

MASTER

Child-friendly densification

A child's way home

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Child-friendly densification: A child's way home

Graduation Project AUDE-Urbanism 7W45M0

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Child-friendly densification: A child's way home

Keywords

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CHILD-FRIENDLY DENSIFICATION: A child's way home

Keywords: Densification, Daily urban system, Parental involvement, Urban green, Active mobility

Graduation Project AUDE-Urbanism 7W45M0 – M. (Maxime) Borger – 1624016

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Abstract

It is expected that two-thirds of the world's population will live in urban areas by 2050, as cities, among others, become increasingly attractive to families with children. For this reason, the Municipality of Eindhoven wants to build 35.000 to 40.000 homes by 2040. It is important that densification can be combined with the development of a child-friendly city, since the time children spend outdoors in the city, especially in urban green spaces, is becoming significantly shorter in the digital age we now live in. The goal of this research is to plan and design a safe, healthy and playable environment (children's daily urban system) so that children (and caregivers) use more active transport modes and participate more often in outdoor (play) activities. By means of a literature study, three case studies, a critical policy analysis and a spatial analysis of Eindhoven, a city strategy was made and designs (based on child-friendly densification) were created for the (selected) neighborhoods Drents Dorp, 't Hool and Zandrijk. Within these neighborhoods (and in general) densification (with facilities) can reduce the distances children have to travel to various activities. However, the route children must take by means of active transport modes towards an activity (which is often determined by a parent or caregiver) must remain safely accessible in a densifying context. Child-friendly housing, safe traffic routes (for the purpose of independent mobility), proximity to services and public spaces (for the purpose of outdoor play and access to green spaces (and/or UGI)) are the four elements of a child-friendly city applied through various principles within the selected neighborhoods.

1.4 The importance of children making use of the daily urban system

The daily urban system is the area within which the most important daily movements take place, such as home to sports, school, activities, play areas, friends, and so on. These movements take place in the three most important living domains: children’s outdoor play spaces (streets, green spaces and play spaces (including schoolyards)), leisure centers and caring institutions. It consists of places that children use and/or go to in everyday life, whether alone, or with friends or with family (Karsten, 2002; Steenhuis et al, 2018; Krishnamurthy, 2019).

Themes such as access to urban green spaces (and/or UGI), independent mobility, proximity to services and outdoor play, are important with the increasing obesity among children and

young people (see figure 2)(Krishnamurthy, 2019; Page, 2010).

Making use of the daily urban system, through the above themes, is crucial for the physical, social and cognitive development of young children (Martin & Wood, 2013; Wells & Lekies, 2006; Khalilollahi et al., 2022). In addition, being in a natural environment is beneficial for children's mental health and physical activity, as it is restorative and associated with children's receptivity, emotional responsiveness and stress management (Wells & Lekies, 2006; Yin et al., 2022). In contrast to these positive effects, the time children spend outdoors in cities, especially in urban greenery, is becoming significantly shorter in the digital age in which we now live (Wells & Lekies, 2006; Yin et al., 2022).

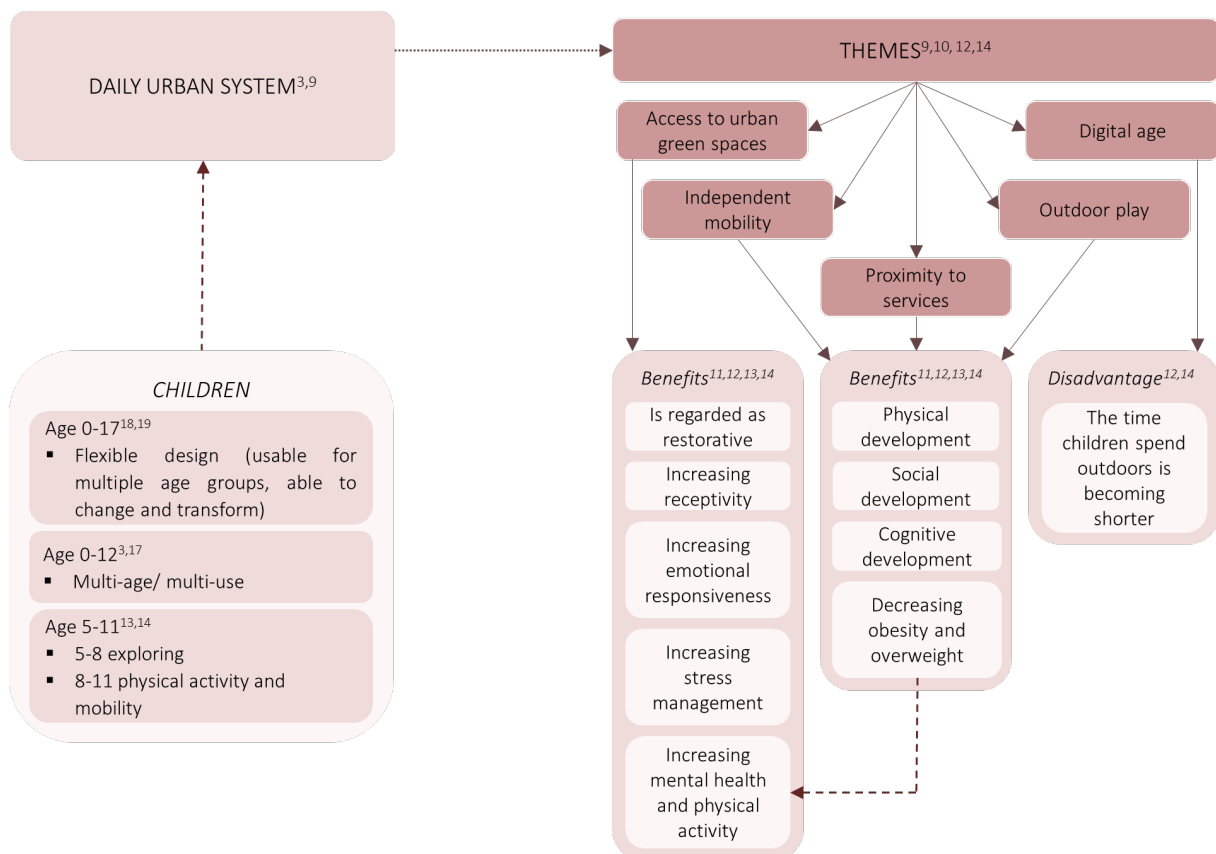


Figure 2, daily urban system

1.5 The importance of child-friendly densification

The word densify often creates many controversial opinions and views among stakeholders (see figure 3). Densification, in fact, is often associated with the addition of high residential and commercial towers, an increase in the number of car trips, the need for more parking spaces and thus a decrease in public space (parks and squares), more shadows (resulting in more heat-islands) and unsafe (or too crowded) streets.

The Municipality of Eindhoven also draws the conclusion that (the outlined developments in) densification often affect the public space, if no further measures are taken (however, this also does not fit the existing policy).

To achieve child-friendly densification, the literature suggests some city-level (and neighborhood and block-level) principles for densification and for a child-friendly neighborhood, some of these will be used as a given, some are adapted.

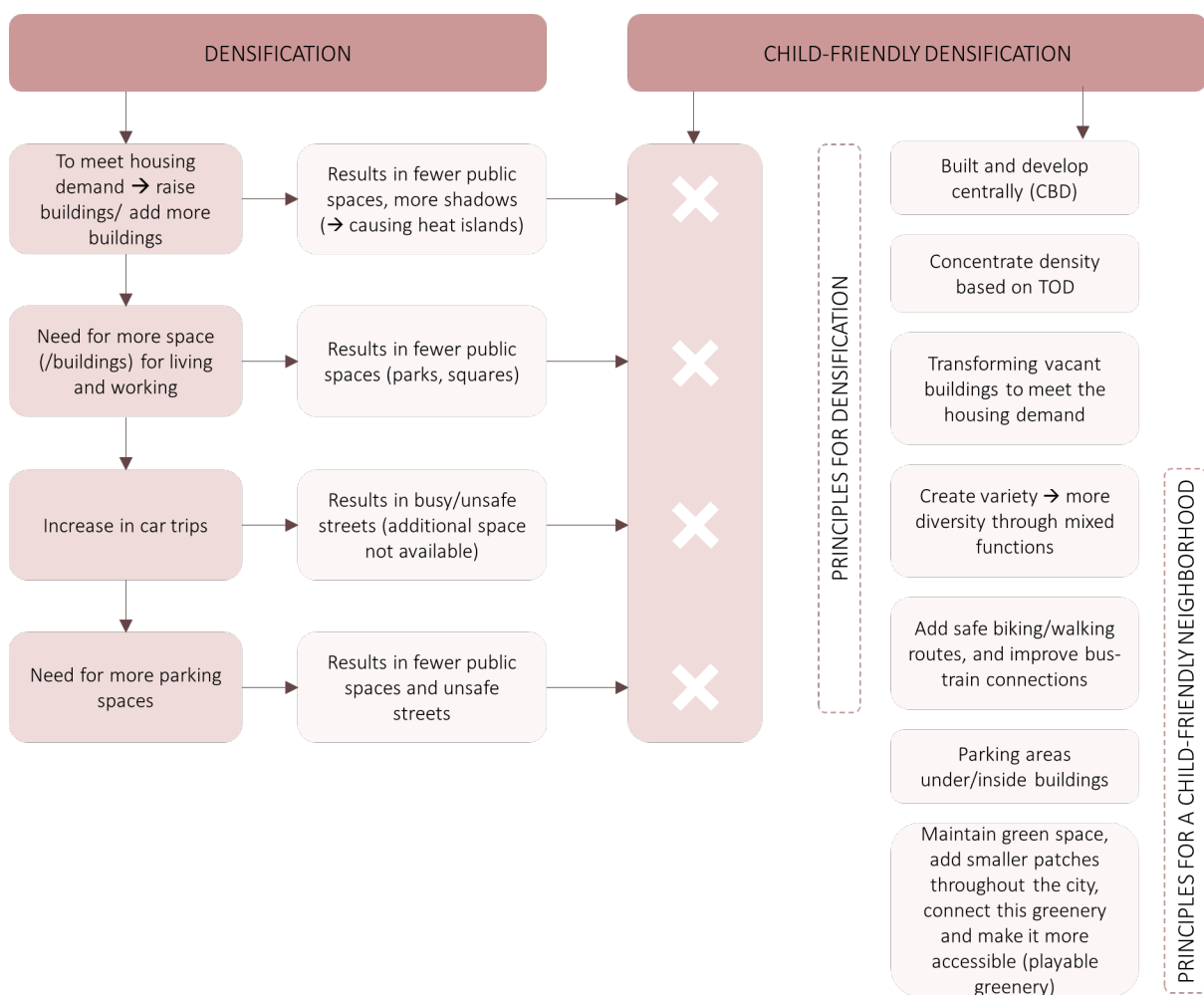


Figure 3, child-friendly densification

1.6 City analysis

Based on the above themes, a city analysis was conducted, which can be fully deduced from the maps in Appendix A (with data from government agencies, which can be found in Appendix B), and literature based on safe, playable and healthy environments for children.

First, Eindhoven is made for cars and not for active transport modes. The city consists of many low-density areas, where spaces are often not efficiently arranged (e.g., wide roads and narrow sidewalks). This makes it unsafe for slow traffic due to fast traffic. In addition, on average, facilities are located further away than the walking distance of 400 meters (5-minute walk), making people more likely to take the car. This causes low air quality and high noise pollution (Martin & Wood, 2013; Khalilollahi et al., 2022; Bruntlett & Bruntlett, 2018).

Secondly, it is often unsafe for children to play, walk or bike during/to activities. This is because of fast traffic and because there is not always direct visibility for passive (or active) surveillance, due to many high bushes, many enclosed buildings and dark spaces. In addition, parental involvement (/engagement) plays a large role in the perceptions they have and the restrictions they impose on their children (Krishnamurthy, 2019; Page, 2010; Khalilollahi et al., 2022; Faulkner et al., 2015).

This also greatly affects the third point, which is that it is often unattractive for children (and thus their caregiver) to play, walk or bike. There is more paved (public) space than there is unpaved (green) space, in addition, there is often not enough shade, there are not enough seats and there is a lot of dog poop on the street and in the grass (Khalilollahi et al., 2022; Yin et al., 2022; Krysiak, 2020).

Children of these days are more likely to play a videogame, and are less likely to play outdoor, play sports and use active mobility, which causes little socialization and more children with mental or physical health issues, like depression, loneliness, diabetes, obesity, anxiety and phobias (Steenhuis et al, 2018;

Page, 2010; Martin & Wood, 2013; Khalilollahi et al., 2022; Yin et al., 2022).

1.7 Target group

The target group of this study is elementary school children in the age category 5 to 11. These are the ages that overlap the most in several studies. In this way, ages 5-8 and 8-11 can be combined in a multi-purpose design. A city for children is often also a city for the elderly or the disabled, since it must be accessible at different levels.

1.8 Research gap

Adverse effects on children's health and well-being continue to increase with the decline in active mobility and spontaneous outdoor play (outdoor activities)(Krysiak, 2020). Active mobility and spontaneous outdoor play will need to increase in the coming years to combat depression, loneliness, diabetes, obesity, anxiety and phobias at an early age. How to get children of different ages, cultures and socioeconomic positions out into the streets remains a challenge in the context of a densifying city. While studies on child-friendly cities exist (Karsten, 2002; Steenhuis et al, 2018; Krishnamurthy, 2019; Krysiak, 2020), there is a need for further focus on how to create a safe, healthy and playable living environment for children under pressure of a densifying city. Furthermore, there is a need to investigate how to implement the results of such studies in the context of a densifying city like Eindhoven.

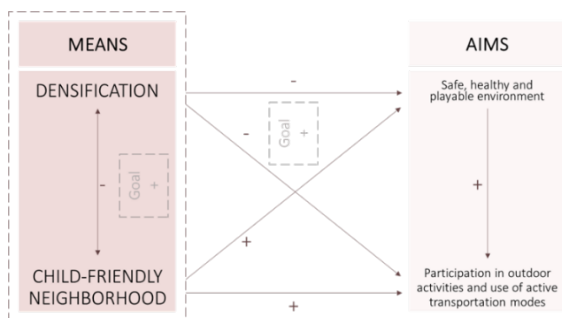


Figure 4, goal of research

1.9 Research goal and question

The goal of this research is to plan and design a safe, healthy and playable environment (the daily urban system of children), so that children (and caretakers) use more active transport modes and participate more often in outdoor (play) activities (see figure 4). This leads to the research question: 'How to create a more safe, healthy and playable environment for children's daily movements in the context of a densifying city (i.e., Eindhoven)?' In order to answer the main research question, some sub-questions have been formulated which are divided into two means:

Densification (and the daily urban system)

- How is densification defined (in the context of Eindhoven)?
- What includes the daily urban system of children?
- What consequences exist for the daily urban system of children, when densification takes place?
- In what ways do children and caregivers make use of the daily urban system of children and what is the proximity to services and healthy spaces (in areas of different densities) in these systems?
- In what ways can the daily urban system of children be made more safe and attractive, simultaneously with densification, so that more use is made of active transport modes by children and so that children will continue to play (and sit) outside?

Child-friendly neighborhood:

- What is a safe, healthy and playable environment for children of different ages (a child-friendly city) and what are the benefits?
- In what way are all life domains, such as education, (active) mobility, recreation, sports, environment and health, part of a child-friendly city?
- In what ways can children be motivated to play outside, instead of playing video games?
- What are the beneficiaries of urban green space for children's optimal development and what is the necessity, regarding a safe, healthy and playable city?
- How can children of different ages, cultures and socioeconomic positions (backgrounds) influence the design of the daily urban system of children?
- In what way can children be included in the design of their daily urban system (participation)?

2. Methodology

This paper is divided into three parts: The research, the design and the reflection (see figure 5). The preliminary research consists of four research methods: a literature review, three case studies, a critical policy analysis and a spatial analysis of Eindhoven, after which three neighborhoods are selected with (a high

average between) a high densification potential and a high need for child-friendly development. Based on the preliminary research, interventions for a design are formulated. Afterwards, the design is reflected upon by means of earlier studies, so that any limitations come to light.

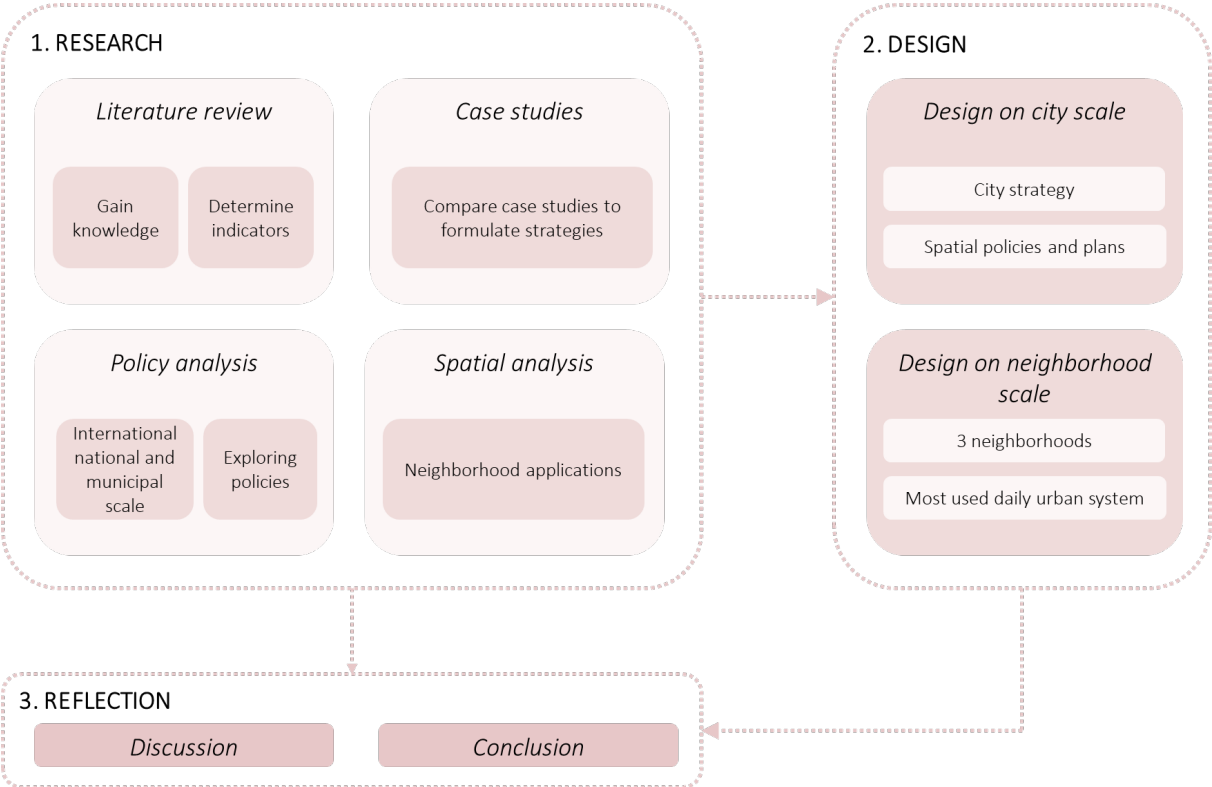


Figure 5, methodology scheme

2.1. Research

2.1.1. Literature review

During the initial period of the research, the goal was to understand the context of the study, after which data (literature) could be collected and selected based on keywords (see figure 6). From these literature studies, indicators are defined that will be important for

the research, the determination of the potential intervention locations and the design of the selected locations. In addition, this method will be used to gain more knowledge about densification, daily urban system, parental involvement, urban green and active mobility.

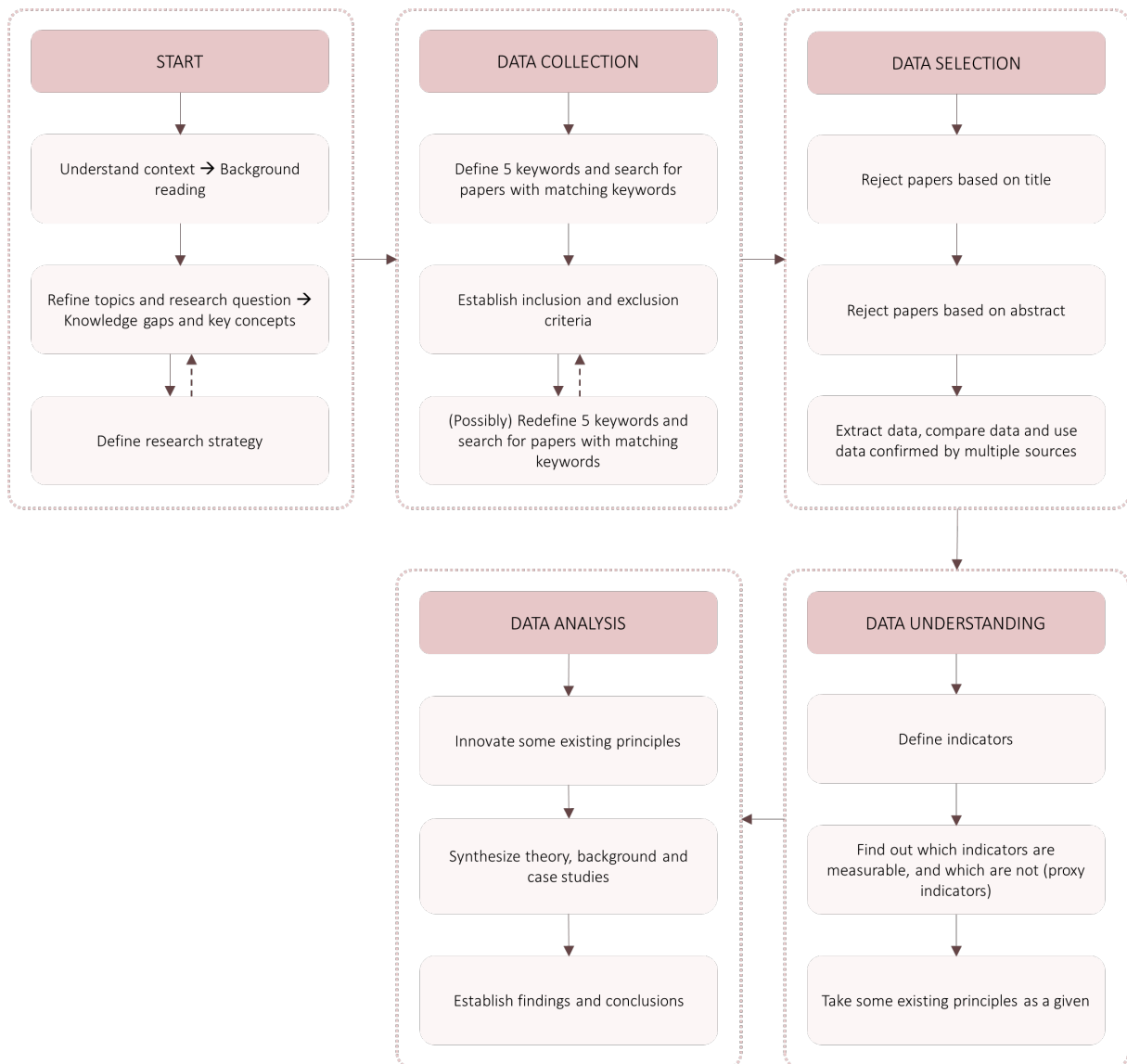


Figure 6, methodology scheme literature review

2.1.2 Case studies

Case studies can be used to formulate strategies. However, results cannot be copied directly, as they have a different context and location (maybe even outdated)(see figure 7). By comparing three case studies, it can be

determined why and which strategies worked in a particular context (and which do not). This paper examined two case studies in Amsterdam (Kindlint, and Children’s Domains) and one in London (Playable Streets and courtyards).

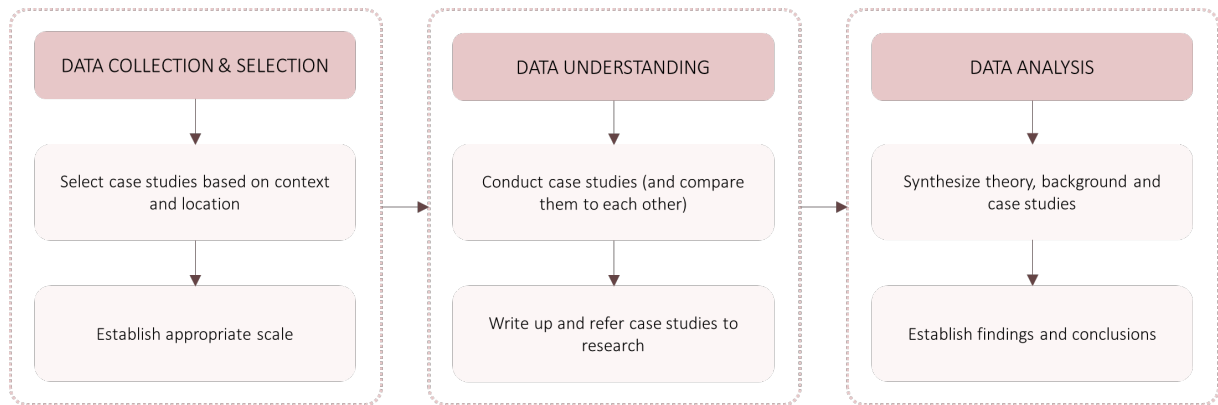


Figure 7, methodology scheme case studies

2.1.3 Policy analysis

A policy research is carried out at the municipal level, so that knowledge can be gained about the plans (for a child-friendly city and for densification) of the municipality of Eindhoven.

In addition, an international and national study will be carried out to find out whether there are already plans on international and national level for a child-friendly city (see figure 8).

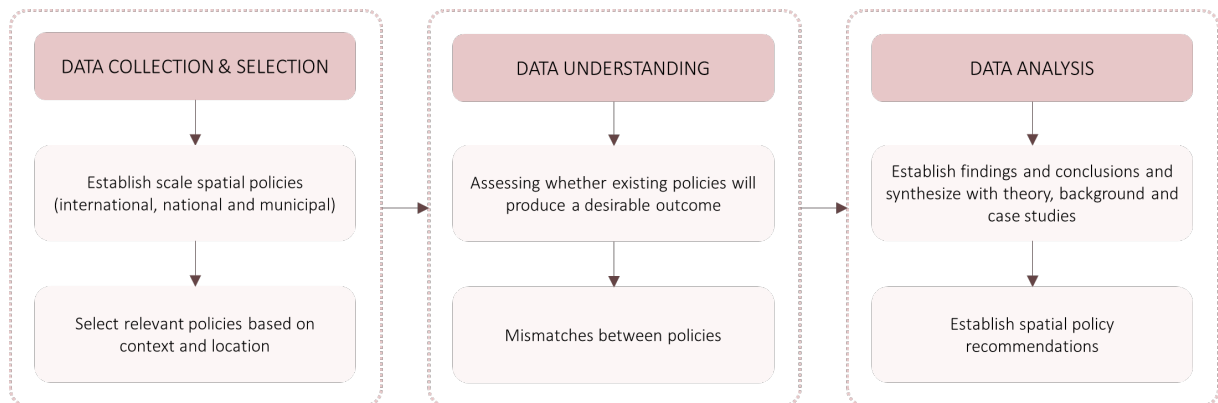


Figure 8, methodology scheme policy analysis

2.2 Design

2.2.1 Design on city scale

Different principles for the purpose of densifying a city and making it child-friendly have been identified based on the results of the indicators from the literature review, case studies and policy analysis. These principles were applied to achieve the most favorable outcome in terms of simultaneously increasing urban density and making the city child-friendly. Whether the densification goals set by the municipality, and whether the application of the principles has a favorable result, will be determined in the reflection phase.

2.2.2 Design on neighborhood scale

During the spatial analysis, 3 neighborhoods were selected through a scoring system with (a high average between) a high densification

potential and a high need for child-friendly development. In addition, the selected neighborhoods have different needs and potentials, allowing them to play a representative role within their typology. A neighborhood design was created based on the indicators, allowing to determine which locations in the neighborhood have the highest potential for densification and a high need for child-friendly development and in addition, which interventions could fit with them.

2.3 Reflection

2.3.1 Conclusion and discussion

A critical reflection was conducted on both the created design and the conducted research in the last part of the paper. Any limitations of the research are highlighted, following which recommendations will be made for further research.

3. Research

3.1 Literature review

The literature found describes multiple principles in favor of densification and of child-friendly cities (and neighborhoods). However, no papers were found that propose principles for combining both topics. For the sake of current trends, it is important to conduct studies regarding combining principles on

behalf of densification and child-friendly cities and neighborhoods. Figure 10 provides an overview of the literature found, including publication years, the discussed topics on behalf of densification and of child-friendly cities and neighborhoods, and the data collection methods used in the paper.

Number	Author(s)	Year	Title
1	Krysiak, N.	2020	Cities For Play
2	Yin, S., Kasraian, D. & van Wesemael, P.	2022	Children and urban green infrastructure in the digital age
3	Khalilollahi, A., Kasraian, D., Kemperman, A.D.A.M. & van Wesemael, P.	2022	Application of the COM-B model to the correlates of children's outdoor playing and the potential role of digital interventions
4	Danenbergh, R., Doumpa, V., & Karssenbergh, H.	2018	The city at eye level for kids
5	Wells, N.M. & Lekies, K.S.	2006	Nature and the Life Course
6	Steenhuis, C., Reijnders, D., Stav, T. & Krishnamurthy, S.	2018	Childs friendly urban design
7	Martin, K.E. & Wood, L.J.	2013	What Makes a Child-Friendly Neighborhood?
8	Arup's Foresight	2017	Cities Alive: Designing for Urban Childhoods
9	Page, A.S.	2010	Independent mobility, perceptions of the built environment and children's participation in play, active travel and structured exercise and sport
10	Krishnamurthy, S.	2019	Reclaiming spaces: Child inclusive urban design
11	Teller, J.	2021	Regulating urban densification: what factors should be used?
12	Pelczynski, J. & Tomkowicz, B.	2019	Densification of cities as a method of sustainable development
13	Haaland, C. & Konijnendijk van den Bosch, C.	2015	Challenges and strategies for urban green-space planning in cities undergoing densification
14	Lin, B., Meyers, J. & Barnett, G.	2015	Understanding the potential loss and inequities of green spacedistribution with urban densification
15	Madureira, H. & Monteiro, A.	2021	Going Green and Going Dense
16	Tillie, N., Borsboom-van Beurden, J., Doepel, D. & Aarts, M.	2018	Exploring a Stakeholder Based Urban Densification and Greening Agenda for Rotterdam Inner City

Number	Densification	Child- friendly neighborhood	Qualitative data collection	Quantitative data collection
1		x	x	
2		x	x	
3		x	x	
4		x	x	x
5		x	x	x
6		x	x	x
7		x	x	x
8		x	x	
9		x		x
10		x	x	x
11	x		x	
12	x		x	
13	x		x	
14	x		x	x
15	x		x	
16	x		x	x

Figure 10, literature scheme

3.1.1 *Densification*

Background and trends

The ratio of a city's total population to its total area is usually defined as urban density (Teller, 2021). The gradual increase in population density (and/or built-up density) is understood as densification (Teller, 2021). To accommodate population growth, the ratio of people per land area or the ratio of housing units can be increased by urban densification (Tillie et al., 2018; Madureira & Monteiro, 2021).

A new planning policy adopted in several cities and regions is aimed at promoting urban densification, through urban consolidation and in-fill development (compact city) (Teller, 2021). This attempts to prevent the development of open/green spaces, limiting further expansion of urban areas (outwards). This expansion causes reduced accessibility (longer distance to facilities and services, longer travel time and high (travel) costs) of these areas. In addition, it leads to a loss of green (public) spaces and agricultural land and the fragmentation of habitats (Tillie et al., 2018).

Nowadays, urban densification is increasingly accepted as a necessity and occurs in many places (Teller, 2021). Especially in cities that are growing rapidly, in combination with economic pressures, demographic changes and major transportation infrastructure projects (such as developing car-free cities) (Pelczynski & Tomkowicz, 2019). Transit-oriented development is a useful way to densify around key nodes with different facilities and services. In addition, densification with amenities shortens the distance between activities, making the use of active transport modes (and public transport) more attractive (Tong et al., 2018).

Urban densification must be addressed at several levels so that the complex, nonlinear process can be optimized (Teller, 2021). The need to identify conditions that promote spatial equity, specify places that are most suitable for

future residents and activities, and can create the most value for the city, is implied by this optimization of densities (Haaland & van den Bosch, 2015).

The literature suggests several principles for densification (see figure 11 and 12).

Densification versus urban green space

In areas of increasing population, the compact city approach -as a planning approach for sustainable development- has gained worldwide importance. Despite all the advantages associated with the application of compact cities, there are several challenges and problems in the field of urban green space development and planning (Pelczynski & Tomkowicz, 2019). Literature confirms that a major threat to urban green space (and/or urban green infrastructure) can be posed by urban densification processes such as consolidation and infill (Haaland & van den Bosch, 2015).

The urban green infrastructure in a city refers to the publicly accessible natural or urban green spaces that are used and experienced by children at the neighborhood and city level. In addition, the UGI is an interconnected network between, around and within urban areas (Yin et al., 2022).

According to the literature, private and public green spaces decrease with urban densification (Lin et al., 2015). However, according to socioeconomic benefits, the availability of public versus private green infrastructure differs (Haaland & van den Bosch, 2015). Suburbs with lower socioeconomic advantages tend to have less private green cover but more public green cover than suburbs with higher socioeconomic advantages (Lin et al., 2015). Thus, densification can lead to the loss of urban green infrastructure. However, it is also mentioned that an increase in the quality of the UGI can compensate for the loss of UGI (Haaland & van den Bosch, 2015).

Block scale	
High rise (vertical densification)	Located in the most urbanized areas (high-rise zones), these dwellings can only be realized where land conditions and regulations permit. Residents benefit from the proximity of amenities to this type of housing. In addition, human scale is very important in the design phase.
Skyborn (vertical densification)	Houses built after 1950 are suitable for the use of densification by "topping-up," as they often have a good construction. This method includes a wide variety of building typologies as new homes are adapted to existing structures. Green surroundings and proximity to urban facilities are exploited optimally.
Ground based (horizontal densification)	Ground-based dwellings are particularly attractive to families due to its ground-level access (street-level access and a garden), as it enhances the livability of the neighborhood while also contributing to individual housing. Large outdoor public spaces and undeveloped parcels are useful for this form of densification.
Water dwellings (horizontal densification)	Different housing types are possible that make full/partial use of this dynamic environment, without being hindered by existing building lines and zoning of land. Some examples are floating houses, pole houses, jetty houses and quay blocks.
Transforming vacant properties	For the purpose of an attractive inner city, a mix of housing with offices and other functions would provide a stable backbone. Vacancy occurs particularly in post-war office areas, which are sensitive to economic conditions (to which housing is less sensitive).
Infill	Infill housing is a valuable method that increases the attractiveness and diversity of a neighborhood, reinforcing the identity of the urban fabric. By means of a kind of bridge, gaps above large courtyards, undeveloped plots and narrow delivery streets can be filled.
Destruction and replacement	Destruction of built-up areas with low population density and replacement with built-up areas with high population density is a form of urban renewal, which is very expensive and involves the loss of many buildings that could possibly have been refurbished or otherwise used.
DIY	DIY housing (belonging to the nineteenth-century housing stock) does not meet current spatial requirements and is often poorly maintained. This housing type is more often a matter of modifying building blocks to accommodate more residents, rather than densification in terms of square footage.

Figure 11, scheme design principles for densification on block scale (Xu et al., 2019; Tillie et al., 2018; Pelczynski & Tomkowicz, 2019; Haaland & van den Bosch, 2015; Teller, 2021; Madureira & Monteiro, 2021)

Neighborhood scale	
Addition of new buildings	When there is space (and demand) to develop housing, new buildings can be added. This usually happens in places where parking lots (or similar) were located, or on greenfields.
Fabric regeneration	In the case of an aging neighborhood, fabric regeneration can be applied. Preferably, the homes are owned by a housing corporation, since this has more design freedom. This is especially attractive in neighborhoods where the construction of the buildings is outdated, but can be reused again. Nowadays, sustainability plays an important role in this.
Transforming of existing areas	In the case of an outdated neighborhood, the choice can be made to transform an area. Preferably, the homes are owned by a housing corporation, since this has more design freedom. This is especially attractive in neighborhoods where the construction of the buildings is outdated. A choice can be made to keep part of the construction, or to demolish everything.

Figure 12, scheme design principles for densification on neighborhood scale (Xu et al., 2019; Tillie et al., 2018; Pelczynski & Tomkowicz, 2019; Haaland & van den Bosch, 2015; Teller, 2021;Madureira & Monteiro, 2021)

3.1.2 Child-friendly cities

Background and trends

The time children spend outdoors in cities has been steadily decreasing in recent decades (in the digital age) (Steenhuis et al, 2018; Khalilollahi et al., 2022; Yin et al., 2022; Martin & Wood, 2013; Page, 2010; Krishnamurthy, 2019). For children's personal development (physical, social, emotional and cognitive health development) and well-being, green spaces and other opportunities for children to play outside and use independent mobility are highly beneficial and fundamental (Steenhuis et al, 2018; Khalilollahi et al., 2022; Yin et al., 2022; Martin & Wood, 2013; Krishnamurthy, 2019). In addition, being in a natural environment is beneficial for children's mental health and physical activity, as it is restorative and associated with children's receptivity, emotional responsiveness and stress management (Wells & Lekies, 2006; Yin et al., 2022; Unicef, 2021). The fact that certain aspects of a child's development positively correlate with the child's psychological and

physical well-being promotes a better alignment between health, safety, play and planning (Steenhuis et al, 2018; Martin & Wood, 2013).

One reason why children spend little time in outdoor spaces in recent decades may be that the quality and quantity of UGI has declined in the face of current urbanization trends (Yin et al., 2022; Krishnamurthy, 2019). In addition, instead of interacting with nature, children spend too much time behind electronic screens (Yin et al., 2022; Steenhuis et al, 2018). However, this causes a very unhealthy lifestyle that can cause many physical health and mental well-being problems such as overweight, obesity, depression, loneliness, diabetes, fears and phobias (Steenhuis et al, 2018; Khalilollahi et al., 2022; Yin et al., 2022; Page, 2010; Krishnamurthy, 2019). Figure 13 plots these child outcomes (physical health and mental well-being). It can be seen that these are influenced by the world in general, the world around the child and the child's world.

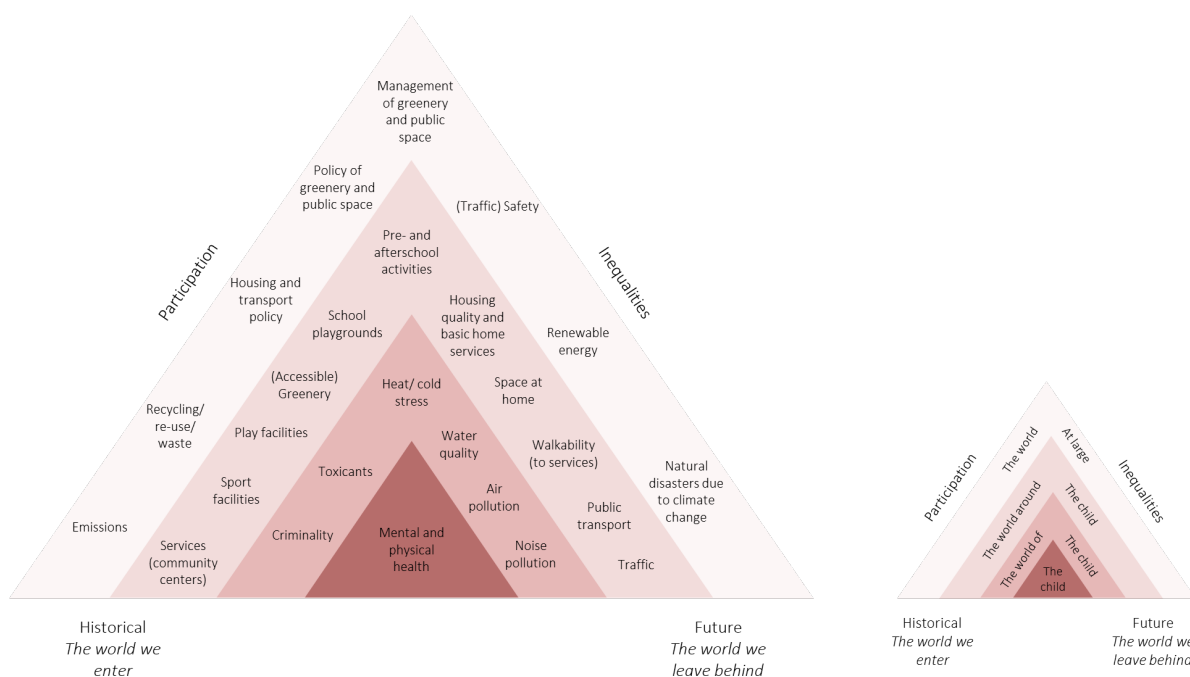


Figure 13, Child outcomes (Timar et al, 2022)

Child-friendly city

To ensure that this unhealthy lifestyle is not part of future generations, different domains (like education, (active) mobility, recreation, sports, environment and health, within children's daily urban system) can be adapted for children. Designing a child-friendly city could be a way to respond to this (Steenhuis et al, 2018; Martin & Wood, 2013; Krishnamurthy, 2019).

The term 'Child-friendly city' refers to a system of local government that is committed to the realization of the rights of the child. This depends on the ability of cities to relate to local, regional and national scales. In a child-friendly city, children have the opportunity to actively and effectively participate in public life, develop their full potential and make decisions on matters that concern them. In addition, there is no discrimination on the grounds of religion, nationality, social status, gender or health status (Astana, 2015; Parker, 2022; Steenhuis et al, 2018).

The framework of urban planning interventions that should be available for a child-friendly city consists of four elements (Steenhuis et al, 2018; Martin & Wood, 2013; Krishnamurthy, 2019): Child-friendly housing, safe traffic routes (for the purpose of independent mobility), the

proximity to services and public space (for the purpose of outdoor play and access to green spaces (and/or UGI)). These points are strongly related, because if a city lacks any of these four elements, it will not work as a child-friendly city is meant to (Steenhuis et al, 2018; Martin & Wood, 2013; Krishnamurthy, 2019).

In some cases, a safe route (neighborhood children's route) connects key facilities (schools, parks, playgrounds, community centers) through visible markings, promoting children's independent mobility through the neighborhood (Steenhuis Et al, 2018). Several studies address the concept of child participation for the purpose of helping to maintain the neighborhood, whose participation is increasingly promoted (Steenhuis Et al, 2018)(Astana, 2015)(Parker, 2022) (Martin & Wood, 2013) (Krishnamurthy, 2019).

Daily urban system

The daily urban system is the area within which the most important daily movements take place, such as home to sports, school, activities, play areas, friends, and so on. These movements take place in the three most important living domains: children's outdoor play spaces (streets, green spaces and play

spaces (including schoolyards)), leisure centers and caring institutions. It consists of places that children use and/or go to in everyday life, whether alone, or with friends or with family, using independent mobility (active transport modes or public transport)(Karsten, 2002; Steenhuis et al, 2018; Krishnamurthy, 2019). However, the route one must travel through active transport modes toward an activity (which is often determined by a parent or caregiver) must remain safely accessible in a densifying context.

Utilizing the daily urban system, through the themes of access to urban green (and/or UGI), independent mobility, proximity to services and outdoor play, is crucial to children's health and development (Martin & Wood, 2013; Wells & Lekies, 2006; Khalilollahi et al., 2022).

The daily urban system depends heavily on when a movement occurs. This includes taking into account the different seasons, school periods or vacations, holidays, weekends or weekdays and whether it is day or night, because the pattern of people will be different.

Behavior and needs of children of different ages

Up to and including a person's 17th year, one is by law (in the Netherlands) a child (Ministerie van Justitie en Veiligheid, 2020). Different age categories and maximum ages are named in the literature to describe a child. Three age categories are most frequently mentioned in the literature. These are the ages 0-17 (Danenberg, Doumpa & Karssenberg, 2018; Arup's Foresight, 2017), 0-12 (Steenhuis et al, 2018; Krysiak, 2020) and 5-11 (5-8 and 8-11) (Khalilollahi et al., 2022; Yin et al., 2022). The ages that overlap the most in different studies are the ages 5 to 11 (primary school children), which allows for a multi-use or multi-age design to combine ages 5-8 and 8-11. Not only children can use a multi-use or multi-age design, but also the elderly and disabled, since it will be accessible on several levels (Steenhuis et al, 2018; Krysiak, 2020).

Opportunity, motivation and ability are three behavioral components that are influential

when looking at the UGI use of children aged 5 to 11 years (Khalilollahi et al., 2022). It is stated that at the age of 11, the relationship between children and nature is most positively influenced (Yin et al., 2022). In addition, this age group spends large amounts of time outside of school and out of the house, as they more often explore their surroundings autonomously and are often physically active. Furthermore, children's autonomous mobility shows a positive relationship with UGI and connectedness. However, the degree of this autonomous mobility varies by gender and age (Yin et al., 2022; Page, 2010; Krishnamurthy, 2019).

Younger children aged 4 to 8 are more motivated and intrinsically enthusiastic by opportunities for adventurous/creative activities, imaginary role play and small-scale exploration. Younger children (in pairs and group interactions) are the most likely to observe playful and energetic interactions. In contrast, slightly older children aged 8-11 are more prone to competition in larger teams (sports activities), mobility and activity on a larger scale (Khalilollahi et al., 2022; Yin et al., 2022; Martin & Wood, 2013; Page, 2010).

Child-friendly city and the UGI

Children's playtime in nature plays a crucial role in their environmental awareness in adulthood (Wells & Lekies, 2006). Children's general health and physical activities are positively associated with proximity to the UGI (Khalilollahi et al., 2022). In addition to proximity, the greater number and increase in the size of the UGI are also associated with higher use by children (Khalilollahi et al., 2022; Krishnamurthy, 2019). The interaction between UGI and children can be facilitated by placing nature-related activities around/inside schools. In addition, research shows that children have better concentration skills in a nature-oriented environment (Khalilollahi et al., 2022; Yin et al., 2022).

Physical environment

When children can physically touch and experience the natural things in their environment (shells, leaves, branches, water and sand), they get a clearer picture of the environment (Wells & Lekies, 2006; Martin & Wood, 2013). In addition, the morphological diversity of the UGI surfaces increases the variety of spatial conditions, leading to more opportunities for children to experience nature and explore (Yin et al., 2022). These opportunities may be limited by the regularity and uniformity of surfaces. For the physical environment, opportunities for tactile interactions with the natural elements of the UGI can also provide an opportunity. In addition, studies show that children have less contact with unorganized and undesigned places (streets and pavements) than with organized and designed UGI (parks, school playgrounds and sports fields)(Yin et al., 2022; Krishnamurthy, 2019). Studies also show that another positive influence on children's outdoor play behavior is related to the presence of informal play areas (Khalilollahi et al., 2022; Martin & Wood, 2013). Children's motivation and resilient sense of ownership of their environment is challenged by poor aesthetics or conditions (poor maintenance). Children express strong evaluations and preferences for these items, as well as for natural elements, such as beautiful flowers and shady trees (Steenhuis et al, 2018; Yin et al., 2022).

Through the application of different play opportunities, car-free roads, child-friendly routes, (communal) facilities, active and passive surveillance and different types of greenery, a safe, healthy and playable environment for children of different ages, cultures and socio-economic positions can be developed (see figure 14 and 15). (Steenhuis et al, 2018; Khalilollahi et al., 2022; Yin et al., 2022; Page, 2010; Krishnamurthy, 2019)..

External factors

The way the UGI is used, experienced and perceived is related to the cultural and social background of children and the economic

status of caretakers (place of residence, ethnicity, race, gender, level of education, income and the number of cars of caretakers) (Steenhuis et al, 2018; Khalilollahi et al., 2022; Yin et al., 2022; Page, 2010; Krishnamurthy, 2019). Low-income caretakers often live in smaller houses without gardens, which means that children are more likely to play outdoors. Another reason why these children play more outside is because they have less digital technology and less access to structured exercise/sports than children of high-income caretakers (Page, 2010). When schools and playgrounds are located further away (walkability) (Martin & Wood, 2013), the amount of children's outdoor play decreases. In addition, the outdoor playtime of younger children is inversely related to the increase in street density in more urbanized areas, in the absence of UGI and public spaces (Khalilollahi et al., 2022; Martin & Wood, 2013; Krishnamurthy, 2019).

Parental involvement

The perceptions of caretakers, in addition to the personal psychological and physical capabilities of children, can limit the interaction between UGI and children (Khalilollahi et al., 2022; Yin et al., 2022; Martin & Wood, 2013; Page, 2010). For example, boys have greater independent mobility at a younger age, as parents restrict girls in this until later in life (due to parental cultures and restrictions). Research has shown that the enjoyment of outdoor activities is enhanced by the involvement and presence of caretakers (Yin et al., 2022). In contrast, research also shows that it is perceived as a barrier when caretakers supervise (Khalilollahi et al., 2022; Page, 2010). Children who play outside without supervision have a higher level of independent play and mobility. This leads to more play activities and more outdoor play and is related to a longer duration of outdoor play. The minimal independence in the mobility of children in public spaces is due to the growth of traffic in today's cities (Steenhuis et al, 2018; Martin & Wood, 2013; Krishnamurthy, 2019). Children are tolerated only under certain

conditions, as public spaces have changed and become adult-oriented. The car is often used by caretakers to take their children to activities or school, as this is encouraged by a large number of cars (Page, 2010).

Various studies have also shown a positive correlation with more outdoor play when caretakers have positive perceptions of certain factors (such as poor aesthetics or (unsafe) conditions) (Khalilollahi et al., 2022; Yin et al., 2022; Martin & Wood, 2013). When measures are applied that increase pedestrian facilities and improve road safety, certain factors are improved that may otherwise lead to negative perceptions (Steenhuis et al, 2018; Martin & Wood, 2013; Krishnamurthy, 2019). In addition, certain factors are enhanced when there is visibility for passive (or active) surveillance by caretakers, walkers or joggers at all times (Steenhuis et al, 2018; Martin & Wood, 2013; Krishnamurthy, 2019).

Besides caretakers, the friends and peers (the social networks of children and both caretakers) have a fundamental influence on the extent to which children engage in cooperative outdoor activities (neighborhood social capital) (Steenhuis et al, 2018; Khalilollahi et al., 2022; Yin et al., 2022; Page, 2010).

Digital environment

Studies have shown that pervasive digital technology can have a negative impact on children's emotional, social and motor skills (Khalilollahi et al., 2022). Nowadays, there are several possibilities where the new technology no longer acts as a barrier, but as a facilitator for the interaction between UGI and children. Through environmental restructuring, persuasion and education, digital interventions stimulate interaction between nature and children (Yin et al., 2022). In addition, digital interventions reduce obstacles and add possibilities, as technology offers opportunities to create and explore (and establish relationships with) both virtual and physical objects and other people (Khalilollahi et al., 2022). The digital interventions, depending on the type of UGI interaction, can be classified into augmented reality interaction (through apps on a phone) and digital immersive experience (through virtual reality) (Yin et al., 2022). Both are integrated with a social and a physical environment, which can have a positive influence on children's health behavior change. By implementing digital interventions in the various play opportunities, a child becomes motivated to play outside and connect with nature and other children (Khalilollahi et al., 2022; Martin & Wood, 2013; Krishnamurthy, 2019).

Block scale	
Rooftop	Outdoor spaces on different levels (rooftop/ sky gardens) eliminate traffic dangers, giving children more freedom and independence to walk and play around. Parking spaces could also be covered. How these can be accessed from the first floor is a major concern.
Courtyards	Community courtyards can be an essential amenity for families who do not have backyards for their children. Easy accessibility for children is made possible in a courtyard by physically and visually connecting units to the courtyard. In addition, a courtyard encourages a sense of community and interaction among age groups.
Indoor amenity	Common indoor spaces offer a center where residents can get to know and meet each other. When housing space is limited, child- and family-friendly common facilities can provide additional play, recreation, and learning space for different age groups, improving livability and a sense of community. Linkage to other community facilities is a very important factor. Facilities for children include child-care facilities, schools, community centers, sports facilities, facilities for arts and culture, play facilities, and facilities for learning/studying.
Outdoor covered play	Neighborhoods, where the majority of residents live in publicly designed housing, can be planned with ground-level common facilities and community spaces scattered throughout the built fabric. Open covered spaces under flats can be used as flexible community facilities, for multi-age activities, promoting a sense of community and ownership among residents.
Playfull corridors and hallways	Spaces for movement within buildings, stairwells, corridors, and lobbies, should be thought of in the same way as streets and alleys (spaces for playing and staying). It should be seen as an extension of the home, reducing the transition between private and (semi) public, allowing a movement space to be used efficiently for social exchange and play.
Underground parking-podium parking	A way to get parked cars off the street is to move parking spaces to underground or above-ground (podium) parking spaces. This makes for a nicer streetscape (because parking spaces can be replaced with green spaces, for example) and a safer street for children.
Maximum of 5 floors for passive (and active) surveillance	Active and passive surveillance is very important in a neighborhood for safety purposes. Because one can recognize people up to the fifth story (to maintain identity with the street), the aim is not to exceed the said number of floors in the development of new buildings (so that children can play safely, through active and passive surveillance).
Type of greenery	Tall dense bushes and trees can also prevent active and passive surveillance from being possible. The type of greenery should therefore be considered in the development phase, as coverage is often different in different seasons. In addition, it should be ensured that different types of greenery look attractive to play on and next to.

Figure 14, scheme design principles for a child-friendly neighborhood on block scale (Steenhuis et al, 2018; Khalilollahi et al., 2022; Page, 2010; Krishnamurthy, 2019; Wells & Lekies, 2006; Martin & Wood, 2013; Danenberg, Doumpa & Karssenber, 2018; Arup's Foresight, 2017; Krysiak, 2020)

Neighborhood scale	
Playable streets	A play street is a street designed specifically with children's play in mind, where no motorized traffic is allowed. Various play opportunities are incorporated into the street (2D drawings), in addition there may be (formal and informal) play equipment. Often this is designed in combination with seating and enough shade for caretakers.
Car free neighborhoods	The danger from traffic is one of the biggest barriers to children playing freely outdoors. The quality of a neighborhood's outdoor environment can be significantly improved by giving pedestrians priority over cars (and other motorized vehicles).
Childfriendly route	Child-friendly routes provide a safe and playable route connecting different facilities and activities. This route consists of safe crosswalks, speed reduction measures, playful interventions, signage or visual markings (including infographics) and more seating and street lights.
Communal toy box	The communal toy box provides a safe space for children and caregivers to come together and get to know each other. This is a simple intervention that can be used in lower socioeconomic neighborhoods or those with little private space. It brings together children and caregivers from different backgrounds. Toys from the toy box can be rented using a membership card (free for all children in the neighborhood). In addition, they can rent special toys if they have collected enough stamps (by completing small tasks).
Urban playground	An urban playground creates a sense of children's belonging to their community and provides space to be adventurous and messy (vital social and play opportunities).
Social place for parents	To enable social support and exchange, spatial facilities (social places) can be created to ensure that caregivers feel supported and connected within their communities. Various activities can take place at this social place.
Communal space-vegetable gardens	A communal space encourages communities to come together to play and share, through shared spaces for passive and creative play. On top of this, a vegetable garden encourages learning and environmental awareness.
Nature play	In a densifying urban environment, it is vital to create natural play environments. These play environments consist of playful and natural elements (tree trunks, rocks, sand and water) placed in a natural setting. These elements serve to stimulate the imagination and make children feel welcome to play freely in public spaces.
Intergenerational play	In high-density residential neighborhoods, an important aspect of social cohesion and integration is the opportunity for residents of all ages and abilities to play together (promoted shared empathy for the needs of others and a sense of responsibility for the youngest residents). Open play areas for children, play zones for young people and exercise equipment for the elderly are located next to each other.
Childcare facility	The livability of a high-density neighborhood can be enhanced by the integration of various childcare facilities. This should include direct access to childcare from the street, located adjacent to private and common open spaces and a private outdoor space for the use of a childcare facility.
Elementary school with green play areas	In spatial and social terms, the school in higher-density neighborhoods is an important asset to the community. The building can act as a hub (heart) of the local community, and the schoolyard (and associated facilities such as a sports field) can provide after-school play space.

Figure 15, scheme design principles for a child-friendly neighborhood on neighborhood scale (Steenhuis et al, 2018; Khalilollahi et al., 2022; Page, 2010; Krishnamurthy, 2019; Wells & Lekies, 2006; Martin & Wood, 2013; Danenberg, Doumpa & Karssenber, 2018; Arup's Foresight, 2017; Krysiak, 2020)

3.2 Case studies

For case studies on densification strategies and strategies for developing a child-friendly neighborhood, two European cities were

chosen (see figure 16). The cities selected are Amsterdam and London, as they are closest in context to Eindhoven.



Figure 16, Map of Europe with locations of the case studies conducted

Case study 1

NEIGHBORHOOD SCALE	
Laneways designed for everyday play (Kings Crescent Estate, 2018; King's Crescent 2018, 2019) (London Population 2022, 2022)	
Location:	Kings Crescent Estate, London, United Kingdom
Population [2022]:	9,540,576
Population density city [2022]:	6081 residents/km2
Residential density neighborhood [2022]:	11770 homes/ km2
Publishing year:	2018
Type of densification:	Increase in residents and dwellings
Type of child-friendly development:	Playable streets and courtyards



Figure 17 (Estate, 2022)

The Kings Crescent Estate (see figure 17) began as a streets-in-the-sky in the 1970s, and was partially demolished in the 1990s. In the latest developments, new housing blocks have been added and others are being redeveloped (transformation of existing areas and fabric regeneration) by Hackney Council in which different techniques were applied (high rise, skyborn, transforming vacant properties, infill and destruction and replacement), designed by Muf Architecture/ Art in association with Karakusevic Carson Architects and Henley Halebrown (from the masterplan stage onwards).

In the Kings Crescent Estate, children are central. A new play street (Murrain Road) has been designed through the middle of the estate, which is partly permanently closed off for play and leisure and partly used for local traffic (with on-street parking outside the neighborhood block). It is both an important thoroughfare (route) and playground (destination). There is room for children on the street, as well as a place for relaxation and meeting for children and their caretakers. The play street is the main route through and to the estate, playfully blending function, nature and theatre. The design of the street is non-prescriptive and intentionally ambiguous, with

objects placed that are open to interpretation. The objects have been placed for children and custom-made. Playful images have been painted on the street to indicate that running, playing, cycling and skating children are the first priority. Different types of trees have been placed to provide shade for the street, encouraging residents to relax on benches.

The street is completed by a number of shared courtyards where there are more opportunities to play, socialize and grow vegetables and flowers. Within these shared informal spaces, residents feel that the place meets their own needs and desires. It also offers many different forms of recreation (relaxation areas for all ages, props for imaginative games and traditional play equipment combined with natural elements).

An important element is the possibility of passive (and active) surveillance, due to the flats that have a direct view of the street and the courtyards. However, the play street consists of many (growing) trees, so passive (and active) surveillance will not always be possible. In addition, there is a direct connection between the street and the house(s), so that children will go outside more quickly. The street is designed for running, playing, cycling and skating children (and for watching caretakers). This ensures that it is a high-priority street for children and without traffic accidents. Figure 18 lists the pros and cons of this design. In addition, figure 19 shows the addressed design principles.

NEIGHBORHOOD SCALE INTERVENTION CASE STUDY 1	
PRO'S	CON'S
Play street and playgrounds closed to motorized traffic, allowing children to walk, bike and play safely.	Figures for kids on the street can create ambiguity, which can lead to unsafe situations.
Space for children on the street.	(Growing) Trees make it more difficult for passive and active surveillance.
Central place for children (and caregivers) in the neighborhood to relax and meet.	
Design playstreet non-prescriptive (own interpretation).	
Children are first priority (figures on street).	
Trees to provide shade, encouraging people to sit.	
Shared courtyard (opportunities to play, socialize and grow vegetables and flowers).	
Relaxation areas for all ages.	
Passive and active surveillance.	

Figure 18, pro's and con's neighborhood scale intervention case study 1

Addressed design principles	
Densification	Child-friendly neighborhood
Neighborhood scale	Neighborhood scale
Addition of new buildings	Playstreet
Transforming areas	Car free neighborhood
Regeneration of buildings	Urban playground
Block scale	Social place for parents/ caretakers
High rise	Communal space/ vegetable gardens
Skyborn	Nature play
Transforming vacant properties	Intergenerational play
Infill	Block scale
Destruction and replacement	Courtyards
	Green (type)

Figure 19, Addressed design principles in case study 1

Case study 2

CITY SCALE	
The spatial and social construction of children's domains in the city (Karsten, 2002)	
(KadastraleKaart.com - De gratis online kadasterkaart, 2022; allecijfers - Informatie gemeente Amsterdam, 2022)	
Location:	Amsterdam, the Netherlands
Population [2022]:	883.939
Population density city [2022]:	5341 residents/km ²
Residential density city [2022]:	2771 homes/ km ²
(Average) Density of children [2022]:	752 children/ km ²
Publishing year:	2002
Type of child-friendly development:	Child-specific spaces (children's domains)

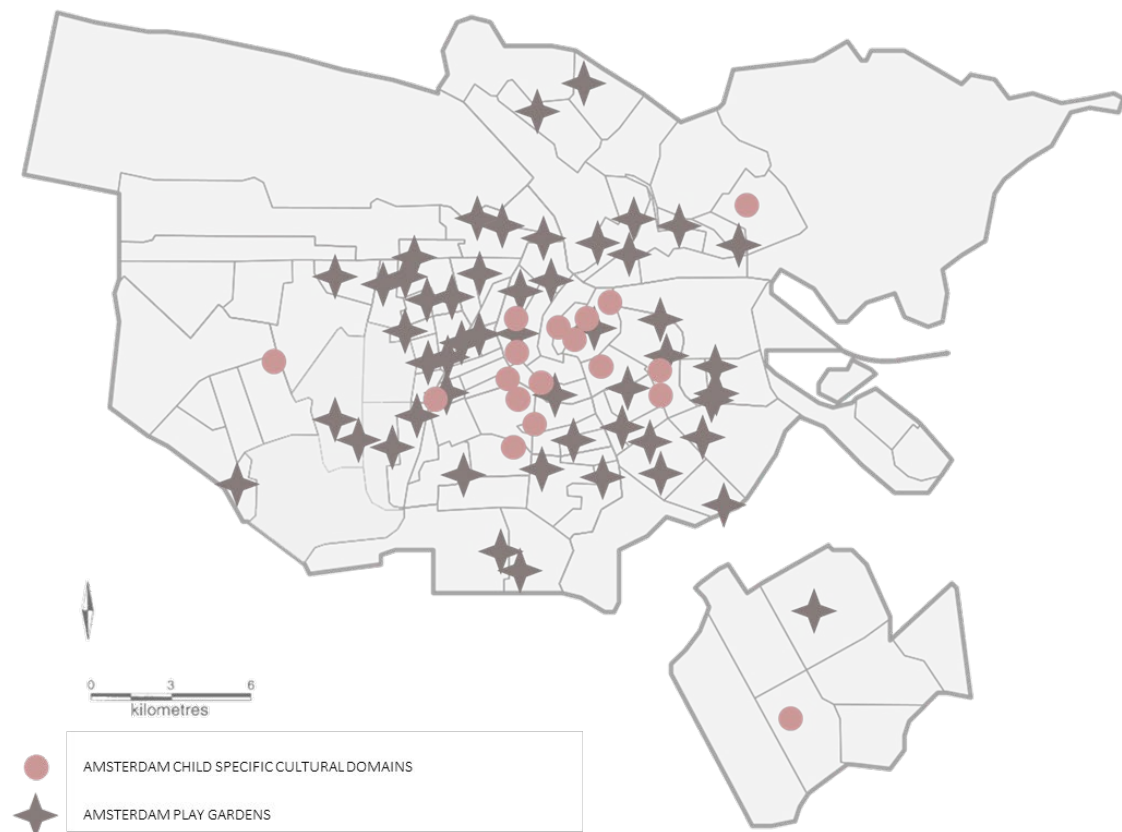


Figure 20, Child-specific cultural domains and playgrounds in Amsterdam (Karsten, 2002)

There is a tendency for people and activities to segregate in cities. One of the most important dimensions along which spatial segregation takes place is age. This article has mapped the wide variety of child-specific spaces in Amsterdam.

During the planning and design of new housing estates in Amsterdam, little attention is paid to

children, reinforcing the temporal and spatial limitations of children in Amsterdam. In addition, contemporary discourses on motherhood, personal achievement and security underlie these processes. At the same time, the needs of children have never been given so much attention through adult efforts. These adult efforts have led to the creation of many domains especially for children, usually

without the knowledge of what children really want. High investments have been made in care facilities, leisure areas and children's play areas, giving children a 'face' in the city. Children are increasingly taken out of the public domain of the street, into their homes or into (semi-) private care, leisure and play areas.

Physical distances (see figure 20), cultural barriers and lack of money often hinder children's access to use these domains, making users often homogeneous (middle-class children). Middle-class children, unlike lower-class children, can move from one domain to another within their urban domain (often accompanied by adults). Lower-class children are encouraged to follow a similar but disparate route through a series of subsidized facilities in their local neighborhood. Both groups are accommodated in separate places from different perspectives, developing in segregated ways.

The income of parents, the density of households, as well as distances to and number of services are telling about the behavior of children within a neighborhood or district. The three main areas in which children live, the care

facilities, the leisure areas and the play areas, are semi-private, which immediately excludes some children (from the lower classes). However, the street, over which children move to care facilities, leisure areas and playgrounds is not mentioned as an important domain for children. It is only mentioned that play areas are demarcated from the public areas of the street, as there is a great concern for the safety of children as a predominant element in the education of children. Streets and public spaces can no longer be seen as safe, due to heavy traffic and 'stranger danger', which is why this paper talks about the institutionalization of childhood. Instead, solutions could be devised on a city and neighborhood scale to counteract this.

The powerful image of a child playing and moving freely in the neighborhood is the ideal that policymakers and parents cherish. The question is whether this (a 'free' moving child) can be achieved when the street (and other public spaces) are not taken into account in the planning and design of future child-friendly living environments. Figure 21 lists the pros and cons of this planning. In addition, figure 22 shows the addressed design principles.

CITY SCALE INTERVENTION CASE STUDY 2	
PRO'S	CON'S
A distinction is made between middle-class children and lower-class children, which can help in the design of a neighborhood.	The street, public spaces and schools (or other educational areas) are not taken into account in the planning and design.
	Adult efforts, without the knowledge of what children really want.
	When talking about institutionalization, every facility and service need to be mentioned, which did not happen.

Figure 21, pro's and con's city scale intervention case study 2

Addressed design principles	
Child-friendly neighborhood	
City scale	Neighborhood scale
--	Childcare facility
	Urban playground
	Communal space
	Nature play
	Intergenerational play

Figure 22, Addressed design principles in case study 2

Case study 3

NEIGHBORHOOD SCALE	
Child-friendly routes in Amsterdam (Wassenberg & Milder, 2008; Steenhuis Et al, 2018)	
(KadastraleKaart.com - De gratis online kadasterkaart, 2022; allecijfers - Informatie gemeente Amsterdam, 2022)	
Location:	Spaarndammerbuurt, Amsterdam, the Netherlands
Population [2022]:	6245
Population density [2022]:	20019 residents/km2
Residential density city [2022]:	11308 homes/ km2
(Average) Density of children [2022]:	2531 children/ km2
Publishing year:	2007
Type of child-friendly development:	Kindlint (child-friendly route)



Figure 23, Route Kindlint Spaarndammerbuurt (Wassenberg & Milder, 2008)

In 2007, the project 'Het Kindlint' was realized for the first time in the Spaarndammerbuurt in Amsterdam. The Kindlint is a child-friendly route that connects all the schools, playgrounds, parks and other children's destinations in a neighborhood (see figure 23). It is a safe route that promotes independent mobility (walking, cycling, or playing) at an earlier age and encourages their independence from cars. The Kindlint was initiated in response to various signals concerning independent movement on the street by children at an

increasingly late age. It is assumed that children do not only play at certain destinations, but also on the route to these destinations.

The Kindlint consists of a marked route; additional playing facilities along the way; traffic-inhibiting and child-friendly crossings; more art and color. On the route, colors and pictures of animals on paving stones indicate whether a child should stop at a road or is allowed to walk/run. According to the developer of the route (SOAB), the route should

bring relief to parents because of an increase in the independence of the children, greater playability and higher safety.

An evaluation of the Kindlint in the Spaarndammerbuurt shows that the implementation was successful, but that it also had some limitations. Unfortunately, children did not use the Kindlint in the way it was originally intended. Not every child understood the meaning behind the different types of tiles and their associated activities. In addition, children only used the Kindlint if it was on the route to a different destination. Contrary to SOAB's statement, parents still guided their children through the neighborhood. Yet they spent most of their time on the street independently. Moreover, the crossings have been improved, cars drive slower, there is

cheerful painting and there are more playgrounds in the neighborhood.

In the implementation of the Kindlint, more attention should be paid to the needs of residents (possible participation with children), existing traffic calming measures and the type of neighborhood. A Kindlint does not work in every context, as not every neighborhood has functions for children within walking distance. In addition, more education should be given to the children who should use the route or leave them to their own imagination, but children should look around them (not at the tiles on the ground at a crossing) so that dangerous situations in traffic can be prevented. Figure 24 lists the pros and cons of this design. In addition, figure 25 shows the addressed design principles.

NEIGHBORHOOD SCALE INTERVENTION CASE STUDY 3	
PRO'S	CON'S
Child-friendly route that connects all children's destinations.	More attention should be paid to the needs of residents (participation of children).
Promotes independent mobility.	A Kindlint does not work in every context.
Taken into account that children do not only play at certain destinations, but also on the route to these destinations.	Not every child understood the meaning behind the different types of tiles (causing unsafe situations).
Consists of traffic inhibiting and child-friendly crossings.	Art and color on the streets can cause distraction to motorists (causing unsafe situations).

Figure 24, pro's and con's neighborhood scale intervention case study 3

Addressed design principles	
Child-friendly neighborhood	
Neighborhood scale	Block scale
Car free neighborhood	Courtyards
Child-friendly route	Indoor amenity
Childcare facility	
Urban playground	
Elementary school with green play areas	
Communal space/ vegetable gardens	
Nature play	
Intergenerational play	

Figure 25, Addressed design principles in case study 3

3.3 Critical policy analysis

On the current state of affairs regarding density and child-friendliness in Eindhoven, there are several policies and goals that have an influence. In this chapter we look at the United Nations Sustainable Development Goals and UNICEF (international scale), national policies and laws (national scale) and the current municipal policy on density and child-friendliness in Eindhoven (municipal scale).

International scale

At the international scale, the goals set by the United Nations to build more prosperous, peaceful societies by reducing inequality and ending poverty are being looked at (United Nations & Neshovski, 2022). In 2015, 17 Sustainable Development Goals (SDGs) were adopted by all United Nations member states to be achieved in conjunction with children's rights by 2030 (UNICEF- The Child Friendly Cities Initiative) (UNICEF and the Sustainable Development Goals, 2022; Unicef | What Is the Child Friendly Cities Initiative, 2022). These SDGs are part of the sustainable development agenda and relate to good education, good health, equality, a clean planet, etc.



Figure 26, 17 Sustainable Development Goals

Children are involved in all SDGs and all SDGs are important in implementing a child-friendly city. Ensure healthy lives and promote well-being for all, at all ages (3) and make cities and human settlements inclusive, safe, resilient and sustainable (11), are particularly relevant to this study (see figure 26).

National scale

At the national scale, children and young people, socially involved organizations and municipalities work together within the network of Child Friendly Cities Nederland, which is part of the international Child Friendly Cities Initiative (Unicef NL, 2022). They strive to improve the situation of children and young people by means of an integrated youth policy, across all policy areas. In addition, in the Netherlands, more and more attention is being paid to the development and health of children when designing the living environment (Houweling et al., 2010). The aim is to create a healthy, child-friendly living environment, whereby a lot of policy has been initiated in the field of (indoor) air quality and exercise.

There are some objectives and guidelines on the (inter)national level that can guide municipalities towards a child-friendly living environment. However, the municipalities themselves must determine a strategy that fits within the context of the municipality in question. However, the SDGs set on an international scale almost match the goals set by the Dutch government. The municipality of Eindhoven has also signed up to the 17 goals formulated by the UN. In addition, the municipality grants subsidies to partner organizations to contribute to a social, livable and future-proof living environment for new generations (Gemeente Eindhoven | Subsidie Global Goals Eindhoven, 2022). Eindhoven's role (as well as its current plans) in achieving these goals is not discussed. However, in order to make these SDGs and goals for healthy, child-friendly living environments more feasible on an (inter)national level, so that they can actually be achieved, better-defined guidelines should be set on a national scale. In this way they can

be more easily implemented on a municipal scale, taking into account the difference in context.

Local-scale, municipality of Eindhoven

At the municipal level, various policy plans are examined. The most relevant policy plans are the Verdichtingsvisie Binnenstad Eindhoven, the Omgevingsvisie Eindhoven, the Handboek Openbare Ruimte, the visie openbare ruimte, the Woonprogramma, the Ontwikkelperspectief Centrum and the Groenbeleidsplan (Gemeente Eindhoven | Verdichtingsvisie Binnenstad Eindhoven, 2020; Gemeente Eindhoven | Omgevingsvisie Eindhoven: Kloppend Hart Van Brainport, 2020; Gemeente Eindhoven | Handboek Openbare Ruimte, 2021; Gemeente Eindhoven | Visie Openbare Ruimte, 2006; Gemeente Eindhoven | Woon Programma 2021 - 2025, 2021; Gemeente Eindhoven | Ontwikkelperspectief 2040 Centrum Eindhoven, 2020; Gemeente Eindhoven | Groenbeleidsplan, 2017). These policy plans discuss, among other things, Eindhoven's role as a knowledge centre in the Netherlands, the increasing demand for housing in the city and how Eindhoven aims to become a healthy, climate-proof, liveable and attractive city.

Eindhoven plays an important role in strengthening the global technology and economy (Gemeente Eindhoven | Omgevingsvisie Eindhoven: Kloppend Hart Van Brainport, 2020). Because Eindhoven is the top technology region and knowledge centre of the Netherlands, the city has been given the predicate Brainport, which the municipality has translated into a broad quality strategy: 'spatial qualities, people, knowledge and technology' (Gemeente Eindhoven | Omgevingsvisie Eindhoven: Kloppend Hart Van Brainport, 2020; Gemeente Eindhoven | Visie Openbare Ruimte, 2006).

In addition, Eindhoven and the region are striving for an excellent living and working climate in order to remain internationally competitive. Healthy and sustainable urbanization with the preservation of historical, urban and village qualities is a precondition. The basis for the future development of the city is based on the strong urban and green structure of Eindhoven's past. The municipality's aim is to preserve and strengthen historical radials and landscapes and to transform historical (industrial) heritage into residential, living and working environments (Gemeente Eindhoven | Omgevingsvisie Eindhoven: Kloppend Hart Van Brainport, 2020).

In Eindhoven, there is a big mismatch between the ambition to be an inclusive and hospitable city and the existing housing stock in the city (Gemeente Eindhoven | Omgevingsvisie Eindhoven: Kloppend Hart Van Brainport, 2020). The demand for space for new housing, businesses and facilities is in fact high, given the ambitions of the municipality, as Brainport continues to grow and because many Eindhoven citizens are looking for places to work, stay and spend leisure time near the city centre (Raspe et al., 2017). The Woondeal (Housing Deal) talks about the realization of 35,000 to 40,000 homes in Eindhoven until 2040, of which a maximum of 21,000 homes within the ring road (see figure 27). The municipality wants to densify centrally (built and develop centrally), combined with adding different amenities and mixing multiple functions. Since accessibility is an important factor here, the use of active transport modes (walking and cycling) and public transport should be promoted. In addition, the municipality states that green space should be accessible to all. (Gemeente Eindhoven | Verdichtingsvisie Binnenstad Eindhoven, 2020; Brainportregio Eindhoven MIRT-Onderzoek Verstedelijking en Mobiliteit Bijlage 1 – Feitenrelaas, 2022).

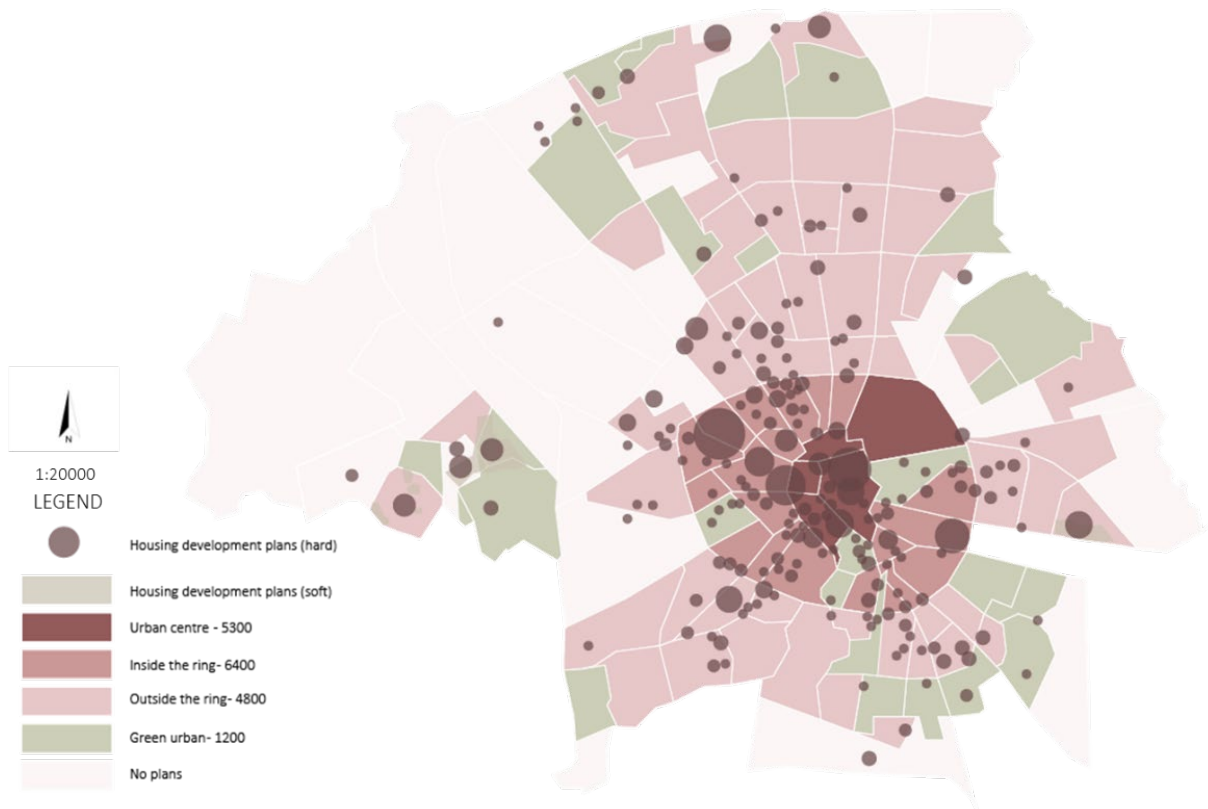


Figure 27, Housing development plans of the municipality of Eindhoven compiled from the aforementioned policy documents

Eindhoven's green structure contributes to this attractive living, working and residential environment. Eindhoven's ambition is to be a liveable, healthy and climate-adaptive city as the basis for a strong business climate in the heart of the Brainport. The greenery in the city is the precondition for this. The green policy plan discusses the ambition to bring back the garden spirit and the green wedges that used to criss-cross the city (*Gemeente Eindhoven / Groenbeleidsplan, 2017*). The role that green space will have within the individual neighborhoods is lacking in detail.

In the *Handboek Openbare Ruimte*, a small heading refers to the number and distance of play areas (*Gemeente Eindhoven / Handboek Openbare Ruimte, 2021*). However,

this information can be questioned, as it does not correspond to actual figures. In addition, the Municipality of Eindhoven believes it is important for children to be able to play safely outside, but this is only discussed in the green policy plan. In all other policy plans (apart from the *Handboek Openbare Ruimte*) children are not directly mentioned, which means children are seen as an afterthought. Moreover, it is not clear what type of green space is and will be used. It could be greenery that provides children with space to play, exercise, walk and cycle, but in addition it could be destinations (such as parks and public gardens, where children can often play freely) that you walk or cycle to (*Gemeente Eindhoven / Groenbeleidsplan, 2017*).

3.4 Conclusion literature review, case studies and policy analysis

The literature has shown that there is a lack of correspondence between the perfect density and child-friendly neighborhoods (amenities, public space and UGI), as there is no mention of combining both topics (while there is enough demand for it, given current trends).

Per topic (densifying a neighborhood and a child-friendly neighborhood) several principles were found (in the literature, the case studies and the policy plans). These principles were (partly) adopted and adapted so that they can be classified into different scales suggested by the literature: block scale, neighborhood scale and city scale. Some neighborhood-scale principles seem to be applicable at the block level as well, however, they only work if a particular intervention is carried out at several places in the neighborhood (rather than at block level only). From combining various policy documents and research papers, city-scale principles can be concluded (see figure 28). Figures 30 and 31 show the principles belonging to the respective scale.

In the final design, several principles can be combined. However, this is not possible with

every principle, as a high-rise building cannot be combined with the child-friendly building of only five floors. By precisely coordinating these principles in the relevant context, the daily urban system of children will be made safer and more attractive, leading to more outdoor play and increased use of active transport modes by children.

The literature states that designs will be different in each neighborhood, as each neighborhood has its own context (socioeconomic and demographic differences). The design will focus on the daily urban system of children, in the context of elementary school children (aged 5-11) on a school day. The specific locations to which the principles can be applied, will be derived from the spatial analysis.

Based on the typologies (see Appendix C), design interventions for child-friendly densification of the selected neighborhoods are considered (based on literature) (see figure 29).

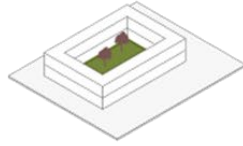
Street profiles that can be applied at block scale can be found in Appendix K.

Design principles for densification on city scale	Design principles for a child-friendly neighborhood on city scale
Build & develop centrally	Improve accessibility to (playable) greenery
Transit-oriented development TOD	Add patches greenery
Transforming buildings (prior to greenfield development)	Improve connections of greenery
Addition of (more) mixed functions and facilities	Addition of (more) mixed functions and facilities
Addition of bike connections	Addition of bike connections
Improve walking routes	Improve walking routes
Addition of buslines	Addition of buslines

Figure 28, scheme design principles for densification and a child-friendly neighborhood on city scale



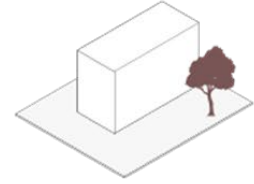
Rooftop



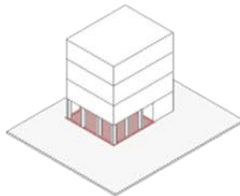
Courtyards



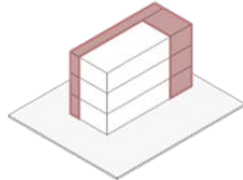
Indoor amenity



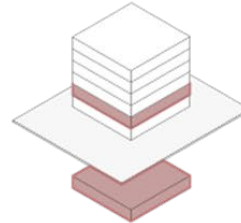
Green (type)



Outdoor covered play



Playfull corridors and hallways

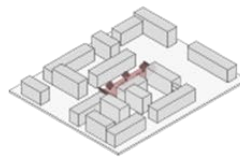


Underground parking/
podium parking

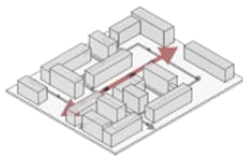


Maximum of 5 floors for passive
(and active) surveillance

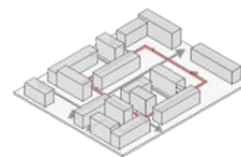
Neighborhood scale



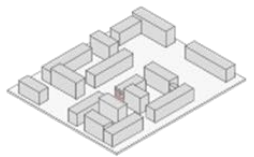
Playstreet



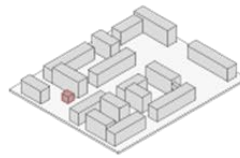
Car free neighborhood



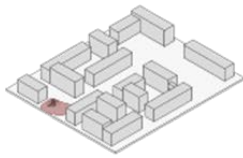
Child-friendly route



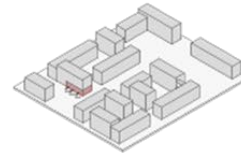
Childcare facility



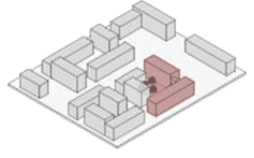
Communal toy box



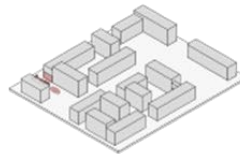
Urban playground



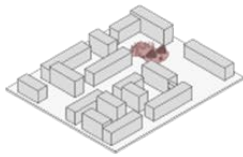
Social place for parents



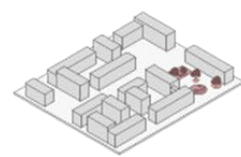
Elementary school with
green play areas



Communal space/
vegetable gardens

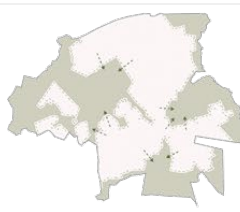


Nature play



Intergenerational play

City scale



Improve accessibility to
(playable) green areas



Addition of patches of greenery

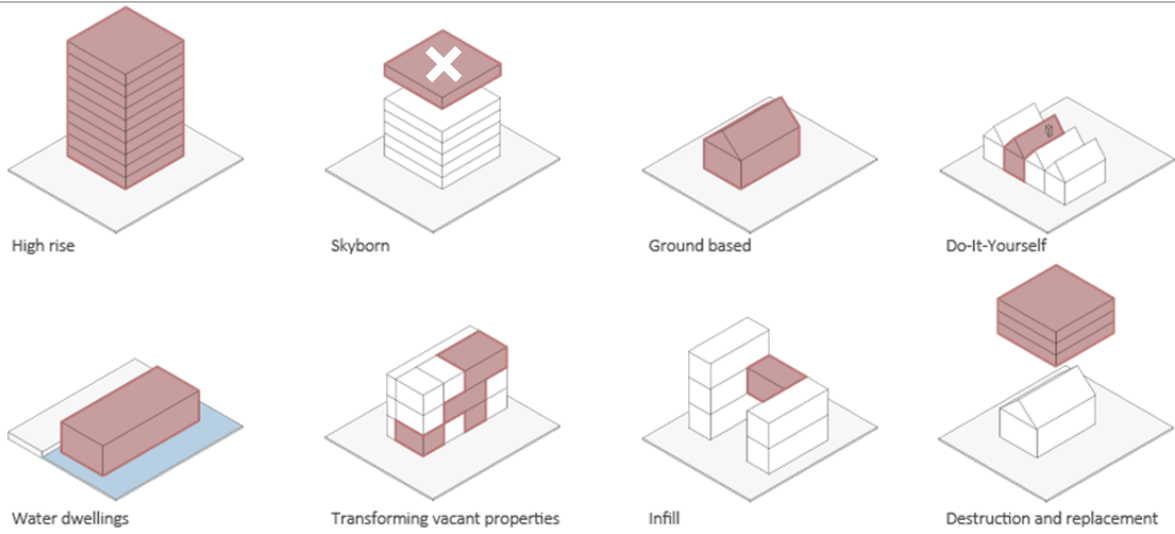


Improve connections of greenery

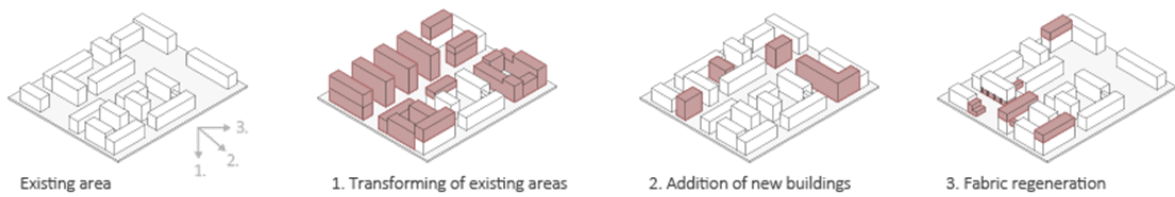
Figure 30, scheme design principles for a child-friendly neighborhood

Block scale

Principles for densification



Neighborhood scale



City scale

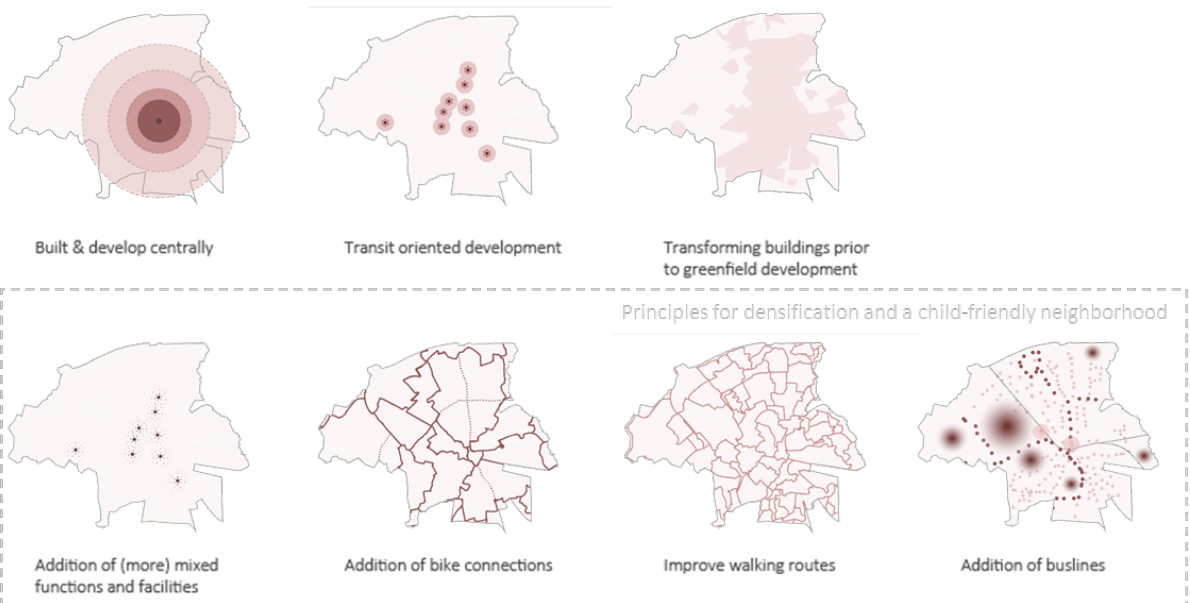


Figure 31, scheme design principles for densification

3.5 Spatial analysis

3.5.1 Indicators

After the data collection and selection (and based on the literature review), some indicators that are important for measuring the potential neighborhoods for densification and the neighborhoods in need of child-friendly development were established. The indicators were first divided into the two main groups (densification and child-friendly neighborhood) and after that into the sub-groups primary, secondary and tertiary (which are not

important for scoring indicators). Tertiary indicators do not affect the scoring system, as these values are based on surveys (carried out by the municipality) that are not measurable. The results of this indicator analysis were used in creating the city strategy (see figure 32). The data used for the maps and calculations are listed in Appendix B. The maps created from this data are in Appendix A.

Means	Relevance	Objectives	Indicator	Unit	Source	Paper		
<i>Background information</i>	<i>Additional indicators</i>	<i>General</i>	Name of neighborhood	Text	Development Plan	.		
			Age composition	#/ %	Buurtmonitor	[1][2][3][4][5][6][7][8][9][10][11][13]		
			WOZ-value	#	Buurtmonitor/ CBS	[1][6]		
			Amount of cars per person	#	Buurtmonitor	[1][3][4][6][7][8][9][11][12][15][16]		
			Origin/cultures/ ethnicity	#/ %	Buurtmonitor	[2][3][4][5][6][7][8][9][10][14]		
			Year of construction	#		[11][16]		
			House type (single-family)	#/ %		[1][4][6][10][15][16]		
<i>Densification</i>	<i>Primary indicators</i>	<i>General</i>	Total population (/km ²)	#/ %	Buurtmonitor	[4][6][7][8][10][11][12][13][14][15][16]		
			FSI	#/ %	data.eindhoven.nl	[11]		
		<i>Playable</i>	GSI	#/ %	data.eindhoven.nl	[11]		
			MXI	#/ %	data.eindhoven.nl	[13]		
		<i>Healthy</i>	Access to public transport within walking distance (train station, bus stops & routes)	#/ %	Buurtmonitor	[1][4][6][7][8][9][10][11][12][13][14][15][16]		
			Rental properties	#/ %	Buurtmonitor	[1][6]		
		<i>Safe</i>	Average housing occupancy	#/ %	Buurtmonitor	[1][6][11]		
			Density children (/km ²)	#/ %	Buurtmonitor	[3][4][6][7]		
		<i>Child-friendly neighborhood</i>	<i>Primary indicators</i>	<i>General</i>	Average income of parent/caretaker	#	Buurtmonitor/ CBS	[1][3][4][5][6][7][8][9][10][13][14]
					Total population (/km ²)	#/ %	Buurtmonitor	[4][6][7][8][10][11][12][13][14][15][16]
<i>Secondary indicators</i>	<i>General</i>		Number of households (/km ²)	#	Buurtmonitor	[1][6][7][10]		
			Number of households with kids	#/ %	Buurtmonitor	[1][4][6][8][10][13][16]		
			Average distance to services in the neighborhood (community centers) (km)	#	Buurtmonitor	[4][6][7][8][9][10][11][12][13][14][15][16]		
	<i>Playable</i>		Average distance to schools in neighborhood (kindergarten, elementary (& secondary) school) (km)	#	Buurtmonitor	[1][2][3][4][6][8][9][10][11]		
			Average distance to pre- and after school facilities or activities (km)	#	Buurtmonitor	[1][4][6][7][10]		
			Average distance to leisure opportunities (km)	#	Buurtmonitor	[1][2][3][4][5][6][7][8][9][15][16]		
			Access (number of) to play areas	#	data.eindhoven.nl	[1][3][4][6][7][8][9][10][13][16]		
			Amount (/km ²) of greenery (/km ²)	#/ %	data.eindhoven.nl	[1][2][3][4][5][6][7][8][10][11][12][13][14][15][16]		
			Obesity + other physical & mental health issues	#/ %	rivm.nl	[1][2][4][5][6][7][8][9][10][11][12][13][14][15][16]		
<i>Tertiary indicators</i>	<i>Healthy</i>		Number of children engages in sports and active transport	#/ %	rivm.nl	[1][2][3][4][6][7][8][9][10][13]		
			Criminality	#/ @	Buurtmonitor	[1][3][4][6][7][8][9][10][11][16]		
	<i>Safe</i>		Access to safe roads (: including separate bike lanes, sidewalks, and crosswalks)	#/ %/ @	Buurtmonitor	[1][4][6][7][8][9][10][16]		

Figure 32, Indicators based on literature review

3.5.2 City-scale indicators

Figure 33 shows the indicators relevant to the application of the city-scale scoring system. The application of the scoring system to indicator data was performed twice for the two main groups. First, the calculation of potential neighborhoods for densification (%)(see section 3.5.3), and after that, the calculation of neighborhoods in need of child-friendly development (%)(see section 3.5.4). Each indicator of interest is given a score between 0 and 5 (which is based on percentages 0-

100%)*(see figure 34). In addition, for the purpose of data accuracy and importance (according to literature), a weight was assigned to each indicator. The results/scores of both calculations are combined (see section 3.5.5) to determine the three neighborhoods with the highest potential for densification and the highest need for child-friendly development to play a representative role. For the exact steps, see figure 9 in the methodology under the heading the spatial analysis.

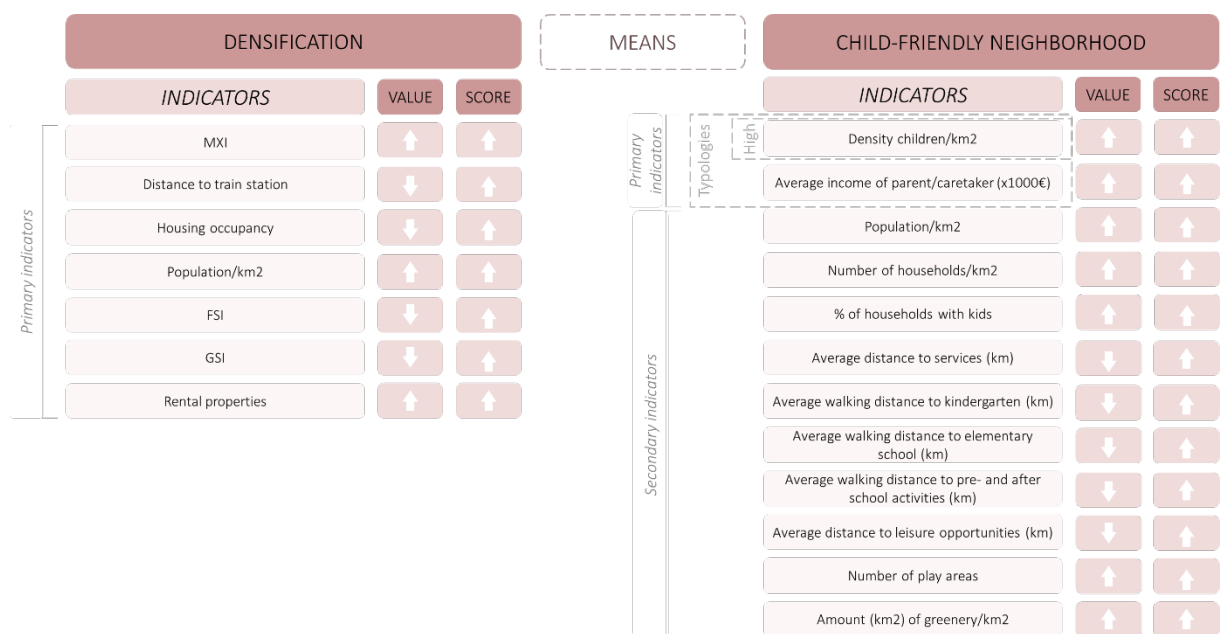


Figure 33, Indicators relevant to the application of the city-scale scoring system

* These scores can never reach or approximate a percentage of 100%. When a percentage of 100% is reached or approximated, it means that the neighborhood in question has very high and/ or very low values in all of the above indicators. Industrial areas could influence (and approximate) the corresponding values, these areas are therefore excluded from the calculations.

Defenitions	Value	Score
Value(s)	83,33% - 100%	5
The data used from various government agencies.	66,67% - 83,33%	4
Score(s)	50% - 66,67%	3
Data values used from various government agencies, converted to scores between 0 and 5, after the application of the scoring system.	33,33% - 50%	2
	16,67% - 33,33%	1
	0% - 16,67%	0

Figure 34, values and scores

3.5.3 Potential neighborhoods for densification

Calculation of densification potential (%) =
 $(\text{Population}/\text{km}^2 + \text{FSI} + (\text{GSI} * 0,5) + (\text{MXI} * 2) + (\text{Rental properties} * 0,5) + (\text{Distance to trainstation} * 2) + (\text{Housing occupancy} * 2)) / 45 * 100$

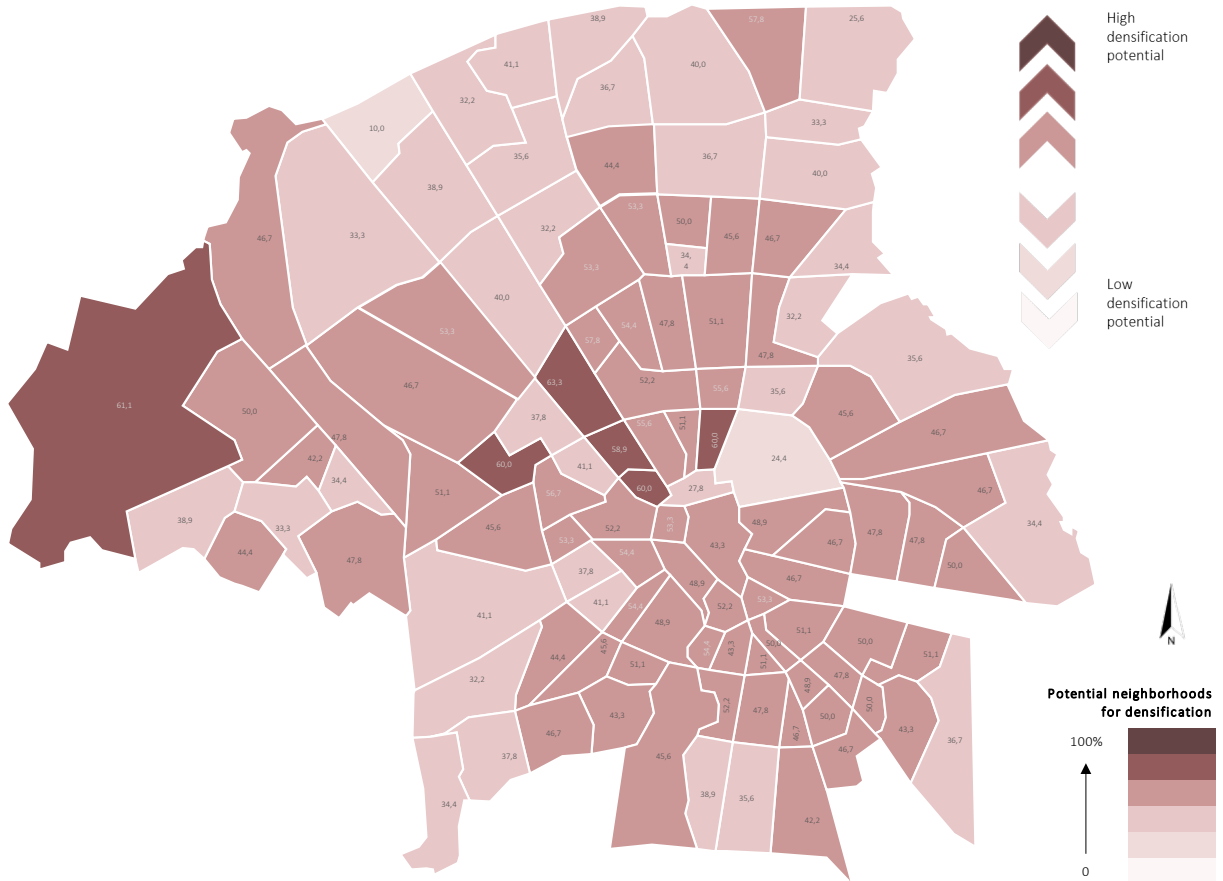


Figure 35, potential neighborhoods for densification

3.5.4 Potential neighborhoods in need of child-friendly development

Calculation of neighborhoods in need of child-friendly development (%) =
 $((\text{Density children per km}^2 * 2) + (\text{Average income of parent/caretaker (x1000€) } * 2) + (\text{Population/km}^2 * 0,5) + (\text{Number of households/km}^2 * 2) + (\% \text{ of households with kids} * 2) + \text{Average distance to services (km)} + \text{Average walking distance to kindergarten (km)} + \text{Average walking distance to elementary school (km)} + \text{Average walking distance to pre- and after school activities (km)} + \text{Average distance to leisure opportunities (km)} + (\text{Number of play areas} * 0,5) + (\text{Amount (km}^2) \text{ of greenery per km}^2)) / 77,5 * 100$

* The average income of a parent/caregiver was used in the formula to indicate the importance of this indicator, rather than its value. Based on this indicator, information about a neighborhood can be obtained, as well as about the children living there. A neighborhood with a higher median income does not have more potential for child-friendly densification, than a neighborhood with a lower median income (there is only distinction, not division). This indicator has no influence on the final scores (the percentages differ minimally, but the order of neighborhoods with more potential for child-friendly densification does not).

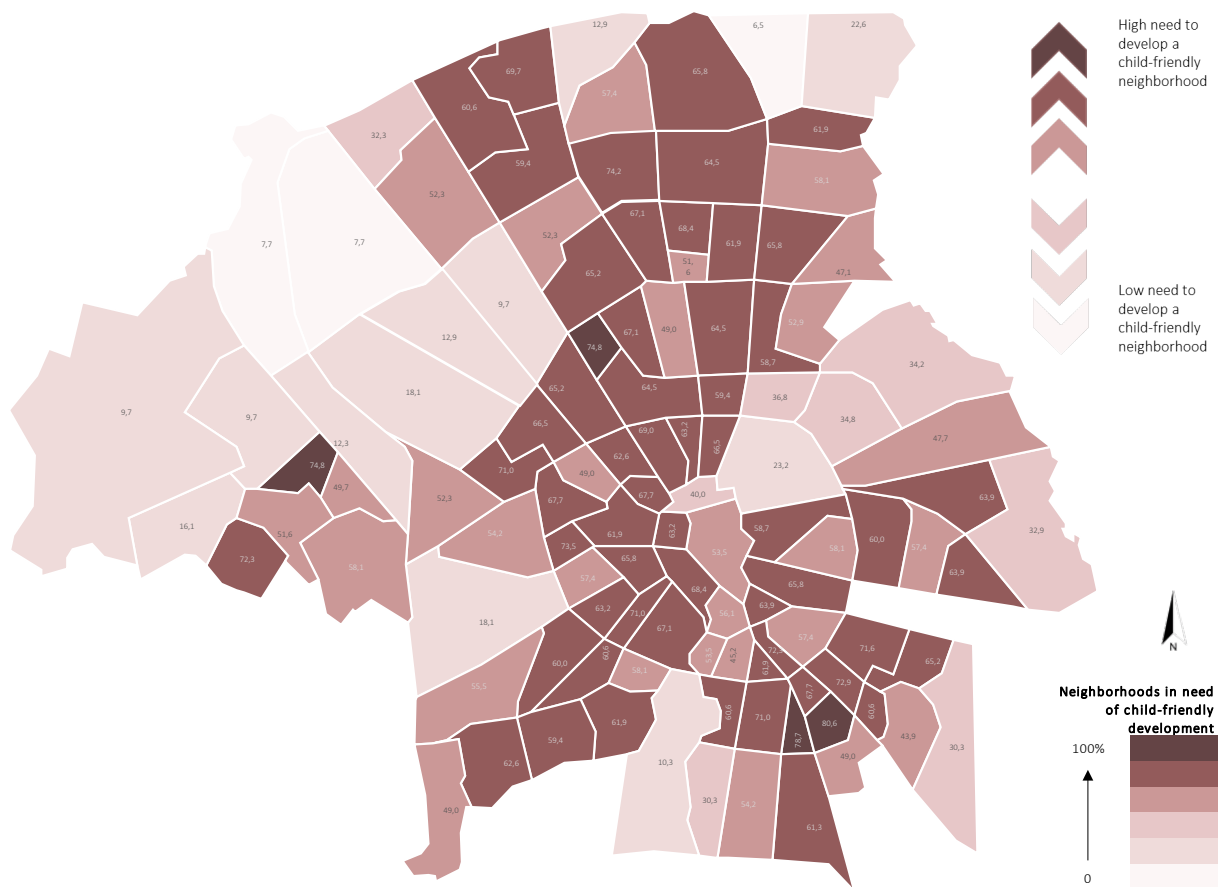


Figure 36, neighborhoods in need of child-friendly development

3.5.5 Potential neighborhoods for child-friendly densification

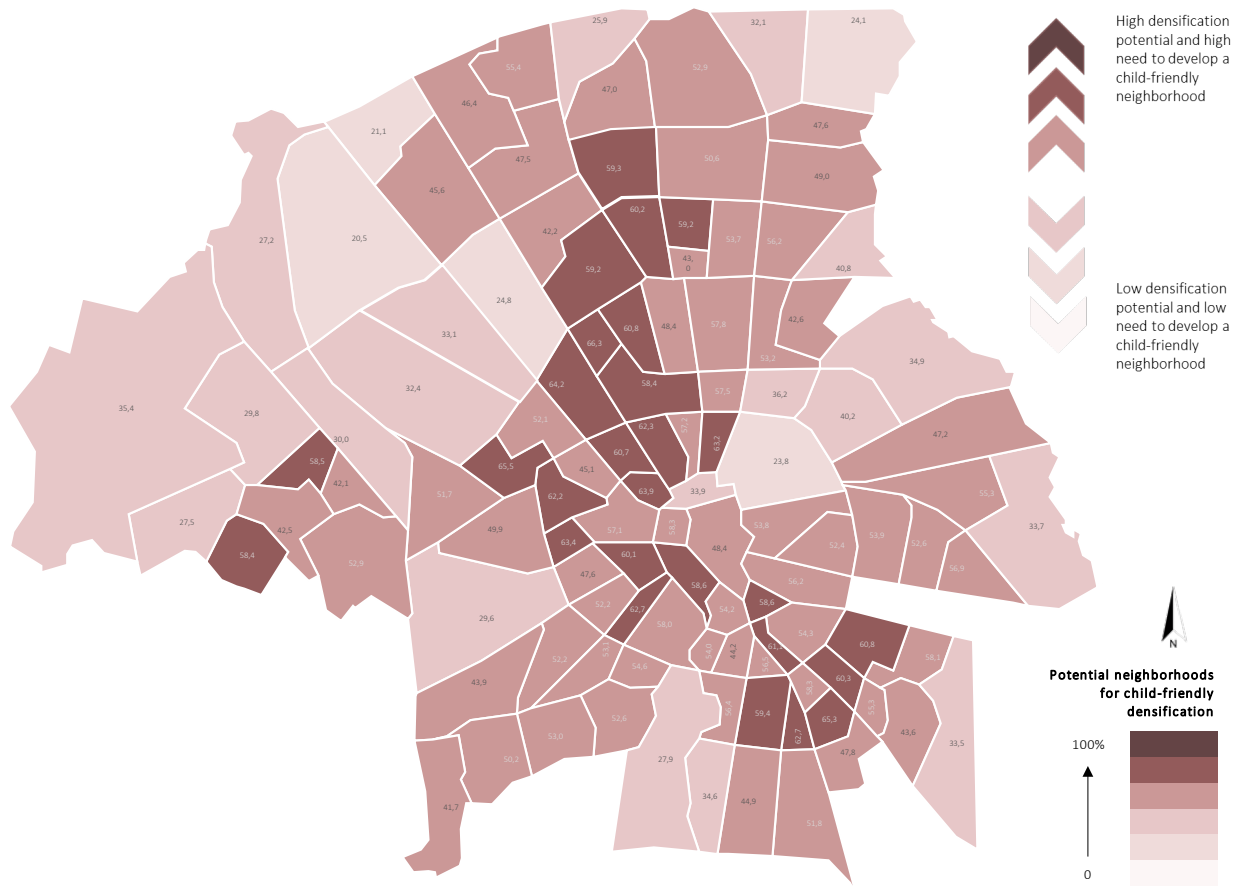


Figure 37, potential neighborhoods for child-friendly densification

3.5.6 Potential neighborhoods for child-friendly densification based on typologies

To demonstrate a distinction in potential neighborhoods for child-friendly densification based on the different neighborhood typologies (which are further elaborated in Appendix C), a scatter diagram was created (see figure 38). This diagram shows on the y-axis the densification potential and on the x-axis the need to develop a child-friendly neighborhood (See Appendix D for the scores of potential neighborhoods for densification and Appendix E for the scores of neighborhoods in need of child-friendly development). It would be best if the neighborhood is located in the upper right area. This is because the neighborhood then has a high densification potential and a high

need to develop a child-friendly neighborhood. Overall, three neighborhoods were selected within three different typologies with a high average between the two factors (See Appendix G for scores in percentage by selected typology).

This method, to determine whether a neighborhood has a high densification potential and a high need to develop a child-friendly neighborhood, a high densification potential, or a high need to develop a child-friendly neighborhood, was applied in creating the city strategy (See Appendix F for scores in percentage).

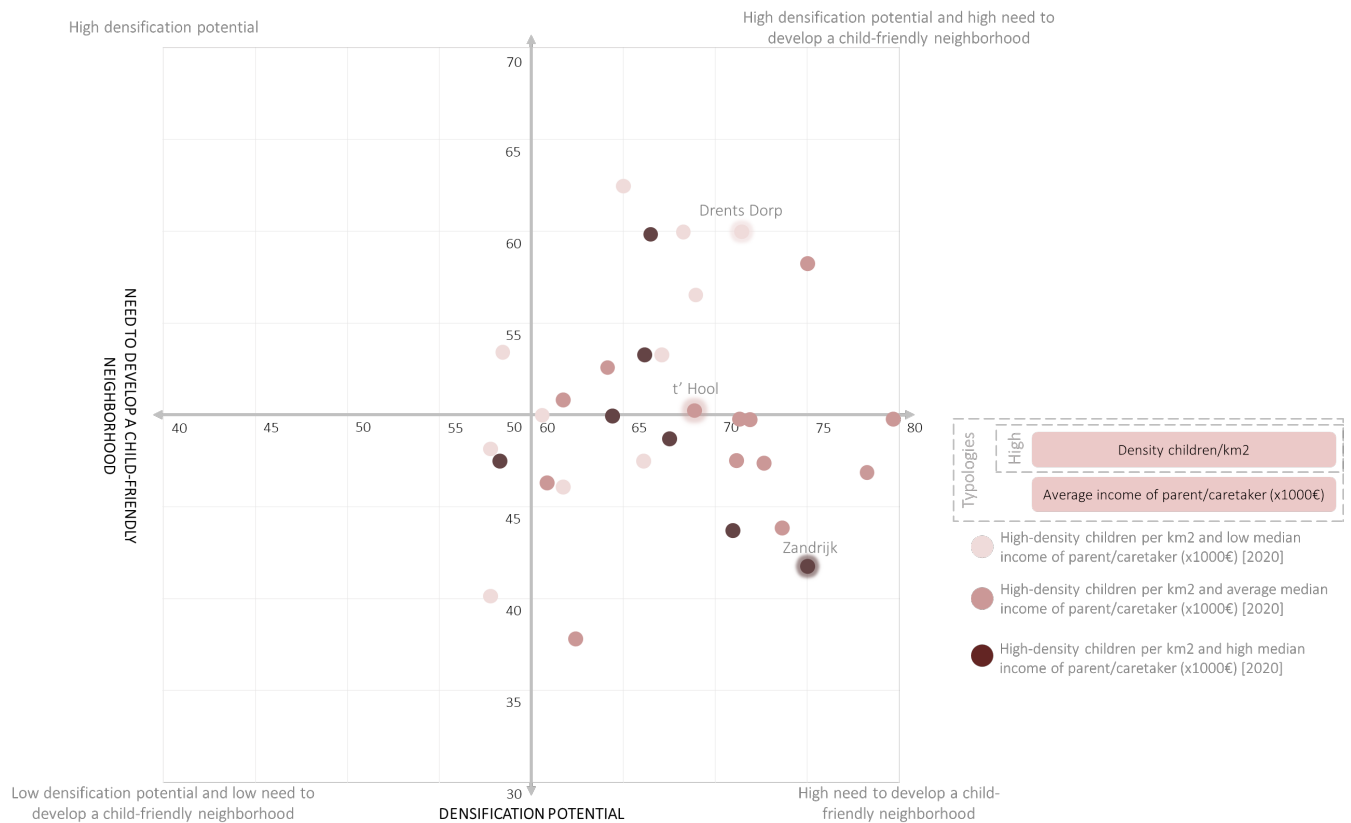


Figure 38, scatter diagram of potential neighborhoods for child-friendly densification based on the different neighborhood typologies

3.5.7 Neighborhood scale indicators

To create a neighborhood-scale design, first the indicators of interest at the neighborhood scale are shown (see Figure 39). In addition, to better understand the selected neighborhoods based

on the spatial analysis, the important figures and maps are shown. From this information and maps, different conclusions can be drawn regarding the possible interventions.

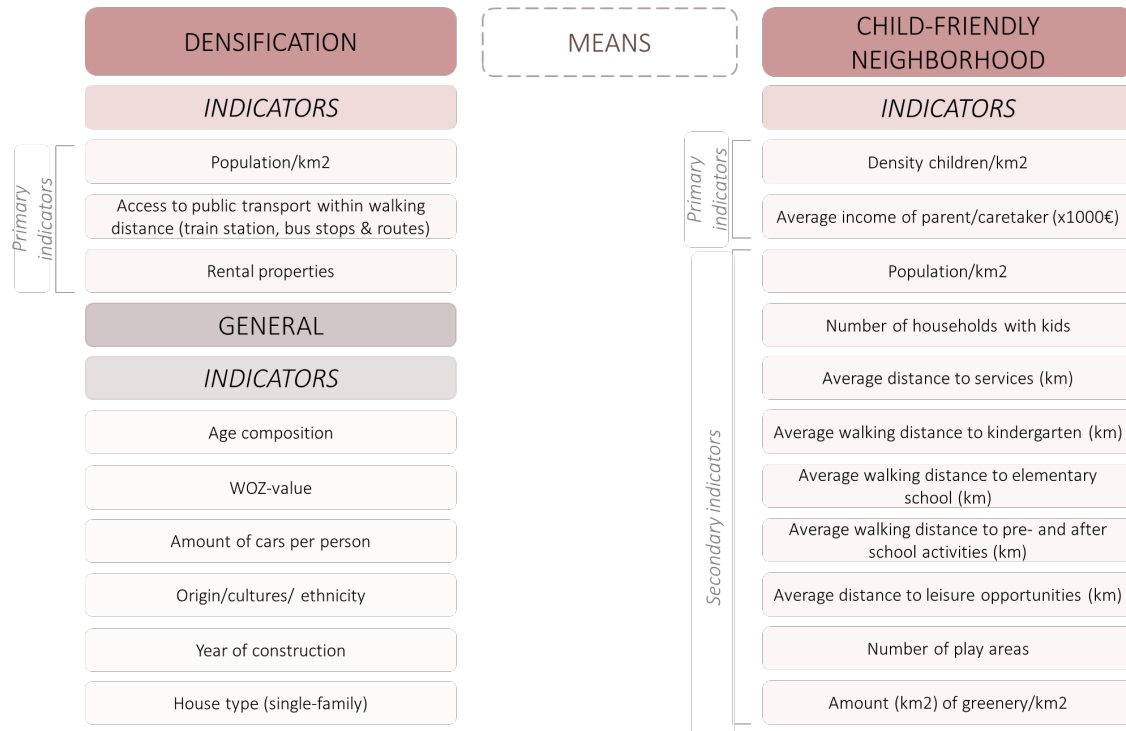


Figure 39, indicators relevant to the neighborhood-scale

Drents Dorp

Drents Dorp concerns a low-income neighborhood with a high density of children, the distribution of which is about the same everywhere. The year of construction of the homes is 1930, of which 79% are owned by a housing corporation (see figures 40 and 41). Along the neighborhood are bus stops that are within the walking distance of a four hundred meter. Within the neighborhood are not more facilities than a school, two kindergartens, two pre-afterschool activities, some playgrounds, a church, and not a lot of public greenery.

't Hooi

'T Hooi concerns an average-income neighborhood with a high density of children, the distribution of which is about the same everywhere, except at the top. The year of construction of the homes is 1970, of which 65% are owned by a housing corporation (see figures 40 and 42). Along the neighborhood are

bus stops that are within the walking distance of four hundred meters. Within the neighborhood are not more facilities than a kindergarten, some playgrounds, and a lot of public greenery.

Zandrijk

Zandrijk concerns a high-income neighborhood with a high density of children, the distribution of which is higher in the middle and the bottom. The year of construction of these homes is 2000, of which 19% are owned by a housing corporation (see figures 40 and 43). In the middle of the neighborhood are bus stops (due to an HOV line that goes right through the neighborhood) that are within the walking distance of four hundred meters. Within the neighborhood are not more facilities than two kindergartens, 2 pre-afterschool activities, some playgrounds, and not a lot of public greenery inside the neighborhood (but a lot on the outside of the neighborhood).



Figure 40, demographics and important information of the selected neighborhoods

Density of children

- Low density children
- High density children



Bus stops and bus lines

- HOV line
- HOV bus stop
- Bus line
- Bus stop



Facilities and type of greenery

- School
- Play areas
- Kindergarten
- Playable greenery
- High density greenery
- Low density greenery
- Height difference
- Wadis

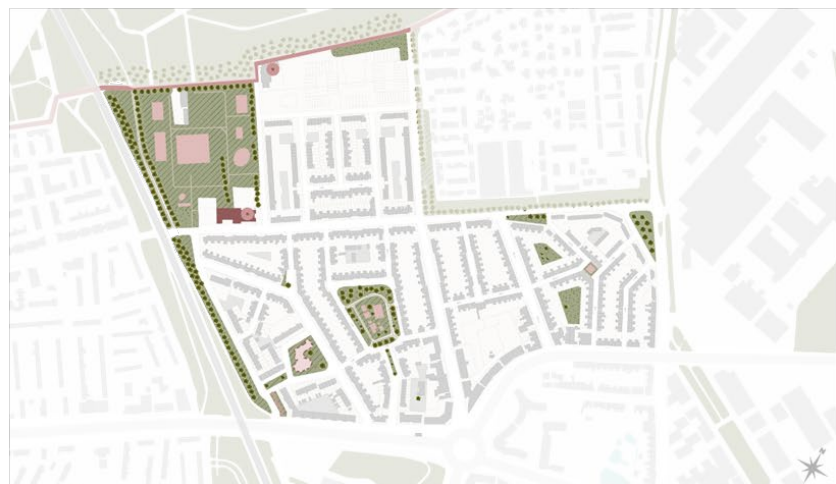




Figure 41, additional information of Drents Dorp based on indicators

Density of children

- Low density children
- High density children



Bus stops and bus lines

- HOV line
- HOV bus stop
- Bus line
- Bus stop








Facilities and type of greenery

- School
- Play areas
- Kindergarten
- Playable greenery
- High density greenery
- Low density greenery
- Height difference
- Wadis



Ownership

-  Multi-fold
-  Company
-  Housing corporation
-  Public (municipality)
-  Private owned



Year of construction














-  1920
-  1930
-  1940
-  1950
-  1960
-  1970
-  1980
-  1990
-  2000
-  2010
-  2020




Figure 42, additional information of 't Hooft based on indicators

Density of children

-  Low density children
-  High density children





Bus stops and bus lines

-  HOV line
-  HOV bus stop
-  Bus line
-  Bus stop








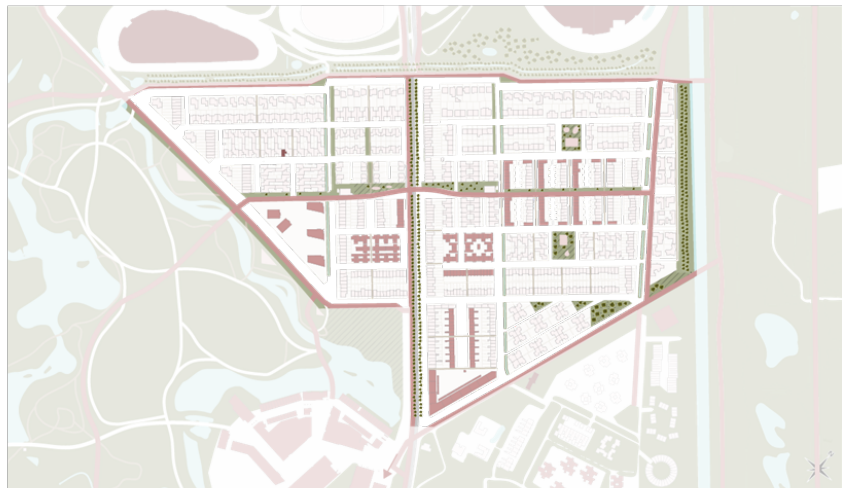
Facilities and type of greenery

-  School
-  Play areas
-  Kindergarten
-  Playable greenery
-  High density greenery
-  Low density greenery
-  Height difference
-  Wadis














Ownership

-  Multi-fold
-  Company
-  Housing corporation
-  Public (municipality)
-  Private owned



Year of construction

-  1920
-  1930
-  1940
-  1950
-  1960
-  1970
-  1980
-  1990
-  2000
-  2010
-  2020

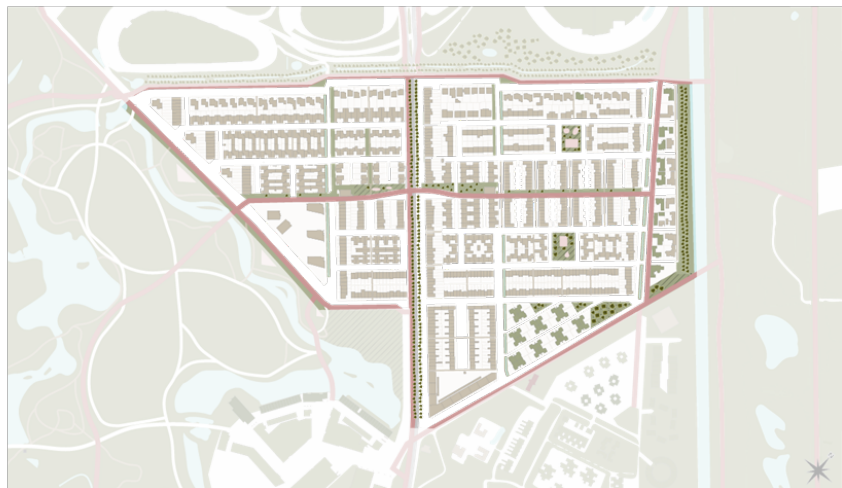


Figure 43, additional information of Zandrijk based on indicators

4. Design

4.1 City strategy

The city strategy is based on literature studies and Eindhoven municipality policy documents. Several city-scale principles were applied to arrive at the final strategy regarding child-friendly densification. These principles include: Build and develop centrally, transit-oriented development (TOD), transforming buildings

(prior to greenfield development), addition of (more) mixed functions and facilities, addition of bike connections, improve walking routes, addition of bus lines, improve accessibility to (playable) greenery, add patches of greenery and improve connections of greenery. See Appendix J for the city strategy in detail.



Figure 44, city strategy based on design principles for densification and a child-friendly neighborhood

4.2 Neighborhood designs

Neighborhood design Drents Dorp

Drents Dorp lacks good infrastructure. For this reason, a child-friendly route will be implemented leading from the kindergarten, past the elementary school, the church, the playground, to another playground. One densification method used is fabric regeneration. This is applied in several phases, starting with the main new phase in the darkest color (see figure 46). Secondly, a couple of buildings will be transformed, so that there will be more passive or active surveillance from the dwellings on the street, instead of a blind wall. In this way, there is room for adding housing in some places.

A new heart is created in the middle of the neighborhood, as a parking lot makes way for new housing. In addition, two stories will be added to existing apartment buildings up to a height of 5 stories. To promote children's participation in outdoor activities in this neighborhood, parts of the vegetable gardens (which are low maintenance in the current situation) will be allocated to elementary school children to maintain (where the courtyards can be closed in the evening to ensure privacy). Some nature play areas have been designed

along the route. Alongside this, an elementary school with green play areas has been designed. An urban playground, a playground for intergenerational play and a communal toy box will be developed in the neighborhood. Digital interventions could be used here to make outdoor play more attractive and educational. Outdoor covered play is going to be added at areas where there are facilities for children, but also where play spaces can be found. Since there are few facilities in the neighborhood, there are several childcare facilities, social places for caretakers and communal spaces added. These social places for parents are located where most children live or come.

A car-free neighborhood was created by adding several one-way roads. In addition, podium parking has been realized to meet parking demand. To make this neighborhood even more child-friendly, streetlights need to be added in some places to avoid dark spaces. Next to this, greenery can be added to parking spaces, so that these spaces are made more attractive to children and caretakers. See figures 45 and 50 for the designs.

Before application of design

- Buildings
- School
- Play areas
- Facilities for children (and caretakers)
- Walking paths
- Cycling path
- Streetlights and greenery along paths and streets
- Playable greenery
- High density greenery
- Low density greenery



Application of design

- Added child-friendly route
- Added facilities for children (and caretakers)
- Added play areas
- Added (or adjusted to safe) greenery
- Added paths
- Added streetlights and greenery along paths and streets
- Added Speedbumps
- Added buildings
- Transformed buildings
- Fabric regeneration



After application of design

- Buildings
- School
- Play areas
- Facilities for children (and caretakers)
- Walking paths
- Cycling path
- Streetlights and greenery along paths and streets
- Playable greenery
- High density greenery
- Low density greenery
- Added child-friendly route



Figure 45, Drents Dorp (before and after) application of design



Figure 46, Drents Dorp phases fabric regeneration

Neighborhood design 't Hool

't Hool has a good infrastructure, but one has to cross wide roads to go to facilities. For this reason, a child-friendly cycling route will be implemented from one elementary school, to another elementary school at to top.

One densification method used is fabric regeneration at the top. This area at the top is chosen because most children live here and there is a lot of open space. Secondly, a couple of buildings will be transformed (because they were really long blocks), so that there will be more passive or active surveillance from the dwellings on the street. In this way, there is room for adding housing in some places.

To promote children's participation in outdoor activities in this neighborhood, vegetable gardens are designed and some nature play areas have been designed along the route. An urban playground, a playground for

intergenerational play and a communal toy box will be developed in the neighborhood. Digital interventions could be used here to make outdoor play more attractive and educational. Outdoor covered play is going to be added in areas where there are facilities for children, but also where play spaces can be found. Since there are few facilities in the neighborhood, there are several childcare facilities, social places for caretakers and communal spaces added. These social places for parents are located where most children live or come.

Speedbumps and paths are added to make the neighborhood more child-friendly and car-free. To make this neighborhood even more child-friendly, streetlights need to be added at some places to avoid dark spaces. In addition, greenery needs to be modified to ensure passive and active surveillance. See figures 47 and 51 for the designs.

Before application of design

- Buildings
- School
- Play areas
- Facilities for children (and caretakers)
- Walking paths
- Cycling path
- Streetlights and greenery along paths and streets
- Playable greenery
- High density greenery
- Low density greenery



Application of design

- Added bike route
- Added facilities for children (and caretakers)
- Added play areas
- Added (or adjusted to safe) greenery
- Added paths
- Added streetlights and greenery along paths and streets
- Added Speedbumps
- Added buildings
- Transformed buildings
- Fabric regeneration



After application of design

- Buildings
- School
- Play areas
- Facilities for children (and caretakers)
- Walking paths
- Cycling path
- Streetlights and greenery along paths and streets
- Playable greenery
- High density greenery
- Low density greenery



Figure 47, 't Hooft (before and after) application of design

Neighborhood design Zandrijk

Zandrijk needs a different approach than Drents Dorp and 't Hooi, as its context is totally different. Zandrijk has a very good infrastructure, but almost no children are using it (whereas in the other neighborhoods it was the exact opposite). To reach green spaces and other amenities, one has to cross wide streets. In this neighborhood it is important to realize multiple functions and play facilities along the existing routes.

On a green area (dryland) in the south of the neighborhood, new buildings (for the purpose of living in greenery) are realized with a building height of up to 5 stories. Different functions and facilities are used in existing buildings, which requires some of these buildings to be transformed. In addition, fabric regeneration is applied to buildings in the middle of the area.

An urban playground, nature play areas and a playground for intergenerational play will be developed in the neighborhood. Outdoor

covered play is going to be added in areas where there are facilities for children, but also where play spaces can be found. Digital interventions could be used here to make outdoor play more attractive and educational. Since there are few facilities in the neighborhood, there are several childcare facilities, social places for caretakers and communal spaces added within but also along the neighborhood. These social places for parents are located where most children live or come.

Safe pedestrian crossings and paths are added to make the neighborhood more child-friendly and car-free. To make this neighborhood even more child-friendly, streetlights need to be added at some places to avoid dark spaces. In addition, greenery needs to be modified in some places to ensure passive and active surveillance. See figures 48 and 52 for the designs.

Before application of design

- Buildings
- School
- Play areas
- Facilities for children (and caretakers)
- Walking paths
- Cycling path
- Streetlights and greenery along paths and streets
- Playable greenery
- High density greenery
- Low density greenery



Application of design

- Added bike route
- Added facilities for children (and caretakers)
- Added play areas
- Added (or adjusted to safe) greenery
- Added paths
- Added streetlights and greenery along paths and streets
- Added Speedbumps
- Added buildings
- Transformed buildings
- Fabric regeneration



After application of design

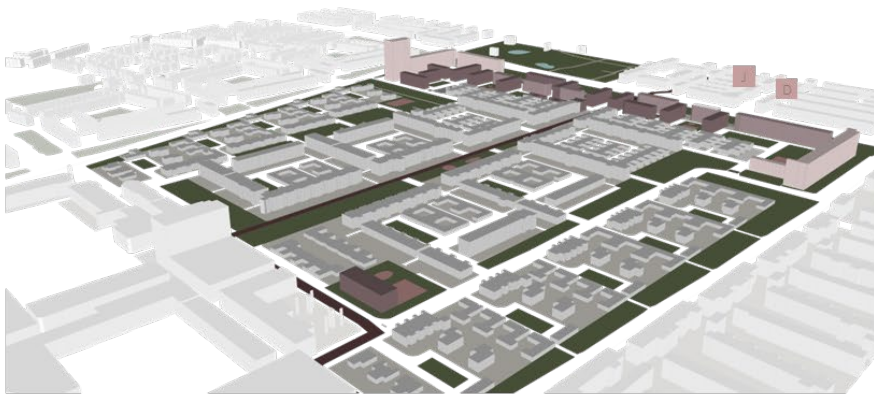
- Buildings
- School
- Play areas
- Facilities for children (and caretakers)
- Walking paths
- Cycling path
- Streetlights and greenery along paths and streets
- Playable greenery
- High density greenery
- Low density greenery



Figure 48, Zandrijk (before and after) application of design



't Hool



Zandrijk



Figure 49, 3D visualizations (application of design)

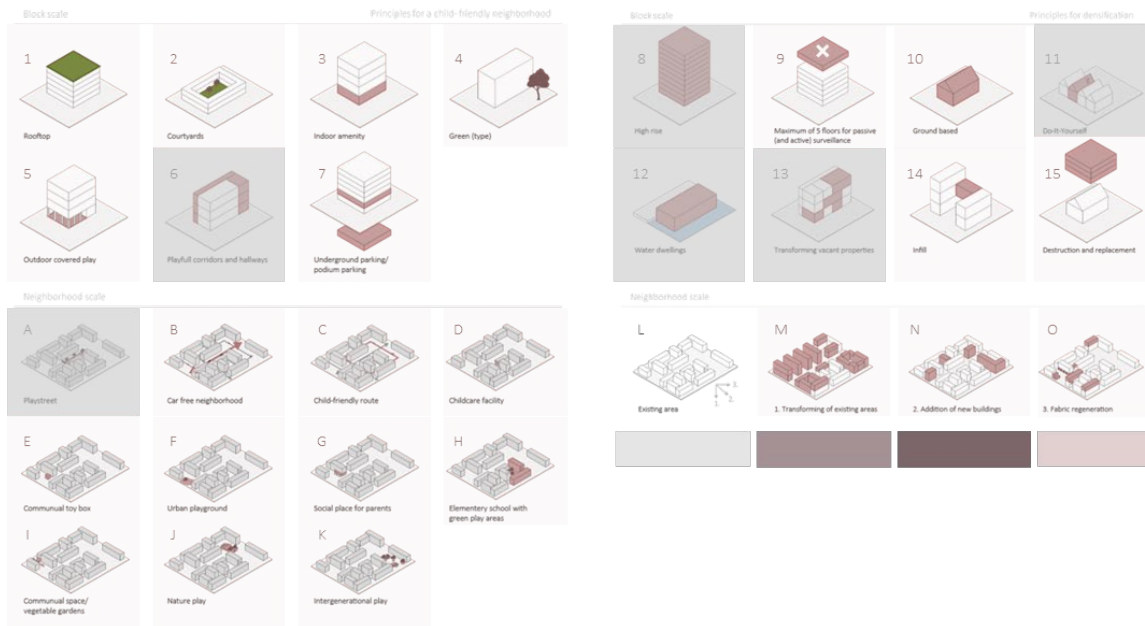
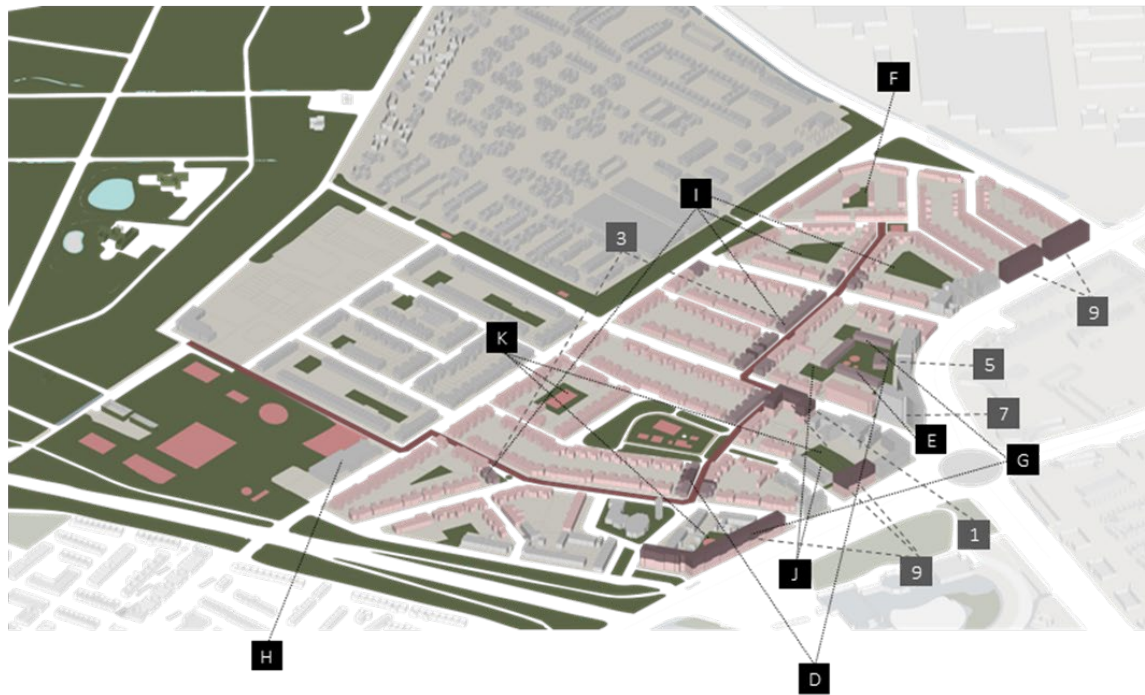


Figure 50, 3D visualization of application of design principles of Drents Dorp

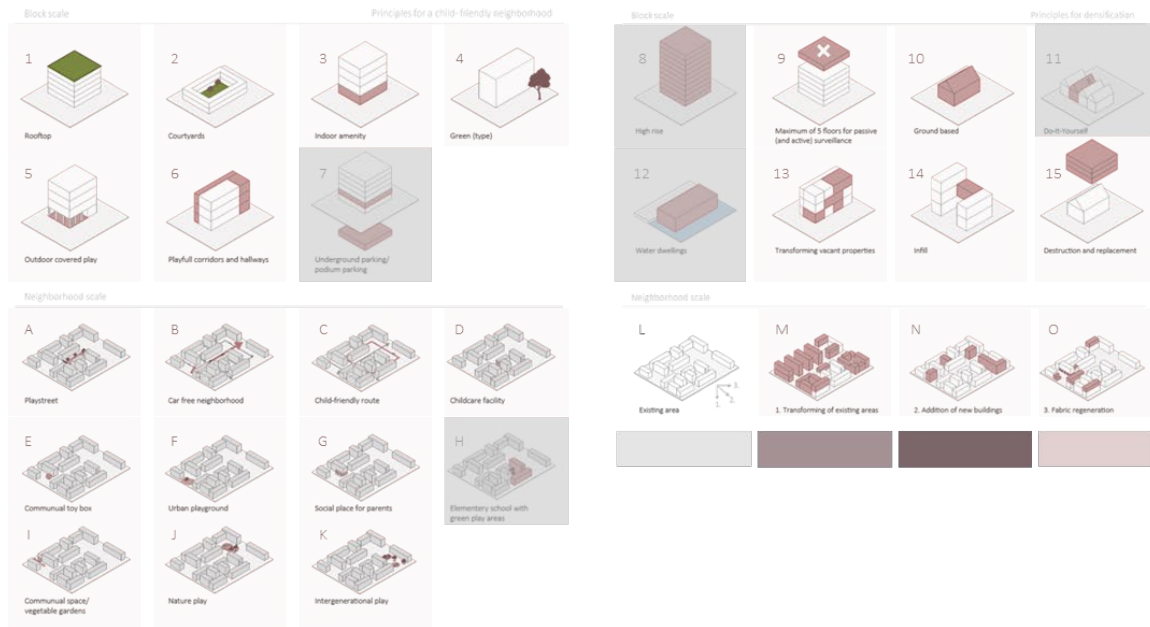
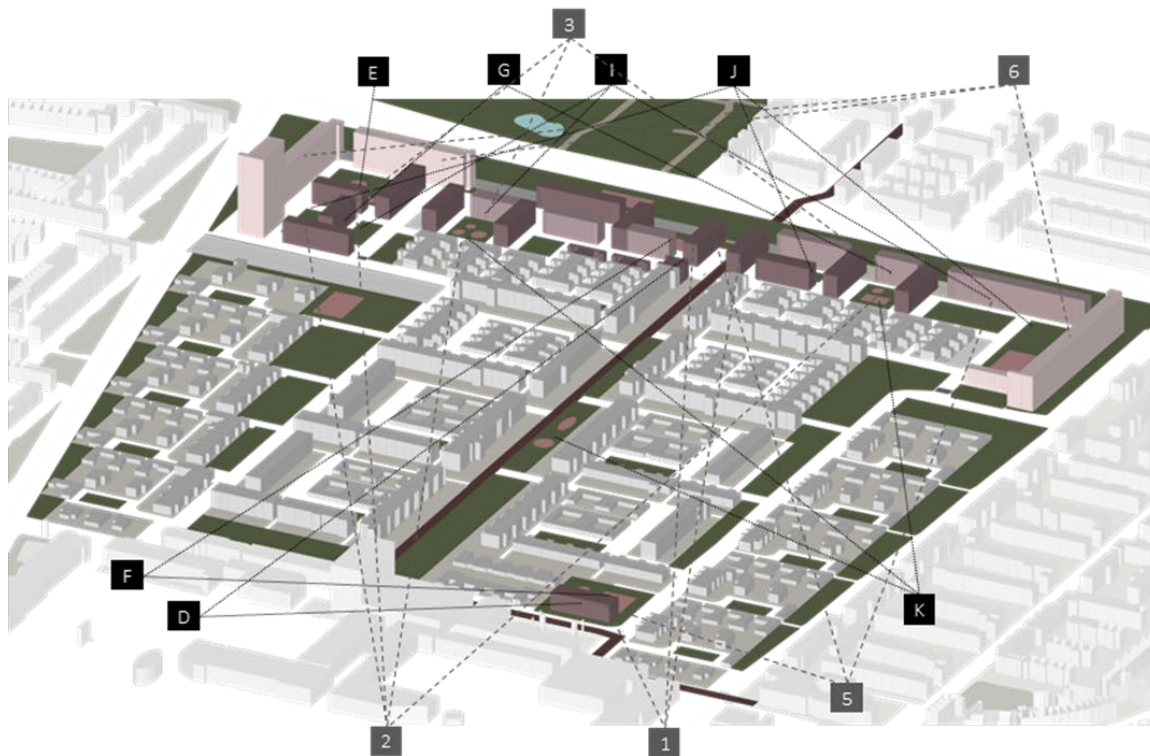


Figure 51, 3D visualization of application of design principles of 't Hooft

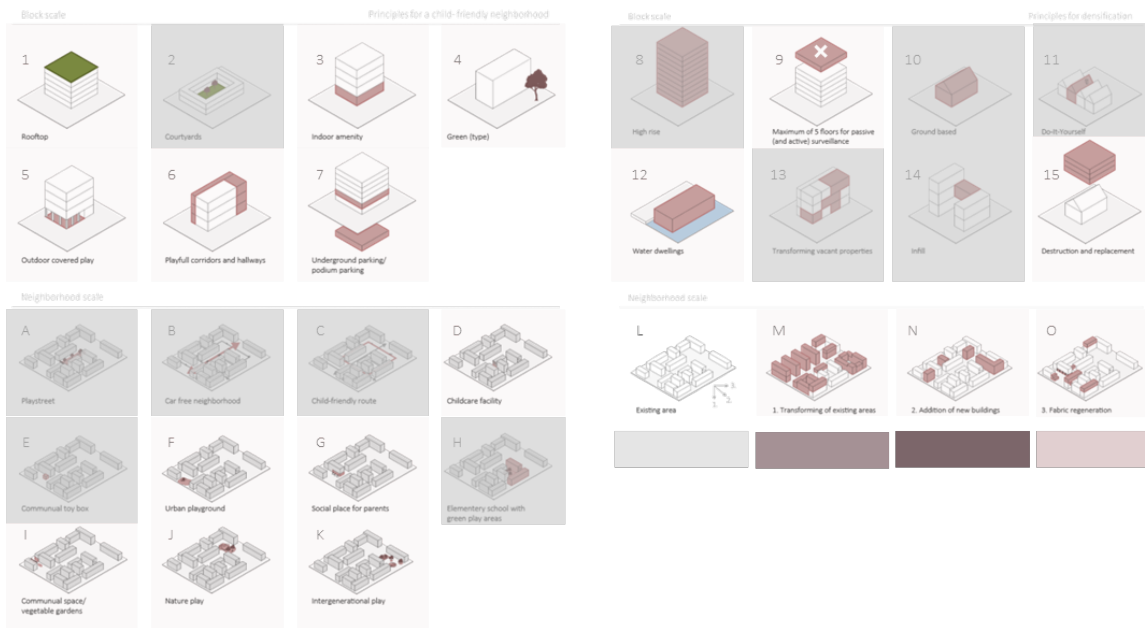


Figure 52, 3D visualization of application of design principles of Zandrijk

Conclusion

This paper investigated the question, "How to create a more safe, healthy and playable environment for children's daily movements in the context of a densifying city (i.e., Eindhoven)? For this purpose, a quantitative and qualitative research was conducted regarding the implementation of a child-friendly city in the context of a densifying city.

Based on information from various policy documents, several neighborhoods in Eindhoven need to be densified. Approximately 35,000 to 40,000 homes, including 21,000 homes within the ring road, are to be built by 2040. Densification in the context of Eindhoven is done by building and developing centrally, combined with adding various amenities and mixing multiple functions. Other densification methods applied in Eindhoven are transit oriented development, transforming buildings prior to greenfield development and adding and improving walking and cycling routes (and public transport).

Densification does not always have unpleasant consequences for children's daily urban system. Densification with amenities shortens the distance between activities, making the use of active transport modes (and public transport) more attractive. However, the route children must travel through active transport modes toward an activity, which is often determined by a parent or caregiver, must remain safely accessible in a densifying context. In addition to this, the public space (for the purpose of

outdoor play and access to green spaces (and/or UGI)) in which a child between 5-11 years old moves during a school day must also be preserved in a densifying context for a child's optimal health and development.

One way to make the (according to the typologies selected) neighborhoods child-friendly is by implementing the four elements related to a child-friendly city. Drents Dorp, 't Hool and Zandrijk each have different contexts, giving them a different approach during designs, but addressing all domains of a child's life.

Through the application of different play opportunities, car-free roads, child-friendly routes, (communal) facilities, active and passive surveillance and different types of greenery, a safe, healthy and playable environment for children of different ages, cultures and socio-economic positions is developed. By precisely coordinating these points with densification in the relevant context, the daily urban system of children will be made safer and more attractive (for the benefit of children and their caregivers), leading to more outdoor play and increased use of active transport modes by children (healthy lifestyle). By implementing digital interventions in the various play opportunities, a child becomes motivated to play outside and connect with nature and other children. Participation of children in the neighborhood and environment is thereby made possible.

Discussion

Data from different government agencies was used to create a city strategy and examine the three selected neighborhoods. Based on this, it can be said that if this part of the research (the spatial analysis) were repeated, the results would be the same and thus the results of the spatial analysis are valid.

For the purpose of the qualitative research, sixteen different literature papers, three case studies and several policy documents were used, which (separately) address the sub-questions posed. All of these do not address combining a child-friendly neighborhood and densification. However, a few literature papers do mention how a child-friendly city can be applied in the context of a densely populated city. The design principles mentioned in these have therefore been partially adopted and

adapted. However, further research should be done on combining densification principles and principles for the purpose of a child-friendly neighborhood (in detail). In addition, this research is limited to the principles found in the found literature, perhaps there are more if a follow-up study is conducted.

Different approaches at different scales have been applied within this research. A further elaboration of a design on block scale has not been addressed due to lack of time. Therefore, the recommendation for further research is to conduct similar research at block scale. In addition, it is important for further research that the municipality make a policy plan completely focused on the liveability of children in the city.

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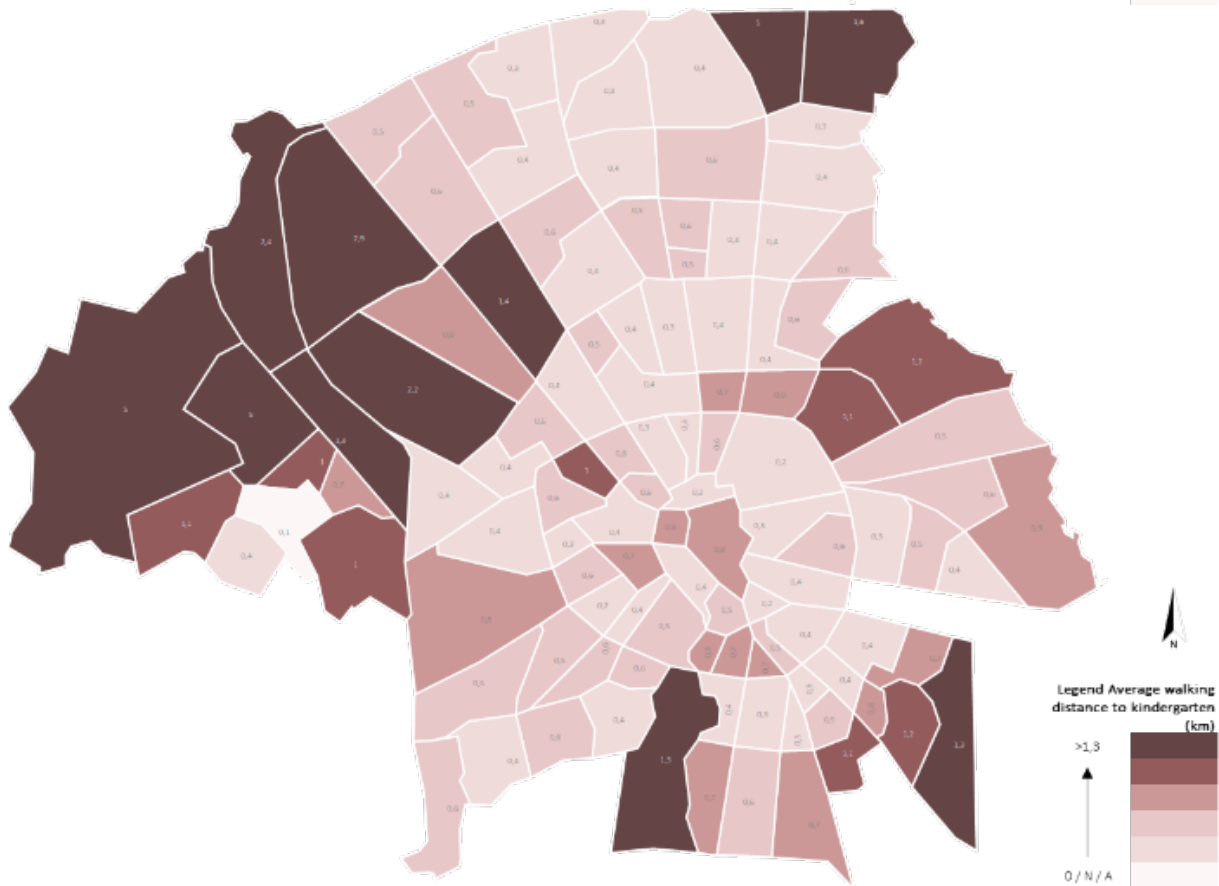
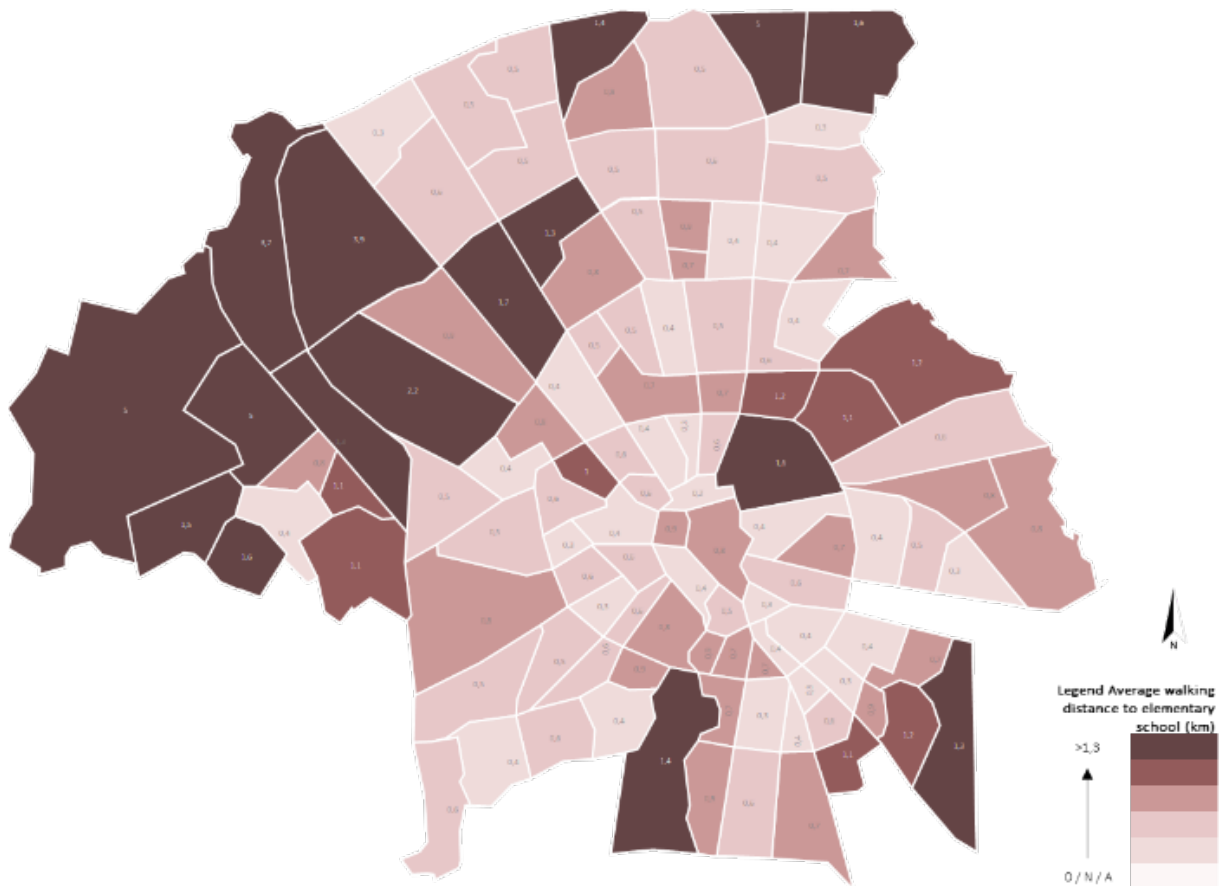
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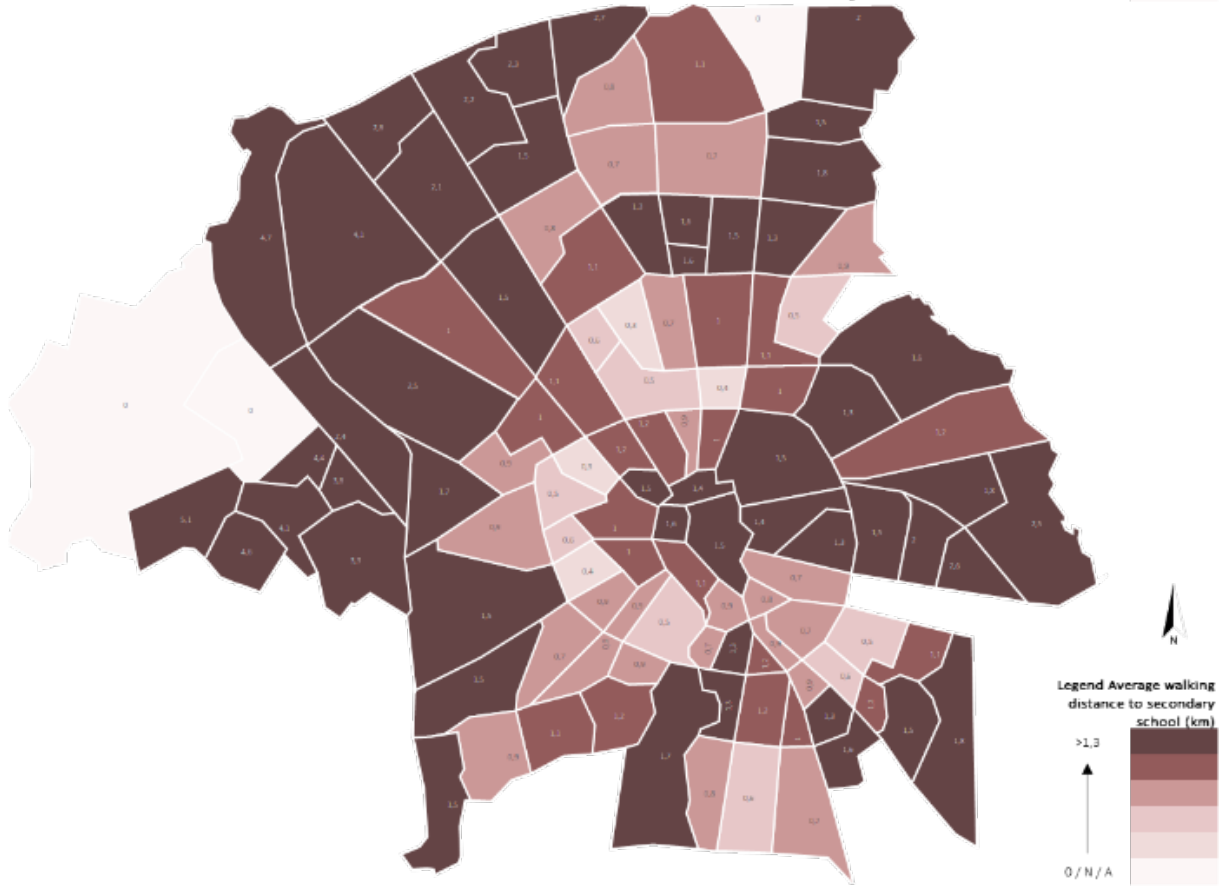
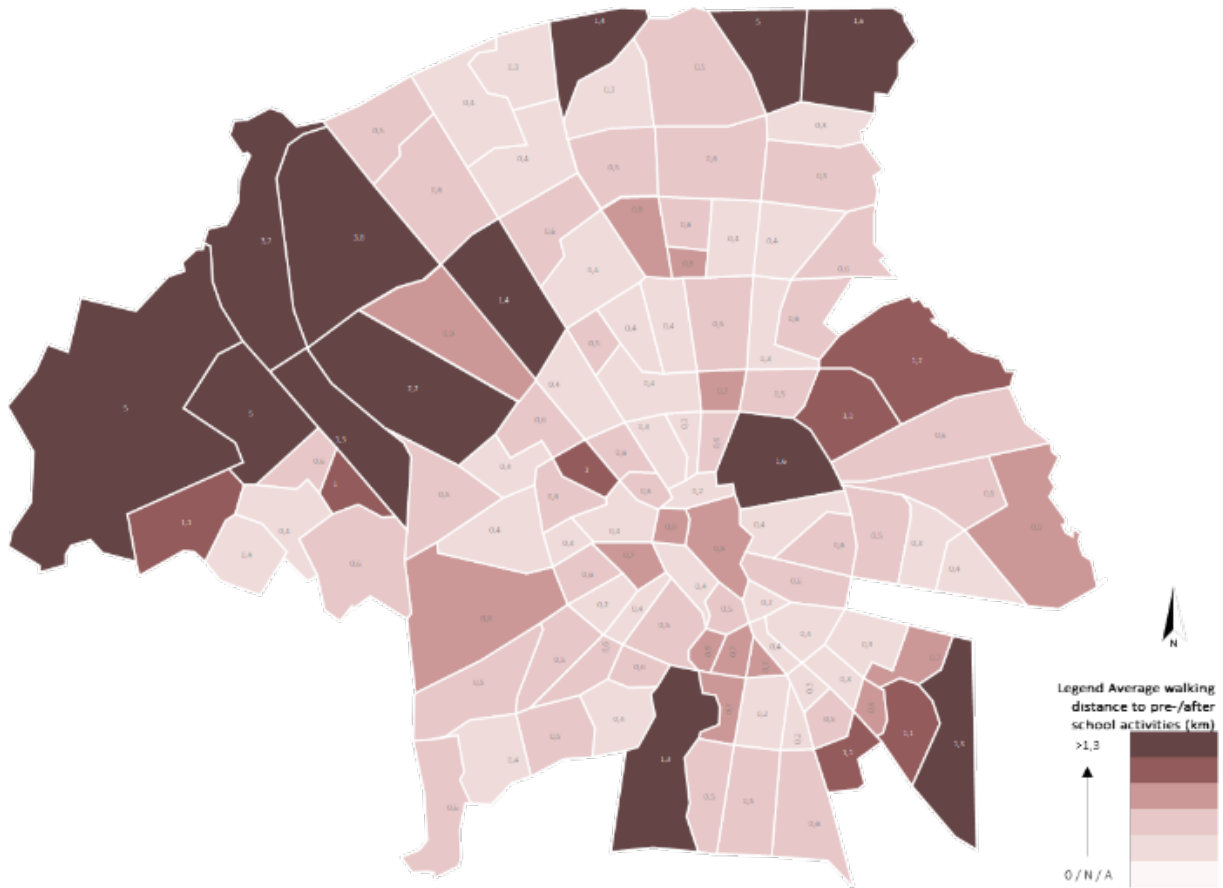
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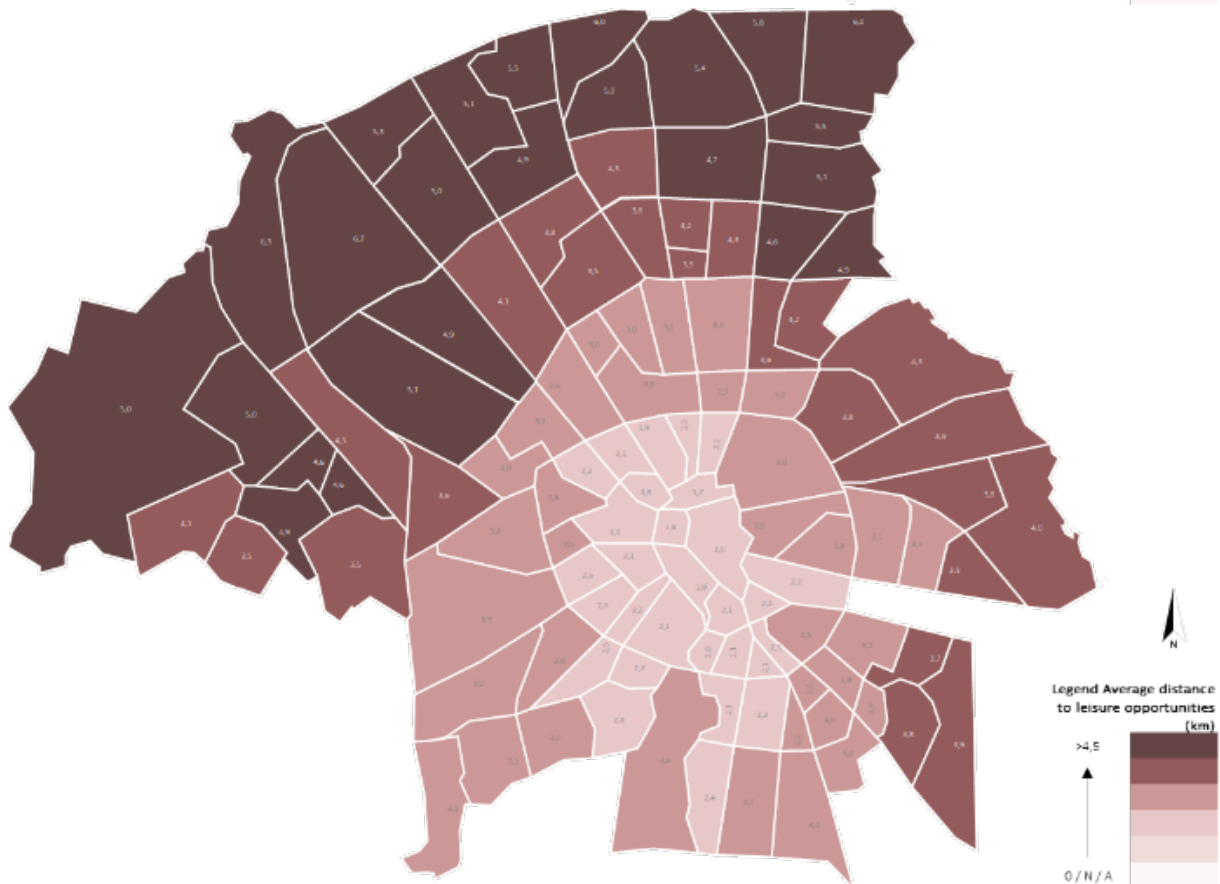
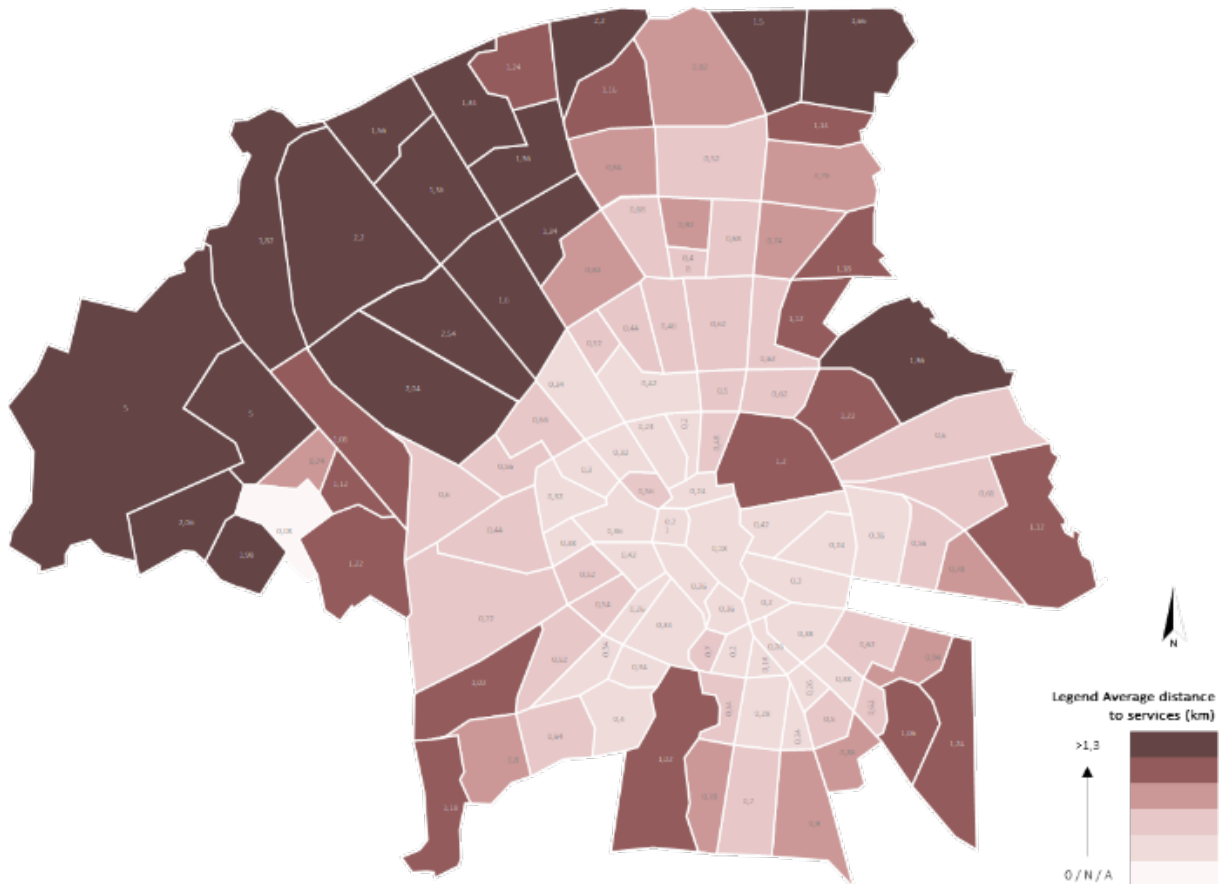
Appendix

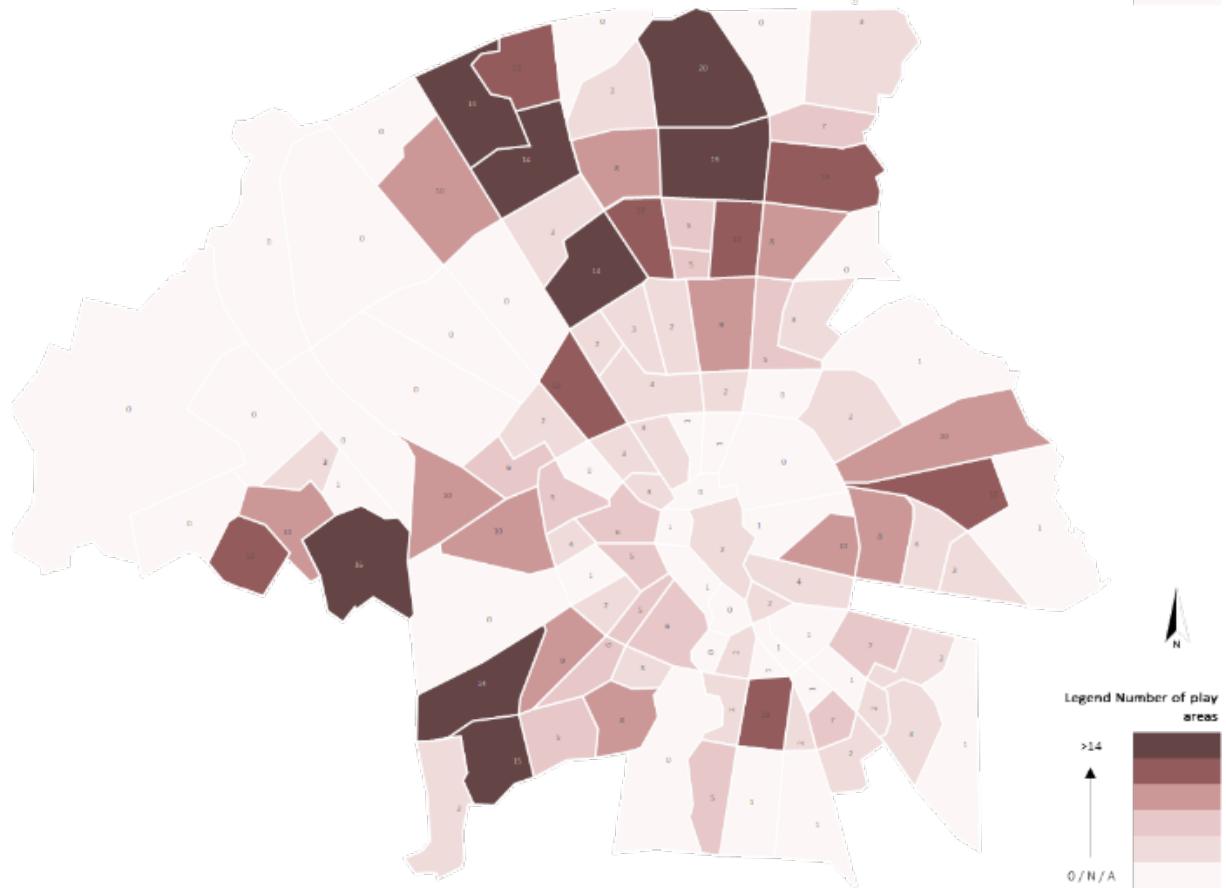
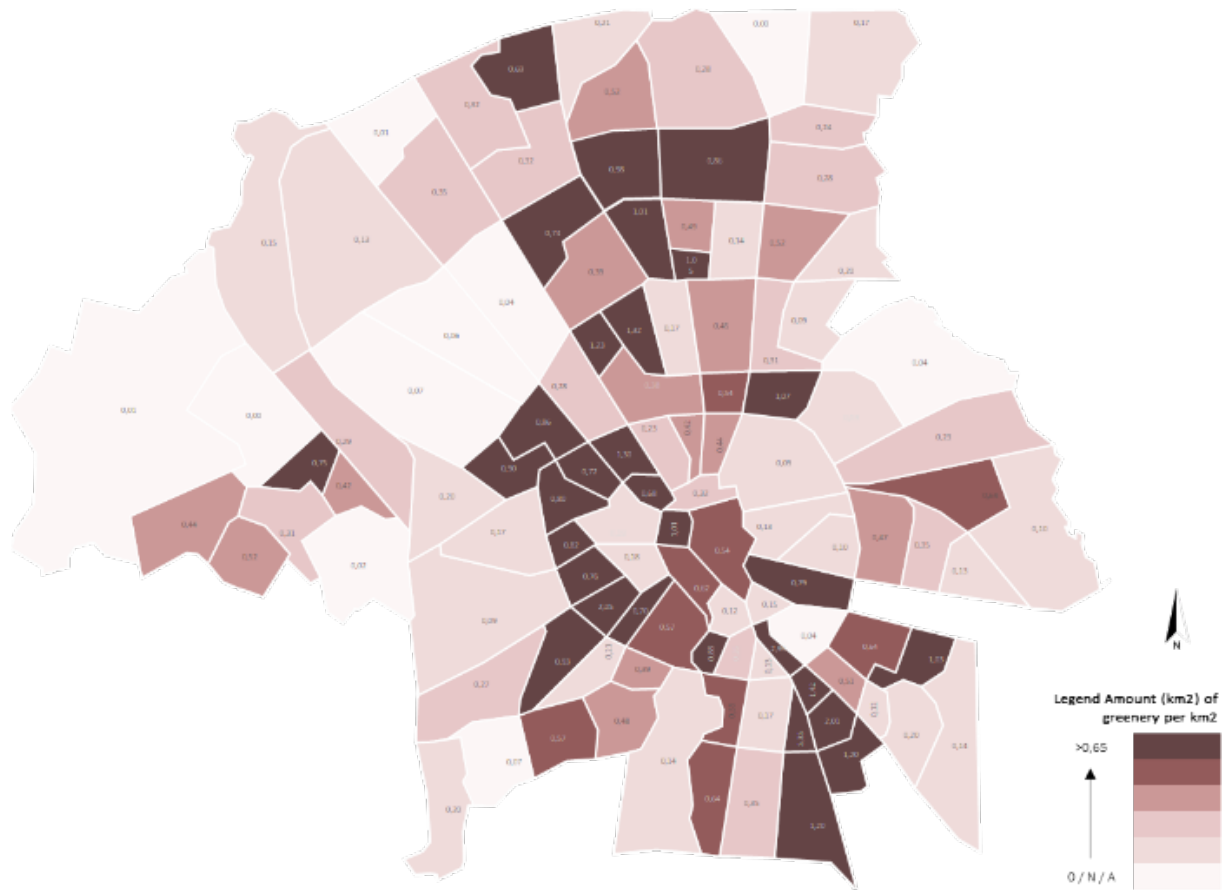
Appendix A – Maps of indicators

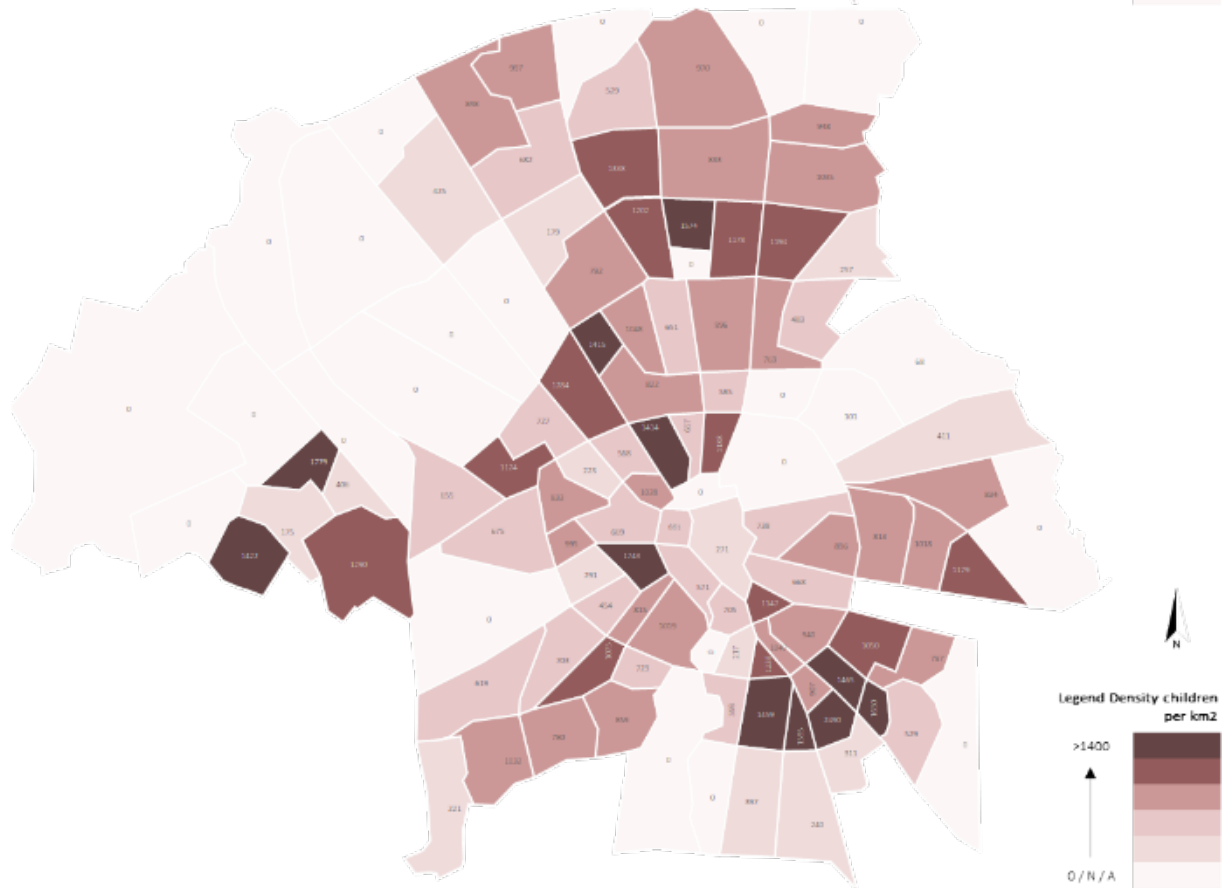
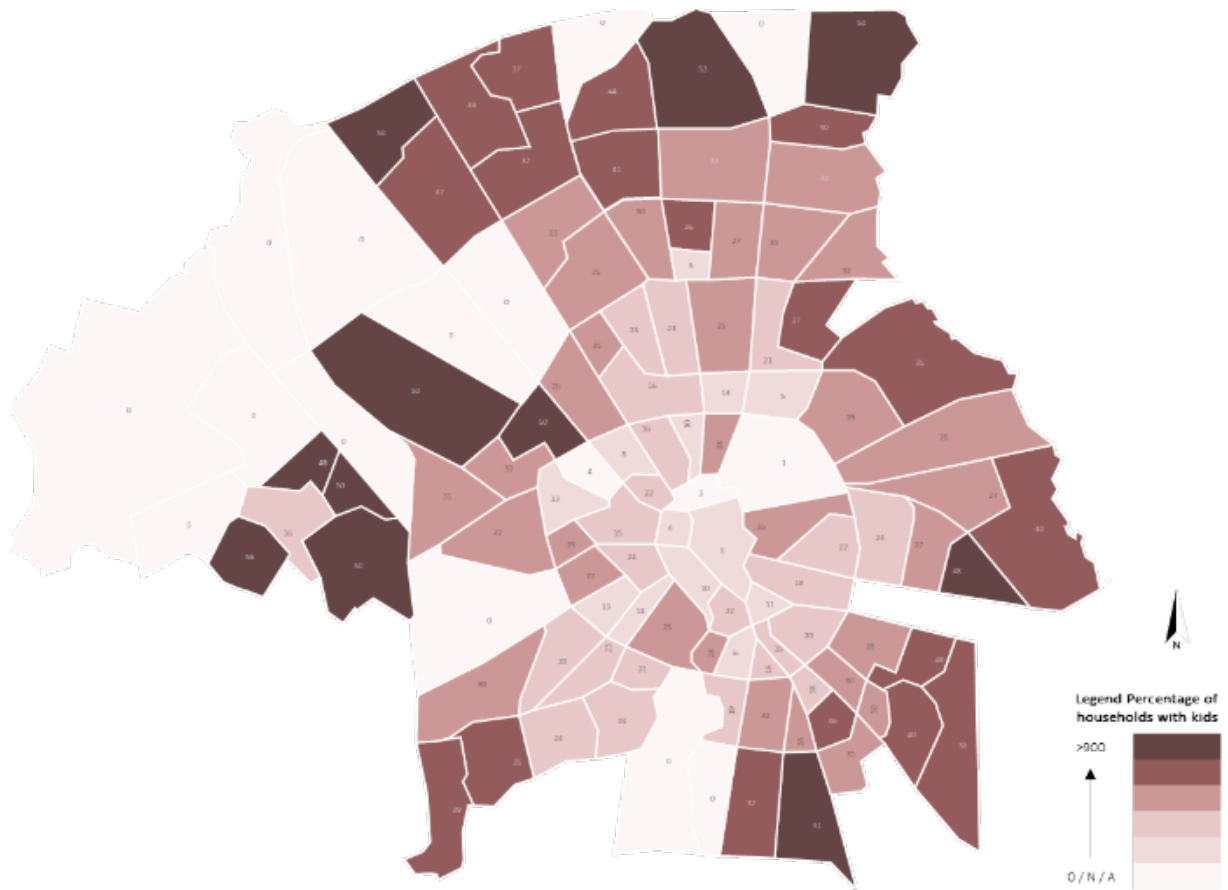
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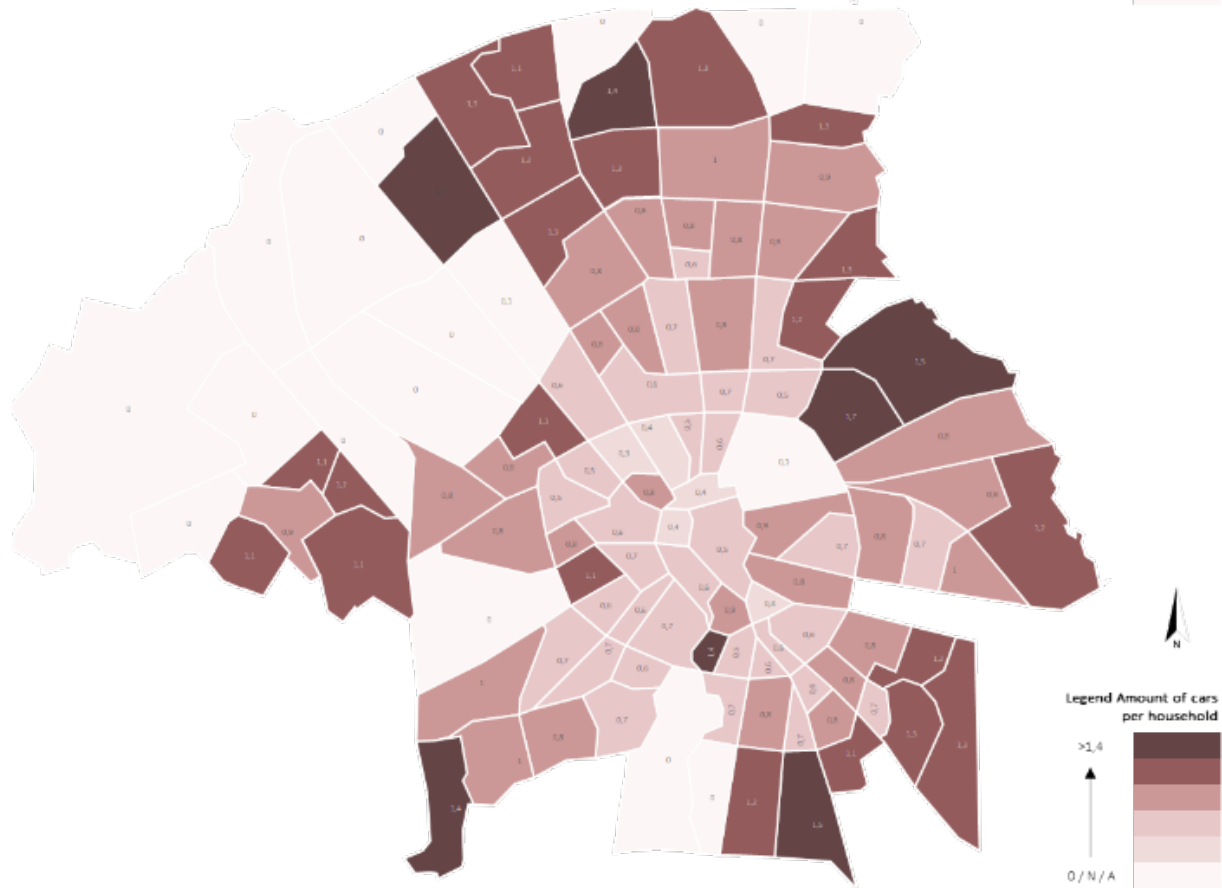
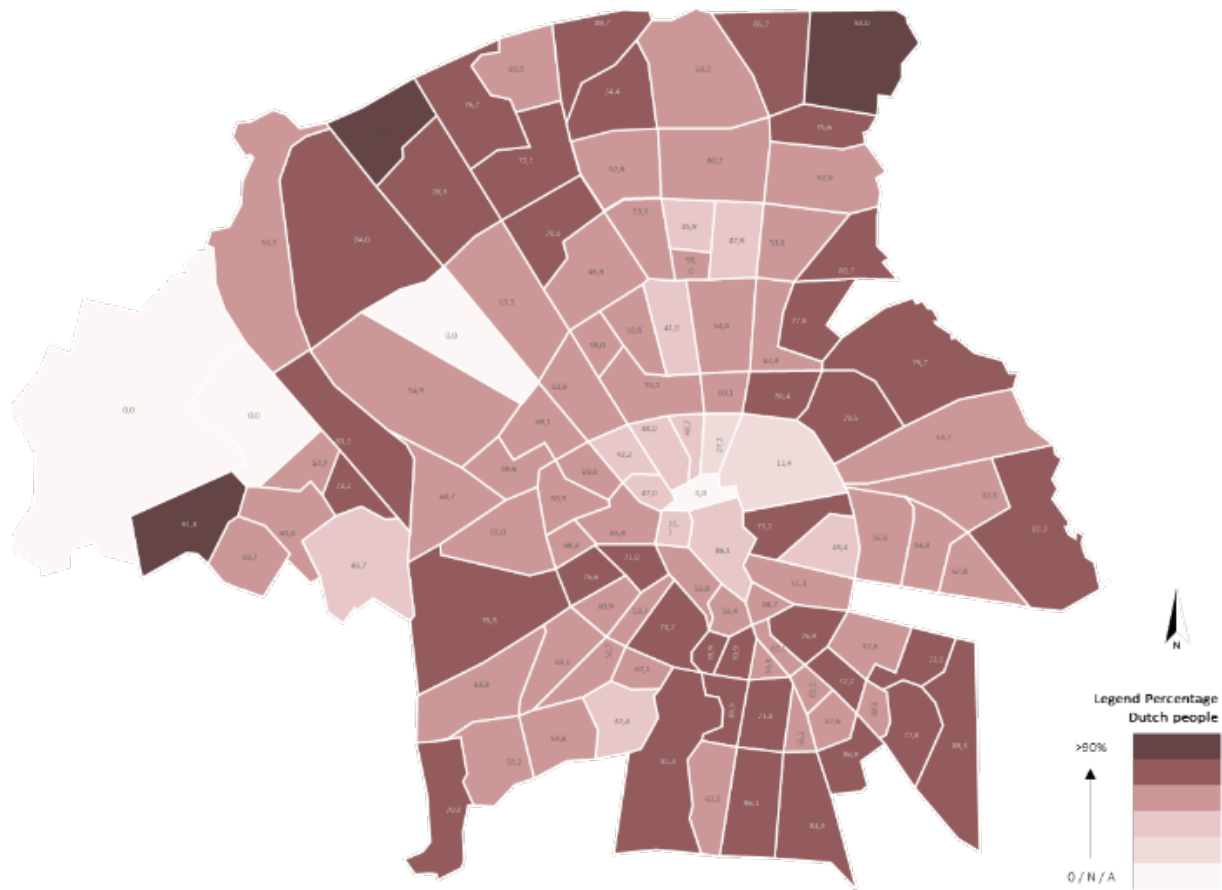


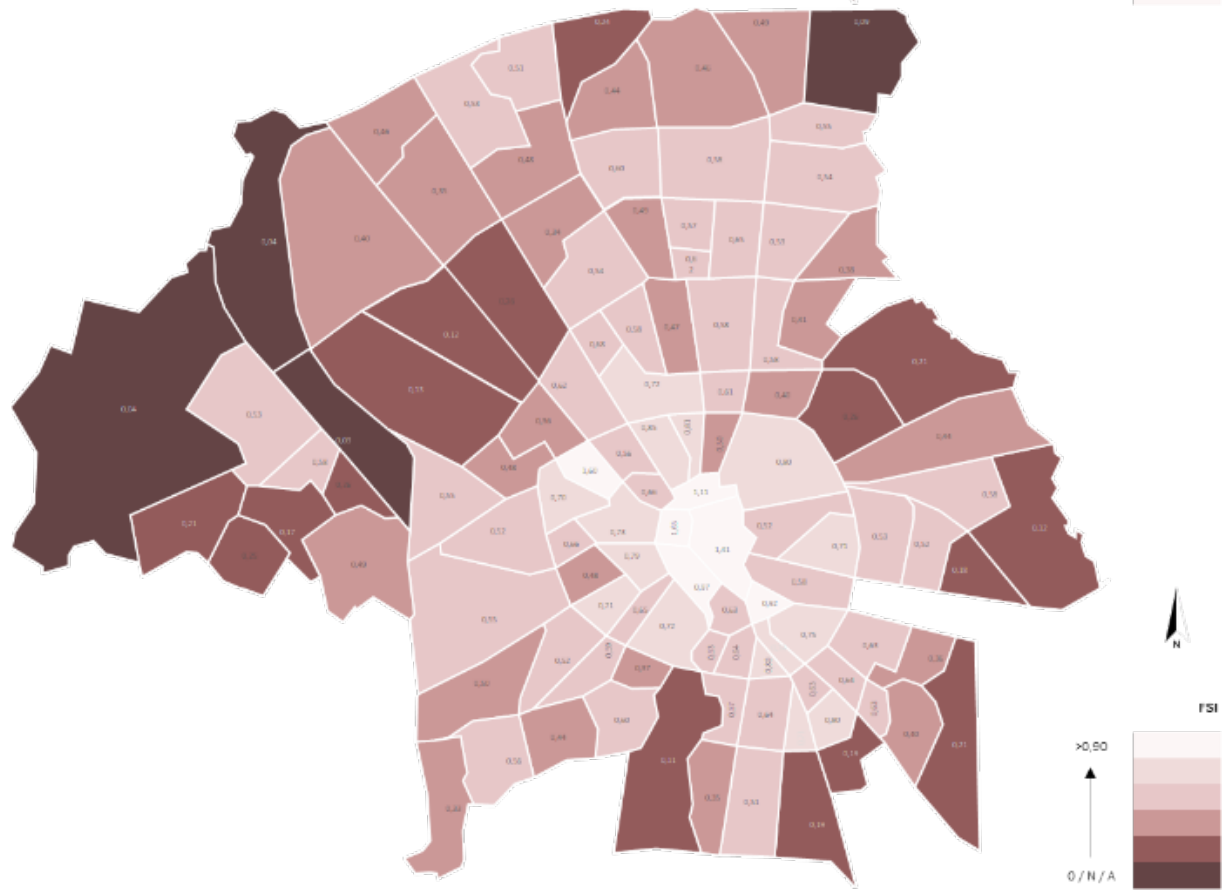
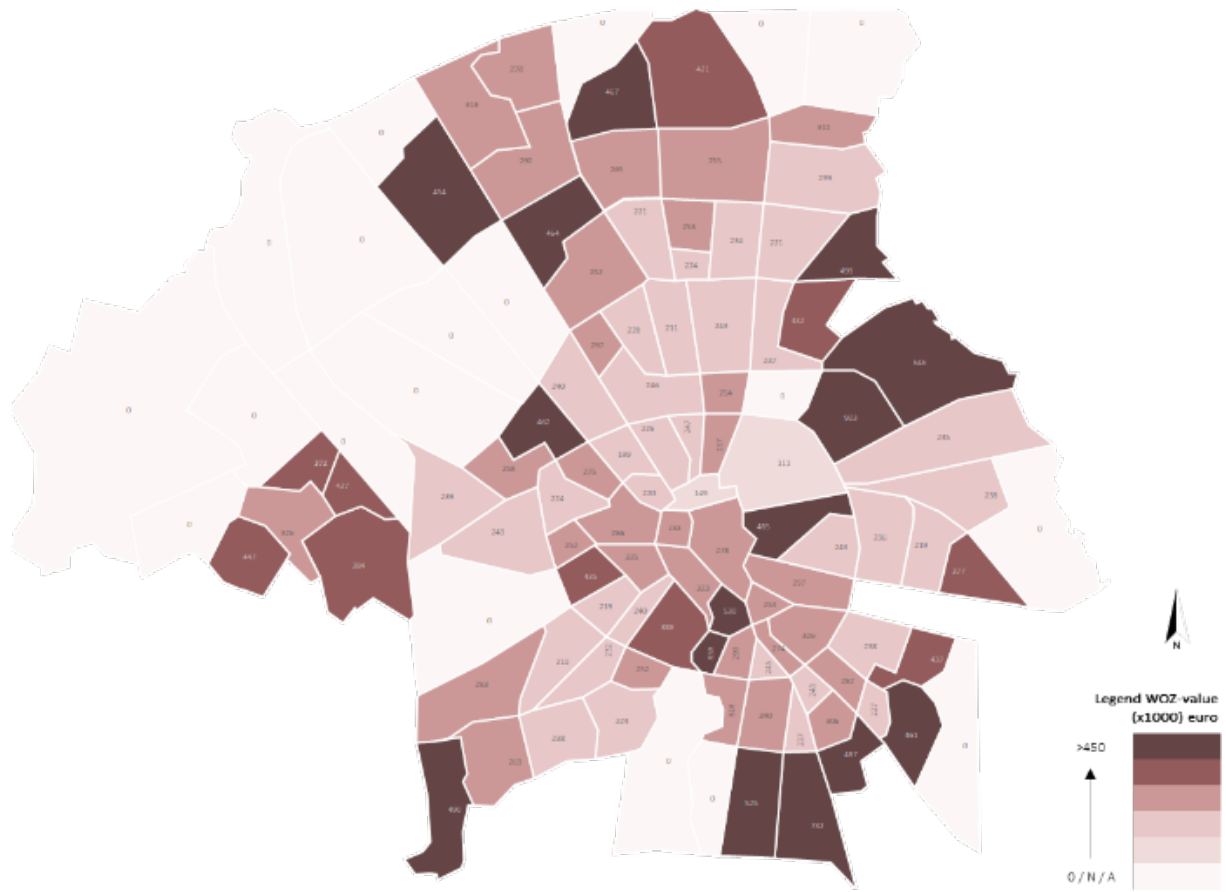


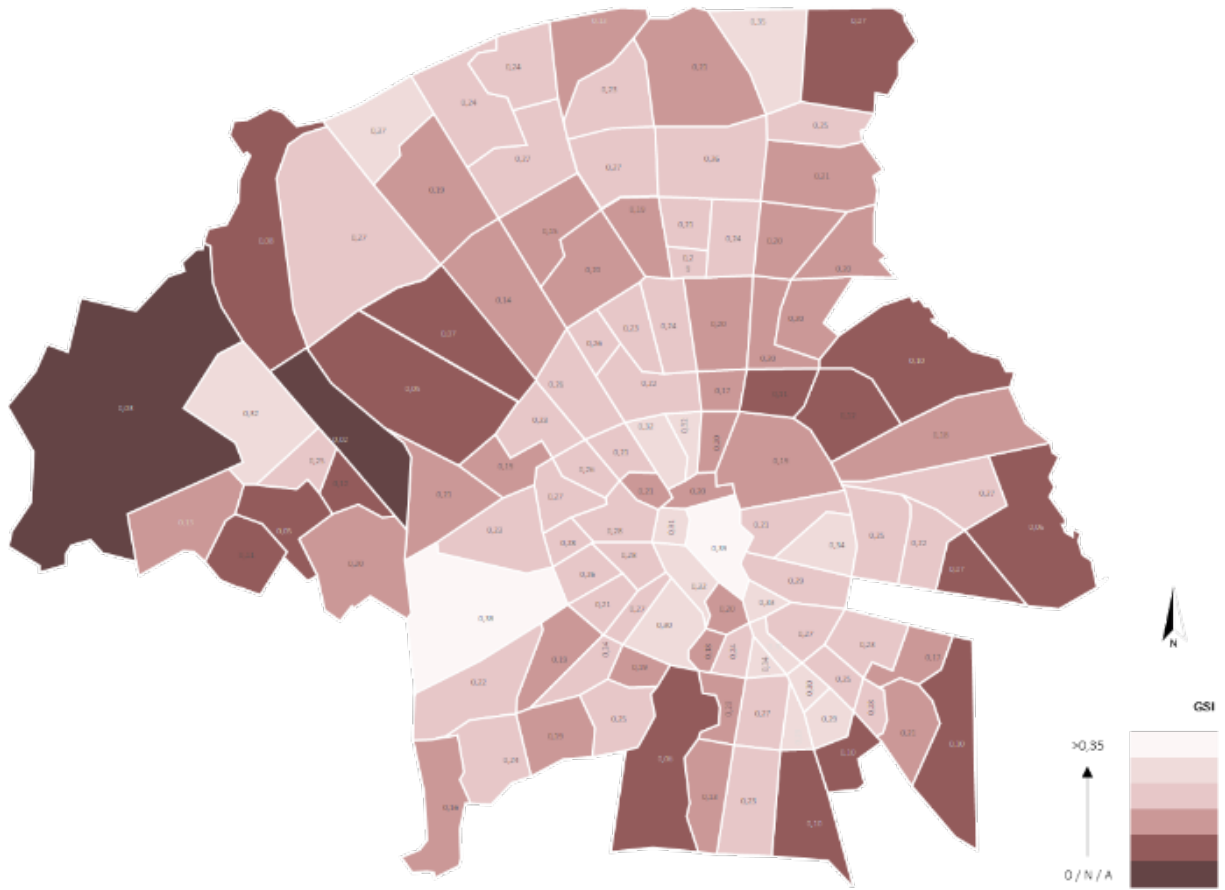


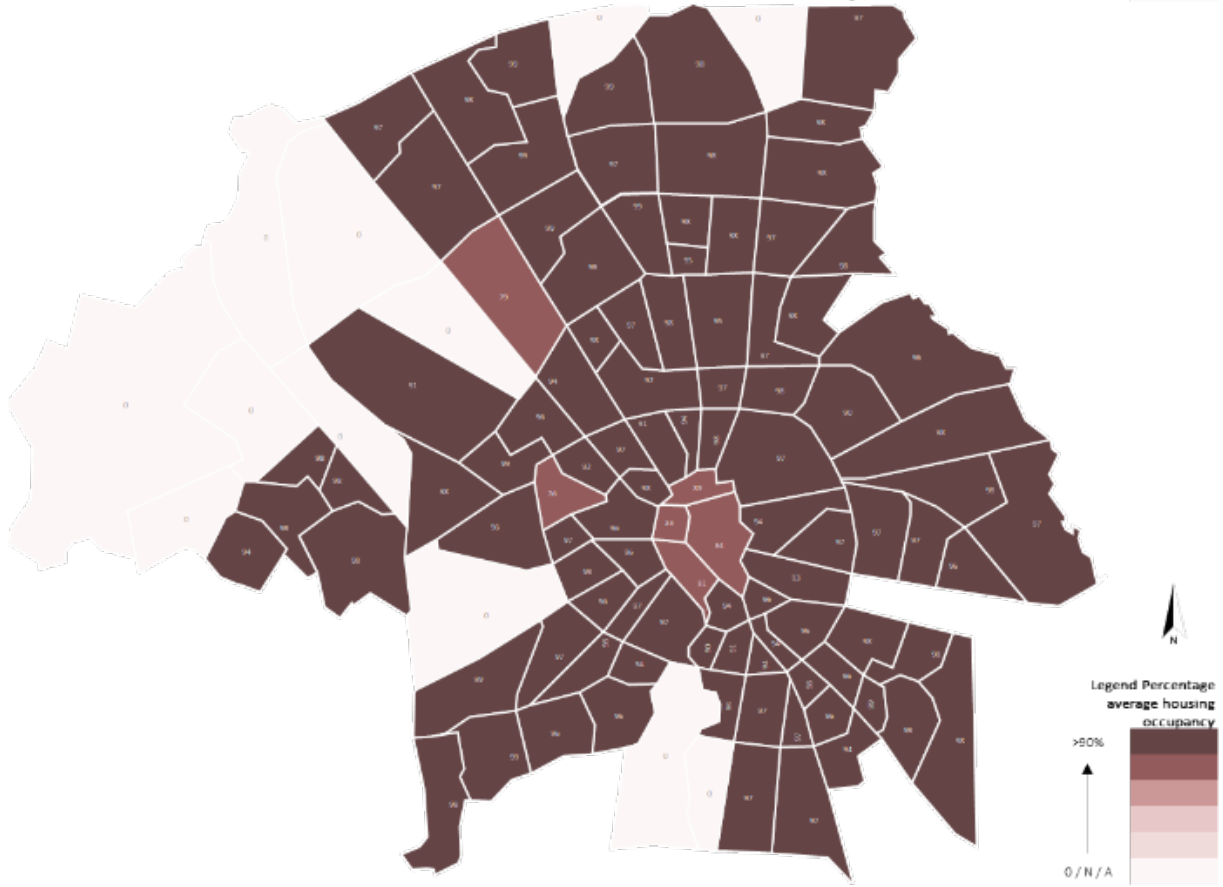
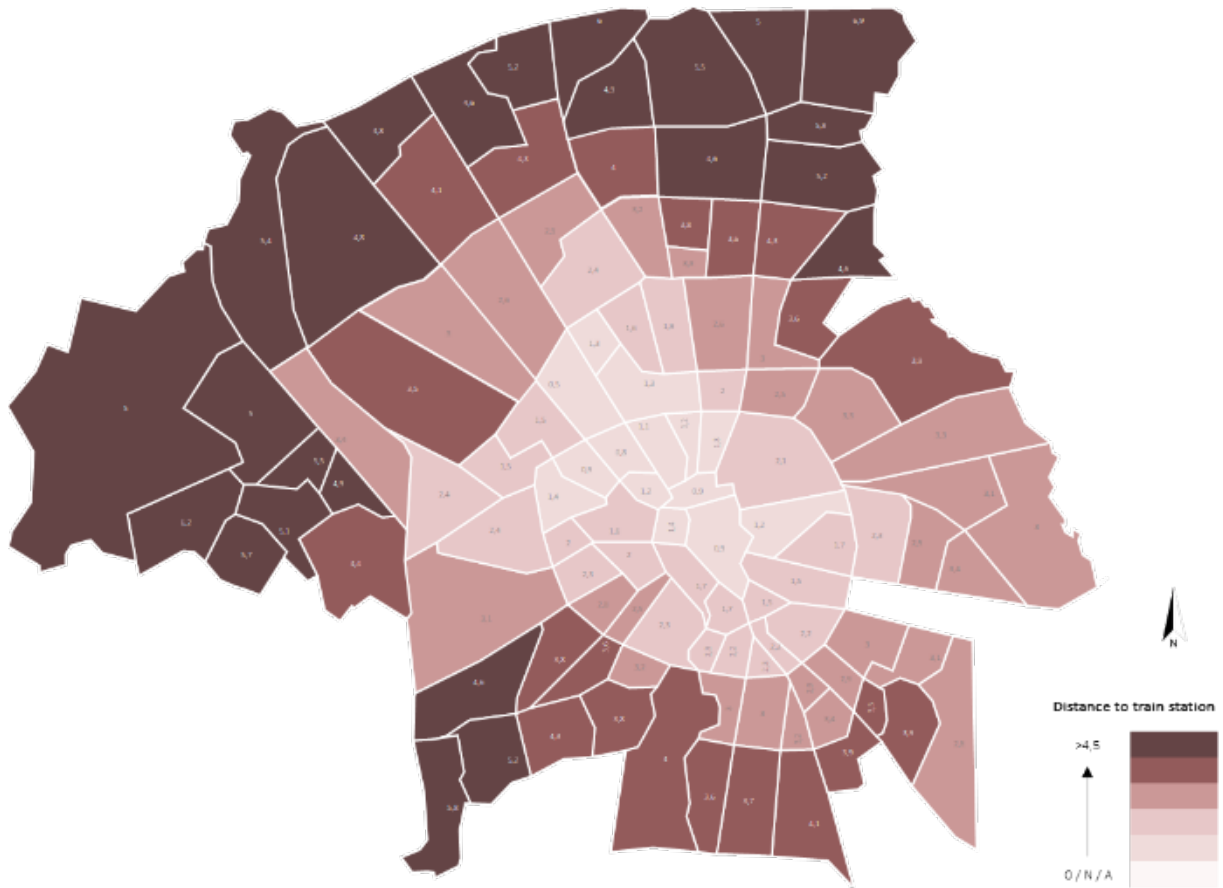


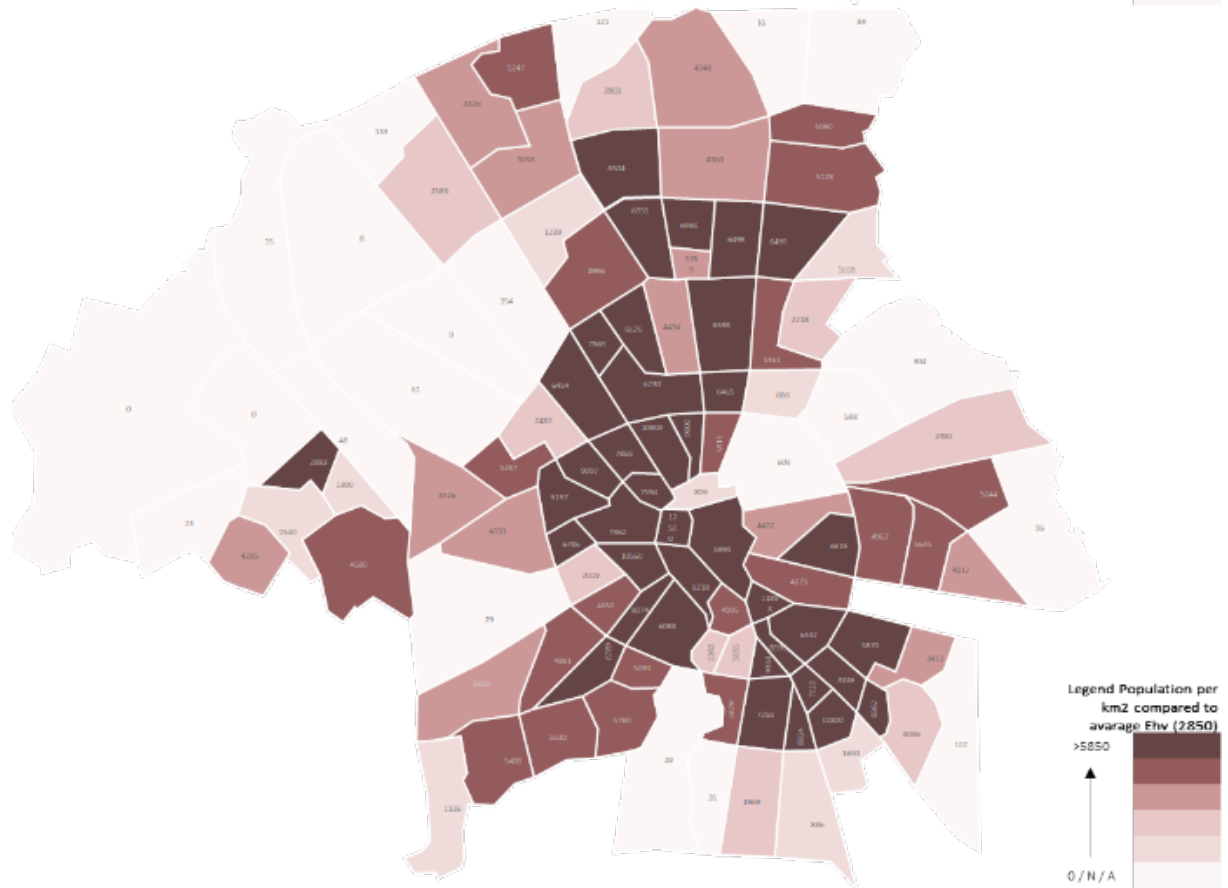
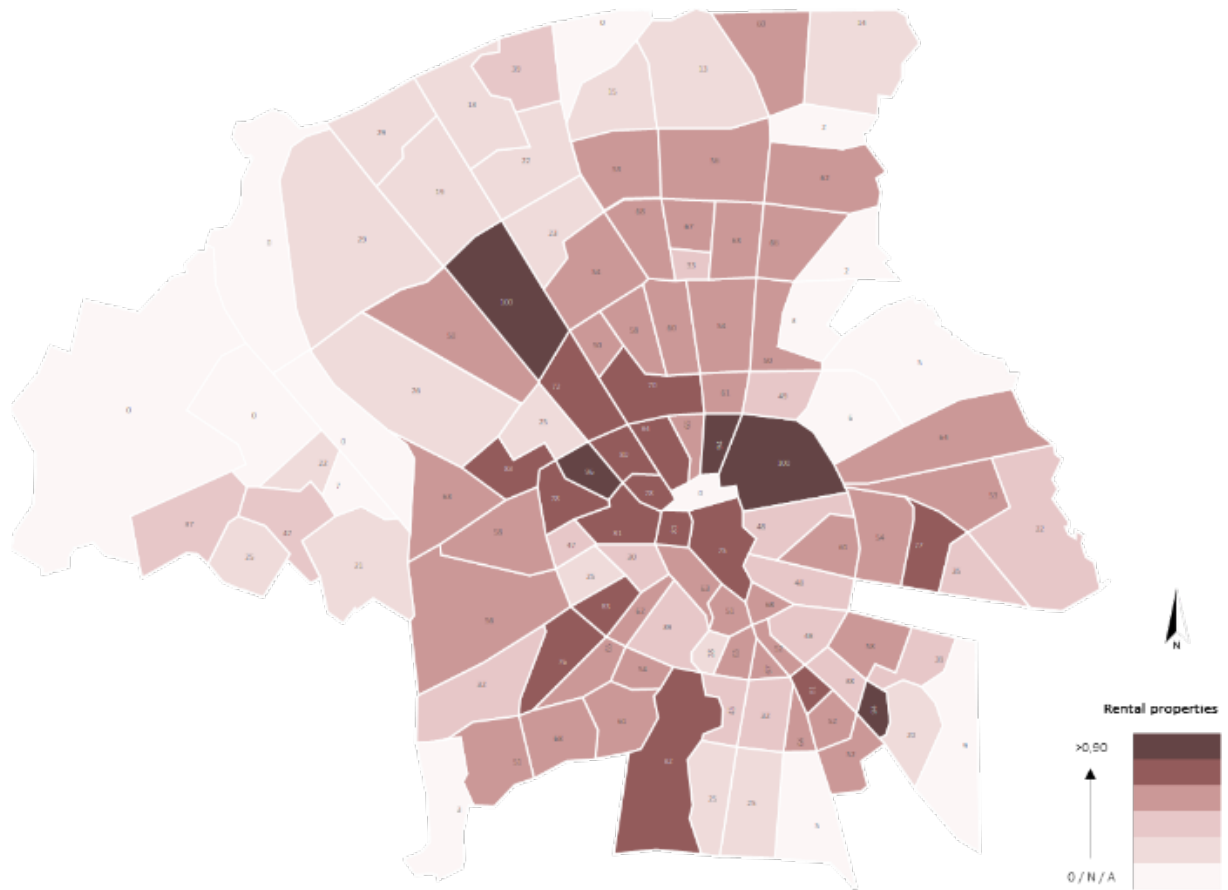


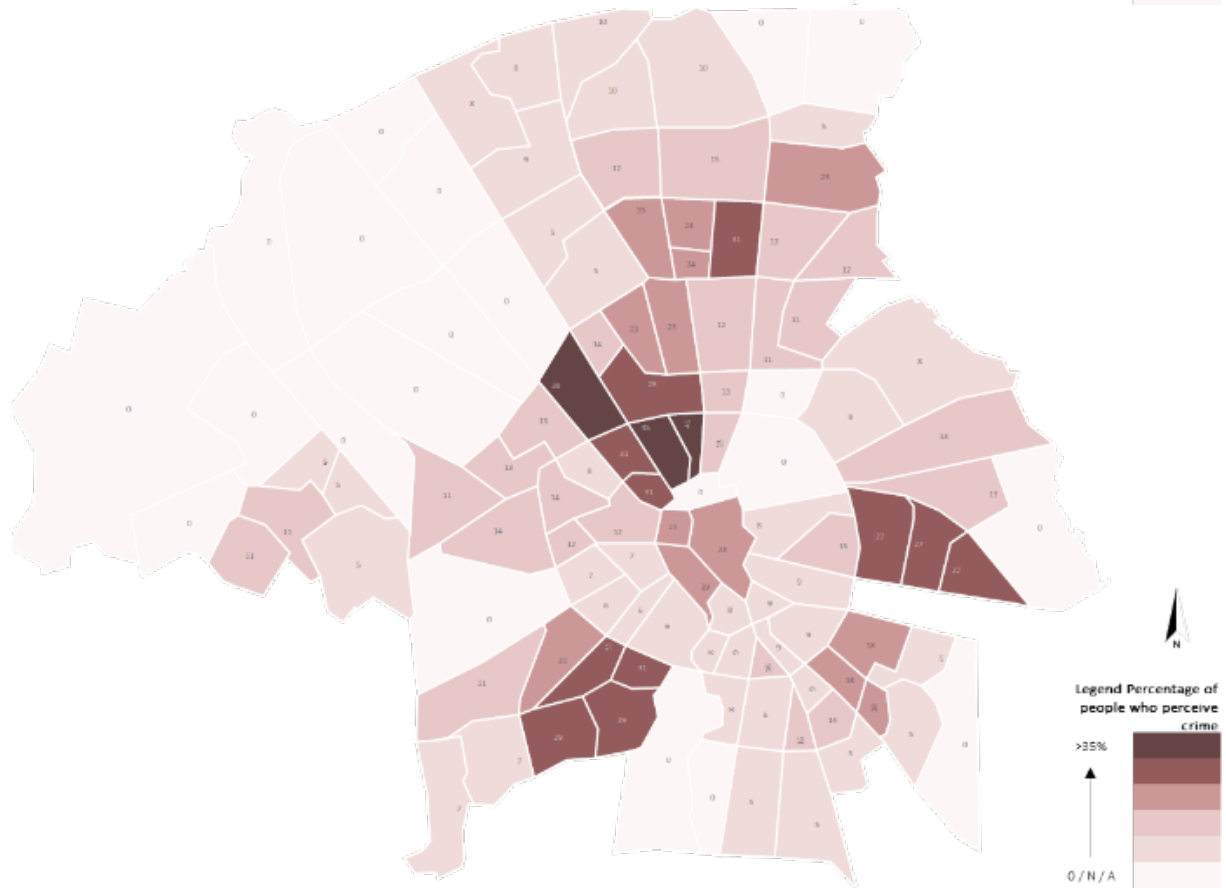
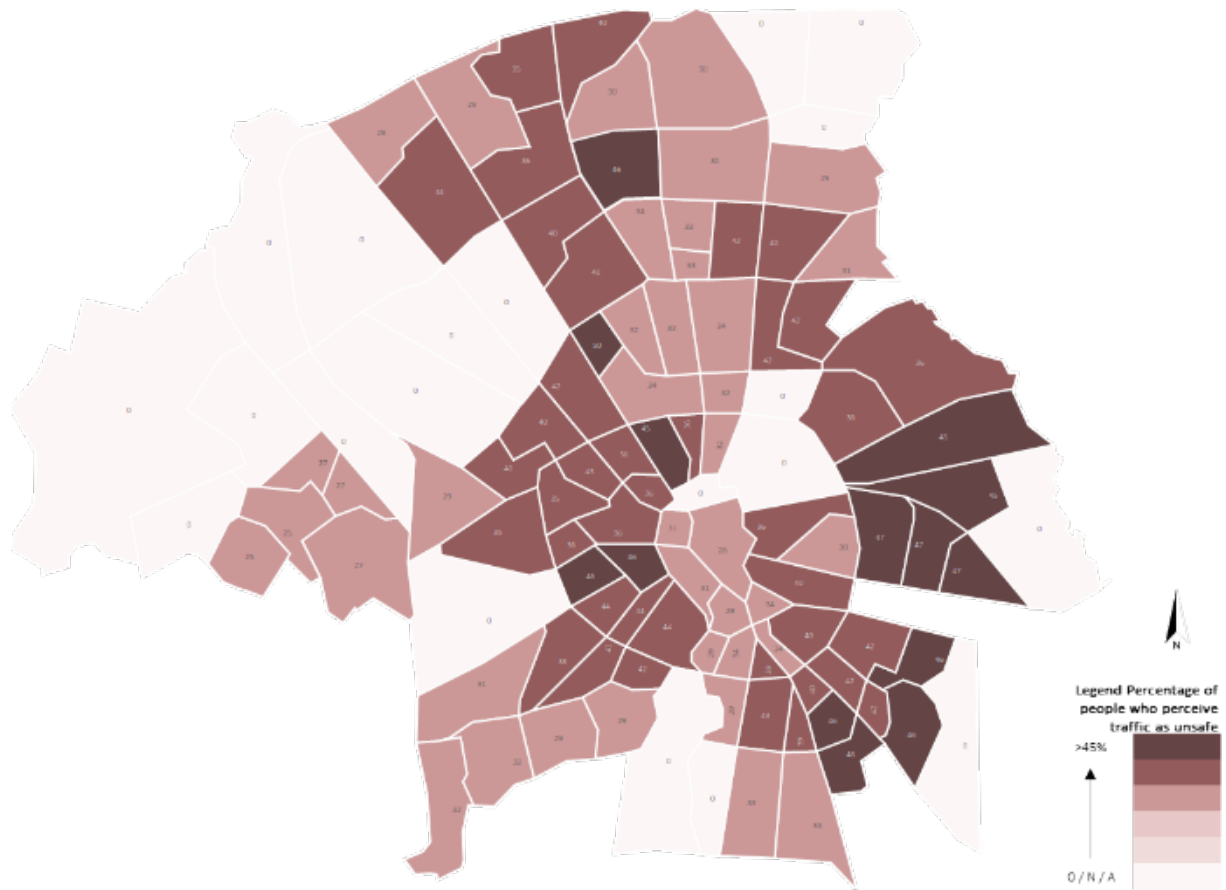


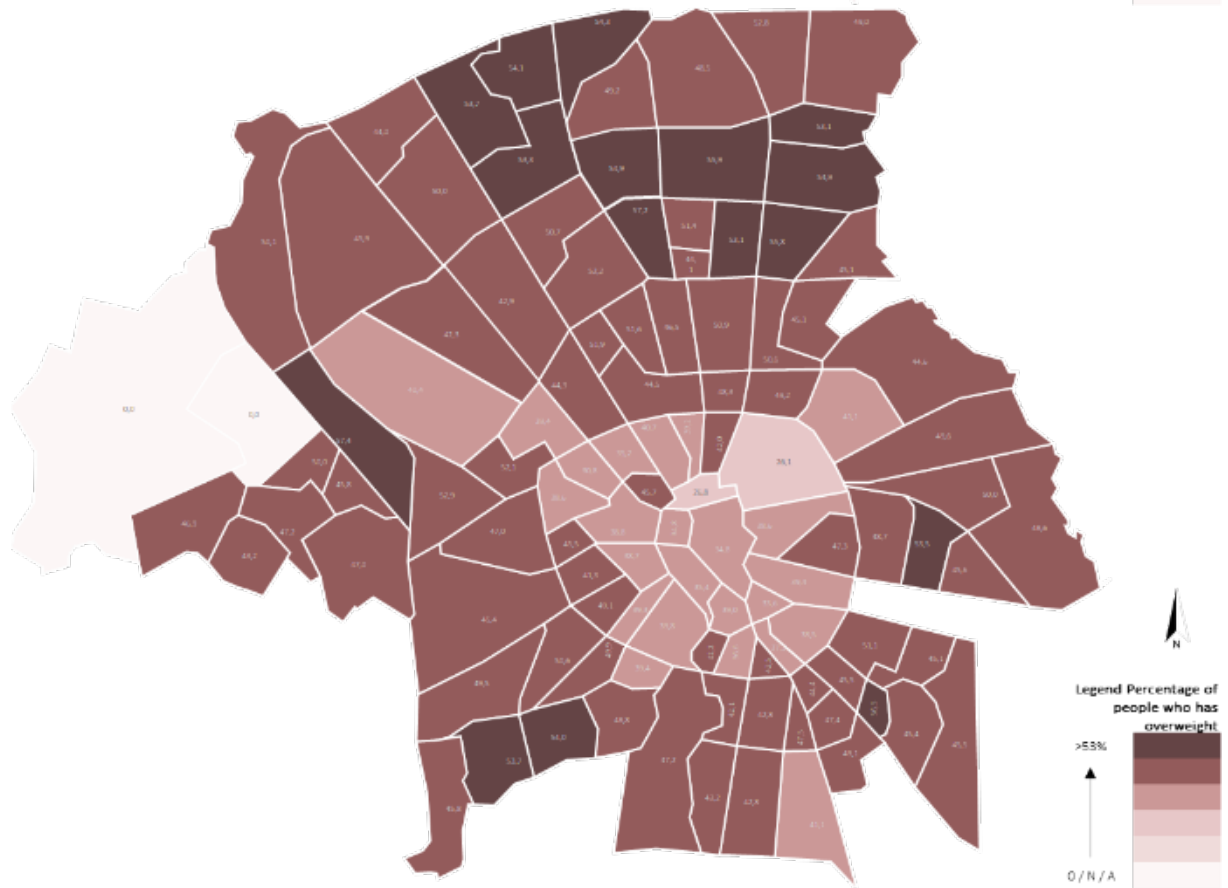
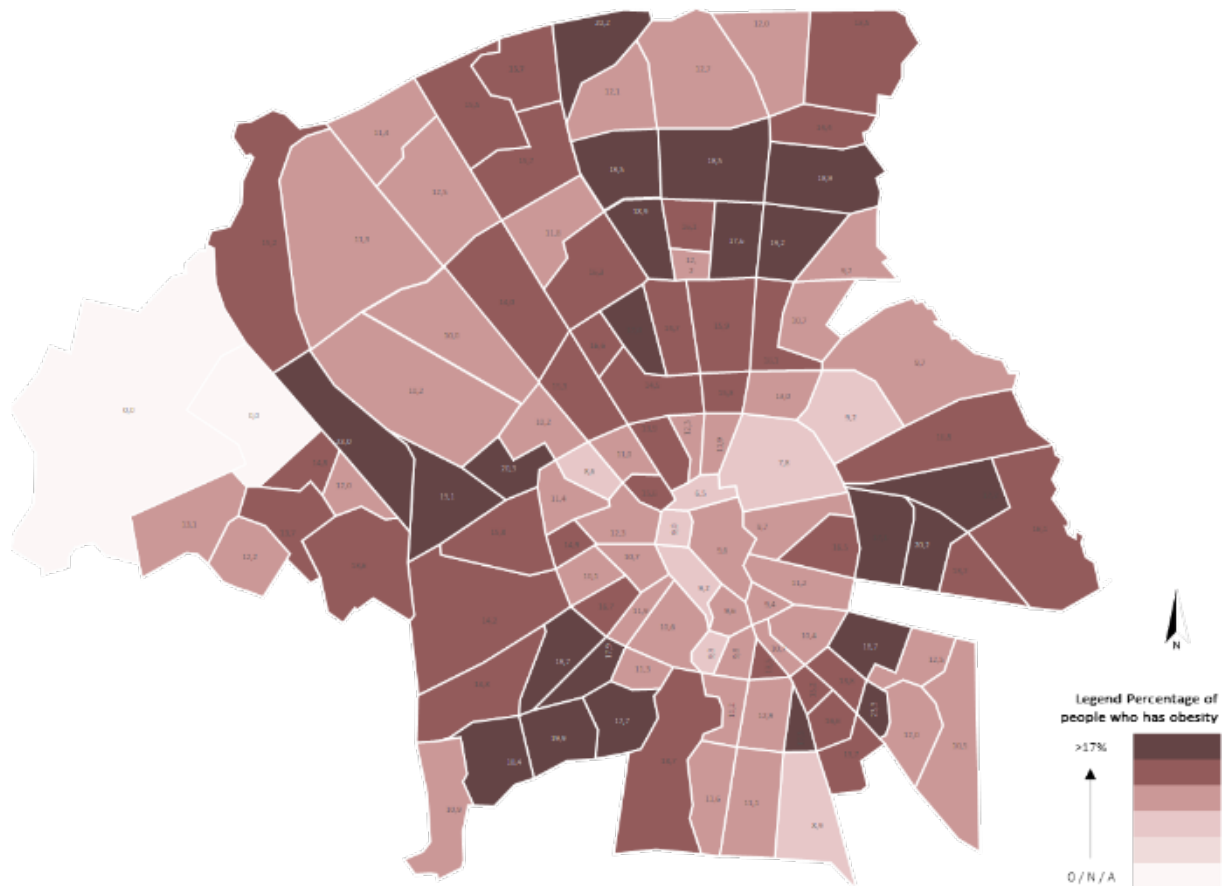


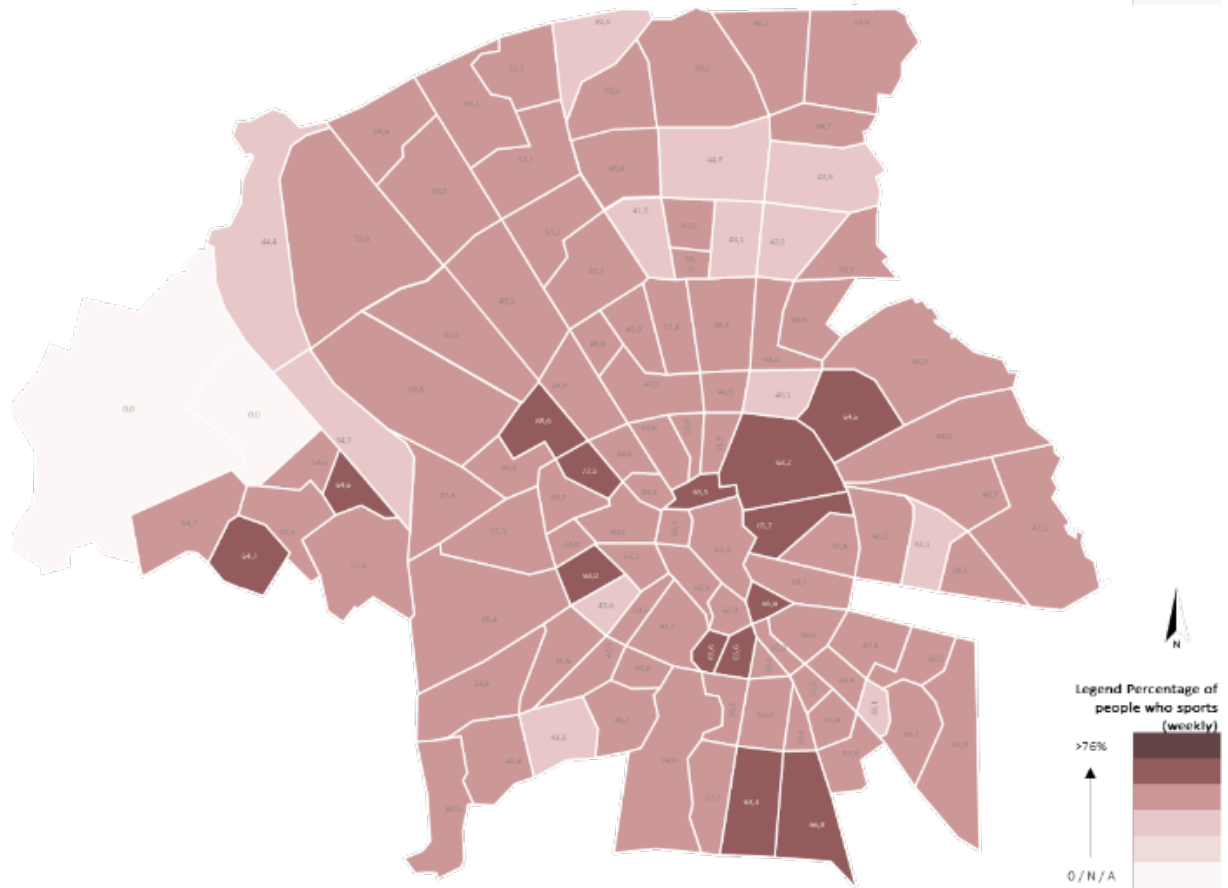
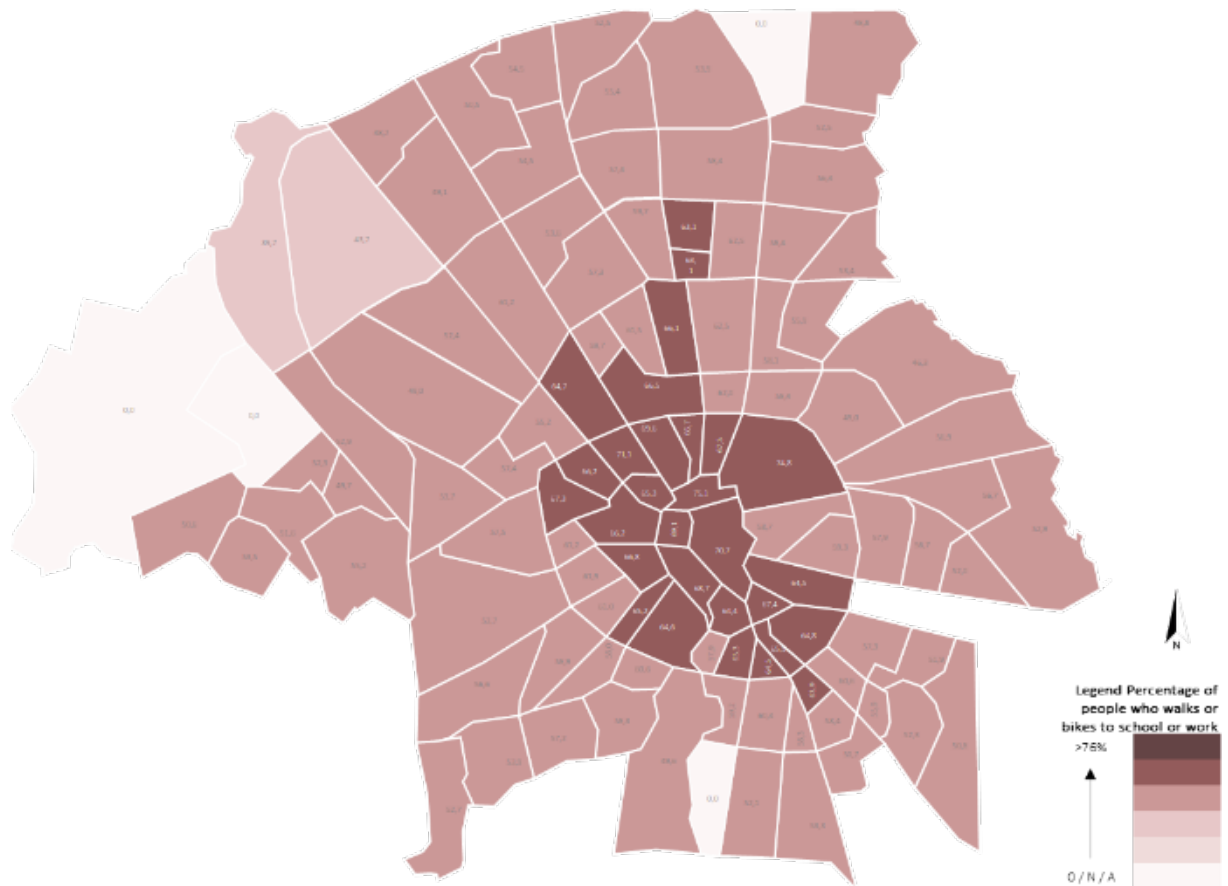


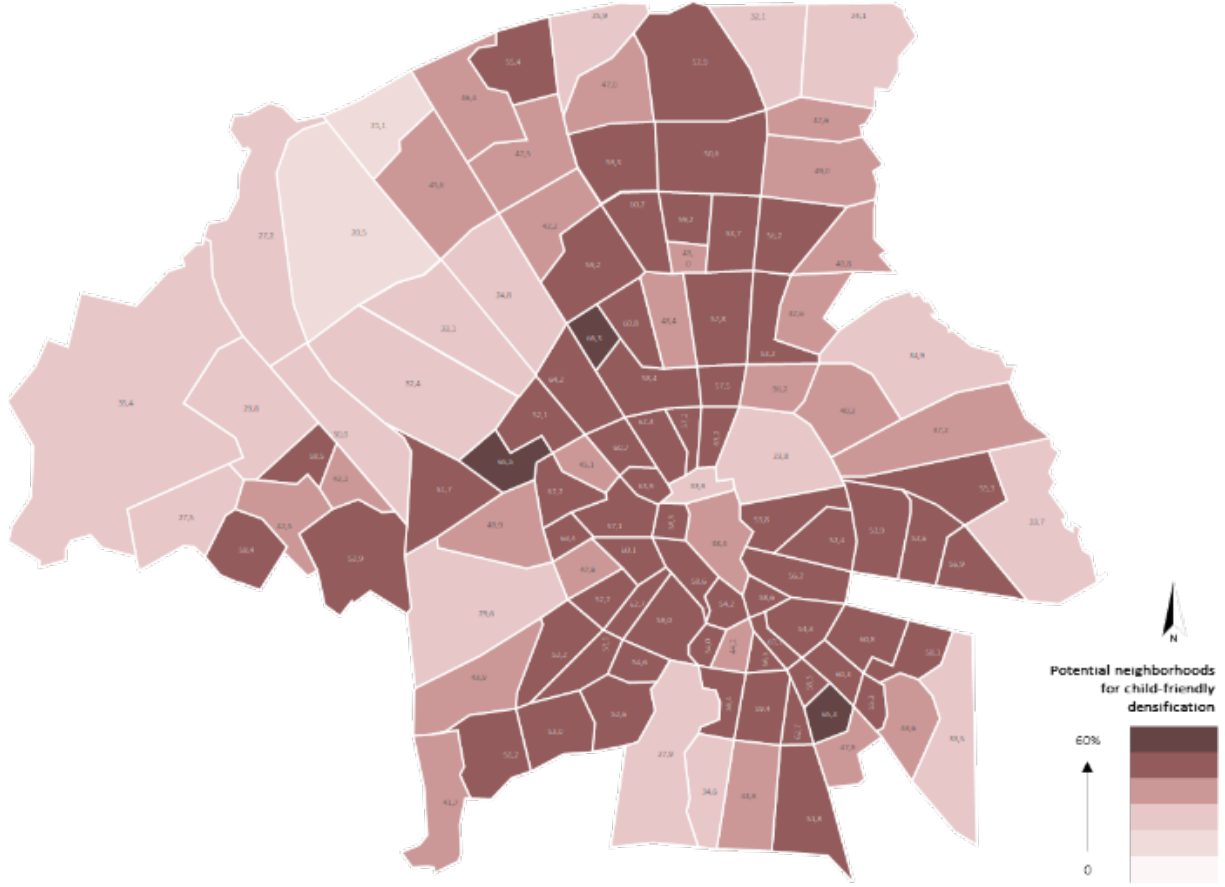
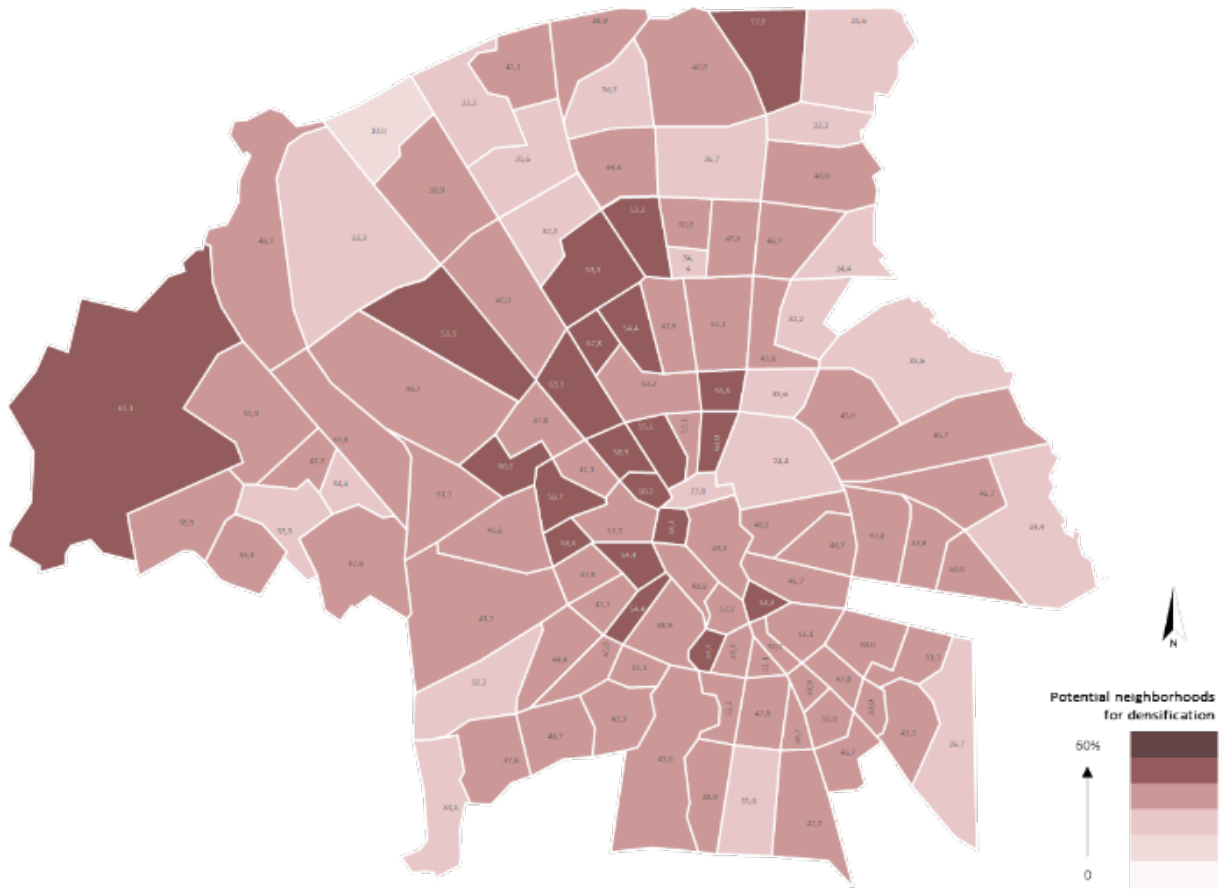












Appendix B – Data of indicators

The data from government agencies used within this study can be found in the tables below. For the exact sources per indicator used, see figure 9 in the research section under the heading spatial analysis. Data Eindhoven is a part of Buurtmonitor (*Onderzoek & (open) data*, 2022). The reason it is specifically referenced in some indicators is because only this source was used. Buurtmonitor itself refers to Eindhoven Open Data (*Eindhoven Open Data*, 2022), Eindhoven In Cijfers (*Eindhoven in Cijfers*, 2022), Buurtkijker Eindhoven (*De BuurtKijker*, 2022) and Eindhoven apps & kaarten (*Eindhoven apps & kaarten*, 2022), since all these sources were used in generating data.

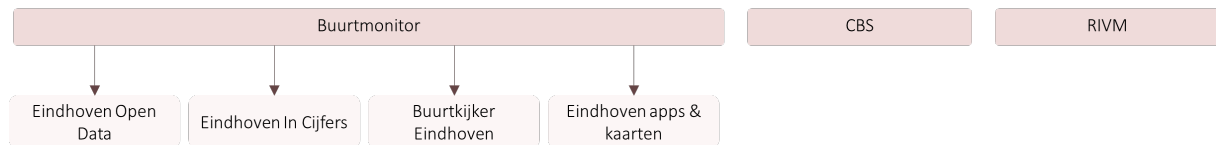


Figure 53, data sources

Neighborhood	Total population/km2 [2022]	Number of households/km2 [2021]	Neighbourhood address density (per km2) [2020]
Achtse Barrier-Gunterslaer	3658,42	1633,66	1781
Achtse Barrier-Hoeven	5247,30	2398,65	1328
Achtse Barrier-Spaaihoef	4425,74	1891,09	1548
Barrier	7865,38	3884,62	2777
BeA2	14,88	4,65	35
Beemden			670
Bennekel-Oost	5760,34	3155,17	2189
Bennekel-West, Gagelbosch	5530,00	2908,33	2397
Bergen	8217,65	5514,71	4321
Binnenstad	5893,94	4333,33	4059
Blaarthem	6788,89	3833,33	2746
Blixembosch-Oost	4348,19	1623,49	1470
Blixembosch-West	2802,74	1054,79	1833
Bloemenplein	9353,85	5653,85	3336
Bokt	83,94	32,85	434
Bosrijk	1300,00	454,55	980
Burghplan	5870,00	3150,00	2212
Castiliëlaan	121,25	18,75	903
Doornakkers-Oost	5645,10	2931,37	2033
Doornakkers-West	4961,97	2669,01	2278
Drents Dorp	5286,67	2722,22	2322
Driehoeksbos	1238,96	532,47	1409
Eckart	6495,45	3174,24	2771
Eckartdal			818
Eikenburg	1969,23	807,69	1439
Eindhoven Airport	0,00	0,00	72
Eliasterrein, Vonderkwartier	10560,00	5533,33	4199
Elzent-Noord	4995,24	2523,81	3695
Elzent-Zuid	2261,54	1076,92	2959
Engelsbergen	2018,75	984,38	3351
Esp	16,13	0,00	1216
Fellenoord	809,09	681,82	4154
Flight Forum	0,00	0,00	240
Genderbeemd	3600,00	1712,12	1813
Genderdal	4881,03	2931,03	2603
Generalenbuurt	6597,56	3317,07	3243
Gennep	18,93	0,00	1246
Genneperzijde	4679,31	2327,59	2148
Gerardusplein	7293,48	3576,09	2851
Gijzenrooi	3035,59	1254,24	1327
Gildebuurt	9800,00	5380,95	3562
Grasrijk	4579,69	1753,91	1435
Hagenkamp	4650,00	2846,15	3208
Hanevoet	5487,88	2568,18	1615
Heesterakker	5059,62	2076,92	1644
Hemelrijken	10802,70	6459,46	4187
Herdgang	8,76	0,00	123

Neighborhood	Total population/km2 [2022]	Number of households/km2 [2021]	Neighbourhood address density (per km2) [2020]
Het Ven	4330,68	2238,64	2002
Hondsheuvels	665,85	243,90	1591
Hurk	29,21	19,80	1398
Irisbuurt	4879,25	2641,51	3491
Jagershoef	6354,55	3254,55	3148
Joriskwartier	8593,33	5300,00	3617
Kapelbeemd	132,53	48,19	551
Karpen	588,31	259,74	823
Kerkdorp Acht	2583,09	1091,91	889
Kerstroosplein	8823,81	4928,57	2622
Koudenhoven	304,05	121,39	696
Kronehoef	6729,85	3768,66	3813
Kruidenbuurt	10800,00	5172,41	2550
Lakerlopen	6616,33	3653,06	2487
Leenderheide			0
Lievendaal	3526,14	1767,05	1619
Limbeek-Noord	7864,52	5709,68	4341
Limbeek-Zuid	7594,44	4500,00	4642
Looiakkers	3034,78	1913,04	3299
Luytelaer	1618,33	700,00	1768
Meerbos	48,33	16,67	1088
Meerrijk	1540,00	733,33	1271
Mensfort	6626,09	3663,04	3348
Mispelhoef	8,47	3,39	125
Muschberg, Geestenberg	5044,16	2688,31	1861
Nieuwe Erven	7620,00	4333,33	3233
Ooievaarsnest	1136,25	462,50	1123
Oude Gracht-Oost	2218,33	950,00	1697
Oude Gracht-West	5460,78	3186,27	2402
Oude Spoorbaan	8074,07	5000,00	3509
Oude Toren	6465,38	4076,92	2967
Park Forum	23,47	0,00	671
Philipsdorp	7361,90	4595,24	4331
Poeijers			1807
Prinsejagt	4986,32	2631,58	2392
Puttense Dreef	3413,16	1407,89	1554
Rapenburg	5090,91	2909,09	2698
Rapenland	4433,96	2471,70	3583
Riel	101,59	39,68	749
Rochusbuurt	11893,33	7866,67	3737
Roosten	835,56	277,78	1395
Schoot	9197,44	5820,51	3350
Schouwbroek	6786,36	3772,73	3471
Schrijversbuurt	6088,14	3203,39	3527
Schuttersbosch	1650,00	763,16	1545
Sintenbuurt	7019,23	3538,46	3061
Sportpark Aalsterweg	34,55	0,00	831

Neighborhood	Total population/km2 [2022]	Number of households/km2 [2021]	Neighbourhood address density (per km2) [2020]
Strijp S	9096,67	4366,67	3994
't Hofke	2491,33	1296,67	1429
't Hool	6594,12	3073,53	3350
Tempel	4359,83	2021,37	2842
Tivoli	8366,67	4583,33	2252
Tongelresche Akkers	4017,02	1414,89	1558
Tuindorp	6442,22	3577,78	3554
TU-terrein	609,02	553,28	1923
Urkhoven	96,49	40,94	1010
Vaartbroek	5127,72	2544,55	2290
Villapark	4421,82	2218,18	2774
Vlokhoven	6498,15	3333,33	3443
Vredeoord	353,73	67,16	756
Waterrijk	4284,75	1516,95	1299
Wielewaal	61,21	17,24	193
Winkelcentrum	3783,33	2722,22	3546
Witte Dame	12500,00	8305,56	4620
Woenselse Heide	6503,70	2765,43	2442
Woenselse Watermolen	5812,50	2854,17	3197
Woensel-West	6454,29	3385,71	3177
Zandrijk	7586,84	3000,00	842
Zwaanstraat	2486,54	894,23	2098

Neighborhood	Number of households with kids [2021]	% of households with kids [2021]	Number of households without kids [2021]
Achtse Barrier-Gunterslaer	605	37%	575
Achtse Barrier-Hoeven	650	37%	565
Achtse Barrier-Spaaihoef	745	39%	680
Barrier	315	31%	240
BeA2	0	0	0
Beemden	0	0	0
Bennekel-Oost	445	24%	425
Bennekel-West, Gagelbosch	415	24%	475
Bergen	180	10%	460
Binnenstad	165	6%	580
Blaarthem	320	23%	300
Blixembosch-Oost	1435	53%	730
Blixembosch-West	345	44%	330
Bloemenplein	130	18%	175
Bokt	25	50%	15
Bosrijk	80	50%	40
Burghplan	445	28%	335
Castiliëlaan	10	0	10
Doornakkers-Oost	410	27%	315
Doornakkers-West	455	24%	485
Drents Dorp	380	31%	260
Driehoeksbos	135	33%	185
Eckart	650	31%	535
Eckartdal	0	0	0
Eikenburg	235	37%	180
Eindhoven Airport	0	0	0
Eliasterrein, Vonderkwartier	395	24%	390
Elzent-Noord	120	22%	190
Elzent-Zuid	40	28%	60
Engelsbergen	85	27%	100
Esp	0	0	0
Fellenoord	0	3%	15
Flight Forum	0	0	0
Genderbeemd	505	30%	550
Genderdal	345	20%	350
Generalenbuurt	685	25%	745
Gennep	0	0	0
Genneperzijde	125	19%	145
Gerardusplein	525	32%	355
Gijzenrooi	295	40%	290
Gildebuurt	115	10%	290
Grasrijk	1125	50%	585
Hagenkamp	100	13%	150
Hanevoet	590	35%	490
Heesterakker	440	40%	430
Hemelrijken	385	16%	400
Herdgang	0	0	0

Neighborhood	Number of households with kids [2021]	% of households with kids [2021]	Number of households without kids [2021]
Het Ven	530	27%	465
Hondsheuvels	0	5%	35
Hurk	0	0	10
Irisbuurt	255	18%	365
Jagershoef	540	30%	430
Joriskwartier	120	15%	195
Kapelbeemd	25	50%	10
Karpen	60	29%	90
Kerkdorp Acht	545	37%	575
Kerstroosplein	290	28%	205
Koudenhoven	75	35%	95
Kronehoef	415	16%	575
Kruidenbuurt	535	36%	340
Lakerloopen	395	22%	420
Leenderheide	0	0	0
Lievendaal	485	31%	395
Limbeek-Noord	150	8%	325
Limbeek-Zuid	180	22%	165
Looiakkers	35	8%	125
Luytelaer	135	32%	200
Meerbos	10	0	10
Meerrijk	70	16%	205
Mensfort	395	23%	400
Mispelhoef	0	0	0
Muschberg, Geestenberg	555	27%	530
Nieuwe Erven	115	18%	145
Ooievaarsnest	145	39%	155
Oude Gracht-Oost	210	37%	195
Oude Gracht-West	340	21%	410
Oude Spoorbaan	195	14%	330
Oude Toren	135	13%	280
Park Forum	0	0	0
Philipsdorp	280	15%	510
Poeijers	0	0	0
Prinsejagt	625	25%	645
Puttense Dreef	205	38%	175
Rapenburg	135	21%	145
Rapenland	310	24%	250
Riel	20	36%	20
Rochusbuurt	130	11%	240
Roosten	130	51%	95
Schoot	285	13%	530
Schouwbroek	205	25%	180
Schrijversbuurt	465	25%	450
Schuttersbosch	90	31%	110
Sintenbuurt	280	30%	205
Sportpark Aalsterweg	0	0	0

Neighborhood	Number of households with kids [2021]	% of households with kids [2021]	Number of households without kids [2021]
Strijp S	55	4%	375
't Hofke	505	26%	450
't Hool	375	36%	220
Tempel	780	33%	700
Tivoli	250	30%	160
Tongelresche Akkers	320	48%	195
Tuindorp	320	20%	350
TU-terrein	0	1%	40
Urkhoven	30	40%	15
Vaartbroek	835	32%	575
Villapark	305	25%	360
Vlokhoven	485	27%	415
Vredeoord	0	%	0
Waterrijk	505	56%	220
Wielewaal	25	50%	10
Winkelcentrum	25	5%	130
Witte Dame	120	8%	490
Woenselse Heide	920	41%	605
Woenselse Watermolen	195	28%	200
Woensel-West	610	26%	455
Zandrijk	530	46%	355
Zwaanstraat	235	50%	165

Neighborhood	% of households without kids [2021]	Density children per km2	Average age of children
Achtse Barrier-Gunterslaer	35%	682,2	8,4
Achtse Barrier-Hoeven	32%	997,3	8,8
Achtse Barrier-Spaaihoef	36%	847,5	8,5
Barrier	24%	1415,4	9,6
BeA2	0	0,0	0,0
Beemden	0	0,0	0,0
Bennekel-Oost	23%	858,6	7,9
Bennekel-West, Gagelbosch	27%	780,0	8,8
Bergen	25%	570,6	7,7
Binnenstad	20%	271,2	5,8
Blaarthem	22%	1075,0	8,2
Blixembosch-Oost	27%	969,9	9,2
Blixembosch-West	42%	528,8	9,7
Bloemenplein	24%	1238,5	9,4
Bokt	30%	0,0	0,0
Bosrijk	25%	406,1	12,5
Burghplan	21%	1050,0	9,0
Castiliëlaan	0	0,0	0,0
Doornakkers-Oost	21%	1017,6	8,3
Doornakkers-West	26%	812,7	7,8
Drents Dorp	21%	1124,4	7,9
Driehoeksbos	45%	179,2	15,1
Eckart	26%	1193,9	8,8
Eckartdal	0	0,0	0,0
Eikenburg	28%	397,4	9,9
Eindhoven Airport	0	0,0	0,0
Eliasterrein, Vonderkwartier	23%	1743,3	8,6
Elzent-Noord	35%	704,8	9,4
Elzent-Zuid	41%	0,0	0,0
Engelsbergen	31%	290,6	17,0
Esp	0	0,0	0,0
Fellenoord	10%	0,0	0,0
Flight Forum	0	0,0	0,0
Genderbeemd	32%	619,2	8,4
Genderdal	21%	703,4	8,5
Generalenbuurt	27%	996,3	8,9
Gennep	0	0,0	0,0
Genneperzijde	21%	593,1	12,3
Gerardusplein	22%	1458,7	8,5
Gijzenrooi	39%	528,8	9,7
Gildebuurt	26%	657,1	4,3
Grasrijk	26%	1289,8	8,4
Hagenkamp	20%	453,8	6,7
Hanevoet	29%	1031,8	9,3
Heesterakker	39%	948,1	8,7
Hemelrijken	17%	1413,5	7,8
Herdgang	0	0,0	0,0

Neighborhood	Age composition 0-3	Age composition 4-11	Age composition 12-17
Strijp S	38	17	12
't Hofke	134	266	216
't Hool	100	243	192
Tempel	201	406	368
Tivoli	70	147	80
Tongelresche Akkers	163	250	141
Tuindorp	87	190	146
TU-terrein	0	0	0
Urkhoven	0	13	15
Vaartbroek	223	446	376
Villapark	83	175	148
Vlokhoven	107	285	244
Vredeoord	0	0	13
Waterrijk	152	398	289
Wielewaal	0	16	21
Winkelcentrum	10	10	0
Witte Dame	60	45	14
Woenselse Heide	206	496	382
Woenselse Watermolen	83	167	35
Woensel-West	227	378	294
Zandrijk	102	307	267
Zwaanstraat	172	155	51

Neighborhood	Average income of parent/caretaker (x1000€) [2020]	WOZ-value (x1000€) [2021]	Amount of cars per household [2020]
Achtse Barrier-Gunterslaer	34,5	290	1,2
Achtse Barrier-Hoeven	33,4	278	1,1
Achtse Barrier-Spaaihoef	37,2	318	1,3
Barrier	30,2	297	0,8
BeA2	0	0	0
Beemden	0	0	0
Bennekel-Oost	27,2	224	0,7
Bennekel-West, Gagelbosch	26,2	238	0,8
Bergen	40,6	323	0,6
Binnenstad	37,3	278	0,5
Blaarthem	28,1	232	0,7
Blixembosch-Oost	42,9	421	1,3
Blixembosch-West	45,1	467	1,4
Bloemenplein	29,6	245	0,6
Bokt	0	0	0
Bosrijk	58,7	427	1,2
Burghplan	29,3	238	0,8
Castiliëlaan	0	0	0
Doornakkers-Oost	24,4	219	0,7
Doornakkers-West	27,2	236	0,8
Drents Dorp	26,9	258	0,8
Driehoeksbos	48,7	464	1,3
Eckart	25,3	221	0,9
Eckartdal	0	0	0
Eikenburg	50,6	525	1,2
Eindhoven Airport	0	0	0
Eliasterrein, Vonderkwartier	38,4	325	0,7
Elzent-Noord	54,5	530	0,9
Elzent-Zuid	67,7	859	1,4
Engelsbergen	40,3	435	1,1
Esp	0	0	0
Fellenoord	33,1	149	0,4
Flight Forum	0	0	0
Genderbeemd	34,5	283	1
Genderdal	25,5	210	0,7
Generalenbuurt	28,7	243	0,8
Gennep	0	0	0
Genneperzijde	42	328	0,7
Gerardusplein	37	340	0,8
Gijzenrooi	45,4	461	1,3
Gildebuurt	29,5	247	0,5
Grasrijk	45,6	384	1,1
Hagenkamp	28,1	219	0,6
Hanevoet	31	263	1
Heesterakker	36,5	310	1,3
Hemelrijken	24	226	0,4
Herdgang	0	0	0

Neighborhood	Average income of parent/caretaker (x1000€) [2020]	WOZ-value (x1000€) [2021]	Amount of cars per household [2020]
Het Ven	28,3	243	0,8
Hondsheuvels	26,5	0	0,5
Hurk	0	0	0
Irisbuurt	38,7	297	0,8
Jagershoef	24,8	221	0,8
Joriskwartier	33,4	274	0,6
Kapelbeemd	0	0	0
Karpen	102,6	923	1,7
Kerkdorp Acht	43,2	454	1,4
Kerstroosplein	26,8	237	0,7
Koudenhoven	71,5	646	1,5
Kronehoef	29	246	0,6
Kruidenbuurt	31,4	306	0,8
Lakerloopen	29	243	0,7
Leenderheide	0	0	0
Lievendaal	30	239	0,8
Limbeek-Noord	27,3	199	0,3
Limbeek-Zuid	27,4	220	0,8
Looiakkers	35,9	299	0,5
Luytelaer	53,9	499	1,3
Meerbos	0	0	0
Meerrijk	45,4	326	0,9
Mensfort	27,2	228	0,8
Mispelhoef	0	0	0
Muschberg, Geestenberg	27,8	238	0,9
Nieuwe Erven	26,8	243	0,6
Ooievaarsnest	51,7	490	1,4
Oude Gracht-Oost	45,9	432	1,2
Oude Gracht-West	29,6	237	0,7
Oude Spoorbaan	34,5	240	0,6
Oude Toren	28,3	254	0,7
Park Forum	0	0	0
Philipsdorp	36,5	286	0,6
Poeijers	0	0	0
Prinsejagt	29,2	252	0,8
Puttense Dreef	48,7	437	1,2
Rapenburg	39,6	252	0,6
Rapenland	26,4	211	0,7
Riel	43	0	1,3
Rochusbuurt	32,4	254	0,4
Roosten	57,8	732	1,5
Schoot	30	224	0,5
Schouwbroek	30,6	252	0,8
Schrijversbuurt	39,5	388	0,7
Schuttersbosch	45,6	487	1,1
Sintenbuurt	33,5	282	0,8
Sportpark Aalsterweg	0	0	0

Neighborhood	Average income of parent/caretaker (x1000€) [2020]	WOZ-value (x1000€) [2021]	Amount of cars per household [2020]
Strijp S	37,6	275	0,5
't Hofke	29,4	245	0,8
't Hool	28,9	253	0,8
Tempel	28,4	255	1
Tivoli	22,7	227	0,7
Tongelresche Akkers	42,4	377	1
Tuindorp	38	326	0,6
TU-terrein	19,8	111	0,1
Urkhoven	25,6	0	1,2
Vaartbroek	26,7	239	0,9
Villapark	57,9	485	0,9
Vlokhoven	24,9	234	0,8
Vredeoord	11,7	0	0,1
Waterrijk	53,5	447	1,1
Wielewaal	0	0	0
Winkelcentrum	37,2	224	0,6
Witte Dame	45,8	288	0,4
Woenselse Heide	28,3	265	1,3
Woenselse Watermolen	45	257	0,6
Woensel-West	26,7	240	0,6
Zandrijk	40,5	372	1,1
Zwaanstraat	54,3	462	1,1

Neighborhood	% Dutch [2022]	Owner-occupied houses [2021]	Owner-occupied houses % [2021]
Achtse Barrier-Gunterslaer	72,1	1232	78
Achtse Barrier-Hoeven	69,9	1054	61
Achtse Barrier-Spaaihoef	76,7	1650	87
Barrier	58,0	449	50
BeA2	56,3	7	100
Beemden	0,0	0	0
Bennekel-Oost	47,3	641	39
Bennekel-West, Gagelbosch	54,8	549	32
Bergen	50,8	598	37
Binnenstad	46,1	559	25
Blaarthem	52,7	451	35
Blixembosch-Oost	68,2	2298	87
Blixembosch-West	74,4	655	85
Bloemenplein	55,3	210	33
Bokt	93,0	31	86
Bosrijk	73,2	149	93
Burghplan	52,8	631	42
Castiliëlaan	89,7	0	0
Doornakkers-Oost	53,3	330	23
Doornakkers-West	56,6	773	46
Drents Dorp	58,6	198	17
Driehoeksbos	78,9	314	77
Eckart	51,6	698	34
Eckartdal	81,7	0	0
Eikenburg	86,1	485	75
Eindhoven Airport	0,0	2	100
Eliasterrein, Vonderkwartier	71,0	985	70
Elzent-Noord	59,4	278	49
Elzent-Zuid	78,9	109	72
Engelsbergen	76,6	211	75
Esp	86,7	2	40
Fellenoord	0,0	0	0
Flight Forum	0,0	0	0
Genderbeemd	63,8	1128	68
Genderdal	53,1	379	24
Generalenbuurt	54,0	1223	46
Gennepe	81,3	2	18
Genneperzijde	83,5	431	55
Gerardusplein	71,8	992	68
Gijzenrooi	77,8	584	80
Gildebuurt	48,7	324	35
Grasrijk	49,7	1743	79
Hagenkamp	60,9	137	17
Hanevoet	59,2	825	49
Heesterakker	75,6	1057	98
Hemelrijken	38,0	314	16
Herdgang	0,0	3	50

Neighborhood	% Dutch [2022]	Owner-occupied houses [2021]	Owner-occupied houses % [2021]
Het Ven	65,0	805	42
Hondsheuvels	86,4	44	51
Hurk	76,3	7	44
Irisbuurt	61,1	662	52
Jagershoef	53,7	556	32
Joriskwartier	67,1	315	48
Kapelbeemd	91,8	27	71
Karpen	79,5	201	94
Kerkdorp Acht	78,3	1194	81
Kerstroosplein	56,2	325	36
Koudenhoven	79,7	211	95
Kronehoef	55,2	751	30
Kruidenbuurt	57,6	642	48
Lakerloopen	49,4	621	39
Leenderheide	0,0	0	0
Lievendaal	60,7	592	37
Limbeek-Noord	42,2	280	20
Limbeek-Zuid	47,0	170	22
Looiakkers	70,9	150	37
Luytelaer	80,7	419	98
Meerbos	81,0	1	100
Meerrijk	61,4	248	53
Mensfort	50,8	667	42
Mispelhoef	84,0	5	71
Muschberg, Geestenberg	62,6	903	47
Nieuwe Erven	63,2	105	19
Ooievaarsnest	70,8	353	97
Oude Gracht-Oost	77,8	545	97
Oude Gracht-West	62,4	769	50
Oude Spoorbaan	53,7	481	38
Oude Toren	60,1	405	39
Park Forum	91,3	5	63
Philipsdorp	65,9	341	19
Poeijers	0,0	0	0
Prinsejagt	65,9	1107	46
Puttense Dreef	72,0	320	61
Rapenburg	67,1	276	46
Rapenland	41,0	482	40
Riel	88,3	42	91
Rochusbuurt	58,7	305	32
Roosten	84,3	241	95
Schoot	50,3	474	22
Schouwbroek	68,3	418	53
Schrijversbuurt	74,7	978	61
Schuttersbosch	86,8	150	48
Sintenbuurt	72,2	552	62
Sportpark Aalsterweg	63,2	6	75

Neighborhood	% Dutch [2022]	Owner-occupied houses [2021]	Owner-occupied houses % [2021]
Strijp S	69,8	49	4
't Hofke	54,7	668	36
't Hool	45,9	335	33
Tempel	60,7	1035	44
Tivoli	59,3	50	6
Tongelresche Akkers	67,8	421	65
Tuindorp	76,9	738	52
TU-terrein	11,4	0	0
Urkhoven	87,3	25	68
Vaartbroek	52,9	944	38
Villapark	73,2	593	52
Vlokhoven	47,9	630	37
Vredeoord	63,3	0	0
Waterrijk	59,7	678	75
Wielewaal	54,9	29	74
Winkelcentrum	53,0	316	67
Witte Dame	36,2	305	19
Woenselse Heide	57,9	1025	47
Woenselse Watermolen	27,2	41	6
Woensel-West	51,9	576	28
Zandrijk	57,7	888	78
Zwaanstraat	69,1	356	75

Neighborhood	Average housing occupancy [2019]	Percentage of people who perceive traffic as	Average distance to train stations [2019]
Het Ven	96	35	2,4
Hondsheuvels	98	0	2,5
Hurk	0	0	3,1
Irisbuurt	93	40	1,5
Jagershoef	99	34	3,2
Joriskwartier	94	34	2,2
Kapelbeemd	97	28	4,8
Karpen	90	36	3,3
Kerkdorp Acht	97	44	4,1
Kerstroosplein	97	39	3,2
Koudenhoven	96	36	3,9
Kronehoef	92	34	1,3
Kruidenbuurt	96	46	3,4
Lakerloopen	97	30	1,7
Leenderheide	0	0	0
Lievendaal	98	29	2,4
Limbeek-Noord	97	36	0,8
Limbeek-Zuid	98	36	1,2
Looiakkers	91	34	2,2
Luytelaer	98	31	4,6
Meerbos	0	0	3,4
Meerrijk	98	25	5,1
Mensfort	97	32	1,6
Mispelhoef	0	0	4,8
Muschberg, Geestenberg	98	45	3,1
Nieuwe Erven	98	40	2,9
Ooievaarsnest	98	32	5,8
Oude Gracht-Oost	98	42	3,6
Oude Gracht-West	97	42	3
Oude Spoorbaan	97	44	2,5
Oude Toren	97	32	2
Park Forum	0	0	6,2
Philipsdorp	96	36	1,6
Poeijers	0	0	0
Prinsejagt	98	40	2,4
Puttense Dreef	98	46	3,1
Rapenburg	94	42	3,2
Rapenland	98	32	1,9
Riel	98	0	2,8
Rochusbuurt	96	34	1,5
Roosten	97	33	4,1
Schoot	76	35	1,4
Schouwbroek	97	36	2
Schrijversbuurt	97	44	2,3
Schuttersbosch	94	46	3,9
Sintenbuurt	96	42	2,9
Sportpark Aalsterweg	0	0	3,6

Neighborhood	Average housing occupancy [2019]	Percentage of people who perceive traffic as	Average distance to train stations [2019]
Strijp S	92	43	0,9
't Hofke	98	45	3,3
't Hool	98	33	3,8
Tempel	98	30	4,6
Tivoli	99	42	3,5
Tongelresche Akkers	96	47	3,4
Tuindorp	96	40	2,2
TU-terrein	97	0	2,1
Urkhoven	97	0	3
Vaartbroek	98	29	5,2
Villapark	94	36	1,2
Vlokhoven	98	42	3,6
Vredeoord	79	0	2,6
Waterrijk	94	25	5,7
Wielewaal	91	0	3,5
Winkelcentrum	95	33	3,3
Witte Dame	88	31	1,4
Woenselse Heide	97	46	4
Woenselse Watermolen	98	32	1,3
Woensel-West	94	42	0,5
Zandrijk	98	27	5,5
Zwaanstraat	96	40	1,5

Neighborhood	Average distance to leisure opportunities (km)	Number of play areas	Average distance to services (km)
Achtse Barrier-Gunterslaer	4,9	14	1,36
Achtse Barrier-Hoeven	5,5	13	1,24
Achtse Barrier-Spaaihoef	5,1	14	1,34
Barrier	3,0	2	0,52
BeA2	6,3		1,82
Beemden			
Bennekel-Oost	2,4	8	0,4
Bennekel-West, Gagelbosch	2,7	5	0,64
Bergen	1,9	1	0,26
Binnenstad	2,0	2	0,18
Blaarthem	2,5	6	0,34
Blixembosch-Oost	5,4	20	0,82
Blixembosch-West	5,0	3	1,16
Bloemenplein	2,1	1	0,18
Bokt	6,0	3	1,66
Bosrijk	4,6	1	1,12
Burghplan	3,2	7	0,62
Castiliëlaan	6,0		2,2
Doornakkers-Oost	3,5	4	0,56
Doornakkers-West	3,1	8	0,36
Drents Dorp	3,0	6	0,56
Driehoeksbos	3,8	3	1,34
Eckart	4,6	8	0,74
Eckartdal	4,5		1,44
Eikenburg	2,7	1	0,7
Eindhoven Airport			
Eliasterrein, Vonderkwartier	2,1	5	0,42
Elzent-Noord	2,1		0,36
Elzent-Zuid	2,0		0,7
Engelsbergen	2,5	1	0,52
Esp	5,8		1,5
Fellenoord	1,7		0,24
Flight Forum			
Genderbeemd	3,2	14	1,02
Genderdal	2,8	9	0,52
Generalenbuurt	3,3	9	0,62
Gennep	2,6		1,02
Genneperzijde	2,1	2	0,54
Gerardusplein	2,3	11	0,28
Gijzenrooi	3,8	3	1,06
Gildebuurt	2,0	1	0,2
Grasrijk	3,5	16	1,22
Hagenkamp	2,5	2	0,54
Hanevoet	3,1	15	0,8
Heesterakker	5,5	7	1,14
Hemelrijken	1,9	3	0,24
Herdgang	4,9		2,54

Neighborhood	Average distance to leisure opportunities (km)	Number of play areas	Average distance to services (km)
Het Ven	3,2	10	0,44
Hondsheuvels	3,2		0,62
Hurk	3,3		0,72
Irisbuurt	2,3	4	0,3
Jagershoef	3,8	12	0,68
Joriskwartier	2,3	1	0,26
Kapelbeemd	5,3		1,56
Karpen	3,8	2	1,22
Kerkdorp Acht	5,0	10	1,36
Kerstroosplein	2,6	2	0,34
Koudenhoven	4,3	1	1,36
Kronehoef	2,5	4	0,42
Kruidenbuurt	3,0	7	0,5
Lakerloopen	2,8	10	0,24
Leenderheide			
Lievendaal	3,6	10	0,6
Limbeek-Noord	2,1	3	0,32
Limbeek-Zuid	1,9	3	0,56
Looiakkers	2,1	2	0,2
Luytelaer	4,9		1,18
Meerbos	4,3		1,06
Meerrijk	4,9	10	0,08
Mensfort	3,0	3	0,44
Mispelhoef	6,2		2,2
Muschberg, Geestenberg	3,8	12	0,66
Nieuwe Erven	2,6	1	0,26
Ooievaarsnest	3,1	2	1,18
Oude Gracht-Oost	4,2	3	1,12
Oude Gracht-West	3,6	5	0,62
Oude Spoorbaan	2,2	5	0,26
Oude Toren	2,7	2	0,5
Park Forum	4,1		2,06
Philipsdorp	2,1	6	0,36
Poeijers			
Prinsejagt	3,5	14	0,84
Puttense Dreef	3,7	2	0,94
Rapenburg	2,2	3	0,34
Rapenland	3,0	2	0,46
Riel	3,9	1	1,24
Rochusbuurt	2,2	2	0,2
Roosten	3,2	1	0,9
Schoot	2,6	5	0,32
Schouwbroek	2,5	4	0,38
Schrijversbuurt	2,1	6	0,34
Schuttersbosch	3,4	2	0,86
Sintenbuurt	2,9	1	0,38
Sportpark Aalsterweg	2,4	5	0,78

Neighborhood	Average distance to leisure opportunities (km)	Number of play areas	Average distance to services (km)
Strijp S	2,3		0,3
't Hofke	3,9	10	0,6
't Hool	4,2	5	0,92
Tempel	4,7	19	0,52
Tivoli	3,4	2	0,62
Tongelresche Akkers	3,9	3	0,78
Tuindorp	2,5	1	0,38
TU-terrein	3,0		1,2
Urkhoven	4,0	1	1,12
Vaartbroek	5,1	13	0,78
Villapark	2,5	1	0,42
Vlokhoven	4,3	12	0,68
Vredeoord	4,1		1,6
Waterrijk	3,5	13	1,98
Wielewaal	5,1		2,04
Winkelcentrum	3,9	5	0,48
Witte Dame	1,8	1	0,22
Woenselse Heide	4,3	8	0,84
Woenselse Watermolen	2,2	1	0,48
Woensel-West	2,6	12	0,34
Zandrijk	4,6	3	0,74
Zwaanstraat	3,1	2	0,66

Neighborhood	Average walking distance to kindergarten (km)	Average walking distance to elementary school	Average walking distance to secondary school
Achtse Barrier-Gunterslaer	0,4	0,5	1,5
Achtse Barrier-Hoeven	0,3	0,5	2,3
Achtse Barrier-Spaaihoef	0,5	0,5	2,2
Barrier	0,5	0,5	0,6
BeA2	2,4	3,7	4,7
Beemden			
Bennekel-Oost	0,4	0,4	1,2
Bennekel-West, Gagelbosch	0,6	0,6	1,1
Bergen	0,4	0,4	1,1
Binnenstad	0,8	0,8	1,5
Blaarthem	0,6	0,6	0,9
Blixembosch-Oost	0,4	0,5	1,1
Blixembosch-West	0,3	0,9	0,8
Bloemenplein	0,7	0,7	1,2
Bokt	1,6	1,6	2
Bosrijk	0,7	1,1	3,8
Burghplan	0,4	0,4	0,5
Castiliëlaan	0,3	1,4	2,7
Doornakkers-Oost	0,5	0,5	2
Doornakkers-West	0,3	0,4	1,5
Drents Dorp	0,4	0,4	0,9
Driehoeksbos	0,6	1,3	0,8
Eckart	0,4	0,4	1,3
Eckartdal	0,1	0,1	0,2
Eikenburg	0,6	0,6	0,6
Eindhoven Airport			
Eliasterrein, Vonderkwartier	0,7	0,6	1
Elzent-Noord	0,5	0,5	0,9
Elzent-Zuid	0,9	0,9	0,7
Engelsbergen	0,6	0,6	0,4
Esp			
Fellenoord	0,2	0,2	1,4
Flight Forum			
Genderbeemd	0,5	0,5	1,5
Genderdal	0,5	0,5	0,7
Generalenbuurt	0,4	0,5	1
Gennep	1,3	1,4	1,7
Genneperzijde	0,4	0,7	1,3
Gerardusplein	0,3	0,3	1,2
Gijzenrooi	1,2	1,2	1,5
Gildebuurt	0,3	0,3	0,9
Grasrijk	1	1,1	3,3
Hagenkamp	0,2	0,3	0,9
Hanevoet	0,4	0,4	0,9
Heesterakker	0,3	0,3	1,5
Hemelrijken	0,3	0,4	1,2
Herdgang	0,9	0,9	1

Neighborhood	Average walking distance to kindergarten (km)	Average walking distance to elementary school	Average walking distance to secondary school
Het Ven	0,4	0,5	0,9
Hondsheuvels	0,9	1,2	1
Hurk	0,8	0,8	1,5
Irisbuurt	0,4	0,6	0,7
Jagershoef	0,5	0,5	1,3
Joriskwartier	0,5	0,4	0,9
Kapelbeemd	0,5	0,3	2,8
Karpen	1,1	1,1	1,3
Kerkdorp Acht	0,6	0,6	2,1
Kerstroosplein	0,3	0,4	1
Koudenhoven	1,2	1,2	1,6
Kronehoef	0,4	0,7	0,5
Kruidenbuurt	0,5	0,6	1,3
Lakerloopen	0,6	0,7	1,3
Leenderheide			
Lievendaal	0,4	0,5	1,7
Limbeek-Noord	0,6	0,6	1,2
Limbeek-Zuid	0,6	0,6	1,5
Looiakkers	0,7	0,7	1,3
Luytelaer	0,6	0,7	0,9
Meerbos	1,3	1,3	2,4
Meerrijk	0,1	0,4	4,1
Mensfort	0,4	0,5	0,3
Mispelhoef	2,9	3,9	4,1
Muschberg, Geestenberg	0,6	0,8	1,8
Nieuwe Erven	0,3	0,3	0,9
Ooievaarsnest	0,6	0,6	1,5
Oude Gracht-Oost	0,6	0,4	0,5
Oude Gracht-West	0,4	0,6	1,1
Oude Spoorbaan	0,4	0,6	0,9
Oude Toren	0,7	0,7	0,4
Park Forum	1,1	1,5	5,1
Philipsdorp	0,4	0,4	1
Poeijers			
Prinsejagt	0,4	0,8	1,1
Puttense Dreef	0,7	0,7	1,1
Rapenburg	0,6	0,9	0,9
Rapenland	0,3	0,4	0,7
Riel	1,3	1,3	1,8
Rochusbuurt	0,2	0,3	0,8
Roosten	0,7	0,7	0,7
Schoot	0,6	0,6	0,5
Schouwbroek	0,3	0,3	0,6
Schrijversbuurt	0,5	0,8	0,5
Schuttersbosch	1,1	1,1	1,6
Sintenbuurt	0,4	0,3	0,6
Sportpark Aalsterweg	0,7	0,9	0,8

Neighborhood	Percentage of parents engages in sports	Amount (km2) of greenery per km2	FSI_a
Achtse Barrier-Gunterslaer	52,1	0,32	0,48
Achtse Barrier-Hoeven	50,4	0,69	0,51
Achtse Barrier-Spaaihoef	54,1	0,32	0,53
Barrier	49,8	1,23	0,68
BeA2	44,4	0,15	0,04
Beemden			
Bennekel-Oost	48,7	0,48	0,60
Bennekel-West, Gagelbosch	43,3	0,57	0,44
Bergen	62,8	0,62	0,97
Binnenstad	62,2	0,54	1,41
Blaarthem	47,6	0,21	0,59
Blixembosch-Oost	60,0	0,28	0,46
Blixembosch-West	59,2	0,52	0,44
Bloemenplein	55,2	0,13	0,80
Bokt	54,9	0,17	0,09
Bosrijk	64,6	0,42	0,26
Burghplan	47,4	0,64	0,63
Castiliëlaan	40,4	0,21	0,24
Doornakkers-Oost	42,1	0,35	0,52
Doornakkers-West	49,2	0,47	0,53
Drents Dorp	45,0	0,90	0,48
Driehoeksbos	57,7	0,74	0,34
Eckart	42,0	0,52	0,53
Eckartdal		0,31	
Eikenburg	63,4	0,35	0,51
Eindhoven Airport		0,01	0,04
Eliasterrein, Vonderkwartier	62,3	0,18	0,79
Elzent-Noord	62,0	0,12	0,63
Elzent-Zuid	63,6	0,88	0,53
Engelsbergen	63,0	0,76	0,48
Esp	46,1	0,00	0,49
Fellenoord	65,5	0,32	1,11
Flight Forum			0,53
Genderbeemd	53,8	0,27	0,50
Genderdal	45,6	0,93	0,52
Generalenbuurt	48,5	0,45	0,58
Gennep	56,9	0,14	0,11
Genneperzijde	55,2	0,53	0,57
Gerardusplein	59,2	0,17	0,64
Gijzenrooi	59,7	0,20	0,40
Gildebuurt	53,9	0,42	0,81
Grasrijk	57,6	0,02	0,49
Hagenkamp	43,6	2,05	0,71
Hanevoet	47,4	0,07	0,56
Heesterakker	56,7	0,24	0,55
Hemelrijken	52,6	0,23	0,85
Herdgang	62,0	0,06	0,12

Neighborhood	Percentage of parents engages in sports	Amount (km2) of greenery per km2	FSI_a
Het Ven	52,3	0,17	0,52
Hondsheuvels	40,1	1,07	0,40
Hurk	55,4	0,09	0,55
Irisbuurt	60,7	0,79	0,58
Jagershoef	41,2	1,01	0,49
Joriskwartier	61,0	2,99	0,74
Kapelbeemd	59,6	0,01	0,46
Karpen	64,6	0,09	0,26
Kerkdorp Acht	58,0	0,35	0,35
Kerstroosplein	50,4	5,35	0,71
Koudenhoven	62,0	0,04	0,21
Kronehoef	47,0	0,38	0,72
Kruidenbuurt	51,8	2,01	0,80
Lakerloopen	50,6	0,10	0,71
Leenderheide			
Lievendaal	47,3	0,20	0,55
Limbeek-Noord	59,3	1,30	0,56
Limbeek-Zuid	49,2	0,68	0,66
Looiakkers	65,6	0,26	0,64
Luytelaer	59,2	0,20	0,38
Meerbos	34,7	0,29	0,03
Meerrijk	57,5	0,31	0,17
Mensfort	45,9	1,32	0,58
Mispelhoef	53,8	0,13	0,40
Muschberg, Geestenberg	48,7	0,64	0,58
Nieuwe Erven	52,2	1,42	0,63
Ooievaarsnest	60,5	0,20	0,33
Oude Gracht-Oost	60,5	0,09	0,41
Oude Gracht-West	48,6	0,31	0,58
Oude Spoorbaan	59,5	0,70	0,65
Oude Toren	46,9	0,54	0,61
Park Forum	58,7	0,44	0,21
Philipsdorp	60,5	0,19	0,73
Poeijers		0,37	
Prinsejagt	47,7	0,39	0,54
Puttense Dreef	60,3	1,03	0,36
Rapenburg	62,4	0,39	0,37
Rapenland	51,4	0,17	0,47
Riel	62,0	0,14	0,21
Rochusbuurt	65,6	0,15	0,92
Roosten	66,8	1,20	0,19
Schoot	59,7	0,80	0,70
Schouwbroek	53,8	0,82	0,66
Schrijversbuurt	61,1	0,57	0,72
Schuttersbosch	52,9	1,20	0,19
Sintenbuurt	53,4	0,51	0,64
Sportpark Aalsterweg	57,7	0,64	0,35

Neighborhood	Percentage of parents engages in sports	Amount (km2) of greenery per km2	FSI_a
Strijp S	72,5	0,72	1,60
't Hofke	48,0	0,23	0,44
't Hool	47,0	0,49	0,57
Tempel	44,3	0,86	0,58
Tivoli	38,1	0,12	0,63
Tongelresche Akkers	59,1	0,13	0,18
Tuindorp	59,0	0,04	0,75
TU-terrein	63,2	0,09	0,80
Urkhoven	47,5	0,10	0,12
Vaartbroek	43,9	0,28	0,54
Villapark	65,2	0,13	0,52
Vlokhoven	43,1	0,14	0,65
Vredeoord	49,5	0,04	0,26
Waterrijk	64,7	0,52	0,25
Wielewaal	62,8	0,07	0,13
Winkelcentrum	55,8	1,05	0,62
Witte Dame	62,5	1,01	1,65
Woenselse Heide	45,4	0,98	0,60
Woenselse Watermolen	51,3	0,44	0,50
Woensel-West	54,4	0,28	0,62
Zandrijk	54,6	0,75	0,58
Zwaanstraat	68,6	0,86	0,36

Neighborhood	GSI_a	MXI_a
Achtse Barrier-Gunterslaer	0,27	0,59
Achtse Barrier-Hoeven	0,24	0,91
Achtse Barrier-Spaaihoef	0,24	0,88
Barrier	0,26	0,81
BeA2	0,08	0,50
Beemden		
Bennekel-Oost	0,25	0,83
Bennekel-West, Gagelbosch	0,19	0,84
Bergen	0,32	0,59
Binnenstad	0,39	0,28
Blaarthem	0,24	0,80
Blixembosch-Oost	0,21	0,93
Blixembosch-West	0,23	0,93
Bloemenplein	0,34	0,75
Bokt	0,07	0,37
Bosrijk	0,12	0,81
Burghplan	0,23	0,74
Castiliëlaan	0,13	0,21
Doornakkers-Oost	0,22	0,73
Doornakkers-West	0,25	0,63
Drents Dorp	0,19	0,75
Driehoeksbos	0,15	0,40
Eckart	0,20	0,86
Eckartdal		
Eikenburg	0,23	0,76
Eindhoven Airport	0,03	0,00
Eliasterrein, Vonderkwartier	0,28	0,90
Elzent-Noord	0,20	0,80
Elzent-Zuid	0,18	0,93
Engelsbergen	0,26	0,49
Esp	0,35	0,02
Fellenoord	0,20	0,04
Flight Forum	0,32	0,00
Genderbeemd	0,22	0,69
Genderdal	0,19	0,70
Generalenbuurt	0,20	0,75
Gennep	0,06	0,08
Genneperzijde	0,20	0,92
Gerardusplein	0,27	0,78
Gijzenrooi	0,21	0,95
Gildebuurt	0,32	0,67
Grasrijk	0,20	0,94
Hagenkamp	0,21	0,62
Hanevoet	0,24	0,85
Heesterakker	0,25	0,85
Hemelrijken	0,32	0,73
Herdgang	0,07	0,13

Neighborhood	GSI_a	MXI_a
Het Ven	0,23	0,61
Hondsheuvels	0,11	0,24
Hurk	0,38	0,00
Irisbuurt	0,29	0,49
Jagershoef	0,19	0,88
Joriskwartier	0,31	0,75
Kapelbeemd	0,37	0,04
Karpen	0,12	0,86
Kerkdorp Acht	0,19	0,88
Kerstroosplein	0,29	0,85
Koudenhoven	0,10	0,78
Kronehoef	0,22	0,68
Kruidenbuurt	0,29	0,92
Lakerlopen	0,34	0,60
Leenderheide		
Lievendaal	0,21	0,71
Limbeek-Noord	0,21	0,90
Limbeek-Zuid	0,21	0,82
Looiakkers	0,24	0,50
Luytelaer	0,20	0,98
Meerbos	0,02	0,03
Meerrijk	0,05	0,62
Mensfort	0,23	0,74
Mispelhoef	0,27	0,00
Muschberg, Geestenberg	0,27	0,78
Nieuwe Erven	0,30	0,75
Ooievaarsnest	0,16	0,98
Oude Gracht-Oost	0,20	0,67
Oude Gracht-West	0,20	0,80
Oude Spoorbaan	0,27	0,81
Oude Toren	0,17	0,89
Park Forum	0,13	0,02
Philipsdorp	0,28	0,74
Poeijers		
Prinsejagt	0,20	0,83
Puttense Dreef	0,17	0,93
Rapenburg	0,19	0,72
Rapenland	0,24	0,55
Riel	0,10	0,65
Rochusbuurt	0,33	0,81
Roosten	0,10	0,94
Schoot	0,27	0,64
Schouwbroek	0,28	0,76
Schrijversbuurt	0,30	0,76
Schuttersbosch	0,10	0,93
Sintenbuurt	0,25	0,76
Sportpark Aalsterweg	0,13	0,02

Neighborhood	GSI_a	MXI_a
Strijp S	0,26	0,15
't Hofke	0,18	0,83
't Hool	0,21	0,95
Tempel	0,26	0,71
Tivoli	0,28	0,88
Tongelresche Akkers	0,07	0,82
Tuindorp	0,27	0,81
TU-terrein	0,19	0,03
Urkhoven	0,06	0,34
Vaartbroek	0,21	0,84
Villapark	0,21	0,69
Vlokhoven	0,24	0,76
Vredeoord	0,14	0,38
Waterrijk	0,11	0,91
Wielewaal	0,05	0,94
Winkelcentrum	0,29	0,47
Witte Dame	0,31	0,50
Woenselse Heide	0,27	0,74
Woenselse Watermolen	0,20	0,70
Woensel-West	0,26	0,77
Zandrijk	0,25	0,97
Zwaanstraat	0,23	0,23

Appendix C - Typologies

Typologies	Density children per km2	Average income of parent/caretaker (x1000€)
	High	High
	High	Average
	High	Low
	Average	High
	Average	Average
	Average	Low
	Low	High
	Low	Average
	Low	low

Eliasterrein, Vonderkwartier
Grasrijk
Schrijversbuurt
Tongelresche Akkers
Waterrijk
Woenselse Watermolen
Zandrijk

Blixembosch-Oost
Elzent-Noord
Irisbuurt
Puttense Dreef
Rapelenburg
Villapark
Witte Dame
Zwaanstraat

Bergen
Blixembosch-West
Bosrijk
Driehoeksbos
Eikenburg
Elzent-Zuid
Engelsbergen
Genneperzijde
Gijzenrooi
Karpen
Kerkdorp Acht
Koudenhoven
Luytelaer
Meerrijk
Ooievaarsnest
Oude Gracht-Oost
Roosten
Schuttersbosch

Barrier
Blaarthem
Bloemenplein
Burghplan
Gerardusplein
Hanevoet
Joriskwartier
Kruidenbuurt
Rochusbuurt
Sintenbuurt
't Hool
Woenselse Heide

Achtse Barrier-Gunterslaer
Achtse Barrier-Hoeven
Achtse Barrier-Spaaihoef
Genderbeemd
Generalenbuurt
Gildebuurt
Heesterakker
Het Ven
Kronehoef
Lakerlopen
Lievendaal
Oude Gracht-West
Oude Spoorbaan
Philipsdorp
Prinsejagt
Schoot
Schouwbroek
Tempel
Tuindorp

Binnenstad
Hagenkamp
Limbeek-Noord
Looiakkers
Oude Toren
Strijp S
't Hofke

Doornakkers-Oost
Drents Dorp
Eckart
Hemelrijken
Jagershoef
Kerstroosplein
Limbeek-Zuid
Mensfort
Tivoli
Vaartbroek
Vlokhoven
Woensel-West

Bennekel-Oost
Bennekel-West, Gagelbosch
Doornakkers-West
Genderdal
Muschberg, Geestenberg
Nieuwe Erven
Rapenland

BeA2
Beemden
Bokt
Castiliëlaan
Eckarddal
Eindhoven Airport
Esp
Fellenoord
Flight Forum
Gennep
Herdgang
Hondsheuvels
Hurk
Kapelbeemd
Leenderheide
Meerbos
Mispelhoef
Park Forum
Poeijers
Riel
Sportpark Aalsterweg
TU-terrein
Urkhoven
Vredeoord
Wielewaal
Winkelcentrum

Appendix D - Scores of potential neighborhoods for densification.

Neighborhood	Population/km2	FSI_a	GSI_a
Achtse Barrier-Gunterslaer	3	3	2
Achtse Barrier-Hoeven	4	2	2
Achtse Barrier-Spaaihoef	3	2	2
Barrier	5	2	2
BeAtwee	0	5	4
Bennekel-Oost	4	2	2
Bennekel-West, Gagelbosch	4	3	3
Bergen	5	0	1
Binnenstad	5	0	0
Blaarthem	5	2	2
Blixembosch-Oost	3	3	3
Blixembosch-West	2	3	2
Bloemenplein	5	1	1
Bokt	0	5	4
Bosrijk	1	4	4
Burghplan	5	2	2
Castiliëlaan	0	4	3
Doornakkers-Oost	4	2	2
Doornakkers-West	4	2	2
Drents Dorp	4	3	3
Driehoeksbos	1	3	3
Eckart	5	2	3
Eikenburg	2	2	2
Eindhoven Airport	0	5	5
Eliasterrein, Vonderkwartier	5	1	2
Elzent-Noord	4	2	3
Elzent-Zuid	2	2	3
Engelsbergen	2	3	2
Esp	0	3	1
Fellenoord	1	0	3
Flight Forum	0	2	1
Genderbeemd	3	3	2
Genderdal	4	2	3
Generalenbuurt	5	2	3
Gennep	0	4	4
Genneperzijde	4	2	3
Gerardusplein	5	2	2
Gijzenrooi	2	3	3
Gildebuurt	5	1	1
Grasrijk	4	3	3
Hagenkamp	4	1	2
Hanevoet	4	2	2
Heesterakker	4	2	2
Hemelrijken	5	1	1
Herdgang	0	4	4
Het Ven	3	2	2
Hondsheuvels	1	3	4
Hurk	0	2	0

Neighborhood	Population/km2	FSI_a	GSI_a
Irisbuurt	4	2	2
Jagershoef	5	3	3
Joriskwartier	5	1	1
Kapelbeemd	0	3	1
Karpen	0	4	4
Kerkdorp Acht	2	3	3
Kerstroosplein	5	1	1
Koudenhoven	0	4	4
Kronehoef	5	1	2
Kruidenbuurt	5	1	1
Lakerlopen	5	1	1
Lievendaal	3	2	3
Limbeek-Noord	5	2	2
Limbeek-Zuid	5	2	3
Looiakkers	2	2	2
Luytelaer	1	3	3
Meerbos	0	5	5
Meerrijk	1	4	4
Mensfort	5	2	2
Mispelhoef	0	3	2
Muschberg, Geestenber	4	2	2
Nieuwe Erven	5	2	1
Ooievaarsnest	1	3	3
Oude Gracht-Oost	2	3	3
Oude Gracht-West	4	2	3
Oude Spoorbaan	5	2	2
Oude Toren	5	2	3
Park Forum	0	4	4
Philipsdorp	5	1	2
Prinsejagt	4	2	3
Puttense Dreef	3	3	3
Rapelenburg	4	3	3
Rapenland	3	3	2
Riel	0	4	4
Rochusbuurt	5	0	1
Roosten	1	4	4
Schoot	5	1	2
Schouwbroek	5	2	2
Schrijversbuurt	5	1	1
Schuttersbosch	1	4	4
Sintenbuurt	5	2	2
Sportpark Aalsterweg	0	3	3
Strijp S	5	0	2
't Hofke	2	3	3
't Hool	5	2	2
Tempel	3	2	2
Tivoli	5	2	2
Tongelresche Akkers	3	4	4

Neighborhood	Population/km2	FSI_a	GSI_a
Tuindorp	5	1	2
TU-terrein	0	1	3
Urkhoven	0	4	4
Vaartbroek	4	2	3
Villapark	3	2	2
Vlokhoven	5	2	2
Vredeoord	0	4	3
Waterrijk	3	4	4
Wielewaal	0	4	4
Winkelcentrum	3	2	2
Witte Dame	5	0	1
Woenselse Heide	5	2	2
Woenselse Watermolen	4	3	3
Woensel-West	5	2	2
Zandrijk	5	2	2
Zwaanstraat	2	3	2

Neighborhood	MXI_a	Rental properties	Distance to trainstation
Achtse Barrier-Gunterslaer	3	2	1
Achtse Barrier-Hoeven	5	3	0
Achtse Barrier-Spaaihoef	4	1	0
Barrier	4	4	4
BeAtwee	2	0	0
Bennekel-Oost	4	5	1
Bennekel-West, Gagelbosch	4	5	1
Bergen	3	5	3
Binnenstad	1	5	4
Blaarthem	4	5	1
Blixembosch-Oost	5	1	0
Blixembosch-West	5	1	0
Bloemenplein	4	5	3
Bokt	2	1	0
Bosrijk	4	1	0
Burghplan	4	5	2
Castiliëlaan	1	0	0
Doornakkers-Oost	4	5	2
Doornakkers-West	3	5	3
Drents Dorp	4	5	4
Driehoeksbos	2	2	2
Eckart	4	5	1
Eikenburg	4	2	1
Eindhoven Airport	0	0	5
Eliasterrein, Vonderkwartier	5	3	3
Elzent-Noord	4	4	3
Elzent-Zuid	5	2	3
Engelsbergen	2	2	3
Esp	0	5	5
Fellenoord	0	0	4
Flight Forum	0	0	5
Genderbeemd	3	3	0
Genderdal	4	5	1
Generalenbuurt	4	5	2
Gennep	0	5	1
Gennepzijdje	5	4	2
Gerardusplein	4	3	2
Gijzenrooi	5	2	1
Gildebuurt	3	5	4
Grasrijk	5	2	1
Hagenkamp	3	5	2
Hanevoet	4	4	0
Heesterakker	4	0	0
Hemelrijken	4	5	4
Herdgang	1	4	2
Het Ven	3	5	3
Hondsheuvels	1	4	3
Hurk	0	5	2

Neighborhood	MXI_a	Rental properties	Distance to trainstation
Irisbuurt	2	4	4
Jagershoef	4	5	2
Joriskwartier	4	4	3
Kapelbeemd	0	2	0
Karpen	4	1	2
Kerkdorp Acht	4	2	1
Kerstroosplein	4	5	2
Koudenhoven	4	0	1
Kronehoef	3	5	4
Kruidenbuurt	5	4	2
Lakerlopen	3	5	3
Lievendaal	4	5	3
Limbeek-Noord	4	5	4
Limbeek-Zuid	4	5	4
Looiakkers	3	5	3
Luytelaer	5	0	0
Meerbos	0	0	2
Meerrijk	3	4	0
Mensfort	4	5	3
Mispelhoef	0	2	0
Muschberg, Geestenber	4	4	2
Nieuwe Erven	4	5	2
Ooievaarsnest	5	0	0
Oude Gracht-Oost	3	0	1
Oude Gracht-West	4	4	2
Oude Spoorbaan	4	5	3
Oude Toren	4	5	3
Park Forum	0	3	0
Philipsdorp	4	5	3
Prinsejagt	4	5	3
Puttense Dreef	5	3	2
Rapelenburg	4	5	2
Rapenland	3	5	3
Riel	3	1	2
Rochusbuurt	4	5	4
Roosten	5	0	1
Schoot	3	5	4
Schouwbroek	4	4	3
Schrijversbuurt	4	3	3
Schuttersbosch	5	4	1
Sintenbuurt	4	3	2
Sportpark Aalsterweg	0	2	1
Strijp S	1	5	4
't Hofke	4	5	2
't Hool	5	5	1
Tempel	4	5	0
Tivoli	4	5	2
Tongelresche Akkers	4	3	2

Neighborhood	MXI_a	Rental properties	Distance to trainstation
Tuindorp	4	4	3
TU-terrein	0	5	3
Urkhoven	2	3	2
Vaartbroek	4	5	0
Villapark	3	4	4
Vlokhoven	4	5	1
Vredeoord	2	5	2
Waterrijk	5	2	0
Wielewaal	5	2	2
Winkelcentrum	2	3	2
Witte Dame	3	5	4
Woenselse Heide	4	4	1
Woenselse Watermolen	4	5	4
Woensel-West	4	5	5
Zandrijk	5	2	0
Zwaanstraat	1	2	4

Neighborhood	Housing occupancy	Densification potential %
Achtse Barrier-Gunterslaer	0	35,6
Achtse Barrier-Hoeven	0	41,1
Achtse Barrier-Spaaihoef	0	32,2
Barrier	0	57,8
BeAtwee	5	46,7
Bennekel-Oost	0	43,3
Bennekel-West, Gagelbosch	0	46,7
Bergen	1	48,9
Binnenstad	1	43,3
Blaarthem	0	45,6
Blixembosch-Oost	0	40,0
Blixembosch-West	0	36,7
Bloemenplein	0	51,1
Bokt	0	25,6
Bosrijk	0	34,4
Burghplan	0	50,0
Castiliëlaan	5	38,9
Doornakkers-Oost	0	47,8
Doornakkers-West	0	47,8
Drents Dorp	0	60,0
Driehoeksbos	0	32,2
Eckart	0	46,7
Eikenburg	0	35,6
Eindhoven Airport	5	61,1
Eliasterrein, Vonderkwartier	0	54,4
Elzent-Noord	0	52,2
Elzent-Zuid	1	54,4
Engelsbergen	0	37,8
Esp	5	57,8
Fellenoord	1	27,8
Flight Forum	5	50,0
Genderbeemd	0	32,2
Genderdal	0	44,4
Generalenbuurt	0	51,1
Gennep	5	45,6
Gennepzijdde	0	52,2
Gerardusplein	0	47,8
Gijzenrooi	0	43,3
Gildebuurt	0	51,1
Grasrijk	0	47,8
Hagenkamp	0	41,1
Hanevoet	0	37,8
Heesterakker	0	33,3
Hemelrijken	0	55,6
Herdgang	5	53,3
Het Ven	0	45,6
Hondsheuvels	0	35,6
Hurk	5	41,1

Neighborhood	Housing occupancy	Densification potential %
Irisbuurt	0	46,7
Jagershoef	0	53,3
Joriskwartier	0	50,0
Kapelbeemd	0	10,0
Karpen	1	45,6
Kerkdorp Acht	0	38,9
Kerstroosplein	0	46,7
Koudenhoven	0	35,6
Kronehoef	0	52,2
Kruidenbuurt	0	50,0
Lakerlopen	0	46,7
Lievendaal	0	51,1
Limbeek-Noord	0	58,9
Limbeek-Zuid	0	60,0
Looiakkers	0	43,3
Luytelaer	0	34,4
Meerbos	5	47,8
Meerrijk	0	33,3
Mensfort	0	54,4
Mispelhoef	5	33,3
Muschberg, Geestenberg	0	46,7
Nieuwe Erven	0	48,9
Ooievaarsnest	0	34,4
Oude Gracht-Oost	0	32,2
Oude Gracht-West	0	47,8
Oude Spoorbaan	0	54,4
Oude Toren	0	55,6
Park Forum	5	38,9
Philipsdorp	0	52,2
Prinsejagt	0	53,3
Puttense Dreef	0	51,1
Rapelenburg	0	51,1
Rapenland	0	47,8
Riel	0	36,7
Rochusbuurt	0	53,3
Roosten	0	42,2
Schoot	1	56,7
Schouwbroek	0	53,3
Schrijversbuurt	0	48,9
Schuttersbosch	0	46,7
Sintenbuurt	0	47,8
Sportpark Aalsterweg	5	38,9
Strijp S	0	41,1
't Hofke	0	46,7
't Hool	0	50,0
Tempel	0	36,7
Tivoli	0	50,0
Tongelresche Akkers	0	50,0

Neighborhood	Housing occupancy	Densification potential %
Tuindorp	0	51,1
TU-terrein	0	24,4
Urkhoven	0	34,4
Vaartbroek	0	40,0
Villapark	0	48,9
Vlokhoven	0	45,6
Vredeoord	1	40,0
Waterrijk	0	44,4
Wielewaal	0	46,7
Winkelcentrum	0	34,4
Witte Dame	1	53,3
Woenselse Heide	0	44,4
Woenselse Watermolen	0	60,0
Woensel-West	0	63,3
Zandrijk	0	42,2
Zwaanstraat	0	37,8

Appendix E - Scores of neighborhoods in need of child-friendly development

Neighborhood	Density children per km2	Average income of parent/caretaker (x1000€)	Population/km2
Achtse Barrier-Gunterslaer	2	3	3
Achtse Barrier-Hoeven	3	3	4
Achtse Barrier-Spaaihoef	3	3	3
Barrier	5	3	5
BeA2	0	0	0
Bennekel-Oost	3	2	4
Bennekel-West, Gagelbosch	3	2	4
Bergen	2	4	5
Binnenstad	1	3	5
Blaarthem	4	3	5
Blixembosch-Oost	3	4	3
Blixembosch-West	2	4	2
Bloemenplein	4	3	5
Bokt	0	0	0
Bosrijk	1	5	1
Burghplan	4	3	5
Castiliëlaan	0	0	0
Doornakkers-Oost	3	2	4
Doornakkers-West	3	2	4
Drents Dorp	4	2	4
Driehoeksbos	1	4	1
Eckart	4	2	5
Eikenburg	1	5	2
Eindhoven Airport	0	0	0
Eliasterrein, Vonderkwartier	5	3	5
Elzent-Noord	2	5	4
Elzent-Zuid	0	5	2
Engelsbergen	1	4	2
Esp	0	0	0
Fellenoord	0	3	1
Flight Forum	0	0	0
Genderbeemd	2	3	3
Genderdal	2	2	4
Generalenbuurt	3	3	5
Gennep	0	0	0
Genneperzijde	2	4	4
Gerardusplein	5	3	5
Gijzenrooi	2	4	2
Gildebuurt	2	3	5
Grasrijk	4	4	4
Hagenkamp	2	3	4
Hanevoet	3	3	4
Heesterakker	3	3	4
Hemelrijken	5	2	5
Herdgang	0	0	0
Het Ven	2	3	3

Neighborhood	Density children per km2	Average income of parent/caretaker (x1000€)	Population/km2
Hondsheuvels	0	2	1
Hurk	0	0	0
Irisbuurt	2	4	4
Jagershoef	4	2	5
Joriskwartier	3	3	5
Kapelbeemd	0	0	0
Karpen	0	5	0
Kerkdorp Acht	1	4	2
Kerstroosplein	5	2	5
Koudenhoven	0	5	0
Kronehoef	3	3	5
Kruidenbuurt	5	3	5
Lakerlopen	3	3	5
Lievendaal	2	3	3
Limbeek-Noord	2	2	5
Limbeek-Zuid	3	2	5
Looiakkers	1	3	2
Luytelaer	1	5	1
Meerbos	0	0	0
Meerrijk	1	4	1
Mensfort	3	2	5
Mispelhoef	0	0	0
Muschberg, Geestenberg	3	3	4
Nieuwe Erven	3	2	5
Ooievaarsnest	1	5	1
Oude Gracht-Oost	2	4	2
Oude Gracht-West	3	3	4
Oude Spoorbaan	3	3	5
Oude Toren	2	3	5
Park Forum	0	0	0
Philipsdorp	2	3	5
Prinsejagt	3	3	4
Puttense Dreef	3	4	3
Rapelenburg	2	4	4
Rapenland	2	2	3
Riel	0	4	0
Rochusbuurt	4	3	5
Roosten	1	5	1
Schoot	3	3	5
Schouwbroek	3	3	5
Schrijversbuurt	3	4	5
Schuttersbosch	1	4	1
Sintenbuurt	5	3	5
Sportpark Aalsterweg	0	0	0
Strijp S	1	3	5
't Hofke	1	3	2

Neighborhood	Density children per km2	Average income of parent/caretaker (x1000€)	Population/km2
't Hool	5	3	5
Tempel	3	3	3
Tivoli	5	2	5
Tongelresche Akkers	4	4	3
Tuindorp	3	3	5
TU-terrein	0	2	0
Urkhoven	0	2	0
Vaartbroek	3	2	4
Villapark	2	5	3
Vlokhoven	4	2	5
Vredeoord	0	1	0
Waterrijk	5	5	3
Wielewaal	0	0	0
Winkelcentrum	0	3	3
Witte Dame	2	4	5
Woenselse Heide	4	3	5
Woenselse Watermolen	4	4	4
Woensel-West	4	2	5
Zandrijk	5	4	5
Zwaanstraat	2	5	2

Neighborhood	Number of households/km2	% of households with kids	Average distance to services (km)
Achtse Barrier-Gunterslaer	2	4	5
Achtse Barrier-Hoeven	2	4	5
Achtse Barrier-Spaaihoef	2	4	5
Barrier	4	3	5
BeA2	0	0	4
Bennekel-Oost	3	2	5
Bennekel-West, Gagelbosch	3	2	5
Bergen	5	1	5
Binnenstad	4	1	5
Blaarthem	4	2	5
Blixembosch-Oost	2	5	5
Blixembosch-West	1	4	5
Bloemenplein	5	2	5
Bokt	0	5	5
Bosrijk	0	5	5
Burghplan	3	3	5
Castiliëlaan	0	0	4
Doornakkers-Oost	3	3	5
Doornakkers-West	3	2	5
Drents Dorp	3	3	5
Driehoeksbos	1	3	5
Eckart	3	3	5
Eikenburg	1	4	5
Eindhoven Airport	0	0	5
Eliasterrein, Vonderkwartier	5	2	5
Elzent-Noord	3	2	5
Elzent-Zuid	1	3	5
Engelsbergen	1	3	5
Esp	0	0	5
Fellenoord	1	0	5
Flight Forum	0	0	5
Genderbeemd	2	3	5
Genderdal	3	2	5
Generalenbuurt	3	3	5
Gennep	0	0	5
Genneperzijde	2	2	5
Gerardusplein	4	3	5
Gijzenrooi	1	4	5
Gildebuurt	5	1	5
Grasrijk	2	5	5
Hagenkamp	3	1	5
Hanevoet	3	4	5
Heesterakker	2	4	5
Hemelrijken	5	2	5
Herdgang	0	0	4
Het Ven	2	3	5

Neighborhood	Number of households/km2	% of households with kids	Average distance to services (km)
Hondsheuvels	0	1	5
Hurk	0	0	5
Irisbuurt	3	2	5
Jagershoef	3	3	5
Joriskwartier	5	2	5
Kapelbeemd	0	5	5
Karpen	0	3	5
Kerkdorp Acht	1	4	5
Kerstroosplein	5	3	5
Koudenhoven	0	4	5
Kronehoef	4	2	5
Kruidenbuurt	5	4	5
Lakerlopen	4	2	5
Lievendaal	2	3	5
Limbeek-Noord	5	1	5
Limbeek-Zuid	5	2	5
Looiakkers	2	1	5
Luytelaer	1	3	5
Meerbos	0	0	5
Meerrijk	1	2	5
Mensfort	4	2	5
Mispelhoef	0	0	4
Muschberg, Geestenber	3	3	5
Nieuwe Erven	4	2	5
Ooievaarsnest	0	4	5
Oude Gracht-Oost	1	4	5
Oude Gracht-West	3	2	5
Oude Spoorbaan	5	1	5
Oude Toren	4	1	5
Park Forum	0	0	4
Philipsdorp	5	2	5
Prinsejagt	3	3	5
Puttense Dreef	1	4	5
Rapelenburg	3	2	5
Rapenland	2	2	5
Riel	0	4	5
Rochusbuurt	5	1	5
Roosten	0	5	5
Schoot	5	1	5
Schouwbroek	4	3	5
Schrijversbuurt	3	3	5
Schuttersbosch	1	3	5
Sintenbuurt	4	3	5
Sportpark Aalsterweg	0	0	5
Strijp S	4	0	5
't Hofke	1	3	5

Neighborhood	Number of households/km2	% of households with kids	Average distance to services (km)
't Hool	3	4	5
Tempel	2	3	5
Tivoli	5	3	5
Tongelresche Akkers	1	5	5
Tuindorp	4	2	5
TU-terrein	1	0	5
Urkhoven	0	4	5
Vaartbroek	3	3	5
Villapark	2	3	5
Vlokhoven	3	3	5
Vredeoord	0	0	5
Waterrijk	2	5	4
Wielewaal	0	5	4
Winkelcentrum	3	1	5
Witte Dame	5	1	5
Woenselse Heide	3	4	5
Woenselse Watermolen	3	3	5
Woensel-West	3	3	5
Zandrijk	3	5	5
Zwaanstraat	1	5	5

Neighborhood	Average distance to leisure opportunities (km)	Number of play areas	Amount (km2) of greenery per km2
't Hool	1	2	3
Tempel	0	5	5
Tivoli	2	1	1
Tongelresche Akkers	1	1	1
Tuindorp	2	0	0
TU-terrein	2	0	1
Urkhoven	1	0	1
Vaartbroek	0	4	2
Villapark	2	0	1
Vlokhoven	1	4	1
Vredeoord	1	0	0
Waterrijk	1	4	3
Wielewaal	0	0	0
Winkelcentrum	1	2	5
Witte Dame	3	0	5
Woenselse Heide	1	3	5
Woenselse Watermolen	3	0	3
Woensel-West	2	4	2
Zandrijk	0	1	5
Zwaanstraat	2	1	5

Neighborhood	Potential neighborhoods children %
Achtse Barrier-Gunterslaer	59,4
Achtse Barrier-Hoeven	69,7
Achtse Barrier-Spaaihoef	60,6
Barrier	74,8
BeA2	7,7
Bennekel-Oost	61,9
Bennekel-West, Gagelbosch	59,4
Bergen	68,4
Binnenstad	53,5
Blaarthem	60,6
Blixembosch-Oost	65,8
Blixembosch-West	57,4
Bloemenplein	61,9
Bokt	22,6
Bosrijk	49,7
Burghplan	71,6
Castiliëlaan	12,9
Doornakkers-Oost	57,4
Doornakkers-West	60,0
Drents Dorp	71,0
Driehoeksbos	52,3
Eckart	65,8
Eikenburg	54,2
Eindhoven Airport	9,7
Eliasterrein, Vonderkwartier	65,8
Elzent-Noord	56,1
Elzent-Zuid	53,5
Engelsbergen	57,4
Esp	6,5
Fellenoord	40,0
Flight Forum	9,7
Genderbeemd	55,5
Genderdal	60,0
Generalenbuurt	64,5
Gennep	10,3
Genneperzijde	60,6
Gerardusplein	71,0
Gijzenrooi	43,9
Gildebuurt	63,2
Grasrijk	58,1
Hagenkamp	63,2
Hanevoet	62,6
Heesterakker	61,9
Hemelrijken	69,0
Herdgang	12,9
Het Ven	54,2

Neighborhood	Potential neighborhoods children %
Hondsheuvels	36,8
Hurk	18,1
Irisbuurt	65,8
Jagershoef	67,1
Joriskwartier	72,3
Kapelbeemd	32,3
Karpen	34,8
Kerkdorp Acht	52,3
Kerstroosplein	78,7
Koudenhoven	34,2
Kronehoef	64,5
Kruidenbuurt	80,6
Lakerloopen	58,1
Lievendaal	52,3
Limbeek-Noord	62,6
Limbeek-Zuid	67,7
Looiakkers	45,2
Luytelaer	47,1
Meerbos	12,3
Meerrijk	51,6
Mensfort	67,1
Mispelhoef	7,7
Muschberg, Geestenberg	63,9
Nieuwe Erven	67,7
Ooievaarsnest	49,0
Oude Gracht-Oost	52,9
Oude Gracht-West	58,7
Oude Spoorbaan	71,0
Oude Toren	59,4
Park Forum	16,1
Philipsdorp	61,9
Prinsejagt	65,2
Puttense Dreef	65,2
Rapelenburg	58,1
Rapenland	49,0
Riel	30,3
Rochusbuurt	63,9
Roosten	61,3
Schoot	67,7
Schouwbroek	73,5
Schrijversbuurt	67,1
Schuttersbosch	49,0
Sintenbuurt	72,9
Sportpark Aalsterweg	30,3
Strijp S	49,0
't Hofke	47,7

Neighborhood	Potential neighborhoods children %
't Hool	68,4
Tempel	64,5
Tivoli	60,6
Tongelresche Akkers	63,9
Tuindorp	57,4
TU-terrein	23,2
Urkhoven	32,9
Vaartbroek	58,1
Villapark	58,7
Vlokhoven	61,9
Vredeoord	9,7
Waterrijk	72,3
Wielewaal	18,1
Winkelcentrum	51,6
Witte Dame	63,2
Woenselse Heide	74,2
Woenselse Watermolen	66,5
Woensel-West	65,2
Zandrijk	74,8
Zwaanstraat	66,5

Appendix F – Scores in percentage

Neighborhood	Percentage densification potential	Percentage potential neighborhood children	Percentage potential neighborhood
Achtse Barrier-Gunterslaer	35,6	59,4	47,5
Achtse Barrier-Hoeven	41,1	69,7	55,4
Achtse Barrier-Spaaihoef	32,2	60,6	46,4
Barrier	57,8	74,8	66,3
BeAtwee	46,7	7,7	27,2
Bennekel-Oost	43,3	61,9	52,6
Bennekel-West, Gagelbosch	46,7	59,4	53,0
Bergen	48,9	68,4	58,6
Binnenstad	43,3	53,5	48,4
Blaarthem	45,6	60,6	53,1
Blixembosch-Oost	40,0	65,8	52,9
Blixembosch-West	36,7	57,4	47,0
Bloemenplein	51,1	61,9	56,5
Bokt	25,6	22,6	24,1
Bosrijk	34,4	49,7	42,1
Burghplan	50,0	71,6	60,8
Castiliëlaan	38,9	12,9	25,9
Doornakkers-Oost	47,8	57,4	52,6
Doornakkers-West	47,8	60,0	53,9
Drents Dorp	60,0	71,0	65,5
Driehoeksbos	32,2	52,3	42,2
Eckart	46,7	65,8	56,2
Eikenburg	35,6	54,2	44,9
Eindhoven Airport	61,1	9,7	35,4
Eliasterrein, Vonderkwartier	54,4	65,8	60,1
Elzent-Noord	52,2	56,1	54,2
Elzent-Zuid	54,4	53,5	54,0
Engelsbergen	37,8	57,4	47,6
Esp	57,8	6,5	32,1
Fellenoord	27,8	40,0	33,9
Flight Forum	50,0	9,7	29,8
Genderbeemd	32,2	55,5	43,9
Genderdal	44,4	60,0	52,2
Generalenbuurt	51,1	64,5	57,8
Gennep	45,6	10,3	27,9
Gennepzijdje	52,2	60,6	56,4
Gerardusplein	47,8	71,0	59,4
Gijzenrooi	43,3	43,9	43,6
Gildebuurt	51,1	63,2	57,2
Grasrijk	47,8	58,1	52,9
Hagenkamp	41,1	63,2	52,2
Hanevoet	37,8	62,6	50,2
Heesterakker	33,3	61,9	47,6
Hemelrijken	55,6	69,0	62,3
Herdgang	53,3	12,9	33,1
Het Ven	45,6	54,2	49,9

Hondsheuvels	35,6	36,8	36,2
Hurk	41,1	18,1	29,6
Irisbuurt	46,7	65,8	56,2
Jagershoef	53,3	67,1	60,2
Joriskwartier	50,0	72,3	61,1
Kapelbeemd	10,0	32,3	21,1
Karpen	45,6	34,8	40,2
Kerkdorp Acht	38,9	52,3	45,6
Kerstroosplein	46,7	78,7	62,7
Koudenhoven	35,6	34,2	34,9
Kronehoef	52,2	64,5	58,4
Kruidenbuurt	50,0	80,6	65,3
Lakerlopen	46,7	58,1	52,4
Lievendaal	51,1	52,3	51,7
Limbeek-Noord	58,9	62,6	60,7
Limbeek-Zuid	60,0	67,7	63,9
Looiakkers	43,3	45,2	44,2
Luytelaer	34,4	47,1	40,8
Meerbos	47,8	12,3	30,0
Meerrijk	33,3	51,6	42,5
Mensfort	54,4	67,1	60,8
Mispelhoef	33,3	7,7	20,5
Muschberg, Geestenberg	46,7	63,9	55,3
Nieuwe Erven	48,9	67,7	58,3
Ooievaarsnest	34,4	49,0	41,7
Oude Gracht-Oost	32,2	52,9	42,6
Oude Gracht-West	47,8	58,7	53,2
Oude Spoorbaan	54,4	71,0	62,7
Oude Toren	55,6	59,4	57,5
Park Forum	38,9	16,1	27,5
Philipsdorp	52,2	61,9	57,1
Prinsejagt	53,3	65,2	59,2
Puttense Dreef	51,1	65,2	58,1
Rapenburg	51,1	58,1	54,6
Rapenland	47,8	49,0	48,4
Riel	36,7	30,3	33,5
Rochusbuurt	53,3	63,9	58,6
Roosten	42,2	61,3	51,8
Schoot	56,7	67,7	62,2
Schouwbroek	53,3	73,5	63,4
Schrijversbuurt	48,9	67,1	58,0
Schuttersbosch	46,7	49,0	47,8
Sintenbuurt	47,8	72,9	60,3
Sportpark Aalsterweg	38,9	30,3	34,6
Strijp S	41,1	49,0	45,1
't Hofke	46,7	47,7	47,2
't Hool	50,0	68,4	59,2
Tempel	36,7	64,5	50,6
Tivoli	50,0	60,6	55,3
Tongelresche Akkers	50,0	63,9	56,9
Tuindorp	51,1	57,4	54,3

TU-terrein	24,4	23,2	23,8
Urkhoven	34,4	32,9	33,7
Vaartbroek	40,0	58,1	49,0
Villapark	48,9	58,7	53,8
Vlokhoven	45,6	61,9	53,7
Vredeoord	40,0	9,7	24,8
Waterrijk	44,4	72,3	58,4
Wielewaal	46,7	18,1	32,4
Winkelcentrum	34,4	51,6	43,0
Witte Dame	53,3	63,2	58,3
Woenselse Heide	44,4	74,2	59,3
Woenselse Watermolen	60,0	66,5	63,2
Woensel-West	63,3	65,2	64,2
Zandrijk	42,2	74,8	58,5
Zwaanstraat	37,8	66,5	52,1











Appendix G – Scores in percentage by selected typology

Neighborhood	Percentage densification potential	Percentage potential neighborhood children	Percentage potential neighborhood
Barrier	57,8	74,8	66,3
Blaarthem	45,6	60,6	53,1
Bloemenplein	51,1	61,9	56,5
Burghplan	50,0	71,6	60,8
Doornakkers-Oost	47,8	57,4	52,6
Drents Dorp	60,0	71,0	65,5
Eckart	46,7	65,8	56,2
Eliasterrein, Vonderkwartier	54,4	65,8	60,1
Gerardusplein	47,8	71,0	59,4
Grasrijk	47,8	58,1	52,9
Hanevoet	37,8	62,6	50,2
Hemelrijken	55,6	69,0	62,3
Jagershoef	53,3	67,1	60,2
Joriskwartier	50,0	72,3	61,1
Kerstroosplein	46,7	78,7	62,7
Kruidenbuurt	50,0	80,6	65,3
Limbeek-Zuid	60,0	67,7	63,9
Mensfort	54,4	67,1	60,8
Rochusbuurt	53,3	63,9	58,6
Schrijversbuurt	48,9	67,1	58,0
Sintenbuurt	47,8	72,9	60,3
't Hool	50,0	68,4	59,2
Tivoli	50,0	60,6	55,3
Tongelresche Akkers	50,0	63,9	56,9
Vaartbroek	40,0	58,1	49,0
Vlokhoven	45,6	61,9	53,7
Waterrijk	44,4	72,3	58,4
Woenselse Heide	44,4	74,2	59,3
Woenselse Watermolen	60,0	66,5	63,2
Woensel-West	63,3	65,2	64,2
Zandrijk	42,2	74,8	58,5






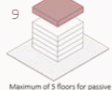
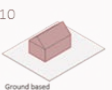




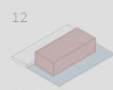












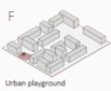





Appendix H – Neighborhood design application

Drents Dorp










Application of design

-  Added child-friendly route
-  Added facilities for children (and caretakers)
-  Added play areas
-  Added (or adjusted to safe) greenery
-  Added paths
-  Added streetlights and greenery along paths and streets
-  Added Speedbumps
-  Added buildings
-  Transformed buildings
-  Fabric regeneration



Block scale				Principles for a child-friendly neighborhood				Block scale				Principles for densification			
1  Rooftop	2  Courtyards	3  Indoor amenity	4  Green (type)	8  High rise	9  Maximum of 5 floors for passive (and active) surveillance	10  Ground based	11  Dark-towered	5  Outdoor covered play	6  Playfull corridors and hallways	7  Underground parking/podium parking	12  Water dwellings	13  Transforming vacant properties	14  Infill	15  Destruction and replacement	
Neighborhood scale				Neighborhood scale				Neighborhood scale							
A  Playstreet	B  Car free neighborhood	C  Child-friendly route	D  Childcare facility	L  Existing area	M  1. Transforming of existing areas	N  2. Addition of new buildings	O  3. Fabric regeneration	E  Communal toy box	F  Urban playground	G  Social place for parents	H  Elementary school with green play areas	I  Communal spaces/vegetable gardens	J  Nature play	K  Intergenerational play	








Application of design

-  Added bike route
-  Added facilities for children (and caretakers)
-  Added play areas
-  Added (or adjusted to safe) greenery
-  Added paths
-  Added streetlights and greenery along paths and streets
-  Added Speedbumps
-  Added buildings
-  Transformed buildings
-  Fabric regeneration

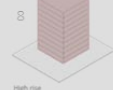

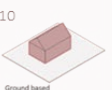

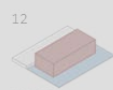





Block scale



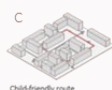


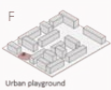





Principles for a child-friendly neighborhood

1  Rooftop	2  Courtyards	3  Indoor amenity	4  Green (type)
5  Outdoor covered play	6  Playfull corridors and hallways	7  Underground parking/ podium parking	





Principles for densification

8  High rise	9  Maximum of 5 floors for passive (and active) surveillance	10  Ground based	11  Don't fill-in
12  Water dwellings	13  Transforming vacant properties	14  Infill	15  Destruction and replacement

Neighborhood scale

A  Playstreet	B  Car-free neighborhood	C  Child-friendly route	D  Childcare facility
E  Communal toy box	F  Urban playground	G  Social place for parents	H  Elementary school with green play areas
I  Communal space/ vegetable gardens	J  Nature play	K  Intergenerational play	

Neighborhood scale

L  Existing area	M  1. Transforming of existing areas	N  2. Addition of new buildings	O  3. Fabric regeneration
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Application of design

-  Added bike route
-  Added facilities for children (and caretakers)
-  Added play areas
-  Added (or adjusted to safe) greenery
-  Added paths
-  Added streetlights and greenery along paths and streets
-  Added Speedbumps
-  Added buildings
-  Transformed buildings
-  Fabric regeneration




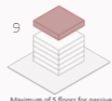
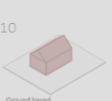

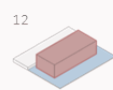


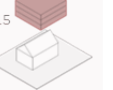
Block scale

Principles for a child-friendly neighborhood



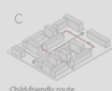


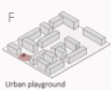





1  Rooftop	2  Courtyards	3  Indoor amenity	4  Green (type)
5  Outdoor covered play	6  Playfull corridors and hallways	7  Underground parking/ podium parking	

Block scale

Principles for densification

8  High rise	9  Maximum of 5 floors for passive and active surveillance	10  Ground based	11  Don't fix itself
12  Water dwellings	13  Transforming vacant properties	14  Infill	15  Destruction and replacement

Neighborhood scale

A  Playstreet	B  Car free neighborhood	C  Child-friendly route	D  Childcare facility
E  Communal toy box	F  Urban playground	G  Social place for parents	H  Elementary school with green play areas
I  Communal space/ vegetable gardens	J  Nature play	K  Intergenerational play	

Neighborhood scale

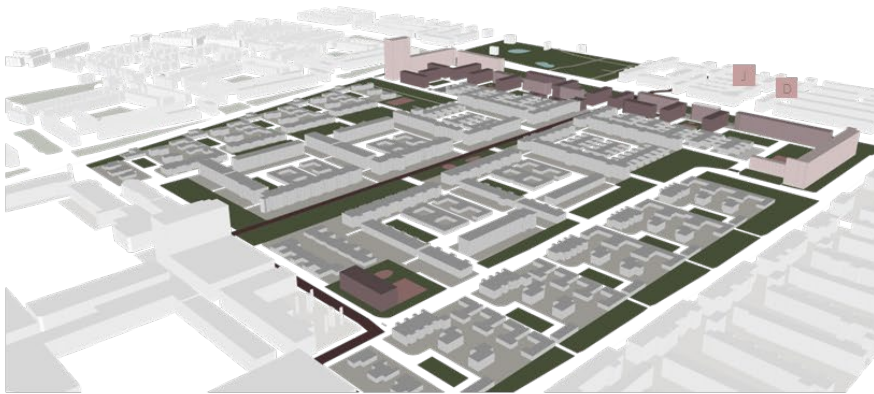
L  Existing area	M  1. Transforming of existing areas	N  2. Addition of new buildings	O  3. Fabric regeneration
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Appendix I – 3D impressions neighborhood scale

Drents Dorp



't Hool

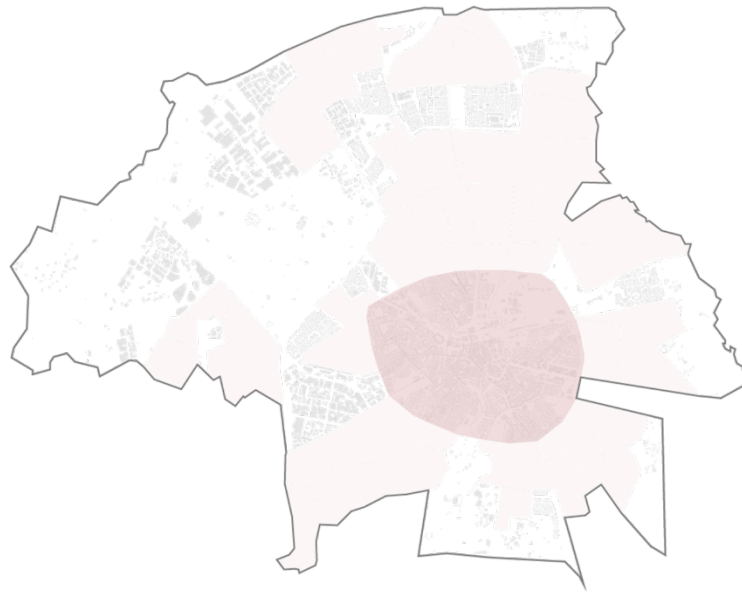
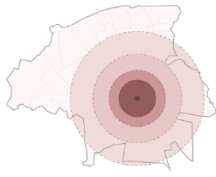


Zandrijk

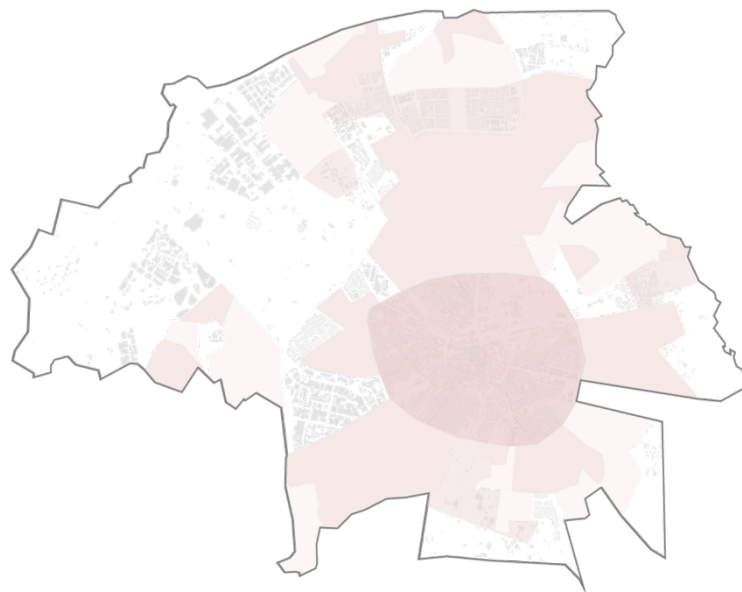
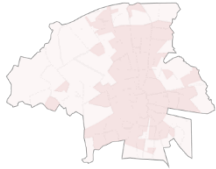


Appendix J – City strategy in detail

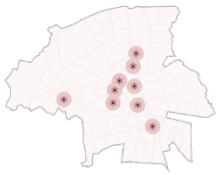
BUILD & DEVELOP CENTRALLY



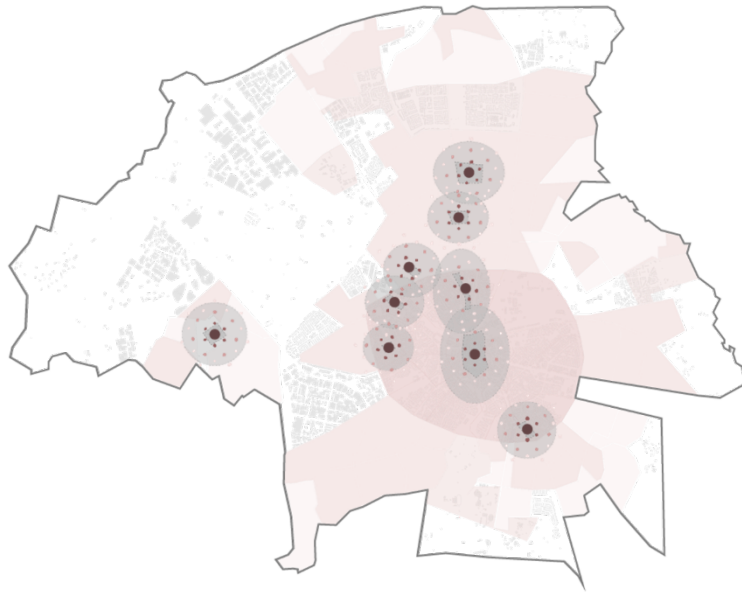
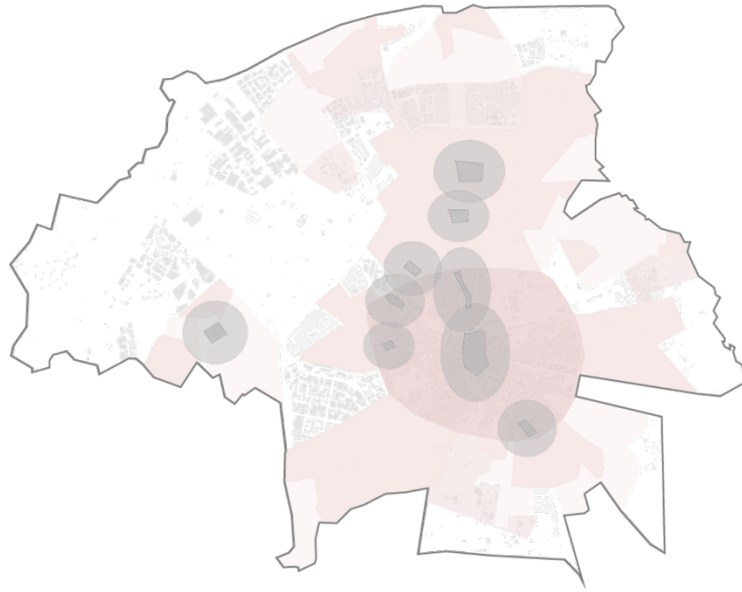
TRANSFORMING BUILDINGS PRIOR TO GREENFIELD DEVELOPMENT

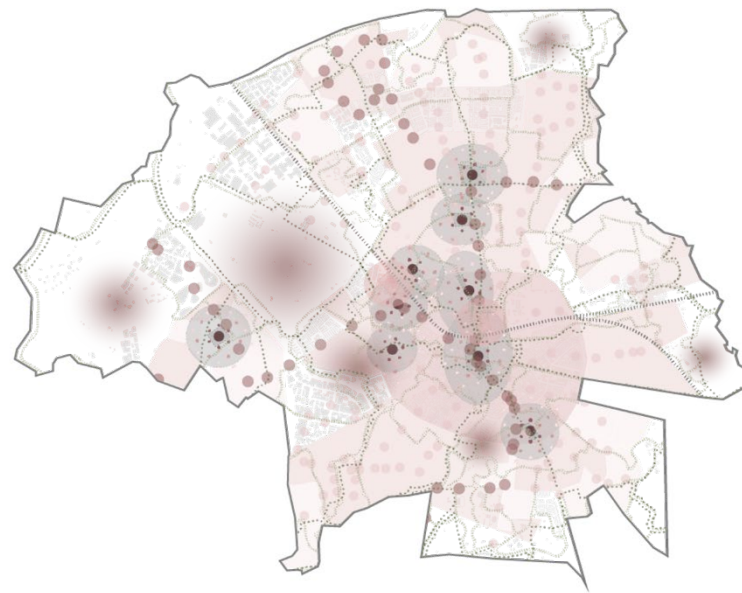
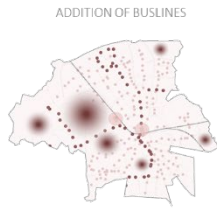


TRANSIT ORIENTED DEVELOPMENT



ADDITION OF (MORE) MIXED FUNCTIONS FOR CHILDREN

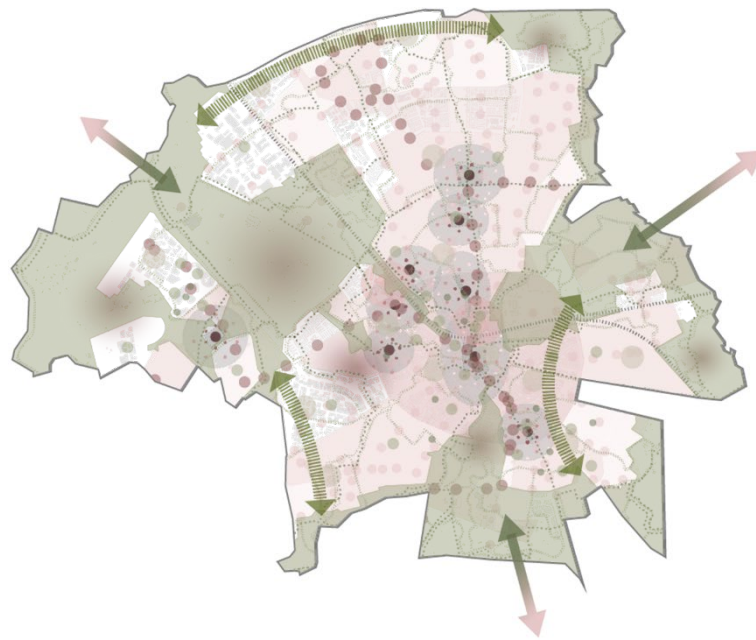
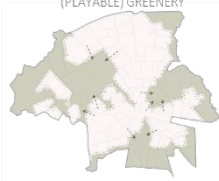




ADD PATCHES OF GREENERY



IMPROVE ACCESSIBILITY TO (PLAYABLE) GREENERY



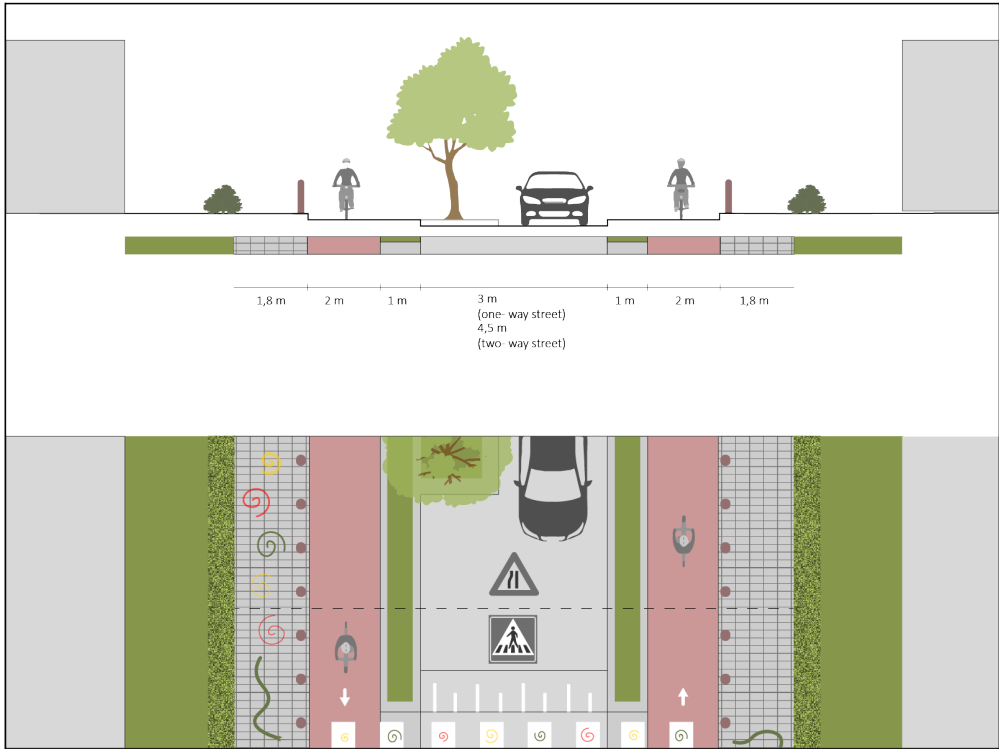
LEGEND

1:20000

- Bus stop
- HOV (no bus stop)
- Addition of (possible) bus stop
- Train station
- Strategic roads with mixed functions (SDF)
- Shared functions related to children
- Improvement of walking routes
- Improvement of walking routes
- Train track
- Subsidy
- Transformation of existing area (high density)
- Transformation of existing area (low density)
- Urban green structure
- Connection of (playable) greenery towards city
- Connection of (playable) greenery within city

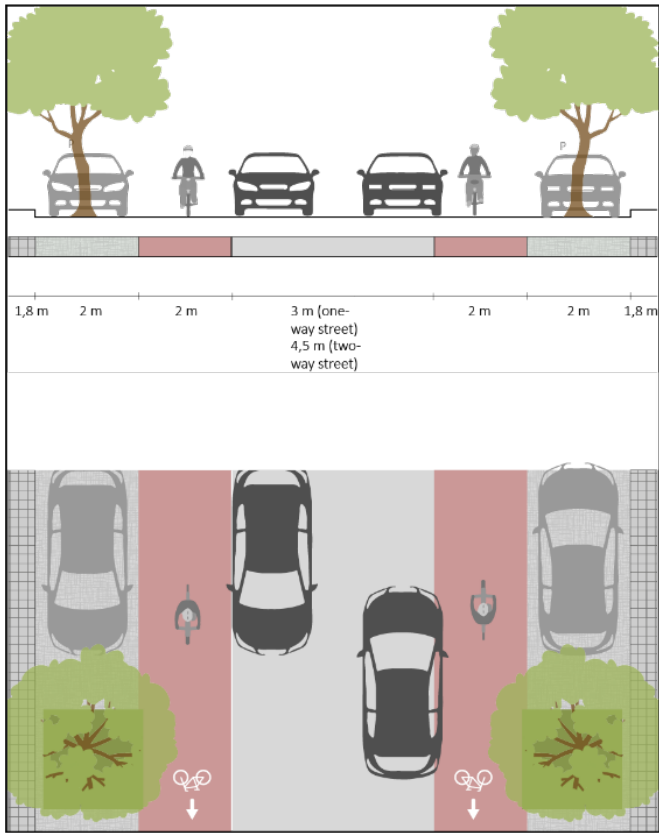
Appendix K - Interventions on block scale

Due to time constraints, visualizations at block scale were not performed. Some cross-sections to work out street profiles are shown in the figures below. Below the figure are the values regarding safety, experience (of children) and compactness. Figure 1 concerns the best street profile based on child friendliness. Figure 2 represents the current situation. Figures 3 through 7 are street profiles that could be implemented in different situations.



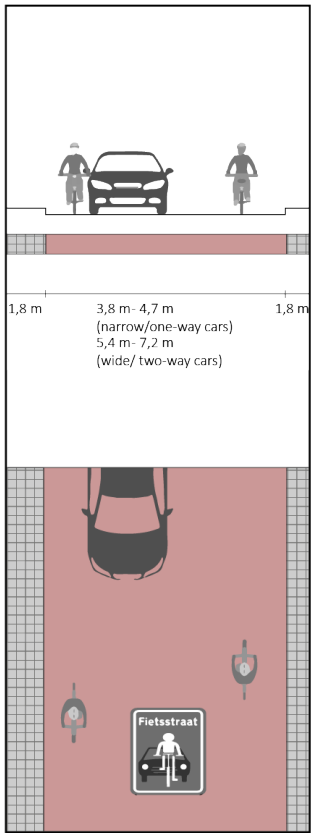
Safety ★★★★★
 Experience ★★★★★
 Compactness ★★★

1



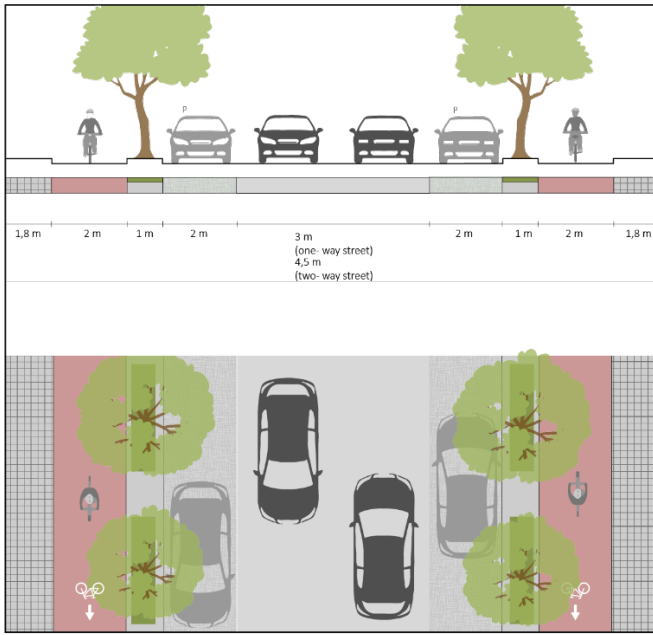
Safety ★
 Experience ★
 Compactness ★★

2



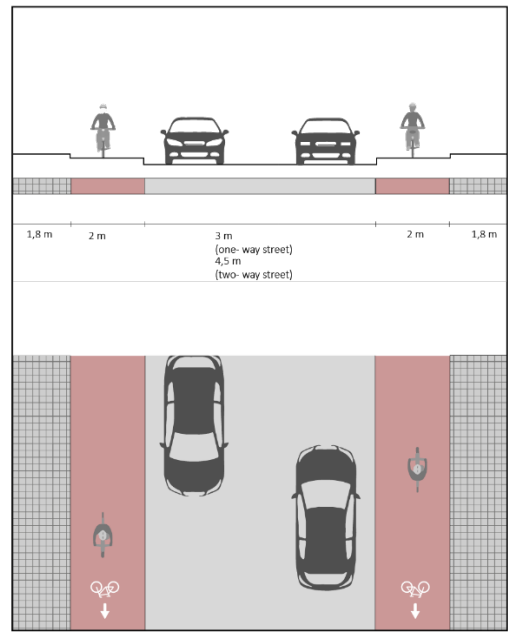
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 Experience ★★★
 Compactness ★★★★★

3



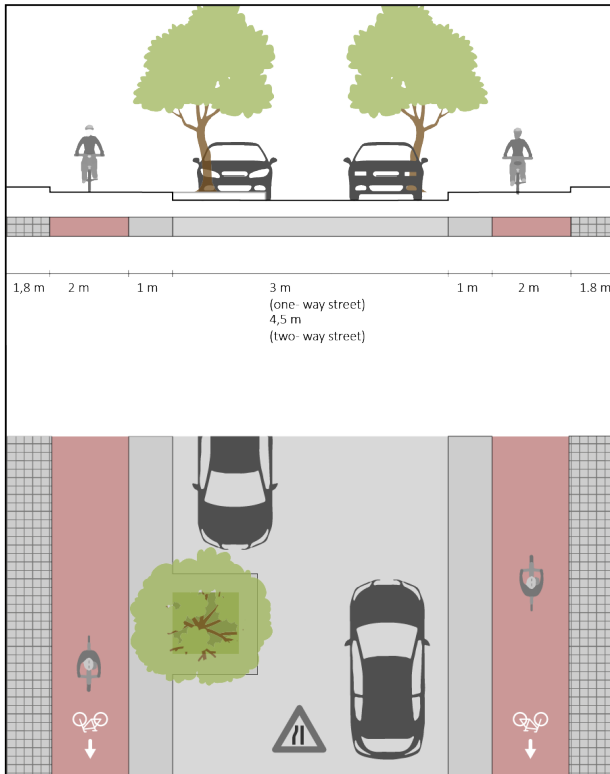
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 Experience ★★★★★
 Compactness ★

4



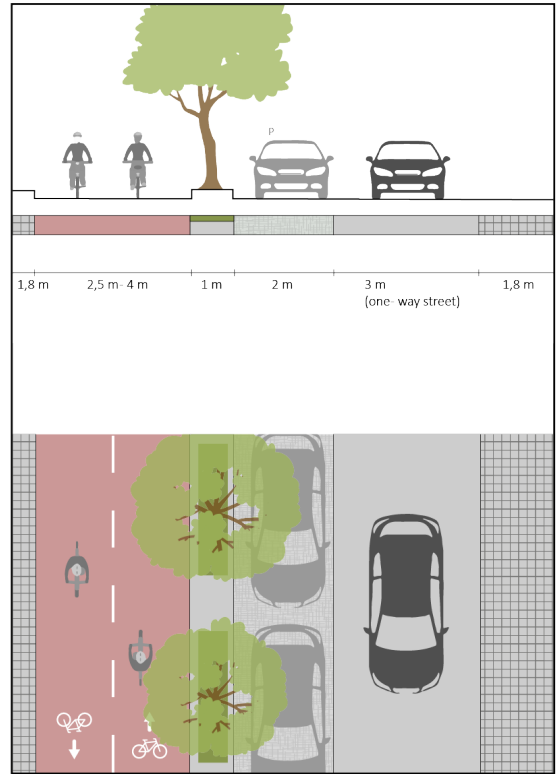
Safety ★★★★★
 Experience ★★★★★
 Compactness ★★★★★

5



Safety ★★★★★
 Experience ★★★★★
 Compactness ★★

6



Safety ★★★★★
 Experience ★★★★★
 Compactness ★★

7