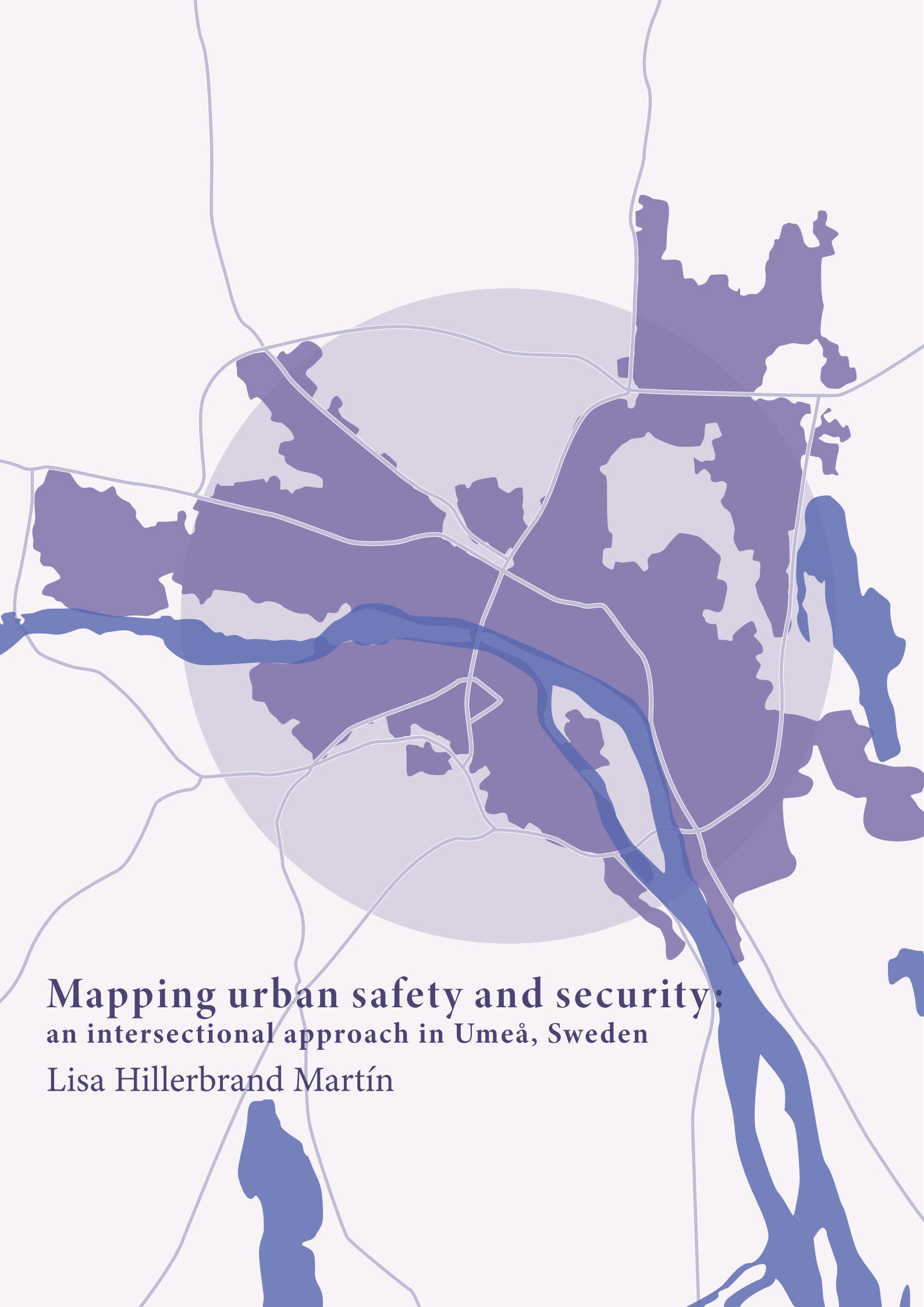
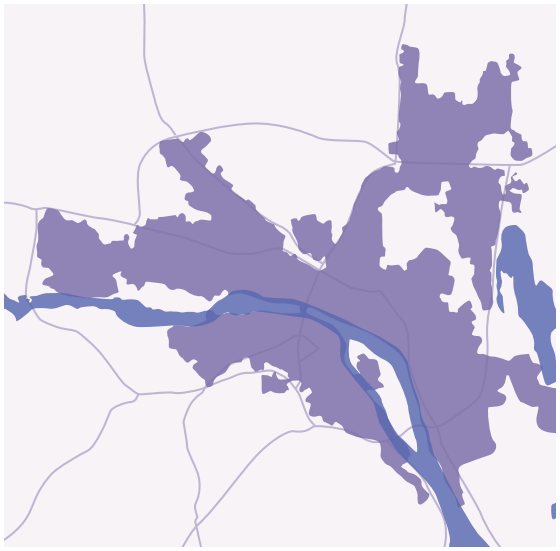


Mapping urban safety and security:
an intersectional approach in Umeå, Sweden

Lisa Hillerbrand Martín



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Abstract

The influence of urban design on the safety and security of public spaces has been studied across various disciplines, as the environment shapes human behavior. Feminist theories take this further by asserting that not only do urban elements influence our behavior, but sociocultural characteristics also condition our perception of safety, thus limiting how we use urban spaces. Urban planning is not neutral, and neglecting the needs of the most vulnerable groups in the design process perpetuates societal injustices in the spaces we inhabit. This thesis aims to identify (un)safe areas in Umeå, Sweden, using an intersectional and feminist perspective, incorporating diverse analyses into a GIS workflow. Through a mixed-methods approach that combines GIS analyses with safety perception surveys, the research explores the meanings of urban safety in Sweden's diverse society, assesses concerns overlooked by feminist urban design principles, and examines how Umeå's urban morphology and social context influence perceptions of (un)safety. The findings from surveys and GIS analyses highlight disparities in safety perceptions, influenced by factors such as gender, familiarity with the area, and access to amenities. Significant contrasts are observed between the local population and newcomers, especially regarding definitions of urban safety and prioritized elements. Low-density residential neighbourhoods, lacking everyday facilities and dependent on cars, hinder the development of support networks and accessibility for various groups. In contrast, high-density areas with a wide variety of facilities have greater demographic diversity and better access to support networks. However, safety perceptions in these areas are dichotomous: some feel protected, while others view these urban centers as impersonal and more prone to violence. Incorporating safety perception into urban safety studies is crucial for addressing the real issues of the territory, influenced not only by physical urban design features but also by sociocultural conditions, reputation, or site history. Other factors, such as climate and snow, need further study, as in cold climates like Umeå, they drastically affect urban safety for much of the year. The study underscores the need for integrated urban safety strategies that combine community engagement, inclusive designs, and accurate data analysis to create safer urban environments. Including the population in decision-making for their neighborhoods and raising awareness to create neighborhood identities based on a safe perception is indispensable for developing urban practices with an intersectional perspective.

Keywords: urban safety and security, safety perception, GIS, feminism, intersectional, urban design

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1. Introduction

Security is a fundamental right (Nations, 1948) that ensures people can live free from fear and violence, which is essential to enjoying a dignified life. When security is absent, people face significant obstacles to exercising other basic rights, therefore it becomes a responsibility of institutions and society as a whole, to work towards ensuring a safe and protected environment for everyone (UN-Habitat, 2008).

As of today, in an unjust and resource-exploited world (Herrero, 2021), escalating political and socio-economic tensions have elevated concerns surrounding security matters (Sager & Mulinari, 2018). The problem of crime and violence in urban areas worldwide has prompted the development of diverse measures and regulations across various disciplines, including urban planning, to address its impact.

The urban context concerning safety and security recognizes the critical role of the built environment in shaping human activities (Falú, 2009), influencing behaviour and vulnerabilities. Therefore, acting on the urban environment shapes the potential development of both violent and criminal activities, associated with the notion of security, as well as defining the ability of the space to address vulnerabilities, tied to the concept of safety.

Sweden has not remained on the sidelines of these global trends. The emergence of the term ***trygghet*** (so to say, the Swedish version of safety and security) became a prominent policy concern in the 1990s (Brandén, 2022). ***Trygghet*** can be understood as a fundamental aspect of the Swedish welfare system, as it embodies a collective and personal comprehension of tranquillity, security, and a nurturing sense of belonging (Airas & Truedsson, 2023).

However, Sweden has faced a surge in urban violence in recent years (Sager & Mulinari, 2018), prompting a re-evaluation of the meaning and scope of trygghet across the political spectrum. While safety is increasingly linked to crime prevention and public order, there is a risk of its appropriation by the extreme right political faction to justify paternalist and racist practices. In urban policies, safety is now understood not only as an individual's psychological response to the physical environment (Brandén, 2022), but also as a reflection of their perceptions, which may not always align with actual crime risks but significantly impact their sense of (un)safety nonetheless.

Certain demographic groups, notably women, are disproportionately vulnerable to security risks such as abuse and sexual violence (Metropolis & Women in Cities International, 2018). Addressing urban safety effectively requires incorporating the perspectives of the most vulnerable, advocating for inclusive urban designs that respond to their needs and ensure safer spaces for all (Michaud, 2002).

Feminist urbanism theories highlight the need for inclusive urban designs that challenge existing inequalities perpetuated by homogeneous elite-driven urban planning processes. These theories underscore the importance of various elements of urban design, such as lighting, street accessibility, visibility, the presence of others, or the sense of belonging (Col.lectiu Punt 6, 2024), in shaping perceptions of (un)safety.

Global trends indicate a growing commitment to participatory methodologies in addressing urban safety and security concerns, involving local populations in analysis and decision-making processes, such as the safety audits, (Kern, 2021) incorporating an intersectional gender perspective with the aim of fostering inclusive and accessible spaces for all. Sweden's government has developed a manual for conducting woman safety audits (Brå et al., 2010), aiming to identify and address perceived unsafe urban elements, thereby fostering a greater sense of belonging and safety for all residents.

However, this method competes with more conventional mechanisms such as police control or preventive measures based on formal and informal surveillance (Brandén & Sandberg, 2021). As all these methods are promoted and supported by the National Council for Crime Prevention (Brå), and since it is up to the municipalities to implement those measures, participatory mechanisms may easily not be integrated into the process as core and indispensable practices, but rather as accessories to the policies.

In addition, there is a need to translate urban safety and security analysis into tangible data, with geographical information systems (GIS) emerging as vital tools in urban safety practices. Yet, it is essential to recognize that GIS technologies are not neutral and universally inclusive (Elwood & Leszczynski, 2018), but can reflect the biases of their users, potentially perpetuating social injustices. Safety audits conducted in Sweden often focus on technical aspects of the built environment, overlooking broader social and power-related causes of (un)safety (Brandén & Sandberg, 2021).

To address these challenges, safety audits should not be narrowed to physical elements but should create spaces for participants to express ideas, feelings, and personal experiences beyond reporting physical issues. In this way, GIS can be con-

figured to integrate local knowledge and participation (Cope & Elwood, 2009), necessary for less biased results and more inclusive urban safety policies. In other words, the participatory methodologies that ensure that urban safety policies are inclusive and accessible, must be reflected into GIS and their respective analysis, to obtain coherent and adaptative results that will lead to efficient measures.

1.1 AIM AND RESEARCH QUESTIONS

The aim of this thesis is to identify the (un)safety areas of an urban environment based on an intersectional and feminist perspective, making use for that of feminist urbanism theories and incorporating diverse analyses into a GIS environment workflow. To achieve this aim, the urban locality of Umeå, in the Västerbotten region, will be analysed as the case study.

I. What do urban safety and security mean within the context of Sweden's diverse society?

II. Are there any concerns affecting urban (un)safety perception that have not been considered in the feminist urban design principles?

III. How do the urban morphology and social context of Umeå city influence the perceived level of urban (un)safety among individuals, considering the physical and sociopolitical elements present in the city and public spaces?

VI. What are the areas of Umeå that could be improved regarding urban (un)safety?

1.2 LIMITATIONS

During the outlining process for this thesis, I have encountered some limitations that have turned into the need of narrowing down the scope of the study. The first limitation concerns the reliance on the survey-data. Given the limited duration of the thesis, the number of responses and the capacity to engage in participatory activities might have not been sufficient to reach valid conclusions. Also my own lack of community networks in Umeå has limited the capability of the analysis to reflect diverse experiences and together with time restrictions, it made the obtention of qualitative data (e.g. safety audits or interviews) inaccessible for this thesis.

Regarding an intersectional approach, the ideal outcome of this study would be a map filled with points defining safe and unsafe areas with explanations based on indicators derived from the theoretical framework. The map would enable a comparison of diverse experiences, aiming to demonstrate the heterogeneity of the terms safety and unsafety linked to urban space. Although the expected result of the thesis is something like this ideal, it is not going to specifically identify the elements of the space that each vulnerability group define as unsafe. The responses of the data collection will be treated as a whole, and the reasons that made the participants define unsafe spaces will be treated without the social background (ethnicity, sexual orientation, economic class) of the individual.

1.3 OUTLINE

The remaining outline of the paper consists of the theoretical framework, where definitions are presented while giving a theoretical background to the method and approach being used. Also, previous evaluation methods are collected, and the Swedish state of the art is presented.

Then the study area will be presented, analysing its context from the historical, territorial and socioeconomic focuses. The methodology section will explain the different techniques used for data collection and the development of the GIS analyses explaining process and indicators. In the last chapters of this thesis the results and discussion will be found. The results will present the outputs for the different types of analyses developed and the synthesis of the analyses will be described. In the discussion, the main findings will be presented, the method will be critiqued and some conclusions for further analyses will be presented.

2. Theoretical Framework

In this chapter, the foundational terms of this thesis will be described to understand its context and scope. The term "urban safety and security" will be introduced from the perspective of "human security" and its synonyms. Subsequently, the concept of feminist urbanism and the scope of the term "urban safety perception" will be introduced. To this end, certain fundamental concepts that characterize the feminist perspective in urban studies will be presented, such as the dichotomy of space and the power of fear. The intersectional perspective will also be introduced through critical voices and studies concerning feminist urbanism theories. Finally, the evaluation methods that have been used and are currently employed in relation to the previously presented theoretical context will be described.

2.1 Safety and security: an urban perspective

Definition: Safety and Security

Safety and security are broad terms that have been defined in multiple ways. In summary, safety typically refers to managing hazards that arise from daily interactions between humans and their environment, such as fires, accidents, or environmental disasters (DCAF – Geneva Centre for Security Sector Governance, 2019); while security implies deliberate intention of humans to cause harm to other people or to the environment (Nas, 2015). Unlike security measures, which aim to completely eliminate risks, safety measures focus on reducing the likelihood and impact of hazards. Safety efforts strengthen people's resilience to their surroundings and help them cope with potential dangers.

However, crime and violence (that according to the definition above, would be part of the term security), are not random occurrences. Inadequate urban environments serve as catalysts for crime since they marginalize certain segments of society from the advantages of urbanization and from their involvement in decision-making and progress. The rise in urban violence and crime globally can be attributed to the lack of sustainable solutions addressing social, economic, and governance challenges in cities, that should promote inclusive policies that prioritize the needs of vulnerable groups. (Safer Cities | UN-Habitat, s. f.).

That is why, regarding the discipline of urban planning, both terms safety & security, become inseparable, as there will always be an external condition beyond human will that influences the development of violent actions. In other words, the urban environment will always exert an influence on human behaviour.

To precisely define the term "***urban safety and security***", the concept of human security, crafted by the United Nations Commission on Human Security, will be incorporated, acknowledging the United Nations as the primary governing body worldwide concerning security concepts.

Human security

In its 1994 Human Development Report, the UNDP (United Nations Development Programme) defines the scope of the concept of human security in terms of "***freedom from fear and freedom from want***"(Nations, 1994). Human security, in this sense, is characterized as the dimension of security "***against chronic threats such as hunger, disease, and repression, as well as protection against sudden and harmful disruptions in patterns of daily life, whether in households, workplaces, or communities***"(Nations, 1994). The four elements defining the scope of the term, according to this report, are characterized as: universal; interdependent in their components; people-centred; and ensured, especially through preventive actions.

Hence, from a human security perspective, it becomes evident that urban safety and security threats correlate with various forms of human vulnerability (Medina Velásquez, 2014). These vulnerabilities can be categorized into three overarching groups: chronic vulnerabilities stemming from fundamental needs like food, shelter, and health; contextual vulnerabilities arising from socio-economic and political processes; and vulnerabilities resulting from extreme events, encompassing both natural and human-induced hazards.

Citizen security

Other authors, especially in the Latin American context, define the term "Citizen security" to speak about similar disciplines. It is also defined introducing the terms of freedom, lack of fear and vulnerabilities:

"*Citizen security [...] is defined as a concern for the quality of life and human dignity in terms of freedom, market access and social opportunities. Poverty and lack of opportunities, unemployment, hunger, environmental*

deterioration, political repression, violence, crime and drug addiction can constitute threats to citizen security" (Villablanca, 1998). From another perspective, it is proposed that citizen security would be a cultural creation that implies an egalitarian form of sociability, a sphere freely shared by all (Arriagada & Godoy, 1999).

Concerning the aforementioned definitions of citizen security, urban design plays a crucial role as it determines how a space is experienced and how life develops in it. Consequently, the urban environment serves as the physical realm where citizen security is assessed and validated.

Urban safety and security

In conclusion, the concept of urban safety and security prioritizes inclusive methodologies that revolve around the welfare and rights of urban residents. This entails strategies aimed at preventing crime, protecting individual rights, and addressing a wide range of vulnerabilities, as highlighted by *UN-Habitat* (2008).

Furthermore, since fear is a potent emotion that manifests in people's behaviour through various channels such as perception, experience, education, and socioeconomic background, it is imperative that the scope and scale of these strategies be addressed from diverse perspectives. This is crucial as fear affects individuals, communities, and the state in multifaceted ways.

Trygghet & Otrygghet

The concept "trygghet" is what the Swedish context refers to in order to speak about safety and security related subjects. It derives from the Old Norse "***trugghet***" and, since in the beginning of its usage was more related to the term "security (Andersson, 1974), nowadays focuses more on the feeling of well-being rather than the more militarised connotations of 'security'(Brandén, 2022). Authors like Jansson (2018) or Airas & Truedsson (2023) define this term in a sense of "***economic, physical and psychological security***", what in theory englobes the meaning of safety. The term is seldom defined but used broadly within Swedish state institutions, individuals and communities in all scales, from the macro to the micro (Dansholm, 2024). It illustrates the creation of relations and spaces that emphasise the wellbeing of the groups involved.

Feeling "***trygg***" or experiencing "***trygghet***" can be seen as a fundamental aspect of existence in Sweden, representing a deeply ingrained perception of how Swedes engage with their surroundings (Dansholm, 2024). Beyond its political or rhetorical usage, "***trygghet***" embodies a collective and personal comprehension of tranquility, security, and a nurturing sense of belonging. It is an experiential wisdom that intertwines both individual and communal notions of comfort and well-being (Airas & Truedsson, 2023).

However, in recent years, Sweden has experienced a surge in urban violence, including shootings, bombings, and grenade attacks, leading to heightened concern in safety and security across the political spectrum. This increase in violence has exacerbated since the last election, with crime rates intensifying (Airas & Truedsson, 2023). The discourse leading up to the 2018 General Election saw a hardening tone across political parties, as they started to address the growing sense of unsafety ("***otrygghet***") in Sweden, positioning themselves as best suited to tackle these safety concerns, emphasizing the need for robust measures to restore a sense of security ("***trygghet***") to Swedish communities.

Boverket, who is the Swedish National Board of Housing, Building, and Planning and the institution in charge of analysing trygghet from an urban perspective, published their latest safety policy, "***Crime-prevention and safety-promoting perspectives and measures in the public planning process***", where it explicitly links safety to crime prevention and public order. It defines safety as an individual's psychological response to the design and use of their physical environment, influenced by sensory perceptions, personal experiences, and media portrayals of crime risks (Brandén, 2022).

2.2 THE DICHOTOMY OF SPACE AND THE URBAN SAFETY PERCEPTION

"*The design of metropolitan areas can reinforce gender dichotomies, so, although the notion of public space points towards inclusion, it can actually be very exclusive*"(Beebeejaun, 2016)

Traditionally, urban planning and the design of the spaces we inhabit have been carried out by a specific sample of society, made up of those who were able to or can opt for technical training. The problem lies in the fact that not everyone has the same privileges, and those who can access this training constitute a very limited group within the broad spectrum that is society.

Urbanism is never neutral

As Lefebvre expressed (1978) "***the city is a privileged center for public life, a logos before which citizens are free and equal***". However, the definition of citizenship is limited to the experiences of the aforementioned elite. Hence, a significant portion of society, comprising minorities, the impoverished, the elderly, women, children, and individuals marginalized due to factors like background, disability, sexual orientation, or gender identity, often goes unnoticed. (Metropolis & Women in Cities International, 2018).

For these reasons, urban planning is not inherently neutral, as it overlooks the diverse ways individuals experience and interact with existing spaces. Capitalism, therefore, emerges as a dominant economic system shaping the creation of cities (Lefebvre, 1978), leading to their segregation into productive and reproductive spaces and people. These notions intersect with patriarchal structures and the gendered division of labour (Carrasco, 1992). This division has influenced the conceptualization of urban space, creating a dichotomy between the public and private spheres, each with its distinct roles and functions, perpetuating societal norms and inequalities (Hayden, 1982).

Dichotomy of space

As a result, the forms of the buildings, the centre-periphery dynamics of cities, and the connections of public and private transportation determine a "***pattern of social inclusion and exclusion***" (Valle Murga, 1991) that has evolved over time, perpetuating roles and creating "dichotomies between home and work, between the private and the public" (Bondi, 1992).

The dichotomous conception of urban space has led to assigning specific functions to each area, such that the public domain is allocated for productive functions, while the private space is reserved for reproductive functions (Col.lectiu Punt 6, 2022). These productive and reproductive functions perpetuate gender categories between the masculine and the feminine. Moreover, activities and relationships that take place in the private sphere are not visible to society (Falú, 2009).

Regarding urban safety and security, the social contrast between groups of people is even greater, as in addition to the physical reality, there is the subjective reality—the perception of safety (Metropolis & Women in Cities International, 2018). While a space may be deemed physically safe and accessible, there exists a significant paradigm that influences its utilization.

Fear and safety perception

This perception of unsafety has an explanation beyond subjectivity and related to the patriarchal-capitalist model of the city. Traditional gender roles define women as vulnerable and men as strong and aggressive (Ortiz i Guitart, 2007), resulting in the establishment of a system where women are more frequently subjected to abuse, aggression, and sexual assault, along with other human rights violations (Michaud, 2002). These narratives reinforce the idea that women see themselves as "***potential victims***"(Sandberg & Coe, 2020), what translate in a normalization of fear, rooted in the unequal distribution of power between genders.

In addition to this, the productive-reproductive dichotomy of space leads to the conception of women being traditionally associated with reproductive roles, which spatially entails the private sphere, consequently excluding them from productive, hence public, spaces. This generates in women a sense of not belonging to public space, nor to its use or enjoyment (Zúñiga Eliade, 2014), with this sense of belonging being one of the main characteristics by which a space is perceived as safe (Jacobs, 1961).

In the Swedish context, women's feelings of unsafety are linked to gender equality politics, particularly addressing men's violence against women. Previous government action plans aimed to improve safety for women in urban areas through gender-equal urban planning initiatives(Brandén & Sandberg, 2021). However, there is a lack of analysis regarding the relationship between unsafety and gendered power dynamics (Brandén, 2022). The current action plan for addressing men's violence against women does not address public safety or women's fear of violence in public spaces. There is no clear definition of safety or unsafety provided, but there is recognition that people's perceptions of safety may not always align with actual crime risks (Swedish Ministry of Justice, 2017). The concepts of "safety-creating work" and "crime prevention" are considered related but separate issues.

2.3 FEMINIST URBANISM AND THE INTERSECTIONAL PERSPECTIVE

To ensure that urban planning is inclusive and promotes fair development for all social groups, it's crucial to adopt a

gender-sensitive and feminist approach when analysing urban spaces. Unlike traditional methods, feminist urbanism employs participatory methodologies in which the population inhabiting a particular space becomes the protagonist (Global Platform for the Right to the City, 2017) in the search for strategies that improve the quality of life for everyone.

"*The disadvantage that insecurity presents for women paradoxically becomes a female expertise from which the entire population benefits. Thus, a city safe for women is a city safe for all*" (Michaud, 2002).

The intersectional perspective becomes indispensable when analysing narratives of fear in urban spaces, as their complexity and diversity require considering multiple factors. Feminist research highlights how ideas of public safety often prioritize the interests of the market and the white, urban, middle-class (Kern, 2010; Listerborn, 2016), while exacerbating inequalities and fear among marginalized groups (Listerborn, 2016). It challenges the notion of a uniform understanding of gender, showing how fear and unsafety are shaped by other factors like sexuality (Hubbard, 2012; Johnston, 2018; Tucker, 2023), race and ethnicity (Kihato, 2007; Listerborn, 2016), or socio-economic status (Listerborn, 2016).

There's also a need to debunk the misconception that assaults in public spaces are mostly committed by racialized men, which perpetuates racist systems (Sager & Mulinari, 2018). In Sweden, concerns about women's safety have been exploited by the political far and extreme right to portray immigrants as a threat to Swedish safety and gender equality (Sager & Mulinari, 2018). Sager and Mulinari (2018) illustrate the Sweden Democrats' failure to confront violence against women, attributing the issue solely to migrant men and justifying their inaction through a racist perspective, viewing it as the problem of the "*other*." Additionally, Listerborn (2016) highlights the intersection of violence against women with racist acts, exemplified by the connection between violence against Muslim women wearing hijabs and their attire.

Overall, the intersectional perspective underscores the complexity of power dynamics and the construction of unsafe spaces, emphasizing the importance of considering gender and race in urban safety initiatives. By recognizing these intersections, we can better address the unequal distribution of safety and challenge governing practices that fail to protect all groups equitably. As a result, numerous researchers have adopted the term "***(un)safety perception***" to denote the intersectional viewpoint, which unveils the varied, occasionally conflicting perspectives on perceptions of safety.

2.4 EVALUATION METHODS

In response to these issues, in 1961, activist Jane Jacobs published her book "*Death and Life of Great American Cities*" (Jacobs, 1961), becoming a pioneer of what would later form a line of research on measures to increase urban safety and security. Despite being deeply criticized for lacking a theoretical foundation to support her vision, this book offers, for the first time, an analysis of the city through the eyes of its inhabitants. Jane Jacobs (1961) asserts that for a space to be perceived as safe, it is necessary to build a network of social and community relationships that result in an appropriation of the space so that it is never seen as lonely and unsafe.

In the 1970s, various social movements began to emerge, such as the "*Take Back the Night*" march in the United States, aimed at promoting women's safety in cities. Specific methods for the analysis and evaluation of safety and security from an urban perspective also began to be studied.

The contrast of this vision with the theory of preventive urban planning is striking, as the latter employs urban elements that privatize and limit the use of space to achieve the same goal. In the discussion of urban safety and security from the perspective of crime prevention policies, two significant contributions arise: the CPTED method by criminologist C. Ray Jeffery (Jeffery, 1971) and architect Oscar Newman's book "*Defensible Space*" (Newman, 1973). Both draw from Jane Jacobs' earlier vision but trying to address the issue from a physical dimension.

CPTED

The CPTED method aims to enhance urban safety and security by modifying the physical environment through five key principles, that include natural access control, which involves designing architectural features to limit access points and enhance privacy; natural surveillance, achieved through strategic placement of windows, lighting, and landscaping to deter potential threats; maintenance, focusing on the upkeep of public spaces; territorial reinforcement, that creates a sense of ownership among residents; and community participation, involving residents in the design process, thereby strengthening social bonds and enhancing safety perceptions.

The CPTED method encapsulates the principles guiding the assessment and application of physical measures currently employed in urban safety and security interventions. Nonetheless, despite its foundation in certain community-building

traits, feminist theories critique it for its inherent bias towards the perspective of those in power, typically white, male, and privileged. Some authors consider that this method perpetuates and reinforces power dynamics, particularly regarding race and social status (Hays & McDonald, 2022). Recognizing that crime is shaped by those in power is the initial stage to understand how CPTED should be utilized to not perpetuate discriminatory behaviours.

The principles underlying the CPTED method remain valid; however, the method itself tends to prioritize outcomes over procedural aspects. For optimal results, emphasis should be placed on the process, as underscored by Jane Jacobs (1961), to foster a profound sense of civic and societal belonging, letting the community define (un)safety in their neighbourhoods and applying adequate measures.

First feminist guides on urban safety perception

In the late 1980s, initial concepts emerged that laid the groundwork for subsequent guidelines and action plans concerning urban safety and security. Canada played a pioneering role, thanks to the Metropolitan Action Committee on Violence Against Women and Girls in Toronto, which developed a women's safety audit initiative. This led to the establishment of the Women and City Committee (Comité Femmes et Ville) in Montreal in 1990, focused on advancing actions to ensure "***the safety of Montreal women***" (Michaud, 2002). During the 1990s, the Women's Action Committee for Urban Safety (CAFSU) published the "***Guide to investigating women's safety in the city***," (***Guide d'enquête sur la sécurité des femmes en ville***) initiating a process of evaluating Montreal neighbourhoods from the perspective of women. This guide outlined key principles of safe urban planning and encouraged citizens to identify measures to enhance safety and perceptions thereof (Lambrick & Travers, 2008).

Drawing on international insights, CAFSU introduced the "***From Dependence to Autonomy***" toolkit in 2002, a cornerstone for global safety assessment guidelines (Metropolis & Women in Cities International, 2018). This resource contrasts paternalistic policies with empowering approaches, advocating for women's autonomy in decision-making regarding (un)safety (Michaud, 2002). It formalizes the women's safety audits, recognizing women as safety experts and prioritizing their perspectives in urban planning (Metropolis & Women in Cities International, 2018).

Woman Safety audits

"*In addition to improving the safety of citizens, safety audits aim to evoke in participants a sense of ownership and control of their environment. [...] the specific changes made to urban space as a result of safety audits contribute to the perception of participants as effective social protagonists. In this sense, safety audits are a factor in strengthening women's capacities and promoting their autonomy, while also encouraging the exercise of their citizenship.*" (Michaud, 2002).

The widespread adoption of Women Safety Audits underscores their efficacy and highlights the necessity of integrating women's viewpoints into urban design. The audit process involves five main steps:

1. Preparation: Organizing the recognition march involves actions like contacting neighbours, forming trust groups, engaging local organizations, selecting the location, forming the group, and scheduling activities.

2.Site exploration: Conducting a situational analysis with participating women to identify unsafe areas and plan the route accordingly.

3.Diagnosis and solution development: Synthesizing collected information, organizing data, and proposing initial solutions through discussion groups and workshops to ensure women's genuine participation.

4.Presentation to local leaders: Emphasizing the urgency of implementing proposed interventions to maintain women's credibility and leadership.

5.Monitoring and maintenance: Assigning individuals to oversee implementation, ensuring timely action, and fostering community ownership to sustain interventions.

Several studies currently assess urban planning through a gender lens, employing methods such as safety audits, surveys, interviews, and physical analysis of public spaces. These evaluations emphasize the importance of involving the population, particularly vulnerable groups, who have a heightened awareness of safety concerns due to their increased exposure to danger.

Sweden's context

Governmental initiatives in Sweden focus on understanding and addressing issues related to (un)safety, particularly con-

cerning crime prevention and public order. The *National Council for Crime Prevention* (Brå) plays a central role in this effort by gathering crime statistics, conducting research, and providing support for local safety initiatives (Brandén, 2022).

The "*Swedish Crime Survey*", conducted annually since 2006, is a key tool for assessing feelings of safety and exposure to crime. The results of it show that gender disparities in safety perceptions are evident, with a higher proportion of women reporting feeling unsafe (38% of women and 22% of men in the year 2020), especially in outdoor environments during the evening and night. Apart from these gender differences, Brå's report from 2020 shows that levels of perceived unsafety are higher in the age group 20–24 years, among people living in apartment buildings, and among those born in Sweden with both parents born outside Sweden.

The government emphasizes local community engagement in crime prevention, promoting measures such as safety walks, neighborhood cooperation, and citizen participation in safety-creating work. Preventive measures include both formal (e.g., camera surveillance) and informal (e.g., neighborhood watch groups) controls, with an emphasis on addressing minor crimes to prevent more serious offenses, as described in the "*Broken windows theory*" (St. Jean, 2007). The role of the private sector, particularly security guards, is also highlighted, although the primary responsibility for maintaining order remains with the police (Swedish Ministry of Justice, 2017).

Efforts to integrate a gender perspective into safety planning focus on addressing unequal power relations, particularly concerning men's violence against women. The main focus has been to address shortcomings in the physical environment, such as poor lighting, overgrown bushes, and dark tunnels (Sandberg & Rönnblom, 2015). Safety walks are identified as a central method for improving women's safety in urban environments, emphasizing dialogue between citizens and public officials to address safety concerns and promote inclusive public spaces.

Also a comprehensive manual covering safety walks was created: "*Safety audits: a guide*" by *Brå, Boverket and Tryggare och Mänskligare Göteborg* (an institution that collaborated with the government in the definition of the guide), that became the national guide for Swedish municipalities to conduct safety walks (Brå et al., 2010). It emphasizes into gendered and power-related aspects of unsafety, such as women's experiences of sexual harassment and fear of sexual violence. It discusses how certain groups are often unfairly portrayed as "*unsafety problems*," like young men and alcohol or drug abusers. Ensuring broad representation from different groups during safety walks is highlighted as essential and it emphasizes that the dialogue between citizens and public officials during safety walks is just as crucial as any physical changes made to the environment (Brandén, 2022).

Despite pointing towards a promising future, the next challenge will be to ensure that the necessary standards of participation and dialogue are met. According to some authors, certain initial practices in various municipalities of the country have focused on addressing specific physical problems of the urban environment, overlooking the more subjective sphere of (un)safety perception (Brandén & Sandberg, 2021), as it is more complex to integrate into urban policies.

3. Study area

In the following pages the study area will be described and analyse, in order to understand why this city was chosen as case study.

3.1. HISTORICAL REVIEW

Umeå boasts a rich historical tapestry, contributing to the socio-cultural complexity of this region of Sweden. This history has fostered an engaged and politically active population, giving rise to significant social movements and milestones at the national level. Umeå's past has led the city through urban and social processes during critical moments that have fostered and required community participation and the involvement of the local population in democratic co-creation processes.

Origins

Umeå's history traces back to prehistoric times, evidenced by carvings found in Norrfors from 3000 BC. The name "Umeå" was likely originated at the end of glaciation, what caused the river to flood with a roaring sound (Uma in old norse). Until the 14th century, the region was predominantly inhabited by nomadic Sami people, but eventually, coastal areas were settled by Germanic peoples. Umeå then emerged as a church parish, centred in the present-day district of Backen, as the city centre was still submerged (See ***Figure 1***). In the 16th century, King Johan III recognized Umeå as a town to control northern trade.

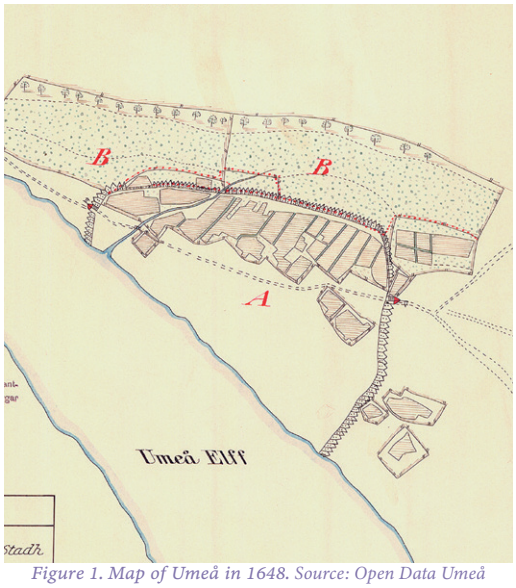


Figure 1. Map of Umeå in 1648. Source: Open Data Umeå

In 1714, Russian invasions sparked fires in Umeå. Despite the destruction, efforts to rebuild included establishing the region's first pharmacy and a hospital. In the beginning of the 19th century and following the Russian conflict, Umeå experienced a population surge (See ***Figure 2***), but constrained resources hampered its industrial expansion, prompting a shift towards administrative and educational roles. It is in this context when the first women's organizations emerged, developing projects to assist women in finding employment and enhancing education. Subsequently, they also tackled more significant issues such as poverty, alcoholism, and healthcare.

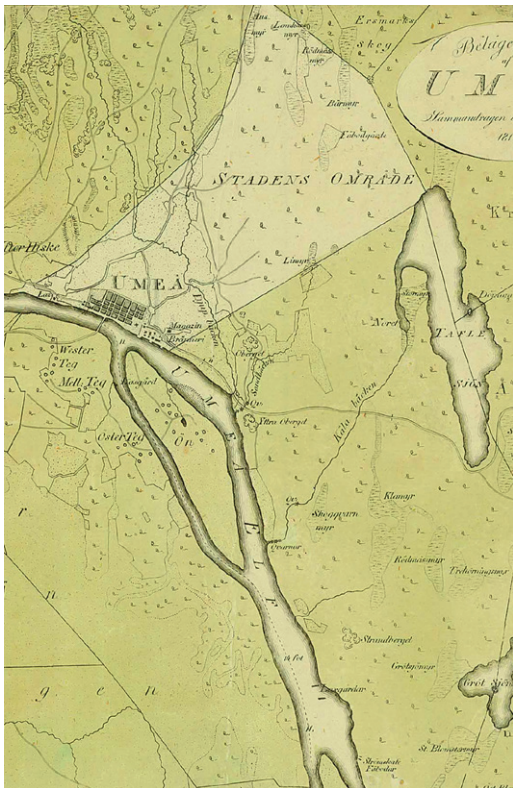


Figure 2. Map of Umeå in 1812. Source: Open Data Umeå

The big fire and the rise of political movements

The 20th century was filled with events for Umeå. In 1888, a devastating fire left 2,300 residents homeless (See ***Figure 3***). However, this situation prompted a modernization effort that led to the construction of wide boulevards (as shown in ***Figure 4 and 5***) and the plantation of birch trees for protection, earning Umeå the name "City of Birches". Umeå becomes and advanced and modern city with brick buildings, street lighting, new rail lines, and a shift to hydroelectric power.

All this modernization coincides with the rise of racist attitudes in state policies targeting the Sámi people, who had a deeply rooted culture in Umeå society at that time, so it led to protests alongside the rise of critical media outlets like Västerbottens-Kuriren and Västerbottens Folkblad. It is also the moment when women's suffrage gained momentum, resulting in universal suffrage by 1919, perhaps incited by the significant contribution of women's groups during the World Wars and post-war with childcare and unemployment support networks.

Figure 3. Photograph from the prison towards the devastated town. Remaining chimneys from houses nearby stand. Source: Umeå400 webpage

Figure 4. Map of Umeå in 1899. Source: Open Data Umeå

Figure 5. Map of Umeå in 1937. Source: Open Data Umeå

Umeå as a pilot municipality for gender equality

Umeå became the first city in Sweden to elect a woman to the city council, so it's no surprise that activism in the 1970s and 1980s focused on women's issues, leading to policy changes. One of these changes led to the establishment of the first gender equality committee in Umeå. Women's shelters became crucial, providing refuge for those fleeing domestic violence and advocating for societal change. In 1983, one of these organizations was evicted from their rented premises, prompting around twenty women in Umeå to occupy a villa slated for demolition for redevelopment projects. The 20th century begins with another occupation protest, this time of a hotel whose construction sparked heated debate. The occupation featured concerts by the hardcore scene and punk straight edge groups, which later were the ones to initiate the vegan movement in Umeå, together with the rise of "militant veganism", with Animal Liberation Front activists engaging in direct action.

Umeå now. The debate and focus on co-creation

Umeå reached 100,000 inhabitants in 1995 and hosted the European Capital of Culture (ECOC) in 2014. 'Curiosity and Passion – the Art of Co-Creation' was Umeå's concept, highlighting its tradition of do-it-yourself (DIY) culture as a core strength and unique feature of its proposal for the ECOC. This tradition of broad community involvement in cultural creation was exemplified by initiatives such as the dialogue meeting organized by Hamnmagasinet (Umeå Municipality, 2009), which brought together various cultural practitioners to discuss DIY culture's role and support. Umeå officials aimed to achieve broad participation and public involvement through open meetings, discussions, and workshops. This participatory approach was seen as giving legitimacy to the project, aligning with the city's strong historical roots in adult education and fostering an open cultural life (Hudson et al., 2017).

Over the last decade, various social movements have addressed environmental sustainability, LGBTQ+ rights, gender equality, refugee rights, and anti-racism efforts. Umeå's active civil society continues to engage with social and political issues, researching and innovating towards human-centered politics and reflecting its rich history of activism and progressivism. For these reasons, Umeå presents itself as an optimal field of study for the application of feminist urbanism theories.

3.2. TERRITORIAL ANALYSIS

Umeå holds a strategic geographical position as the largest city in northern Sweden. It is connected through a complex infrastructure system, attracting populations from surrounding areas who commute to Umeå for work. Accessible by plane, train, and ferry, Umeå's university draws thousands of individuals annually, many of whom choose to settle in the city. This diverse and vibrant population enriches the intersectional perspective of the thesis.

Figure 6. Map of Sweden. Self-elaboration

Location

Umeå is a city located in northeastern Sweden, in the Västerbotten region (See ***Figure 6***), on the banks of the Ume River. It is situated approximately 600 kilometers north of Stockholm.

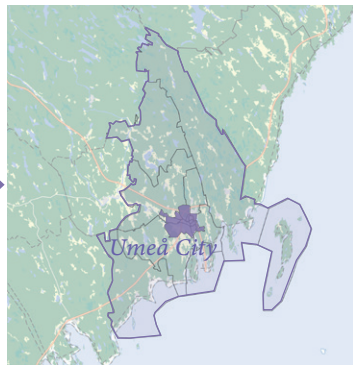


Figure 7. Umeå Municipality. Self-elaboration

The city of Umeå is one of the 20 localities within the municipality of Umeå, as shown in ***Figure 7***. It is the most significant not only within the municipality but also within the Västerbotten region.

Connections

As shown in ***Figure 8***, Umeå is well-connected both nationally and internationally. It has a network of roads linking it to other major cities in Sweden, such as Stockholm and Gothenburg, via the E4 highway. It also has railway connections to other parts of the country.

In terms of international connectivity, Umeå Airport offers flights to destinations both within and outside of Europe, facilitating international travel. Additionally, Umeå is located on the east coast of Sweden, making it accessible by sea for the transportation of goods and passengers. At the local level, the city of Umeå has a good public transportation system that connects various areas of the city.

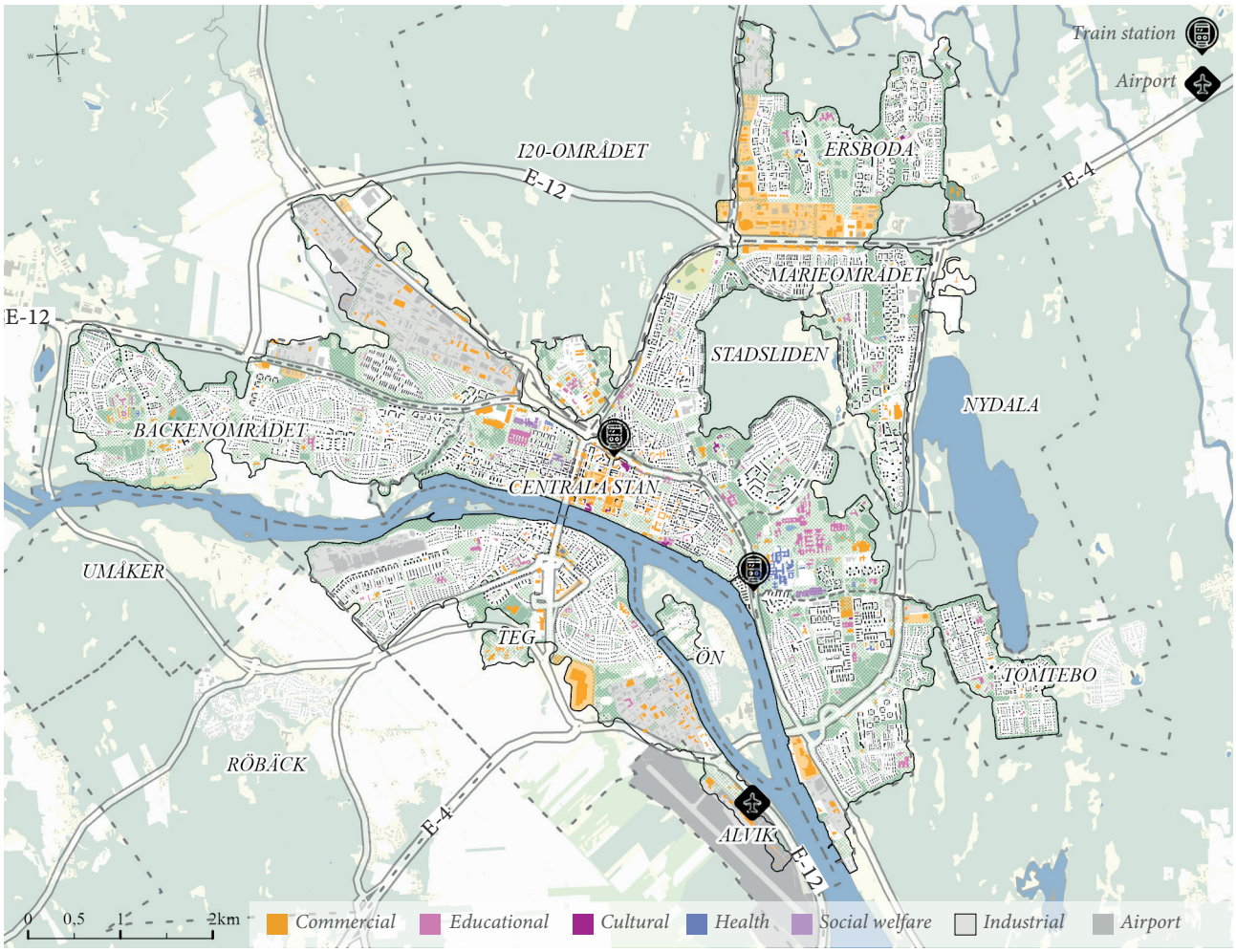


Figure 8. Map of the city of Umeå. Main uses and connections. Self-elaboration

3.3. SOCIOECONOMIC REVIEW

Umeå has a population of 133,091 people (Statistics Sweden SCB, 2013), distributed unevenly across the territory. *Figure 9* includes a representation of the population density in the city of Umeå. It can be observed that the most densely populated neighborhoods are those close to the University (Ålidhem, Öbacka, and the southern part of Berghem), the east and west of the city center, and the neighborhoods of Tomtebo and Mariehem, followed by Haga and some areas of Ersboda, Teg, and Umedalen. The rest of the neighborhoods have a low density typical of single-family residential development.

As seen in ***Figure 10***, the population is young, with 55% of people under 40 years old and 28% between 40 and 64 years old (Open Data Umeå, 2022).

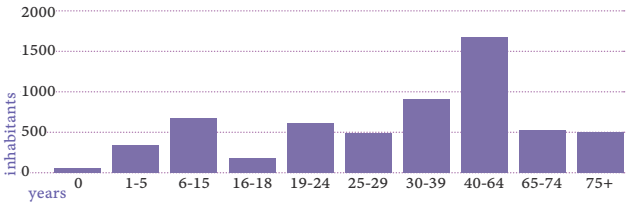


Figure 10. Population by age group 2022. Source: Open Data Umeå

Umeå has a high percentage of people from other countries, coming from Nordic countries, Europe, but mostly from outside Europe. The university annually attracts numerous foreign students, many of whom opt to settle in the city permanently. Consequently, neighborhoods in close proximity to the university exhibit a higher concentration of international residents, as shown in *Figure 11*.

Interestingly, areas with greater economic affluence tend to have fewer foreign residents. For instance, Öbacka stands out as an enclave with a higher proportion of well-off migrants, likely comprising university-affiliated professionals such as researchers and doctoral candidates. Conversely, Ålidhem emerges as a district characterized by lower socioeconomic status and a higher percentage of foreigners, reflecting its predominantly student-centric population.

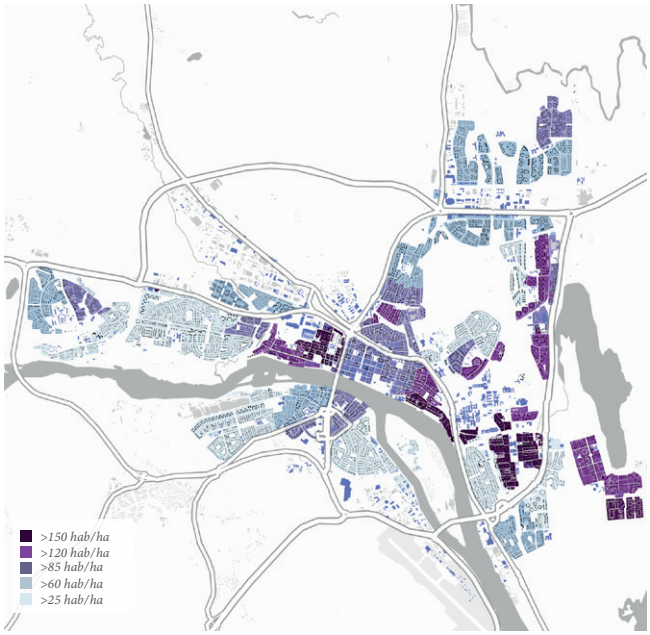


Figure 9. Population density Map. Self-elaboration

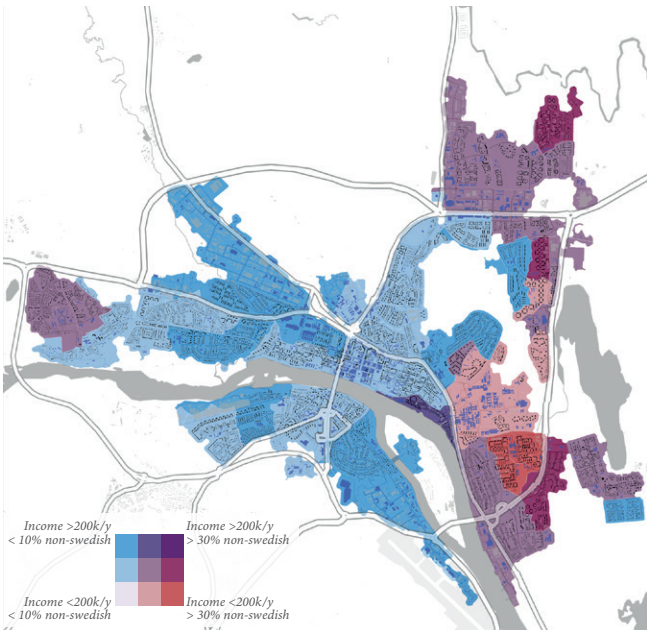


Figure 11. Bivariate: Cultural diversitty and Income level. Self-elaboration

Meanwhile, neighbourhoods like the northern sector of Ersboda, Carlshem, and Mariehem represent regions with relatively stable migration patterns and moderate purchasing power. Conversely, the central and southern regions of Umeå exhibit medium to high purchasing power and lower levels of migrant populations.

Overall, Umeå's urban landscape is a mosaic of diverse socioeconomic realities, fostering a rich and intricate social and cultural fabric.

4. Methodology

This thesis draws upon the principles of feminist urban theory regarding safety perception in public spaces to incorporate them within a GIS environment, what allows to create an analyst workflow. By incorporating feminist urbanism principles, the analysis becomes adaptable to include the perspectives of those previously overlooked in the city's design process.

To achieve this, a mixed methods approach is necessary, combining different types of analyses to identify specific urban design elements influencing people's perception of urban safety. To explore diverse experiences within the territory, a synthesis map is proposed to collect insights from various demographic profiles. This map will gather data from surveys and GIS analyses to delineate safe and unsafe areas and understand the reasons behind these perceptions.

GIS analyses will focus on urban design elements identified by feminist urbanism theories as safety perception indicators. Their presence or absence will be examined using GIS and represented through choropleth maps. Additionally, the study will incorporate variables such as demographic diversity. These diverse datasets will be cross-referenced using reclassification processes and symbology tools.

Through this mixed methods approach, specific areas within the urban environment where safety and security can be improved will be identified. It will also pinpoint elements contributing to safety perceptions or potential additions to enhance urban spaces. The subsequent sections will delve into the technical aspects of the analyses, detailing the tools utilized and strategies employed.

4.1. PARTICIPATORY ANALYSES

The participatory analyses in this thesis have focused on developing a survey based on guidelines and methodologies from feminist urbanism, such as those of Col.lectiu Punt 6 (2024), Renagh O'Leary (2011), Women in Cities International (2010), and the United Nations Human Settlements Programme (2020, 2023).

4.1.1 (Un)Safety perception Survey

Survey design

For the design of the survey, the app ArcGIS Survey123Connect was used. This app allows to create anonymous surveys and it offers an adaptable interface for all type of devices (phone, tablet, computer). The survey was divided into four sections, consisting of the following elements:

> *Section 1. General information.* This section includes personal inquiries about the respondent's connection to the city, such as age, gender, length of residency, and pertinent characteristics (e.g., disabilities, caregiving responsibilities, neurodiversity). The objective is to categorize and comprehend the results across diverse demographics.
>
> *Section 2. Unsafety perception.* This section aims to assess the respondent's perception of unsafety in the city of Umeå. It will include interactive maps where respondents can mark locations where they have felt unsafe or where they have experienced or witnessed violent incidents. Additionally, questions will be included to gauge the respondent's definition of safety and to identify urban design elements or general factors that significantly impact their sense of unsafety. Respondents will be presented with a series of situations or urban design elements and asked to rank their influence on their perception of unsafety (e.g. time of the day and of the year, presence of urban elements like street lights or shops, situations like waiting for the bus or going to a crowded/empty area).
>
> *Section 3. Safety perception.* Here, the questions center around factors that contribute to the respondent's sense of safety, with the inclusion of a map for pinpointing specific locations.There will also be some rank-type questions as in section 2.
>
> *Section 4. Final questions.* The respondent can add any last comments.

AcrgGIS Survey123 Connect offers various interfaces for designing surveys. Surveys can be created either through the web version or the downloadable computer app. The web interface is more user-friendly, but it has limitations in terms of detail and configuration options, particularly regarding maps. Notably, if multiple maps are included in a survey, only

responses from the first map are collected. To address this issue, surveys must be designed within the *Survey123 Connect* app, where the survey creation interface is an Excel file equipped with preconfigured tools and columns, such as *Label* (text with the questions, how the data is going to be presented), *Name* (how the responses will be stored in the database) or *Type* (type of question, different types allow different ways of collecting data). One such tool is *repetition* (begin & end repetition), which enables the collection of multiple responses for the same question, such as multiple points on a map. This tool resolves the limitation found within the web interface. The final look is attached as an Appendix to this thesis.

Dissemination methods and response rate

Once the survey concluded, it was distributed through diverse channels like Discord, WhatsApp, Facebook, and email. Targeting individuals in intersecting situations such as women, migrants, those with disabilities, or caregivers, it was shared in spaces of feminist and queer organizations in Umeå like Kvinnojouren, Tjejjouren or Lesbisk Frukost, alongside WhatsApp and Discord groups mostly comprising international students. Additionally, to reach broader demographics like locals or older individuals, a QR code poster (See *Figure 12*) was printed and displayed across University Campus and City Centre advertisement panels.

Figure 12. Poster design. Self-elaboration

The survey and all the advertisements were developed in English due to time restrictions, so it was known from the beginning that the participation of the elderly or recent arrivals from other countries would be very limited.

Calculating the response rate proved challenging due to the broad dissemination. The survey reached an estimated 1000 individuals through WhatsApp (a group of international students with 690 people, an LGBTQ+ student collective in Umeå with 36 people), Discord (Lesbisk Frukost group consisting of 12 people), Facebook, physical posters, and Kvinnojouren Umeå's email contact chain (estimated in 100 people).

The survey garnered 42 responses, with 54% originating from international students, while the remaining respondents were locals. Among the participants, 62% identified as women, 31% as men, and 7% as non-binary. Notably, 15 respondents disclosed personal characteristics, with 10 reporting disabilities and 5 indicating responsibilities for children or individuals with special needs.

4.2 GIS ANALYSIS

The analyses that will take place using ArcGIS Pro will all start with simple data analysis, making use of the Spatial Analyst extension, Data Management tools, Spatial Statistics and 2d & 3d Analysis, until the raw data is represented following the definitions of the indicators explained below. In the last step, the outputs will be reclassified into simple classes based on their grade of influence regarding safety perception. This reclassification process becomes the "diagnosis" step.

The GIS analyses are divided into categories, following the recommendations of different guides for the evaluation of public spaces from a gender perspective (Brå et al., 2010; Col.lectiu Punt 6, 2024; Col.lectiu Punt 6 & Ciocoletto, 2014; Taboada, 2016; UN-Habitat, 2023). Within these categories, the analyses will be conducted based on a series of indicators outlined in the following section. The aforementioned references also provide the rationale for the parameters used in the various indicators studied. The categories are the following:

Facilities: having mixed-uses increases both the volume of people and the activity within spaces throughout the day. This also enhances the feeling of belonging, as frequent visits to familiar spaces foster a sense of connection. In this section 2 indicators are being studied.

Public spaces: not only referring to their distribution and size, but to the quality of them, including the number of elements present in the public spaces that make the place useful and comfortable. Here, three different indicators are developed.

Mobility: the access to different types of mobility, alternative transports, distance to bus stops, protection from cars and accessibility of pedestrian paths and public areas. Three indicators are included in this category.

Safety perception: focusing of the elements of the urban design that specially affect the perception of safety, like illumination, visibility or level of maintenance of the places. In this section 3 indicators are studied.

Urban morphology: balance between open spaces and buildings, proportions of the streets and buildings and urban design strategies. Two indicators are included in this section.

In total, 13 indicators are included, which constitute 13 different GIS analyses. In *Table 1* a summary of all the different indicators is presented, with data needed and parameters established.

The analysis process commences by delineating the study area to the urban zone of Umeå, as defined in relation to the *Tätorter i Sverig*e by the *Statistics Sweden SCB* (See *Figure 13*).

To facilitate data representation and analysis, a minimum unit of measurement is established. This is operationalized as a hexagonal tessellation with a 200-meter diameter, corresponding to hexagons covering an area of 3 hectares. These hexagons serve as the fundamental unit for classification across all analyses.

In the final step, where all analyses are amalgamated, a reclassification process based on these equal-area hexagonal units is employed. The tessellations are clipped to the extent of Umeå's *Tätort* (See *Figure 14*).

In the upcoming sections, each category will be thoroughly described, outlining the different indicators considered and explaining how the various outputs are obtained from a procedural point of view.

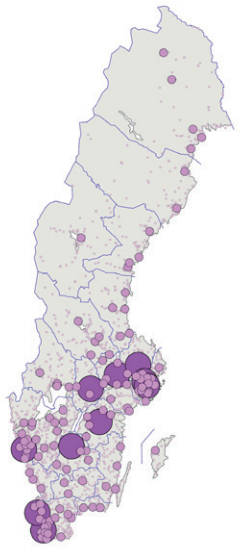


Figure 13. Map of urban areas and size. Source: Statisctis Sweden

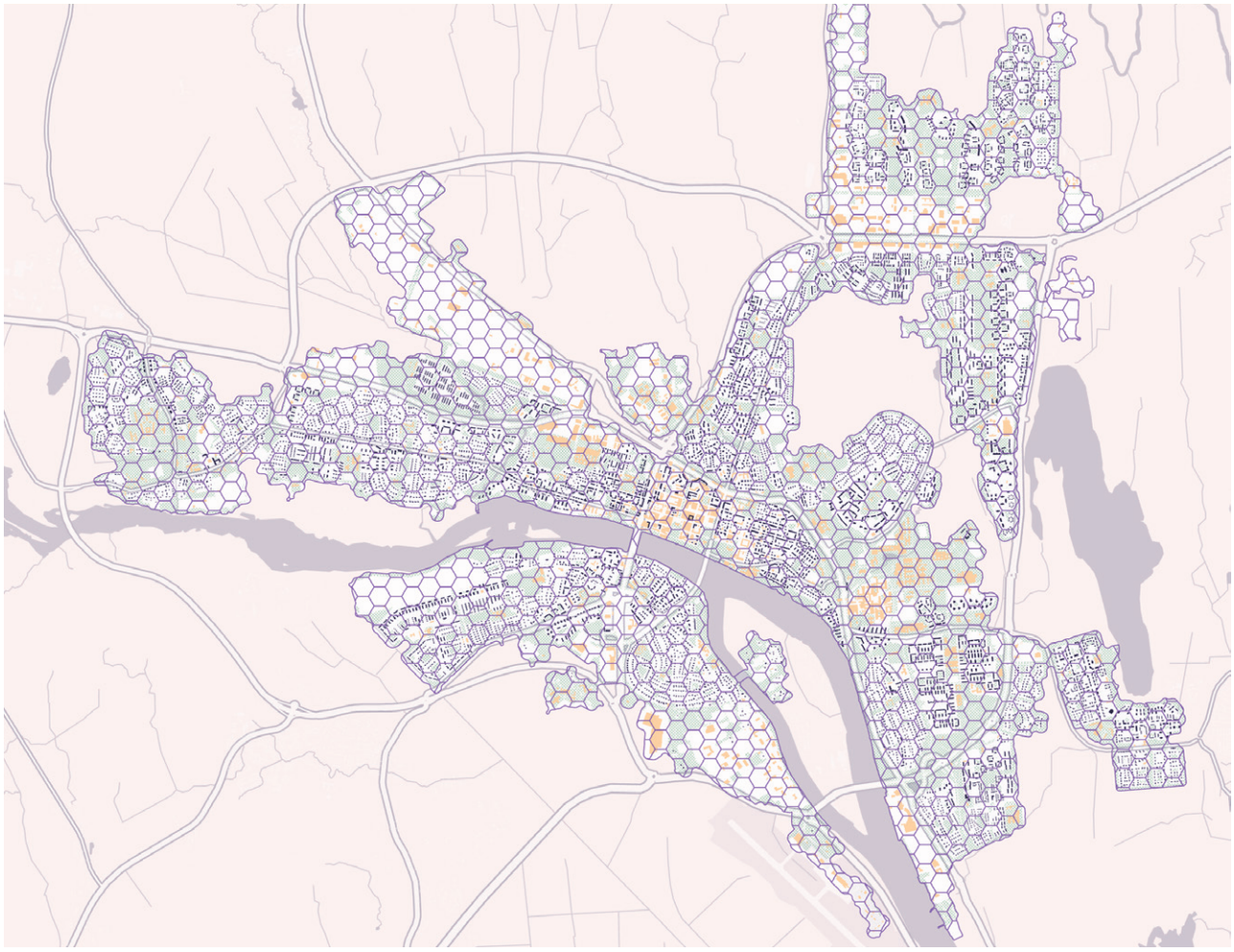


Figure 14. Hexagonal grid over Umeå urban environment. Self-elaboration

Table 1. Summary of GIS analyses and indicators. Self-elaboration

Analysis		*Indicator*	*Data needed*	*Parameters*
Facilities	U1	*Dresidential (no. people) = [number of people per hexagon]*	Population count (polygon layer) Building footprints (polygon layer) Built-up environment (polygon layer)	**Low density <120 people/ ha** **Medium density 120 -240** **High density >240 people/ ha**
	U2	*Pservices (no. serv)= [sum of everyday facilities available regarding their proximity area established for every category per hexagon]*	Facilities (point and polygon layers) Park layer (polygon layer) Roads (polyline layer)	**Low access <6** **Medium access 6-12** **High access >=13**
Public space	PS1	*DenOS (no. OS) = [total amount of type of open spaces available per hexagon]*	Green areas (polygon layer) Property parcels (polygon layer) Public space (polygon layer)	**Low <4** **Medium 4** **High 5**
	PS2	*GreenA (m2/per) = [green area in square meters by hexagon/people count per hexagon]*	Green areas (polygon layer) Property parcels (polygon layer) Public space (polygon layer)	**Low <10 m2/per** **Medium 10-15 m2/per,** **High >15m2/per**
	PS3	*EquipOS (no. equip)= [sum of equipment categories per hexagon]*	Urban furniture, trees & toilets (point layers) Playgrounds & Sport areas (polygon layers) Street lights (point layer) Green areas (polygon layer) Roads (polyline layer)	**Low <4** **Medium 4-5** **High >=6**
Mobility	M1	*Speed(km/h): Speed per section of street*	Roads (polyline layer)	**Unsafe >60 km/h Neutral 40-60 km/h Safe < 40 km/h**
	M2	*Nturns (nturns): number of turns available per hexagon, that is a 200 m diameter*	Roads (polyline layer)	**Low <4** **Medium 4-6** **High >6**
	M3	*Aroads(%)= [pedestrian mobility area with sufficient or excellent accessibility / total pedestiran mobility area]*	Roads (polyline layer) DEM (raster layer) Public space (polygon layer) Pedestrian mobility areas (polygon layer)	**Bad <70%** **Poor 70-90%of sufficient accessibility** **Good accessibility 90%**
Safety perception	SP1	*Aillumination(%): [ground area reached by light bulbs/total public area per hexagon]*	Street lights (point layer) DEM (raster layer) Building footprints (polygon layer) Pedestrian mobility areas (polygon layer) Public space (polygon layer)	**Bad illumination <70%** **Poor illumination 70%-85%** **Good illumination <=85%**
	SP2	*AHidden (%): [hidden area/total public space area per hexagon]*	Roads (polyline layer) DEM (raster layer) Public space (polygon layer)	**Low visibility >50%** **Medium visibility 50-10%** **High visibility <10%**
Urban morphology	UM1	*PEgreen (%)= [public road surface covered by greenery / total public road surface]*	Trees (point layer) Pedestrian mobility areas (polygon layer)	**Low <50%** **Neutral 50-85%** **High >85 %**
	UM2	*PRca (%)= [public space area / total area per hexagon]*	Public space (polygon layer)	**Insufficient <25%** **Neutral 25- 50%** **High proportion > 50 %**

4.2.1 Facilities

Residential density *U1*

The amount of residences affects the capacity of the urban fabric to gather in the same space a sufficient critical mass of people to encourage exchanges and new communicative relationships. A correct density will efficiently develop those urban functions linked to sustainable mobility and the provision of services. It also creates a more conducive environment for the development of an active community present in open spaces, providing greater informal surveillance (there are more people who can witness whatever may happen).

Dresidential (no. people) = [number of people per hexagon]

DATA

Data needed: Population count, obtained through SLU Geodata Extraction Tool. Since 2022, the population count is available distributed in a grid of 100x100 meters ["B13-Rutor-100-2022"].

Data processing: The data is uploaded as a polygon feature class and then using the "Apportion polygon" tool, is it joined to the tessellation, specifying the field containing the total amount of population ("TotBef") as the field to apportion and the "Area" apportion method. Then the values are reclassified into 3 classes (low, medium, high density) according to the parameters.

PARAMETERS

Regarding the literature reviewed, the desirable value would be 240 people/ha, therefore 720/hexagon. These values were thought for dense cities. Since Umeå's density is much lower, regarding these parameter the whole urban environment would be classified as low density. But to be able to score differences between the urban configuration of Umeå, the parameter is adjusted to the following values:

Low density <120 people/ha , Medium density 120 -240, High density >240 people/ha

Mixed use and access to everyday facilities & services *U2*

The degree of simultaneous accessibility to the four types of basic services considered is assessed. This indicator affects not only the accessibility and autonomy of the city but also the informal surveillance and sense of belonging. Types of basic facilities & services:

Everyday facilities and services: (< 600 m) Educational, cultural, sports, health and social welfare (5 services)

Everyday commercial activities: (< 300 m) Groceries, electronics, fashion, pharmacy, books and newspapers, entertainment like bars and restaurants (6 services)

Everyday mobility: (< 300 m) Urban bus stops, bicycle network, pedestrian network (3 services)

Parks: (< 200 m) Parks > 1ha (1 service)

Pservices (no. serv)= [sum of everyday facilities available regarding their proximity area established for every category per hexagon]

DATA

Data needed: distribution of different facilities, obtained from *OSM* (points of interest and polygons of interest) and *SLU Geodata Extractio*n Tool (land use). The information regarding parks was not complete in these sources, so it was manually checked and drawn following information from *Umeå kommun*, that offers an online map with all the parks and there is also a point layer available to download in *Umeå Open Data*. In addition, mobility data (roads) was obtained from *Lastkajen*.

Data processing: The data was divided into different layers according to the categories presented above. ***Table 2*** shows which OSM & SLU categories were considered for each category regarding the analysis. In the case of "Everyday mobility", the data was filtered by the attribute table of the geopakage obtained from *Lastkajen*. Field "Vagtrafiknat" specified the type of road and field "Halplatslage" included the busstops, that were later converted to points.

Once all the data was distributed into layers, they were all buffered using their respective proximity distances (in meters) specified above. The buffer layers for each type of use were then merged into only one layer per type of facility, since the aim is to know if a specific area has access to that facility, not the amount of facilities available. The different buffer layers were then joined by category using the "Spatial join" tool, establishing a tessellation layer as target layer. The "*Field-Count"* shows the amount of facilities available. This field (for all 4 categories) is joined to a new layer with another tesse-

llation, and a new field is created to sum the 4 values per hexagon.

Table 2. Classification of source data into uses and services categories. Self-elaboration

Category		OSM data Points & Polygons	SLU data Buildings	SLU data Land data
Everyday facilities and services	Educational	kindergarden, school	School, university	högskola, universitet, skola, samfund
	Cultural	artwork, cinema, community-centre, library, museum, theatre	cultural building	-
	Sports	pitch, playground, sports-centre, stadium, swimming-pool, track	multiarena, sportshall	Fotbollsplan, Idrottsplan, ishocketbana, koloniområde, skjutbana, övrigt
	Health	clinic, dentist, doctors, hospital	hospital	sjukhus, vårdcentral,
	Social Welfare	bank, community-centre, post-box, post-office, courthouse	police station, associations, public unspecified	-
Everyday commercial activities	Groceries	mall, beverages, convenience, department-store, greengrocer, market-place, supermarket	-	
	Electronics	mall, computer-shop, department-store, mobile-phone-repair		
	Pharmacy	mall, pharmacy, department-store		
	Books	mall, kiosk, bookshop, department-store		
	Fashion	mall, clothes, department-store, recycling-clothes, sports-shop, shoe-shop		
	Entertainment	mall, bakery, bar, cafe, department-store, pub, kiosk, fast-food, restaurant		
Parks*	Parks	playgrounds, parks, picnic-areas	* This layers were merged and edited to create new features according to the park points obtained from Open data Umeå.	

Finally, the Sum field is reclassified according to the parameters shown below.

PARAMETERS

Low access <6, Medium access 6-12, High access >=13

4.2.2 Public spaces

Open space diversity *PS1*

Green spaces are considered all living spaces with a minimum surface area of 1,000 m² and with more than 50% of the area pervious (public parks, gardens, open spaces for the exclusive use of pedestrians, squares). Both green spaces and smaller open socializing areas of the urban fabric are needed to develop a sense of community and improve informal surveillance and sense of belonging. The spaces and access distances considered are:

Smaller plazas or gardens of less than 1000 m² at less than 50 meters: everyday socializing space.

Green area of 1,000 m² at less than 200 meters: garden areas, such as squares or living areas that offer a function of daily contact of the citizen with the greenery.

Green area of 5,000 m² at less than 750 meters: most basic functions of stay and outdoor recreation for the resident population.

Green area of 1 ha at less than 2 km: urban parks that guarantee different recreational possibilities.

Green area > 10 ha at less than 4 km: free areas that can be integrated into the natural environment.

DenOS (no. OS) = [total amount of type of open spaces available per hexagon]

DATA

Data needed: Land data layers from *SLU Geodata Extraction Tool* and *OSM*, self-made park layer developed in *U2* and roads from *Lastkajen*. Also *Fastigshet* layer is downloaded to identify private plots and clip them away from the layer containing green areas, since private properties don't count.

Data processing: The layer containing all the public space need to be produced from the merging and editing of other layers ("Open land and forests", "Marshland" and "Other facilities" from *SLU*, in addition to polygon layer from *OSM*). The layers were merged assuring there were no overlaps between polygons, using tools as "Select by location", "Intersect" and "Merge" (Edit tool). Once all the data is within the same layer, the layer is clipped from the editing toolbox, extracting the surface of car roads (being previously buffered by their width) and of private plots (fastigshet layer previously manually classified by private, semiprivate and public plots, in function of the type of building existing within them) by using the clip option "Discard (Remainder)".

Both layers containing open space data (being, the parks layer and the layer obtained from the process explained above) are classified into the categories described in the description. The data is segregated into layers based on their category and the buffer areas are calculated. Then the data is joined again using the "Spatial join" tool and establishing as target feature a tessellation layer, where the "Field-Count" field represents the diversity of open spaces per hexagon. The data is then reclassified following the parameters.

PARAMETERS

Low <4 Medium 4 High 5
(green areas > 10 ha are allways ensured in Umeå)

Green areas per inhabitant *PS2*

Green areas are considered by the World Health Organization (WHO) as "essential" spaces due to the benefits they bring to the physical and emotional well-being of people and for helping to mitigate the urban deterioration of the city, making it more liveable and healthier.

GreenA (m2/per) = [green area in square meters by hexagon/people count per hexagon]

DATA

Data needed: same as *PS1*.

Data processing: First the attributes smaller than 1000 m^2 are removed and then all the data is merged (Data Management) into one layer and then merged (Modify Features) into one feature, to avoid overlaps. The result is then divided by hexagons using the tool "Tabulate intersection", so as to obtain the m^2 and percentage of covered green area by hexagon.

Then the "AREA" field is divided by the total population count per hexagon to obtain percentages.

PARAMETERS

Low <10 m2/per, Medium 10-15 m2/per, High >15m2/per
(OMS recommendations)

Equipment of open public spaces *PS3*

In order to make public space accessible and liveable, it should be equipped with the necessary urban elements, categorized by toilet, furniture (benches), trees and vegetation, lights, playgrounds, sports areas, and access to cycle lanes and pedestrian roads.

EquipOS (no. equip)= [sum of equipment categories per hexagon]

DATA

Data needed: urban furniture, trees and toilets from Open Data Umeå, playgrounds from OSM and Open Data Umeå (point data), sport areas created in previous analyses, and lights obtained from Umeå Energi and Umeå Kommun. In addition the green areas (layer produced in previous analyses) and roads are needed.

Data processing: First all the different layers except the roads are converted to point data. Then the amount of point per layer is sum within the tessellation using "Summarize within", having previously selected by location only the points that are within green areas. The cycle and pedestrian roads are selected and by "Select by location", the hexagons that intersect those roads are classiffied as accessible, creating a new field and calculating a value of 1 to the accessible parks. The different "Field-count" fields are reclassified in 1 and 0 values, according to the existence or not of uses by park, and the results are summarize into a new field. This result is later imported to a tessellation layer using the tool "Spatial Join", establishing the highest value in the input fields. The final count is later reclassified according to the parameter.

PARAMETERS

Low <4, Medium 4-5, High >=6

4.2.3 Mobility

Speed limit *M1*

Regulating the speed of cars in urban areas is crucial for accident prevention.

Speed(km/h): Speed per section of street

DATA

Data needed: roads from *Lastkajen*.

Data processing: First the car roads are extracted into a new layer and reclassified into the parameters described below. Then a "Spatial join" is run to add this reclassification into the tessellation by intersection, maintaining the worst value available in each hexagon.

PARAMETER

Unsafe >60 km/h, Neutral 40-60 km/h, Safe < 40 km/h

Pedestrian ability to turn *M2*

The amount of different routes a pedestrian can take while being on a public space. It will affect their capability to run if a dangerous situation comes up. It will also define the connectivity of the spaces and their ability to know where they are.

Nturns (nturns): number of turns available per hexagon, that is a 200 m diameter

DATA

Data needed: same a *M1*

Data processing: First the pedestrian and cycling roads are selected and extracted into a new layer. Then the "Unsplit Lines" tool is run to merge coincident endpoints of lines so they do not count as intersections. Then, by the tool "Intersect", intersection points are created as the tool output.

The points are then summarize by hexagons using the tool "Summarize within". The values are then reclassified following the parameters. Regarding big parks, the analysis was done the same way, considering that, even though it is easier to get out of the paths and roads in the green areas, these terrains are not accessible and the conditions of the surroundings are not appropiate to ask for help (it is improbable to find other people in the woods compared to the paths and public spaces).

PARAMETER

In the reviewed literature, there was no established measurement parameter for this indicator. Therefore, it is established based on personal experience, taking the center of Umeå as an example. Here, the blocks are 100 meters wide, and 3 turns are determined every 100 meters, resulting in 6 within 200 meters (diameter of the unit hexagon). This measurement is considered high.

Low <4, Medium 4-6, High >6

Accessibility *M3*

Depending on the dimensions of the sidewalks and the slope of the sections, the following categories are established:

Excellent accessibility (slope <5% and sidewalks with more than 2.5 m wide)
Sufficient accessibility (slope between 5 and 8% or sidewalks less than 1 meter)
Insufficient accessibility (slope between 5 and 8% and sidewalks less than 1 meter)
Very insufficient accessibility (slope >8% and/or sidewalks less than 1 meter).

Aroads(%)= [pedestrian mobility area with sufficient or excellent accessibility / total pedestiran mobility area]

DATA

Data needed: in adition to the roads, the DEM (obtained from lidar points available in *SLU Geodata Extraction Tool*) is needed to calculate the slopes. Also the Open space layer is needed (self elaborated as explained in *PS1)*, in order to substract from it the parks and plazas to end up with the layer of pedestrian mobility areas.

Data processing: Calculate "Euclidean distance" using as feature source data the layer containing the buffered car roads, and defining as the "processing extend" the layer containing pedestrian mobility areas. This "pedestrian mobility layer" is define in that way because this analysis focus on the areas of the public space destinated to mobility, not having into consideration big parks or plazas, where the accessibility cannot be ensured homogeneously thorugh the space (think for example on a park, there can be inaccessible areas as long as the paths are accessible). The output raster from the "euclidean distance" tool is then reclassiffied according to the values above.

To analyse the slope, the tool "Surface Parameters" was used and then it was reclassified into three categories. The different categories were "Extracted by Attributes", converted to polygons and merged into layers using the tool "Interect" (to find

the common areas to both parameters) according to the categories explained above. Then, the two layers corresponding to "sufficient" and "excellent accessibility" were added to a tessellation using the tool "Tabulate Intersection" and the areas were divided into the total area of pedestrian mobility available per hexagon, to obtain percentage values.

PARAMETER

Bad <70%, Poor 70-90%of sufficient accessibility, Good accessibility 90%

4.2.4 Safety perception

Ilumination *SP1*

Public spaces must be well illuminated during dark hours. Illumination allows people to know where they are and to be seen in case of a dangerous situation.

Aillumination(%): [ground area reached by light bulbs/total public area per hexagon]

DATA

Data needed: Street lights obtained from *Umeå Energi* and *Umeå Kommun*, lidar points (to calculate DEM) obtained from *SLU Geodata Extraction Tool* and building footprints also from *SLU*. The base layer consists of the pedestrian street layer from *M3,* and in addition to it, the open public spaces layer from *PS1*.

Data processing: First, the streetlights data is edited to add height values for the light bulbs. This information was gathered through field work, estimating the height for the different types of lights existing in Umeå. In addition, another field is created and filled with light reach distance, meaning the illuminated area that is covered by each type of light, which was also gathered through field work.

Secondly, the tool "Buffer 3D" is run to calculate the illuminated areas (the buffer distance being the field containing the light reach distance), and the result is extracted from a layer containing the public space of Umeå using the tool "Intersect 3D", previously converting the public area polygon layer into a multipatch using the tool "Layer 3D to Feature Class". The remaining space consists of those areas that are poorly illuminated.

With "Tabulate Intersection" the areas of both public space and non-illuminated public space are calculated per hexagon of the tessellation. Then the percentage of illuminated areas can be calculated.

PARAMETER

Bad illumination <70% Poor illumination 70%-85% Good illumination <=85%

Visibility *SP2*

A visible environment is one that promotes the ability to see and be seen, to perceive and be perceived in space. The visibility is defined by how many area is hidden.

AHidden (%): [hidden area/total public space area per hexagon]

DATA

Data needed: roads, DEM and public space layer from previous analyses.

Data processing: First the 3d Buildings data has to be completed with missing areas. To do that the building height of the missing buildings needs to be extracted from the DSM (produced by the Lidar Points), using the Raster Calculator to subtract ground values ("DSM – DEM"). Then the mean height values are stored within the building footprint using the tool "Zonal Statistics" and the missing buildings are extruded and converted to multipatches to, in the end, merge with the 3d Buildings layer.

A "Viewshed" analysis is run using roads as observers. For the surface model, a raster layer containing the DEM and the 3D Buildings is created, by converting the 3D buildings into raster and then using the "Raster Calculator" to sum both rasters. The raster obtained is reclassified according to the classes described below. The results are imported to a tessellation by "Tabulate Intersection" tool. Also the public space area per hexagon is imported using the same method, in order to calculate the percentage of hidden areas per hexagon.

PARAMETER

Low visibility >50%, Medium visibility 50-10%, high visibility <10%

4.2.5 Urban morphology

Presence of greenery on public roads — *UM1*

Beyond an aesthetic criteria, the presence of trees contributes to the climatic comfort of the public space, acting as a mitigating element for extreme temperature conditions at street level. The trees increase the perception of the spaces as maintained and clean, and also increase the comfortability of a space.

PEgreen (%)= [public road surface covered by greenery / total public road surface]

DATA

Data needed: Trees from Open Data Umeå and pedestrian mobility areas from previous analyses.

Data processing: The trees are buffered with a distance of 5 m, as the average diameter of the tree tops in Umeå. The result layer is clipped to the extent of the pedestrian mobility areas. Then the data is joint into a tessellation layer using the tool "Tabulate Intersection", so the area of both tree-covered and total pedestrian mobility areas per hexagon is obtained. Then the percentages are calculated.

PARAMETER

Low <50%, Neutral 50-85%, High >85 %

Public/private space proportion — *UM2*

The availability of public space directly impacts access to communal areas for social interaction. In areas with limited public spaces, fostering a sense of community becomes challenging, and informal surveillance tends to decrease.

PRca (%)= [public space area / total area per hexagon]

DATA

Data needed: public space area from previous analyses

Data processing: The "Tabulate Intersection" tool is used to calculate the are of public space per hexagon.

PARAMETER

Insufficient <25% , Neutral 25- 50%, High proportion > 50 %

4.3 CROSSING DATA: A MIXED METHODS APPROACH

Upon concluding all analyses, the results must be synthesized into a unified map. Initially, this entails merging all GIS analyses into a single map, representing and normalizing the values across the board. Subsequently, data from the survey is incorporated into the map.

4.3.1 Merging GIS Analyses

All analyses are spatially represented using a uniform hexagonal grid (tessellation) and are stratified into three discrete categories: positive, neutral, and negative values. To merge these analyses into a comprehensive map, a reclassification approach is undertaken, assigning numerical values to each category. Negative values are assigned a nominal value of 0, while neutral values receive a designation of 1, and positive values are denoted with a value of 2. The concept is that places deemed safer according to the studied indicators exhibit higher category values across multiple analyses.

A complexity arises when conducting this merge. Certain hexagons lack applicable data for specific analyses, specifically those regarding the indicators U1, PS2, PS3, M1 and UM1. For example, hexagonal units corresponding to uninhabited areas of the city exhibit null values in U1. Imposing a value of 0 on these units would disproportionately penalize such regions, as they lack the opportunity to attain the same values as those with available data. To mitigate this bias, a normalization strategy is adopted, whereby hexagonal units are divided by the number of analyses with available data. Consequently, the resultant values are expressed as ratios rather than absolute counts. This strategy is followed both to create the synthesis of each category and the synthesis of all the analyses.

All the outputs from the GIS Analyses can be found as an *Appendix 2* to this thesis. The summarized result for each category (Facilities, Public Spaces, Mobility, Safety Perception and Urban Morphology) and the synthesis map will be discussed in the Results section.

4.3.2 Survey results processing

Once the GIS analyses have been summarized, the survey data needs to be incorporated. In this scenario, three distinct maps are generated from the survey. The first map marks locations where individuals have encountered or witnessed violent incidents. The second map indicates areas identified as unsafe by respondents, while the third displays safe locations. These three maps will be merged into a single map, consolidating the factors influencing respondents' identification of safe and unsafe areas into simplified categories.

The data acquired here enables the verification of the accuracy of GIS analyses concerning perceptions of (un)safety. It facilitates comparison between the safe and unsafe areas identified through GIS analyses and those pinpointed through the survey responses. Additionaly, these data could be added to the sinthesis map by summarizing the values through weighted values, becoming an active part in determining the values of each hexagon. However, the reasons behind the placement of some marked points in the surveys are highly subjective, and their influence on the final results should be weighed, especially given the limited number of responses. This is not a significant sample of the population of Umeå, and a generalized perception of safety or insecurity cannot be determined.

4.4 METHODOLOGICAL CONSIDERATIONS

4.4.1The use of maps as a method of work and analysis

The representation of results in maps provides an additional dimension to the analysis. It comprehensively adds spatial dimension, allowing for an understanding of the diversity of results and their distribution across the territory. Maps enable the quick identification of hot and cold spots through simple symbology such as the use of choropleth maps, as is the case in this work. They facilitate identifying areas of the territory where it is interesting to intervene in improving the analyzed indicators and are accessible from a communicative standpoint. With the right labeling and contextual symbology, maps become a colloquial tool familiar to a large part of the population.

4.4.2 Regarding GIS Analyses

Several challenges and limitations were faced in developing the analyses. In GIS analyses, some indicators were discarded due to data inaccessibility, while in others, like visibility analysis, hardware processing capacity was tested, necessitating

measures such as splitting and reassembling analyses to fulfill the expected results.

In synthesizing maps, a challenge was to avoid penalizing any area unfairly due to uneven distribution of urban fabric factors. Normalization was employed to ensure fair results by counting applicable analyses in each cell and normalizing sums accordingly. However, this method presents certain considerations worth mentioning. Hexagons without data should not be penalized, so they are not assigned a value of 0 (referring to negative values). However, in the normalization process, there are occasions where a hexagon without data may show higher values than another hexagon with data, which has a neutral value of 1, due to the division process by the total number of analyses applied to each hexagon. This flaw is reduced as the denominator increases, which is why in the synthesis map of all analyses, this normalization process is carried out by giving equal weight to all indicators and not considering categorizations: all values for all analyses are summed and divided by the total number of analyses.

The grid itself also poses a limitation on the analysis. Due to computer processing capacity, analyses couldn't be done pixel by pixel. The issue with the grid is that it generalizes values within each grid cell, which in this case is 30000 m2. If tools like "summarize within" are used, points are summed based on their nearest position, but their real distribution may not necessarily correspond to the contrast presented by the grid. However, the grid offers other advantages, such as dividing urban space into constant areas that allow for mathematical measurement of the variables studied, which led to its use despite the limitations of the analysis.

4.4.3 Regarding survey analysis

Regarding the survey, the biggest limitation was outlined in the introduction section, which is the time factor. The survey's scope was not going to achieve a representative sample of Umeå's population, both due to targeting vulnerable groups and lacking the necessary social tools to reach the true diversity of the territory. As expressed in the *Participative Analyses* (4.1) section, not translating the survey to other languages, especially swedish, has probably been a limiting factor for some potential respondents to not participate, especially within older groups and newly arrived migrants or asylum seekers. However, it remains pertinent to include the results obtained in the results section, as they offer significant insights that reinforce the intersectional perspective of the analyses.

4.4.4 Ethical considerations derived from survey data

As it was an anonymous survey, the privacy of the respondents was ensured throughout the process. The personal information obtained from the survey was limited to the gender and age of the respondents, allowing for the segregation of results into different groups. All data collected in the survey was voluntary, and care was taken to explain the purposes of the survey at the beginning, including contact information in case of any questions.

While the collection of sensitive data regarding origin and sexual orientation could have been added, as they are interesting characteristics from an intersectional perspective, it was decided to forego this option to facilitate the processing of results and the need for obtaining signed permissions.

4.4.5 Lack of qualitative data

The most comprehensive definition of a mixed-method approach includes qualitative analysis. Initially, conducting safety audits was considered to complement this work with a qualitative dimension. However, the short duration of the project made it impossible to carry out these workshops. Interviews could also have been conducted. In both cases, subsequent processing of the results would have been necessary, and this process should have been included in the methodology.

Surveys were the closest to qualitative data collection, but the delimitation of responses (many of which were not open-ended but defined within various options or rankings) means that it cannot be considered a qualitative analysis.

5. Results

This section provides an overview of the findings derived from the two data sources outlined in the Methodology section. Initially, it delineates the results obtained from the survey, accompanied by a synthesis map depicting pertinent geographic information. Subsequently, it presents the results derived from summarizing the outputs of the various analyses conducted in GIS, categorized into the five general areas: facilities, public space, mobility, safety perception, and urban morphology. Each map is supplemented with a concise reflection, minimising the textual content of this section to a reflective summary of the diverse analyses conducted.

Finally, a synthesis map encapsulating all analyzed categories in the GIS analyses will be juxtaposed with the survey response mapping, aiming to ascertain the presence of a relationship between both datasets. It is expected that there will be certain common behavioral patterns between both sets of results that somehow complement each other to provide a more accurate description of the complexity of the coexisting realities in the territory.

5.1. RESULTS FROM SURVEY

As collected in the previous section, the survey yielded 42 responses, with 62% identified as women, 31% as men, and 7% as non-binary. In the subsequent section, the survey results will be presented, delineating the disparities between genders as well as between the local population and newcomers.

5.1.1 (Un)Safety perception Survey

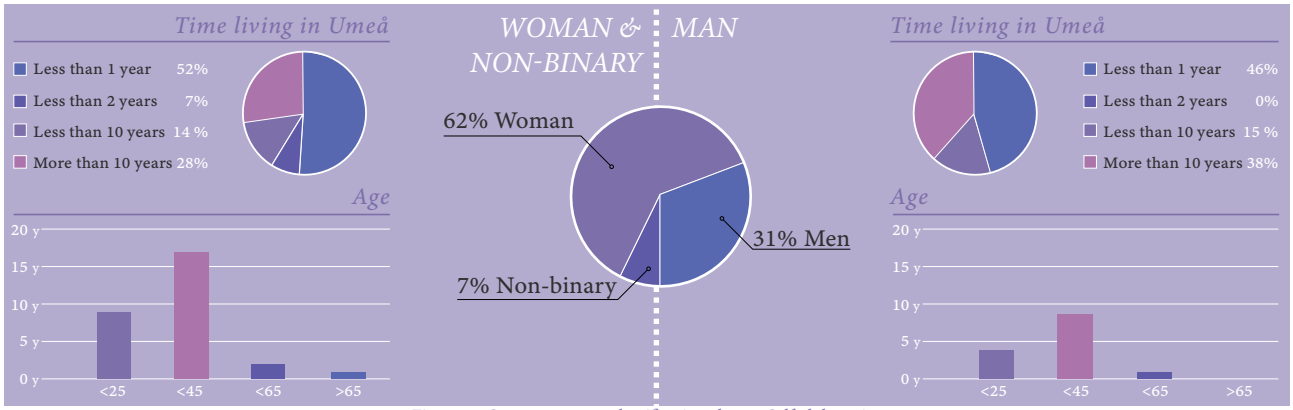


Figure 15. Survey response classification charts . Self-elaboration

The profile of respondents regarding their time living in Umeå is quite similar (See ***Figure 15***). The majority of responses come from individuals who have spent a short time in Umeå; only 28% of women& non-binary and 38% of men can be considered as locals. The most common age in both cases is less than 45 years, allthough the profile with women & non-binary is more diverse.

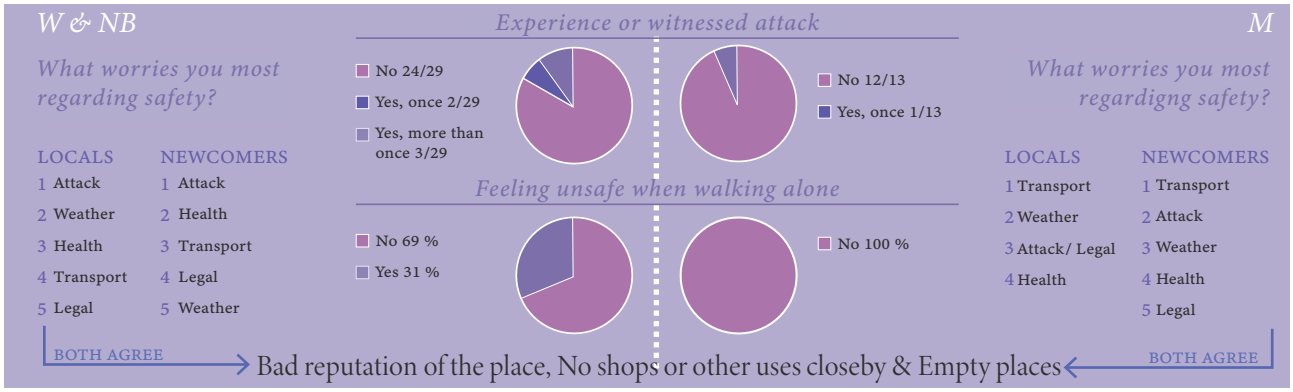


Figure 16. Survey responses regarding Unsafety perception. Self-elaboration

Gender differences become evident when discussing perceptions of unsafety (See ***Figure 16***). While no men report feeling unsafe when walking alone, this figure rises to 31% among women and non-binary, with 5 of them having experienced violence themselves. When defining the concepts of urban (un)safety and the factors influencing it, women and

non-binary prioritize fear of physical attacks and violence as the most significant, whereas men prioritize issues related to traffic. Women and non-binary also prioritize health-related concerns more than men, who identify it as the least worrying concept. This difference could be led to the social belief that categorize men as the strong/powerful gender and woman as the vulnerable, that could translate into a sense of security or control over men's own body while creating insecurities or more concern over women's thoughts about their own body. Problems related to weather conditions rank higher for the local population of both groups. However, there seems to be a consensus that a place is perceived as unsafe primarily due to its bad reputation, but also if it lacks uses and services and appears deserted.
In the survey, respondents were asked to rank how safe they feel in specific situations (for example, returning home from work or waiting for the bus). Both groups agree that using public transportation and waiting for the bus are the riskiest situations, but in terms of percentages, it contrasts that 35% of women and non-binary individuals identify feeling insecure in these situations compared to 8% of men. An interesting fact is that 27% of non-local men and 38% of non-local women and non-binary state that they do not have means to ask for help if something happens in public spaces. Many comments refer to not knowing emergency numbers or the location of help centers. Therefore, lack of knowledge is identified as a major enemy of urban safety and security.

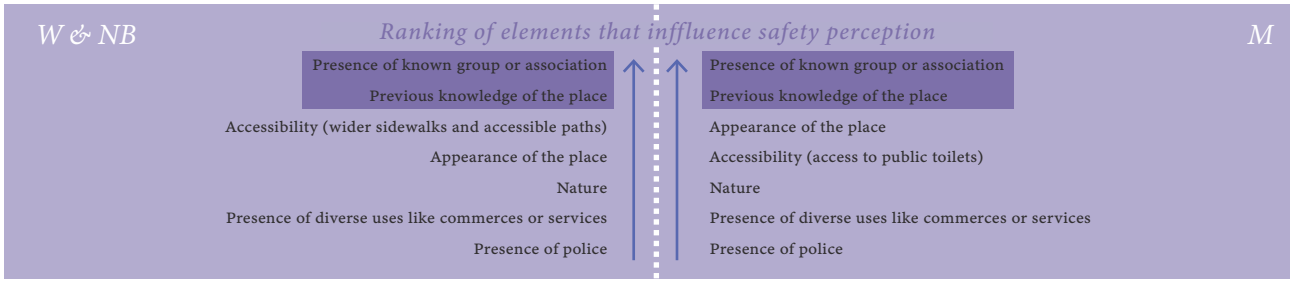


Figure 17. Survey responses regarding Safety perception. Self-elaboration

Both groups prioritize proximity to familiar groups or associations as the primary factor contributing to a sense of security, followed by familiarity with the area (see ***Figure 17***). Both groups also agree on the importance of accessibility, but women and non-binary focus more on wider streets and accessible paths, while men prioritize access to public toilets. Additionally, both groups regard the presence of nature as crucial for feeling safe and comfortable in public spaces, although women and non-binary individuals emphasize the importance of appearance more. Interestingly, the variety of available uses and the presence of police rank lower. This is noteworthy because, concerning perceptions of insecurity, the presence of diverse activities and a sense of belonging are identified as among the most important factors.

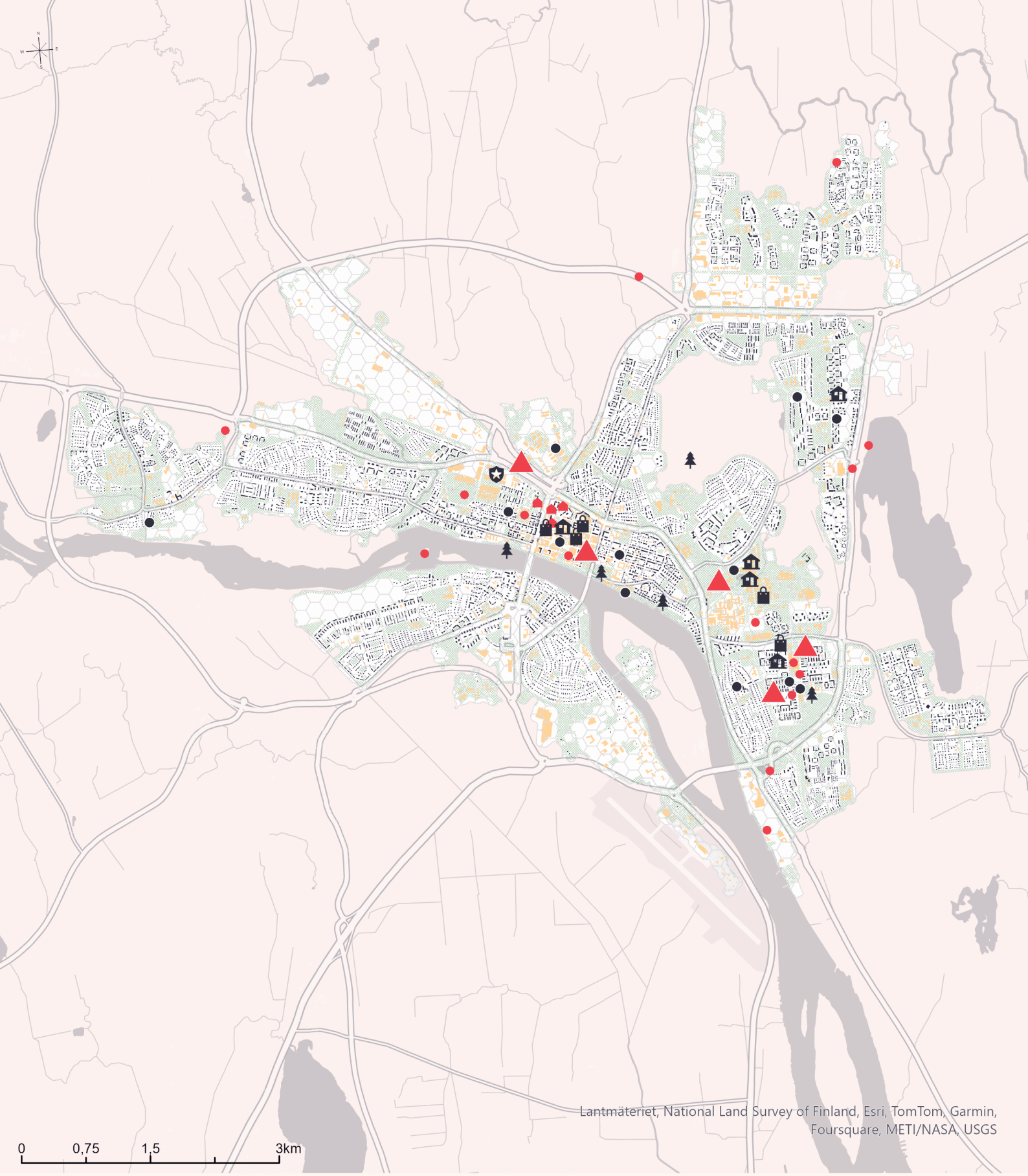
In the final section of the survey, respondents were given the opportunity to address additional aspects they deemed important or worthy of inclusion. It was intriguing to note numerous comments regarding the accessibility of streets during the winter season and other issues related to snow management. Some comments drew attention to the increased police presence in the vicinity of Ålidhem, with two comments specifically linking police presence to the development of student basement parties. Several comments also mentioned "drunk students" as a frequent issue in Umeå, and 3 individuals spoke about the lack of community life.

5.1.2 Survey-based maps

Three of the survey questions involved pinpointing areas on a map. The first question focused on places where respondents had experienced or witnessed violent situations, while the subsequent maps were dedicated to identifying safe and unsafe areas. Respondents were asked to describe the different points marked on the maps, enabling a further classification into broader categories. See ***Figure 18*** for transcription of survey responses regarding map questions.

As demonstrated by the analysis of the survey results, many of the points marked as safe are related to a sense of belonging, with comments such as "it's where my home is" or "my neighborhood," and also menctioning the safety generated by being familiar with the area. Other points reward high activity and a wide variety of uses, many of which are located in the city center and in the center of Ålidhem.

Regarding the unsafe points, it is interesting that many are located in the same areas that others mark as safe zones. Comments mention areas under construction or unfinished, parking lots, and spaces that do not encourage walking alone in the middle of the night, or the presence of other drunk individuals seeking attention. However, many unsafe points are also located in the urban periphery, such as in the north of Ersboda, industrial areas, Umedalen, or Nydala. Several comments refer to empty and poorly lit paths in these cases. Points where violent acts have occurred are also located, again, in the vicinity of the city center and Ålidhem.



SURVEY-BASED MAP

Results from map surveys regarding responses about safe and unsafe areas

- *Residential buildings*
- *Industrial and others*
- *Public buildings and services: urban infrastructure*
- *Open land and forest*
- *Water bodies*

Safety perception

- *Active spots and uses available*
- *Sense of belonging*
- *Safety nature*
- *Presence of police*
- *Other (not defined)*

Unsafety perception

- *Places where violent situations have happened*
- *Building sites*
- *Unsafety walking alone or in dark*

In the survey, participants were asked to explain why they marked certain points. This allowed for classification into different categories. For safe points, many people mentioned feeling secure due to familiarity with the area, seeing it as home. Additionally, mixed-use and active areas, nature, and the presence of police were cited as factors contributing to safety. In the case of unsafe spaces, one category represents points where certain responses indicated experiences of violence. However, the majority referenced feeling unsafe when walking home alone at night.

Figure 18. Survey-based map. Self-elaboration

5.2. RESULTS FROM GIS ANALYSIS

This section presents synthesis maps for each of the 5 categories studied in the analyses conducted using ArcGIS Pro. Specific results for each indicator within each category are documented in ***Appendix 2.*** Finally, a synthesis map of all categories is included, representing the final outcome of the GIS analyses. After interpreting the results, a comparison will be made with the data obtained through the survey, thus analyzing the degree of accuracy or discrepancy between the more quantitative aspect of the study and the more qualitative part.

5.2.1 Results from categories

Overall, Umea's urban landscape fosters an active environment with strategically placed activity nodes spread across the city. As shown in *Figure 19*, the modernity of its urban fabric is evident and its layout distribute these nodes throughout the territory, displacing non-mixed industrial activities to the periphery, while nature and public spaces intermingle with residential designs. Residential neighborhoods are framed by community parks or connecting roads, allowing for alternative modes of transportation besides private vehicles.

Access to quality public spaces is vital for urban safety, promoting community life, health, and recreational opportunities. While Umeå boasts well-designed urban layouts with broad avenues and green spaces, challenges exist, particularly in the city center, where densification limits public space availability, and in industrial areas. As seen in *Figure 20*, in terms of green space accessibility, Umeå has a fairly distributed network, with large community parks between neighborhoods that offer various services and amenities, ensuring a safe and active environment. Yet, central areas of the neighborhoods often have limited access compared to the periphery, largely due to higher urban density limiting green space availability. However, other amenities like schools or local commerce could offset this limitation, promoting community development.

Regarding access to amenities and services, Umea's design is generally praised, but not flawless (See *Figure 21*). The development of low-density residential areas, reminiscent of North American suburban models, poses challenges in ensuring safe access to all daily necessities, as they are designed from a car-centric perspective rather than a pedestrian one. Areas like southern Grubbe and eastern Tomtebo, with limited access to services, experience lower activity levels, potentially triggering feelings of unsafety, especially among unfamiliar individuals. Peripheral industrial areas and neighborhoods like northern Berghem and Ersboda also lack mixed-use amenities and necessitate travel for access, prioritizing vehicular mobility over pedestrian comfort. However, these areas are less concerning due to their non-residential nature.

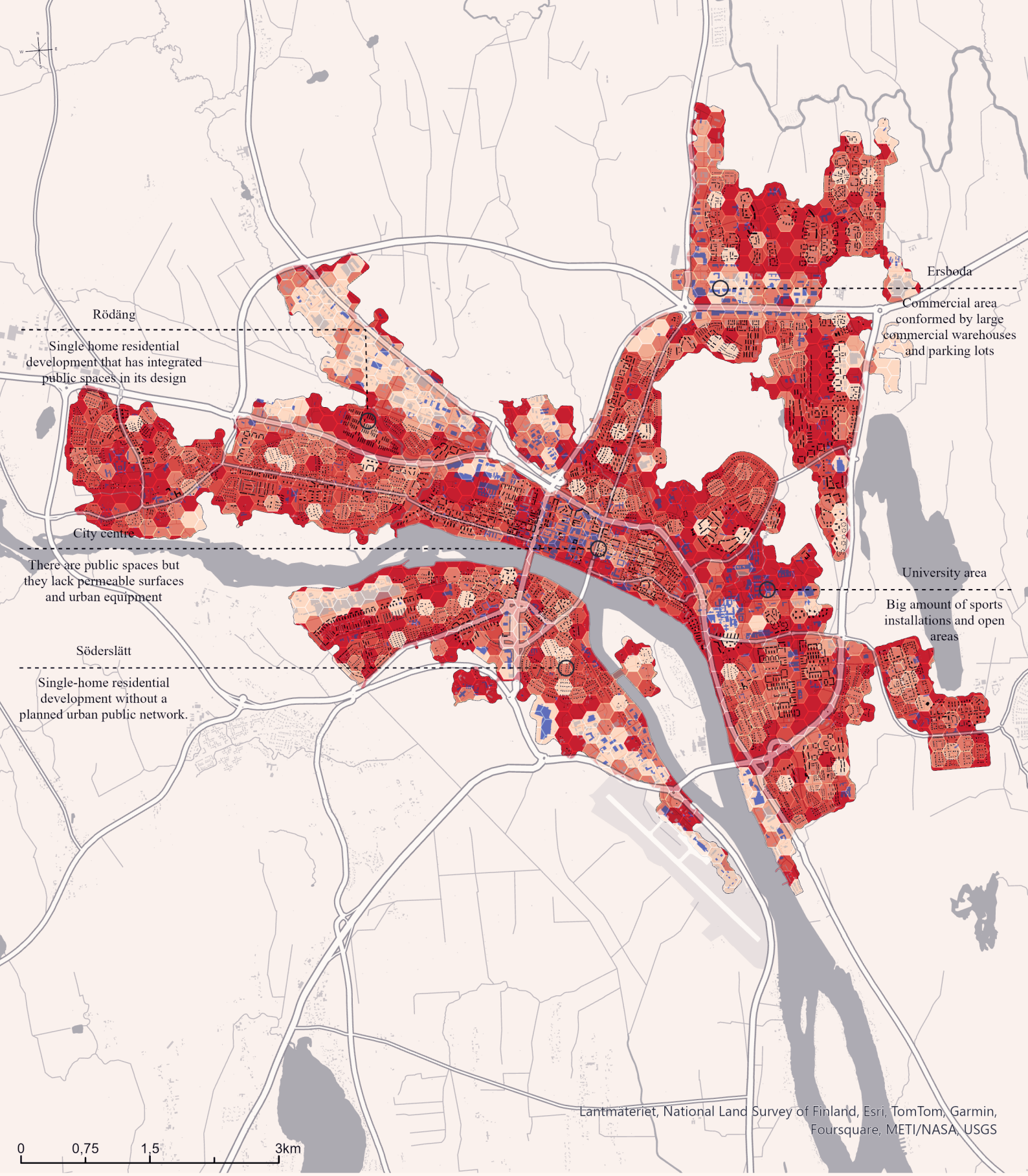
While analyzing mobility shown in *Figure 22*, Umeå's urban layout prioritizes pedestrian safety with safe, accessible, and car-free routes. However, areas near major roads pose higher risks due to car speed and pollution, impacting people's safety perception. Despite a shift towards car-free spaces within neighborhoods, it's important to focus on accessibility measures ensuring safe spaces for all. Therefore, the design of green urban spaces, including semi-private ones within residential complexes, must ensure safe and connected pedestrian paths.

Regarding urban elements directly influencing unsafety perception collected in *Figure 23*, Umeå exhibits a suitable design, minimizing hidden or dark areas. The areas presenting more issues are in parks, but given their natural surroundings, it's understood they cannot adhere to the same standards as urban central areas. Also industrial areas present worse urban design and less care, since they are not design based on the pedestrian experience.

5.2.2 Synthesis map

The synthesis of the analyses (See *Figure 24*) shows a fairly consistent result. The normalization process ensures that no area is unfairly penalized, allowing for the integration of analyses encompassing different urban infrastructures. Areas with higher ratios are located in the central zones of various neighborhoods of Umeå, notably the Center and its eastern and western surroundings, the university area of Ålidhem, and the residential neighborhoods of Mariehem, Carlshöjd, Rödänd, and Umedalen.

Less consistent are the results in the Haga area, which exhibit clear contrasts possibly due to the grid configuration and territorial cuts, as well as the homogeneous urban design characterized by parallel streets. Söderslätt also stands out for a center with a lower ratio, possibly due to the homogeneity of its urban fabric, consisting of private plots and limited community development. The Ön area is undoubtedly the residential area with the lowest urban quality in terms of the parameters studied, contrasting with the reality of single-family homes with high purchasing power, yet requiring transportation for daily activities. These areas could pose a problem in terms of safety perception, especially for those unfamiliar or new to the environment. Limited community development mechanisms hinder the development of a sense of belonging, which is a key characteristic for perceiving an environment as safe.



SYNTHESIS OF URBAN MORPHOLOGY ANALYSIS

UM

Accessibility to public spaces and greenery through condensed areas

- *Public buildings and services: urban infrastructure*
- *Residential buildings*
- *Other buildings (e.g. industrial)*
- *Water bodies*

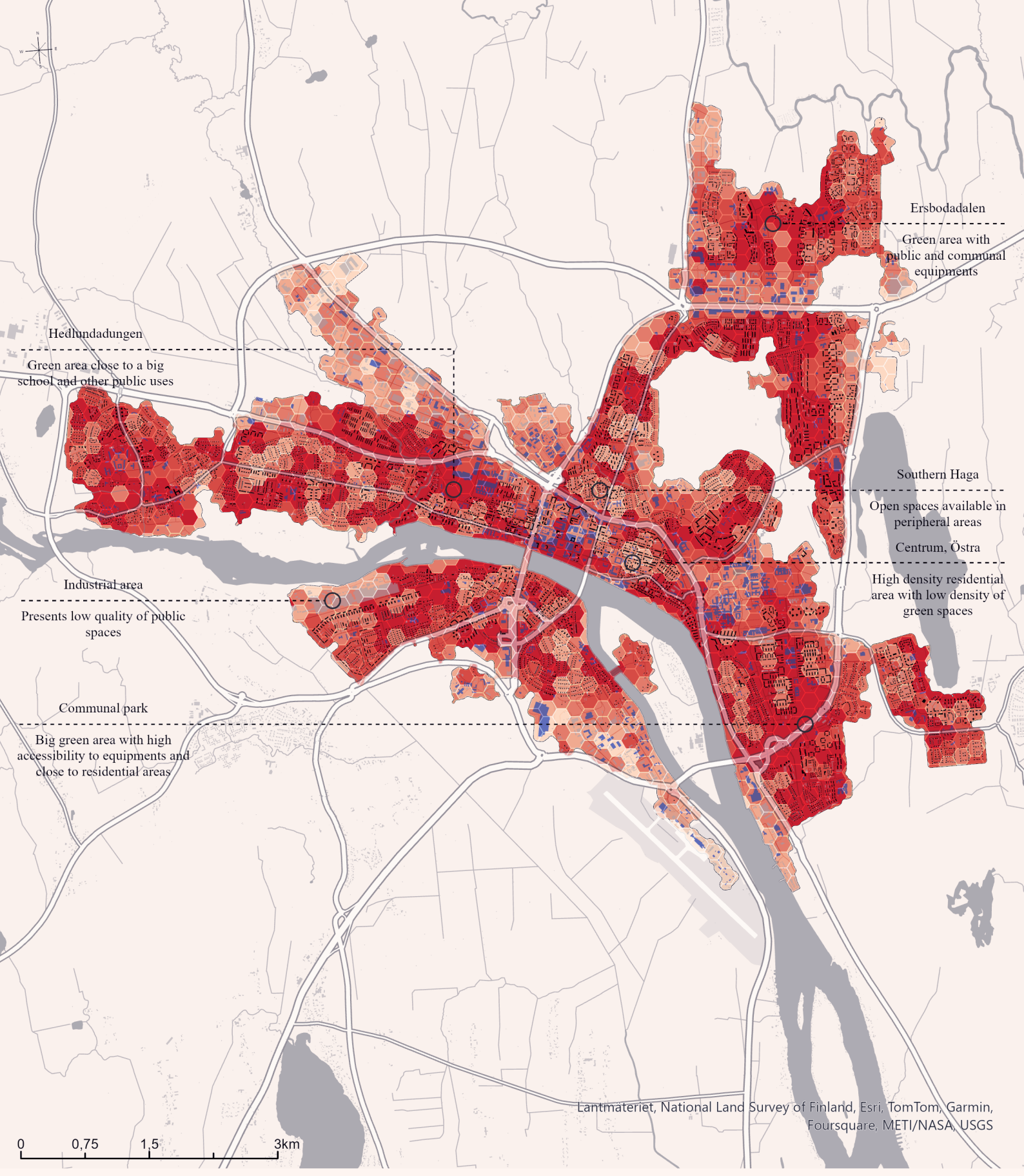
Access to quality public spaces is crucial for urban security for several reasons. Firstly, it fosters community life, promoting a sense of belonging and facilitating the formation of support networks. Secondly, it enhances the overall health of the urban environment. And thirdly, it offers a range of recreational activities and amenities accessible to residents. Umeå boasts a well-designed urban layout, featuring broad avenues and designated areas for parks and green spaces. However, the city center lags behind other areas in terms of public space availability, mainly due to urban densification and extensive paving, which may pose challenges if further densification occurs. Peripheral residential developments, characterized by single-family homes, also suffer from a lack of public spaces and amenities, necessitating residents to travel for access. Moreover, peripheral commercial areas near industrial zones prioritize vehicular mobility over individual comfort.

Quality of urban morphology

- *Low access - Ratio ≤ 0*
- *≤ 0.5*
- *Medium access - Ratio ≤ 1*
- *≤ 1.5*
- *High access - Ratio ≤ 2*

Ratios are calculated by summing the values of the categories from analyses UM1 and UM2 and subsequently dividing that value by the number of applicable analyses per hexagon. This adjustment accounts for hexagons lacking analyses due to a lack of data like public space.

Figure 19. Map containing urban morphology analysis. Self-elaboration



SYNTHESIS OF PUBLIC SPACE ANALYSIS

PS

Accessibility and equipment offered by different types of public spaces

- *Public buildings and services: urban infrastructure*
- *Residential buildings*
- *Other buildings (e.g. industrial)*
- *Water bodies*

The accessibility to urban green spaces in Umeå is fairly well distributed throughout the territory. Notable are large community parks located in the intermediate spaces between neighborhoods. In general, a clear pattern is observed where the central area of the neighborhoods has lower access to green spaces, which increases as one approaches the periphery.

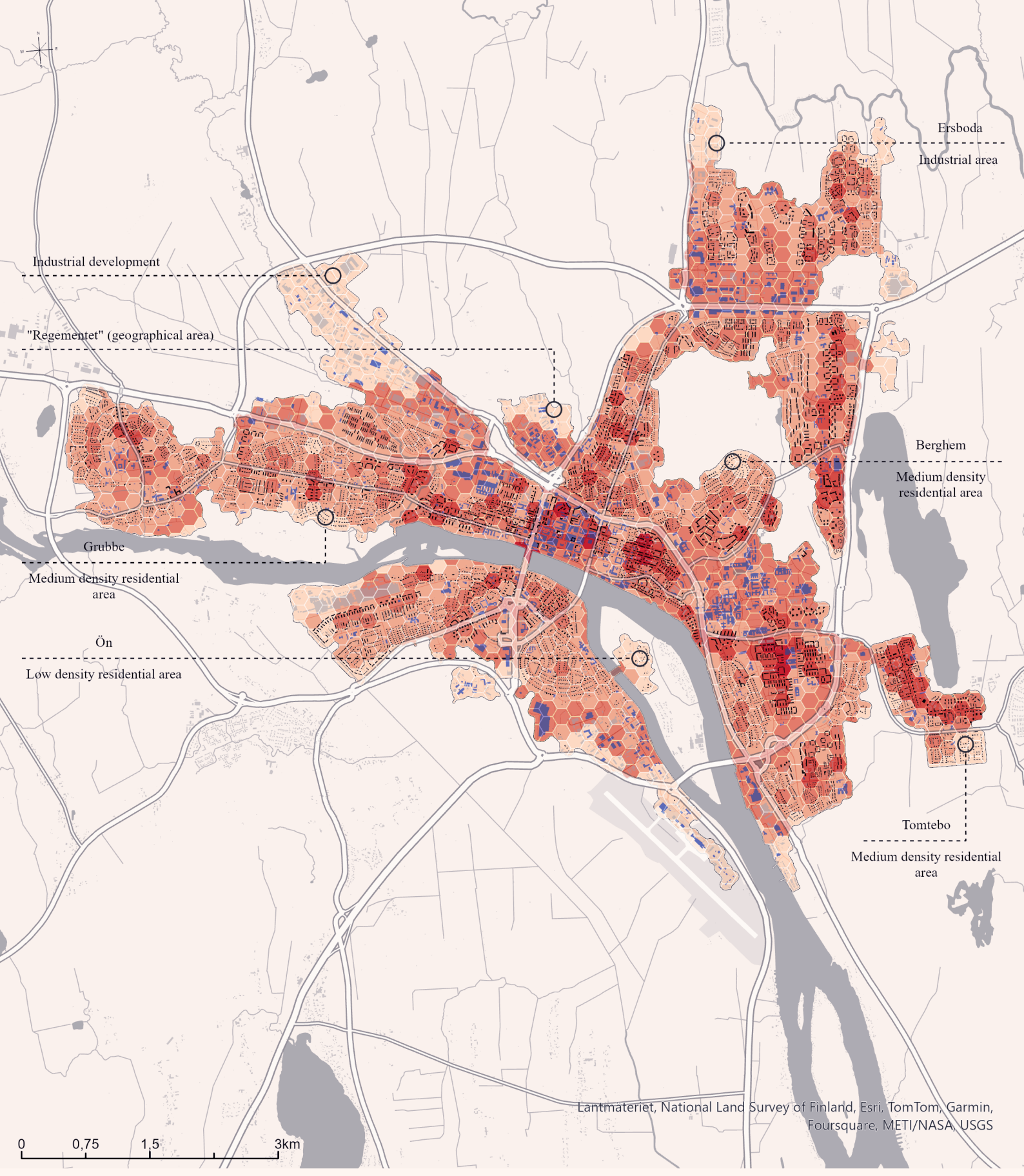
The city center and its surroundings exhibit higher urban density, limiting access to green spaces. These conditions could be compensated for by the existence of other amenities such as schools or everyday commerce, which could offer spaces for socialization and community development.

Access to quality public spaces

- *Low access - Ratio ≤ 0*
- *≤ 0.5*
- *Medium access - Ratio ≤ 1*
- *≤ 1.5*
- *High access - Ratio ≤ 2*

Ratios are calculated by summing the values of the categories from analyses PS1. PS2 and PS3, and subsequently dividing that value by the number of applicable analyses per hexagon. This adjustment accounts for hexagons lacking both analyses due to a lack of resident population or green areas.

Figure 20. Map containing public space analysis. Self-elaboration



SYNTHESIS OF LAND USE ANALYSIS

U

Accessibility to mixed-use areas and dense residential fabric

- *Public buildings and services: urban infrastructure*
- *Residential buildings*
- *Other buildings (e.g. industrial)*
- *Water bodies*

Overall Umeå presents a balanced use distribution that translates into an active and dynamic urban fabric. There are activity nodes distributed through the whole urban area, specially in the areas between the city centre and the university.

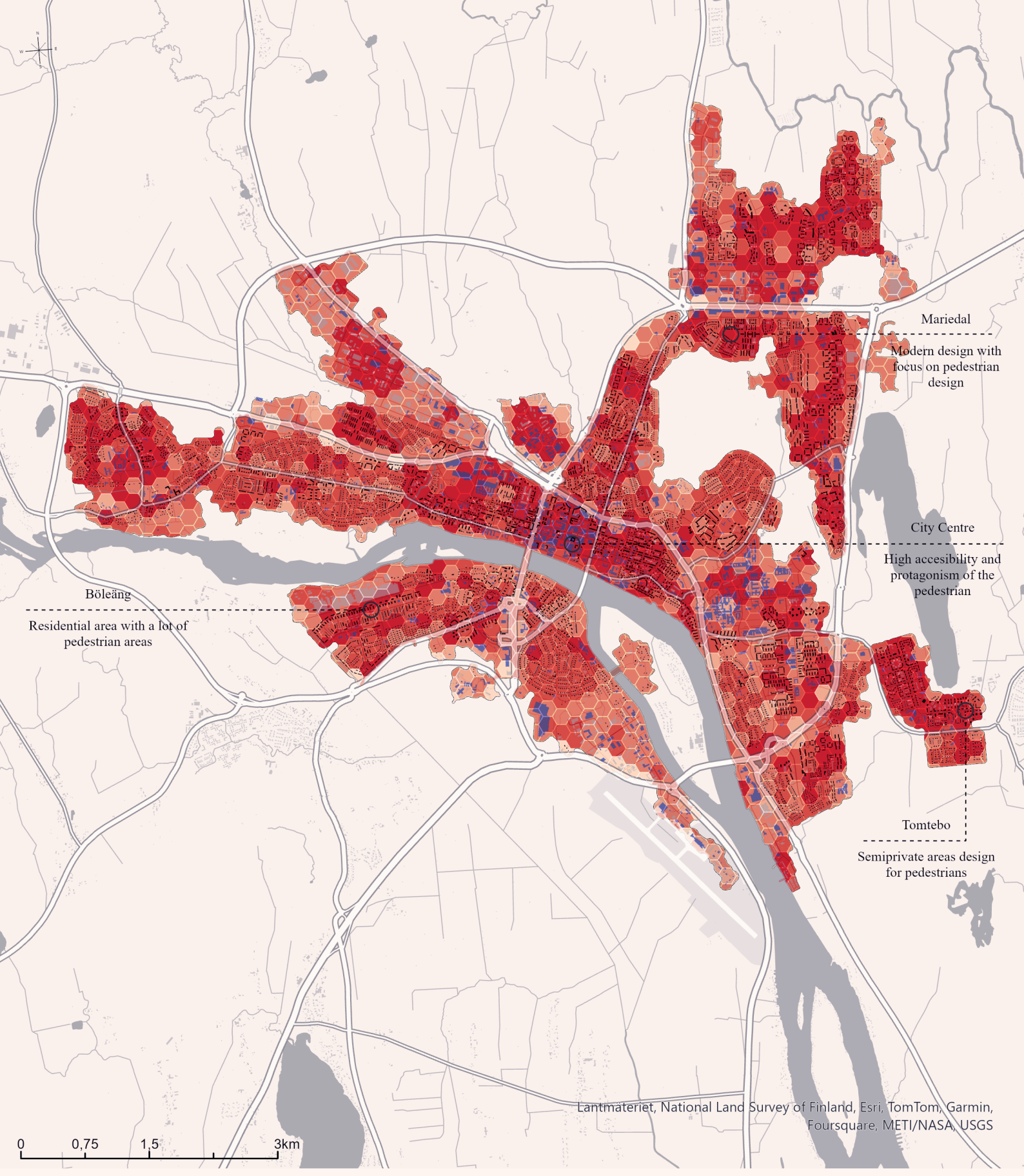
Concerning are some areas in the limits of the urban area, as in southern Grubbe, Ön or eastern Tomtebo. These areas are low-density residential areas and have low access to everyday uses and services, so the level of activity is low. Other areas as northern Berghem, northern Ersboda and the big industrial areas, also present low access to mixed use but since they are not residential areas their situation is not as concerning.

Access to everyday uses & services

- *Low access - Ratio ≤ 0*
- *≤ 0.5*
- *Medium access - Ratio ≤ 1*
- *< 1.5*
- *High access - Ratio ≤ 2*

Ratios are calculated by summing the values of the categories from analyses U1 and U2, and subsequently dividing that value by the number of applicable analyses per hexagon. This adjustment accounts for hexagons lacking both analyses due to a lack of resident population.

Figure 21. Map containing land use analysis. Self-elaboration



SYNTHESIS OF MOBILITY ANALYSIS

M

Accessibility of the road network, speed limits related to security and ability to turn and change direction

- *Public buildings and services: urban infrastructure*
- *Residential buildings*
- *Other buildings (e.g. industrial)*
- *Water bodies*

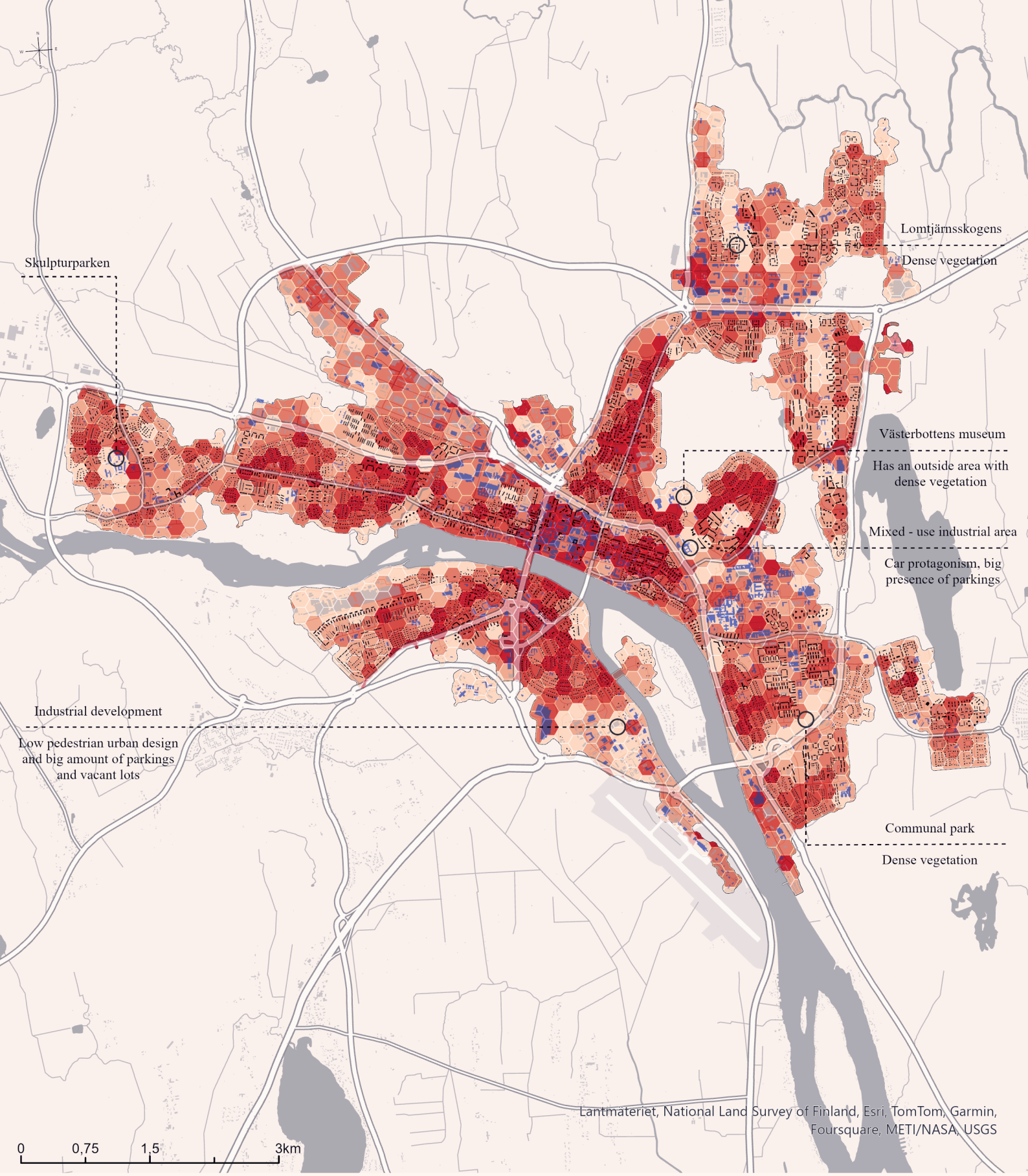
The urban fabric configuration of Umeå largely protects pedestrian activities by offering safe, accessible, and alternative routes to private vehicles. In areas near Umeå's main connecting routes with the rest of the Swedish territory, there is a higher risk due to car speed and the noise and air pollution they produce. Within neighborhoods, there is a trend towards car-free spaces designed for pedestrian socialization. However, it is important to be careful with accessibility guidelines because simply removing cars is not enough to create a safe space for residents.

Access to everyday uses & services

- *Low access - Ratio ≤ 0*
- *≤ 0.5*
- *Medium access - Ratio ≤ 1*
- *≤ 1.5*
- *High access - Ratio ≤ 2*

Ratios are calculated by summing the values of the categories from analyses M1 M2 and M3, and subsequently dividing that value by the number of applicable analyses per hexagon. This adjustment accounts for hexagons lacking analyses due to a lack of data like streets.

Figure 22. Map containing mobility analysis. Self-elaboration



SYNTHESIS OF SAFETY PERCEPTION ANALYSIS

SP

Street lighting, visibility and maintenance of public spaces

- *Public buildings and services: urban infrastructure*
- *Residential buildings*
- *Other buildings (e.g. industrial)*
- *Water bodies*

The areas with the worst conditions in terms of urban characteristics that contribute to a safer perception of space are primarily industrial zones and parks. Industrial areas are designed prioritizing automobiles over pedestrians, resulting in limited development and general maintenance of public spaces. The car parks that occupy a large part of these areas appear desolate and dark. Regarding parks, although they may have good lighting conditions, the areas covered by trees obviously cannot be adjusted to optimal lighting and visibility conditions.

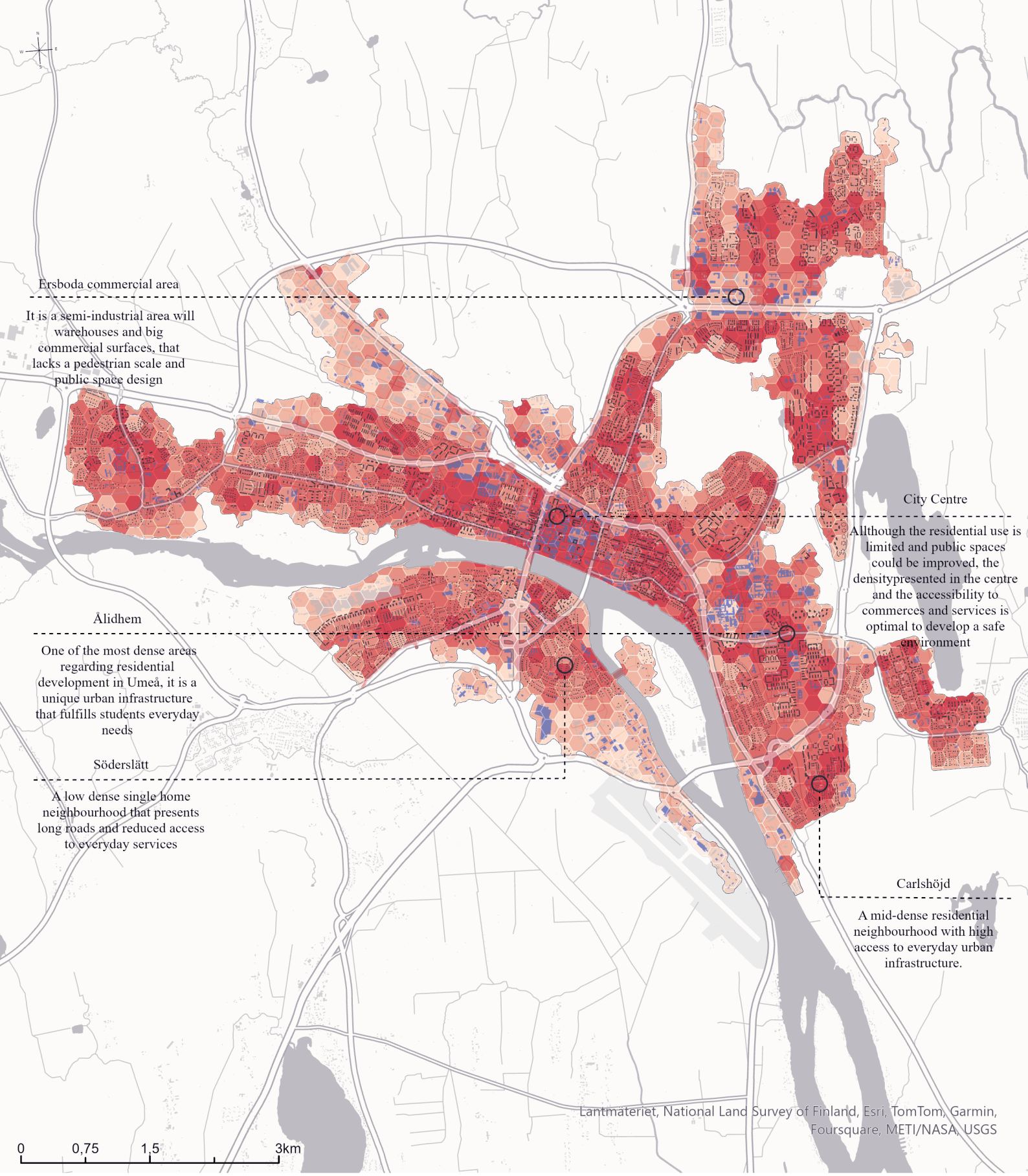
Areas of medium to high residential density present an average ratio, as there is often reliance on the informal surveillance provided by the apartments themselves for semi-private spaces. However, these areas lack visibility from main roads, and their lighting is somewhat limited.

Urban safety perception elements

- *Low access - Ratio ≤ 0*
- *≤ 0.5*
- *Medium access - Ratio ≤ 1*
- *< 1.5*
- *High access - Ratio ≤ 2*

Ratios are calculated by summing the values of the categories from analyses SP1 and SP2, and subsequently dividing that value by the number of applicable analyses per hexagon. This adjustment accounts for hexagons lacking both analyses due to a lack of data available.

Figure 23. Map containing urban safety perception analysis. Self-elaboration



URBAN SAFETY AND SECURITY SYNTHESIS ANALYSIS PLAN

Synthesis of GIS Analysis regarding Uses, Public Space, Mobility, Safety Perception and Urban Morphology

- *Public buildings and services: urban infrastructure*
- *Residential buildings*
- *Other buildings (e.g. industrial)*
- *Water bodies*

The analyses' synthesis yields a fairly consistent result. Normalization ensures no area is unfairly penalized, allowing integration of analyses covering different urban infrastructures. Higher ratio areas are predominantly central zones of various Umeå neighborhoods, notably the Center and its eastern and western surroundings, Ålidhem's university area, and residential neighborhoods like Mariehem, Carlshöjd, Rödänd, and Umedalen. Less consistent are Haga's results, displaying clear contrasts possibly due to grid configuration, territorial cuts, and homogeneous urban design with parallel streets. Söderslätt also stands out for a lower ratio center, likely due to its homogeneous urban fabric with private plots and limited community development. Ön, undoubtedly, has the lowest urban quality in terms of studied parameters, despite featuring single-family homes with high purchasing power, necessitating transportation for daily activities.

Figure 24. Synthesis map. Self-elaboration

Urban safety and security accessibility

- *Low access - Ratio ≤ 0*
- *≤ 0.5*
- *Medium access - Ratio ≤ 1*
- *≤ 1.5*
- *High access - Ratio ≤ 2*

Ratios are calculated by summing the values of the categories and subsequently dividing that value by the number of applicable analyses per hexagon. This adjustment normalizes the values to prevent results that penalize certain areas of the territory because of lacking data.

5.2.3 Comparative from GIS Analaysis and survey-based maps

As shown in *Figure 25*, the comparison between both analyses highlights the importance of incorporating qualitative analyses that reflect the knowledge and opinions of diverse profiles. What may theoretically be categorized as an optimal area, in this case, safe areas, may not accurately reflect the complexity of society, and its theoretical simplification could lead to errors.

These issues are evidenced by the contradiction between safe and unsafe areas on the map. While many areas coincide in their location, individuals may focus on different elements of urban design, leading to varied perceptions and definitions of urban safety and security. These discrepancies, especially notable in Umeå city center and the commercial center of the Ålidhem neighborhood, suggest that certain common characteristics trigger diverse opinions regarding safety perception.

For instance, areas with medium-high urban density and access to a wide range of uses may provoke varied reactions. The constant activity in public spaces could lead to the development of activities perceived as unsafe, such as nightlife and alcohol consumption. However, diversity of uses and accessibility foster inhabitants' inclusion in their environment, promoting a sense of safety and a secure environment.

As mentioned in the survey results section, it is intriguing that the ranking of elements leading to feelings of safety differs from those contributing to feelings of unsafety. This discrepancy may provide insights into avoiding seemingly contradictory results. Perhaps the study of urban safety should be approached separately from the study of urban unsafety. Thus, areas of high density, from an urban design perspective, are identified as hotspots, both in terms of safety and unsafety.

Regarding other areas on the map, GIS analysis accurately represents the perception of (un)safety in the territory. Peripheral or low-density areas with high privatization of space appear as less safe areas. However, a qualitative analysis reveals that residential developments of single-family homes are perceived as safe by their inhabitants, given the safety offered by the private environment. Nevertheless, from the perspective of someone unfamiliar with the neighborhood or lacking social or community ties, the analysis may yield an almost opposite result. Additionally, the purchasing power of these neighborhoods significantly influences the perceived safety, with factors such as maintenance, cleanliness, cachet, and neighborhood reputation playing crucial roles.

In conclusion, it is prudent to include both studies in the final result to better understand the obtained results. Expanding the scope of the qualitative part to uncover representative patterns of the Umeå population could shed light on the intricate relationships between safe and unsafe spaces in denser areas. The analyses should include a comparison between spaces perceived as safe and unsafe to understand the complexity of the urban fabric and the interrelation of elements. As a simplification, we could highlight these low-density neighborhood centers as spaces that, with further analysis, could serve as testbeds for new urban strategies aimed at improving community infrastructure and access to everyday uses and services, thus enhancing urban safety and security.

5.2.4 Responses to research questions based on results

I. What do urban safety and security mean within the context of Sweden's diverse society?

The term is defined in various ways depending on the institution or individual. Urban safety and security extends beyond physical security related to sexual violence or hate crimes and intersects with issues related to transportation systems and traffic accidents. Urban safety and security varies with the seasons, and during the colder months, unsafety includes the fear derived from the condition of the streets as a threat to individual integrity. Safe environments are perceived as those that are familiar, while at the same time, the lack of support networks is criticized and identified as a crucial factor in defining safe spaces.

II. Are there any concerns affecting urban (un)safety perception that have not been considered in the feminist urban design principles?

Indicators studying the climate and the accumulation of snow or ice in specific spots of the city have not been included, despite this being a significant concern in a high-latitude climate like Umeå. Additionally, the survey results demonstrate that certain points in the city, particularly the more populated areas with mixed uses, require a more detailed study to determine the advantages and disadvantages these areas present in relation to the degree of safety perception.

III. How do the urban morphology and social context of Umeå city influence the perceived level of urban (un) safety among individuals, considering the physical and sociopolitical elements present in the city and public spaces?

The urban morphology and social context of Umeå city significantly influence the perceived level of urban (un)safety among individuals, with various physical and sociopolitical elements playing a role. The city's layout, with strategically placed activity nodes and green spaces, fosters an active environment, but densification in the city center and industrial areas limits public space availability, impacting safety perception. Safe, accessible, and car-free routes within neighborhoods promote pedestrian safety, yet areas near major roads pose higher risks due to car speed and pollution. Umeå has a well-distributed network of green spaces, but central areas often have limited access compared to the periphery due to higher urban density, making proximity to nature crucial for safety perception. Areas with medium-high urban density and diverse uses can provoke varied reactions, with constant activity sometimes perceived as unsafe due to nightlife and alcohol consumption.

The sense of belonging and familiarity with an area, along with the presence of support networks, are crucial for perceived safety. Lack of knowledge about emergency services and unfamiliarity with the environment contribute to feelings of insecurity. Perceptions of safety vary by gender, with women and non-binary individuals prioritizing fear of physical attacks and violence, while men focus more on traffic-related issues. Social beliefs about gender roles influence these perceptions. Additionally, neighborhoods with higher purchasing power and better maintenance are perceived as safer. The privatization of space in low-density residential areas also affects safety perception, with private environments offering a sense of security to residents.

Access to public spaces and amenities is vital for urban safety. Areas with limited access to services and lower activity levels, such as low-density residential zones, are perceived as less safe. While the diversity of uses fosters inclusion and safety, it can also lead to perceptions of unsafety if associated with undesirable activities. The interplay between urban morphology and social context shapes the perception of (un)safety in Umeå. Effective urban planning and design, coupled with inclusive community engagement and support networks, are essential to enhance the perceived safety of public spaces in the city.

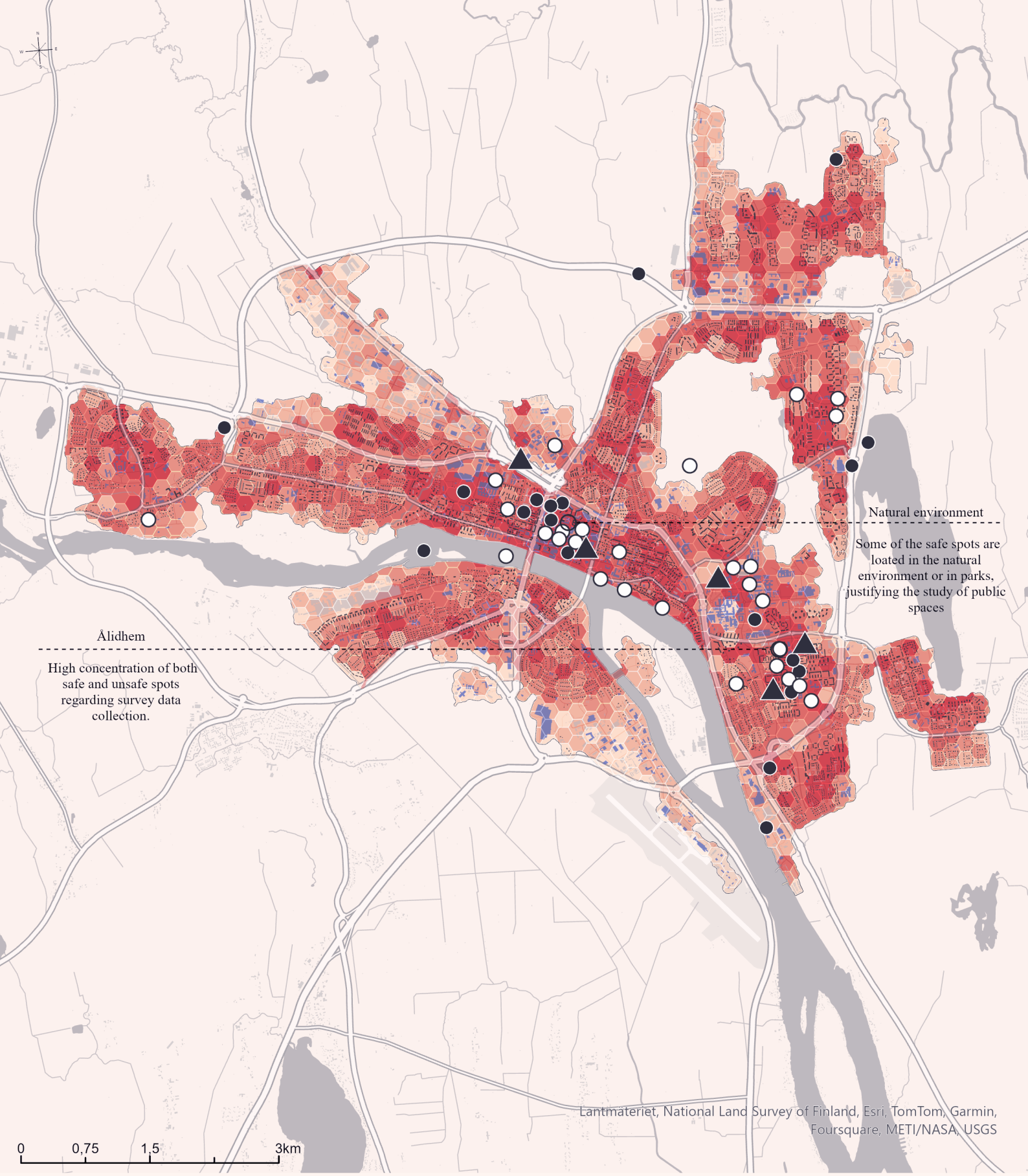
VI. What are the areas of Umeå that could be improved regarding urban (un)safety?

In low-density residential neighborhoods, fostering a sense of community is vital. This can be achieved by developing essential community infrastructure such as parks, community centers, and local shops. These amenities not only provide recreational spaces but also encourage social interaction among residents, thus promoting a feeling of security and belonging within the neighborhood. Additionally, ensuring convenient access to essential services, whether through improved public transportation or local facilities, plays a significant role in reducing feelings of isolation and enhancing overall well-being.

In the industrial areas, pedestrian safety and accessibility often pose challenges due to inadequate urban design. Enhancing pedestrian pathways and ensuring safe routes can greatly improve safety perceptions and encourage more people to utilize these areas. Introducing mixed-use development can also transform these spaces into more vibrant and active environments, offering amenities that not only enhance safety but also increase accessibility and usability.

Areas with high traffic and major roads require specific attention to pedestrian safety. Implementing traffic calming measures such as speed bumps, pedestrian crossings, and designated pedestrian lanes can significantly enhance safety for pedestrians and alleviate concerns related to heavy traffic. By creating a more pedestrian-friendly environment, these areas can become more inviting and accommodating for all users.

Inthe city center and high-density areas, managing overcrowding and ensuring safety are paramount concerns. Prioritizing the development of public spaces, such as plazas and parks, provides residents and visitors with areas for relaxation and recreation, thus alleviating the strain of crowded urban environments. Additionally, improving lighting and surveillance, particularly during nighttime, can address safety concerns associated with bustling nightlife and busy streets. Furthermore, fostering a sense of community through the implementation of community-based projects can help counteract the impersonal nature of dense urban areas, strengthening social ties and enhancing a sense of belonging among residents.



COMPARATIVE FROM QUANTITATIVE AND QUALITATIVE ANALYSES

Urban Safety and Security Analyses: Synthesis of GIS Analysis regarding Uses, Public Space, Mobility, Safety Perception and Urban Morphology, with Qualitative Analysis collected through surveys.

GIS Analysis - quantitative and qualitative analysis

- *Low access - Ratio ≤ 0*
- *≤ 0.5*
- *Medium access - Ratio < 1*
- *≤ 1.5*
- *High access - Ratio ≤ 2*

Given the relatively short qualitative sample from the surveys, it's intriguing to note how certain behavioral patterns are already emerging, aligning closely with the theoretical framework developed in the GIS Analysis. It's also interesting to see this comparison revealing contradictions in certain areas (like the Center and Ålidhem), which provide opportunities to expand and refine the theoretical model.

Survey data collection - qualitative analysis

- *Safety perceptions*
- *Violent situations*
- *Unsafety perceptions*

While the unsafe spots identified by survey respondents are heterogeneously located, the safe spots are more evenly distributed, in higher ratios regarding GIS Analyses and ususally coincident with "high density" residential areas.
Unsafe spots are located in bussy places and high dense areas (Ålidhem and Centrum) or in the boundaries of the urban fabric, coinciding with lower ratios regarding GIS Analyses.

Figure 25. Comparative map from both quantitative and qualitative analyses. Self-elaboration

6. Discussion

In the following pages, the main findings of this study are summarized, and a critique of the methods employed is presented as points to consider for future research. Additionally, certain subjects and concepts are gathered which could complement this study in order to carry out more holistic and intersectional practices.

6.1. MAIN FINDINGS

6.1.1 Population Group Contrasts: Resident vs Visitor

The contrasts between the local population and visitors have been mentioned in previous chapters. As demonstrated in the survey results and also in the reviewed literature, a sense of belonging is a key element in developing a safe perception of our surroundings (Col.lectiu Punt 6, 2022; Jacobs, 1961). In this regard, accessibility to spaces that allow socialization, enjoyment, and engagement in everyday activities near residential areas enables the construction of a community network that brings people closer and makes us feel more protected by the environment: we acquire support tools that generate confidence and safety.

In the previous chapter, the dichotomy between residents and visitors regarding low-density residential developments was mentioned because, although perceived as safe spaces by residents, as they associate them with their homes, visitors could experience unfriendly environments due to the lack of public uses and privatization of space.

The availability of resources in a given environment is also crucial in this context. Residential areas with more resources exhibit urban models based on privatization and car dependency. This creates social barriers by limiting the population to an exclusive group that can afford this type of lifestyle, which is generally not very diverse. This contrasts with the reality of the presented case study. In these spaces, the presence of community spaces can determine the integration capacity of newcomers, as building support networks from private spaces takes time.

onversely, areas with fewer resources present different conclusions regarding integration capability. These areas have a much more diverse population and often have more community uses and local commerce, although they frequently emerge informally or are located in non-traditional spaces. Instead of being situated on main streets, they may be found in secondary areas or near the residences of those who manage them. These characteristics result from a participatory population that is open to co-creation policies, as community members identify a neighborhood deficiency and promote measures from within to address it.

As a result, newcomers need to build connections to become familiar with these new neighborhoods, but since the population is more diverse, creating these support networks can be easier. This is simply because there are more individuals in similar situations or who have recently been in that position, making them more open to supporting integration efforts.

Based on these reflections, one could say that the contrast between the local population and newcomers becomes blurred in diverse areas or in neighborhoods with lower socioeconomic status and higher levels of co-creation and informality. The theoretical model of urban space neutrality tends to favour this population contrast, whereas the informality and co-creation of spaces aid in the formation of support networks and community development. This generates a sense of belonging and perceived safety from a diverse perspective, not limited to people of a certain social class. Non-neutrality fosters safety perception.

6.1.2 The dichotomy of dense and active spaces: two sides of the same coin

The analysis of urban centers presents an added complexity when examining urban (un)safety perception. On one hand, it is due to a subjective factor, whereby different individuals may have almost opposing thoughts about the influence of certain factors on their perception of (un)safety. For example, thoughts about crowds: certain individuals appreciate the multitude of observers or access to more support resources, or even the ability to blend in for a sense of calm; however, others may feel overwhelmed by the crowd, especially if they have neurodivergences, or perceive these spaces as centers of depersonalization and loss of identity.

If there are more people, there are more opportunities for support, but also more opportunities for criminal actions to occur. This assertion marks the second reflection that I want to provide. It is no longer a subjective matter but presents a statistical logic that complicates the approach. It is a reality that high rates of criminal activity often occur in dense urban

centers, where there is a higher frequency of individuals (Jagori & Women in Cities International, 2011; Michaud, 2002; UN-Habitat, 2020). But at the same time, it is in these spaces where access to more resources fosters the development of policies more focused on people's well-being, on providing welcoming spaces to visitors, and on creating nice, careful and safe environments.

6.1.3 The differences between safety and its perception

The actual safety of a given space and the perception of safety do not necessarily coincide. A space with a low crime rate can be perceived as unsafe, and vice versa. The ideas previously discussed reflect on the perception of (un)safety among various population groups or in specific areas of the city that present marked contrasts.

The reduction of crime and the improvement of actual safety are undeniably necessary, but the perception of safety entails additional challenges. Feminist theories delve into the perception of safety, positing that even if an area is statistically safe, if it is perceived as unsafe, it creates a spatial barrier that limits and complicates everyday life. This avoidance generates stress and can negatively impact the socio-economic development of the area in question.

Studies on urban perception show that certain compensatory measures implemented to improve street safety can have the opposite effect. A clear example is the use of surveillance mechanisms. A significant portion of society may feel threatened by these features, whether due to distrust in institutions and law enforcement or because of neurodivergences, among other possibilities.

In certain cases, the perceived (un)safety of a neighborhood can be due to a poor reputation or historical events that perpetuate fears no longer relevant. In such situations, it is evident that no urban design can alter this behavior. Change must come from social awareness, education, and participatory co-creation aimed at endowing these spaces with new perceptions and memories.

6.1.4 The importance of an intersectional perspective: Gender-biased studies are outdated

This statement seems somewhat radical, as there is still much progress to be made in eliminating power relations derived from a patriarchal system. Furthermore, this is not a topic whose development is homogenized worldwide: progress in feminism varies greatly depending on the context(Col.lectiu Punt 6, 2022; Jagori & Women in Cities International, 2011). In fact, this issue was evident when working on the methodology indicators, as literature from Southern Europe was initially used (Taboada, 2016), but several studies did not apply in the context of Umeå. In Sweden, gender policy development is quite advanced on a global scale (Brandén & Sandberg, 2021), and the male population appears to be quite sensitized to this issue compared to other contexts. This is shown by survey results indicating the significance of various factors on urban safety, where responses between men and women frequently aligned, contrasting with other contexts.

Gender dichotomies are not the only issue; they extend to other vulnerable groups like migrants, refugees, people with disabilities, the elderly, and the poor, who remain largely marginalized in discussions on city and urban space design (Michaud, 2002). In Sweden, the current political climate and the emergence of extremist discourses highlight this growing reality (Sager & Mulinari, 2018). Economic, war-related, and climate crises contribute to increased displacement, economic hardships, and an aging population, underscoring the need to include this perspective in future studies.

The differences between areas with higher and lower economic resources are notable in analyses. The contrasts between the local population and newcomers, language limitations, signage, street accessibility, and the ease of creating support networks are all spatial characteristics tied to the study of intersectionality.

Generic measures cannot address the existing problems in urban spaces. Improving urban design alone is not sufficient to ensure urban safety and security. What might work in one specific location may not be useful in another. The site's reputation and historical memory also influence safety perception, just as certain environmental characteristics can provoke opposite reactions in different individuals. The intersectional approach recognizes these diversities and allows the cultural and social spheres to actively participate in designing the spaces we inhabit.

6.1.5 Participation and co-creation as tools for change

Participation and co-creation act as powerful tools for change. By encouraging community involvement and allowing for flexible, adaptive use of urban spaces, these approaches can bridge gaps between different population groups. They enable residents to address local deficiencies collaboratively, promoting a more inclusive and supportive environment. This participatory process not only helps integrate newcomers but also strengthens the overall social fabric, leading to more resilient and cohesive communities.

Participation fosters respect and a sense of community. Co-creation aims to democratize and decentralize decision-making processes by involving audiences in the design, creation, and evaluation of projects. Co-creation proceses become a political arena of conflicts and struggles, where meanings are constructed differently by social actors in specific contexts. Public participation has become central to policymaking in advanced democracies, being seen as essential for achieving social justice (Hudson et al, 2017).

By actively involving residents in the creation and implementation of cultural and social projects, Umeå fosters a collaborative environment where individuals feel respected and valued. This participatory approach not only democratizes cultural production but also encourages community members to take ownership of their shared spaces and activities. Such engagement helps break down social barriers, builds trust among diverse groups, and cultivates a collective identity. As residents collaborate on projects that reflect their needs and aspirations, they develop a deeper connection to their community, enhancing their sense of security and well-being. Moreover, the inclusive nature of co-creation ensures that various voices are heard and considered, leading to more equitable and responsive urban development. This, in turn, creates a more inclusive and safer environment, as the community works together to address issues, share resources, and support one another, ultimately reinforcing a positive safety perception across Umeå.

6.2. CRITIQUE AND LIMITATIONS

6.2.1 Reachability of participatory analysis and sensitive data

Despite the interesting findings of the survey, which seemed to reveal certain patterns, the sample size was not sufficient to be considered representative. My own lack of networks in the area due to my brief stay in Umeå, in addition to the usage of english as the only language for developing the survey and the advertisements, limited the ability to obtain responses and focused on specific groups, such as students, youth, feminists, and queer individuals.

From an intersectional perspective, there was a missed opportunity to compare the responses of people from different backgrounds and socioeconomic statuses. These realities would have added another layer of complexity that I consider necessary for the study of (un)safety perception. However, due to time constraints and bureaucracy related to handling sensitive information, which could affect the number of responses obtained in the survey (if proper mechanisms are not used, some individuals may object to sharing this information), it was decided to exclude their use.

6.2.2 Inclusion of qualitative analyses

In terms of feminist theories on assessing urban safety perception, they all agree on the inclusion of women's safety audits as mechanisms for obtaining qualitative data. In this study, conducting such audits was proposed, leading to the organization of two audits. However, once again, the limitation of my networks in Umeå reduced the number of participants to a non-binding level.

Qualitative analyses require time and community networks. Undoubtedly, a longer-term organization would have favored the inclusion of certain groups in the proposed audits. Several associations contacted responded with interest in the proposal, but by the time I received their responses, it was too late to meet the deadlines. I believe that being a foreigner has connected me with social groups (migrants from various cultures and backgrounds, international student groups, foreign workers in academia, or Swedish nationals who work or study in Umeå but come from other parts of the country) whose opinions could be of great interest. If I had to repeat this work, I would possibly opt for conducting personal interviews rather than convening an urban safety audit.

I justify this with the fact that certain population groups, especially migrants, do not feel secure sharing their reflections or fears in a mixed environment. If I had had the time to conduct various safety audits, I would have done so with the help of individuals who could assist in translating reflections into the languages spoken by the attendees and in environments where the attendees felt comfortable (cultural, non-mixed, or generational groups).

In addition to these considerations, qualitative analyses require subsequent data processing, which constitutes a methodology in itself and for which I was not prepared. The bias in subjective and open-ended responses can be approached in various ways, and it is important to justify the chosen methods for classification based on theoretical proposals to avoid reflecting personal biases.

6.2.3 Accessibility and availability of quantitative data

The development of GIS analyses had to adapt, on one hand, to the available data, and on the other hand, to the amount

of effort put on field work. Much context information was not available for download, and obtaining layers like street lighting depended on contacting institutions storing the data, defining the analysis's development capacity. However, spaces like university or sports environments manage data through private companies, necessitating the exclusion of these areas from the analyses.

Regarding the available data for public spaces, it is segregated across various information sources, complicating the merging process. Additionally, it requires constant updating, leading to manual review and editing. Moreover, the distinction between public and private spaces is unclear, and there is no available information (at least for individuals) about the dimensions of pedestrian mobility networks, necessitating data manipulation from other information layers. These issues led to the exclusion of certain analyses, such as the proportion of pedestrian networks/car networks or the proportion between roadways and building height, which would have required specific street measurements.

In addition to these considerations, quantitative analyses could have been more detailed with additional fieldwork to identify missing data, such as street permeability (gaps opening onto the street create a sense of informal surveillance) or to focus more on accessibility, such as streets with ramps for people with reduced mobility. In certain analyses, such as the study of mixed uses, the informal sphere of urban spaces was overlooked due to the lack of time and appropriate tools for its study.

Secondary uses and the reuse of urban spaces can completely change the perception of an area. Sometimes, this can create tensions in the territory (when a specific social group informally appropriates a space, it may be negatively perceived by other users of the same space). However, it can also activate the area during times of the day when it formally lacks activity and can contribute to community building by addressing existing needs in the territory that have not been met formally (e.g. support groups, resting areas or children's activities).

6.3. FOR FURTHER STUDIES

6.3.1 Emphasize the qualitative approach

This study has demonstrated the importance of including qualitative methodologies to achieve accurate results. Allthough it cannot be considered a qualitative study, the development of the survey was considered crucial for the analysis of urban safety and security. It is recommended to increase the sample size to acquire a representative sample of the study area. However, further qualitative studies, such as interviews, could have been conducted to add more layers of complexity, such as relevant historical information. Many areas perceived as unsafe are ingrained in the collective imagination due to past events. In Umeå, one respondent mentioned the case of "Hagamannen," a man who assaulted numerous women in the Haga area, which led to a strong avoidance of the area by an entire generation of women. On a positive note, the development of social movements or cultural history awareness can also increase the sense of belonging or inclusion in a particular area.

Other qualitative methodologies, such as safety audits, could be included to increase data from fieldwork and explore the population's feelings from a closer environment. Creating activities with non-mixed groups of minorities breaks certain protocol mechanisms and creates safe spaces to discuss insecurities and vulnerabilities.

6.3.2 Improving the participation of diverse groups

Participation can be the solution for carrying out processes that integrate the voices of diverse groups from intersectional perspectives, thereby making participants the owners of the processes and developing a sense of connection and belonging that promotes the perception of safety. However, these processes can also reproduce social and economic inequalities by marginalizing certain practices, people, and places. Participatory approaches often overlook power asymmetries and assume equal terms for all participants, which is not always the case. Critical questions arise about who gets to participate, speak, and set the terms of discussion. Participation can sometimes obscure undemocratic processes, marginalize dissenting voices, and induce willing subordination to dominant power structures.

Meaningful participation requires participants to have control over the activities they engage in. Cultural policies should acknowledge power inequalities, legitimize conflicting parties, and empower marginalized groups through democratic processes. Co-creation, a form of participatory approach, involves collaboration and interaction to generate and develop meaning collectively. While it can democratize the creative process and foster social innovation, it also risks appealing mainly to cultural elites and excluding others, making it context-dependent and complex.

To increase the participation of diverse groups, it is important to create safe spaces for diversity. This often involves the

creation of non-mixed activities aimed at the participation of specific groups, fostering trust to reflect and subjectify collectively. For these initiatives, it is often necessary to have mediators or personnel trained in such activities, and these projects require significant preparation time. Having the support of existing associations in the area is key to ensuring the creation of trust bonds between the local population and technical staff. Additionally, preparing questionnaires or conducting preliminary interviews before developing participatory analysis processes can help establish the foundations for these processes and identify the specific needs of the groups involved.

6.3.3 Processing of statistical data

The implementation of statistical data processing techniques for survey data is crucial in scientific research and offers several advantages. These include increased efficiency in analysis, as structured responses allow for the use of automated statistical tools that can process large volumes of data quickly. Statistical techniques also provide greater precision and objectivity, reducing the risk of interpretative biases. Furthermore, they facilitate the generalization of findings to a broader population, which is crucial for identifying large-scale trends and patterns.

These techniques enable researchers to transform raw data into meaningful insights, ensuring the accuracy and reliability of findings. By employing methodologies such as descriptive statistics, inferential statistics, and multivariate analysis, researchers can uncover patterns, test hypotheses, and make informed decisions. Descriptive statistics provide summaries about the sample and measures, inferential statistics allow generalization from the sample to the population, and multivariate analysis helps understand complex relationships among variables.

Effective statistical processing not only strengthens the validity of research but also enhances its credibility and impact in the scientific community. It helps detect significant relationships between variables and enables effective data visualization through charts and tables, making findings more comprehensible and communicable. Additionally, the standardized nature of these techniques ensures reproducibility and comparability of results across different studies and over time. In summary, statistical data processing maximizes the efficiency, precision, and generalizability of survey analysis, providing objective and easily interpretable results essential for informed decision-making in scientific research.

6.3.4 The informal sphere in quantitative analyses

As discussed in the limitations section, certain aspects of quantitative analyses should have been complemented with informal sphere data. However, studying this requires local knowledge and expertise. To obtain this information, it is necessary to conduct qualitative analysis, engaging with the local population to physically define the informal characteristics present in the space. Scanning online diffusion channels, such as analyzing events and pages on Facebook or Instagram, might provide clues about the informal sphere, but it will only capture a portion of what is happening. These processes also necessitate subsequent data processing based on qualitative information processing methodologies.

6.3.5 Other possible categories and indicators. Climate and weather

The sphere of sustainability and bioclimatic urbanism could shed light on the development of practices focused on urban safety and security. Shadow analysis or spaces with high climatic comfort can determine the use of a particular public space.

A comprehensive analysis of climatic seasons would significantly enhance this study. Survey responses often cited concerns regarding safety due to snow and ice accumulation during the cold months, which dominate much of the year in Umeå. Snow and ice affect access to various everyday activities and pose risks of falling and reduced visibility in certain parts of the city. Moreover, the darkness of winter highlights the importance of sufficient artificial lighting to mitigate safety concerns. Cold weather and snow accumulation further restrict the use of public space, emphasizing the importance of access to community facilities and participation in cultural and leisure activities.

6.3.6 The semiprivate sphere and domestic public spaces

During the development of this study, certain patterns of behaviour have been observed in the semi-private spaces typical of multifamily residential complexes. These areas exhibit characteristics of both private and public land: they rely on informal surveillance and expect that people using the space are not strangers to it; however, they do not restrict access or promote community through access to everyday uses and services. For these reasons, it is considered that they require a more detailed study, which highlights the specific behaviours and dynamics of semi-privateness.

In current feminist currents, there is discussion about the boundaries between private and public spheres, with this being a diffuse and changing boundary depending on the context. From an intersectional perspective, limiting the domestic sphere to the private space is exclusionary, just as limiting the productive sphere to the public space is. For these reasons, for further studies, it would be interesting to investigate the boundaries between public domesticity and the privacy of everyday uses, perhaps including analyses focused on privatized or semi-private spaces. Because, overall, safety and security issues are not an exclusivity of public spaces.

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Appendix 1. Survey interface

Urban safety perception in Umea

General information

Hello! thanks for being here! This survey wants to collect data regarding safety perception in public spaces in the urban environment of Umeå. We will start gathering some general data that will be relevant to analyse the results. Apart from this contextual data, all the survey is anonymous.

How long have you been in Umeå?*

- Less than one year
- Less than 2 years
- Less than 10 years
- More than 10 years

What is your relation to the city?*

- I am a student here
- I work here
- I visit periodically (family, work, studies, other)
- Other

How old are you?*

- Less than 15
- Less than 20
- Less than 25
- Less than 45
- Less than 65
- More than 65

What is your gender?*

- Female
- Male
- Other

[Not required] Do you have any personal characteristic that could be relevant to this study and you don't mind sharing?

If you dont, leave blank

- Mobility impairment
- Visual disability
- Hearing impairment
- Children in my care
- Person with special needs in my care
- Neurodivergency
- Other

Next

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Urban safety perception in Umea

Unsafety perception

Now we will go through specific questions regarding unsafety areas. Don't be afraid to include those areas you avoid or don't feel comfortable but you don't have specific reasons for it! There is probably more reasons than what we ususally think.

Have you ever experienced a dangerous or violent situation in Umeå?*

Either you were involved or not

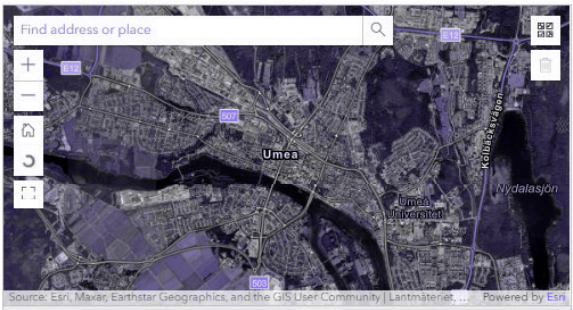
- Yes, once
- Yes, more than once
- No

Could you point out where it/they happened and the time of the day it was? (1)

1

Where did it happen?

You can only add one point per map. If you want to add more points, click the "+" button above



Lat: Lon:

What time was it?

- Before sunrise (dark sky)
- Early but after sunrise (light sky)

- ○ During the day
- ○ Evening before sunset
- ○ Evening after sunset

Regarding public spaces, how do you define unsafety? What are you most concious of?

Please rank the following statements by how important are for you

	1 (It is very important to me)	2	3	4 (I don't think about it)
Someone attacking me in some way (robbery, abuse, harassment, fights)*	○	○	○	○
Something could happen to me (health issue, fall, not being able to be independet)*	○	○	○	○
Transport related (speed, accidents)*	○	○	○	○
Weather conditions (snow, ice, falls)*	○	○	○	○
Legal safety (control forces, papers, being questioned)*	○	○	○	○

Any other interpretation that you want to mention?

Do you define unsafety in any other way regarding public spaces?

If you are alone, how unsafe would you feel in these situations?

	I feel safe	I might feel unsafe (depends on weather conditions or other reasons)	I feel unsafe
At night*	○	○	○
At a crowded area*	○	○	○
At a dirty place*	○	○	○
The presence of police or other control forces*	○	○	○
At a place with bad reputation*	○	○	○
At a place with no shops or other uses around*	○	○	○
At an empty place*	○	○	○

Do you think winter time affects your safety perception?

Please rank the following statements by how important are for you

	1 (It is very important to me)	2	3	4 (I don't think about it)
I am afraid of slipping or falling*	○	○	○	○
The snow limits my ablity to get to places*	○	○	○	○
I am more afraid because it is allways dark*	○	○	○	○
I feel hidden because of the snow piles*	○	○	○	○

What other worries do you have in winter regarding safety issues?

From the list below, could you define how important these elements are for you?

	1 (It is very important to me)	2	3	4 (I don't think about it)
Lighting*	○	○	○	○
Benches*	○	○	○	○
Toilets*	○	○	○	○
Shops or restaurants closeby*	○	○	○	○
Trees or green areas*	○	○	○	○
Wide sidewalks*	○	○	○	○
Accessible paths*	○	○	○	○
Wifi*	○	○	○	○
Visibility*	○	○	○	○
Protection towards car roads (e.g. no crosswalks or divisions like fences)*	○	○	○	○

Could you define how safe you feel in the following situations?

	I feel safe	I might feel unsafe (depends on weather conditions or other reasons)	I feel unsafe
Going to work/uni/school*	○	○	○
Coming back from work/uni/school*	○	○	○
In public transport*	○	○	○
From the bus stop to my destiny*	○	○	○
Waiting for the bus*	○	○	○
Having a walk in nature*	○	○	○
Visiting the city centre*	○	○	○

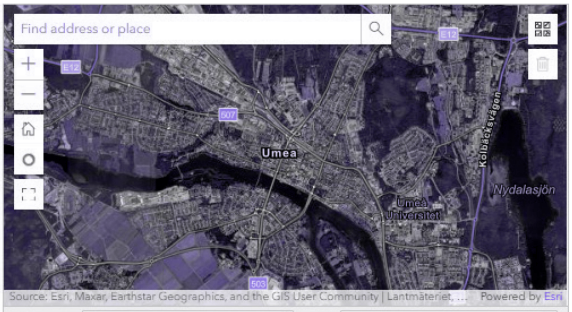
Can you think of any space in Umeå that you avoid or where you have felt unsafe?*

- ◉ Yes
- ○ No

Unsafe spaces (if a map doesn't show, click '+' button) (1)

Can you point out any place in the city that you avoid or where you have felt unsafe?

You can only add one point per map. If you want to add more points, click the "+" button above



Lat: ° Lon: °

Description of the place

If something happens in a public space, do you feel you have the tools for asking for help?*

Would you know where to call or where to go, or either how to defend yourself?

- Yes
- No

Regarding last question, could you describe the tools you have or lack?

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Urban safety perception in Umea

Safety perception

We are almost done. Now let's reflect on safe spaces and the elements that make us feel safe.

Could you rank the next characteristics of the space that make you feel more comfortable?

	1 (Makes me feel safer or more comfortable)	2	3	4 (Does not make me feel comfortable)
Having previous knowledge of the place*	○	○	○	○
Presence of police or other control forces*	○	○	○	○
Being close to an association or group that I know*	○	○	○	○
The appearance of the place (being clean, inviting)*	○	○	○	○
Having shops and other uses around*	○	○	○	○
Being accessible and well connected*	○	○	○	○
Having nature or open spaces closeby*	○	○	○	○

Could you describe any other element that must be present in the area to make you feel safer?

Can you identify areas of the city where you feel especially comfortable or safe?*

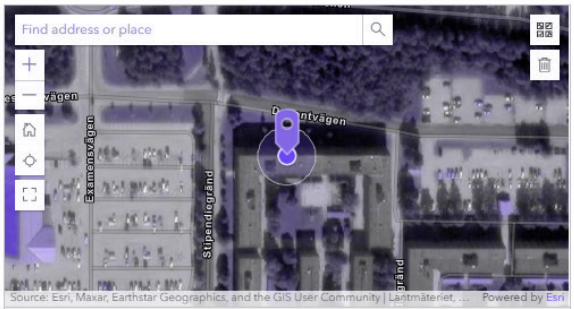
- Yes
- No

Safe spaces (if a map doesn't show, click '+' button) (1)

1

Can you point out any place in the city where you feel more comfortable?

You can only add one point per map. If you want to add more points, click the "+" button above



Lat: 63,813542 Lon: 20,316924

Description of the place

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Urban safety perception in Umea

Final questions

Final questions! Just some space where you can include anything you feel we have missed out. Thank you very much for your time!

Do you identify any specific issues in your neighbourhood or somewhere around Umeå that you want to mention?

Do you want you add something else?

I am going to develop a workshop called safety audit in the upcoming weeks. It will consist of a walk around an area of the city to identify safe and unsafe spaces, while we will discuss the possible reasons that could make those areas feel unsafe (from the urban design perspective and social perception). If you are interested in participating, please leave your email here so I can contact you! :)

The email adress will not be stored for survey data collection, surveys will remain anonymous

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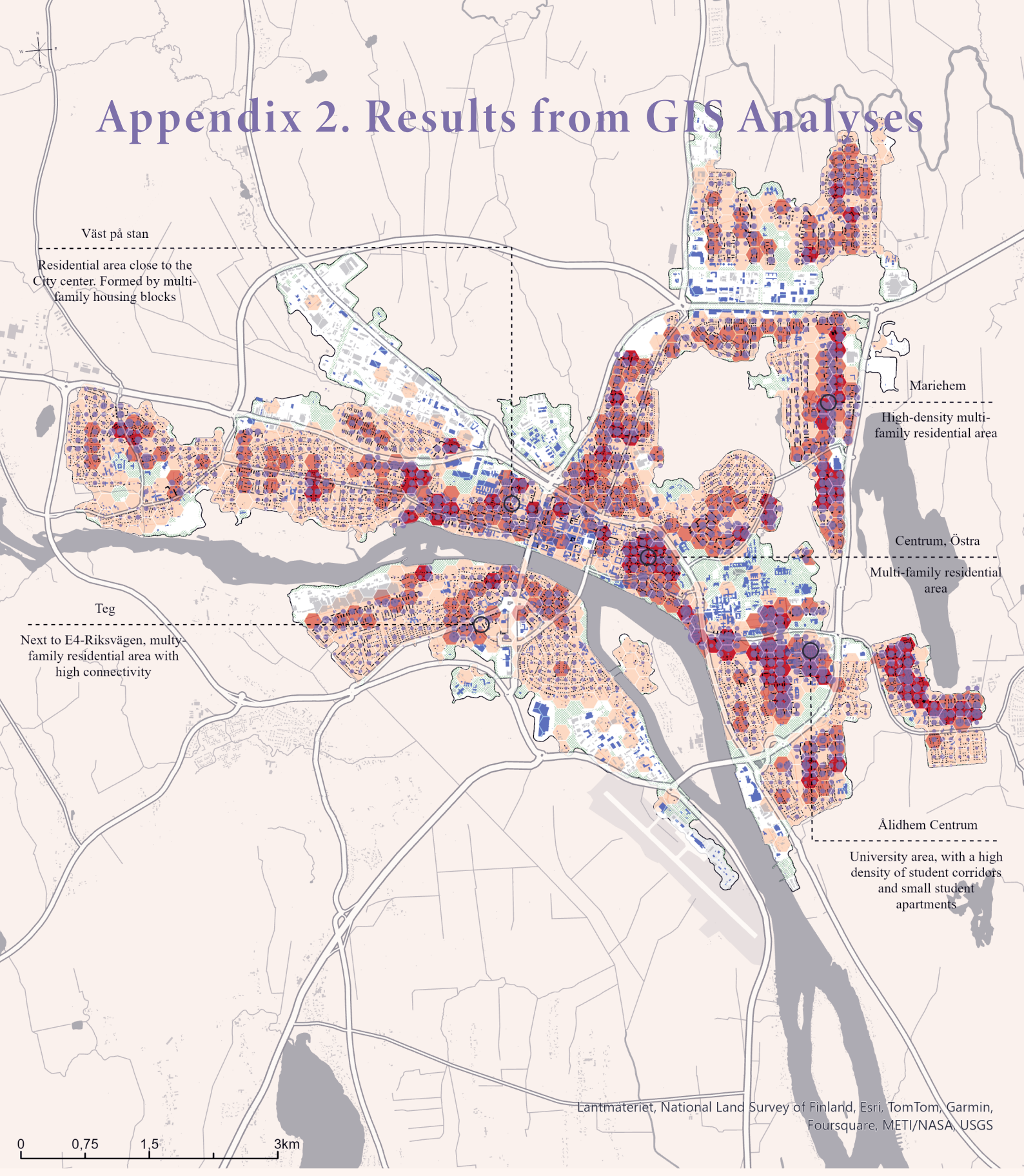
Appendix 2. Results from GIS Analyses



POPULATION DENSITY **U1**

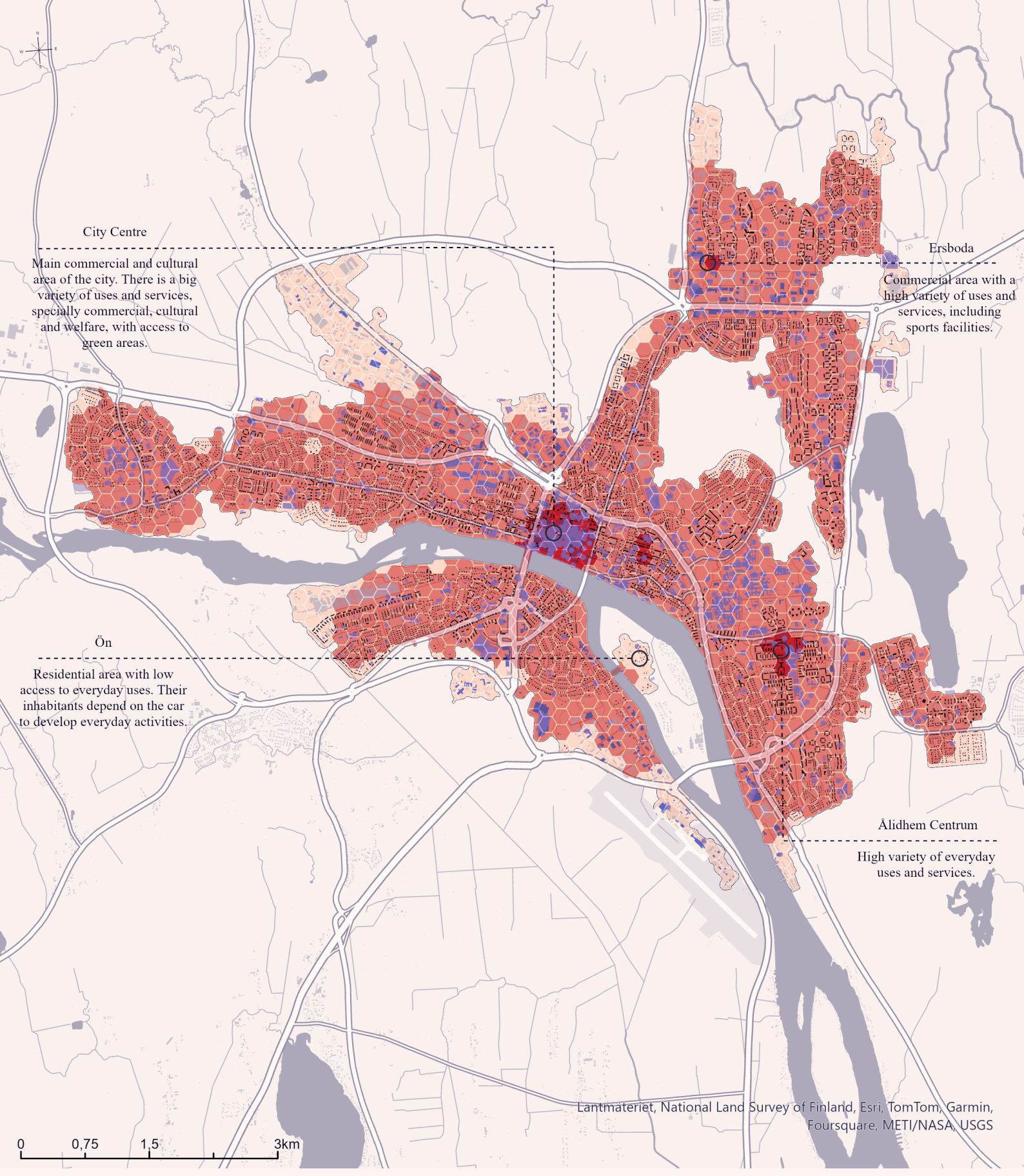
Distribution of inhabitants within Umeå urban centre

- *Public buildings and services: urban infrastructure*
- *Residential buildings*
- *Other buildings (e.g. industrial)*
- *Public space and green areas*
- *Water bodies*
- *285 inhabitants*
- *1 inhabitant*

The highest density is concentrated in the vicinity of the university, the city centre and near the Nydala river and the central area of Teg.
These areas are primarily composed of multi-family housing buildings, contrasting with the large area covered by single-family houses distributed throughout the territory.
There are some areas whith null values as in the case of the industrial areas or the big green spaces, since there is no people living there.

Residential density

- *Low density <120 inhab*
- *Medium density 120-240 inhab*
- *High density >240 inhab*
- *No data (0 inhabitants)*



ACCESS TO EVERYDAY USES AND SERVICES

U2

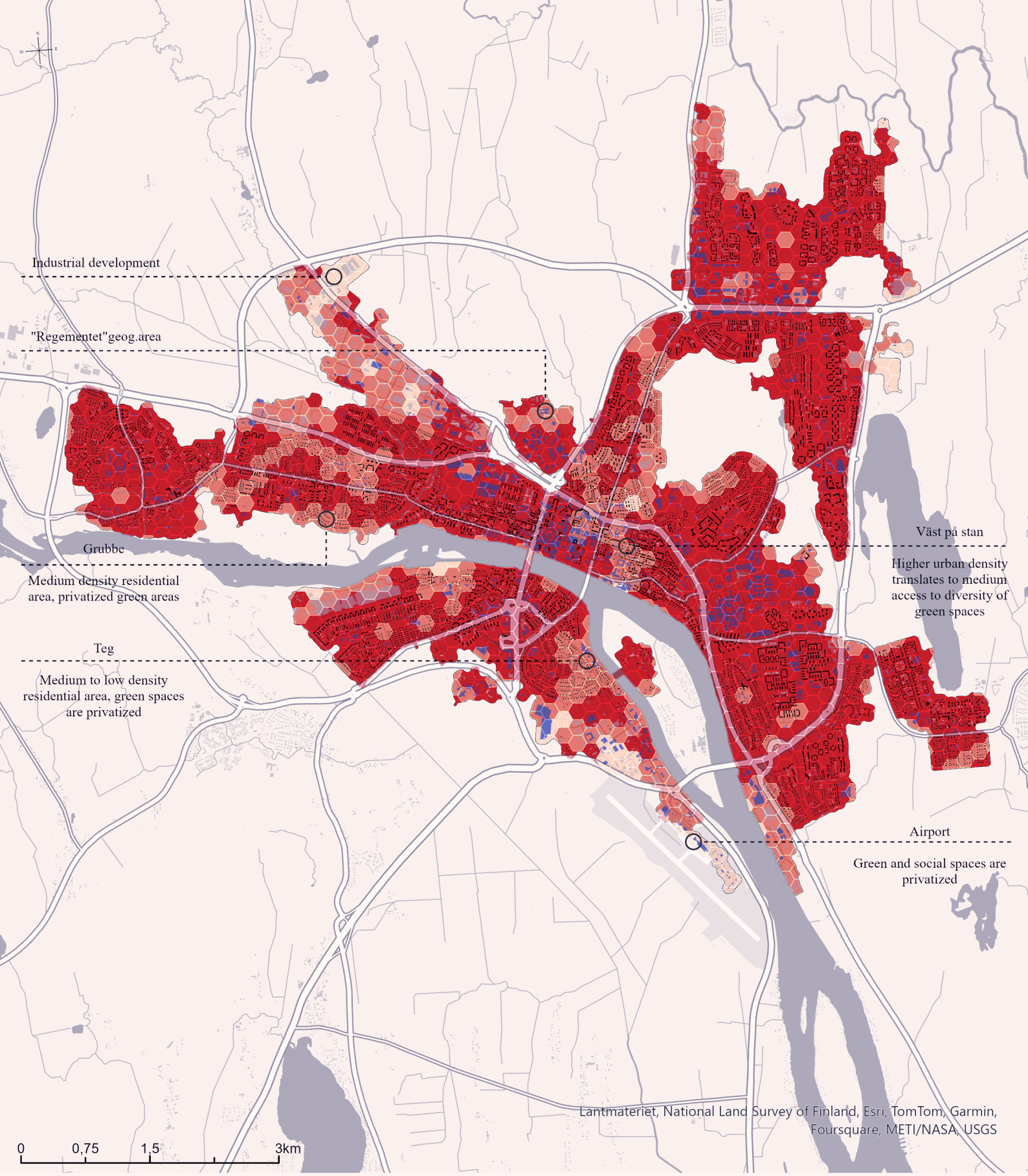
Distribution of everyday services, everyday commerce, alternative mobility and parks in Umeå

- *Public buildings and services: urban infrastructure*
- *Residential buildings*
- *Other buildings (e.g. industrial)*
- *Everyday uses and services*
- *Water bodies*

The purple dots define where the uses are located. However, there are areas with a lot of uses but the diversity of them is still low. The areas where a big diversity of uses can be found appear in red.
The highest density of diverse everyday uses and services can be found in the city centre and in Ålidhem centrum, wihch is the commercial area of the university area. Places like Ön show a low access to everyday uses and services. Other central areas like Teg, Haga or the eastern area from the centre, show a medium access to everyday uses. This means that they depend on the city centre or the other high density areas.

Access to everyday uses & services

- *Low diversity >12 diff. uses*
- *Medium diversity 6-12 diff. uses*
- *High diversity <6 diff. uses*



OPEN SPACE DIVERSITY

PS1

Access to a diversity of green spaces in the vicinity

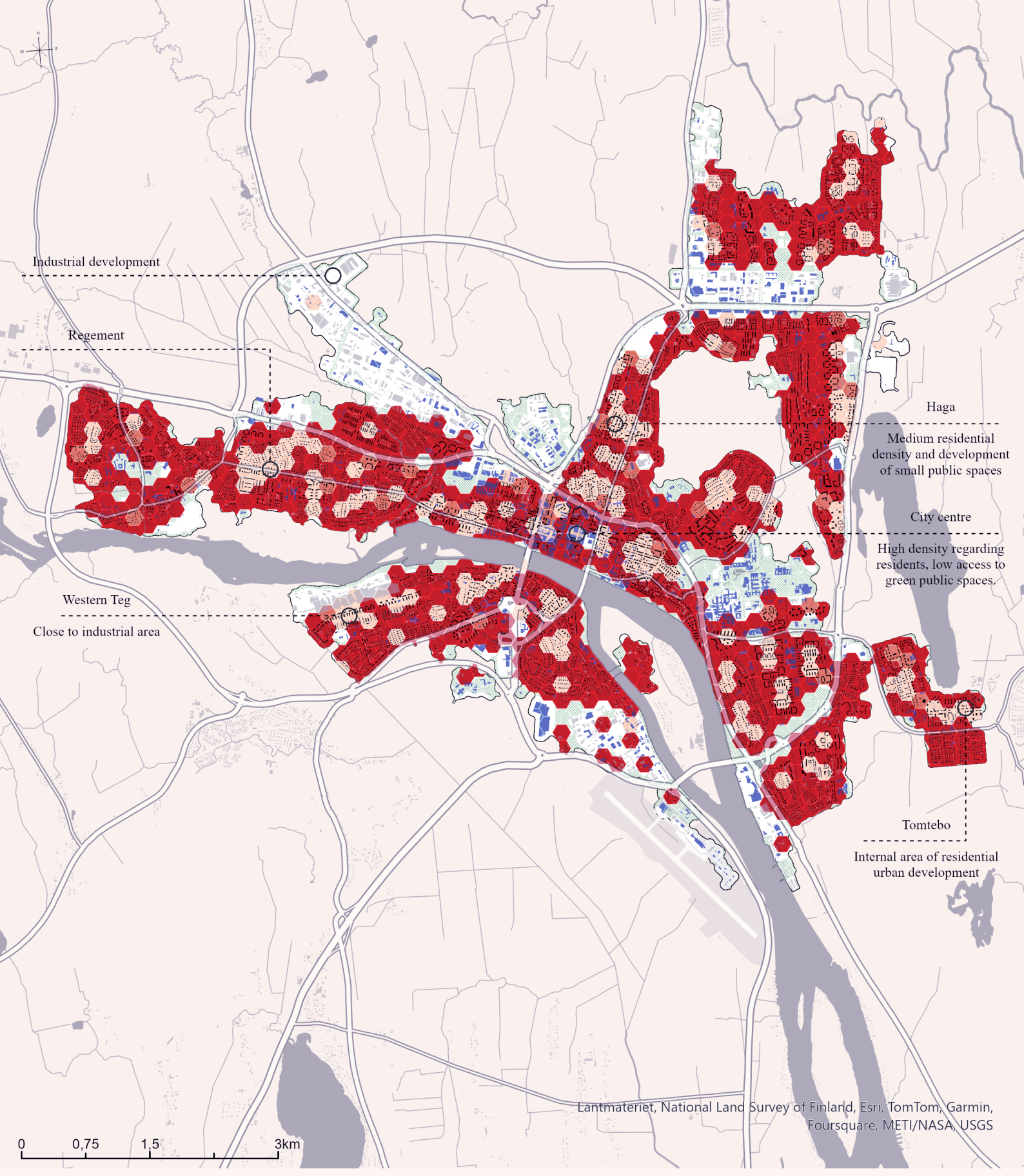
- *Public buildings and services: urban infrastructure*
- *Residential buildings*
- *Other buildings (e.g. industrial)*
- *Water bodies*

As expected, Umeå offers high accessibility to open green spaces, as it is located in a rich natural environment and its urban center has a medium density. Almost all urban areas provide high access to the 5 types of green spaces studied (see Methodology section for more information). It is common for industrial areas to have lower access to green spaces, but apart from these areas, some blocks in the central and eastern parts of the city also stand out. This situation can be explained by the increase in urban density, which limits green spaces to the riverbank and some inner parks. However, socialization in this area can still occur in other spaces, such as sports or commercial areas (see analysis U2). The eastern area of Teg also stands out, a residential area with medium to low density, where there are plenty of green spaces but they are privatized. Therefore, the development of social activities is limited.

Open space diversity

- *Low access <4 types*
- *Medium access 4-5 types*
- *High access >5 types*

The access to the different types of green spaces is calculated using a buffer area. The distance for each buffer area varies from type of green area (see Methodology section for further information).



GREEN AREAS PER INHABITANT

PS2

Density of green areas: Square meter available per person

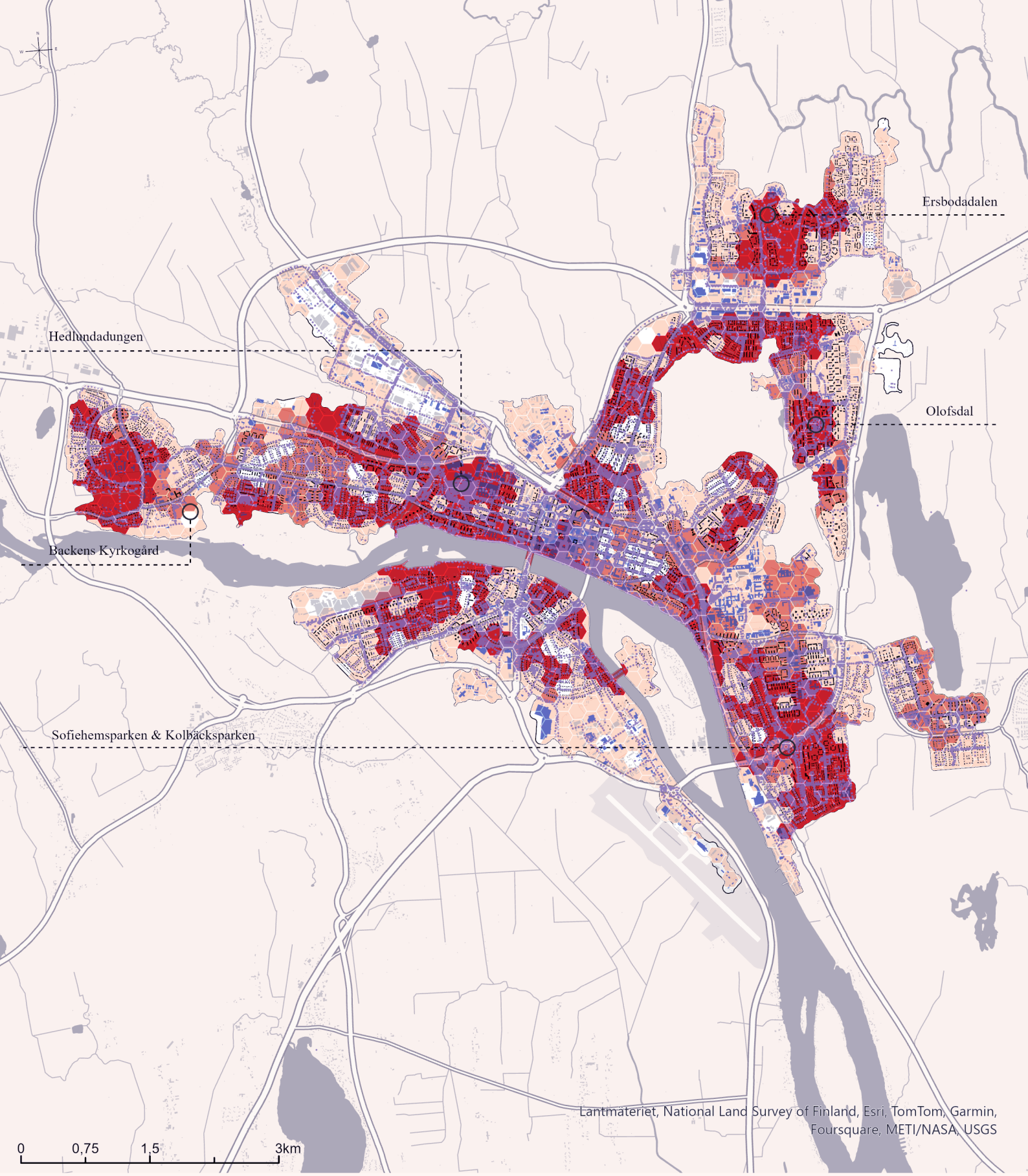
- *Public buildings and services: urban infrastructure*
- *Residential buildings*
- *Other buildings (e.g. industrial)*
- *Water bodies*

The density of public green space remains high throughout Umeå. It is logical that the most densely populated areas present average values, while the entire periphery, in each of the neighborhoods that make up the urban area of Umeå, presents high values. Again, in this analysis, only public spaces are considered, so privatized areas have low green space values. Additionally, in this case, only green spaces larger than 1000 m2 are counted, as smaller spaces do not ensure adequate socializing quality and natural environment.

Green space density

- *Low access <10 m2/inhab*
- *Medium access 10-15 10 m2/inhab*
- *High access >15 10 m2/inhab*
- *Null values*

Null values are those areas where there are no inhabitants living, as industrial areas or parks.



EQUIPMENT OF OPEN PUBLIC SPACES

PS3

Accessibility to a diversity of urban equipments: sports, playground, illumination, furniture, trees, toilets and cycling/pedestrian roads

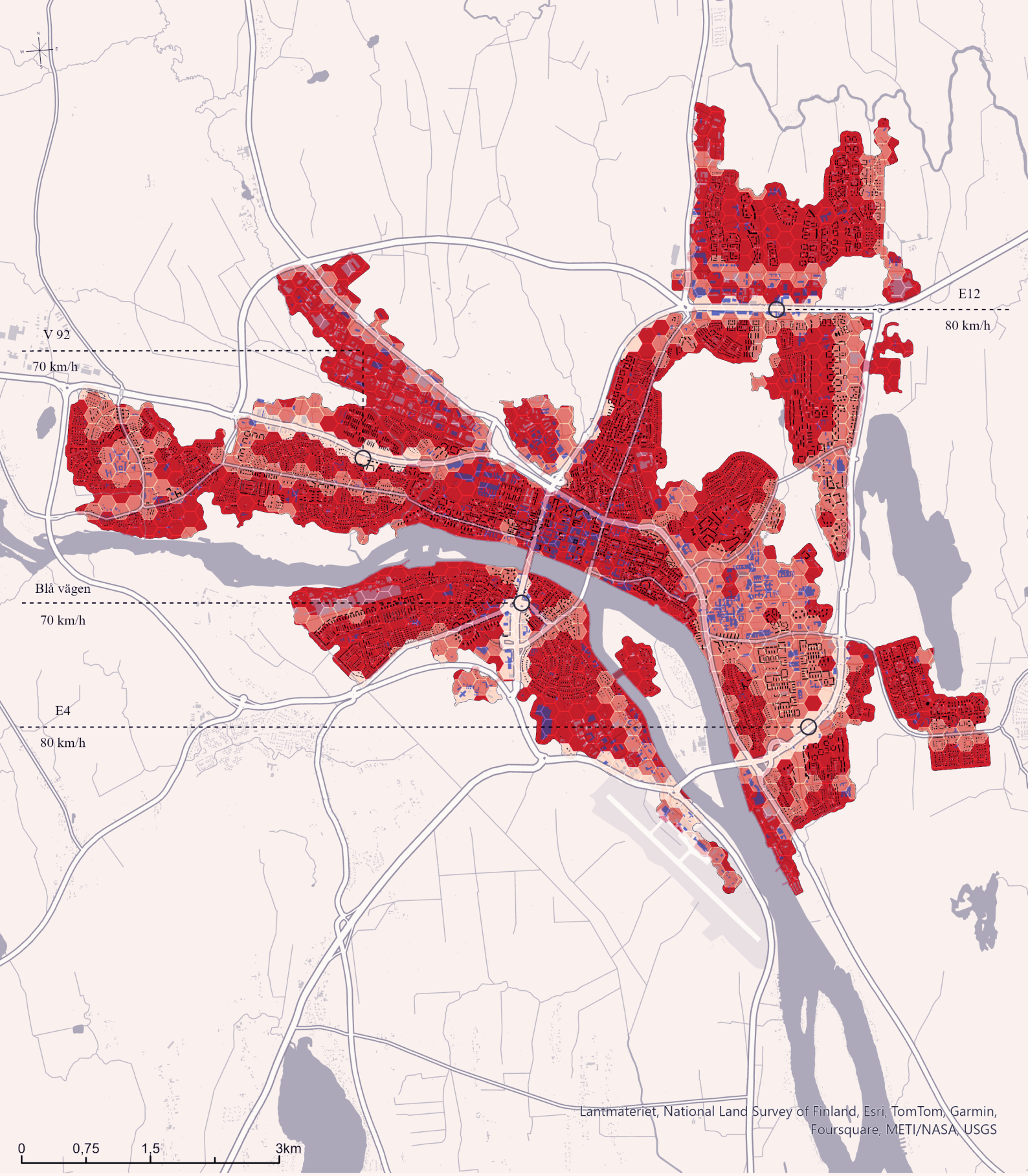
- *Public buildings and services: urban infrastructure*
- *Residential buildings*
- *Other buildings (e.g. industrial)*
- *Equipments*
- *Water bodies*

Public spaces with the most diverse amenities are the large parks within the urban fabric of Umeå, as their dimensions allow for a greater variety of elements. Despite this, the parks feature a wide diversity of uses, especially in terms of playgrounds, benches, trees, and lighting. The equipment that is most lacking is public restrooms, which are especially important for children and the elderly.

Accessibility to urban equipments

- *Low access <4 types*
- *Medium access 4-5 types*
- *High access >5 types*
- *Null values*

Null values are those areas where there are no green areas.



SPEED LIMIT ANALYSIS

M1

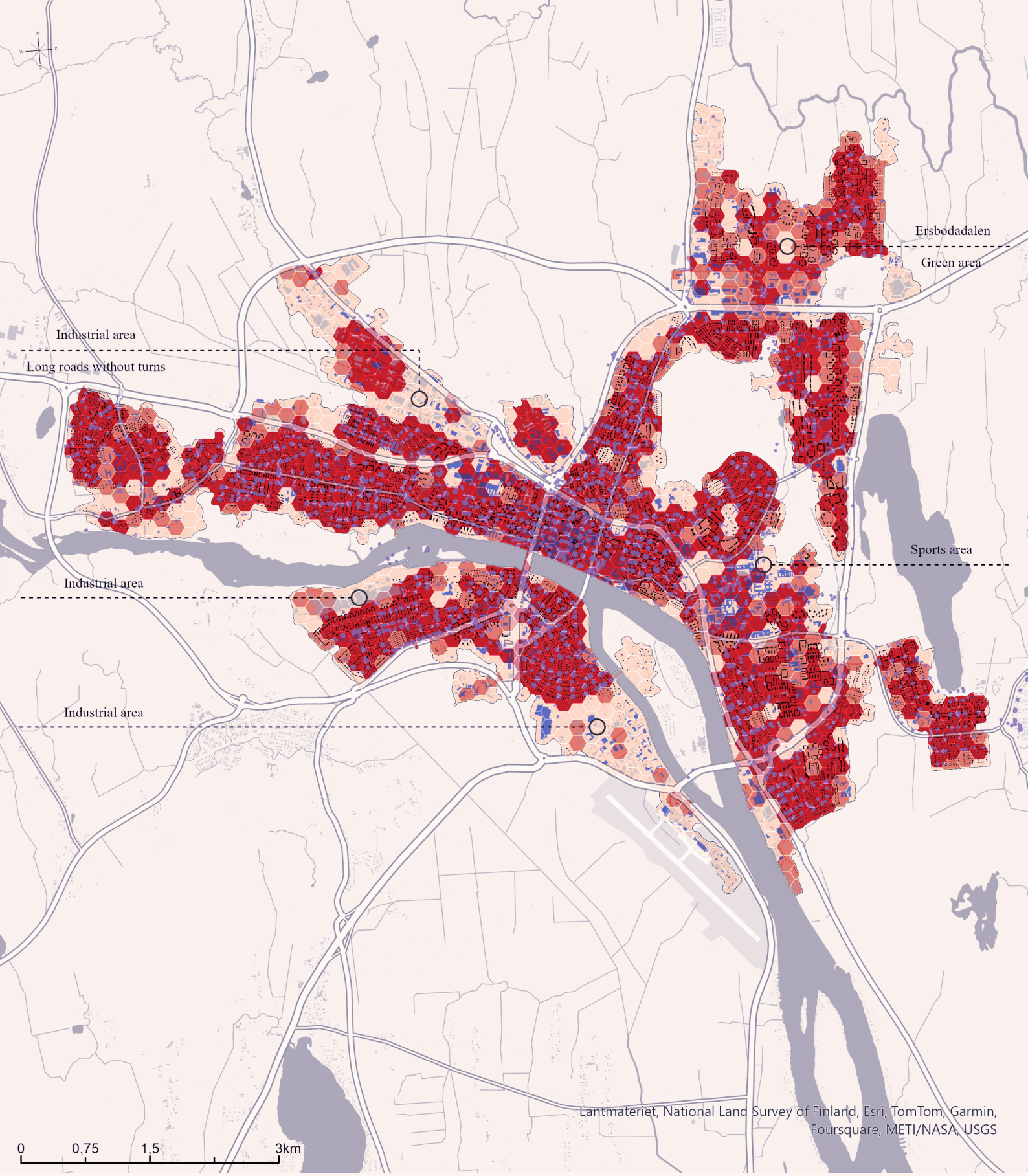
Road speed in urban areas

- *Public buildings and services: urban infrastructure*
- *Residential buildings*
- *Other buildings (e.g. industrial)*
- *Water bodies*

The speed limit on Umeå's urban roads is tightly controlled except for the main connecting routes. However, they are adequately separated from pedestrian and cyclist mobility spaces. Nevertheless, the noise from high-speed cars and potential accidents can affect the perception of safety in their vicinity.

Driving speed

- *Unsafe speed >60 km/h*
- *Neutral speed 40-60 km/h*
- *Safe speed <40 km/h*



PEDESTRIAN ABILITY TO TURN

M2

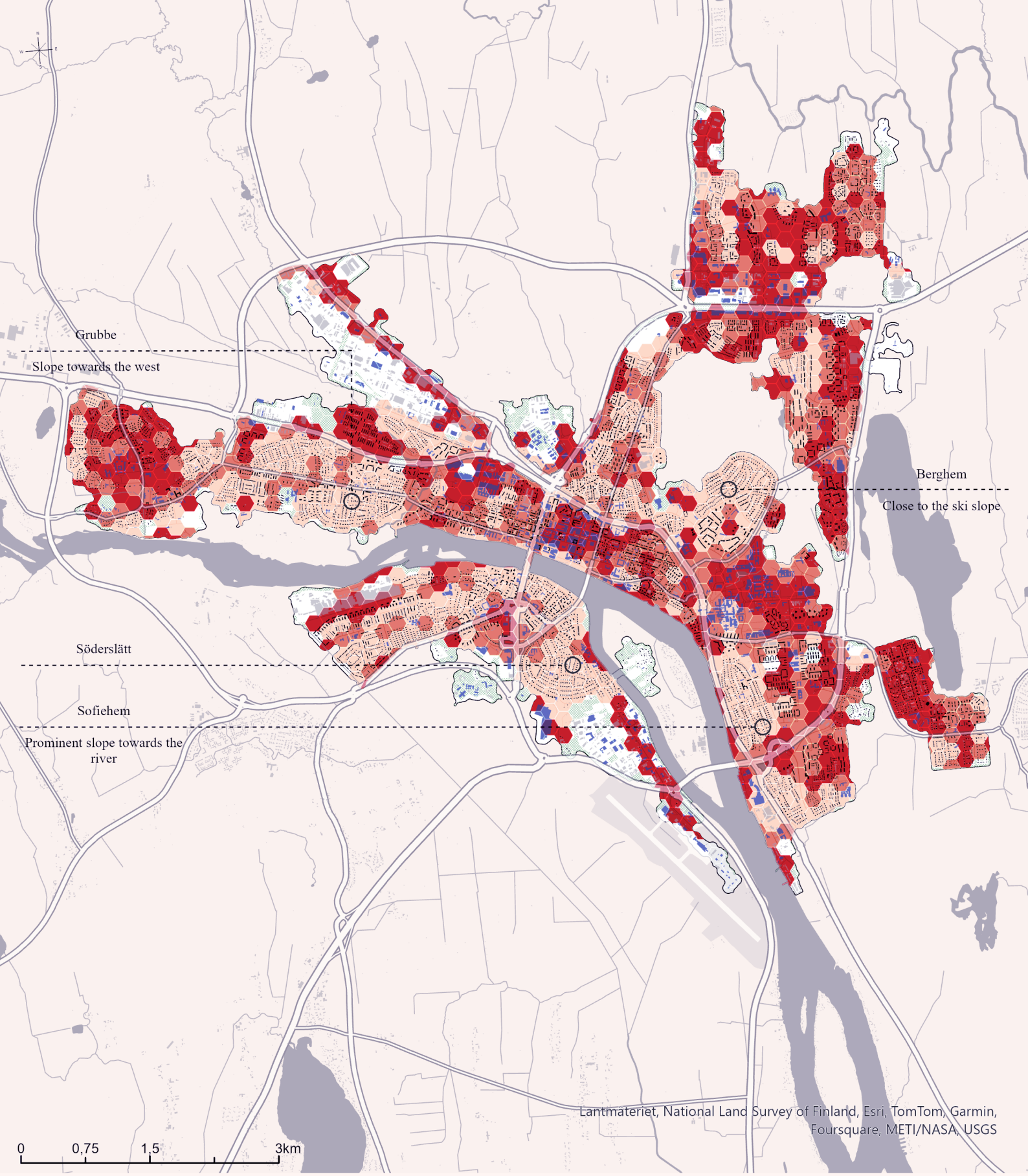
Analysis of the amount of turns or intersections available within the pedestrian roads

- *Public buildings and services: urban infrastructure*
- *Residential buildings*
- *Other buildings (e.g. industrial)*
- *Turns*
- *Water bodies*

Being a relatively modern city, the street design in Umeå allows for frequent changes in direction. Only in some peripheral areas such as industrial zones or large green areas, this capacity is reduced. In some residential designs, the amount of internal streets is limited, since the outer space is considered as walkable in general, with the idea of not wanting to restrict the movement in specific areas. However, from an accessibility standpoint, only properly paved and delimited paths and roads will be considered, since people with reduced mobility will need to follow them.

Residential density

- *Low amount <4 turns*
- *Medium amount 4-6 turns*
- *High amount >6 turns*



ROAD ACCESSIBILITY

M3

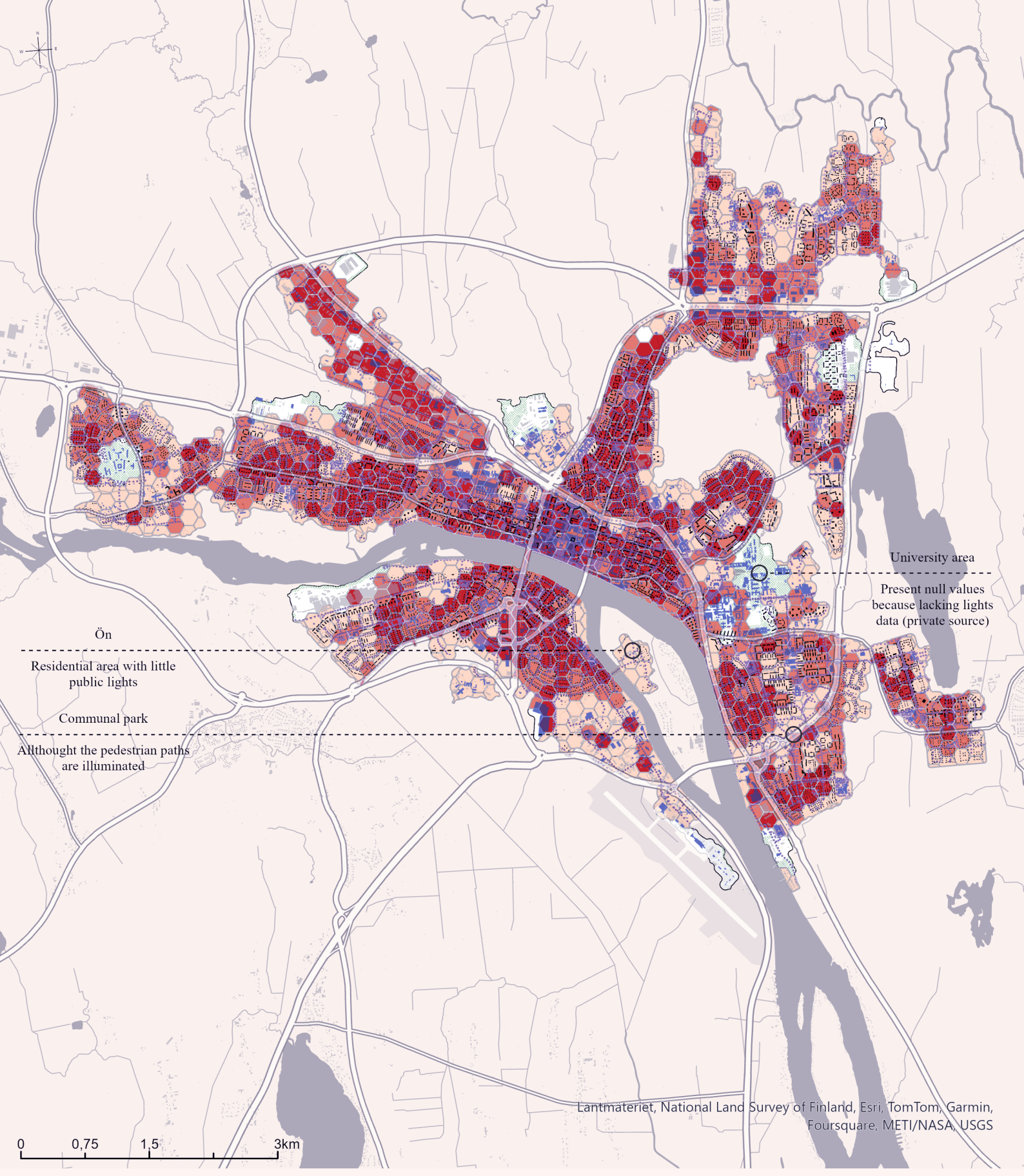
Analysis of the slopes and widths of the pedestrian roads and paths

- *Public buildings and services: urban infrastructure*
- *Residential buildings*
- *Other buildings (e.g. industrial)*
- *Water bodies*

Taking into account the slopes of pedestrian streets and their width, percentages of streets with sufficient accessibility are determined. This is defined as areas where the slope is less than 8% and the sidewalks are wider than 2.5 meters, or where the slope is less than 5% and the sidewalks are wider than 1 meter, or when the slope is less than 5% and the sidewalks are wider than 2.5 meters. Umeå has some neighborhoods in hilly areas, such as Sofiehem, Berghem, Söderslätt, or Grubbe, as the proximity to the river affects the terrain and makes it difficult to design streets with minimal slopes. In terms of sidewalk width, the design is optimal, and there are hardly any areas of the city with narrow sidewalks.

Road accessibility

- *Low <60% with sufficient accessibility*
- *Medium 60-80% with sufficient accessibility*
- *High >80% with sufficient accessibility*



ILLUMINATION ANALYSIS

SP1

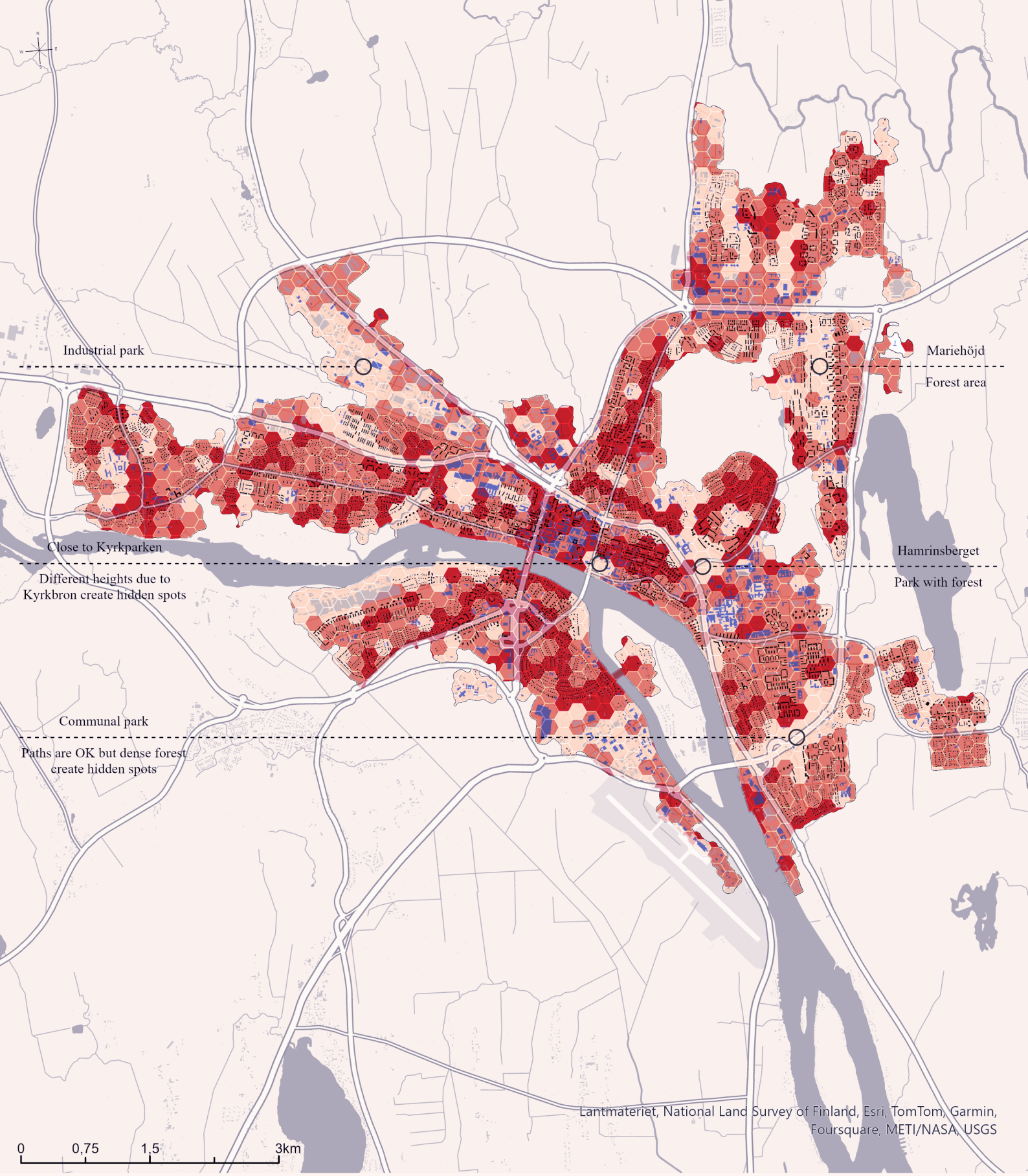
Presence of street lighting in public areas

- *Public buildings and services: urban infrastructure*
- *Residential buildings*
- *Other buildings (e.g. industrial)*
- *Street lights*
- *Water bodies*

The public lighting in Umeå is highly developed and well-maintained. Areas lacking lighting are mainly green areas where illumination is not necessary, of course. However, this factor can contribute to a perception of insecurity. Lighting is also crucial here due to the long and dark winters, addressing not only security concerns such as violence and assaults but also safety concerns such as preventing falls. Certain areas of the city had to be excluded from the analysis because they have private lighting and do not appear in the available data.

Area covered by street lights

- *Bad illumination <70 %*
- *Improvable lighting 70-85%*
- *Good illumination > 85%*



VISIBILITY ANALYSIS

SP2

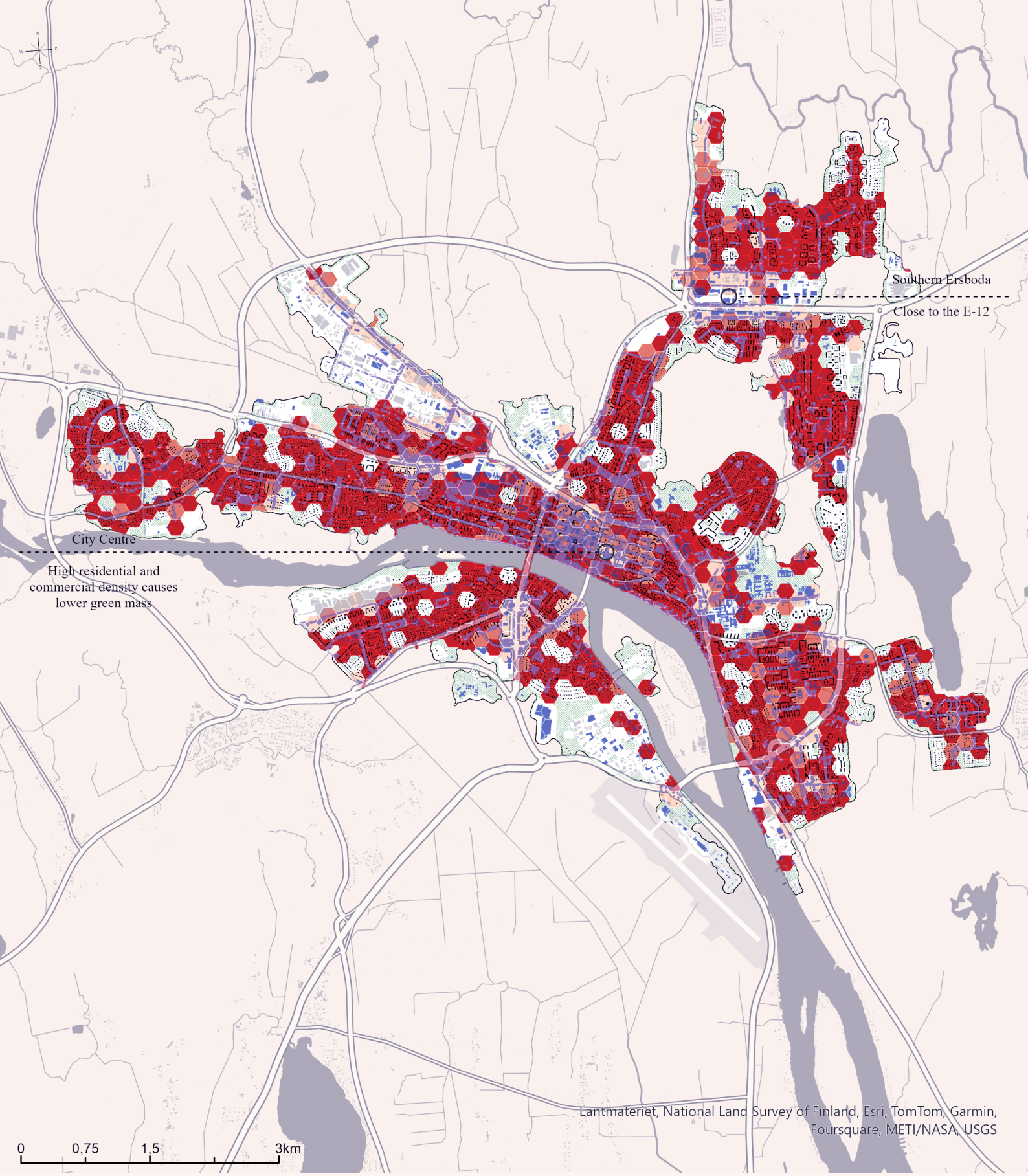
Lack of hidden areas in public spaces using roads as observers

- *Public buildings and services: urban infrastructure*
- *Residential buildings*
- *Other buildings (e.g. industrial)*
- *Water bodies*

The visibility in urban public spaces is relatively good due to the careful design of avenues and streets. It becomes limited in parks and green areas with dense tree cover, as although pathways are visible and safe, there are many hidden areas among the trees.
Industrial areas also exhibit lower visibility because they have a large number of residual spaces and parking lots hidden behind buildings and industrial warehouses.
It's worth mentioning a characteristic condition of residential developments, especially in multifamily housing developments with the design of semi-private parks, which often are surrounded by residential blocks and remain hidden from the main streets. However, windows and entrances often face these spaces, creating an informal surveillance condition that keeps them visible.

Percentage of hidden areas

- *Low visibility >50 %*
- *Medium visibility 50-10%*
- *Good visibility < 10%*



PRESENCE OF GREENERY ON PUBLIC ROADS

UM1

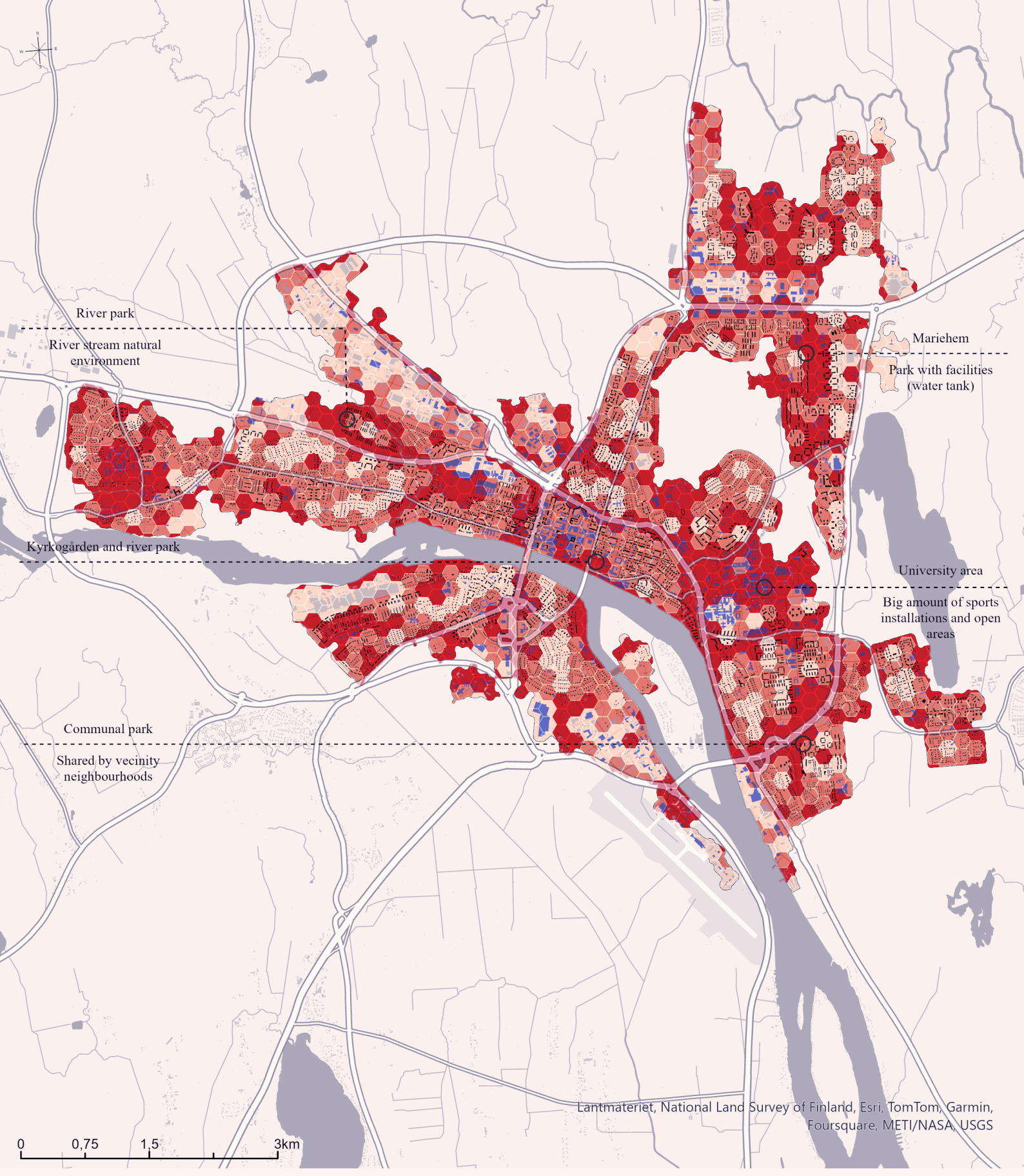
Analysis of the amount of trees existing in public roads in Umeå

- *Public buildings and services: urban infrastructure*
- *Residential buildings*
- *Other buildings (e.g. industrial)*
- *Trees*
- *Water bodies*

This analysis shows the proportion of public thoroughfares designated for pedestrian mobility that is covered by vegetation provided by urban trees. It is calculated considering a canopy diameter of 5 meters, and the ratio is calculated by dividing the area with vegetation coverage by the total area of public thoroughfares, excluding green spaces. The result demonstrates significant green coverage in almost all of Umeå's urban fabric, except for some peripheral areas such as the southern area of Ersboda near the E12 highway. In the center of Umeå, due to urban density and the lack of permeable ground spaces, the quantity of trees is also somewhat limited.

Greenery ratio in public roads

- *Low <50%*
- *Neutral 50-85%*
- *High >85%*



PUBLIC/PRIVATE SPACE PROPORTIONS

UM2

Analysis of availability of public space

- *Public buildings and services: urban infrastructure*
- *Residential buildings*
- *Other buildings (e.g. industrial)*
- *Water bodies*

This analysis illustrates the distribution of public space in the urban fabric of Umeå. As can be observed, the areas in close proximity to the university exhibit the highest proportions, either due to the presence of community parks located nearby or due to university facilities. The city center displays a lower ratio because the land is more densely developed, with the majority of uses being private. Residential areas on the outskirts show lower ratios, especially those consisting of single-family homes.

Public/private ratio

- *Low <25% of public space*
- *Neutral 25-50%*
- *High >50% of public space*