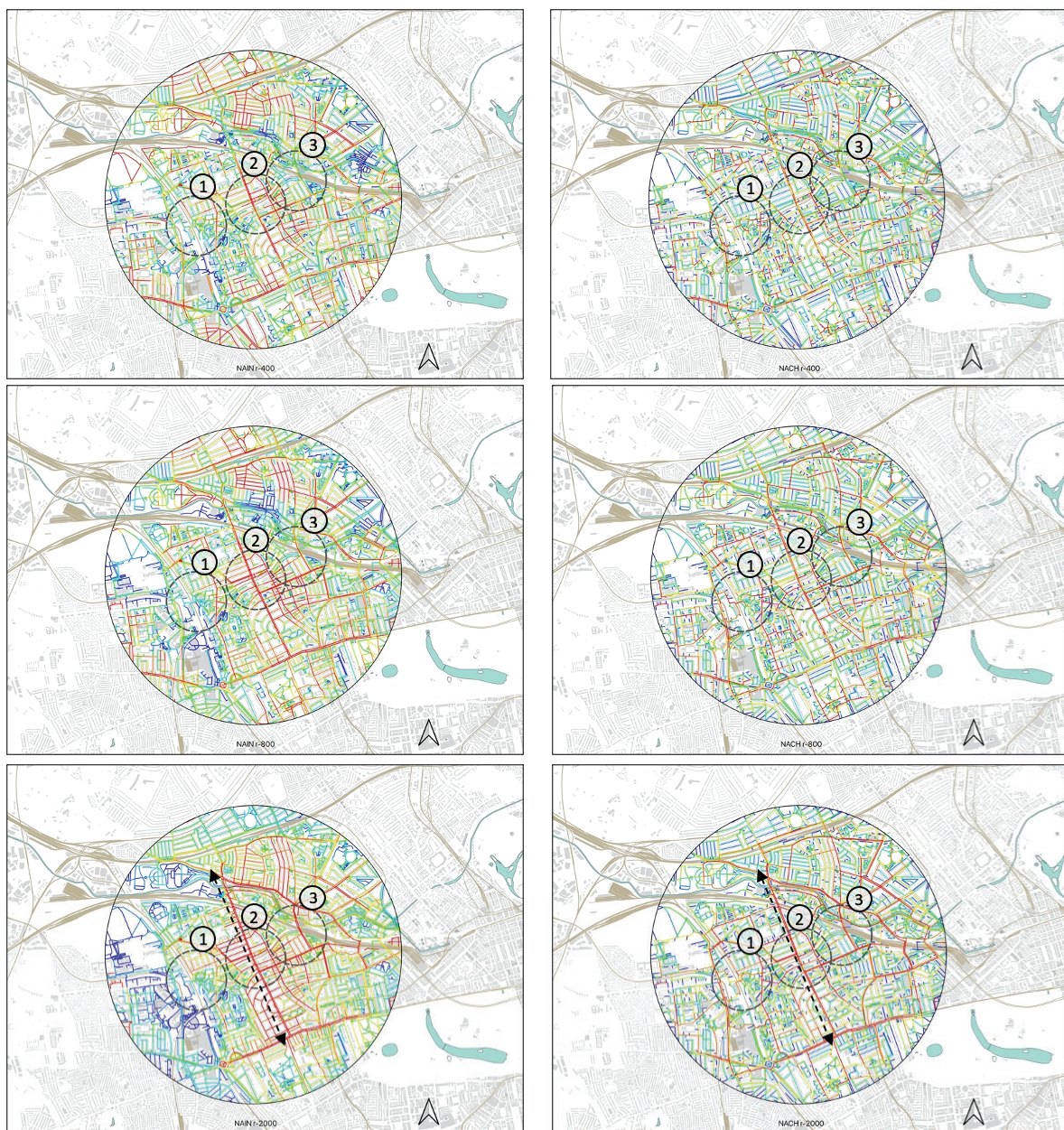


Figure 72. Angular segment analysis of proposal.



Figure 73. Set of angular segment analyses comparing present and future potential spatial configuration for Area 1.



Figure 74. Set of angular segment analyses comparing present and future potential spatial configuration for Area 2.

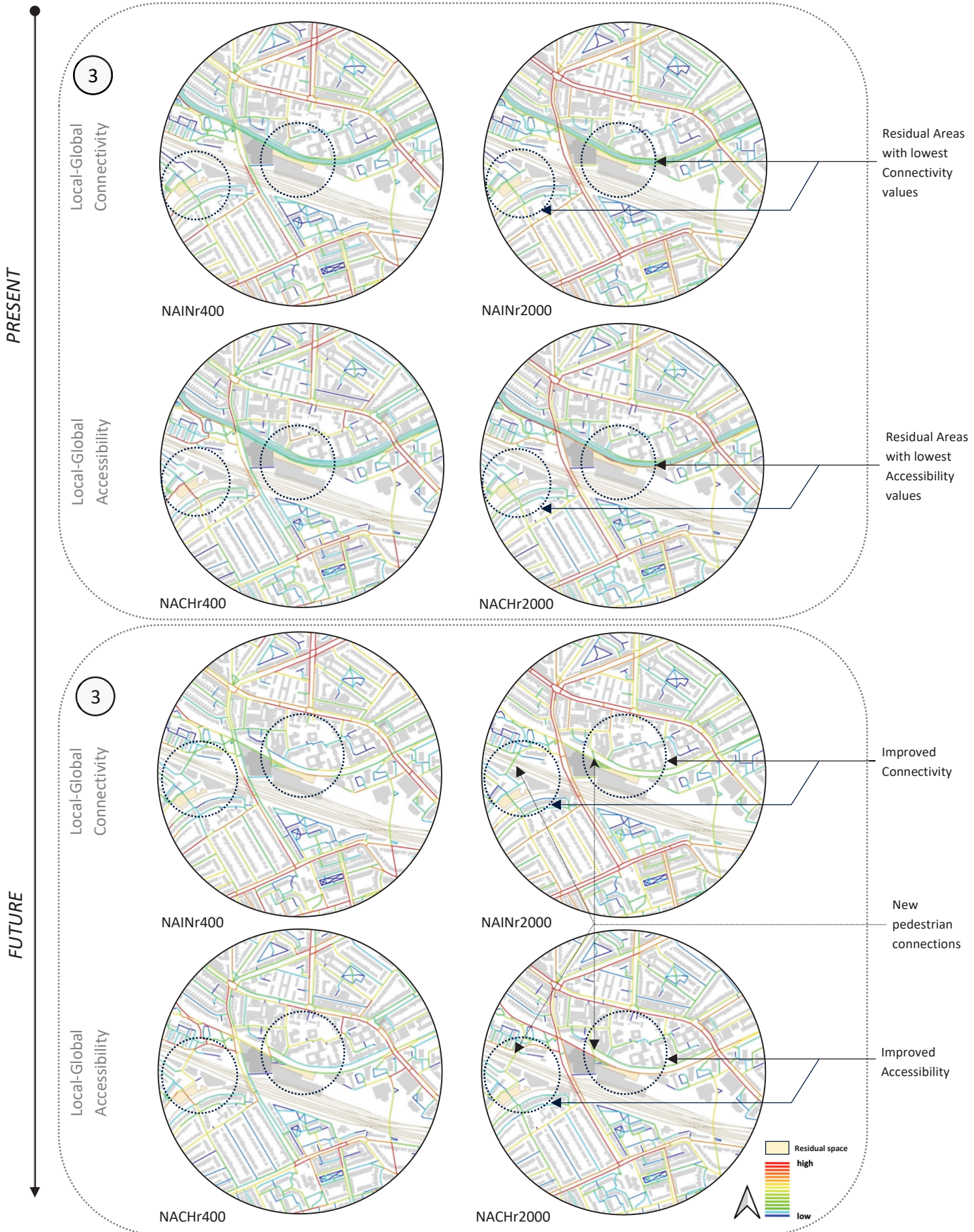


Figure 75. Set of angular segment analyses comparing present and future potential spatial configuration for Area 3.

Local-global spatial structure correlations of Proposal

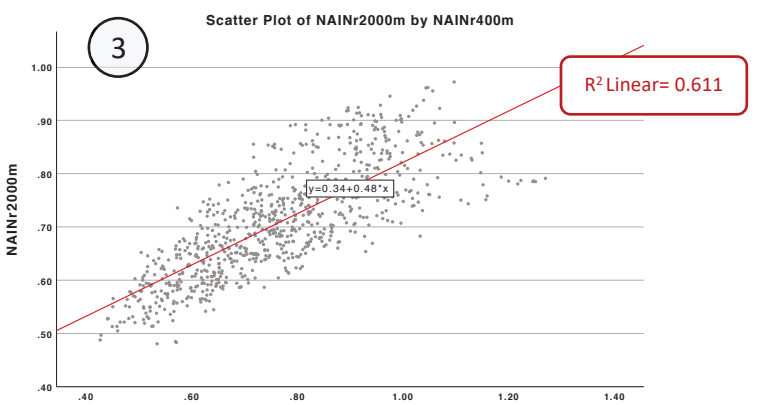
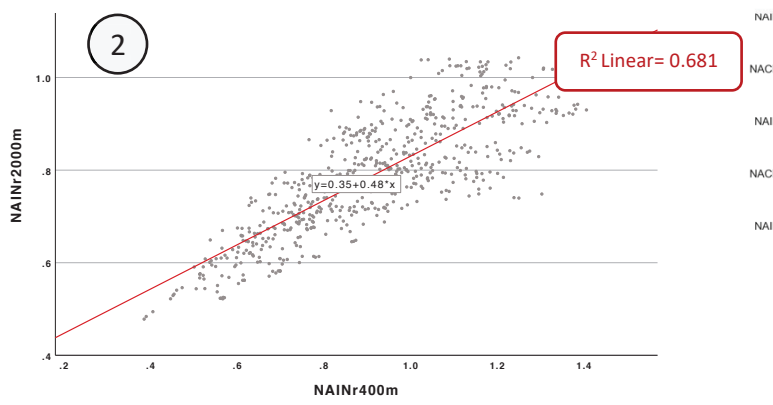
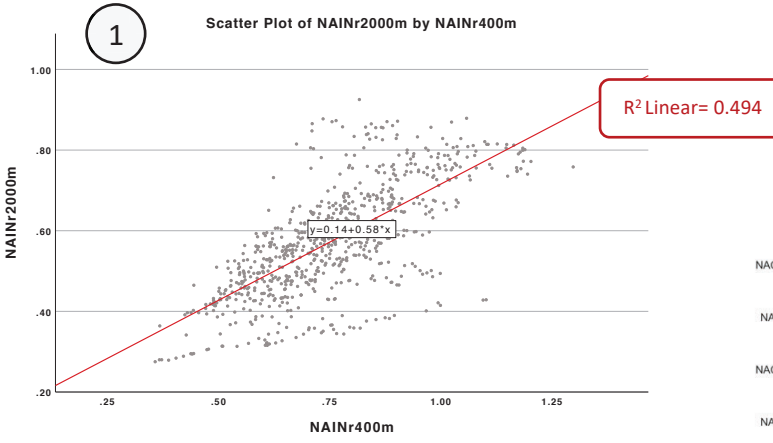


Figure 77. Scatter plot showing local-global spatial structure correlation at pedestrian level for each of the three study areas.

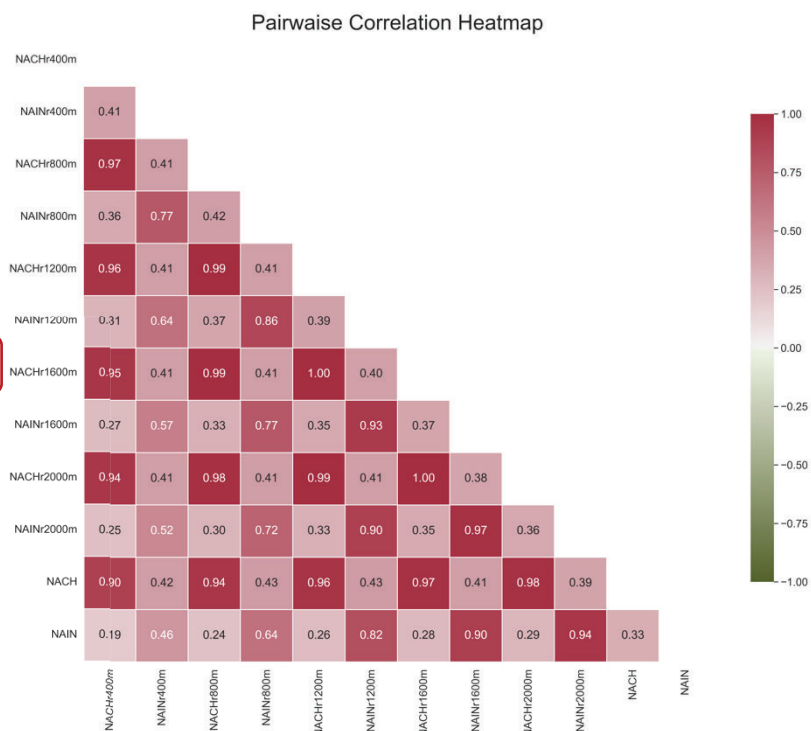


Figure 76. Pairwise Correlation Heatmap across all normalised centrality measures that resulted from angular segment analysis on the pedestrian segment model representing the potential future spatial configuration of the site.

7.4.2 Visual Graph Analysis (VGA) – Proposal

The Visual Graph Analyses conducted at both knee and eye levels clearly demonstrate the enhancements in *Visual Integration* and *Connectivity* achieved through the design solution. These improvements are striking when compared to the existing condition (Figures 78-81). Since the majority of questionnaire participants favoured improved visibility within the study sites, the proposed strategy directly addresses this design parameter. By amplifying visual integration, the proposal aims to create more welcoming settings.

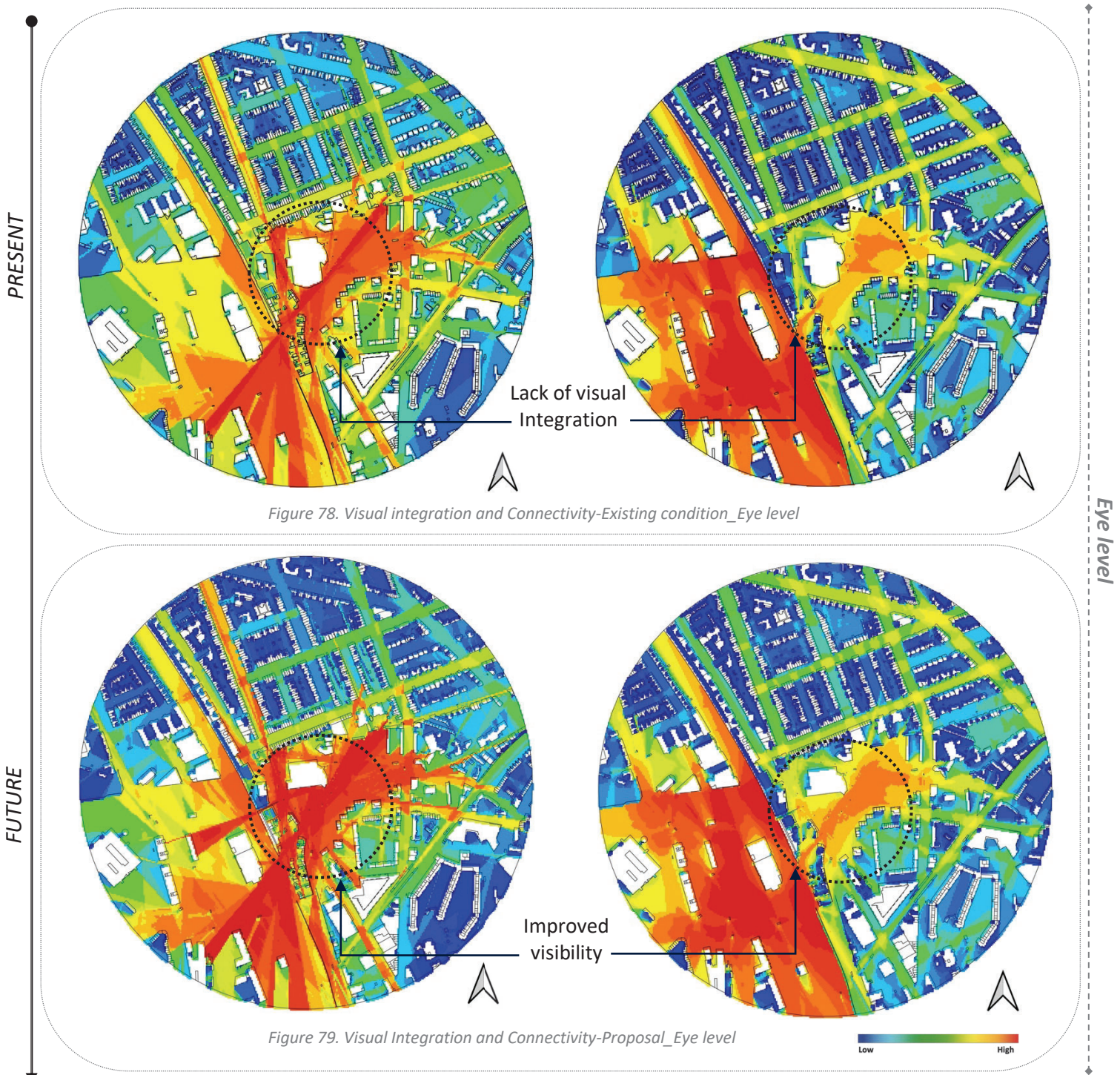
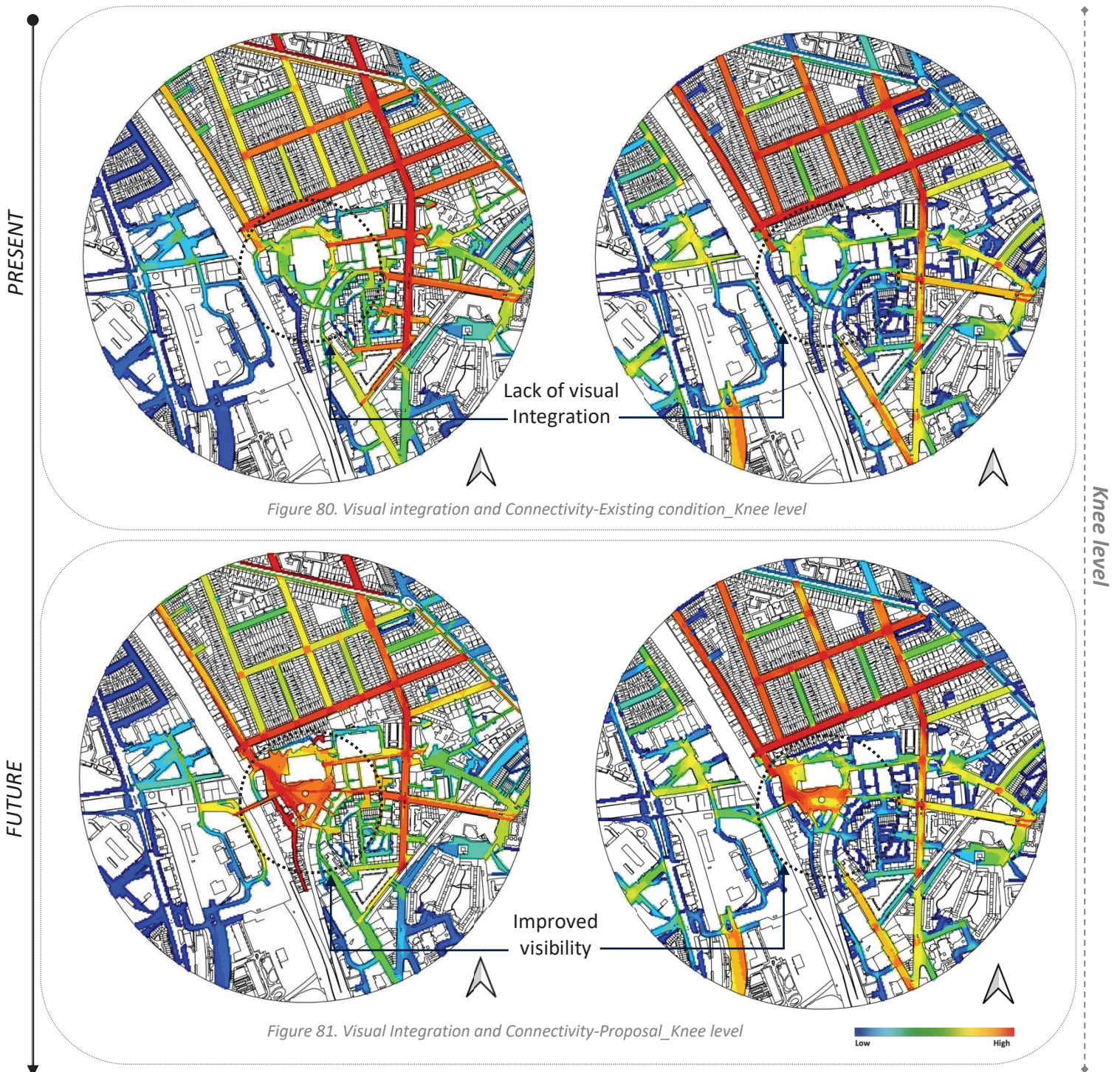


Figure 78. Visual integration and Connectivity-Existing condition_Eye level

Figure 79. Visual Integration and Connectivity-Proposal_Eye level

Consequently, this aspect holds the potential to significantly influence the urban environment's perception underneath the motorway. The enhancement of visual relationships aims to offer a wider perspective of the area and instil a pervasive sense of security among individuals occupying the space. As a result, this improvement carries implications for the overarching classification of the space, as heightened visibility leads to a decrease in the degree of residuality.



7.4.3 Mapping the improvements in residuality degree

The map displayed in *Figure 82* shows the reduction in levels of residuality across the three study sites following the proposed regeneration planning. The comparison with the categorisation referring to the present situation illustrated in the same figure (top), showcases a notable improvement in the overall area conditions, confirmed by the decrease of the *Index of Residuality* (*Table 7*). However, the residuality degree depicted in the map below pertains to a hypothetical scenario. Hence, it does not factor in perceptual elements within the defined categorisation (*Table 8*) as data concerning the sense of safety needs to be collected through questionnaires and cannot be simply hypothesised.

	Area 1	Area 2	Area 3
PRESENT	Existing Residuality Index per Area		
	0.78	0.56	0.65
PRESENT	Existing Residuality Index per Area %		
	78%	56%	65%
FUTURE	Potential future Residuality Index per Area		
	0.10	0.10	0.07
FUTURE	Potential future Residuality Index per Area %		
	10%	10%	7%

Table 7. Residuality Index values concerning the existing and potential conditions of all three study areas.



Figure 82. Maps of present and proposed condition of residual spaces, showing the improvement in residuality degree.

RESIDUALITY INDEX SPREADSHEET REFERRING TO PROPOSAL FOR AREA 1

AREA	AREA 1 a	AREA 1 b	AREA 1 c	AREA 1 d	AREA 1 e	AREA 1 f	AREA 1 g	AREA 1 h
INTRINSIC								
Lack of visual connectivity_Visual correspondence Index	x	x					x	x
Distance from the main urban pathways		x			x	x		
Lack of local accessibility		x						
Lack of local connectivity								
Geometrical irregularity	x	x					x	x
Spatial fragmentation								
USE RELATED								
Low usage/Emptiness								
Poor land use diversity								
Air Pollution								
Acoustic discomfort								
Lack of lighting								
Large presence of graffiti					x	x	x	
Poor maintenance								
Poor cleanliness								
Lack of social interactions								
SEMANTIC								
Lack of identity-related elements								
Poor interaction with surrounding								
Unwelcomed and unsafe environment								
TOT FACTORS	2	4	0	0	2	2	3	2
RESIDUALITY INDEX Percentage	11%	22%	0%	0%	11%	11%	17%	11%

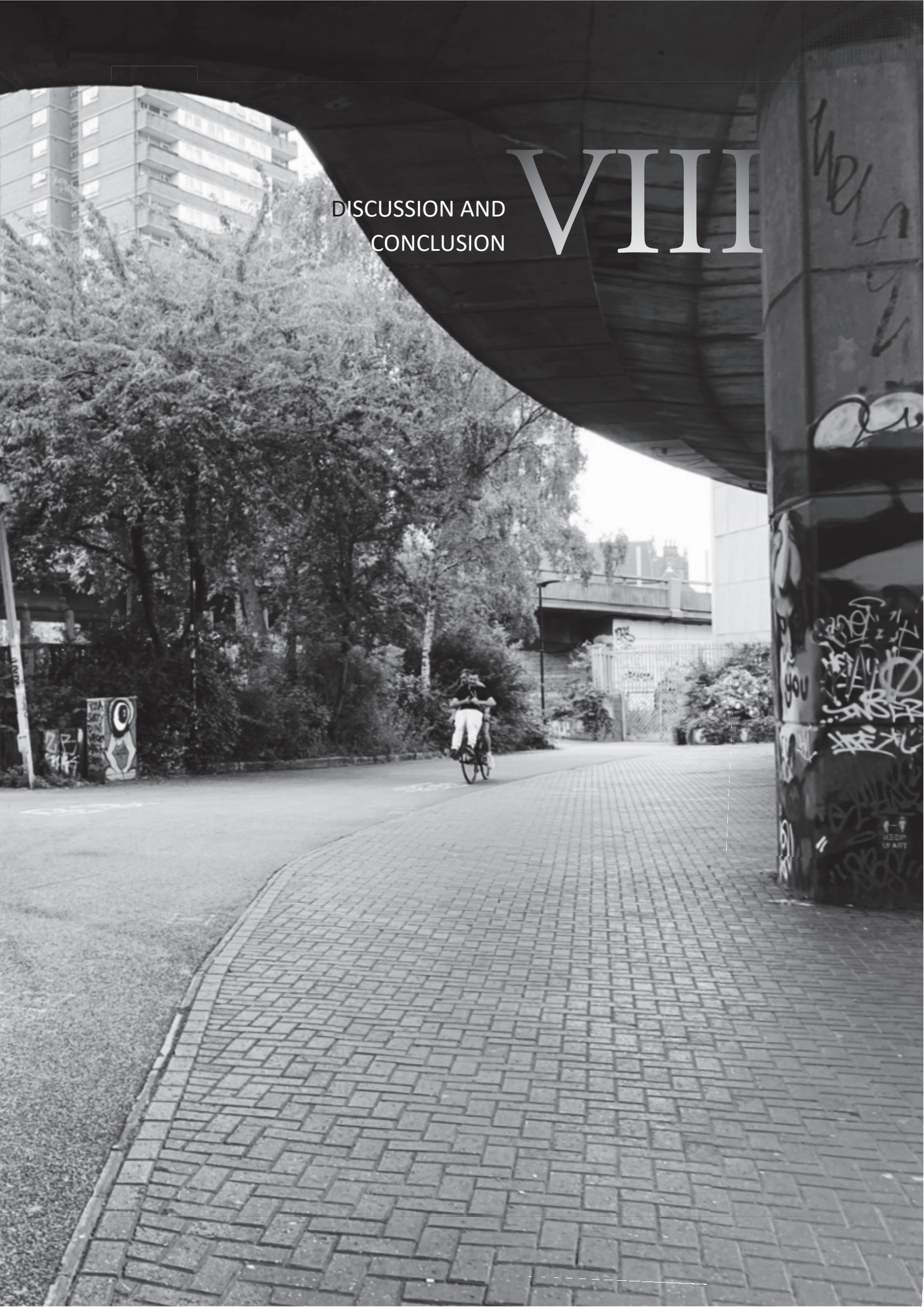
Table 8. Identification of intrinsic, use related, and semantic factors within Area 1, with corresponding measurement of the Area Residuality Index from the combination of all the factors concerning the regeneration proposal.

7.5 CONCLUSION

By deeply and objectively analysing weaknesses and threats of residual urban spaces, while concurrently recognising their strengths and opportunities, these sites can be comprehensively understood and strategically redeveloped. The presented analytical approach holds the potential to formulate plans and guidelines capable of determining positive and beneficial impacts on the existing spatial system, subsequently enhancing the social condition of the nearby communities.

Moreover, as illustrated in the showcased masterplan, a deliberate strategy focused on diversifying land use and mitigating both physical and visual disconnections, is delineated. The outcome could contribute to activating more attractive pedestrian routes, decreasing the level of residuality, and establishing better functioning urban systems. The inquiry has also revealed that minor yet strategic changes in the configurational aspect of the site, can yield substantial improvements in spatial *Connectivity* and *Accessibility*. In turn, this transformation may lead to a more welcoming area for local residents and visitors alike, thereby reducing the diffused sense of unsafety and potentially revitalising these often-overlooked urban areas.

In conclusion, it can be asserted that regeneration strategies embody opportunities for enhancing overlooked and neglected urban areas. In the contemporary context, promoting the redevelopment of forgotten and underused spaces is essential, as they serve as evidence of urban land wastage in increasingly urbanised cities. It is our responsibility to define strategies addressed to the reappropriation of residual sites and their reintegration in the city network.



DISCUSSION AND
CONCLUSION

VIII

Chapter 8

8. DISCUSSION AND CONCLUSION

8.1 INTRODUCTION

This dissertation has tackled a series of aspects centred on residual spaces within the contemporary city, aiming to provide an extensive response to three overarching sets of structured research questions (“*PAST*”, “*PRESENT*”, “*FUTURE*”). An evidence-based and data-driven systemic approach was employed, involving the use of space syntax measures alongside traditional spatial and observational analysis methods. The research endeavoured to reveal how these disregarded places came into existence within the city structure in conjunction with specific adverse spatial, socio-economic, and perceptual factors occurring over time. Specifically, the study explored the implications of these spaces on the socio-spatial urban context of London.

The first group of research inquiries delved into the emergence of residual spaces across time, examining the 1950s spatial configuration prior to the Westway’s construction and the historical poverty condition in the vicinity. The second set of questions focused on the spatial and socio-economic transformations following the motorway’s implementation, which led to the consequent formation of residual spaces. Within this section, the study also encompassed the classification of residual areas through a systematic framework considering a range of influencing factors. The third and last set of questions concentrated on potential strategic regeneration plans, as opportunities for spatial integration and community cohesion. The forthcoming chapter will offer an overview of the outlined contents, ultimately addressing all the research questions and presenting significant key-findings achieved through the study.

8.2 DISCUSSION: EXPLORING THE FUTURE THROUGH THE PAST

This section brings into dialogue the main aspects of the research in order to summarise the socio-spatial factors involved in the emergence of residual spaces, the characteristics defining these spaces, and the positive outcomes stemming from strategic urban regeneration processes. These pivotal lines of inquiry delineate the core segments of the study, sequentially organised as “*PAST Evolution*”, “*PRESENT Transformation*”, and “*FUTURE Regeneration*”.

The initial historical investigation, comprising the “PAST-Evolution” section, suggests that during the 1950s the area exhibited certain advantageous spatial properties, including good *Connectivity* and *Accessibility*, particularly at global scale (NAINr4000 and NACHr4000) (*Figures 20-23*). However, the already complex socio-economic dynamics highlighted by the analysis of poverty by Charles Booth (*Figure 26*), deteriorated with the construction of the Westway, leading to the spatial isolation of the neighbourhoods and the decline of social conditions among local communities. Gradually, the combination of these adverse spatial and socio-economic circumstances contributed to the emergence of residual areas.

Subsequently, the second empirical study section “PRESENT-Transformation” revealed that configurational properties play a crucial role in the occurrence of neglected spaces within the study site, by employing Space Syntax analysis and statistical testing. Data visualisations (*Figures 37-38*) illustrated that the spatial logic of the urban system encourages clustering of residuality patterns in areas demonstrating primarily lack of connectivity at the pedestrian level. This in turn fostered the isolation and exclusion of these places from the surrounding broader urban network and from the effective functioning of the social structure, defining underused areas that divide instead of unifying communities. More specifically, the analysis validated the assumption that residual areas usually display low *Connectivity* (normalised angular Integration or NAIN). However, no conclusive effect was determined in terms of *Accessibility* (normalised angular choice or NACH).

The study also underpinned that residual spaces generally tend to appear in proximity of high degree of deprivation and poor economic conditions, as well in areas lacking a certain land use diversity, as demonstrated by the socioeconomic analyses presented in Chapter 5 (*Figures 39-43*). Here, the acquired datasets have been distributed along the London’s segment model in order to obtain relevant results for the study.

Moreover, the conducted surveys within the study sites revealed a prevalent sense of insecurity perceived in these neglected flyover areas, particularly during night-time and predominantly among female individuals (*Figures 56-58*). This finding alone is a stepping stone towards further investigation, providing valuable insights into the formulation of more caring guidelines that could shape regeneration strategies tailored to overlooked urban areas and individuals occupying such spaces.

Lastly, the “FUTURE-Regeneration” study section argues that the application of strategic regeneration planning, grounded on an evidence-based approach, can achieve socio-spatial improvements within residual urban spaces. This is supported by the decrease of the *Residuality Index* (*Figure 82*), from the elevated residuality values observed in the current context to lower values in the potential future scenario.

8.2.1 Hypotheses discussion

In summary, the systemic evaluation of the five initial Hypotheses (Section 1.3, p.17) has yielded relevant findings in this study. Spatial and statistical analyses unveiled a connection between the presence of residual spaces underneath the Westway and specific unfavourable spatial properties, as posited in **Hypothesis 1**. Moreover, the visual attributes inherent to the study site align, in most cases, with the spatial structure features of areas housing residual spaces. This suggests a synergistic relation between these visual factors with the formation of overlooked areas, providing evidence in support of **Hypothesis 2**. This aspect is further explored through the definition of a *Visual Correspondence Index*, which is used within the context of the third research question, regarding the classification of residual spaces. **Hypothesis 3** is investigated through correlation tests, which point to a connection between *Deprivation* rates and the spatial structural attributes of residual sites in the London's flyover regions. This finding demonstrates the interplay between adverse socio-economic conditions and the occurrence of residuality factors. Subsequently, the investigation of **Hypothesis 4**, which pertains to the correlation between land use densities (specifically retail and residence densities) and the existence of residual spaces, supports the notion that areas lacking functional diversity are more susceptible to experiencing residuality-related issues. Lastly, the survey analysis concerning observational data collected through a structured subjective questionnaire (*Figure 55-Appendix 4*), corroborates **Hypothesis 5**, suggesting that a prevailing perception of unsafety is experienced by individuals while occupying residual areas.

8.3 RESIDUAL SPACES: EMPOWERING URBAN INTEGRATION AND REGENERATION

The proposed methodology demonstrates promising effectiveness in supporting complex and advantageous urban transformations. By implementing decision-making interventions that target urban regeneration processes, the last section of the study has revealed that modifying the spatial configuration of an area might lead to improvements in both connectivity and accessibility of the site. This in turn, has a beneficial effect on reducing the residuality degree within a given area. Additionally, the study shows that strategic planning has the potential to enhance visibility factors, thereby fostering a heightened sense of safety among individuals occupying the space and potentially resulting in a more comprehensive consideration of the area as a public and functional site. In this context, the incorporation of diverse functions, ranging from retail establishments to communal facilities, holds the potential to amplify the appeal of the area. Attention towards the improvements of key-factors such as more adequate lighting and green spaces, would also positively affect the overall condition of the place. This transformation may result in infusing the flyover space with more vitality attracting a larger population of users and promoting community bounding as well as social equality.

8.4 LIMITATIONS AND FUTURE WORK

This study faced a number of practical limitations such as the availability of data sets, or the subjectivity and bias of several aspects related to the specific research topic. Time constraints resulted in the capability to investigate a limited case selection of three study areas underneath the Westway's flyover. In light of this, it is important to note that this sample may not necessarily be representative of all types of flyovers that can be found in London as well as in other cities. However, the system could be used in future research by simply applying the structured methodology to assess larger and more diverse samples of neglected spaces both in London and other urban environments worldwide.

Time constraint also imposed a limited sample size of participants in the subjective data collection (i.e. *questionnaires*). Specifically, the number of individuals interviewed to gather data about safety perceptions within the study site was reduced to 96 compared to the initially planned sample size of 180 participants. This aspect could potentially restrict the applicability of the findings to a broader scope, cases, and population. Additional future data collection may encompass more diversity in respondent groups, allowing a more comprehensive exploration of relevant factors influencing the perception of neglected areas. Moreover, limits concerning hazards to personal safety while conducting field observations in disregarded areas prevented data collection during night-time for comparison with daytime data. However, the questionnaire methodology allowed for an overall understanding of the night time usage patterns by asking participants about their usual occupancy of the space at night.

In regards to the classification framework, a well-structured weighting system may improve the accuracy and rationale of the defined methodology, by attributing diverse weight values to each factor of residuality according to their impact influence.

8.5 CONCLUSION

Numerous cities, including London, have continuously experienced the impact of urbanisation processes, resulting in the transformation of their spatial systems and the consequent emergence of residual spaces, including leftover spaces that can be frequently found beneath flyovers. These sites often lack the essential attributes needed to seamlessly function within the urban fabric, thereby representing complex urban anomalies that warrant deep investigations. This study endeavours to heighten awareness about these urban sites and embark on transformative interventions that strategically enhance liveability, functionality, and equity among local communities.

The research questions proposed in this dissertation revolve around the creation, categorisation, and regeneration of residual urban spaces within the contemporary city. To address these inquiries, the study was structured into three main sections, namely *Past Evolution*, *Present Transformation*, and *Future Regeneration*. The entire research process was driven by both objective and subjective methods that were used to enable a comprehensive investigation of the multidimensional concept of residual spaces.

The study findings suggest a strong correlation between issues of physical and social isolation within specific urban sites and the presence of neglected areas. This relationship is inherently tied to the alterations in the configurational structure of the street and pedestrian network brought about by urban transformations. Moreover, the challenges arising from the often-unfavourable spatial properties of these areas, encompassing low *Connectivity*, in conjunction with adverse socio-economic circumstances and social inequality dynamics, underscore the fundamental factors associated with the existence of these disregarded spaces. Similarly, visual properties have a significant contribution to the emergence of neglected areas, concurrently prompting feelings of unsafety. This perception affects particularly female individuals who face social inequalities within urban settings, leading to reduced occupancy and utilisation of public space.

An effective urban transformation strategy is required for enhancing residual areas, aiming to reintegrate them into the broader city system. Tactical planning with spatial and functional focus, can yield substantial improvements in the regulation of residual urban spaces. Successful renewal efforts require the involvement of a multi-faceted and comprehensive approach that encompasses various factors, including spatial configuration, visual attributes, and functional considerations.

This study sets the stage for future work, which could extend its scope by encompassing a broader case selection of residual spaces along the Westway in London, as well as widely expanding the investigation into diverse typologies of residual spaces within cities worldwide, and propose a widened classification system.

In conclusion, the presented research, rooted in empirical evidence, has shed light on both the problems and opportunities concealed within these overlooked areas. The study has also provided a significant contribution towards the identification and classification of residual spaces, ultimately paving the way for strategic, evidence-based design interventions driven by an analytical and systematic methodology that holds the potential for universal applicability.

REFERENCES

- Azhar, J., & Gjerde, M. (2016). Re-thinking the role of urban in-between spaces. *Fifty Years Later: Revisiting the Role of Architectural Science in Design and Practice: 50th International Conference of the Architectural Science Association*, 279–288.
- Barron, P., & Mariani, M. (2013). *Terrain vague: Interstices at the edge of the pale*. Routledge.
- Bondi, L., & Domosh, M. (1998). On the contours of public space: A tale of three women. *Antipode*, 30(3), 270–289. <https://doi.org/10.1111/1467-8330.00078>
- Della Spina, L., Lorè, I., Scrivo, R., & Viglianisi, A. (2017). An integrated assessment approach as a decision support system for urban planning and urban regeneration policies. *Buildings*, 7(4), 85.
- Gabbianelli, A. (2017). *SPAZI RESIDUALI. La vegetazione nei processi di rigenerazione urbana* (1st ed.). Gotoeco.
- Groth, J., & Corijn, E. (2005). Reclaiming urbanity: Indeterminate spaces, informal actors and urban agenda setting. *Urban Studies*, 42(3), 503–526. <https://doi.org/10.1080/00420980500035436>
- Hanson, J., & Hillier, B. (1987). The architecture of community: Some new proposals on the social consequences of architectural and planning decisions. *Architecture et Comportement/Architecture and Behaviour*, 3(3), 251–273.
- Hillier, B. (1989). The architecture of the urban object. *Ekistics*, 5–21.
- Hillier, B. (1996). *Space is the machine: A configurational theory of architecture* (1st ed.). Cambridge University Press.
-

- Hillier, B. (2012). Studying cities to learn about minds: Some possible implications of space syntax for spatial cognition. *Environment and Planning B: Planning and Design*, 39(1), 12–32.
- Hillier, B., Burdett, R., Peponis, J., & Penn, A. (1986). Creating life: Or, does architecture determine anything? *Architecture & Comportement/Architecture & Behaviour*, 3(3), 233–250.
- Hillier, B., & Hanson, J. (1984). *The Social Logic of Space* (1st ed.). Cambridge University Press.
<https://doi.org/10.1017/CBO9780511597237>
- Hillier, B., Penn, A., Hanson, J., Grajewski, T., & Xu, J. (1993). Natural movement: Or, configuration and attraction in urban pedestrian movement. *Environment and Planning B: Planning and Design*, 20(1), 29–66.
- Hillier, B., & Vaughan, L. (2007). The city as one thing. *Progress in Planning*, 67(3), 205–230.
<https://doi.org/10.1016/j.progress.2007.03.001>
- Hillier, B., Yang, T., & Turner, A. (2012). Normalising least angle choice in Depthmap and how it opens up new perspectives on the global and local analysis of city space. *Journal of Space Syntax*, 3(2), 155–193.
- Hoshii, H. (2021). *Spatial legacies of Westway motorway: A study of the impact of the Westway motorway on urban morphologies and community severance using space syntax theory and methods* [Master Thesis]. UCL.
- Jacobs, J. (2020). *The Death and Life of Great American Cities / Jacobs, Jane*. Jonathan Cape.
- Jiang, B., Mak, C. N. S., Zhong, H., Larsen, L., & Webster, C. J. (2018). From broken windows to perceived routine activities: Examining impacts of environmental interventions on perceived safety of urban alleys. *Frontiers in Psychology*, 9, 2450.

- Karimi, K. (2012). A configurational approach to analytical urban design: 'Space syntax' methodology. *Urban Design International*, 17(4), 297–318.
<https://doi.org/10.1057/udi.2012.19>
- Kern, L. (2021). *Feminist city: Claiming space in a man-made world*. Verso Books.
<https://ebookcentral.proquest.com/lib/ucl/detail.action?docID=6178348>
- Khalil, M. H., & Eissa, D. M. (2013). *Reclaiming Residual spaces for the public: A case study from the city of Cairo*. 105–121.
- Lapham, S. C., Cohen, D. A., Han, B., Williamson, S., Evenson, K. R., McKenzie, T. L., Hillier, A., & Ward, P. (2016). How important is perception of safety to park use? A four-city survey. *Urban Studies*, 53(12), 2624–2636.
<https://doi.org/10.1177/0042098015592822>
- Lauria, A., & Vessella, L. (2021). *Small Forgotten Places in the Hearth of Cities: On the residuality of public spaces in historical contexts: Florence as a case study*. Firenze University Press.
- Lerman, Y., Rofé, Y., & Omer, I. (2014). Using Space Syntax to Model Pedestrian Movement in Urban Transportation Planning. *Geographical Analysis*, 46(4), 392–410.
<https://doi.org/10.1111/gean.12063>
- London School of Economics & Political Science. (2016). *Charles Booth's London* [Map].
<https://booth.lse.ac.uk/learn-more/download-maps>
- Mindell, J. S., & Karlsen, S. (2012). Community Severance and Health: What Do We Actually Know? *Journal of Urban Health*, 89(2), 232–246. <https://doi.org/10.1007/s11524-011-9637-7>

- Monokrousou, K., & Giannopoulou, M. (2016). Interpreting and predicting pedestrian movement in public space through space syntax analysis. *Procedia-Social and Behavioral Sciences*, 223, 509–514.
- Obilor, E. I., & Amadi, E. C. (2018). Test for significance of Pearson's correlation coefficient. *International Journal of Innovative Mathematics, Statistics & Energy Policies*, 6(1), 11–23.
- Plonsky, L., & Ghanbar, H. (2018). Multiple regression in L2 research: A methodological synthesis and guide to interpreting R2 values. *The Modern Language Journal*, 102(4), 713–731.
- Roberts, P., Sykes, H., & Granger, R. (2016). *The evolution, definition and purpose of urban regeneration*. SAGE Publications, Limited.
- Robertson, S. (2007). Visions of urban mobility: The Westway, London, England. *Cultural Geographies*, 14(1), 74–91.
- Sharmin, S., & Kamruzzaman, M. (2018). Meta-analysis of the relationships between space syntax measures and pedestrian movement. *Transport Reviews*, 38(4), 524–550. <https://doi.org/10.1080/01441647.2017.1365101>
- Shukla, D., & Deshmukh, R. G. (2021). Need for Conscious Planning: Residual Spaces—A Consequence of the Current Planning Process. *Conscious Urbanism*, 1(1), 23–29.
- Trancik, R. (1986). What is lost space? In *Finding Lost Space: Theories of Urban Design* (pp. 1–20). John Wiley & Sons.
- Van Nes, A., & Yamu, C. (2021). *Introduction to space syntax in urban studies*. Springer Nature.
- Varoudis, T., & Psarra, S. (2014). Beyond two dimensions: Architecture through three dimensional visibility graph analysis. *The Journal of Space Syntax*, 5(1), 91–108.

- Vaughan, L. (2007). The spatial form of poverty in Charles Booth's London. In *The Spatial Syntax of Urban Segregation* (pp. 231–250). Elsevier.
- Vaughan, L. (2015). *Suburban Urbanities: Suburbs and the Life of the High Street*. UCL Press.
- Vaughan, L., Ancaes, P., & Mindell, J. (2020). *Cars, conflict and community severance*. Elsevier.
- Villagomez, E. (2010). Claiming residual spaces in the heterogeneous city. In *Insurgent public space: Guerrilla urbanism and the remaking of contemporary cities* (pp. 81–96). Routledge New York.
- Wall, E. (2011). Infrastructural form, interstitial spaces and informal acts. *Infrastructural Urbanism: Addressing the Inbetween*, 145–157.
- Yamu, C., Van Nes, A., & Garau, C. (2021). Bill Hillier's legacy: Space syntax—A synopsis of basic concepts, measures, and empirical application. *Sustainability*, 13(6), 3394.

APPENDICES

APPENDIX 1_ LONDON EXPECTED ATMOSPHERIC EMISSIONS REDUCTION

The study incorporates considerations regarding the reduction of atmospheric emissions in London, as regeneration processes require improvements in the physical, socio-economic, and environmental conditions of a specific urban context (Roberts et al., 2016). This section serves as a valuable addition to the overall methodological framework, offering significant evidence of potential future environmental enhancements in the flyover areas along the Westway.

Data from Greater London Authority pertaining to the London Atmospheric Emissions Inventory (LAEI) 2019 represents the latest version of the London Atmospheric Emissions Inventory. This dataset considers and estimates ground-level concentrations of key pollutants such as NO_x, PM₁₀, and PM_{2.5} across Greater London for the years 2019, 2025 and 2030 using an atmospheric dispersion model. According to the LAEI 2019 Summary (p. 8) produced by Transport for London and the Greater London Authority, the expected nitrogen oxides (NO_x) emission from road transport in central London will decrease by 52% in 2025 and 75% in 2030 respectively, if compared to 2019. The expected reductions rise respectively to 72% and 85% in comparison to 2016. This demonstrates a remarkable accelerated progress towards achieving cleaner air since 2016, addressing the necessity to safeguard public health. Although this reduction is significant, it is projected that by 2025, road transport will no longer represent the primary source of NO_x emissions in London. Instead, industrial and commercial heat along with power generation source category, will overtake the emissions, surpassing those from road transport. In this regard, the World Health Organisation (WHO) has updated their health-based guidelines for air quality in 2021 aspiring to different clean air targets. As a result, the recommended level for annual mean NO₂ is set to 10 µg/m³, while for PM_{2.5} is revised to 5 µg/m³.

2019

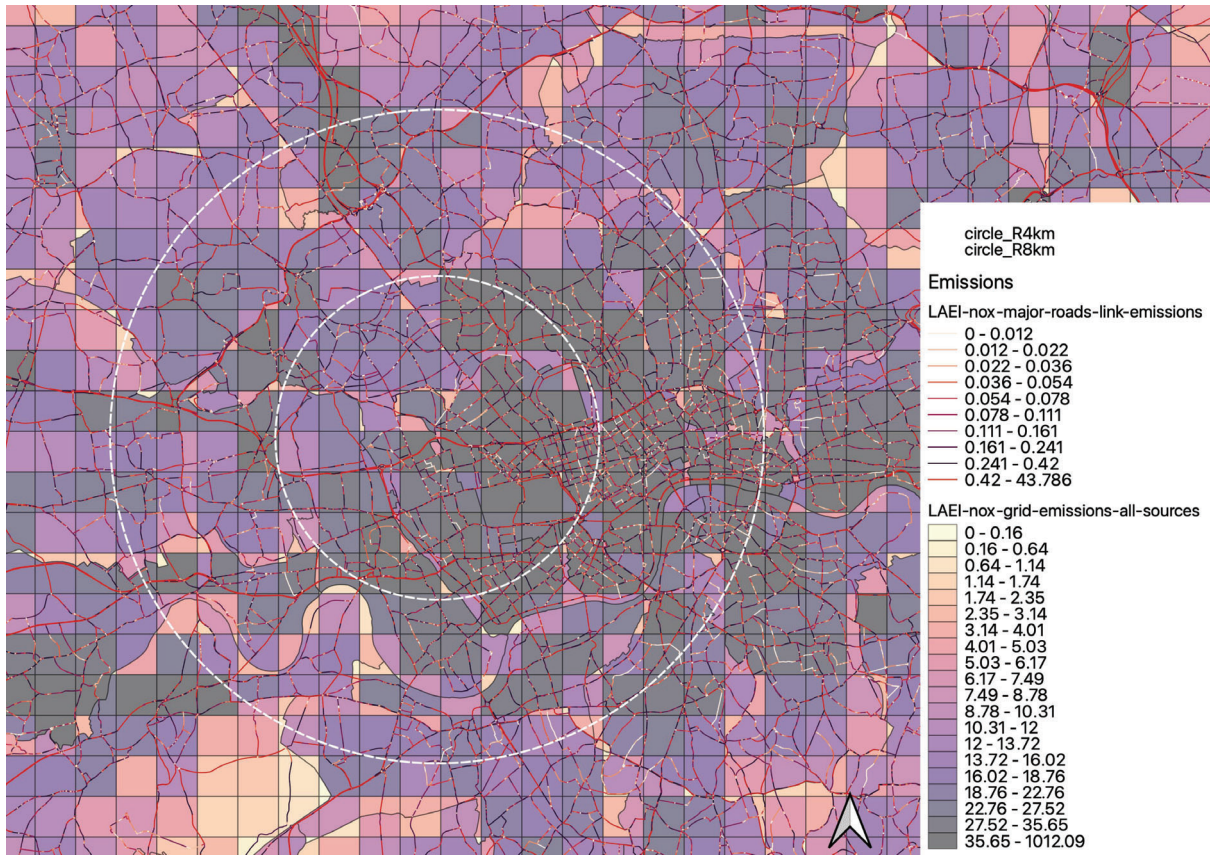
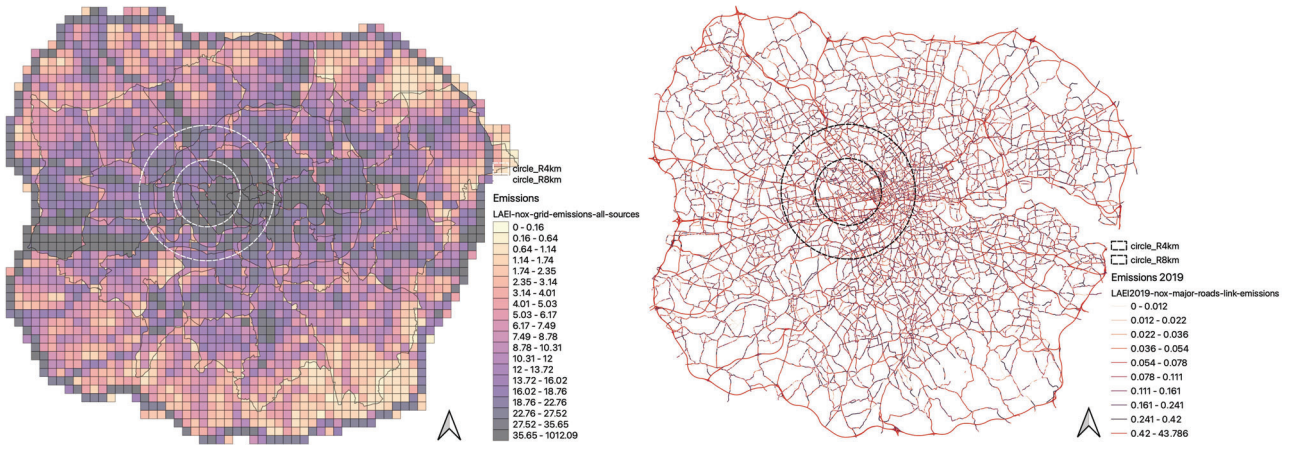


Figure 83. LAEI 2019_Nitrogen Oxides (NOx) Emissions along the main roads. Data source: London Datasore.

2025

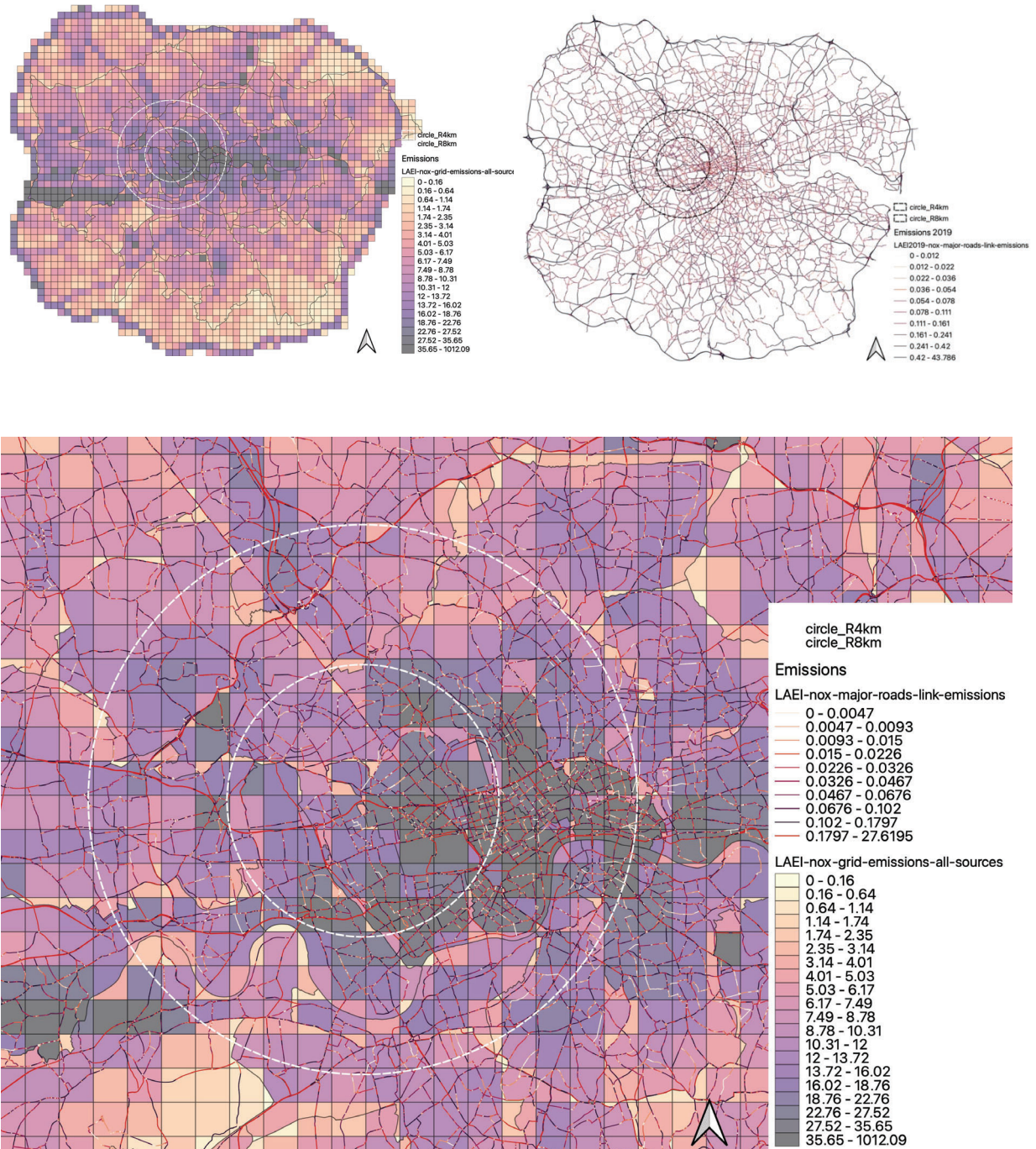


Figure 84. LAEI 2025_Nitrogen Oxides (NOx) Emissions along the main roads. Data source: London Datastore.

EMISSIONS AND CLEAN AIR TARGETS_

NOx emissions reduced by 18% in Greater London between 2016-2019 and are forecast to reduce further by **31%** in **2025**, and **44%** in **2030** compared to **2019** levels.

2030

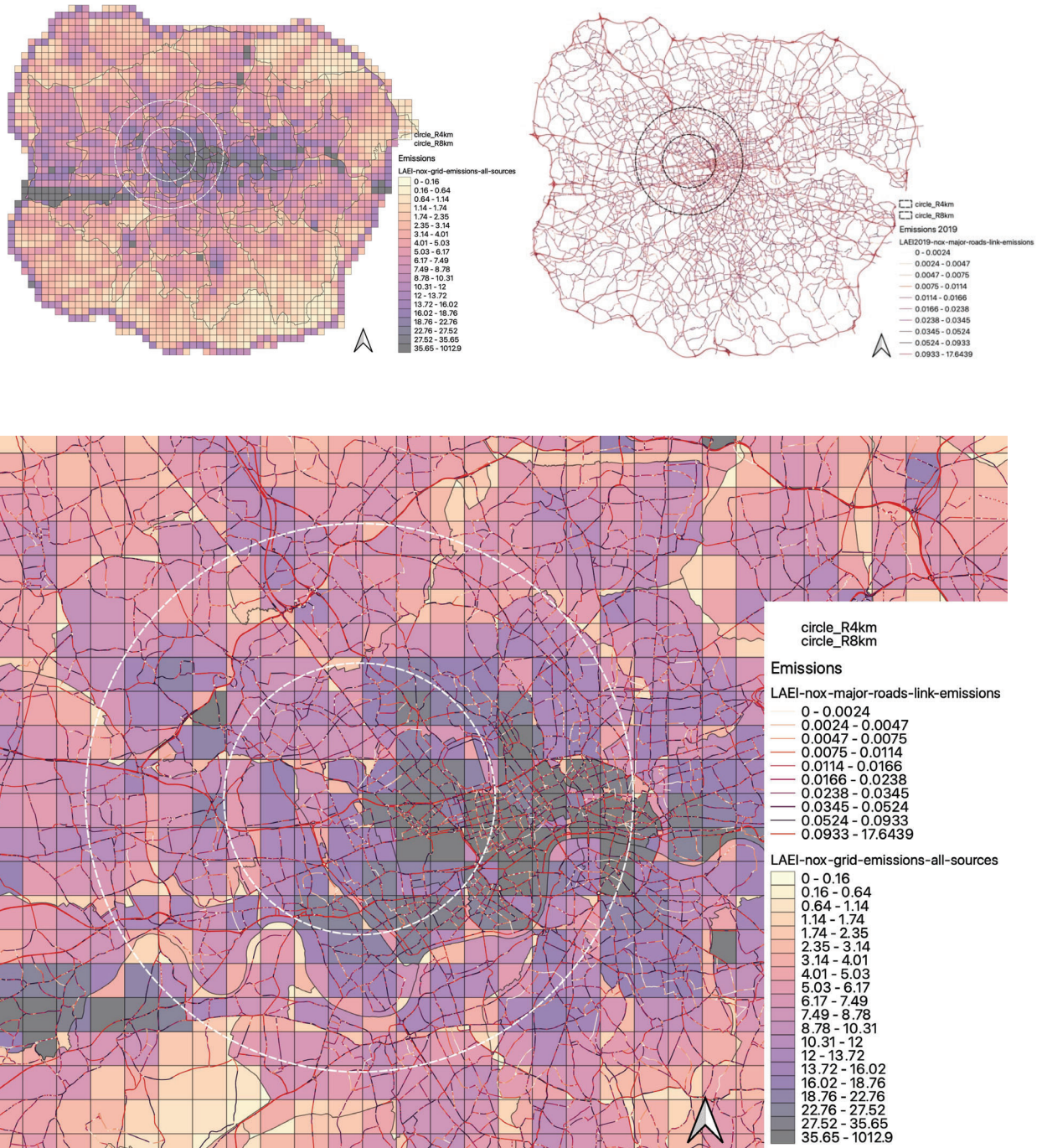


Figure 85. LAEI 2030_Nitrogen Oxides (NOx) Emissions along the main roads. Data source: London Datastore.

Future emissions

Emissions Data – Source Apportionment

The LAEI provides a breakdown of pollutant emissions by source, for 1km grid square resolution. The summary charts below show that, in 2019, the largest contributing source for NO_x and PM_{2.5} emissions was from road transport at 44% and 31% respectively.

For PM₁₀, in 2019, the largest contributing source is construction at 30%, closely followed by road transport at 27%. The PM_{2.5} chart also shows that domestic biomass/wood burning is a significant contributor at 17% of total emissions.

In future years, however, the proportion of road transport contributing to total emissions is expected to reduce significantly. By 2025, road transport emissions are expected to contribute 28% of total NO_x emissions and would be overtaken as the main source of pollution across Greater London by the industrial/commercial heat and power generation source (29% of total NO_x). By 2030, road transport would only represent 17% of total NO_x emissions, a similar proportion to aviation and industrial processes.

The contribution by source from 2016 is also provided for comparison. It shows a similar source apportionment compared to 2019, although the road transport NO_x contribution reduced notably (52% in 2016 vs. 44% in 2019), whilst the contribution of industrial/commercial heat and power combustion sources increased (from 17% in 2016 to 21% in 2019).

Whilst the Mayor, working with boroughs, has put in place some programmes and policies which are having an effect (e.g. the Non Road Mobile Machinery Low Emission Zone, Air Quality Positive and Neutral planning policies which are reducing emissions from construction and buildings), this data shows why it is so essential that the Mayor has additional powers to tackle non-road transport sources of pollution, including from buildings, construction, wood burning, commercial cooking and the river.

*The data shows that in **2019** the largest contributing source for Nitrogen Oxides (**Nox**) and Particulate Matter (**PM2.5**) emissions was from road transport (**44%** and **31%** respectively).
However, by **2030**, road transport would only represent **17%** of total NO_x emissions*

NITROGEN OXIDES (NO_x)

Key findings

Emissions Trends

Nitrogen Oxides (NO_x)

Since 2013, there has been a significant reduction in total NO_x emissions across the whole of London, including in central London. Figure 1 and Figure 2 show the trend in NO_x emissions per source. Compared to 2016, total NO_x emissions reduced by 18% in Greater London, and 17% in central London in 2019. The largest reduction in (tonnes of) NO_x emissions is from road transport in both Greater London and central London, as shown in the graphs below. Between 2016 and 2019, road transport NO_x emissions reduced by 31% across London, and 43% in central London, reflecting the impact of the central London ULEZ.

The pace of reductions notably accelerated from 2016⁶. Between 2013 and 2016, the change in road transport emissions in Greater London was a reduction of 14%, **therefore the rate of reduction has more than doubled between 2016 and 2019**. A comparison against UK emissions reductions⁷ show that nationally, road transport NO_x emissions reduced by only 10% between 2016 and 2019, far slower than the reductions achieved in London.

This trend in NO_x reduction is expected to continue over the period modelled, although at a slightly lower rate than as observed between 2016 and 2019. Total NO_x emissions across Greater London are forecast to be 31% lower in 2025, and 44% lower in 2030, compared to 2019 emission levels (and respectively 44% and 54% lower if compared to 2016 emissions). In central London, the reduction is expected to be 24% in 2025, and 37% in 2030, compared to 2019 NO_x emissions (and respectively 37% and 48% if compared to 2016 emissions).

The largest reduction in NO_x emissions is forecast to come from road transport in both Greater London and central London, as shown in the graphs below. Road transport NO_x emissions are expected to reduce by 56% across London by 2025 and 77% by 2030, compared to 2019 (and by respectively 70% and 84% compared to 2016), as the vehicle fleet continues to become cleaner accelerated due to schemes such as the ULEZ. The expected reduction of NO_x emissions from road transport in central London is 52% in 2025 and 75% in 2030 respectively, compared to 2019 (and respectively 72% and 85% compared to 2016). However, what is also clear is that despite significant improvements following bold policies, without further and urgent action, London will not be able to realise the emissions reductions required to help meet WHO air quality standards (see more in the air quality concentrations section).

It is important to note that, due to this significant reduction, **it is forecast that by 2025 road transport will no longer be the dominant source of NO_x across London anymore, overtaken by the industrial and commercial heat and power generation source category** (see further details pages 32 to 34).

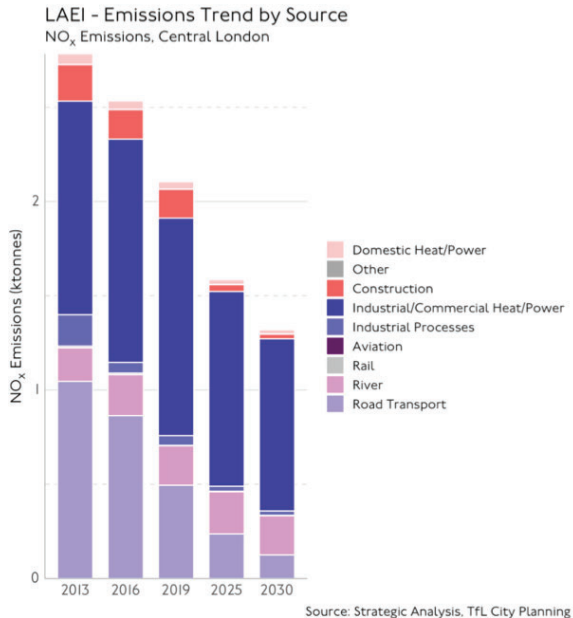
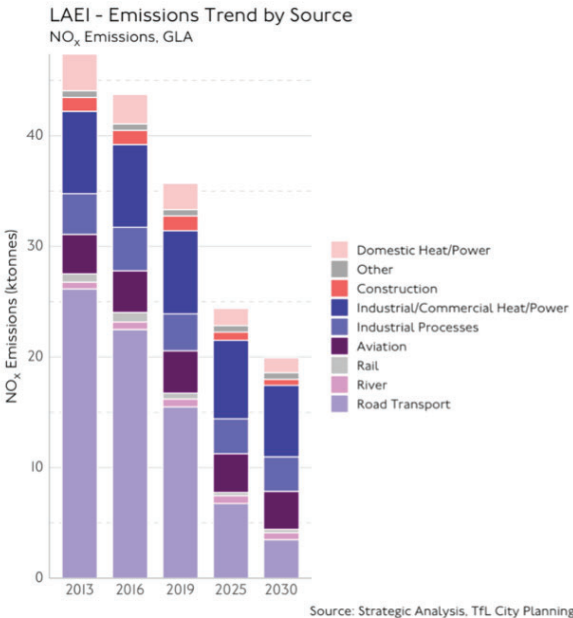


Figure 86. NO_x Emissions Trend by Source in Greater London (top), and NO_x Emissions Trend by Source in Central London (bottom).

APPENDIX 2_T-TEST ON HYPOTHESIS 1

An independent T-Test has been employed to validate Hypothesis 1 concerning the relation between lack of spatial properties and occurrence of residual spaces. The test compared the distribution of spatial metrics (segment angular choice and segment angular integration) of the pedestrian segment model, within the residual spaces against the distribution of the same metrics in the surrounding areas. The evidence from the assessment shows that significant differences in spatial connectivity values (NAIN) are found at 95% and 99% level, when considering the distributions of the whole set of segment values (taken from QGIS analysis) within the totality of the area (minus the residual spaces), in comparison to the distribution of the totality of the residual spaces within said areas. More specifically, the effect is significant in relation to normalised integration NAIN400 and NAIN2000 within Area 2, as shown in the printout below, where the differences between the residual spaces and related neighbour segments are starker. In summary, the results suggest that within areas of high average connectivity (NAIN), significantly lower values are found in the coincidence of residual spaces. On the other hand, no significant differences are found with the NACH metrics. However, the found effect did not always emerge in all cases, as no statistically significant differences were detected in area 1 and 3 when taken singularly. In summary, this result points towards the need of ulterior data collection to expand the analysis dataset and improve statistical confidence.

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T-Test results on NACHr400m
Area 1: Ttest_indResult(statistic=-1.8533436595783166, pvalue=0.06454265751587827)
Area 2: Ttest_indResult(statistic=-1.2397222299804698, pvalue=0.21580496435438093)
Area 3: Ttest_indResult(statistic=1.2301537294084854, pvalue=0.21926420180599113)
All Areas: Ttest_indResult(statistic=-1.4570567505568257, pvalue=0.1453456000722513)
-----
T-Test results on NACHr2000m
Area 1: Ttest_indResult(statistic=1.2564188978251858, pvalue=0.2096709107768784)
Area 2: Ttest_indResult(statistic=-0.004382423019475381, pvalue=0.9965055228330731)
Area 3: Ttest_indResult(statistic=-2.37692221604312, pvalue=0.01786324143728998)
All Areas: Ttest_indResult(statistic=0.8646299909255114, pvalue=0.38740353169095976)
-----
T-Test results on NAINr400m
Area 1: Ttest_indResult(statistic=0.6749904248819105, pvalue=0.5000116536426344)
Area 2: Ttest_indResult(statistic=3.1870694282503336, pvalue=0.0015478462241334463)
-->Significant at 95% level
Area 3: Ttest_indResult(statistic=0.31930165263198357, pvalue=0.749633305022546)
All Areas: Ttest_indResult(statistic=3.183133511069553, pvalue=0.0014894835499861727)
-->Significant at 95% level
-----
T-Test results on NAINr2000m
Area 1: Ttest_indResult(statistic=1.1294433216488995, pvalue=0.259283320409974)
Area 2: Ttest_indResult(statistic=3.3792869057356403, pvalue=0.0007966908301532906)
-->Significant at 99% level
Area 3: Ttest_indResult(statistic=0.695237264609342, pvalue=0.4872348441986879)
All Areas: Ttest_indResult(statistic=5.2877924713247255, pvalue=1.4383046698942073e-07)
-->Significant at 99% level
-----
T-Test results on NACH
Area 1: Ttest_indResult(statistic=2.4505780663988532, pvalue=0.014675551043160215)
Area 2: Ttest_indResult(statistic=0.8256159264749019, pvalue=0.4095166000017675)
Area 3: Ttest_indResult(statistic=-2.346291841719626, pvalue=0.019383869143734276)
All Areas: Ttest_indResult(statistic=1.9519067321008428, pvalue=0.05116759912243364)
-----
T-Test results on NAIN
Area 1: Ttest_indResult(statistic=2.5361345118308005, pvalue=0.011529016028676342)
Area 2: Ttest_indResult(statistic=2.541550696065332, pvalue=0.011405347093486643)
Area 3: Ttest_indResult(statistic=0.16896118231042, pvalue=0.8658966151400536)
All Areas: Ttest_indResult(statistic=5.218760440436368, pvalue=2.0772668463797424e-07)
-->Significant at 99% level

```


APPENDIX 3_ STATIONARY ACTIVITY-TRACES OBSERVATIONS

Stationary activity and traces observations for all three study areas are displayed in the Figures below, providing supplementary evidence to the study presented in *Chapter 5* (section 5.2.7). This examination reveals usage patterns among the three sites and compares the diverse results obtained. Remarkably, all areas exhibit a noticeable absence of stationary activity, suggesting that residual areas are not conducive to inviting people to spend time within these neglected urban environments, but rather to use them simply as walkways.

AREA 1

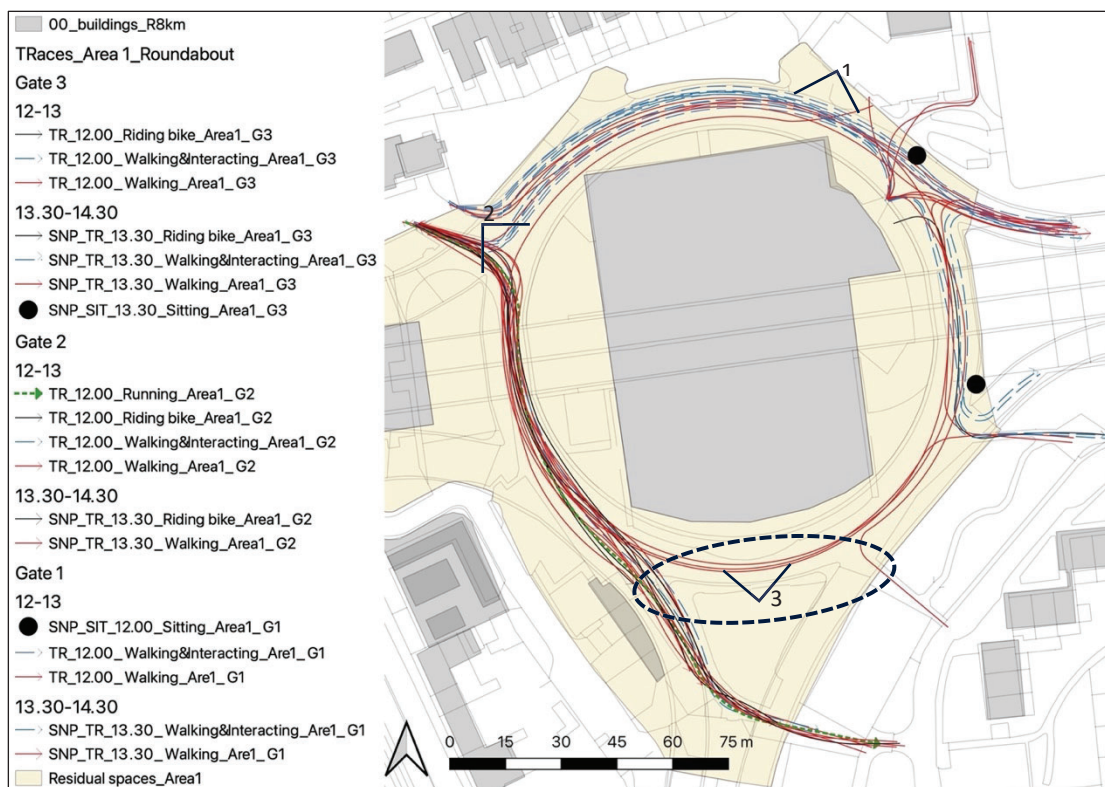
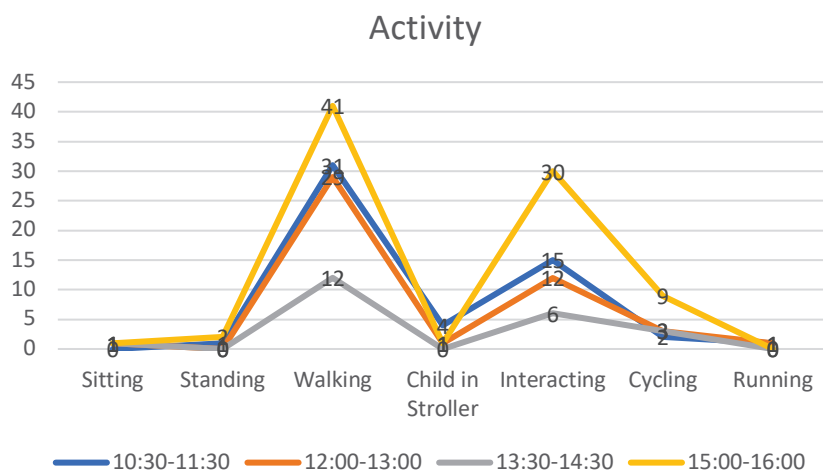


Figure 87. Area1 - Traces and snapshots analysis.



AREA 1 TOT.				
GATE 1-2-3				
Activities	10:30-11:30	12:00-13:00	13:30-14:30	15:00-16:00
Sitting	0	1	1	1
Standing	1	0	0	2
Walking	31	29	12	41
Child in Stroller	4	1	0	1
Interacting	15	12	6	30
Cycling	2	3	3	9
Running	1	1	0	0
TOT PEOPLE	38	30	18	54
TOT PEOPLE/H	456	360	216	648
Male	17	22	10	46
Female	18	12	5	7

Absence of relevant stationary activity

Presence of a school-bus with numerous children going to play soccer in the nearby football pitches.

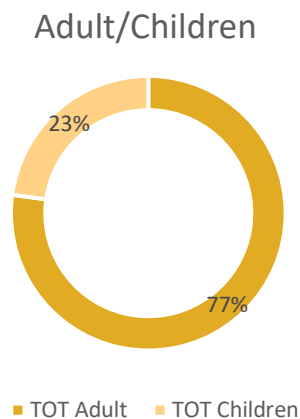
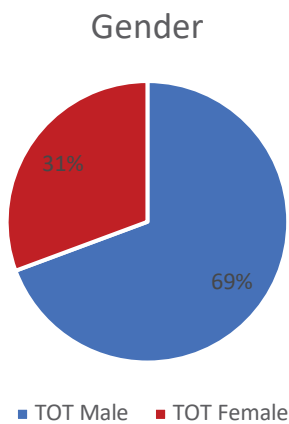
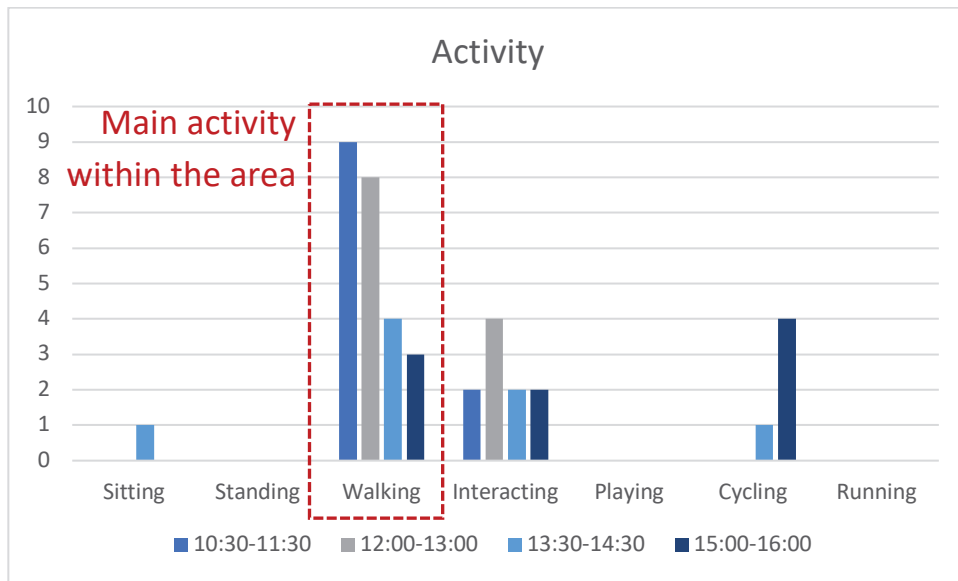
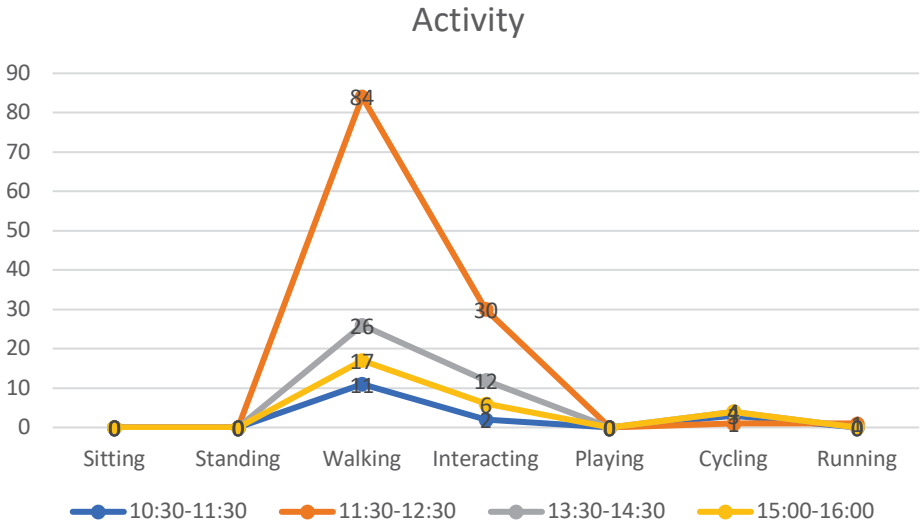


Figure 88. Examination of main activities observed within Area 1 and identification of corresponding user groups.

AREA 2



Figure 89. Area2 - Traces and snapshots analysis.



AREA 2				
GATE 1				
Activities	10:30-11:30	12:00-13:00	13:30-14:30	15:00-16:00
Sitting	0	0	0	0
Standing	0	0	0	0
Walking	11	84	26	17
Interacting	2	30	12	6
Playing	0	0	0	0
Cycling	3	1	4	4
Running	0	1	0	0
TOT PEOPLE	14	86	30	21
TOT PEOPLE/H	168	1032	360	252

Absence of stationary activity

Men	6	70	14	10
Women	8	16	12	11

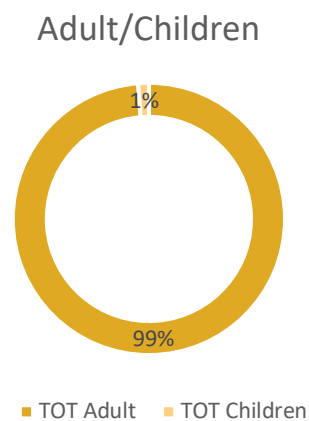
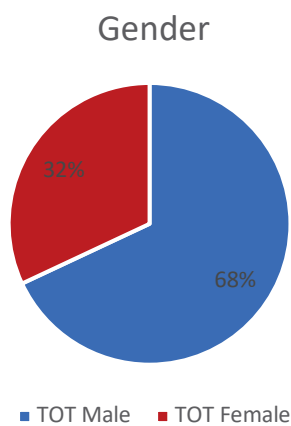
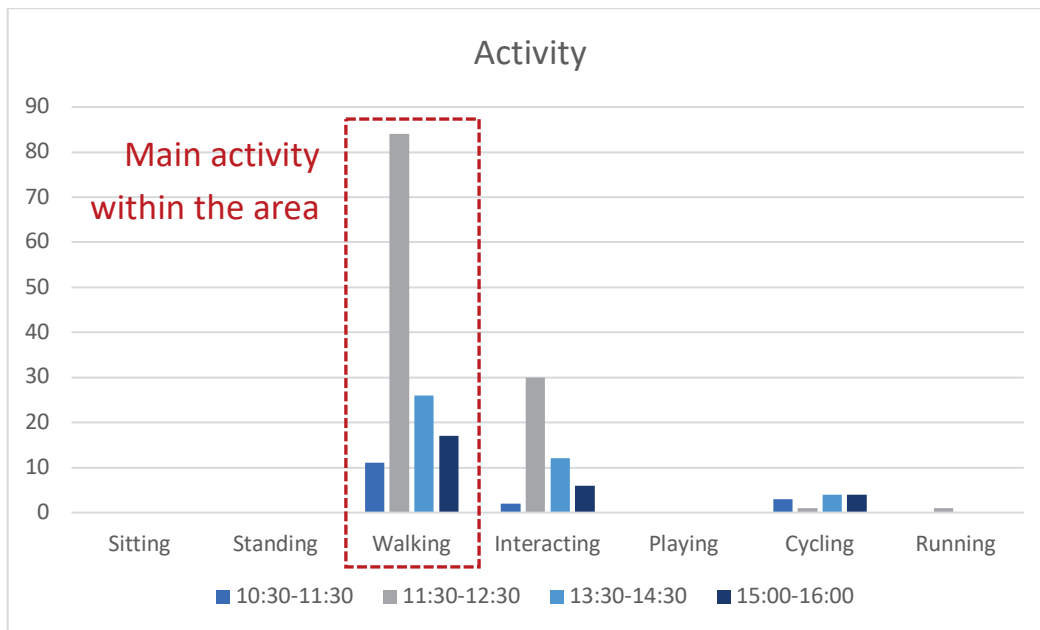


Figure 90. Examination of main activities observed within Area 2 and identification of corresponding user groups.

AREA 3

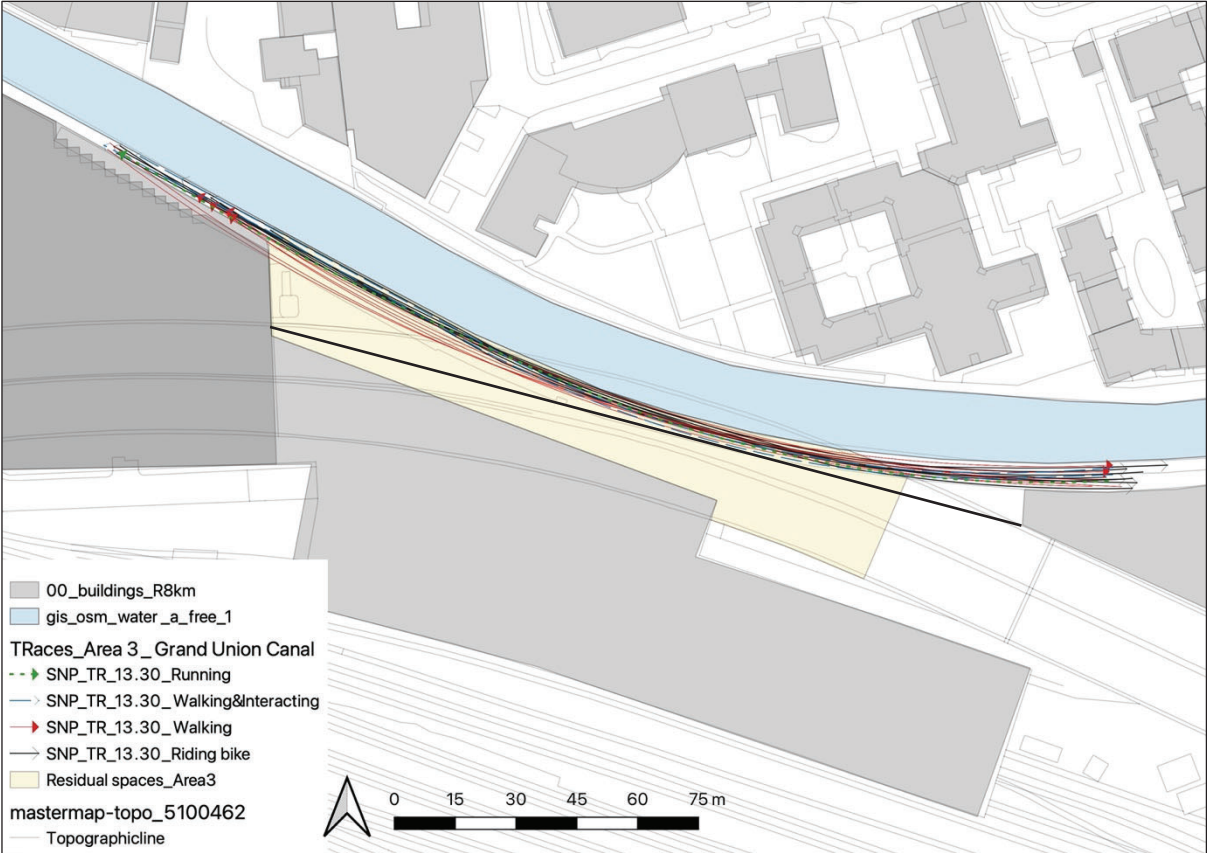
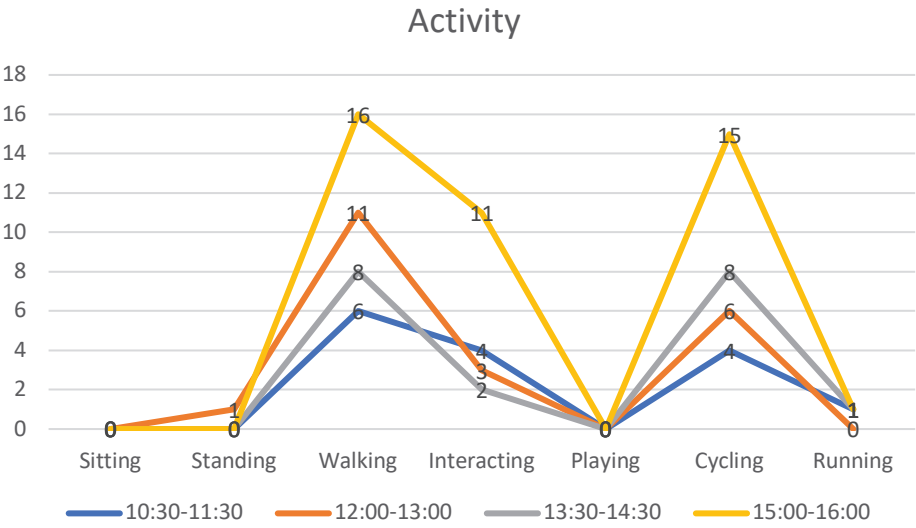


Figure 91. Area3 - Traces and snapshots analysis.



AREA 3				
GATE 1				
Activities	10:30-11:30	12:00-13:00	13:30-14:30	15:00-16:00
Sitting	0	0	0	0
Standing	0	1	0	0
Walking	6	11	8	16
Interacting	4	3	2	11
Playing	0	0	0	0
Cycling	4	6	8	15
Running	1	0	1	1
TOT PEOPLE	11	18	17	32
TOT PEOPLE/H	132	216	204	384
Male	8	14	10	17
Female	3	4	7	15

Absence of relevant stationary activity

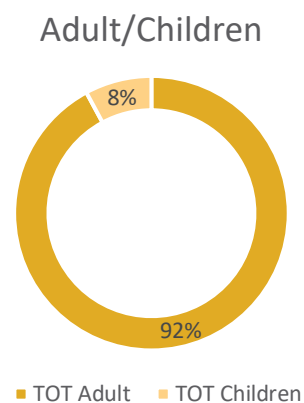
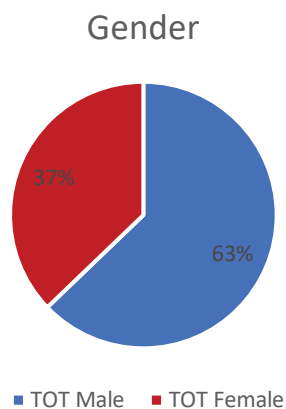
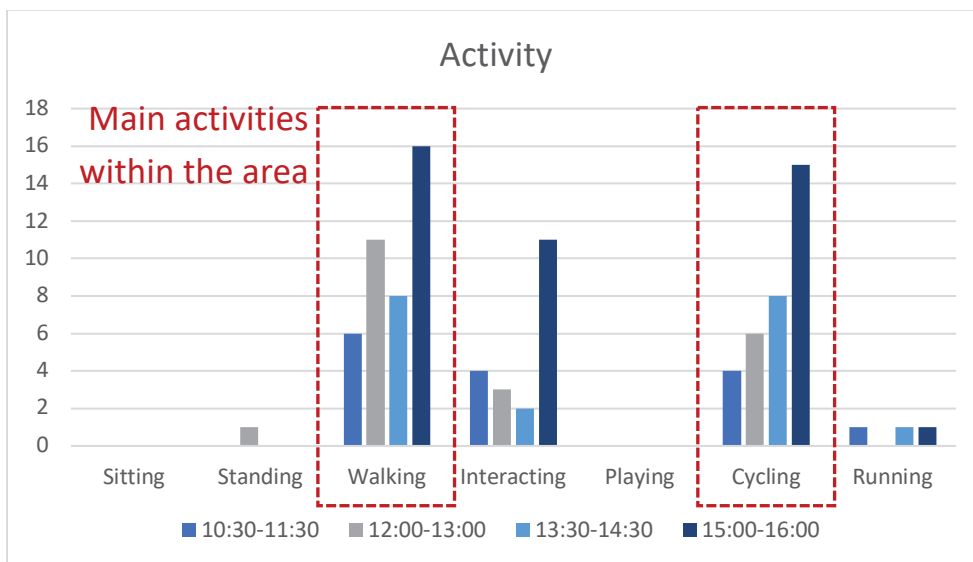


Figure 92. Examination of main activities observed within Area 3 and identification of corresponding user groups.

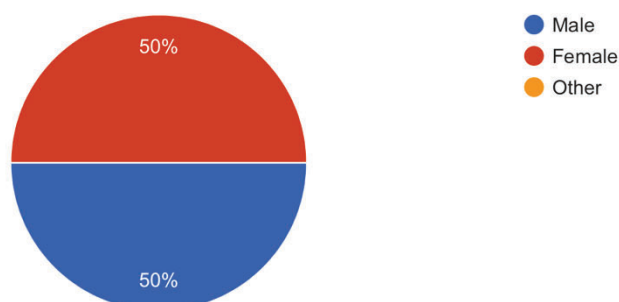
APPENDIX 4_ QUESTIONNAIRE ON SAFETY/UNSAFETY PERCEPTION WITHIN RESIDUAL AREAS

Qualitative observations conducted in all three study areas over a sample of 96 people, are reported through the following diagrams. This section serves as supplementary information to complement the findings presented in *Chapter 5 (section 5.4)*. Specifically, pie charts depict proportions of responses for “gender”, “age”, “residency” (questions 1 to 4), and “sense of safety” (questions 4,6) provided by all participants, both during day and night-time. Additionally, bar charts illustrate the frequency of common reasons that make individuals feel either safe or unsafe within the study areas, and the motivations that lead participants to pass through the sites (questions 5,7,8). Finally, the last section of the questionnaire (question 10), which inquires whether participants have recommendations for enhancing the overall state of the designated residual areas, offers valuable suggestions for potential design proposals.

AREA 1

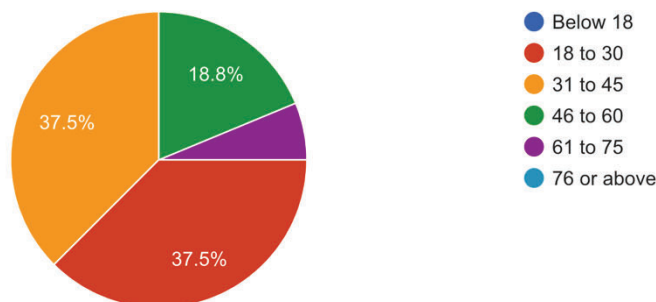
1. Please indicate your gender

32 responses



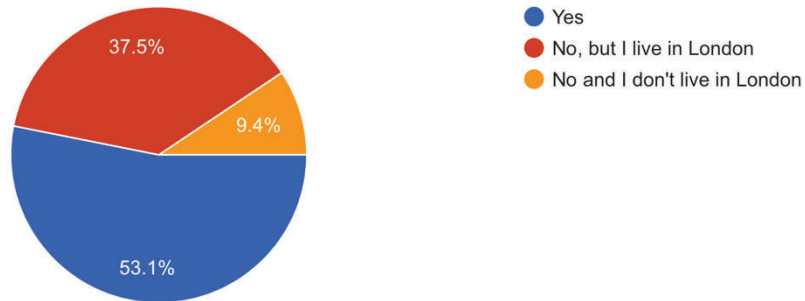
2. What is your age?

32 responses



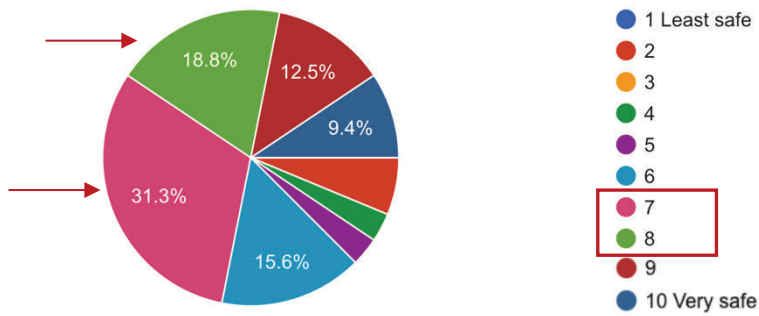
3. Are you a resident of this local area?

32 responses



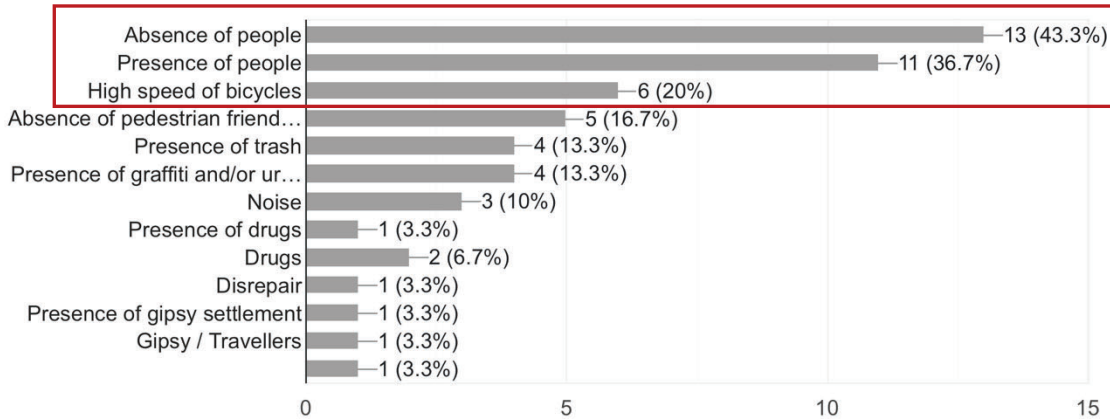
4. When you are in this location (the Westway Roundabout flyover underneath the Westway), do you generally feel more or less safe during daytime?

32 responses



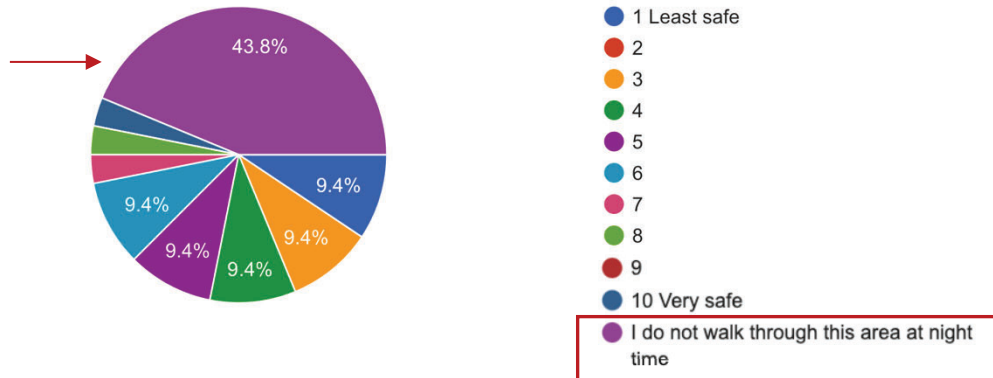
5. If possible, please name the most significant aspects that contribute to your feeling of safety/unsafety during daytime while occupying this area.

30 responses



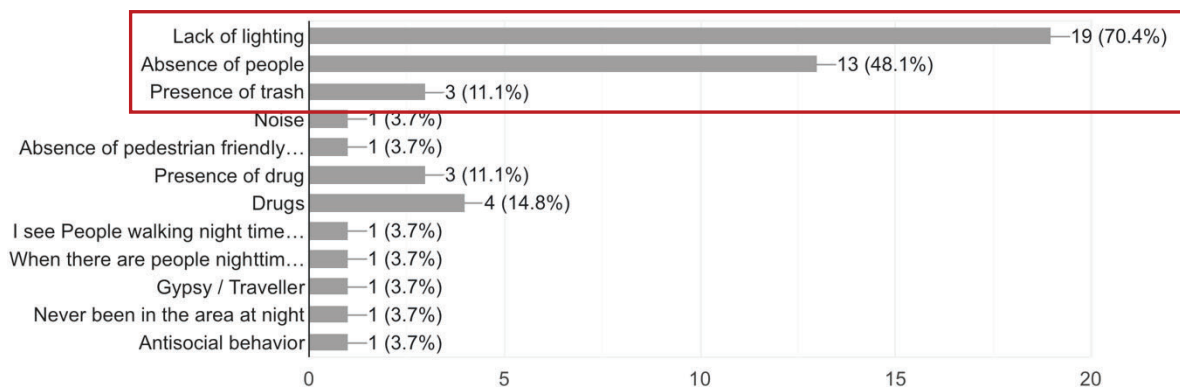
6. Please answer the same question as above in regards to night time. If you have never been here at night time, please indicate it.

32 responses



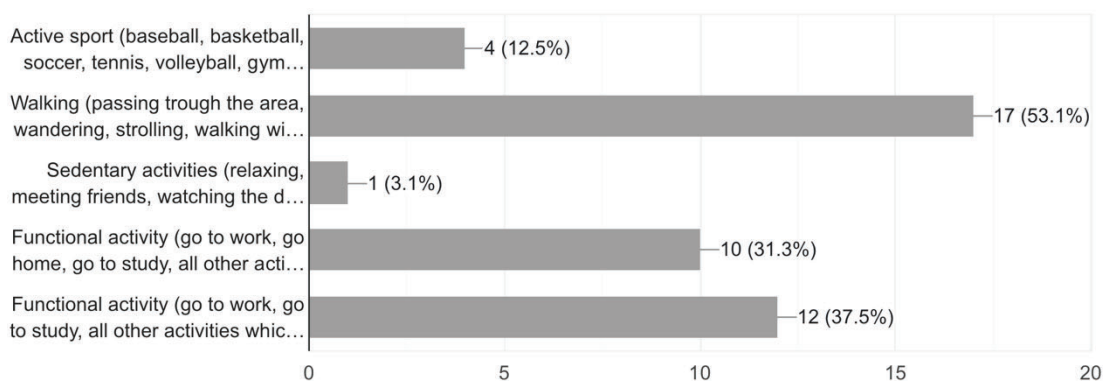
7. If possible, please name the most significant aspects that contribute to your feeling of safety/unsafety during night time while occupying this area.

27 responses



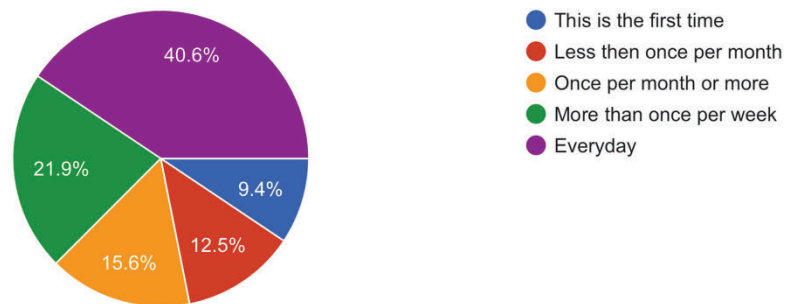
8. What are all the reasons that make you pass by this area?

32 responses



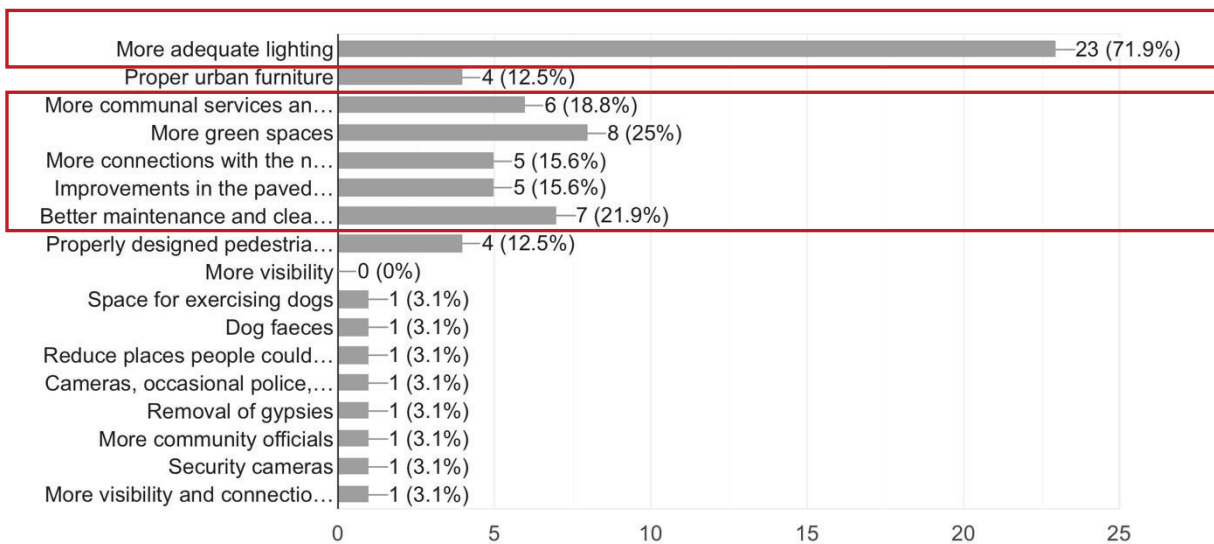
9. How often do you pass through this area?

32 responses



10. What do you think would improve this area?

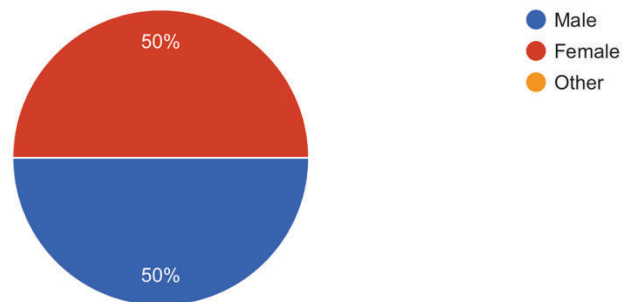
32 responses



AREA 2

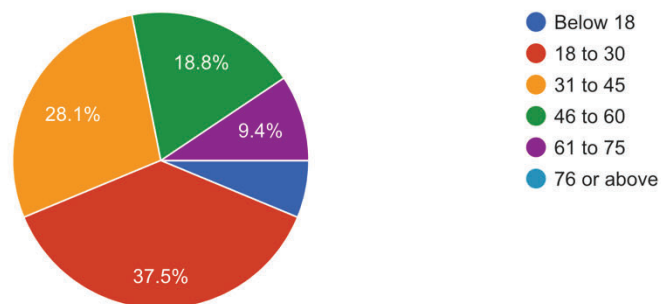
1. Please indicate your gender

32 responses



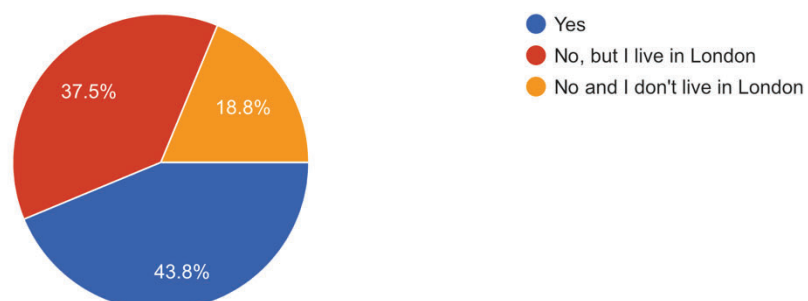
2. What is your age?

32 responses



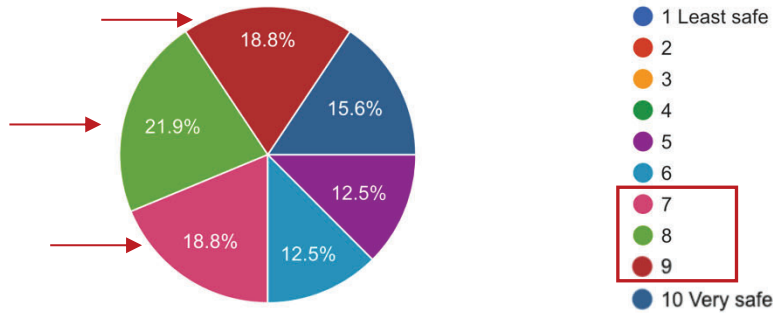
3. Are you a resident of this local area?

32 responses



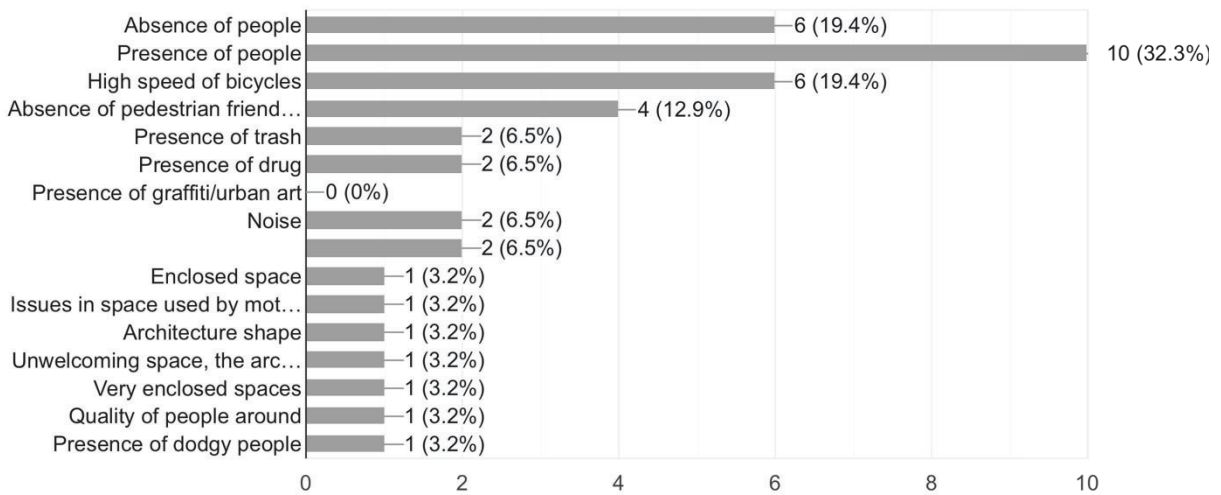
4. When you are in this location (the Portobello Road flyover area underneath the Westway), do you generally feel more or less safe during daytime?

32 responses



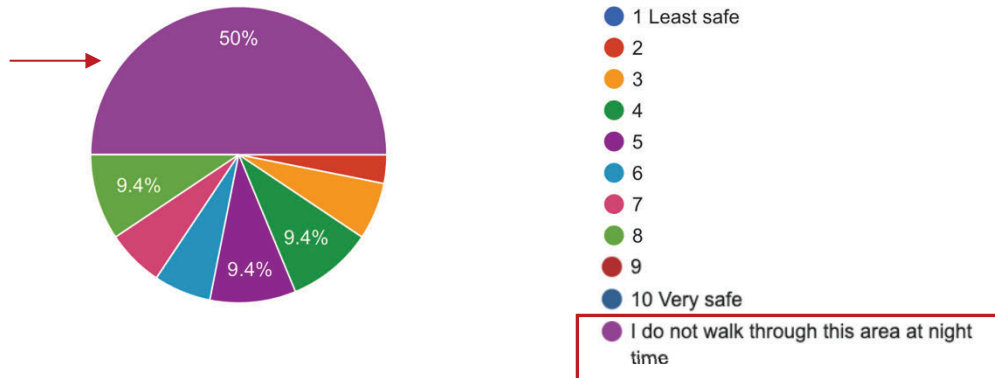
5. If possible, please name the most significant aspects that contribute to your feeling of safety/unsafety during daytime while occupying this area.

31 responses



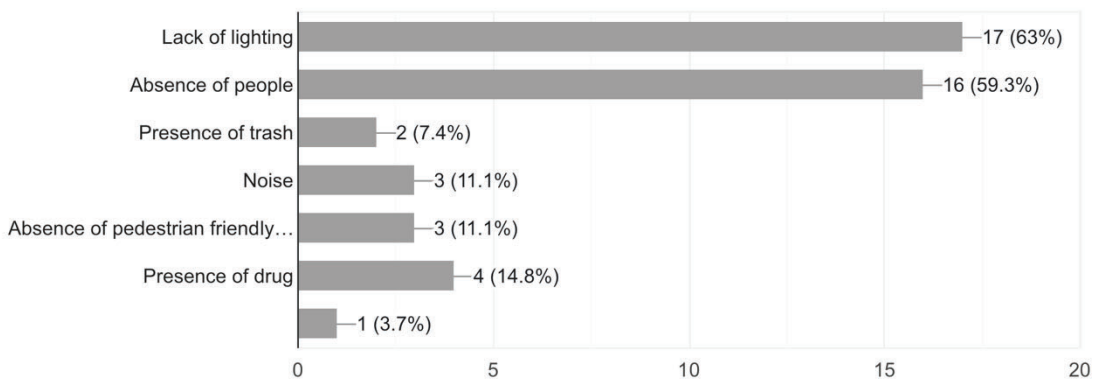
6. Please answer the same question as above in regards to night time. If you have never been here at night time, please indicate it.

32 responses



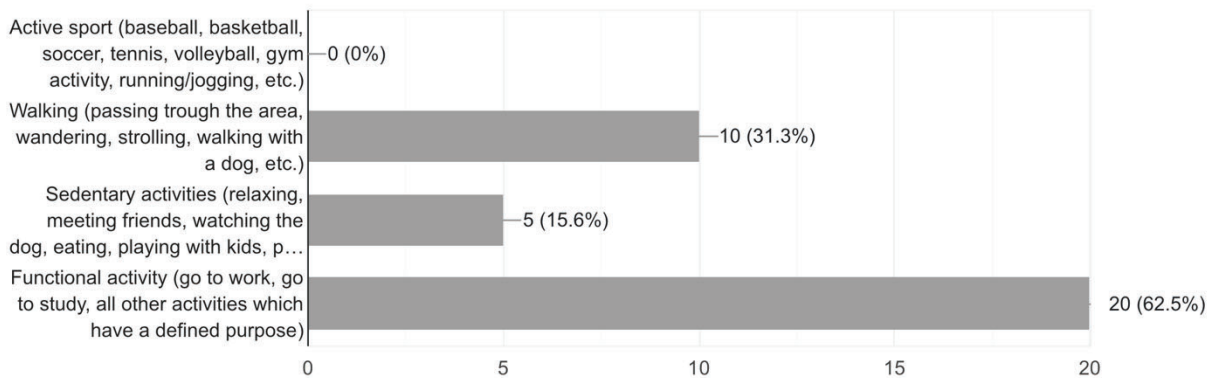
7. If possible, please name the most significant aspects that contribute to your feeling of safety/unsafety during night time while occupying this area.

27 responses



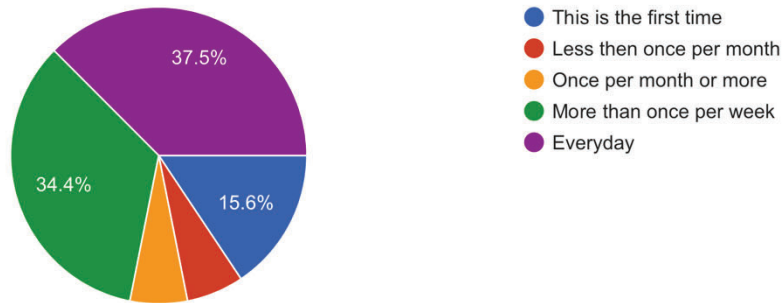
8. What are all the reasons that make you pass by this area?

32 responses



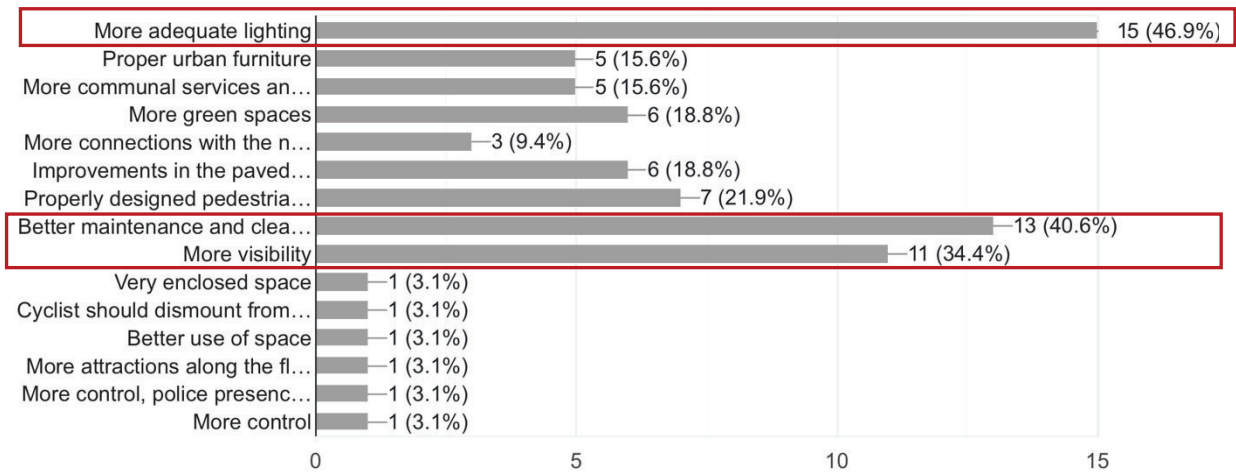
9. How often do you pass through this area?

32 responses



10. What do you think would improve this area?

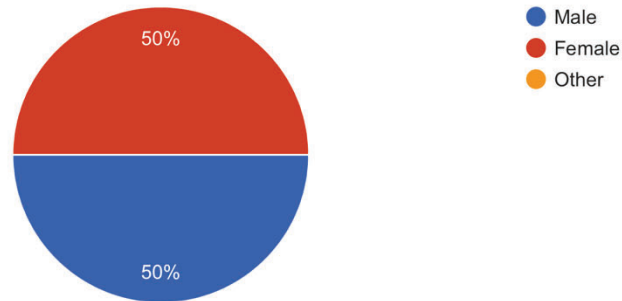
32 responses



AREA 3

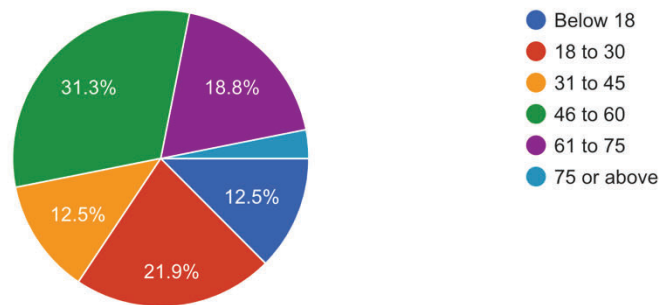
1. Please indicate your gender

32 responses



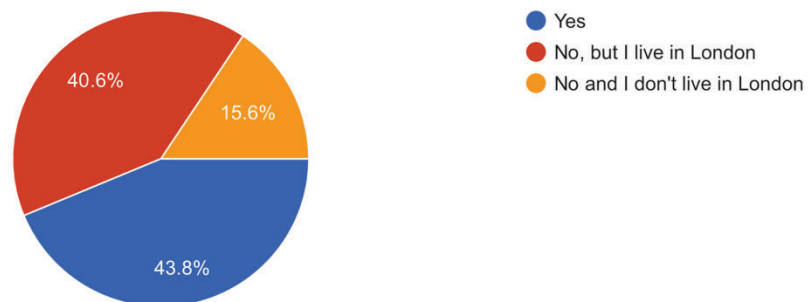
2. What is your age?

32 responses



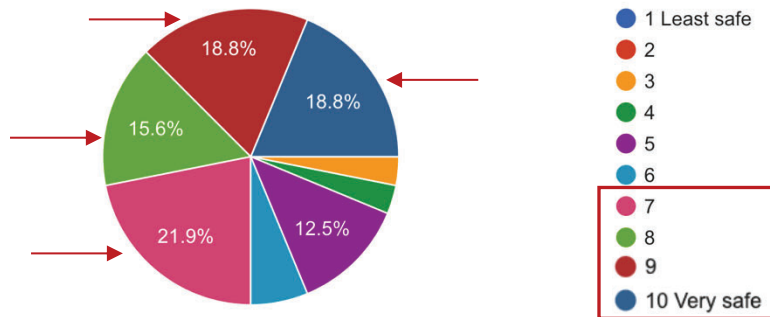
3. Are you a resident of this local area?

32 responses



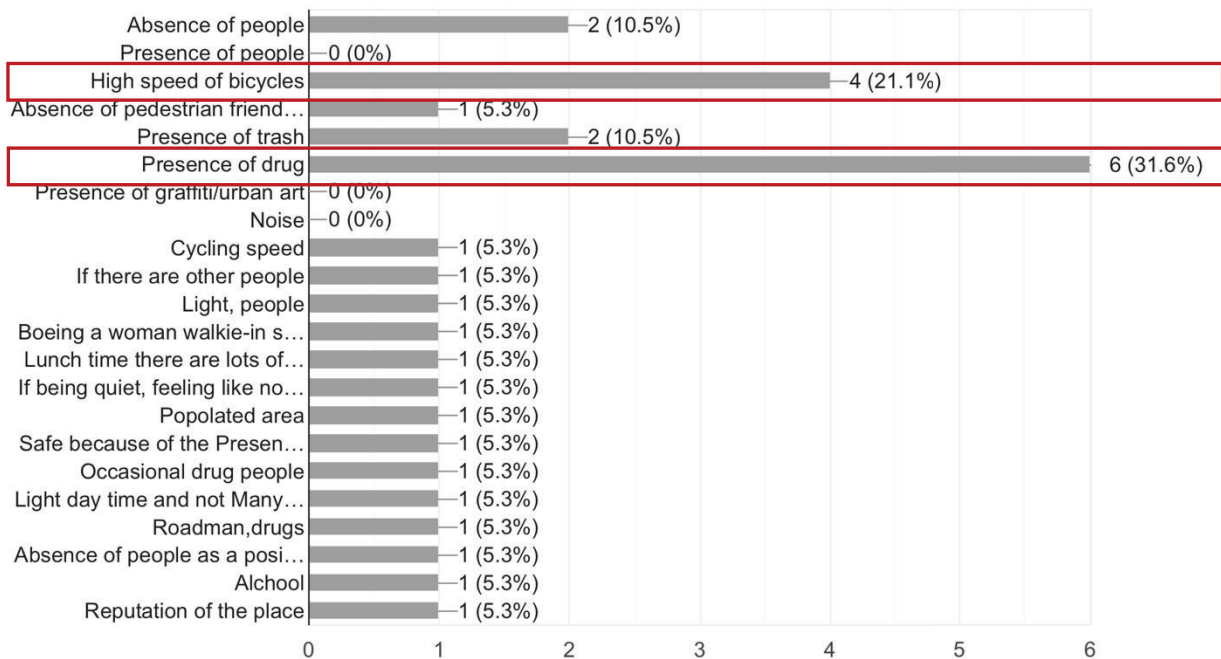
4. When you are in this location (the Grand Union Canal flyover underneath the Westway), do you generally feel more or less safe during daytime?

32 responses



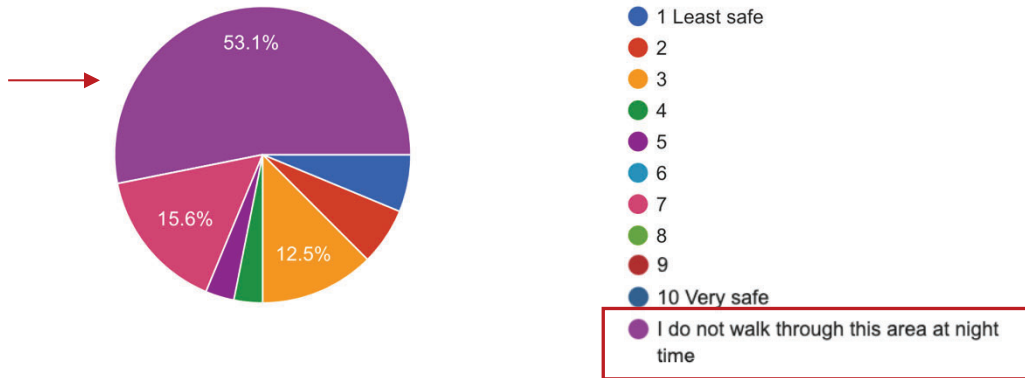
5. If possible, please name the most significant aspects that contribute to your feeling of unsafety during daytime while occupying this area.

19 responses



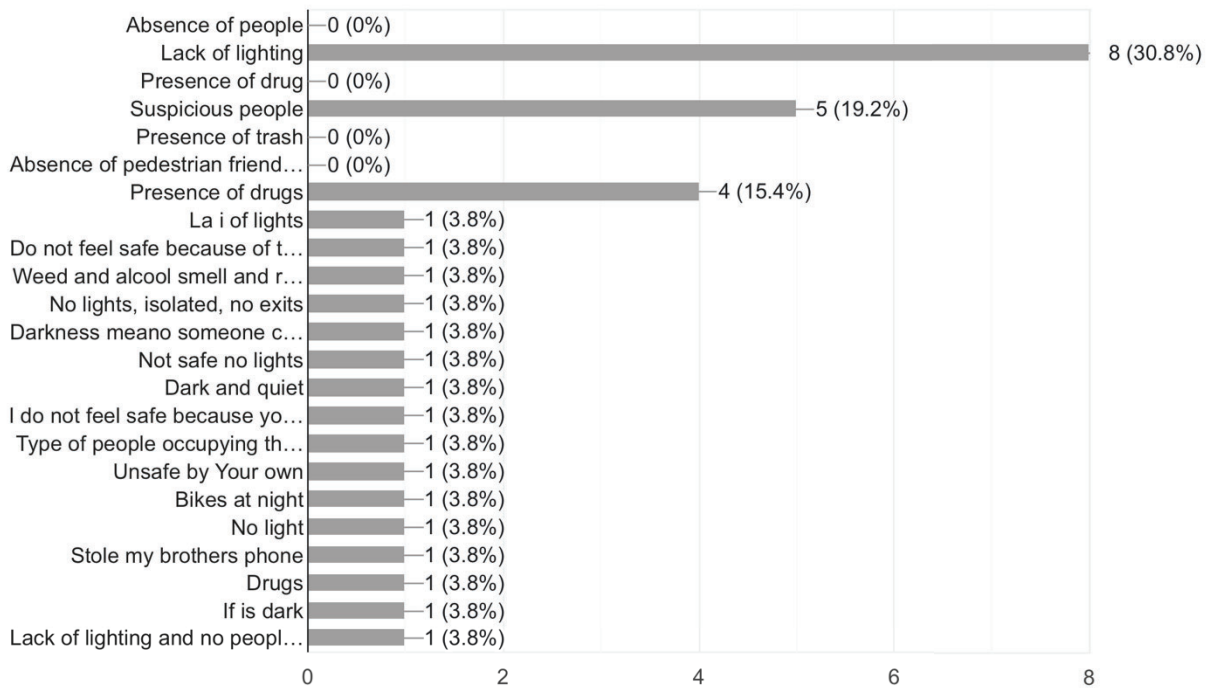
6. Please answer the same question as above in regards to night time. If you have never been here at night time, please indicate it.

32 responses



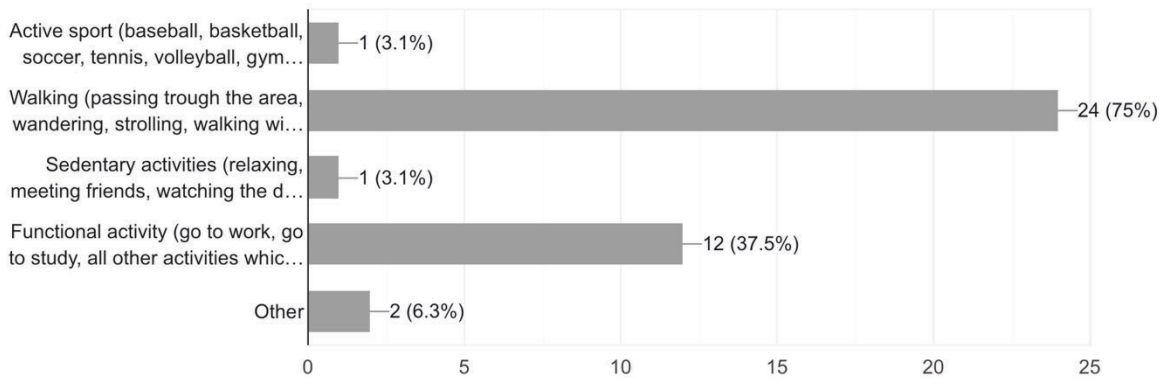
7. If possible, please name the most significant aspects that contribute to your feeling of unsafety during night time while occupying this area (lack of lighting, absence of people, etc.).

26 responses



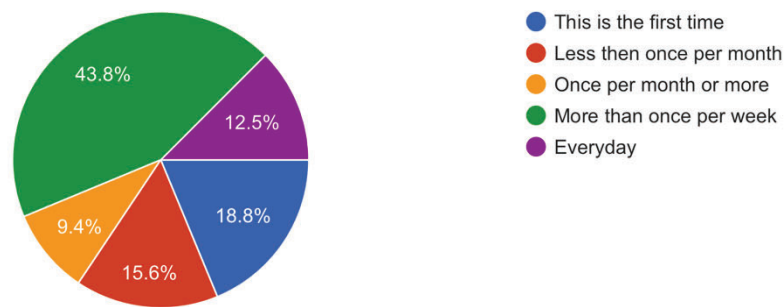
8. What are all the reasons that make you pass by this area?

32 responses



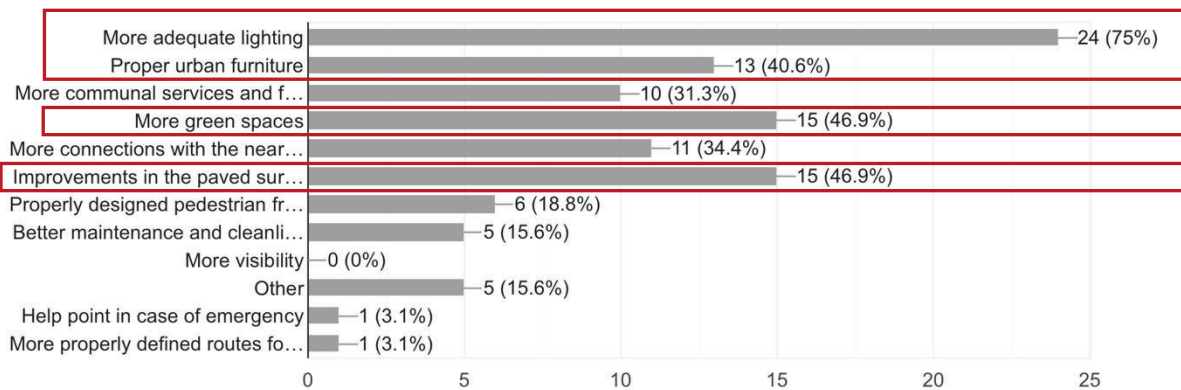
9. How often do you pass through this area?

32 responses



10. What are your suggestions on potential improvements for this area?

32 responses



APPENDIX 5_ GRAFFITI AND URBAN ART MAPPING

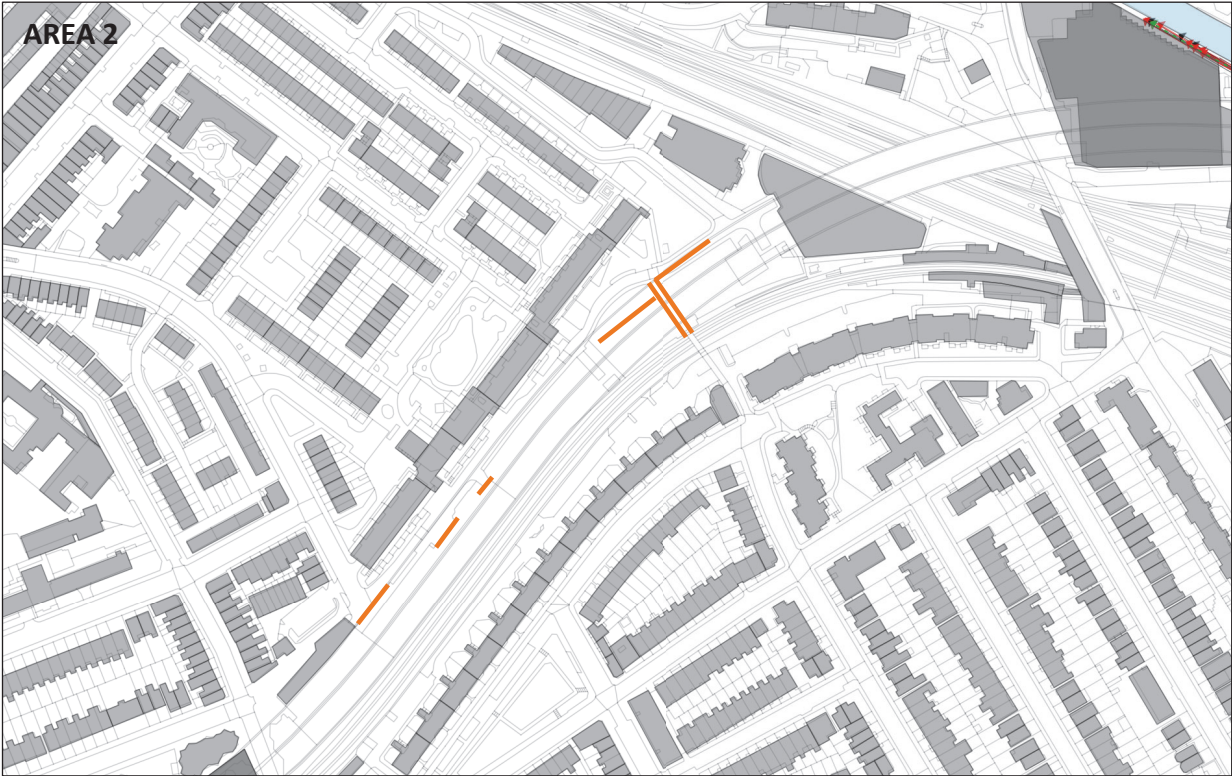
The presence of graffiti within all three study sites has been mapped to support the investigation concerning the manifestation of anti-social behaviours in residual urban settings. This aspect is particularly relevant to the research as it considers graffiti, typically created without any permission and distinct from “urban art”, as an expression of defacement of public areas. Graffiti, viewed as a form of urban practice, could be conceived as a reflection of social conditions within a space. They appear to hold a potential negative impact on the space appearance and the way individuals perceive the urban environment. Therefore, this aspect is integrated into the established classification framework (refer to *Figure 58*) under the category of “use related” causes. The investigation provided an insight into the usage of these neglected spaces, revealing that all the identified sites exhibit a high presence of graffiti activity. This suggests that these often-disregarded places host symbolic significance and are used to express the social and economic conditions of the urban context in which they are placed.



- Graffiti
- Urban Art

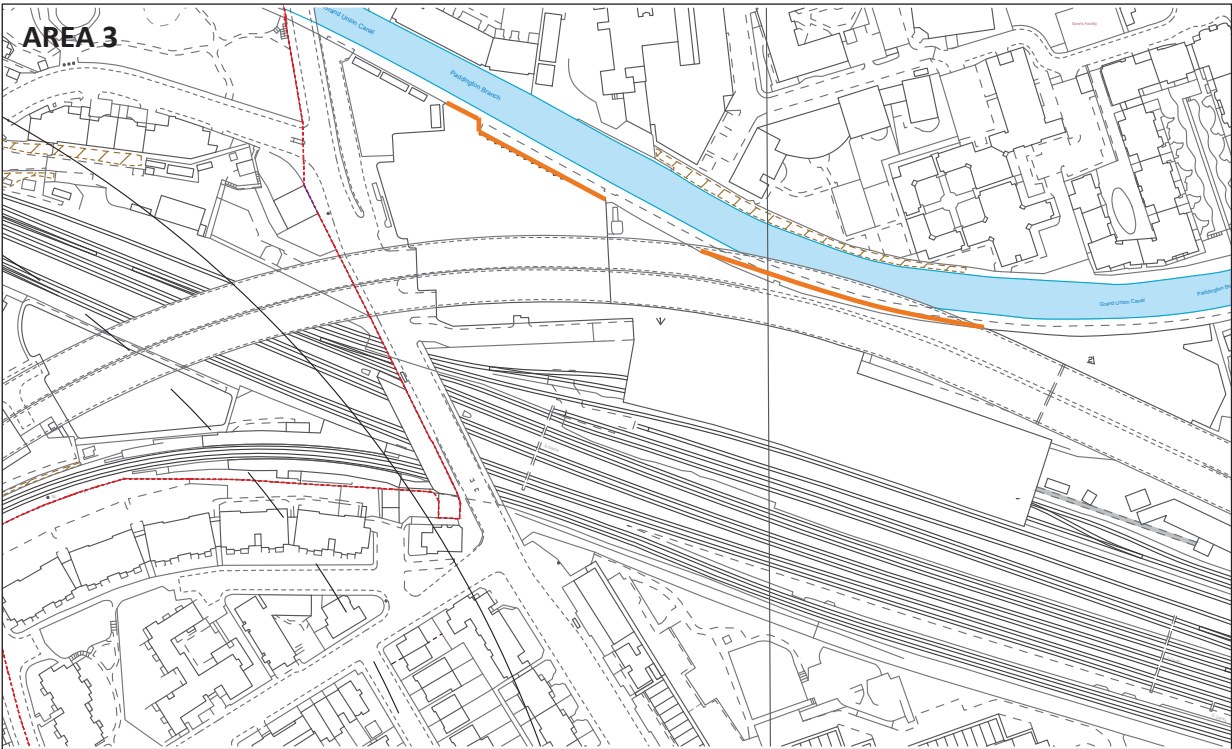
Major presence of graffiti in these areas

Figure 93. Map of graffiti concerning Area 1.



— Graffiti
— Urban Art

Major presence of graffiti
in these areas



— Graffiti
— Urban Art

Figure 95. Map of graffiti concerning Areas 2-3.

APPENDIX 6_ INVESTIGATING THE FACTORS OF RESIDUALITY-PRESENT TIME

Residual spaces within all three study areas have been mapped and classified, as illustrated below. A *residuality degree* and *severity level* values are the results of the defined Residuality Assessment Process (see Tables 9-10-11) involving the identification of spatial, social, and perceptual factors contributing to the establishment of residuality conditions.

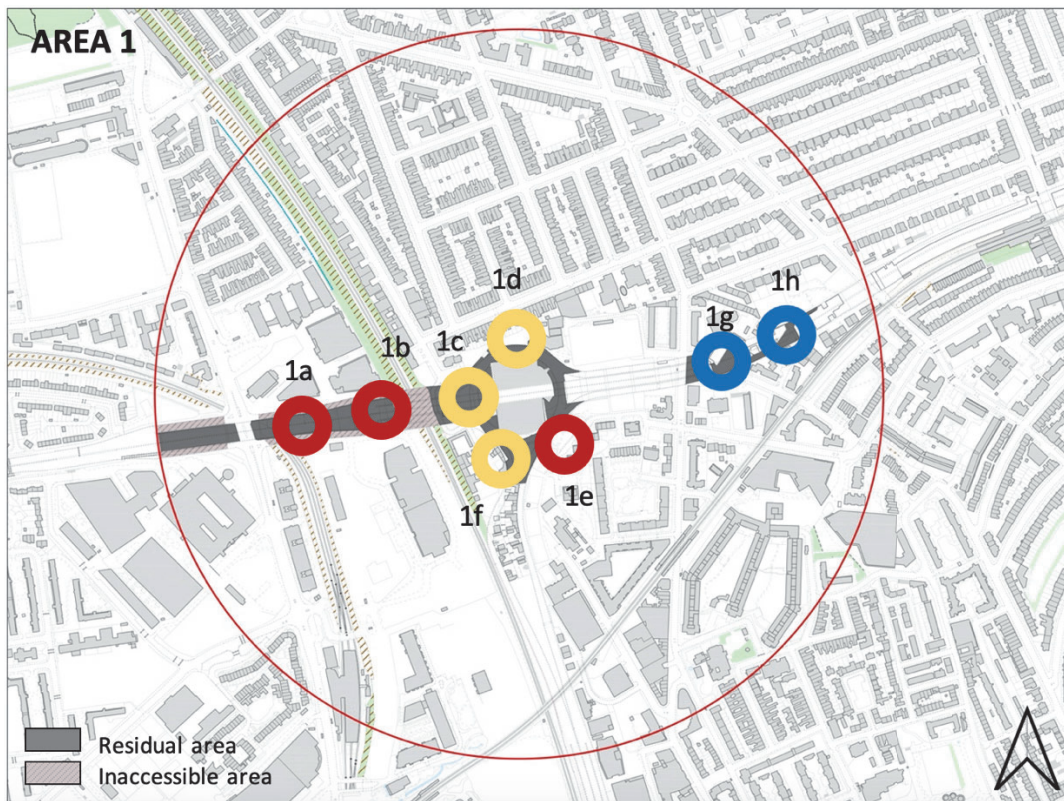


Figure 96. Map of residual spaces within Area 1 classified according to their residuality degree and severity level.

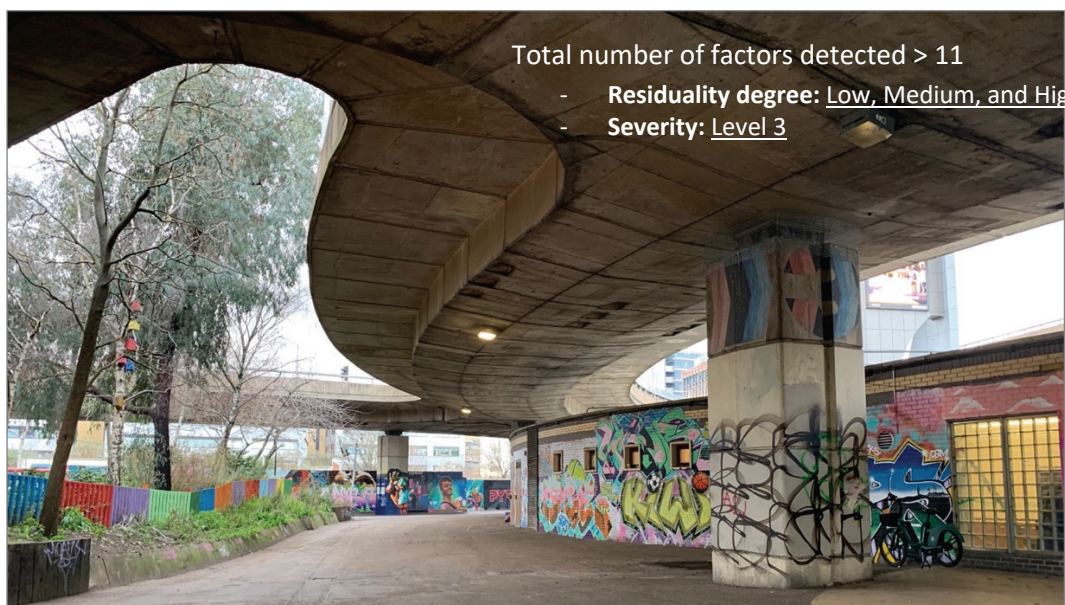


Figure 97. View of residual space in Area 1.

Total number of factors detected > 11
 - Residuality degree: Low, Medium, and High
 - Severity: Level 3

AREA	AREA 1 a	AREA 1 b	AREA 1 c	AREA 1 d	AREA 1 e	AREA 1 f	AREA 1 g	AREA 1 h
INTRINSIC								
Lack of visual connectivity_Visual correspondence Index	x	x	x	x	x	x	x	x
Distance from the main urban pathways		x			x	x		
Lack of local accessibility		x						
Lack of local connectivity			x	x	x	x		
Geometrical irregularity	x	x	x	x	x	x	x	x
Spatial fragmentation			x				x	x
USE RELATED								
Low usage/Emptiness	x	x	x	x	x	x	x	
Poor land use diversity	x	x	x	x		x		x
Air Pollution	x	x	x	x	x	x	x	x
Acoustic discomfort	x	x	x	x	x	x	x	x
Lack of lighting	x	x	x	x	x	x	x	x
Large presence of graffiti			x		x	x	x	x
Poor maintenance	x	x	x	x	x	x	x	x
Poor cleanliness	x	x	x		x	x	x	x
Lack of social interactions	x	x	x		x	x	x	x
SEMANTIC								
Lack of identity-related elements	x	x	x	x	x	x		
Poor interaction with surrounding	x	x	x	x	x	x	x	x
Unwelcomed and unsafe environment	x	x	x	x	x	x	x	x
TOT FACTORS	13	15	16	12	15	16	13	13
RESIDUALITY INDEX Percentage	72%	83%	89%	67%	83%	89%	72%	72%
Area Residuality Index (Mean)_Area 1	14.1 = 78%							

Table 9. Identification of intrinsic, use related, and semantic factors within Area 1, with corresponding measurement of the Area Residuality Index.

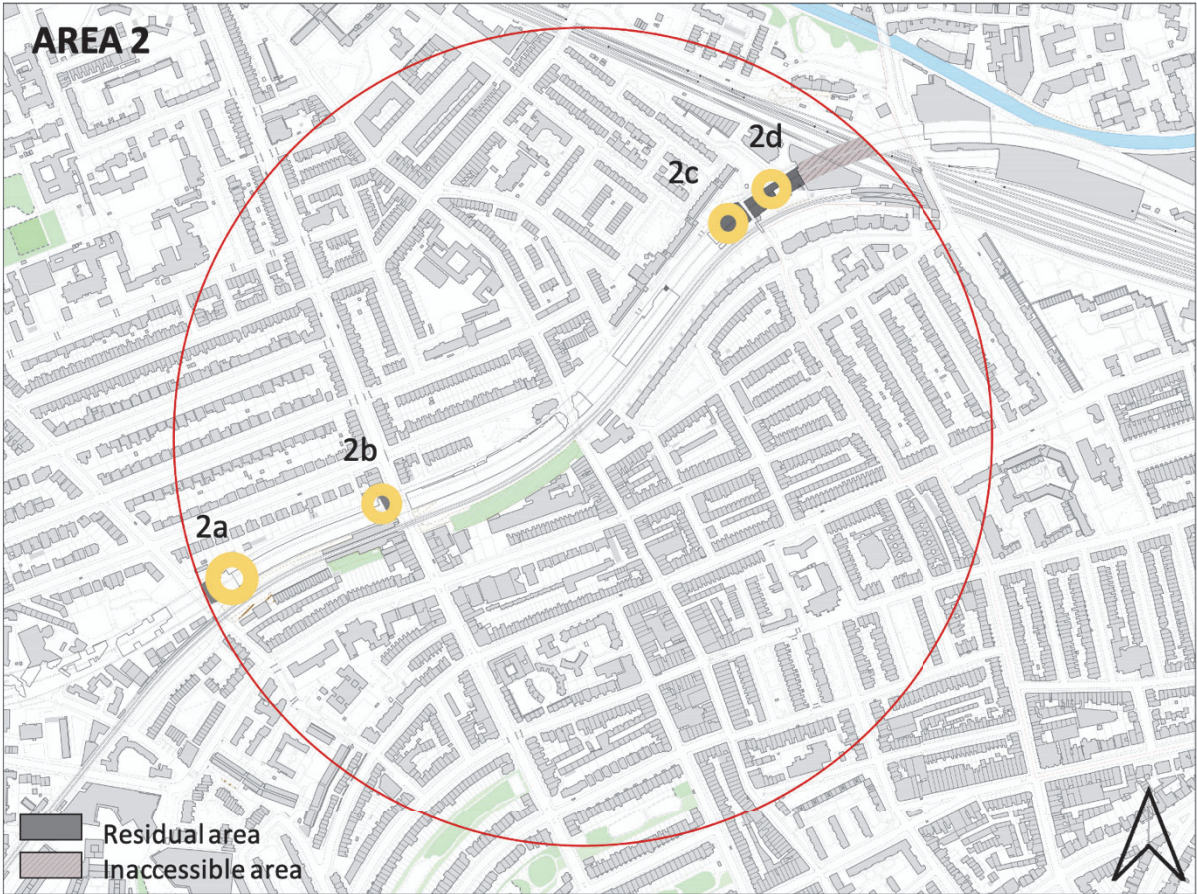


Figure 98. Map of residual spaces within Area 2 classified according to their residuality degree and severity level.



Figure 99. View of residual space in Area 2.

AREA	AREA 2 a	AREA 2 b	AREA 2 c	AREA 2 d
INTRINSIC				
Lack of visual connectivity_Visual correspondence Index	x		x	x
Distance from the main urban pathways				
Lack of local accessibility				x
Lack of local connectivity	x			x
Geometrical irregularity	x	x		
Spatial fragmentation	x	x		
USE RELATED				
Low usage/Emptiness	x	x		
Poor land use diversity			x	x
Air Pollution	x	x	x	x
Acoustic discomfort	x	x	x	x
Lack of lighting	x	x	x	x
Large presence of graffiti	x			
Poor maintenance	x	x		
Poor cleanliness		x		
Lack of social interactions			x	x
SEMANTIC				
Lack of identity-related elements	x	x	x	x
Poor interaction with surrounding			x	x
Unwelcomed and unsafe environment	x	x		
TOT FACTORS	12	10	8	10
RESIDUALITY INDEX Percentage	67%	56%	44%	56%
Area Residuality Index (Mean)_Area 2	10 =	56%		

Table 10. Identification of intrinsic, use related, and semantic factors within Area 2, with corresponding measurement of the Area Residuality Index.

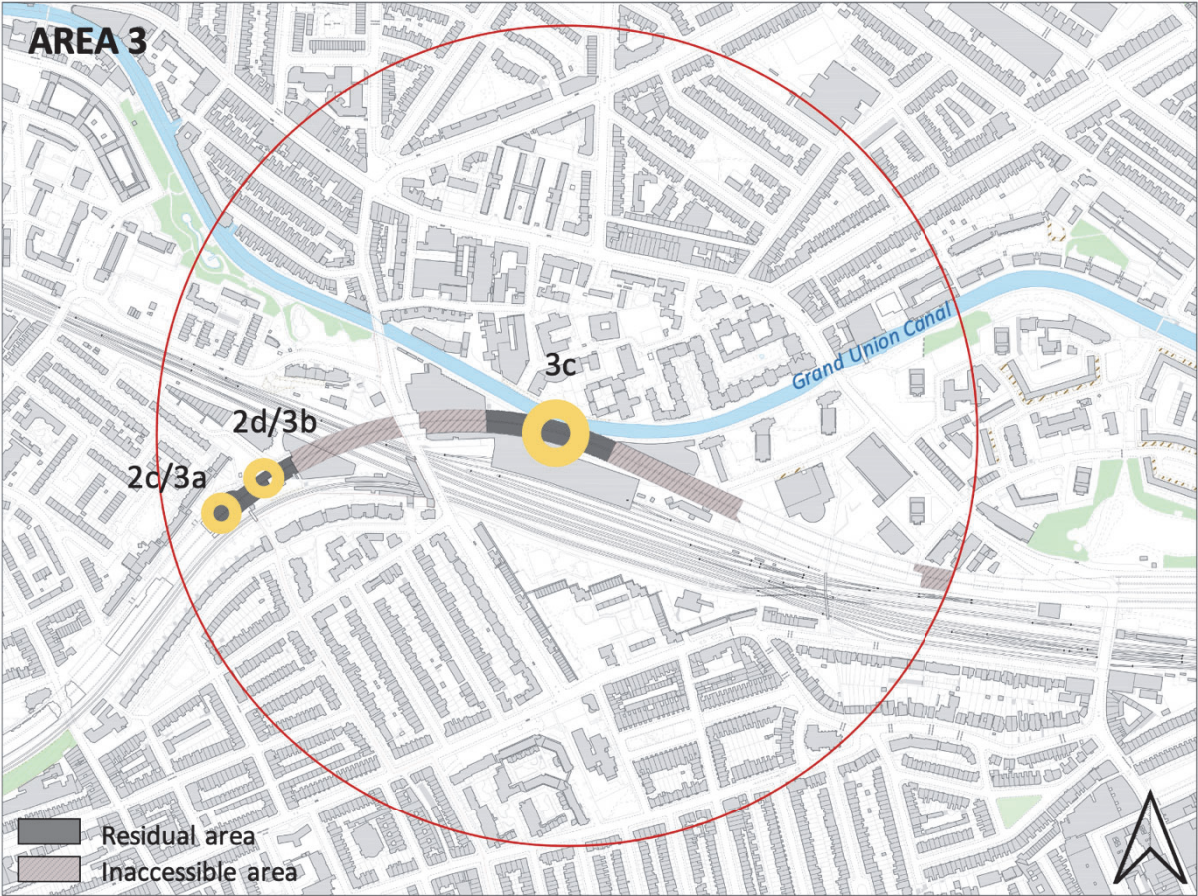


Figure 100. Map of residual spaces within Area 3 classified according to their residuality degree and severity level.



Figure 101. View of residual space in Area 3.

AREA	AREA 3 a	AREA 3 b	AREA 3 c
INTRINSIC			
Lack of visual connectivity_Visual correspondence Index	x	x	x
Distance from the main urban pathways			x
Lack of local accessibility		x	x
Lack of local connectivity		x	x
Geometrical irregularity			x
Spatial fragmentation			x
USE RELATED			
Low usage/Emptiness			x
Poor land use diversity	x	x	x
Air Pollution	x	x	x
Acoustic discomfort	x	x	x
Lack of lighting	x	x	x
Large presence of graffiti			x
Poor maintenance			x
Poor cleanliness			x
Lack of social interactions	x	x	
SEMANTIC			
Lack of identity-related elements	x	x	x
Poor interaction with surrounding	x	x	x
Unwelcomed and unsafe environment			x
TOT FACTORS	8	10	17
RESIDUALITY INDEX Percentage	44%	56%	94%
Area Residuality Index (Mean)_Area 3	11.7 =	65%	

Table 11. Identification of intrinsic, use related, and semantic factors within Area 3, with corresponding measurement of the Area Residuality Index.

APPENDIX 7_ INVESTIGATING THE FACTORS OF RESIDUALITY-PROPOSAL

AREA	AREA 1 a	AREA 1 b	AREA 1 c	AREA 1 d	AREA 1 e	AREA 1 f	AREA 1 g	AREA 1 h
INTRINSIC								
Lack of visual connectivity_Visual correspondence Index	x	x					x	x
Distance from the main urban pathways		x			x	x		
Lack of local accessibility		x						
Lack of local connectivity								
Geometrical irregularity	x	x					x	x
Spatial fragmentation								
USE RELATED								
Low usage/Emptiness								
Poor land use diversity								
Air Pollution								
Acoustic discomfort								
Lack of lighting								
Large presence of graffiti					x	x	x	
Poor maintenance								
Poor cleanliness								
Lack of social interactions								
SEMANTIC								
Lack of identity-related elements								
Poor interaction with surrounding								
Unwelcomed and unsafe environment								
TOT FACTORS	2	4	0	0	2	2	3	2
RESIDUALITY INDEX Percentage	11%	22%	0%	0%	11%	11%	17%	11%
Area Residuality Index (Mean)_Area 1	1.88 = 10%							

AREA 2_Proposal

AREA	AREA 2_a	AREA 2_b	AREA 2_c	AREA 2_d
INTRINSIC				
Lack of visual connectivity_Visual correspondence Index	x			
Distance from the main urban pathways				
Lack of local accessibility				x
Lack of local connectivity				
Geometrical irregularity	x	x		
Spatial fragmentation	x	x		
USE RELATED				
Low usage/Emptiness				
Poor land use diversity				
Air Pollution				
Acoustic discomfort				
Lack of lighting				
Large presence of graffiti	x			
Poor maintenance				
Poor cleanliness				
Lack of social interactions				
SEMANTIC				
Lack of identity-related elements				
Poor interaction with surrounding				
Unwelcomed and unsafe environment				
TOT FACTORS	4	2	0	1
RESIDUALITY INDEX Percentage	22%	11%	0%	6%
Area Residuality Index (Mean)_Area 2	1.75 =	10%		

Table 12. Identification of intrinsic, use related, and semantic factors within Area 1-2, with corresponding measurement of the Area Residuality Index (proposal).

AREA 3_Proposal

AREA	AREA 3_a	AREA 3_b	AREA 3_c
INTRINSIC			
Lack of visual connectivity_Visual correspondence Index			
Distance from the main urban pathways			x
Lack of local accessibility		x	
Lack of local connectivity			
Geometrical irregularity			x
Spatial fragmentation			x
USE RELATED			
Low usage/Emptiness			
Poor land use diversity			
Air Pollution			
Acoustic discomfort			
Lack of lighting			
Large presence of graffiti			
Poor maintenance			
Poor cleanliness			
Lack of social interactions			
SEMANTIC			
Lack of identity-related elements			
Poor interaction with surrounding			
Unwelcomed and unsafe environment			
TOT FACTORS	0	1	3
RESIDUALITY INDEX Percentage	0%	6%	17%
Area Residuality Index (Mean)_Area 3	1.3 =	7%	

Table13. Identification of intrinsic, use related, and semantic factors within Area 3, with corresponding measurement of the Area Residuality Index (proposal).

APPENDIX 8_ POTENTIAL WEIGHTING SYSTEM

The following illustration provides an explanatory instance of the potential weighting system that could be implemented to the overall classification framework.

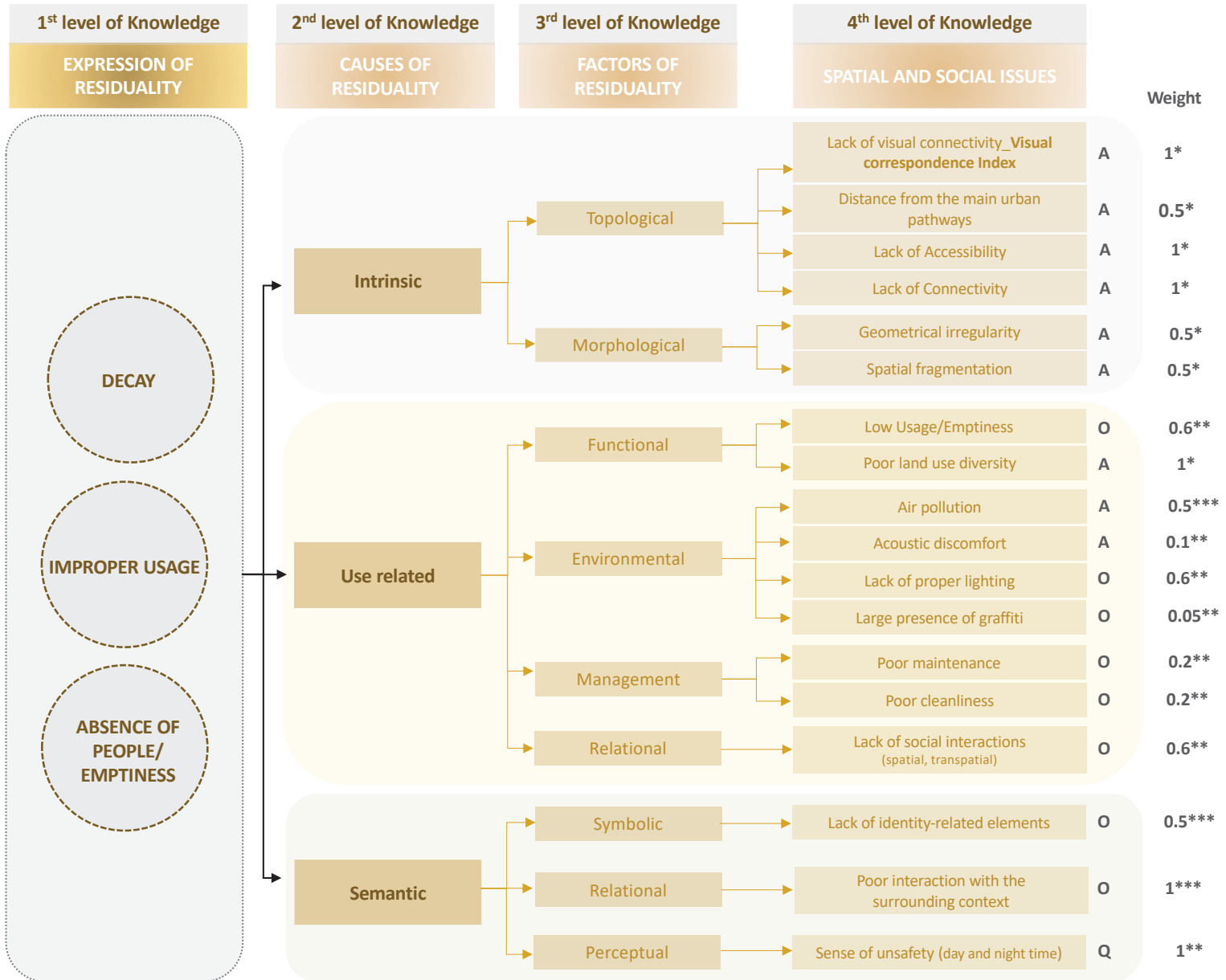


Figure 102. Classification methodology consisting of four main levels of knowledge.

Legend

- O Field Observation
- A Data Driven Analysis
- Q Questionnaire

Weighting Source

- * Spatial Analysis
- **Questionnaire responses
- ***Literature

Note: The assigned weight values are to be considered provisional and require further validation for ensuring accuracy.

The weight values assigned to each factor have been determined based on three criteria: qualitative analyses data, insights from existing literature, and results obtained from questionnaire responses. Particularly with regard to the questionnaire, weight values for various factors have been derived by averaging the participant responses, considering both daytime and night-time, to specific questions addressing aspects like “lack of proper lighting” or “presence of graffiti”.

As a result, the *weighted Residuality Index* for each study area is displayed in the table below, alongside the non-weighted index scores expressed in percentage, facilitating straightforward comparison.

	Area 1	Area 2	Area 3
Residuality Index per Area % (Average across residual spaces within areas)	78%	56%	65%
Weighted Residuality Index per Area (Average across residual spaces within areas)	0.76	0.55	0.53
Weighted Residuality Index per Area % (Average across residual spaces within areas)	76%	55%	53%

Table 14. *Weighted Residuality Index values concerning the existing condition of all three study areas.*

However, it is important to note that this currently stands as a preliminary weighting structure, and its objectivity might need further refinement. Therefore, future research is required to validate and enhance the assigned weighting values.

APPENDIX 9_CORRELATIONS AMONG SPATIAL AND VISUAL FACTORS

Pearson Correlations have been conducted for all three study areas in order to investigate the relationship between spatial properties (Connectivity and Accessibility) derived from angular segment analyses of the pedestrian segment model, and visual integration values obtained from visual graph analyses.

The outcomes of these correlations served as analytical foundation for the definition of the *Visual Correspondence Index*, which has been introduced in Chapter 5 (Section 5.2.5). This index represents a key component of the classification framework (refer to Figure 61) used to characterise residual urban spaces, ultimately assigning them a *Residuality Index*.

Area 1

		Correlations										Visual_Integrat	Visual_Integrat	Connectivity_	Connectivity_
		NACHr1200m	NACHr1600m	NACHr2000m	NACHr400m	NACHr800m	NAINr1200m	NAINr1600m	NAINr2000m	NAINr400m	NAINr800m	ion_max	ion_mean	max	mean
Visual_Integration_mean	Pearson Correlation	.045	.049	.049	.019	.035	.374**	.376**	.368**	.277**	.326**	.745**	1	.309**	.286**
	Sig. (2-tailed)	.221	.187	.183	.615	.344	<.001	<.001	<.001	<.001	<.001	<.001		<.001	<.001
	N	735	735	735	735	735	735	735	735	735	735	735	735	735	735
Connectivity_max	Pearson Correlation	.197**	.200**	.200**	.122**	.182**	.487**	.486**	.495**	.437**	.477**	.061	.309**	1	.938**
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	.100	<.001		<.001
	N	735	735	735	735	735	735	735	735	735	735	735	735	735	735
Connectivity_mean	Pearson Correlation	.210**	.213**	.213**	.138**	.196**	.461**	.456**	.461**	.444**	.467**	.021	.286**	.938**	1
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	.578	<.001	<.001	<.001
	N	735	735	735	735	735	735	735	735	735	735	735	735	735	735

** . Correlation is significant at the 0.01 level (2-tailed).
 * . Correlation is significant at the 0.05 level (2-tailed).

Area 2

		Correlations										VisualInt	Visual_I
		NACHr1200m	NACHr1600m	NACHr2000m	NACHr400m	NACHr800m	NAINr1200m	NAINr1600m	NAINr2000m	NAINr400m	NAINr800m	ion	on_1
NAINr400m	Pearson Correlation	.612**	.622**	.630**	.571**	.606**	.838**	.825**	.825**	1	.890**	.035	.421**
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001		<.001	.386	<.001
	N	623	623	623	623	623	623	623	623	623	623	623	623
NAINr800m	Pearson Correlation	.578**	.590**	.601**	.489**	.566**	.956**	.900**	.892**	.890**	1	.021	.381**
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001		.603	<.001
	N	623	623	623	623	623	623	623	623	623	623	623	623
Visual Integration_Max	Pearson Correlation	.065	.063	.062	.069	.073	.020	.003	-.008	.035	.021	1	.478**
	Sig. (2-tailed)	.107	.115	.123	.085	.070	.616	.938	.848	.386	.603		<.001
	N	623	623	623	623	623	623	623	623	623	623	623	623
Visual Integration_Mean	Pearson Correlation	.271**	.267**	.264**	.260**	.276**	.340**	.281**	.266**	.421**	.381**	.478**	1
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
	N	623	623	623	623	623	623	623	623	623	623	623	623

** . Correlation is significant at the 0.01 level (2-tailed).

Area 3

		Correlations										Connectivity_	Connectivity_	Visual_Integrat	Visual_Integrat
		NACHr1200m	NACHr1600m	NACHr2000m	NACHr400m	NACHr800m	NAINr1200m	NAINr1600m	NAINr2000m	NAINr400m	NAINr800m	max	mean	ion_max	ion_mean
Connectivity_max	Pearson Correlation	.065	.061	.052	.064	.081*	.176**	.147**	.143**	.080*	.180**	1	.923**	-.032	.033
	Sig. (2-tailed)	.068	.088	.146	.072	.022	<.001	<.001	<.001	.024	<.001		<.001	.370	.360
	N	795	795	795	795	795	795	795	795	795	795	795	795	795	795
Connectivity_mean	Pearson Correlation	.018	.012	.003	.031	.034	.092**	.060	.059	.020	.101**	.923**	1	-.039	.042
	Sig. (2-tailed)	.612	.735	.935	.377	.341	.009	.091	.096	.575	.004	<.001		.271	.238
	N	795	795	795	795	795	795	795	795	795	795	795	795	795	795
Visual_Integration_max	Pearson Correlation	.080*	.076*	.075*	.056	.077*	.091*	.130**	.146**	.074*	.067	-.032	-.039	1	.879**
	Sig. (2-tailed)	.025	.032	.035	.117	.031	.011	<.001	<.001	.036	.059	.370	.271		<.001
	N	795	795	795	795	795	795	795	795	795	795	795	795	795	795
Visual_Integration_mean	Pearson Correlation	.105**	.104**	.103**	.069	.103**	.124**	.168**	.185**	.111**	.098**	.033	.042	.879**	1
	Sig. (2-tailed)	.003	.003	.004	.051	.004	<.001	<.001	<.001	.002	.006	.360	.238	<.001	<.001
	N	795	795	795	795	795	795	795	795	795	795	795	795	795	795

** . Correlation is significant at the 0.01 level (2-tailed).
 * . Correlation is significant at the 0.05 level (2-tailed).

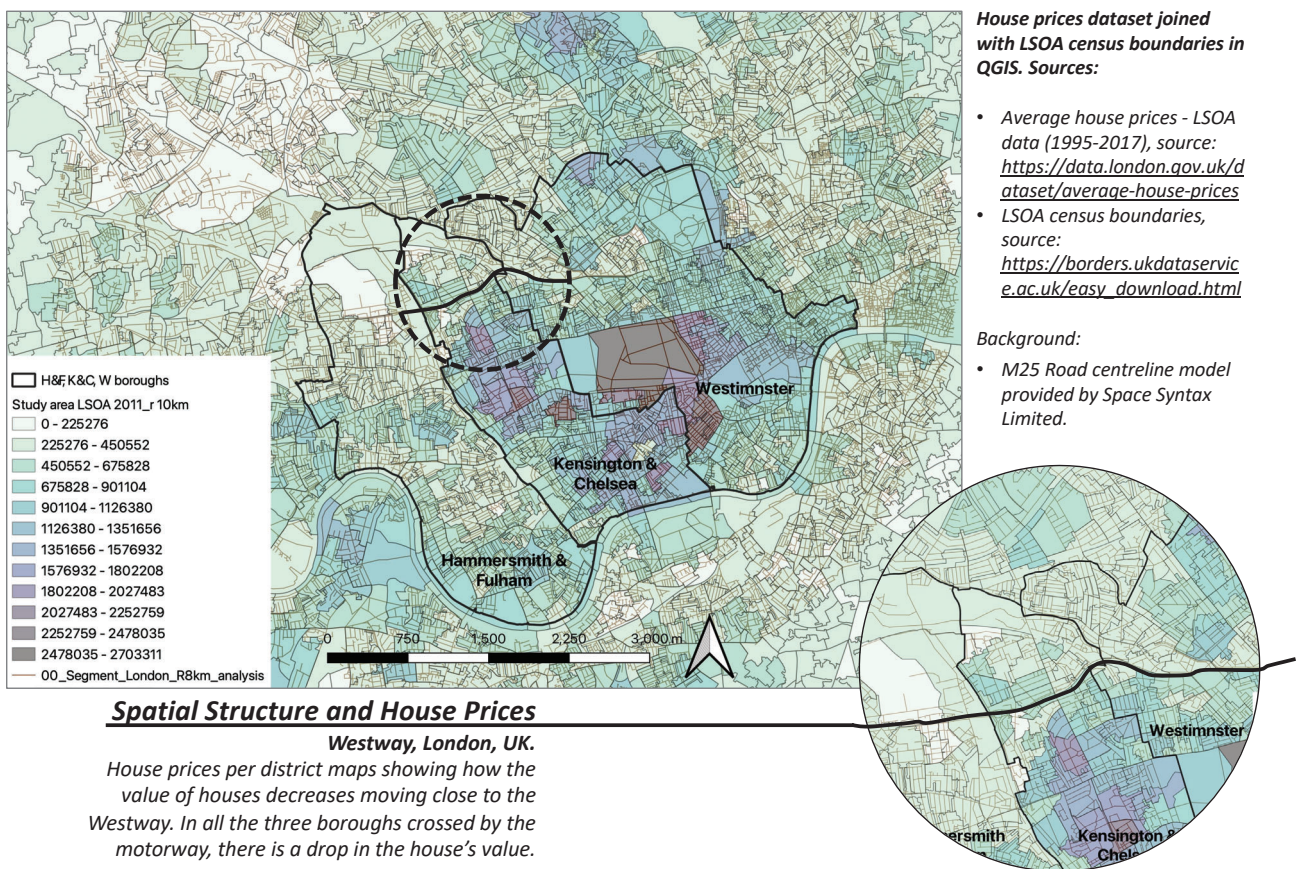
Table 15. Pearson Correlations among space syntax spatial values (NAIN and NACH) and visual graph analysis values conducted for all three study areas.

APPENDIX 10_FURTHER EXPLORATION: HOUSE PRICES ANALYSIS

The investigation into house prices has been incorporated as an additional but not fundamental analytical section of the study. This exploration enabled the understanding of how property values drop approaching to the Westway and its adjacent residual spaces. The dataset pertaining to house prices, sourced from the London Datastore portal, has been merged to compile an *Average house price* recorded between 1995 and 2017. These prices are specifically aggregated per LSOA (Lower Super Output Area). The dataset was firstly joined with LSOA census boundaries, and later the values were distributed along the segment model (road centre line model) by applying a spatial join between the given segment model and the LSOA layer in the QGIS software. As a result, an analysis of house prices per segment was conducted. The findings of this examination reveal a decrease in the average house prices between 1995 and 2017 as one moves close to the Westway and the flyover residual spaces underneath the elevated infrastructure.

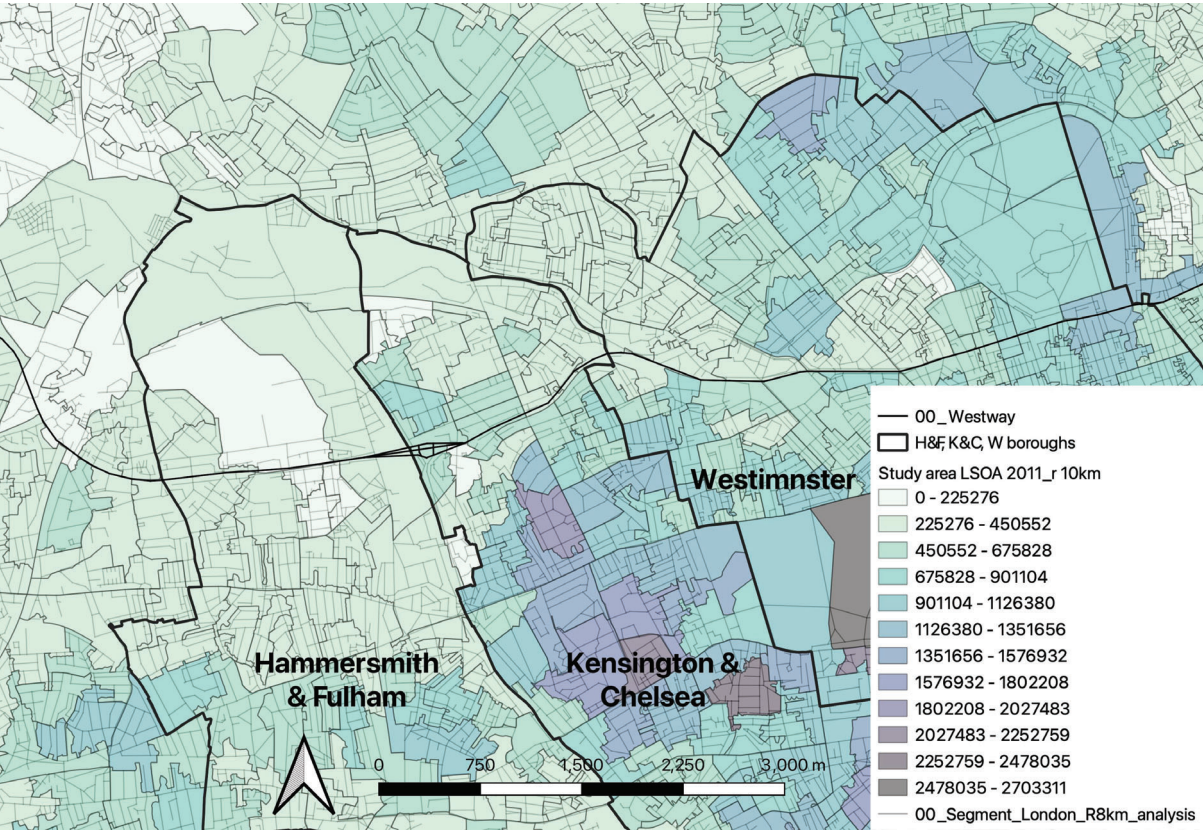
However, it is important to note that house prices are affected by a multitude of factors beyond just the presence of the motorway and of the adjacent residual spaces. Therefore, this additional investigation should be considered rather as a supplementary assessment that, when combined with the previous spatial and socio-economic analyses, seeks to offer a comprehensive insight of the overall state of the areas surrounding the flyover spaces.

House Prices Analysis



**Spatial Structure and House Prices
Westway, London, UK**

House prices per district maps showing the decrease of house values moving close to the Westway. This situation occurs in all the three boroughs crossed by the motorway, namely Hammersmith and Fulham, Kensington and Chelsea, and Westminster.



House Prices

Westway, London, UK

House prices per segment. The map shows how the average value of houses (considered between 1995 and 2017) drops moving close to the Westway motorway and the flyover space created underneath its section.



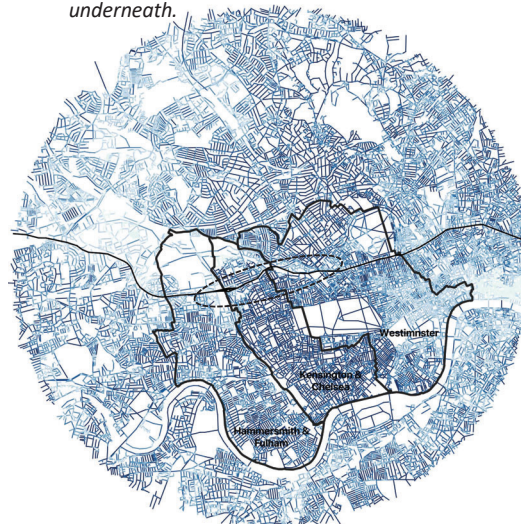
The House prices dataset was firstly joined with LSOA census boundaries, and later the values were distributed along the segment model (road centre line) applying the spatial join between the segment model and the LSOA layer in QGIS.
Sources:

- Average house prices - LSOA data source: <https://data.london.gov.uk/dataset/average-house-prices>
- LSOA census boundaries source: https://borders.ukdataservice.ac.uk/easy_download.html
- M25 Road centreline model provided by Space Syntax Limited

House Prices

Westway, London, UK.

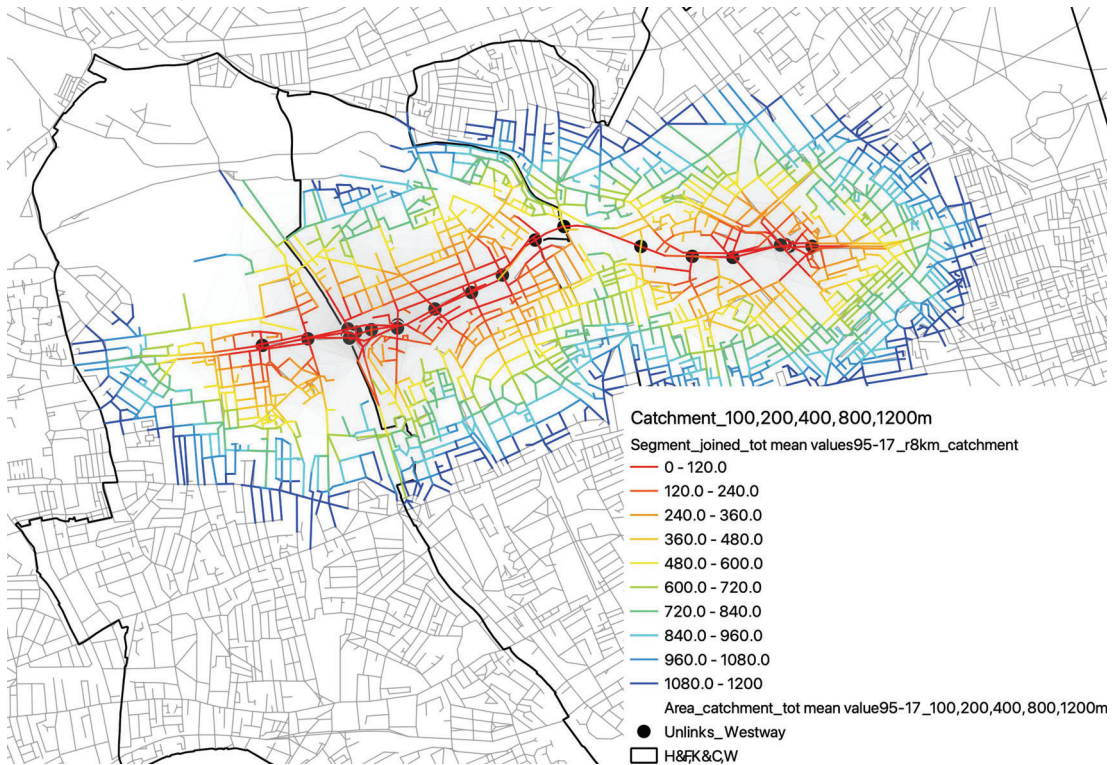
House prices per segment. The map shows how the average **value of houses** (considered between 1995 and 2017) **decreases moving close to the Westway and the flyover space** created underneath.



- 00_Westway
- H&F K&C, W boroughs
- LSOA 2011_tot mean values 1!
- Segment_joined_tot mean values9!
- 0 - 1267
- 1267 - 2156
- 2156 - 3040
- 3040 - 4047
- 4047 - 5254
- 5254 - 6800
- 6800 - 8937
- 8937 - 12276
- 12276 - 19043
- 19043 - 574972
- 00_Segment_London_R8km_

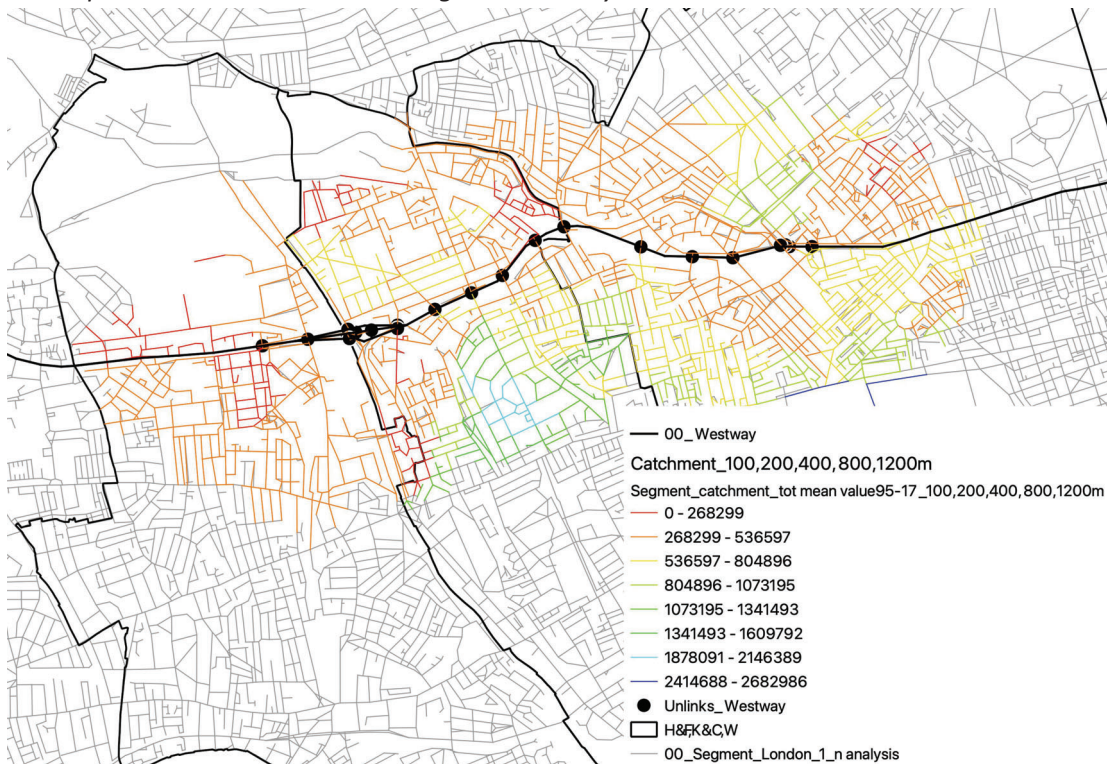
Catchment map_100,200,400,800,1200m.

Unlinks have been chosen as reference points to run the catchment analysis at different metric distances along the Westway.



Catchment house prices_100,200,400,800,1200m.

House prices in the areas surrounding the Westway.



POEM
NEVER FORGET..

AKIT-
SPOE

I WILL NEVER FORGET THE SIRENS
I WILL NEVER FORGET HOW SCARY THE FIRE WAS
I WILL NEVER FORGET HOW WORRING THE FIRE WAS
I WILL NEVER FORGET THAT I SURVIVED
I WILL NEVER FORGET MY FRIENDS AND NEIGHBOURS WHO DIDNT SURVIVE
WE CANT CHANGE THE PAST BUT WE CAN CHANGE THE FUTURE
WE WILL STAY STRONG
WE WILL RISE UP AS A COMMUNITY

WE WILL FIGHT FOR JUSTICE TOGETHER
WE WILL ALWAYS REMEMBER OUR FRIENDS AND OUR NEIGHBOURS
WE WILL ALWAYS REMEMBER OUR HOMES
WE CANT CHANGE THE PAST BUT WE CAN CHANGE THE FUTURE...
NEVER FORGET

