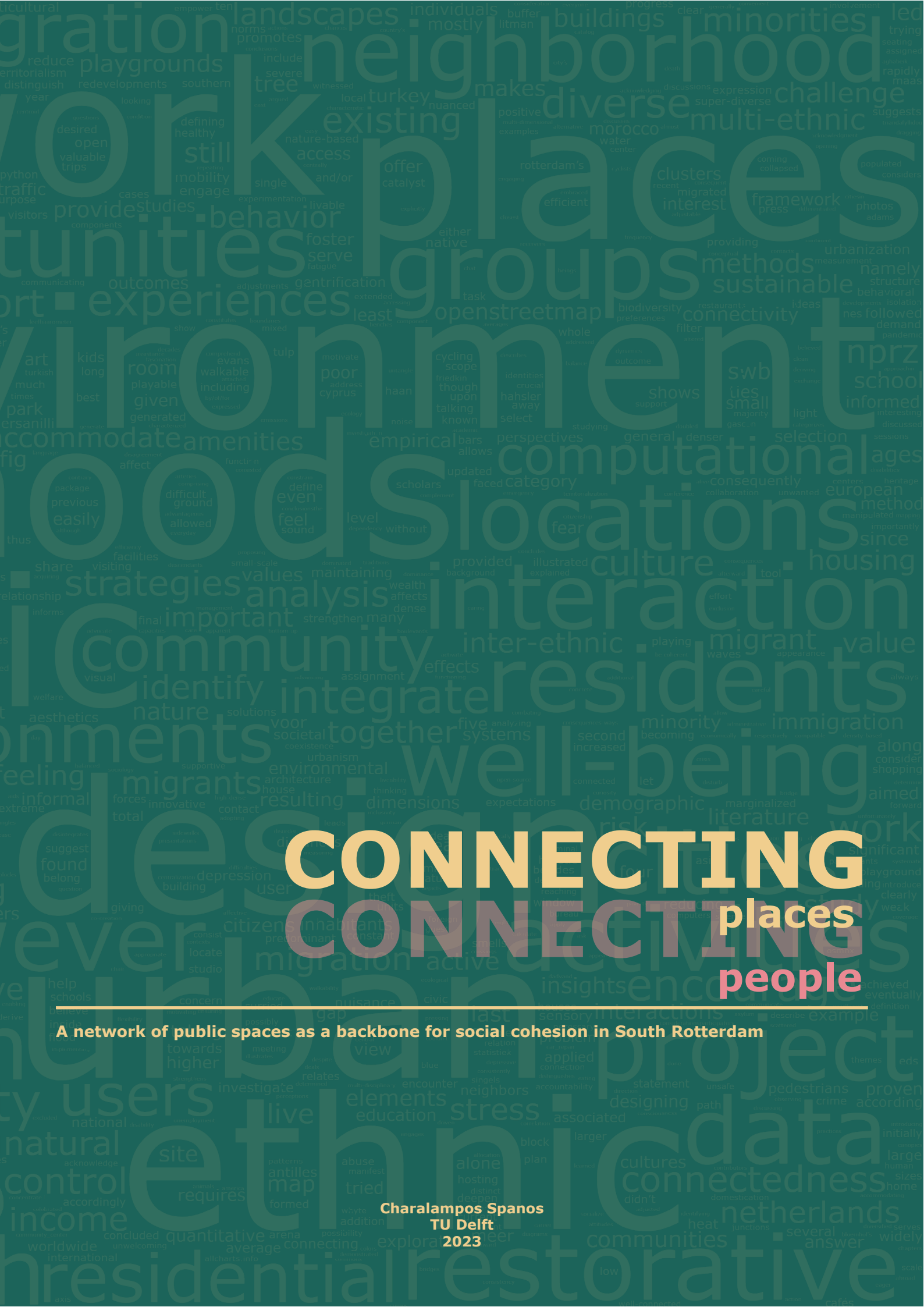



**A network of public spaces as a backbone for social cohesion in South Rotterdam**

**Charalampos Spanos**
**TU Delft**
**2023**

# CONNECTING PLACES - CONNECTING PEOPLE

A network of public spaces as a backbone for social cohesion in South Rotterdam

Master Thesis


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## Abstract

The continuous immigration around the world increases ethnic diversity in major cities. At the same time, the growing population, urbanization, and crowding in cities negatively impact well-being, bringing to the forefront the need for integrating restorative environments. In the context of multi-ethnic cities, there is a pressing need for integration to foster social cohesion and well-being. This thesis challenges these issues, with a case study of South Rotterdam, an ethnically segregated multi-ethnic area, with the reported need for improved quality of public space, safer urban environments, and opportunities for developing trust among residents. This thesis illustrates a methodology for designing public spaces that promote ethnic diversity by stimulating inter-ethnic social interaction in restorative environments.

I approach this assignment by proposing a network of public spaces that encourages participation in public life to stimulate social interaction, improving the social cohesion and well-being of residents in the area. To develop the network, I introduced a multi-method approach in both research and design, by integrating computational tools for urban design. Bringing together three disciplines, urban design, landscape architecture, and urban analytics, I propounded specific design strategies for the formation of the network and the transformation of public space, toward inclusive restorative landscapes that promote diversity.

The outcomes of this project determined that implementing multi-methods approaches in urban design requires careful consideration and acknowledgment of the extent to which each method can be applied. However, there is great potential in advancing knowledge through different perspectives and creating innovative methodologies to approach such projects.

Finally, public space design has a promising opportunity to accommodate places that bring people together and increase feelings of belonging and trust, while embracing diversity. By reimagining the value of the street, I illustrate a strengthened public space that accommodates diverse activities in South Rotterdam, enhancing shared spaces and identity expression in public spaces.



### Keywords

*public space, ethnic diversity, social cohesion, restorative landscapes, well-being*

# Preface

## Motivation

I come from Cyprus, an occupied island in the East Mediterranean Sea, which population consists of mainly Greek Cypriots and Turkish Cypriots, as well as other ethnic minorities, such as Armenian and Maronite. However, since the 1974's invasion from Turkey, the northern part of the island is populated only by Turkish-Cyprios and Turkish migrants, while the South has mainly Greek Cypriots. Growing up, I always imagined how it would be like if Cyprus was unified and all ethnicities would coexist, share experiences, and possibly face conflicts.

Later, by studying architecture and recently urbanism, I realized that public space is a shared room, a place where we can all meet and realize that our commons are much more than the differences that separate us. And with that thinking, I was eager to challenge myself and research the role of urban design in this context, and the way I could contribute to a future where diversity is embraced.

The case of South Rotterdam provided a living lab for a project that explores diversity in public space. Also, the availability of data and the experience of my mentors led me to select a place in The Netherlands where the population, although mixed, is still segregated, trying to untangle the potential of public space and the opportunities provided by the urban landscape to promote ethnic diversity.

## Acknowledgment

The graduation year has been a challenging journey through which I had the opportunity to discover myself as an urban designer and researcher. In this process, I had the pleasure of collaborating with three excellent mentors, Maurice, Denise, and Vasileios. I thank you all for the guidance you provided, the inspiring sessions, and the support throughout the year. I am glad for the chance to learn from you, and I am looking forward to applying all the skills and knowledge I developed.

Lastly, I want to thank my family for their continuous support and their trust in me. Though being in the distance for a long time, you always showed that you are here for me, and I appreciate it. I want to thank, also, my friends and fellow students with whom I shared my worries and anxiety, but also the moments that kept us going, creating memories that will last.

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# MULTI-ETHNIC CITIES

In the first chapter, a problem is presented, that relates to various cities around the world. Continuous migration results in multi-ethnic cities that are eventually facing the need for more integrated communities in the social spectrum. Rotterdam, as a case study, serves as the means of examining the potential of public space in becoming a catalyst for forming connectedness between different communities.


**IMMIGRATION AND SOCIAL INTEGRATION**

Integration Policies in Europe

Immigration in The Netherlands

Multi-ethnic Rotterdam

Rotterdam South

**CITIES AND WELL-BEING**

Cultures and well-being

Well-being in South Rotterdam

**PROBLEM STATEMENT**

**RESEARCH AIM**

**RESEARCH QUESTIONS**


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## Immigration and Social Integration

Global migration is estimated at 280.6 million, in mid-2020, according to the Migration Policy Institute (MPI, 2020). In the last decades, migration increased in all the UN regions, with higher rates in Europe and Asia, where the migrant population almost doubled, as shown in Figure 1. Currently, North America hosts 58,7 million migrants (Fig.2), while in Europe, the largest population of migrants is resigned in Germany with 15,8 million (McAuliffe & Triandafyllidou, 2021).

In the last century, the global population witnessed the most substantial waves of migration. The most common reasons were poverty and work-related migration. In Europe, the population was received from outside the continent, in their search of better living conditions or to seek asylum. Additionally, over 30 million "guest workers" mainly from southern European countries migrated to northern economies to meet the increasing labor demand (Kaulfuss, 2000).

Immigration has resulted in various effects on public perception, including consequences in the labor market, changes in demographic development, and social and cultural alterations. Additionally, migration processes led to tension between the hosting and migrant population, especially after World War II with refugees establishing in other countries (Kaulfuss, 2000).

### Integration Policies in Europe

During this process, countries proceeded on integrating policies, to facilitate social changes. To promote integration, European countries focused on protecting the residence of migrants in the welcoming country by creating policies for citizenship and adjusting policies for individual equality regarding the ethnic and cultural characteristics of migrants. Applying policies for individual equality allows migrants to manifest their traditions and be respected for them. On the contrary cases, the migrant population tends to self-isolate in their group and integration becomes difficult (Ersanilli, 2012).

Different models were applied in different countries. France's example of the *republican model* focused on the idea of "common culture and "common language" (Kaulfuss, 2000). Their approach was restrictive towards the Islam population, by barring headscarves from all levels of society, from school to professional. In addition, the naturalization procedure included testing not only on language proficiency but also on the culture and the values of French society (Ersanilli, 2012). The core of the integration policies in France was the state education system through which immigrants adopted values and patriotic attitudes while assimilating into society (Kaulfuss, 2000).

The German *ethnic-cultural model* aimed through policies not only to integrate migrants but also to prevent further immigration waves. The policies followed, succeeded in integrating migrants into school and work environments while relations between the native population and newcomers were weak (Kaulfuss, 2000). To gain citizenship in Germany, a migrant had to pass a test on German culture, and the policies applied, appear to promote less individual equality than in France and The Netherlands (Ersanilli, 2012).

In The Netherlands a *multi-ethnic model* was introduced, supporting the recently-established cultures through dedicated religious and political institutions (Kaulfuss, 2000). This model maintained the cultural integrity of migrants and their equality, protecting against religious discrimination. Compared to the other two countries, Dutch policies were the most accommodating. However, due to the progressive culture of the Dutch community, migrants' culture was challenged. The "value gap" between the native population and immigrants hampered integration (Ersanilli, 2012).

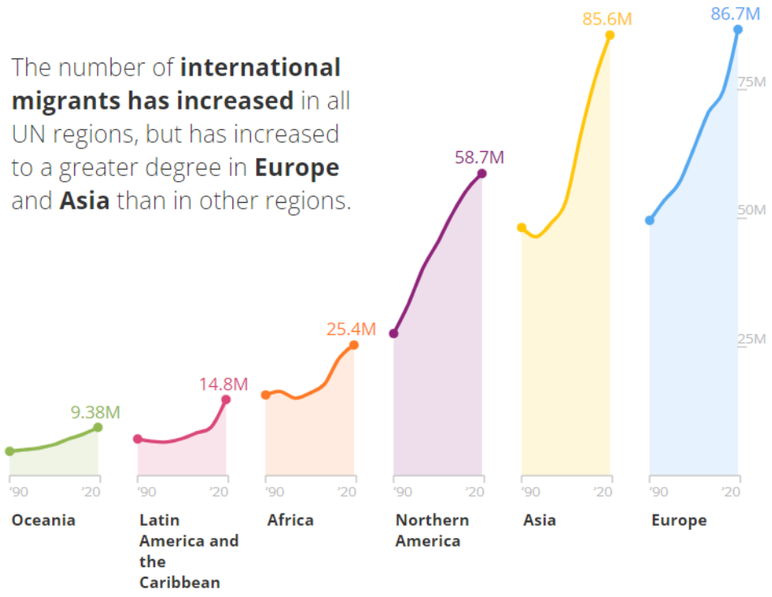



**Figure 1:** Increase of migrant population (McAuliffe & Triandafyllidou, 2021)

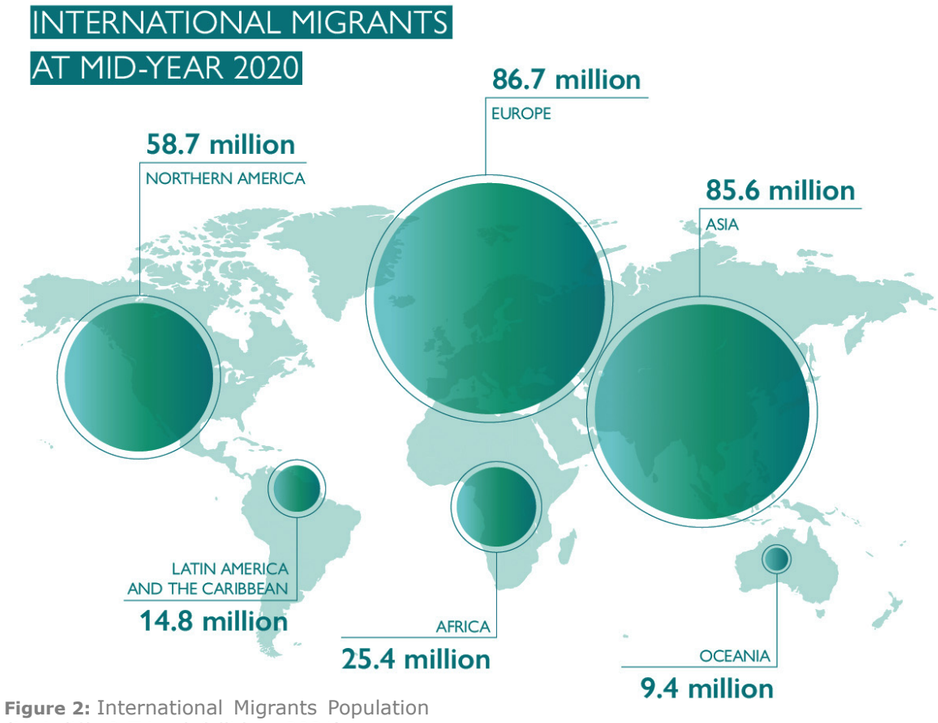



**Figure 2:** International Migrants Population (McAuliffe & Triandafyllidou, 2021)

## Immigration in The Netherlands

Immigration in The Netherlands after World War II was largely driven by the country's need for labor to help with the post-war reconstruction efforts. At the end of the 1950s and early 1960s, first private companies and later the Dutch government recruited guest workers from Southern Europe, who mostly return to their countries later. In the years following the war, the country experienced a severe shortage of workers, also due to the rise of industrial activity in the country. This prompted the government to encourage immigration from countries such as Turkey, Morocco, Suriname, and Dutch Antilles (UCL, n.d.; Zorlu & Hartog, 2021).

With the oil crisis of 1973, immigration for work purposes in the Netherlands stopped. However, the new low for family unification enabled the wives and children of established immigrants to move to The Netherlands, increasing the amount of foreign population in the country (UCL, n.d.).

In this process, The Netherlands implemented a "multicultural" model for integration, which, via the societal "pillars", established religious and political groups organized in their own institutions. After the Second World War, nationality legislation was enriched and integration programs were launched (Kaulfuss, 2000). Until the latest decades, the differences between native Dutch and non-Western migrants were observed in various sectors. Migrants' children had difficulties in school since they had to attend the Dutch education program, creating a knowledge gap between natives and migrants. Also, unemployment and poverty rates were higher in the migrant population compared to native Dutch, which related to income inequality as well. These problems resulted in a higher possibility for non-Western migrants to be involved in criminal activities (UCL, n.d.).

The recent demographics of the Netherlands, illustrate a foreign population in the country reaching more than a quarter of the total inhabitants (Fig: 3), with the largest amounts coming from European countries. Other migrants have backgrounds originating from Indonesia, Morocco, Suriname, Turkey, Dutch Antilles, and others as presented in Figure 4 (CBS, 2022).

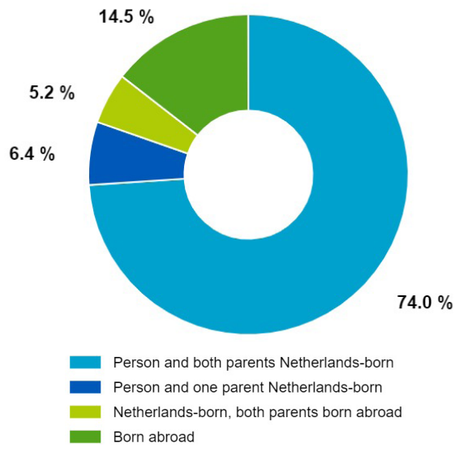



**Figure 3:** Demographics of population origin in the Netherlands (CBS,2021)

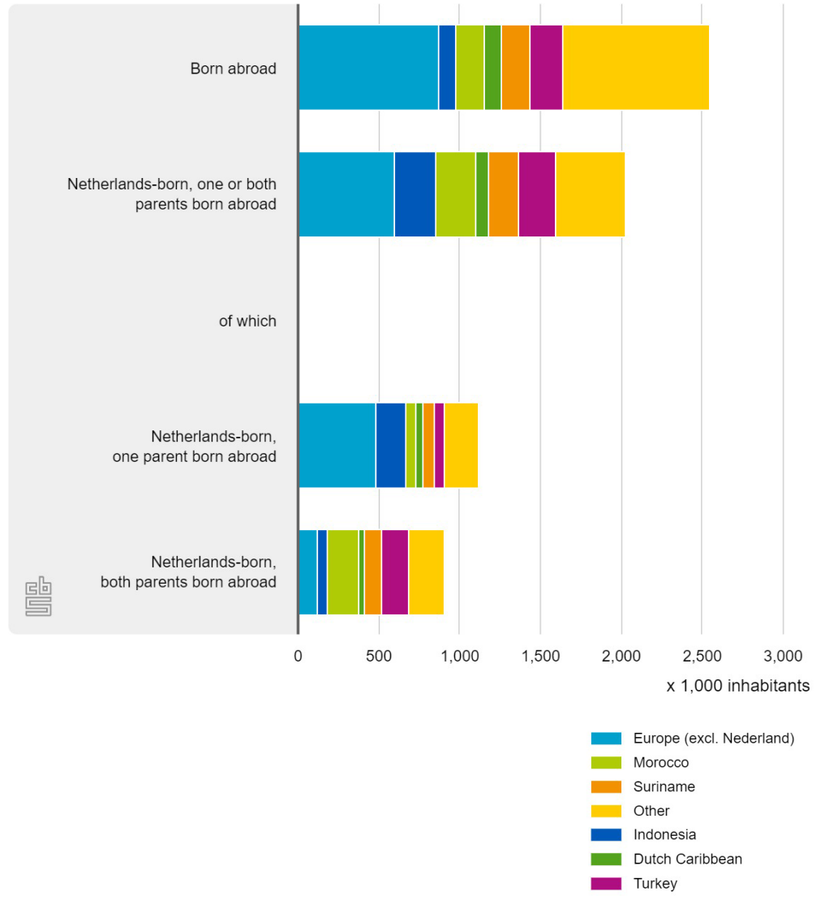



**Figure 4:** Demographics of non-Dutch population in the Netherlands (CBS,2021)

## Multi-ethnic Rotterdam

Rotterdam had been steadily developing until World War II when the continuous bombardment of the city took place. This resulted in the necessity to reconstruct the city and later the effort to expand the harbors. However, the labor shortage demanded the recruitment of guest workers, who were eventually established in South Rotterdam, creating the need of developing emergency residential neighborhoods. Harbor workers migrated mainly from Italy, Spain, Turkey, and Morocco (Tulp, 2021). As migrants were established in Rotterdam, they started forming ethnic minorities in the city.

The rapid expansion of the city created a clear division between the north and the south part of the river Maas. North Rotterdam is the city center, an area with growing business activity and flourishing cultural expression. The city center is also denser in terms of population and consists of more high-rise buildings. On the other side of the river Maas, the area is mainly residential. The direct connection to the port and the establishment of industrial workers in South Rotterdam resulted in a segregated and deprived neighborhood (Brouwer, 2022). The lack of contact between native Dutch and ethnic minorities creates a negative effect in multi-ethnic neighborhoods (Aghabeik & van Nes, 2015), becoming an obstacle for immigrants to integrate into the hosting country and strengthening the effect of ethnic segregation.

Currently, the majority of the population in Rotterdam is immigrants from inside and outside Europe. While a large amount is Western people, in total 49% are non-western, originating from Turkey, Suriname, Dutch Antilles, and Morocco (Fig. 5). The 13% portion of the population, described as "other non-western" by CBS, consists of people from Africa, Asia, America, and Oceania.

The multicultural character of Rotterdam asks for integration policies but also integration projects, that bring to the forefront the need for diversity in the city. Especially with a population that is segregated and marginalized, it is essential to invest in a city that welcomes all and creates conditions that promote the co-existence of a diverse population, with different cultural characteristics, embracing each of their backgrounds and roots.

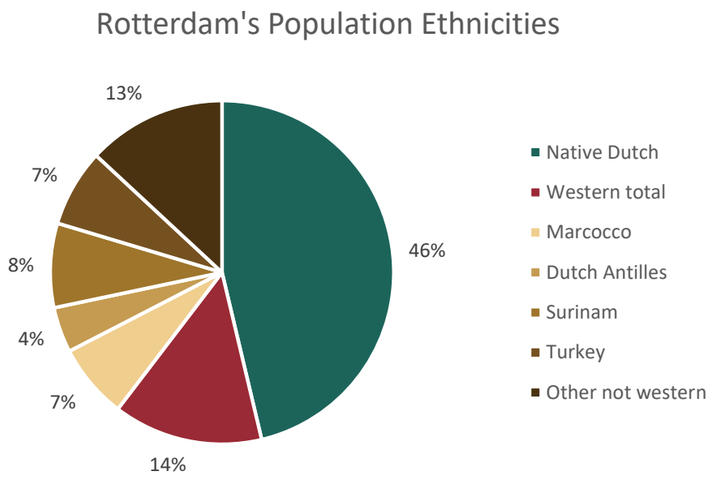



**Figure 5:** Rotterdam's population ethnicities (allcharts.info, edited by the author)

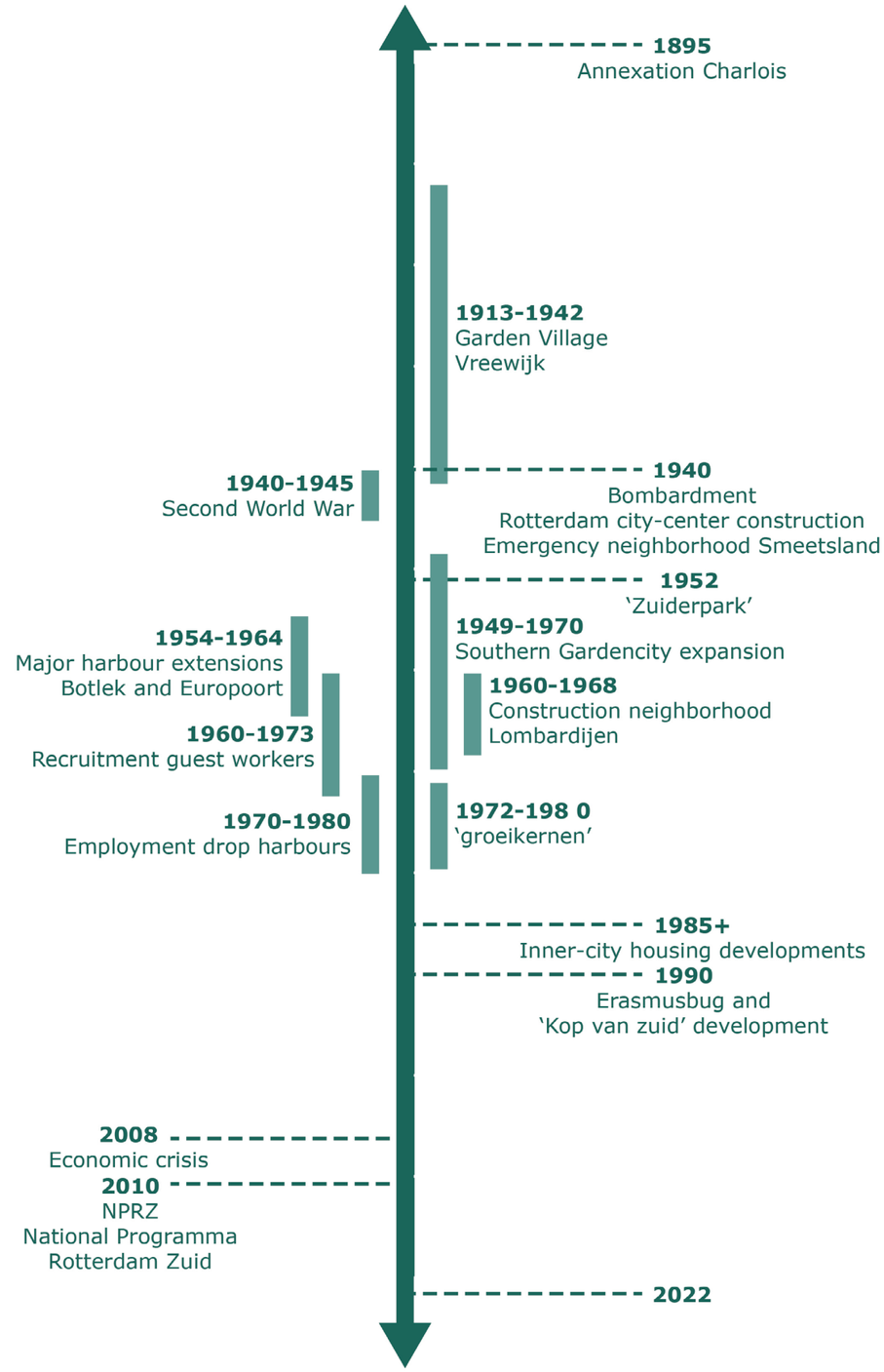



**Figure 6:** Storyline of Rotterdam, edited by the author (Tulp, 2021)

## Rotterdam South

The neighborhoods in the South are now mainly populated by non-Western populations with some of them exceeding 60% of non-Westerns (*Allcharts.Info*, n.d.). At the same time, the lack of amenities and the low maintenance of the urban environment result in deprived neighborhoods, that are not attractive to other populations, established in the area (Doff & Snel, 2022). Amongst the migrant population in the Netherlands, Muslims and non-western are considered to be less integrated into the society, living in the "periphery", marginalized, and segregated (Long, 2015).

Taking action toward more diverse neighborhoods the National Government with other partners initiated in 2010 the Nationaal Programme Rotterdam Zuid. Focusing on the pillars of school, work, living, residents, culture, and safety, this program promotes the transformation of Rotterdam South into an enriched neighborhood, that offers opportunities for a diverse population (NPRZ, 2017). This program targets urban redevelopments in the area to not only densify but also provide a better living environment. Specifically, they propose development with diverse housing, for residents of various incomes. Also, the program establishes an effort to educate more people in multiple directions and create more job opportunities, enabling the local economy (NPRZ, n.d.).

The ongoing transformation of South Rotterdam has inevitably had an impact on the current residents of the area. Specifically, the non-Western population that feels marginalized and is mainly low-income, opposes NPRZ, fearing the gentrification of their neighborhood and eventually their possible push away from their own houses. On top of that, they identify more urgent challenges for their area, like safety, quality of public space, and familiarity with neighborhoods (Doff & Snel, 2022). Those characteristics of public spaces are known to affect people's well-being as well (CBS, 2020) and need to be addressed as primary needs of the residents.

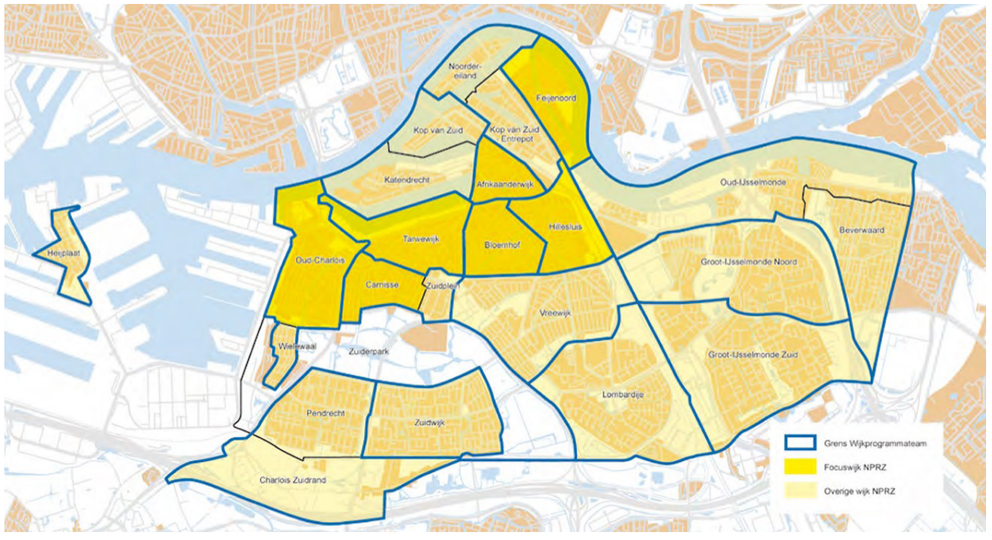
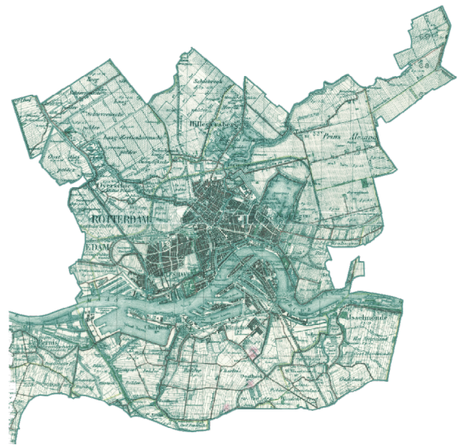



**Figure 7:** NPRZ map with the six focus neighborhoods of Rotterdam South (NPRZ,n.d.)





Rotterdam - 1925




Rotterdam - 1950




Rotterdam - 1900




Rotterdam - 1999

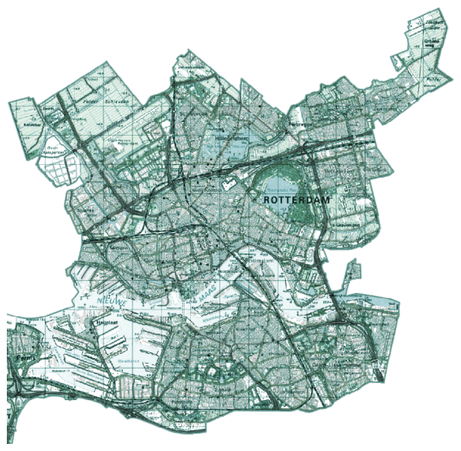



**Figure 8:** Spatial development of Rotterdam (source: https://www.topotijdreis.nl/, edited by the author)

## Cities and well-being

CBS adopted the definition of well-being as "the quality of life here and now and the extent to which it is at the expense of the quality of life of future generations and/or of people elsewhere in the world" (CBS, 2020). Using this definition, the organization depicts the need of maintaining a good quality of life without withholding the advancement of others and preserving the durability of this quality in future generations. To measure the well-being of the population now, CBS selected eight main themes that indicate well-being in its multiple dimensions. Specifically looking into subjective well-being, material well-being, health, labor and leisure time, housing, society, safety, and the environment.

In the urban context and for this thesis, specific attention is given to the indicators that are mostly related to the built environment and the potential of the city to improve its well-being through its transformation. In their book, Janny Roe and Layla McCay (2021) introduce the concept of Restorative Urbanism, which brings to the forefront of urban design mental health, wellness, and quality of life. Through this concept, they argue the importance of restorative landscapes to benefit the mitigation of daily stress, mental fatigue, anxiety, and depression (Roe & McCay, 2021). This relates to the Sustainable Development Goals (SDGs) of the United Nations, which advocate for cities that are "inclusive, safe, resilient and sustainable" (target 11.7 of goal 11) (UN, 2022).

With the continuous inhabitation of cities and the growing need for housing, urban planning worldwide faces a constant challenge in maintaining a sustainable environment (UN, 2022). Especially dealing with the consequent effects of urbanization, like $CO_2$ emissions and air pollution, increasing waste, lack of public space, and weak accessibility to public transport, well-being is challenged, and the urban environment becomes unwelcoming. The effects of urbanization are reflected in individual well-being as well. Urban stressors are widely found in high-dense cities. As Koene (2018) categorizes them, urban stressors can derive from five themes, urban environment stressors, social urban stressors, stressors from urban conditions, health stressors, and economic urban stressors (Koene, 2018).

It is evident that urbanization and the built environment severely affect the well-being of inhabitants. According to The Sustainable Development Goals Report (2022), cities have a poor distribution of parks, boulevards, and playgrounds in the urban fabric, and less than 40% of the neighborhoods, amongst 962 cities have accessible open public space within 400 meters (UN, 2022). It is, hence an urgency, for urban planners and policymakers to face this challenge with well-being as the guiding value of future urban developments. Specifically taking into account, the integration of public spaces in the city that are inclusive and in proximity, accommodating diverse populations, and contributing to the improvement of well-being.

**"Data for 2020 from 962 cities around the world point to poor distribution of such spaces. Only about 37.8 per cent of urban residential neighbourhoods are conveniently located within 400 metres walking distance to an open public space"**

The Sustainable Development Goals Report (2022), by the United Nations




**Figure 9:** Indicators of well-being, by CBS (CBS, 2020b), created by the author

## Cultures and well-being

Improving the built environment can have a positive impact on the neighborhood's perception and experience of residents in public spaces (Jacobs, 1992) and therefore increase the individual's level of satisfaction with life and personal well-being, hence improving subjective well-being.

Subjective well-being (SWB), as mentioned by Liu et al. (2017), "refers to how people experience the quality of their life and is composed of life satisfaction and affect (comprising positive and negative affect)" (Liu et al., 2017). Consequently, neighborhood experiences, social interactions, and the built environment are pivotal in improving well-being in cities. In a "super-diverse" society, where multiple religions, languages, and ethnicities coexist, the subjective experience of inhabitants, especially those with multicultural origins, is implicated. People from "mixed" cultural heritage are faced with various norms, values, and practices. This is noticed in immigrants as well and the way each individual handles this challenge has an important impact on their well-being (Yampolsky et al., 2013).

The migrant population, which usually lives in more deprived areas with lower living standards (Liu et al., 2017), tries to adapt to a new social environment, as well. Immigrants are usually faced with identity challenges, that impact first and second generations. This interaction with new norms and cultures creates conflict between the personal values of migrants and those of the predominant population. It is, therefore, a struggle for migrant individuals to adjust, adopt and integrate the new cultural characteristics with their heritage traditions (Yampolsky et al., 2013). This constant process of identifying themselves affects SWB as well. Dealing with cultural identity usually leads to three options. Aligning with only cultural heritage groups usually results in self-isolation and less social integration. On the other hand, adopting the new culture distance the migrant individual from their cultural group. The most beneficial outcome for well-being has been proven to be associated with integrating cultures. Equally validating and acknowledging all identities achieves greater coherence on the individual level, but also benefits the resolution of inter-ethnic conflicts (Yampolsky et al., 2013).

Integrating into a new society is a process of redefining yourself, creating new social relationships, and forming a new social network. After establishing, immigrants need to create new social ties, find support from friends and interact with neighbors. Improved neighborhood experience has shown to be beneficial for well-being and life satisfaction. Yet, SWB is also associated with neighborhood design. Physical surroundings and the quality of the built environment is important for the experience of residents in a city. Specifically, a significant positive impact on SWB has been linked to a "clean and uncontaminated" environment, a well-connected neighborhood, and good access to amenities and public transport (Liu et al., 2017).




**Figure 10:** Photo of multi-ethnic square at Lange Hilleweg | Bloemhof, 04 Jun 2023

## Well-being in South Rotterdam

In South Rotterdam, residents' well-being does not appear to be sufficient and this is illustrated in data but also through empirical studies carried out with participants in the area.

The liveability metrics from Leefbaarometer show mainly an insufficient quality of life in the neighborhoods of Rotterdam South. Especially for the neighborhood Carnisse and Hillesluis the poor quality of life is evident. This is also connected to the urban environment which usually affects the perception of the neighborhood among residents. Comparing the two maps, a correlation is observed between the quality of life and the level of insecurity and nuisance. Insecurity and nuisance are characteristics of the environment that usually reflect on neighborhood satisfaction, negatively impacting the experience of the inhabitants in the area and the perception and reputation of the neighborhoods.

This data is validated by residents of the area as well. A recent study, curried by Wenda Doff and Erik Snel, in collaboration with the Erasmus School of Social and Behavioral Sciences, aimed to define "How different social groups use, experience, and appreciate the city". Through interviews with inhabitants of South Rotterdam, the quality of public space had a significant role in their perception. They report the lack of maintenance and the low-quality pedestrian network (Doff & Snel, 2022).

Additionally, insecurity and nuisance are important subjects for the people. In the area, there are often complaints of fights in public spaces that involve inappropriate behavior and stabbing. Furthermore, the predominance of males in public space and their behavior towards women, makes the street an unwelcoming place and the feeling of fear is increased, negatively impacting their well-being. Finally, their last concern regarding the livability of their neighborhoods is the connectedness between the inhabitants. Many participants report very weak ties with their neighbors and a lack of social capital. This creates a poor feeling of belongingness that distance them from public social life (Doff & Snel, 2022).

### *Testimonies*

> "But I have been followed. A lot of times, in this neighborhood. There's a lot of men, they are checking you. And even if you dress like this, not exposing much but just a little bit. But I'm not afraid. I know taekwondo. how to defend myself. So I'm not afraid but I'm uncomfortable so many times"

> "But if you look at the gardens below, that's also what annoys me. The backyards that people take very bad care of. (...) That also means that this doesn't feel super like my neighborhood, because I don't enjoy looking down."

> "Often I then walk a route that allows me to avoid them and I can just avoid them. Even though we walk via a different route, we are still called after with 'I'm going to kill your dog'. I am also called names because it is quite clear to me what my sexual orientation is, I often get that thrown at my head"

**Gedeelde ruimte op Zuid:** Hoe verschillende sociale groepen de stad gebruiken, beleven en waarderen.

(Doff & Snel, 2022)

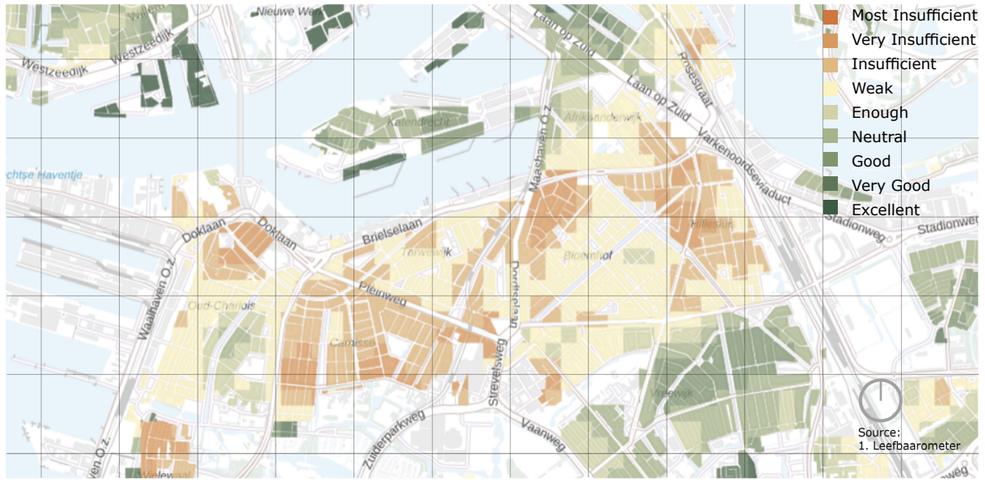



**Figure 11:** Map of livability scores in Rotterdam South (data source: Leefbaarometer, OSM)

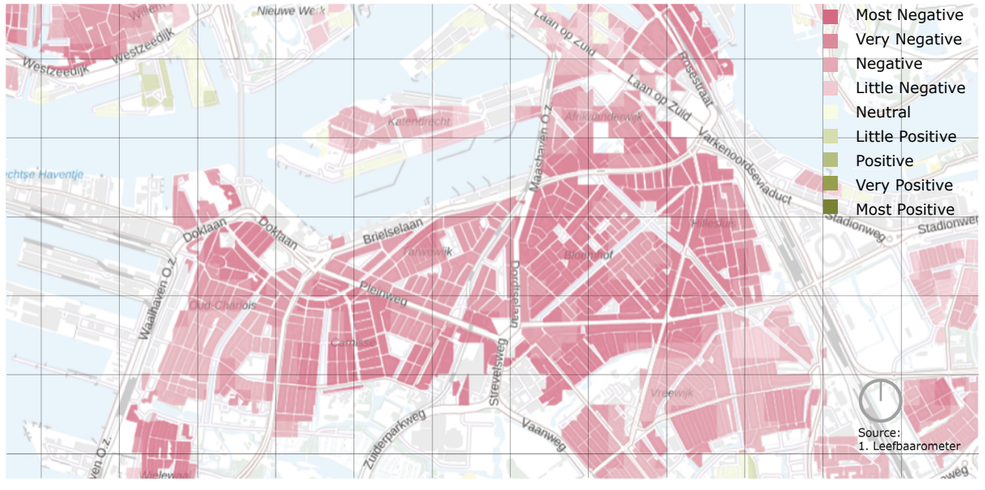



**Figure 12:** Map of nuisance and insecurity in Rotterdam South (data source: Leefbaarometer, OSM)

## Problem Statement

In Rotterdam South, neighborhoods are known to be segregated. Based on the indexes of the national livability meter (leefbaarometer), they present negative metrics on social cohesion and negative to very negative conditions when it comes to nuisance and insecurity. As described before, Rotterdam South is mainly inhabited by a migrant population, which is proven to be associated with lower education and income. Since 2010, the National Government with other partners has been in the process of transforming Rotterdam South with a focus on the pillars of school, work, living, residents, culture, and safety (NPRZ, 2017). This, on the one hand, creates opportunities for middle-income social groups to establish in the area, on the other hand, it creates a negative feeling to the existing inhabitants who feel like they are being evicted. Furthermore, the residents of the area are emerging the need for safer neighborhoods, improved public space quality, and increased feelings of familiarity among neighbors (Doff & Snel, 2022).

However, the availability of public spaces in urbanized cities is gradually decreasing, leaving no room for people to socialize and appropriate the city. As the population of cities is growing and the inhabitants have no access to common spaces, there is less interaction between them, and therefore people live more isolated with a negative impact on their well-being. Loneliness and social isolation have been found to seriously affect mental conditions, especially among minority social groups, such as migrants (CDC, 2021). Especially in multi-ethnic neighborhoods, where segregation is evident, public space is critical in establishing better cohesion between ethnicities and promoting diversity.

In this transformation, integration becomes a critical process that can facilitate the establishment of new residents in the area. The main challenge here is to create the conditions that allow different ethnicities to interact, acknowledge and welcome the diverse population of their neighborhoods. Especially, when it comes to local businesses and existing residents, the fear of gentrification comes into place. With the changes in the area, it is essential to ensure the viability of the economic structure, as well as the sustainability of the existing inhabitants with their current economic and cultural characteristics.

It is therefore critical to exploit the potential of public space as a shared living room, where social interaction is fostered and diversity is promoted. A transformation of public space is necessary, to create a fertile ground for social connectedness, allowing new dynamics between residents to be developed.

> **Rotterdam South is facing a transformation of both the physical environment and the social structure of neighborhoods. Public space can be a catalyst of connectedness between residents and the formation of a supportive social network.**




**Figure 13:** A new dictionary generated during a reflective evening organized by Recht op de stad and AIR with residents of Rotterdam South. (source: https://rechtopdestad.nl/wijzer-over-wonen-doordenkavonden-in-aanloop-naar-verkiezingen/)




**Figure 14:** Demostration of the "Recht op de stad" movement regarding the housing policy in Rotterdam. (source: https://www.rotterdamswoongenootschap.nl/recht-op-de-stad/)

## Research Aim

This research aims to **identify the opportunities of public space in dense urbanized environments to foster inter-ethnic social interaction**, by researching the potential of streets to accommodate diverse activities and encourage the participation of diverse social groups. To achieve that, designing a network that connects public spaces across the neighborhoods becomes the assignment. Connecting spaces and making routes more accessible have been shown to increase the activity and participation of citizens in public spaces (Adams & Tiesdell, 2013; Gehl, 2010). This extended public space can create room for people to meet and get to know each other, interact, and socialize.

In South Rotterdam, creating opportunities for the diverse population of the area to interact in the city is important. In these neighborhoods, public areas are mainly parks and playgrounds. However, more places of interest attract the public, such as schools, shops, community centers, etc. It is essential that the proposed network can facilitate the movement of pedestrians from and to these places, creating pleasant, welcoming, and safe environments.

As explained in the problem statement, the challenge in the case of Rotterdam South is to facilitate the interaction between different ethnicities, create public spaces that are more inclusive and diverse, and integrate the different populations of the neighborhoods. For this task, it is necessary to examine the accessibility of these populations to current public spaces and places of interest, understand where people meet, and how to encourage diversity in those places without interfering with the existing social structure and urban fabric.

The lack of public green space in South Rotterdam worries the residents and it is a missed opportunity. A variety of nature-based publicly accessible places create the foundation for a healthier and more united community. Interaction with green, as well as interaction with other people, is known to have a positive impact on individual well-being as well as increasing social capital among community members (Gehl, 2010; Jacobs, 1992; Roe & McCay, 2021). A stronger social network can be established with public space that is inclusive and alive, one that provides opportunities for different activities to take place, and accounts for the variety of users in the area.





## Research Questions

In this project, I address the research aim by bringing together three disciplines, urban design, landscape architecture, and urban analytics. From the urban design lens, I study the social behavior of people in public spaces and the importance of the built environment in their experience. Also, the wide availability of data, in The Netherlands, creates a great opportunity for informing urban design projects. Moreover, landscape architecture has elaborated on the importance of nature-inclusive designs for improved well-being. I, therefore, formulated the following main research question, which is supported by sub-questions addressing the different disciplines involved in this project.

**Main Research Question:**

**How to design a network of public spaces to foster inter-ethnic social interaction in South Rotterdam?**

**Sub-Questions:**

**Urban Design:**

RQ1 **What is the relation between the urban environment and neighborhood experience?**

RQ2 **What design principles contribute to encouraging participation in public life?**

**Landscape Architecture:**

RQ3 **How to implement nature-inclusive designs to promote well-being?**

RQ4 **How restorative environments can contribute to increasing social interaction?**

**Urban Analytics:**

RQ5 **How to improve accessibility to public spaces to enhance ethnic diversity?**

RQ6 **How to identify places that foster interaction in the urban fabric?**

# MIXED-METHODS APPROACH

In this chapter, I elaborate on the methodology proposed to address the challenges of ethnic integration in cities. Different research methods are explained concerning their role in a mixed-methods approach and linked to desired and expected outcomes. Also, the relevance of the project is illustrated in the societal and scientific discourse.


**METHODOLOGY**

**METHODS**

Quantitative Analysis

Qualitative Analysis

Design

**METHODOLOGICAL SUMMARY**

**RELEVANCE**

Societal Relevance

Scientific Relevance


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## Methodology

To address the research questions of this project I explore mixed methods in urban design. By integrating methods from urban analytics, not only in research but also as a design tool, I propose a multi-disciplinary approach, that brings forward the exploration of data-driven analysis in urban projects. For this reason, the methodology of this report consists of quantitative and qualitative methods that are interrelated and inform the design and the literature review.

As presented in the  ure, a literature review is used to create the theoretical foundation necessary for the research but also to investigate design examples as inspiration for the final design. For location-specific research, quantitative and qualitative methods are used. The quantitative methods deal with data gathering and data visualization, as well as network analysis. Qualitative methods are used in human-scale research, which has to do with small-scale areas. For that, fieldwork and observation as well as informal interviews come to enrich the research and make the design more concrete. Finally, design strategies are developed with a combination of methods, namely computational design, and research and design.

## Methods

### Quantitative Analysis

#### Data-Driven Analysis

Data-driven analysis is used to integrate a large amount of data that are gathered from publicly available data sources, such as OpenStreetMap and CBS. This data is analyzed through a computational approach and visualized for communication purposes.

#### Network Analysis

Network analysis is the method used to inform the design of the network of public spaces. Using network analysis, different criteria can be integrated, and more experimentation is allowed to examine the existing opportunities offered by the walkable street network.

### Qualitative Analysis

#### Fieldwork & Observations

For design decision-making, it is always important to study the location. This can be done by taking photos and visiting the place at different times and days. Field trips are performed to validate research outcomes and also to understand and experience the environment.

#### Informal Interviews

Informal interviews are taken during field trips. Their purpose is to understand the perception of the users regarding the area of interest, investigate their needs and discuss future visions. The people that usually visit the locations are the ones that have a more holistic view that sometimes does not reflect in the data.

### Design

#### Computational Design

The formation of the network of public spaces builds upon the existing pedestrian network and the activities already present in the area. Computational design is used to process the data and develop strategies that analyze and generate possible design solutions.

#### Research & Design

Research by design is used for the design assignment and the development of design strategies. The process consists of experimentation of design solutions and evaluations of their impact, socially and spatially, while being informed by the research conducted throughout the project.

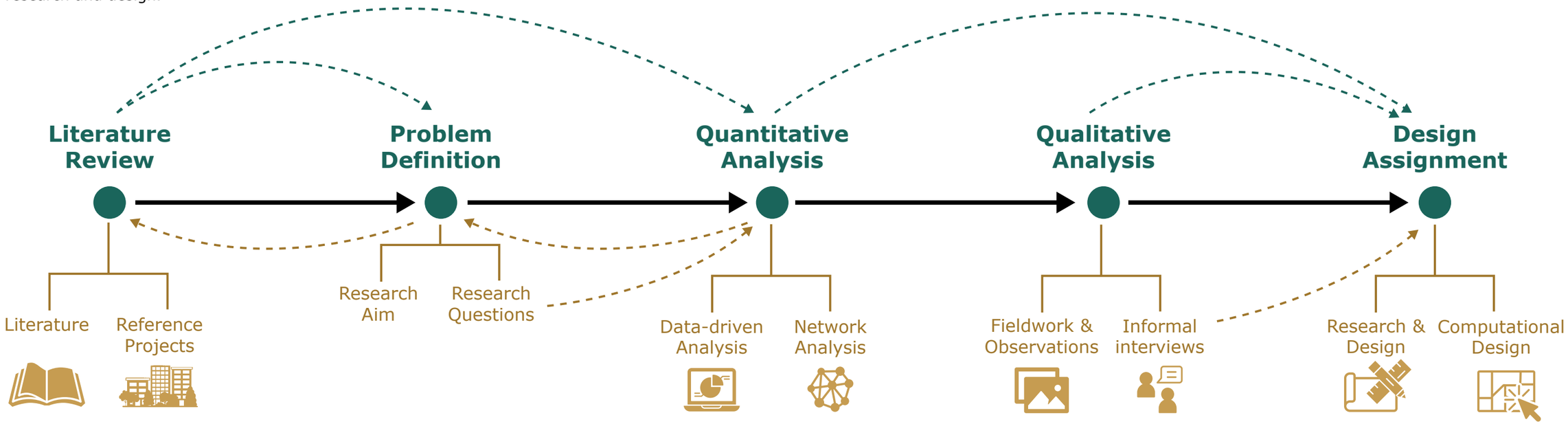



**Figure 15:** Methodology Diagram

## Methodological Summary

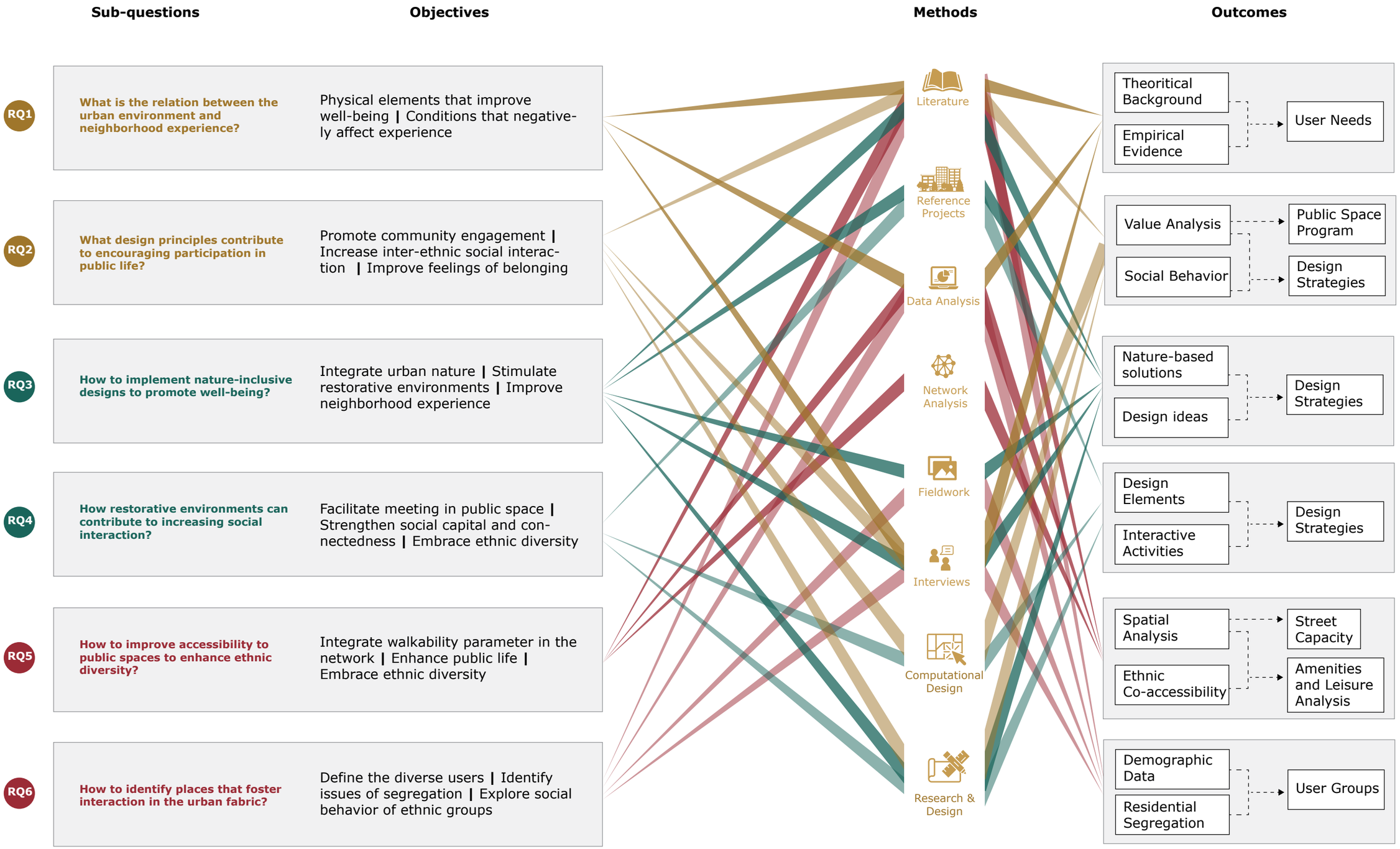



**Figure 16:** Methodological Summary Diagram

# Relevance

## Societal Relevance

A network of public spaces that encourages public life, increases inter-ethnic social interactions, stimulates social cohesion, and strengthens feelings of trust, belonging, and safety can add significant societal value to a neighborhood.

By creating public spaces that are accessible and welcoming to all members of the community, individuals from different ethnic, cultural, and socio-economic backgrounds can come together to share experiences, exchange ideas, and build social ties. This can promote understanding and empathy between different groups and help reduce feelings of social isolation and exclusion.

Integrating restorative environments in proximity, designed with restorative elements, such as greenery, natural light, and water features, can have a positive impact on the well-being of individuals. Exposure to nature and natural elements has been shown to reduce stress and promote mental health, which can contribute to a more resilient and healthy community.

Public spaces that are designed to encourage social interaction, such as community gardens, outdoor seating areas, and playgrounds, can help create a sense of community and belonging. This can foster feelings of trust and safety among community members and reduce fear of crime or other negative social outcomes.

## Scientific Relevance

This thesis aims to fill a gap between urban analytics and urban design. Urban analytics have been progressing to innovative methods for understanding the complexity of urban environments. However, the link between those methods and urban design is rarely seen. Consequently, the current project's effort is to integrate urban analytics tools with traditional urban design methods to result in a design informed by both disciplines.

Therefore, this research methodology consists of both quantitative and qualitative approaches for analysis. The quantitative approach is mainly methods derived from urban analytics, that create evidence regarding the accessibility and connectivity of places, their network of paths, and the participation of specific social groups. On the other hand, the qualitative approach consists of small-scale site analysis, through fieldwork, observations, and informal discussions. The qualitative analysis serves also as the means for validating the results from quantitative analysis.

Finally, computational methods are used for the design assignment on a large scale. Network analysis offers opportunities for experimentation and prioritization of criteria for the selected paths of the network. Using tools from urban analytics, the design can be more efficient and result in the most desired outcome.

The design of urban environments is a complex process, mostly because it involves multiple disciplines. Accordingly, multi-disciplinarity should also describe the professionals that engage with city planning. This way, it creates room for further exploration, integration of knowledge, and innovation.



**Figure 17:** Photo of neighbors having barbecue at Maastunnel park | Oud Charlois, 04 Jun 2023

# PLACE & MIND

Place and mind are interrelated. The purpose of this chapter is to establish this relationship between environment and perceptions, urbanization and feelings, and city and experiences. A literature review informs the project from different perspectives and disciplines, discovering particularities of multi-ethnic cities and the impact of the environment in promoting diversity and improving well-being. Those concepts are the foundation for both research and design of this thesis.


**THEORETICAL FRAMEWORK**

**URBAN ENVIRONMENT AND WELL-BEING**

**SOCIAL COHESION**

Social Cohesion and Ethnic Diversity

**RESIDENTIAL SEGREGATION**

Ethnic Segregation

**PUBLIC SPACE AND PUBLIC LIFE**

Public Space

Cultural Behaviour

Meeting and Appropriation

Connectivity and Accessibility

**LANDSCAPE AND EXPERIENCE**


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## Theoretical Framework

In the context of multi-ethnic cities, there is a pressing need for integration to foster social cohesion and well-being. The challenge of this project is to propose the integration of restorative environments to increase inter-ethnic social interaction and therefore, promote ethnic diversity. These concepts are intertwined, and an understanding of their interrelationships is essential for designing effective interventions.

Ethnic diversity refers to the presence of different ethnic and cultural groups in a given area. Social interaction involves people from these diverse groups coming together and engaging in activities that promote understanding, empathy, and social connections. Restorative landscapes refer to green spaces and other natural elements that can promote well-being.

These concepts are analyzed in the context of public space. For this reason, I researched the role of aesthetics and attractiveness as concepts that relate to the physical environment and their impact on perception and experience. Additionally, connectivity and accessibility refer to the movement of people around the city, and the ease of accessing locations and interacting with others. Residential segregation is reflected in public spaces with reduced opportunities for interaction and limited social cohesion. Finally, appropriation and domestication examine the opportunities for residents to project their needs and adjust public space accordingly, making room for their activities to take place and forming communities in the neighborhood that embrace diverse identities.

The concepts illustrated in the diagram are analyzed through their interrelationships. This chapter consists of a literature review to provide insights and develop a better understanding of what this project deals with.

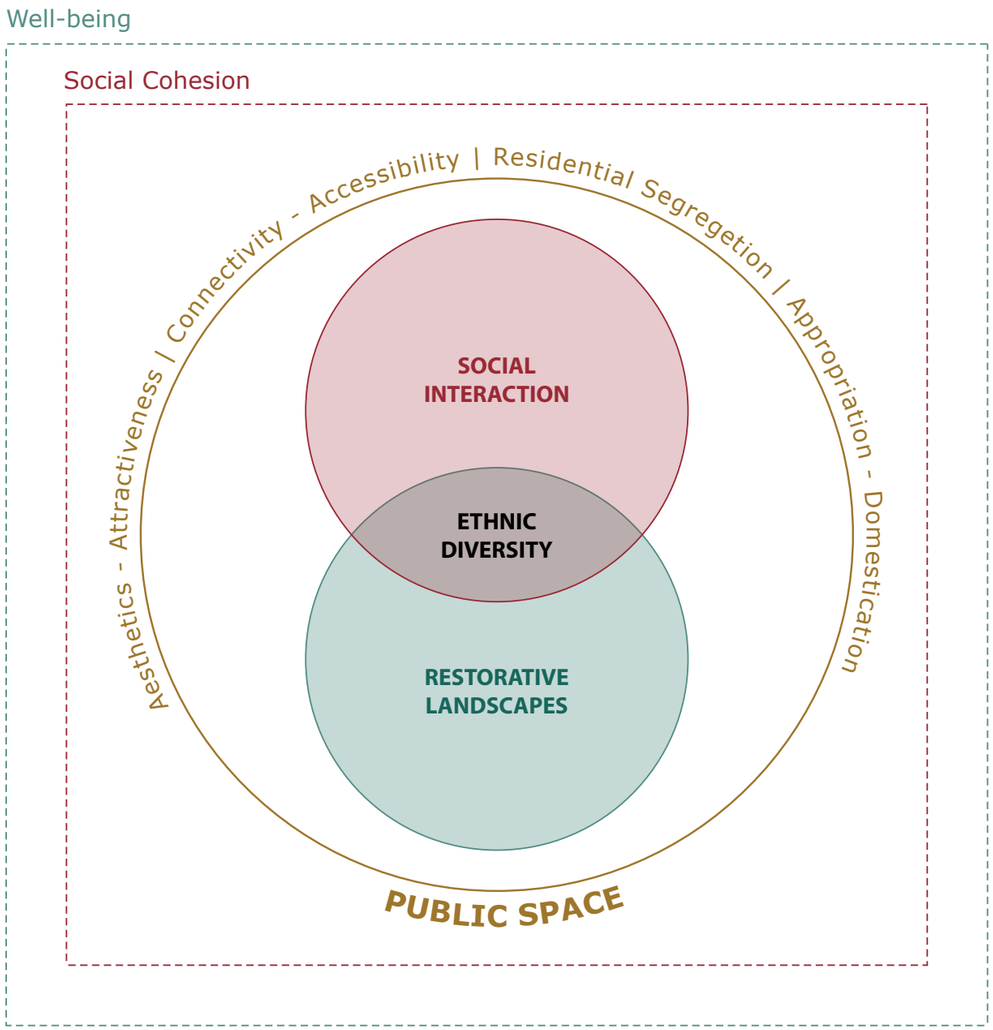



**Figure 18:** Theoretical Framework Diagram

## Urban Environment and Well-being

Population in urban environments is rapidly growing, with a projected 60% living in cities by 2030 (Gascon et al., 2015). At the same time, the rates of depression and anxiety raised by 25% during the first year of the pandemic (World Health Organization, 2022). As the literature suggests, one of the aspects that affect mental state is the environment in which we live (Gascon et al., 2015; Roe & McCay, 2021), which makes it crucial to identify what are the characteristics of urban environments that either benefit or worsen the mental conditions of its residents. Of course, those characteristics go beyond the physical aspects and include the social conditions as well, as their consequent expression in the urban environment.

The physical environment creates several stimuli, especially in high-dense cities. Noise (traffic, surrounding area, etc.) and air pollution (traffic) in a neighborhood is associated with depressive symptoms (Rautio et al., 2018). Also, insufficient light exposure may occur seasonal affective disorder, which leads to sadness, fatigue, and occasionally depression (Evans, 2003). Another characteristic that affects well-being is aesthetics. The degree of attractiveness and beauty of a neighborhood relates to the environment's performance on mental health, creating experiences that "change human consciousness" (Meyer, 2008).

Well-being is strongly related to the social capacity of a neighborhood and/or a city. While Litman (2022) argues that cities "offer more social opportunities", the need for personal control is still important, especially when exposed to acute noise, crowding, and smelly pollutants (Evans, 2003). The control over the social and physical environment is related to (perceived) "freedom, individualization, tolerance, and identity", which is beneficial when it comes to the formation of your surroundings or the control over the amount of social interaction (van Dorst, 2012). Opportunities for social interaction between neighbors in low-traffic streets and common spaces, boost the development of socially supportive networks (Evans, 2003). Diverse neighborhoods with social cohesion form mutual support among the residents, that in combination with strategic design decisions, such as windows towards the streets, also facilitate social control with "eyes on the streets" and hence, a safer environment (Jacobs, 1992).



**Figure 19:** Photo of three generations family at Karel de Stouteplein | Oud Charlois, 30 Nov 2022

## Social Cohesion

Social cohesion is a multi-dimensional concept, widely researched by different disciplines, sociologists, psychologists, and other scholars. In principle, social cohesion refers to "the degree of interconnectedness between individuals that is both a result and cause of public and civic life. It encompasses feelings of commitment and trust and norms of reciprocity and is demonstrated by participation in networks and civic organizations" (van der Meer & Tolsma, 2014). However multiple indicators for social cohesion vary from economic to social indices, others are more explicit and measurable, and others are more empirical and qualitative. Duhaime et al. (2014) argue that social cohesion is predominantly a political instrument to measure the distribution of wealth in society. Consequently, their research proposes an alternative model for social cohesion, that brings forward the social dimensions of social cohesion, namely the quality of life, social support, and subjective well-being (Duhaime et al., 2004).

Additionally, Friedkin discusses the importance of group membership for social cohesion, supporting that to develop an understanding of social cohesion, one should value not only the individual's behavior but also the group members and the way they interact and influence each other (Friedkin, 2004). Social interaction between individuals creates social capital, leading to social bonds and supportive networks. In the urban context, interactions take place mainly in public spaces. Peters et al. (2016) argue that a sense of belonging is developed with repeating visitation in spaces, that creates not only a connection with the place itself but also the people and the activities. They refer to place attachment as a tri-dimensional concept that concerns the person or group, the psychological processes, and the place (Peters et al., 2016). With similar thinking van der Meer and Tolsma (2014) question whether the essence of social cohesion is about "Who is connected to whom, where and how?" (van der Meer & Tolsma, 2014).

### Social Cohesion and Ethnic Diversity

In the multi-ethnicity discourse, there is a weak linkage between social cohesion and ethnic diversity. Since migration is rapidly growing and cities are populated by diverse inhabitants, understanding the impact of ethnic diversity on social cohesion is significant. It was initially hypothesized that ethnic heterogeneity negatively impacts social connectedness between and within ethnic groups. However, van der Meer and Tolsma (2014) compared multiple empirical studies across the world and concluded that contact between different ethnic groups stimulates feelings of trust between them and inside the same group, heterogeneity in the neighborhoods disintegrates cohesion across neighborhoods and in principle, ethnic diversity does not negatively impact social cohesion (van der Meer & Tolsma, 2014).





## Residential Segregation

Residential segregation is defined by Massey and Denton as "the degree to which two or more groups live separately from one another, in different parts of the urban environment" (Massey & Denton, 1988). In this section, I discuss the dimensions of residential segregation as described by Massey and Denton with a reading of those dimensions in the Dutch context and more specifically the city of Rotterdam that serves as the case study of this thesis.

Residential segregation is a multi-dimensional concept that is presented when minority groups are observed to be isolated in the urban fabric. Usually, those groups are diversified by income, education level, or ethnicity, but can also be distinguished based on age or disability. In general, residential segregation is the event when citizens of a specific social group are separated from the general public, resulting in homogeneous residential areas. Extreme examples are found in American cities with ghettos, and gated communities, but can also be present in less extreme examples, one of which is Rotterdam South with ethnic minorities being densely located in specific areas of the city.

In their analysis, Massey and Denton distinguish the phenomenon of residential segregation into five axes of measurement. The first axis is *evenness*, which refers to the proportional distribution of social groups in the urban environment. The level of evenness is measured compared to the total amount of those social groups in the city. The second measurement is *exposure*, which illustrates the potential of interaction between minority and majority groups in geographical units. It is important to take into account that equally distributed social groups do not necessarily encounter one another. *Concentration* is the third axis and relates to the physical space occupied by the minority groups in question compared to the predominant group. The fourth axis examines the distribution of a minority group compared to the center of a city, namely *centralization*. Minority groups, regardless of the area they occupy, may be located centrally in the city but also its periphery. Finally, clustering refers to the distribution of minority units in the urban fabric in proximity to each other, eventually forming a contiguous enclave (Massey & Denton, 1988).

### Ethnic Segregation

Ethnic segregation is observed when residential segregation is evident concerning the ethnic backgrounds of residents. In this case, specific areas in the city are predominantly occupied by specific ethnic groups and usually result in more deprived neighborhoods.

In Europe, ethnic residential segregation was faced with five main housing policies to achieve more distributed settlement of ethnic minorities in cities. *Scattered-site programs* were established to accommodate ethnic minorities in wealthier neighborhoods, by building social housing in these locations. An effective measure is *rental subsidies*, which are offered to provide more choices for housing and decrease segregation. Another policy applied is the *housing allocation policy,* which aimed to balance the share of ethnic minorities in the neighborhood to be close to the total share of them in the city. *Mobility Programs* were introduced mainly in the USA to encourage minority populations to move into less diverse neighborhoods. Finally, the *housing diversification* policy ensures the availability of diverse housing options in urban (re)developments and therefore the diverse population (Bolt, 2009).

# Public space and public life

## Public Space

Public space is a term used to describe areas that are accessible and open to everyone, regardless of their social, economic, or cultural background. It includes places such as parks, squares, sidewalks, and streets that are designed to be used by the public for a variety of purposes, including socializing, recreation, and cultural events. There are different perspectives on what constitutes public space and how it should be designed and managed.

According to Jane Jacobs (1992), public space is an essential component of a thriving city. She argues that successful public spaces are those that attract a diverse mix of people and encourage social interaction (Jacobs, 1992). Additionally, Whyte (2001) describes successful spaces as those capable of accommodating a variety of activities and allowing a degree of flexibility in use, fostering social interaction amongst its users (Whyte, 2001). Public spaces should be human-centric, inviting, accessible and safe for all members of the community (Gehl, 2011).

Public spaces are a complex and multifaceted concept, and there is no single definition to describe them. However, public spaces are generally understood as a shared resource that is essential to the functioning of a vibrant and inclusive city. They should accommodate a variety of activities, foster social interaction, and prioritize the needs of the people who use them.

## Cultural Behaviour

Public spaces are accessible to everyone and are critical in encouraging social interaction, especially in multi-ethnic neighborhoods, to stimulate social cohesion. This is where ethnic diversity is most manifest, especially in leisure places such as parks, playgrounds, and squares (Peters & de Haan, 2011). The behavior of people in public space, however, differs between cultures and it is important to value the specificities associated with each ethnic group when addressing the design of public space.

It is generally observed that in multi-ethnic communities, public space can function as a place of attachment and connectedness, where diversity is celebrated. However, the territorialization of public space can lead to conflicts, and then public space becomes an arena of negotiation (Peters, 2011).

In the Netherlands, ethnic minorities consist of Western migrants (European) and Non-Western migrants, mainly originating from Turkey, Suriname, Dutch Antilles, and Morocco. Peters and de Haan (2011) researched the behavior of these ethnic groups in leisure spaces and observed that diversity in public spaces, not only raises awareness but also creates a pleasant environment to live in. However inter-ethnic contacts are mostly superficial, while meaningful relationships are mainly mono-cultural (Peters & de Haan, 2011). Nevertheless, small inter-ethnic interactions can initiate the formation of social capital and empower feelings of trust between the residents of a neighborhood.

Peters (2011) also distinguishes mobility patterns across cultures. Specifically, she notes that migrants are more likely to use city parks in proximity to their residences, while the Dutch population travels to nature reservoirs and larger greenery (Peters, 2011).



**Figure 20:** Photo of a young man with his dog at Karel de Stouteplein | Oud Charlois, 30 Nov 2022

## Meeting and Appropriation

Public space is crucial when it comes to interaction between people on the same street or neighborhood and those passing by. It is considered as the space where one can express themselves but also as a common room for shared activities between neighbors or strangers. The functioning of the public space changes according to its dimensions, location in the urban fabric, and proximity to different users or visitors. Therefore, concerning each public space's character, different activities take place that either has to do with people meeting or locals appropriating the space.

City planning has been addressing walking as a mobility infrastructure, mainly considering sidewalks' capacity and distances. However, walking itself is a process of experiencing the city, interacting with your environment and the people in it, embracing natural elements like the sun and air, or enjoying art in the public space (Gehl, 2010). Walking in the street creates opportunities for social interaction, sometimes not even by talking but only by participating in a shared activity, such as simply walking in the same direction as someone. Streets should be attractive, and this can be achieved when the streets are eligible to accommodate activities. Just by maintaining the adjacent' buildings appearance and providing space and safety, streets can be filled with children playing and people shopping or talking (Jacobs, 1992). Streets with activities are more likely to be used by strangers as well. "Faced with the choice walking down a deserted or a lively street, most people would choose the street with life and activity. The walk will be more interesting and feel safer" (Gehl, 2010). A liveable neighborhood starts with the streets and the public life that takes place there. The residents that have their local grocer and chat at the store's front door, the cafés with their sittings on the sidewalk, that visitors prefer because they observe the people walking by, the bus stop that people take to go to their jobs or ask for directions (Gehl, 2010).

Streets are the arteries of a neighborhood. In combination with the public spaces in proximity, the park next to someone's house or the playground close to a kid's home, they provide places for appropriation, that change how people experience and perceive their neighborhood's environment. Harteveld (2020) argues that "Public space evolved into living rooms by/of/for people even further. The value of 'living together' is not changed. The quality of being together as a community is." (Harteveld, 2020). This creates a challenge to maintain public space accessible to all and avoid appropriating public space to exclude possible users. For this reason, as Malonza (2020) suggests for the city of Rwanda, a balance is needed between top-down policies and frameworks with bottom-up initiatives and interventions. Primarily, public space is a social space defined by the people in it. Therefore, its qualities should promote social cohesion, catalyzing the "feelings of trust, belonging, acceptance and connectedness" (Jennings & Bamkole, 2019).



**Figure 21:** Photo of elderly ladies meeting at Bad Skatepark | Oud Charlois, 30 Nov 2022

## Accessibility and Connectivity

Places "derive their meaning and value from people and without them, they would remain mere elements of space defined by physical characteristics alone" (Adams & Tiesdell, 2013). Thus, strategic city planning must create conditions for public spaces to be easily accessible and well-connected. Sustainable cities provide a safe environment, with an efficient public transport system. They additionally improve the environment to increase accessibility in public spaces that are safe, inclusive, and green (Roe & McCay, 2021).

Accessibility to public spaces touches upon their proximity from places of residence but also the inclusivity of people with disabilities, different ages, or parents with pushchairs. The proximity of green spaces that benefits well-being has various impacts depending on different characteristics. While studies propose multiple distances to be proven in favor of mental health, they all agree that the closest (<300m) the green space the better (Ekkel & de Vries, 2017). Others suggest that even a view of natural elements is beneficial (Pouso et al., 2021), giving value in locating greenery close to office buildings and places of work as well. Having nearby green spaces also creates a place of meeting for a diverse population, increasing the opportunity for interaction. Age diversity is observed in the largest Dutch cities when walking 10-15 minutes to reach a destination (Milias & Psyllidis, 2022). This proves that the denser the public spaces the fewer chances for age segregation. For a more inclusive public space, at a neighborhood scale, Roe & McCay (2021) suggest that the principles should be to:

> "Provide accessible pedestrian infrastructure, such as wide streets, pedestrian ramps, timed crossings, benches for resting, and full access to public transport for people with different physical abilities and mobility aids. Design potential subdivisions of parks and other public spaces to encourage use by different groups".

To develop an efficient public space network that is attractive and welcoming, where diverse activities take place, it is essential to create connections, improve the experience of movements between public spaces and increase life in the public realm. As Gehl (2010) mentioned:

> "Better conditions for bicyclists invite more people to ride bikes, but by improving the conditions for pedestrians, we not only strengthen pedestrian traffic, we also — and most importantly — strengthen city life."

The well-designed network of public spaces considers natural movement patterns, and direct routes to facilitate connectivity, helping people to understand how places work and thereby stiffening urban vitality (Adams & Tiesdell, 2013).

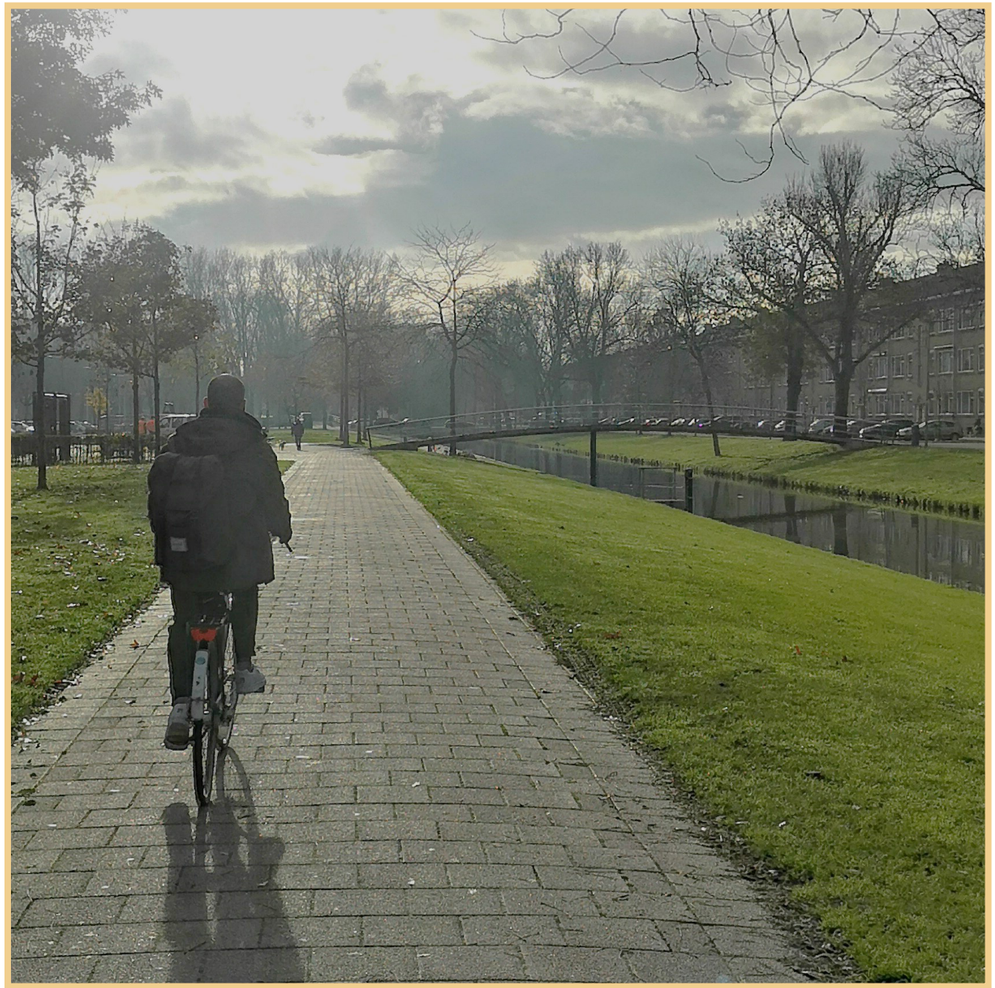


**Figure 22:** Photo of a cyclist along the water at Carnissedreef | Carnisse, 30 Nov 2022

## Landscape and experience

As mentioned before, the urban environment can have a severe impact on health and restorative landscapes provide a mechanism for coping with mental fatigue, stress, depression, and anxiety. For that reason, public space must be designed in a way that promotes healthy behaviors, gives space for relaxation, and creates conditions that promote well-being (Roe & McCay, 2021). Restorative landscapes are described in the literature to be having various characteristics, in terms of experiences but also in their capability to provide diverse opportunities for activities.

In their work, Kaplan et al. (1998) elaborate on the preferences of landscapes that are attractive to their study participants. Specifically, they present a preference matrix that highlights the need for coherence, complexity, legibility, and mystery (Kaplan et al., 1998). To better understand, let us first establish that aesthetics and beauty, though rarely reported as important factors for sustainable cities, still have a performance toward the environment and the experience (Meyer, 2008). In the literature is most common to come across the role of urban nature as a mitigator for heat islands or a solution for water management, and a biodiversity booster. However, Meyer (2008) argues that nature-based landscapes enable "social routines and spatial practices", they create awareness through somatic and sensory experiences, transforming cultural behaviors. Restorative landscapes need to be attractive to be effective. Therefore, their design should be *coherent*, which means that it is organized in distinct regions and there are "repeating themes and unifying textures". The amount of *complexity* should be balanced, with a wealth of components in the setting. At the same time, the orientation needs to be easily achieved, using memorable elements or landmarks, thus creating a *legible* environment. Finally, a sense of *mystery* would create a "desire to explore", making the place more appealing and interesting (Kaplan et al., 1998).

Restorative landscapes consist of various identities, each of which provides different opportunities for interacting with nature, or other human beings. Roe and McCay (2021) present those ideas as forming a framework for restorative cities. They argue the need for diverse green, from small porches to larger nature-based spaces, with water settings and hybrid parks that encourage sports and social interaction (the *green and blue city*). The design of public space should provide a sensory experience, and produce visual stimuli, a multitude of smells, and enjoyable sounds while creating space for art and colors in the city (*sensory city*). At the same time, urban planning needs to integrate social infrastructure and diverse amenities that allows social interaction in safe and informal settings (*neighborly city*), while welcoming population from different backgrounds and incorporating the needs of all citizens, considering different genders and possible disabilities (*inclusive city*). Finally, the availability of playful artifacts/public interactive art and outdoor/accessible facilities encourages the playfulness of all ages, as well as opening facilities such as school fields and creating structures for activities like parkour or skateboarding (*playable city*). In addition, the city's infrastructure should promote a healthier lifestyle through attractive exercising spaces within walkable distances and well-connected cycling paths (*active city*) (Roe & McCay, 2021).




**Figure 23:** Photo of a young man with his dog at Karel de Stouteplein | Oud Charlois, 30 Nov 2022



**Figure 24:** Photo of a family at Amelandseplein | Carnisse, 30 Nov 2022

# WELL-BEING AND THE CITY

This chapter consists of an analysis of South Rotterdam. The analysis is distinguished into four aspects social, accessibility, restorativeness, and urban stressors. The distinction derives from the framework developed that addresses ethnic segregation through the opportunities for social interaction in restorative environments.

**DEMOGRAPHICS**

Income Deprivation

Crime in South Rotterdam

Ethnic Residential Segregation

Distribution of Age groups

**CONNECTIVITY - ACCESSIBILITY**

Street Network

Street Profiles

Public Transport

**RESTORATIVE ENVIRONMENTS**

Parks and Playgrounds

Street Greenery

Urban Nature in South Rotterdam

Third Places

**URBAN STRESSORS**

Sound Pollution, Flood Risk and Heat Stress

Generated using AI, by Microsoft Bing Image Creator, powered by DALL-E

# Demographics

## Income Deprivation

The data on income for the neighbourhoods of this project, clearly indicate the deprivation of the area compared to the average income values of Rotterdam.

Specifically, Figure 25 shows the percentage of social welfare receivers, which refers to the "people receiving benefits on the grounds of incapacity for work, social assistance benefits, unemployment, and AOW" (*Allcharts. Info*, n.d.). It is apparent that of the six neighborhoods, five of them have a higher percentage of welfare receivers, with Bloemhof and Afrikaanderwijk reaching 9% and 10%, respectively, compared to Rotterdam's average of 5%.

Additionally, the average income per inhabitant as presented in Figure 26, is significantly lower compared to the average income of Rotterdam's residents. In all six neighborhoods, the income average does not exceed the € 22.500, while Rotterdam's income is at around € 27.500.

The data reflect income segregation between the residents of South Rotterdam and the rest of the city. As such, it is understandable why South Rotterdam is considered deprived, taking into account not only the income averages but also the established population in the area that receives social welfare and is possibly not economically active.

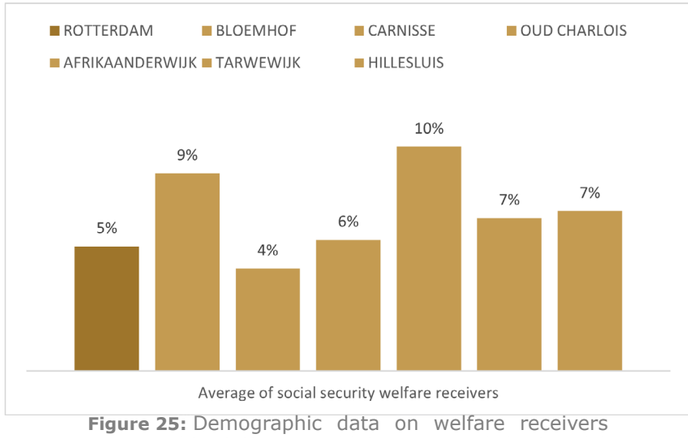



**Figure 25:** Demographic data on welfare receivers compared to Rotterdam (data source: allcharts.info)

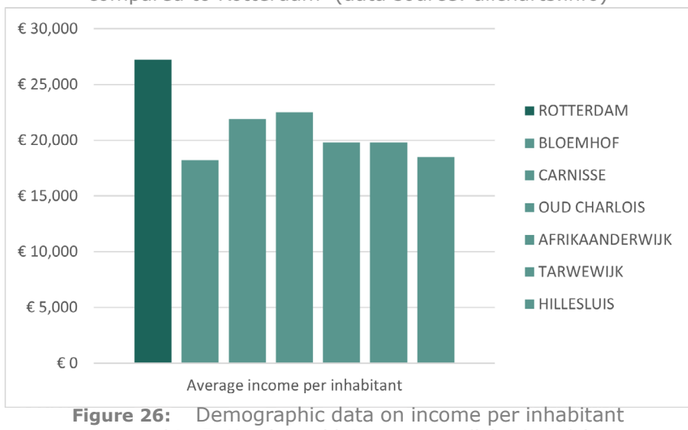



**Figure 26:** Demographic data on income per inhabitant compared to Rotterdam (data source: allcharts.info)

## Crime in South Rotterdam

Crime in South Rotterdam is presented in different forms. The predominant type of criminal activity is theft in all six neighborhoods, which can lead to high rates of daily stress and worsen the neighborhood experience, reducing well-being (fig.:27).

Theft is followed by traffic violations, which is a result of the high dependency on the car in the area, which is more explicitly analyzed in later chapters.

However, an important amount of crimes are related to violence and sexual abuse. This is also reported by residents in the research of Doff and Snel (2022), that express their worry about male residents in public spaces who verbally abuse female pedestrians. This kind of behavior, not only makes people feel unsafe but also forces them to keep their distance from public life, resulting in their exclusion from public space, due to the territorialization by specific groups that present such behavior.

Overall the higher amount of crime is illustrated by Tarwewijh and Hillesuils, while Afrikaanderwijk, seems to be the safest neighborhood among the others.

The information shows a necessity for public space that feels safer and is inclusive to all the residents. The need for more control is evident to mitigate unwanted behavior that makes people feel unsafe and reduce their potential of them to belong and engage in public life.

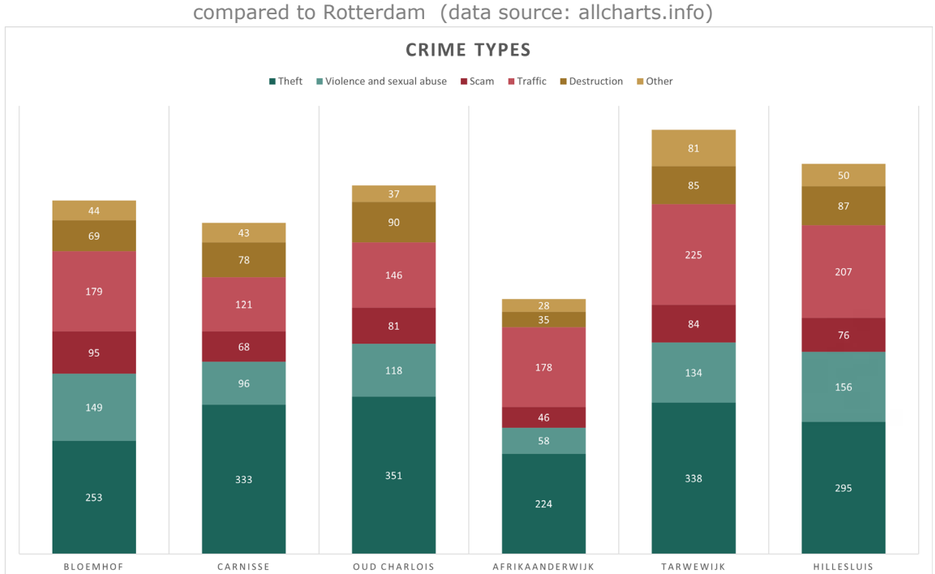



**Figure 27:** Statistical data on crime at South Rotterdam (data source: allcharts.info)

## Ethnic Residential Segregation

Figure 29 presents clearly that Rotterdam South is a case of ethnic residential segregation. The ethnic groups are distinct into the Dutch population, Western and non-Western. However, it is very important to also consider the sub-groups, with individual cultural needs. The non-Western population of these neighborhoods comes mainly from Morocco, Surinam, Dutch Antilles, and Turkey (Allcharts.Info, n.d.). When designing specific public spaces of the network, detailed data, as well as in-field observations will inform the decisions.

As the figure shows, while we observe a dominance of non-western migrants in all the deprived neighborhoods, Bloemhof's and Hillesluis's populations show very small percentages of the other two ethnic groups. Also, a large concentration of the western population is presented in Carnisse, where they cover around one-third of the residents, compared to the other neighborhoods (fig.28).

Finally, it is evident that among the deprived neighborhoods of South Rotterdam, the most preferred for the Dutch population is South Oud Charlois. Also, a high concentration of Surinamese is recorded in Tarwewijk, while Bloemhof, Afrikaanderwijk, and Hillesluis, show an important amount of Turks (fig.28).

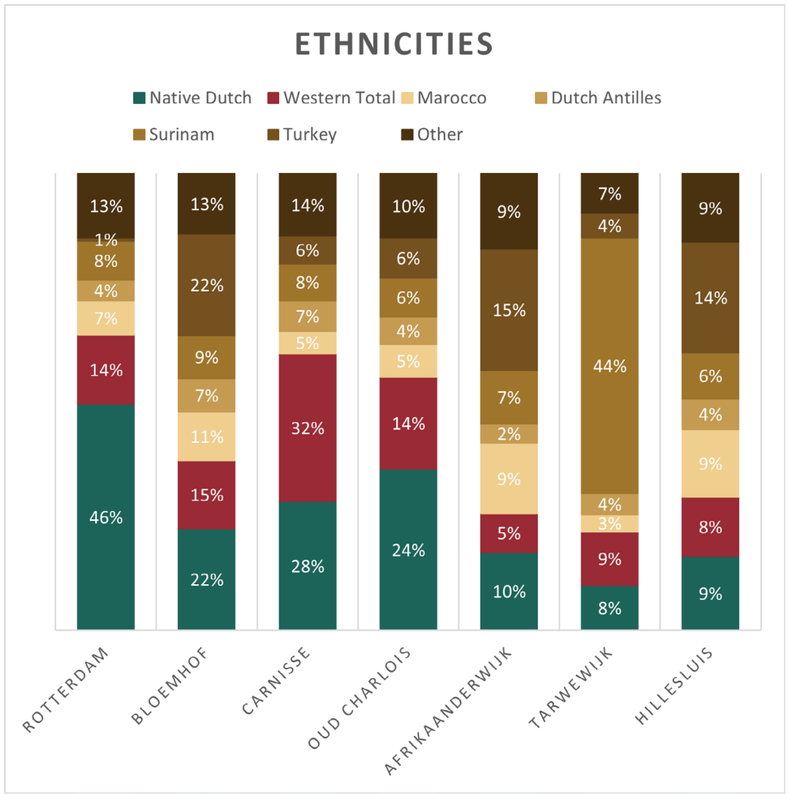



**Figure 28:** Statistical data on ethnic backgrounds compared to Rotterdam (data source: allcharts.info)

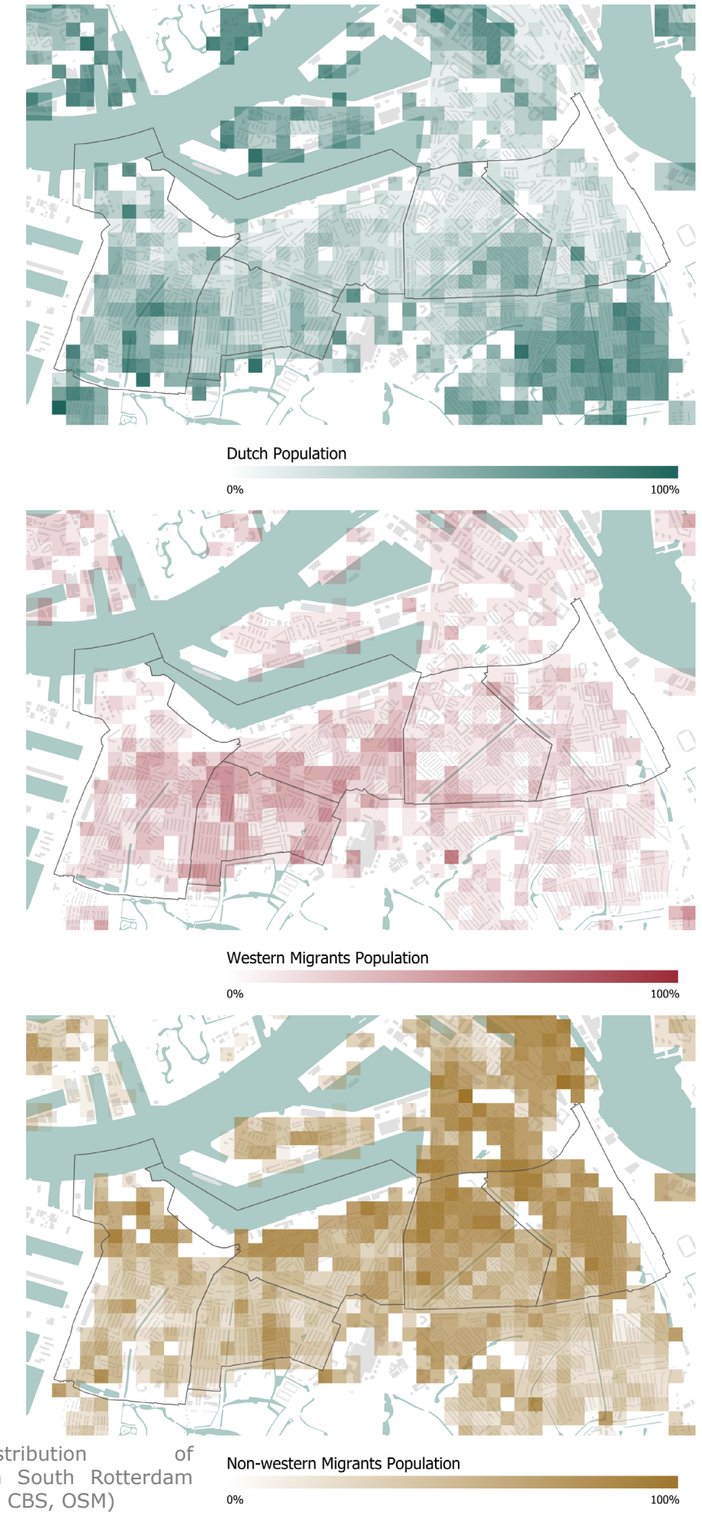



**Figure 29:** Distribution of Ethnicities in South Rotterdam (data source: CBS, OSM)

## Distribution of Age groups

The investigation into the distribution of age groups in the area is conducted to first understand the profile of the users of public spaces and concerning that, use this information to inform the design regarding the program of the public space.

As presented in Figure 31 , age groups are evenly distributed in the neighborhoods. For more elaboration, I deepen into three categories, kids up to 15 years old, active adults between 25-45 years old, and elderlies more than 65 years old. Active adults occupy the largest percentage of the population and are mostly concentrated in Carnisse and Tarwewijk.

On the other hand, elderlies appear to be very little in the area, followed by the number of kids up to 15 years old. The two age categories occupy the least amount of the population. In general, the distribution of ages does not present segregation, nor severe differentiation among the five neighborhoods.

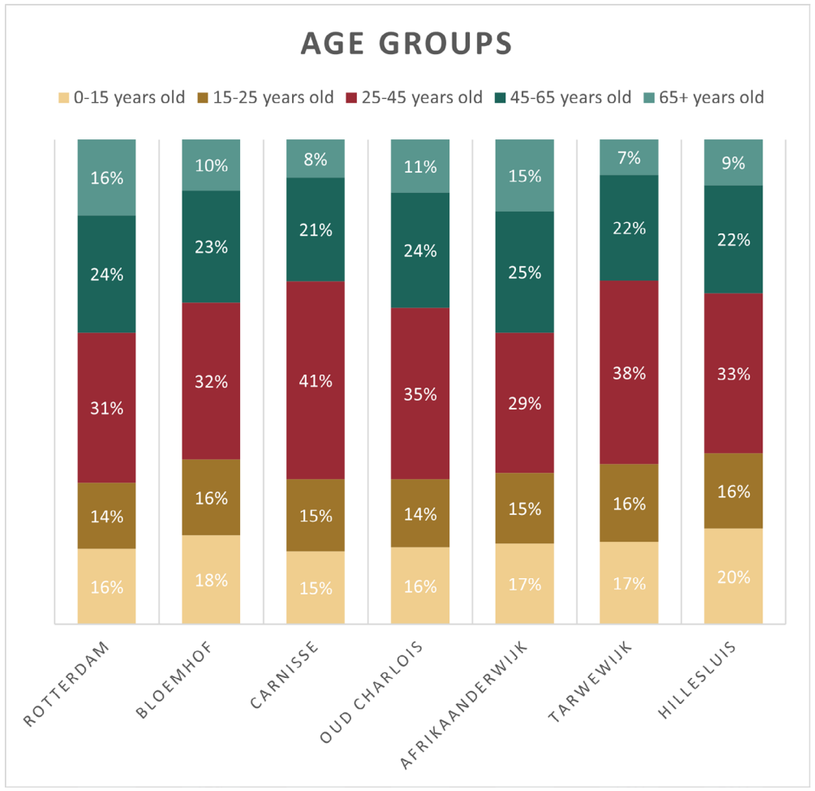



**Figure 30:** Statistical data on age groups compared to Rotterdam (data source: allcharts.info)

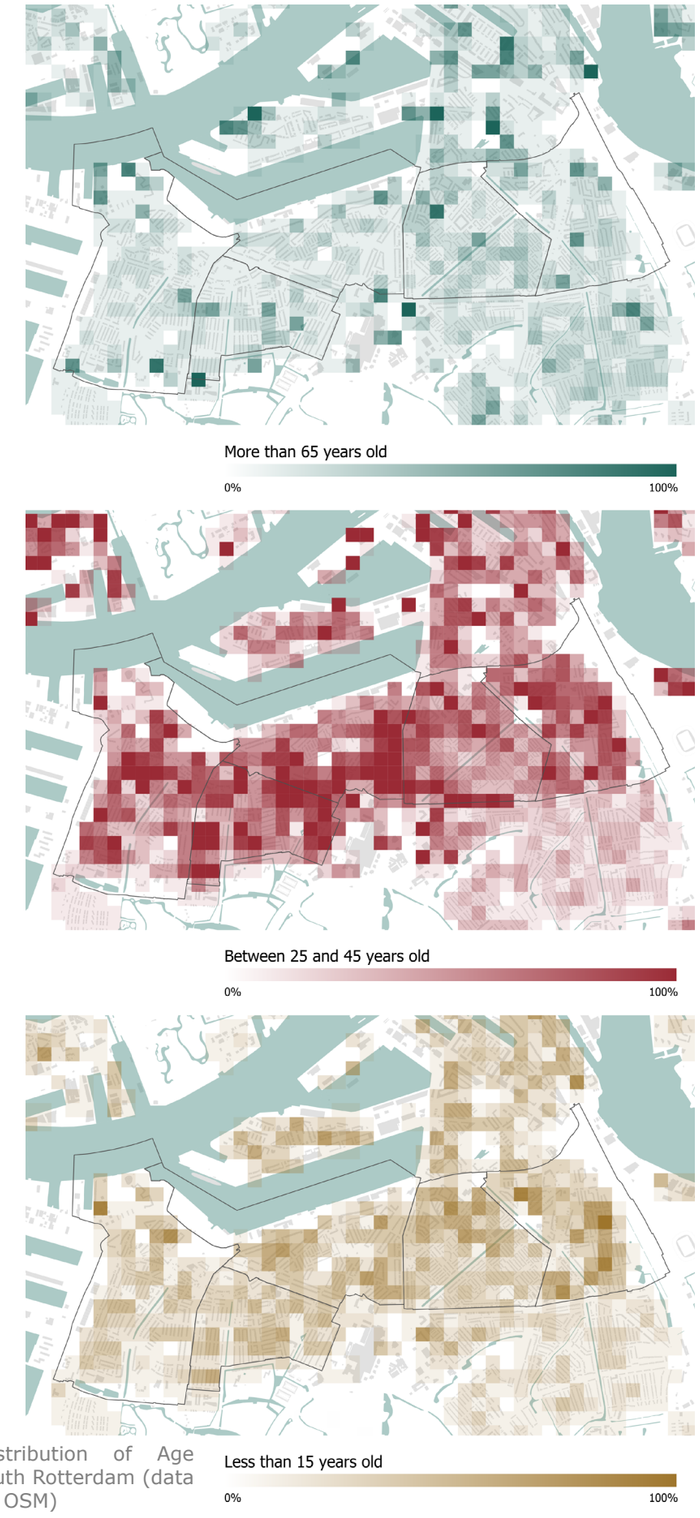



**Figure 31:** Distribution of Age groups in South Rotterdam (data source: CBS, OSM)

# Connectivity - Accessibility

## Street Network

In Rotterdam South, the street network creates a separation of the different neighborhoods. Primary streets of 4-lane traffic run across the boundaries of the neighborhoods, creating distinct barriers for pedestrians to cross between residential areas.

However, most of the streets have a residential character, which create subdivision of the area into more and less quiet streets. Also, residential streets have greater potential to become small-scale restorative landscapes, as streets can accommodate shares activities for the community, improving public life and increasing social interaction amongst residents.

Residential streets have a pivotal role in social connectedness. Creating spaces where people can share, and get to know each other, can boost the social bonds of Rotterdam South. Such designs transform public space into an urban living room (Harteveld, 2020) that accommodates shared experiences and memories.

Looking into the photos of the streets in figure 33, high car dominance is observed in public space. Cars take the place for mobility but also as parking lots, which shows the strong attachment of residents to their car. The availability of green in the streets is minimum, and sidewalk space is limited.

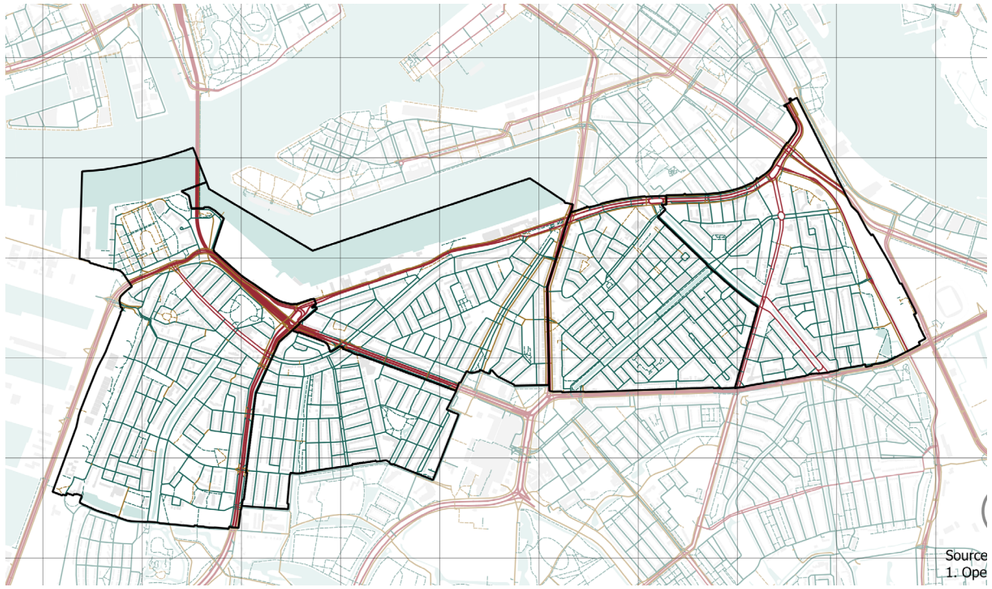



**Figure 32:** Map of street types in Rotterdam South (data source: OSM)




1. Primary Street
Pleinweg




2. Secondary Street
Wolphaertsbocht




3. Residential Street
Ranonkelstraat




4. Living street
Talingstraat




5. Cycleway
Brielselaan

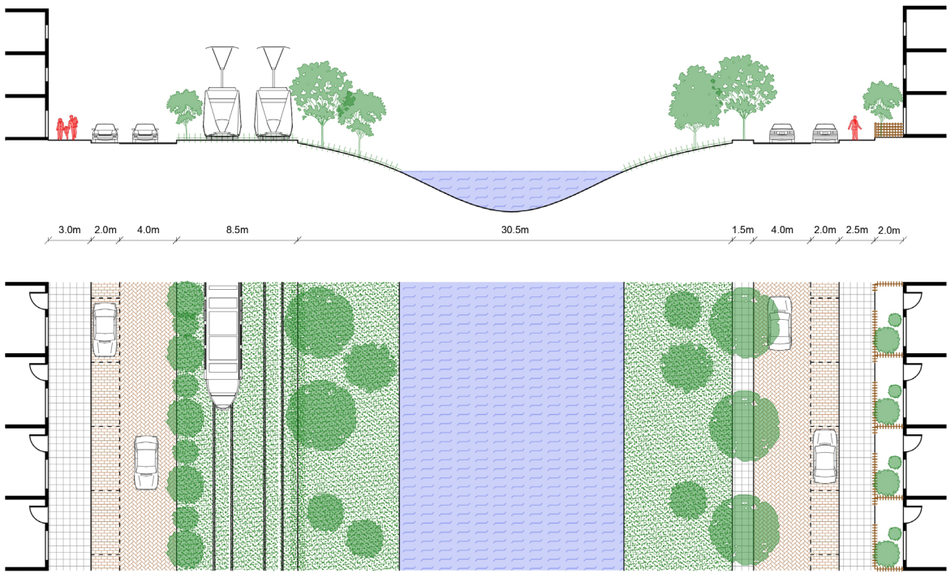



6. Single
Katendrechtse Lakendijk

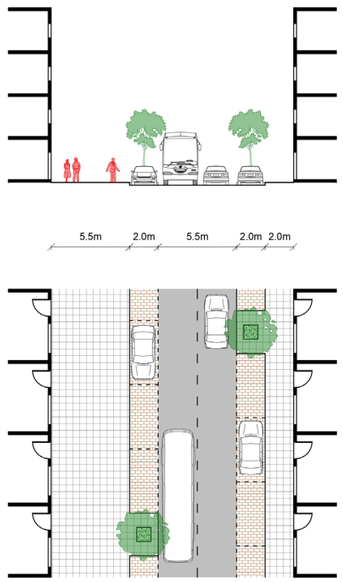
**Figure 33:** Photos of street typologies, by Google Maps

## Street Profiles

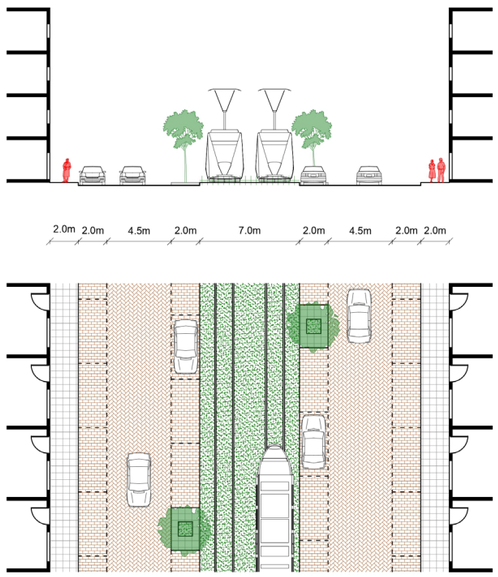
### Singel



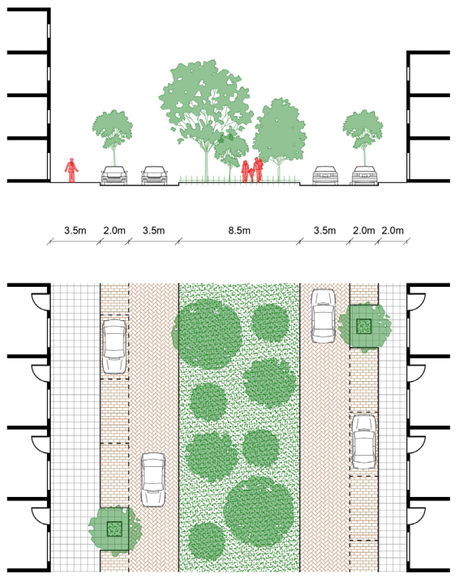

### Tertiary Streets




### Primary Streets




### Secondary Streets




### Residential Streets

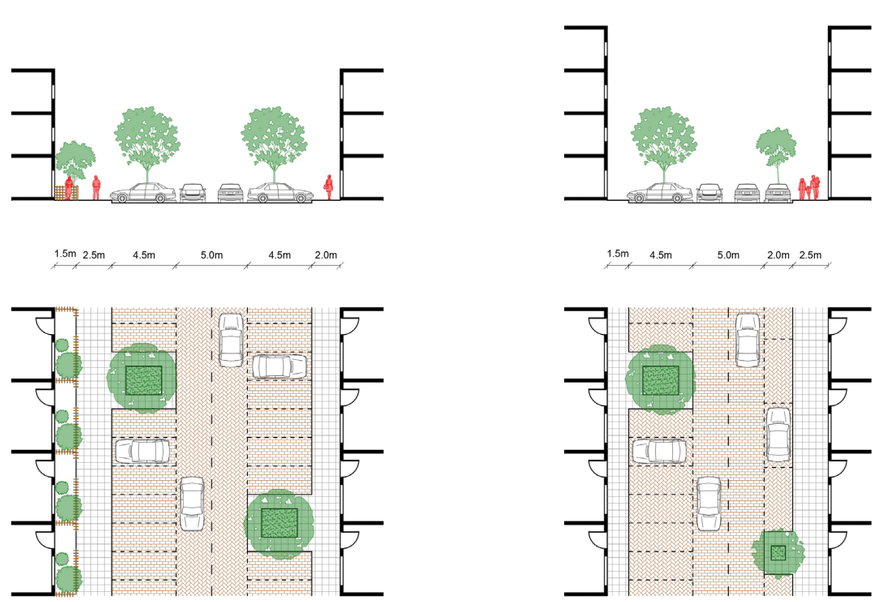



**Figure 34:** Street profiles in the area

## Public Transport

Rotterdam South has an extensive plurality of public transport systems, which create a foundation for good connectivity with Rotterdam North. Observing the different stop locations, it is evident that access to public transport is available. However, it is not clear yet that the consistency and frequency of the network, appear to be inconclusive.

Nevertheless, the proposed network of public spaces should facilitate the use of public transport. A safe network, that prioritizes pedestrians and cyclists can offer more opportunities for the residents to use public transport instead of cars.

Consequently, as the demand increases, the frequency and efficiency of public transport would adjust accordingly to meet the need of the population of Rotterdam South.

It is also important to consider the spatial expression of public transport. As presented in the photos of Figure 35, the infrastructure of certain transportation systems is very evident in the public space. This infrastructure appears as a barrier and is usually noisy, while the leftover places are hidden, and dark, again dominated by cars in the form of parking lots. These are qualities that should be addressed in the design, to integrate more restorative landscapes in the city and facilitate the movements of residents along the proposed network.




1. Maashaven subway station



2. Elevated subway infrastructure



3. Tram station at Wolphaertsbocht

**Figure 35:** Photos of public transport infrastructure, by Google Maps

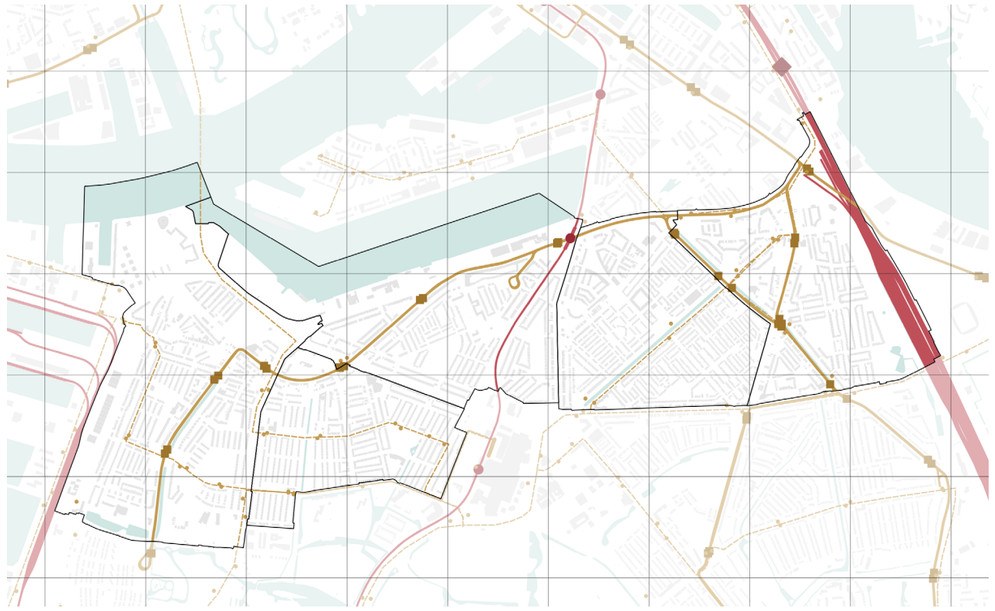



**Figure 36:** Map of transport network in Rotterdam South (data source: OSM)

## Restorative Environments

### Parks and Playgrounds

The public space of Rotterdam South, besides streets, consists of parks and playgrounds. Therefore, the network of public spaces, as a restorative environment, aims to connect those places, while integrating more urban nature.

In Figure 38 many playgrounds are scattered in the urban fabric with a higher concentration in the Bloemhof neighborhood. Each of these playgrounds has the potential to become part of the network and accommodate more space that can be restorative for young and older adults.

The parks in the area present a variety of sizes and locations. Though not many parks are available in the neighborhoods, they have large sizes. However, urban nature needs to be multi-scalar, from small pocket parks on the corner of a block to larger parks where more activities can take place (Roe & McCay, 2021).

The network should consider that the existing parks are not sufficient for the density of this area. As the city attracts more and more residents, more space for green should be secured. This way, the experience of the city will be more pleasant, and the availability of urban nature can serve the different needs and interests of the people.



1. Amelandseplein park | Carnisse



2. Playground at Texelsestraat | Carnisse



3. Nachtegaalplein park | Oud Charlois

**Figure 37:** Photos of parks and playgrounds, 30 Nov 2022




**Figure 38:** Map of parks and playgrounds in Rotterdam South (data source: OSM)

## Street Greenery

Street greenery is an important element for well-being and is argued to have important restorative characteristics. Even, a view of a tree from the window or the experience of walking in a green street can benefit the mental condition and improve the perception of a neighborhood.

In South Rotterdam, the greenest environments are predominately in parks and along singels. However, street greenery is also observed on several main roads (fig. 40) Tree canopies can improve the micro-climate of a street, provide shade during summer months and reduce the heat stress effect.

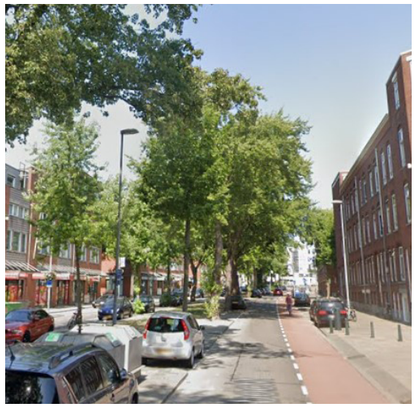
In the area the absence of street greenery is evident. Specifically in residential streets, where greenery could improve the neighborhood experience, trees are not available and therefore, the residents lack the opportunity to interact with natural elements that improve their well-being.

Additionally, looking into the quality of street greenery (fig.39), there is a very low contribution to biodiversity. Street greenery is limited to trees and grass, which while advantageous, still misses the opportunity to integrate a variety of nature species to improve biodiversity and contribute to recent environmental challenges.

Nevertheless, street greenery is essential for different reasons. It can advance the experience of the pedestrian, as well as the climatic conditions. At the same time, street greenery contributes to biodiversity and facilitates the connectedness of green infrastructure in the city, creating a pleasant and diverse environment that re-establish human-nature coexistence.



1. High street greenery | Dordtselaan



2. Medium street greenery | Wolphaertsbocht



3. Low street greenery | Carnisselaan

**Figure 39:** Photos of street greenery, by Google Maps

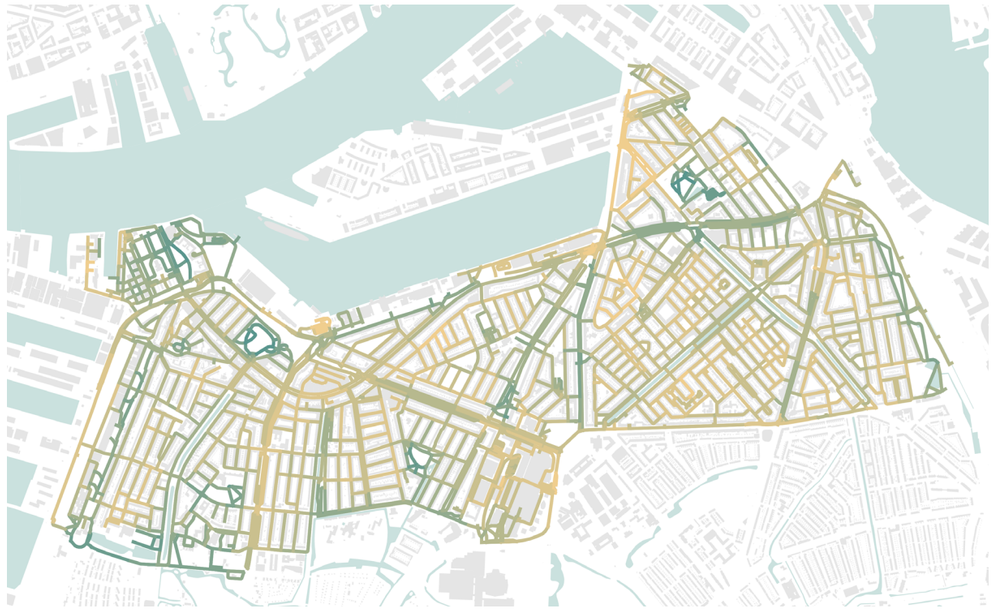
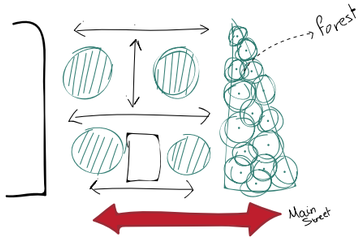



**Figure 40:** Map of street greenery in Rotterdam South (data source: HumanKind, edited)

# Urban Nature in South Rotterdam

**1. Dokhavenpark**
Oud Charlois



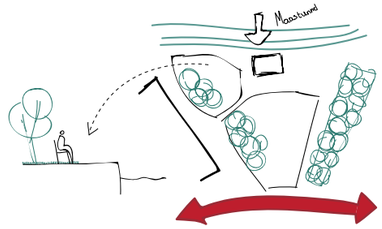



**PROS**
- Contact to water
- Large area

**CONS**
- Isolated in urban fabric
- Weak connection to residential area
- Lack of biodiversity
- Close to industries

**2. Maastunnel park**
Oud Charlois



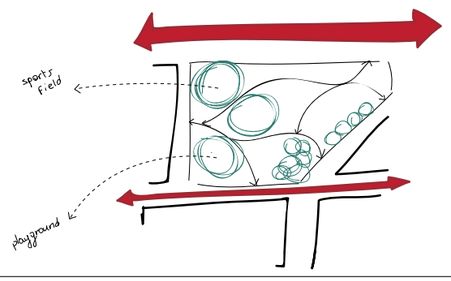



**PROS**
- The entry to Rotterdam South from Maastunnel
- Large area
- Contact to water

**CONS**
- Main street works as a strong boundary
- Lack of biodiversity
- Lack of direct routes

**3. Karel de Stouteplein**
Oud Charlois






**PROS**
- Connected to residences
- Distincted in smaller areas with pathways
- Rich biodiversity
- Availability of playground

**CONS**
- Adjacent to main streets
- Lack of amenities to activate the park

**4. Rietdijk Linear Park**
Oud Charlois



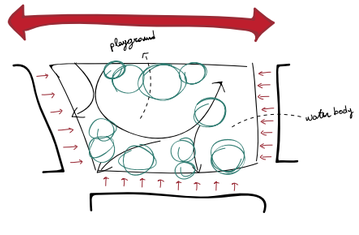


**PROS**
- Make use of a dijk to create a linear park
- Different levels to seperate from industries

**CONS**
- Not connected to areas beyond the adjacent residences
- Lack of activities beyond some sport fields

**5. Amelandseplein**
Carnisse






**PROS**
- Connected to residences
- Distincted in smaller areas with pathways
- Rich biodiversity
- Availability of playground

**CONS**
- Adjacent to main street
- Lack of amenities to activate the park

**6. Carnissedreef**
Carnisse



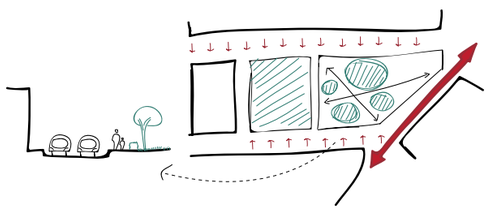


**PROS**
- Contact to water
- Connecting element in the urban fabric
- Pedestrian/cyclist path
- Availablity of playground

**CONS**
- Adjacent to streets and parking areas
- Lack of connectivity in the transverse axis

**7. Millinxpark**
Tarwewijk



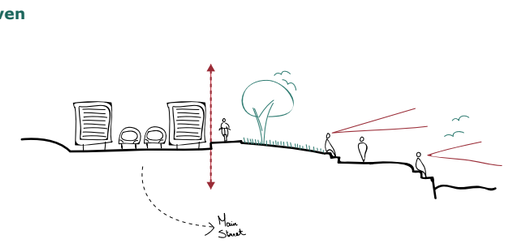


**PROS**
- Connected to multifunc-tional building
- Located in the heart of residential area

**CONS**
- Lack of biodiversity
- Lack of amenities to activate the park
- Adjacent to streets and parking areas

**8. Balkon aan de Maashaven**
Tarwewijk



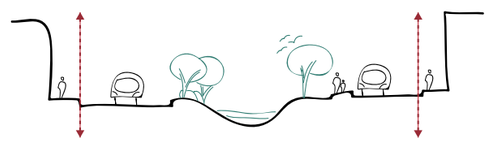



**PROS**
- Contact to water
- Connected to cycling network

**CONS**
- Isolated in urban fabric
- Weak connection to residential area
- Lack of biodiversity

**9. Lange Hilleweg**
Bloemhof



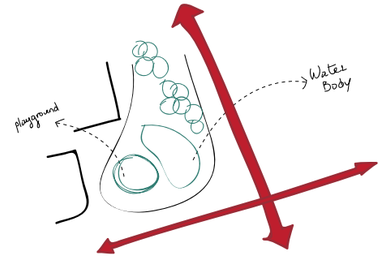


**PROS**
- Contact to water
- Connecting element in the urban fabric
- Pedestrian/cyclist path

**CONS**
- Adjacent to streets and parking areas
- Lack of connectivity in the transverse axis

**10 Varkenoordse Park**
Hillesluis






**PROS**
- Contact to water
- Large area
- Availability of playground
- Direct paths in greenery

**CONS**
- Adjacent to railway, air and sound pollution
- Lack of amenities to activate the park

## Third Places

To address social connectedness, I looked into places that encourage socializing and interaction, but also improve the feeling of belongingness and the formation of a community. Having that said, Figure 42 shows places of leisure, like bars and cafes, places of education, and cultural places, like libraries, and event venues. These places are defined by Oldenburg (1991) as third places, which are social environments that are distinct from home (first place) and work (second place). These are the informal gathering spots where people can relax, socialize, and foster community connections. Third places serve as the anchors of community life and are essential for social engagement and a sense of belonging (Oldenburg, 1991). They provide such characteristics that attract a diverse population and foster social interaction (Mehta & Bosson, 2010).

The purpose of mapping those places is first to locate the clusters in the area and identify the already existing relationships between places. For example, we observe cafés and restaurants along the main streets, but also around parks and close to schools.

Also, we can see the clustering of schools, which leads to the conclusion that kids may walk or cycle to go to their school, hence the need for safe pathways that improve accessibility.

Finally, the lack of amenities in some areas, like the southern Oud Charlois, or the southern Hillesluis, represents a need for more scattered opportunities for leisure and socializing.

The proposed network aims to first connect and improve accessibility to those places, while in the meantime creating places where new places such as the ones explained, can flourish.



1. Feyenord Library



2. Public Elementary School De Triangel



3. Square along Pleinweg

**Figure 41:** Photos of third places, by Google Maps

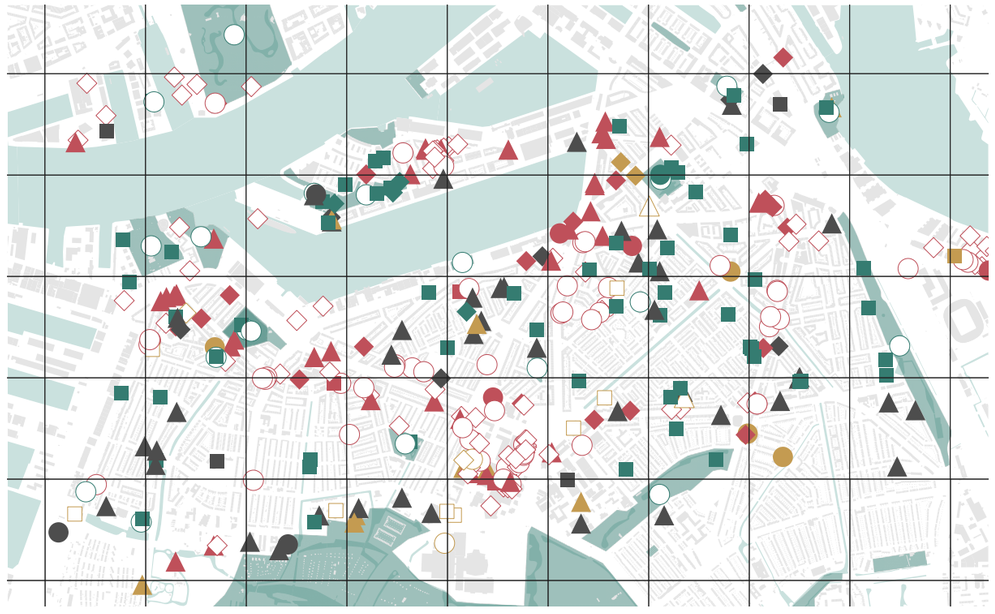



**Figure 42:** Map of places of interest in Rotterdam South (data source: OSM)

# Urban Stressors

## Sound Pollution, Flood Risk and Heat Stress

Designing a restorative landscape is also about creating comfortable environmental conditions for the user. This means that the design of each public space, as well as the network, addresses sound pollution, heat stress, and flood risk problems.

In Figure 43, we can relate sound pollution to primary streets and industrial activity (closer to the port). Of course, traffic in the area is a challenge, with the use of cars in the area reaching more than 2000 cars per km2. (CBS, 2020) Noise nuisance can disturb sleep and cause cardiovascular disease (RIVM, n.d.) and during the day creates an unpleasant and unsafe environment, that possibly increases stress and anxiety. Public space becomes unwelcoming and the opportunities of appropriating the space for activities are limited.

Additionally, Figure 44 shows clearly the effect of nature on heat stress. It is evident that where parks exist, the temperature is lower, while industrial activities such as the ones in the West produce very high environmental temperatures.

Finally, flood risk is found in several different locations in the area. (Figure 45) This means that in the selected public spaces, the flood risk should be checked, and adjust the design accordingly.




**Figure 43:** Map of Sound Pollution in Rotterdam South (data source: RIVM, OSM)




**Figure 44:** Map of heat stress in Rotterdam South (data source: Klimaatatlas, OSM)

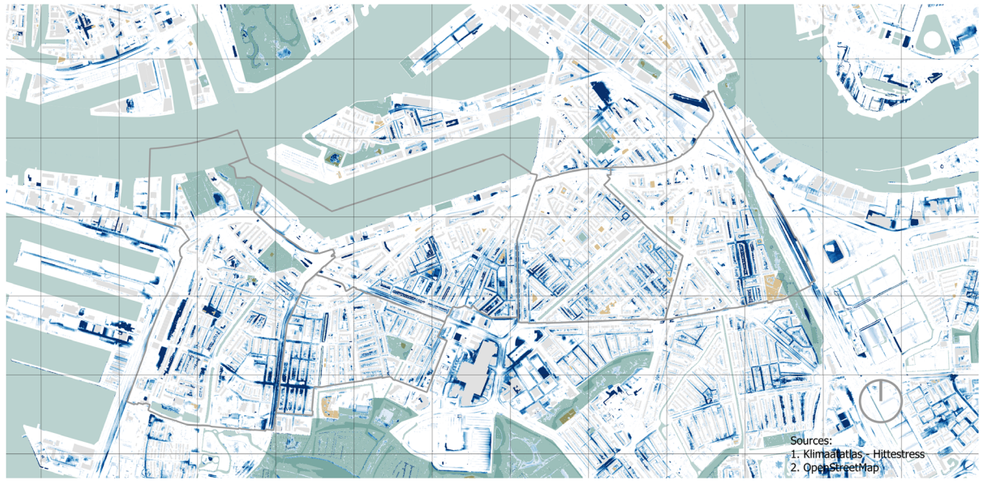
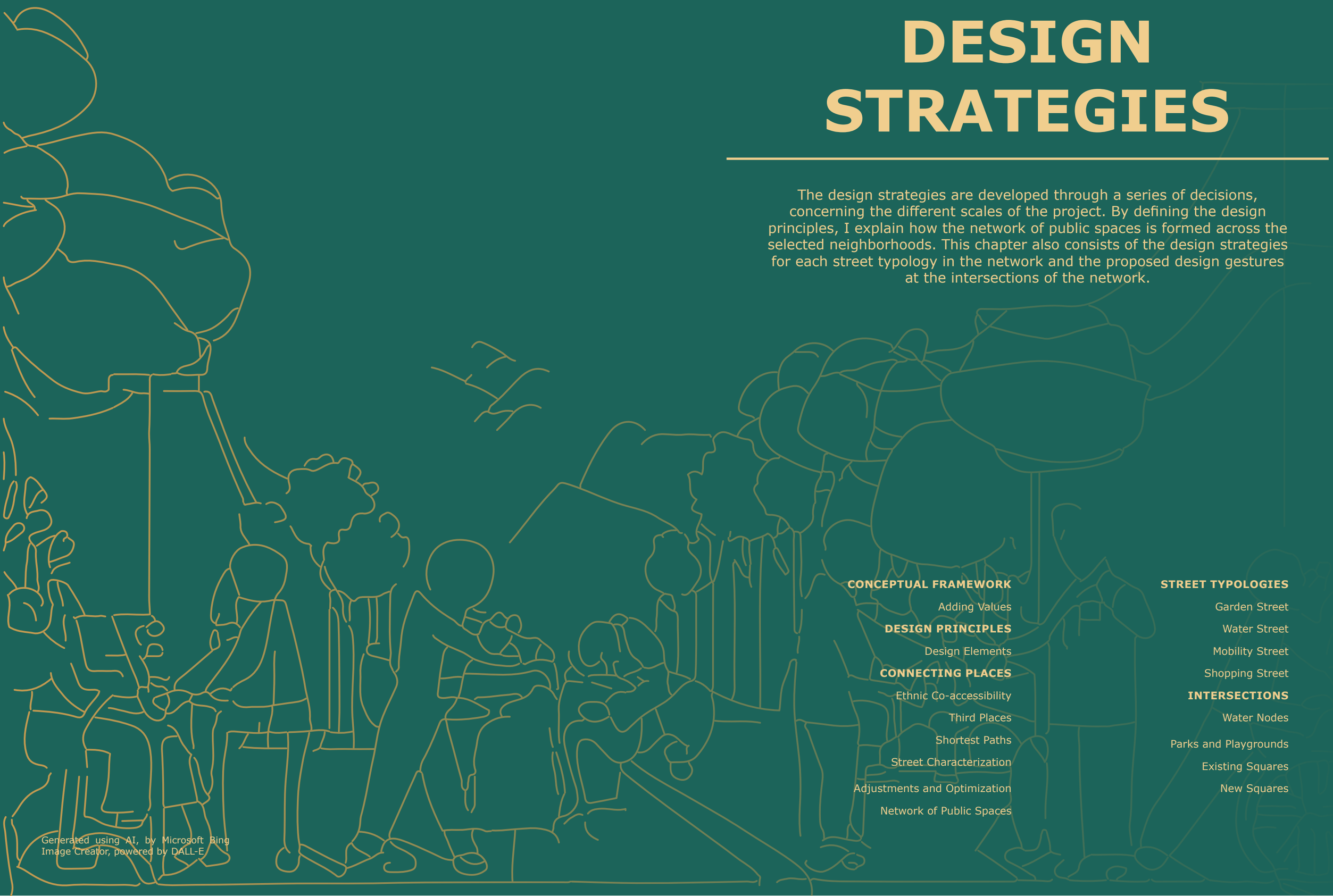



**Figure 45:** Map of flood risk in Rotterdam South (data source: Klimaatatlas, OSM)

# DESIGN STRATEGIES

The design strategies are developed through a series of decisions, concerning the different scales of the project. By defining the design principles, I explain how the network of public spaces is formed across the selected neighborhoods. This chapter also consists of the design strategies for each street typology in the network and the proposed design gestures at the intersections of the network.



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**CONCEPTUAL FRAMEWORK**

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**DESIGN PRINCIPLES**

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Street Characterization

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Network of Public Spaces

**STREET TYPOLOGIES**

Garden Street

Water Street

Mobility Street

Shopping Street

**INTERSECTIONS**

Water Nodes

Parks and Playgrounds

Existing Squares

New Squares

## Conceptual Framework

Researching the theoretical concepts elaborated in the previous chapters, I concluded that restorative landscapes, with an increased sense of aesthetics and attractiveness, encourage people to engage in activities and enhance social interaction. Thus, to promote ethnic diversity in Rotterdam South, through stimulating opportunities for social interaction, I propose the development of a network of public spaces that is accessible and appealing, motivating a diverse population to use public space.

Connecting places fosters accessibility and improves coherence in the city. However, to ensure the success of such a network, I established specific activities that relate to public life, increasing the potential of the network to be vibrant. A livable network reduces the potential for criminal activity. Having people moving around the city forms social control and minimizes the risk of unwanted behaviors. The selection of these locations refers to ethnic diversity as well, using a specific methodology to facilitate the participation of diverse ethnicities in these places.

The components of the network reflect the daily public life of a multi-ethnic city. Initiating the network from leisure locations, such as parks and playgrounds, I ensure the availability of accessible and inclusive public spaces, that have restorative effects on well-being and promote ethnic diversity. Third places serve the daily needs of residents in a city and motivate movement across the network. I, therefore, propose to include the existing places to encourage the appropriation of public space by shops, bars, and restaurants, establishing an active and enriched public life. Transforming streets, that function as connectors of the network, into living streets, I create opportunities for community engagement, shared activities, and experiences between neighbors, improving feelings of trust and belonging among citizens.

The network, as an extended public space in South Rotterdam, stimulates restorative environments across neighborhoods, increases opportunities for meetings, and promotes ethnic diversity and social connectedness, hence improving social cohesion in the area.

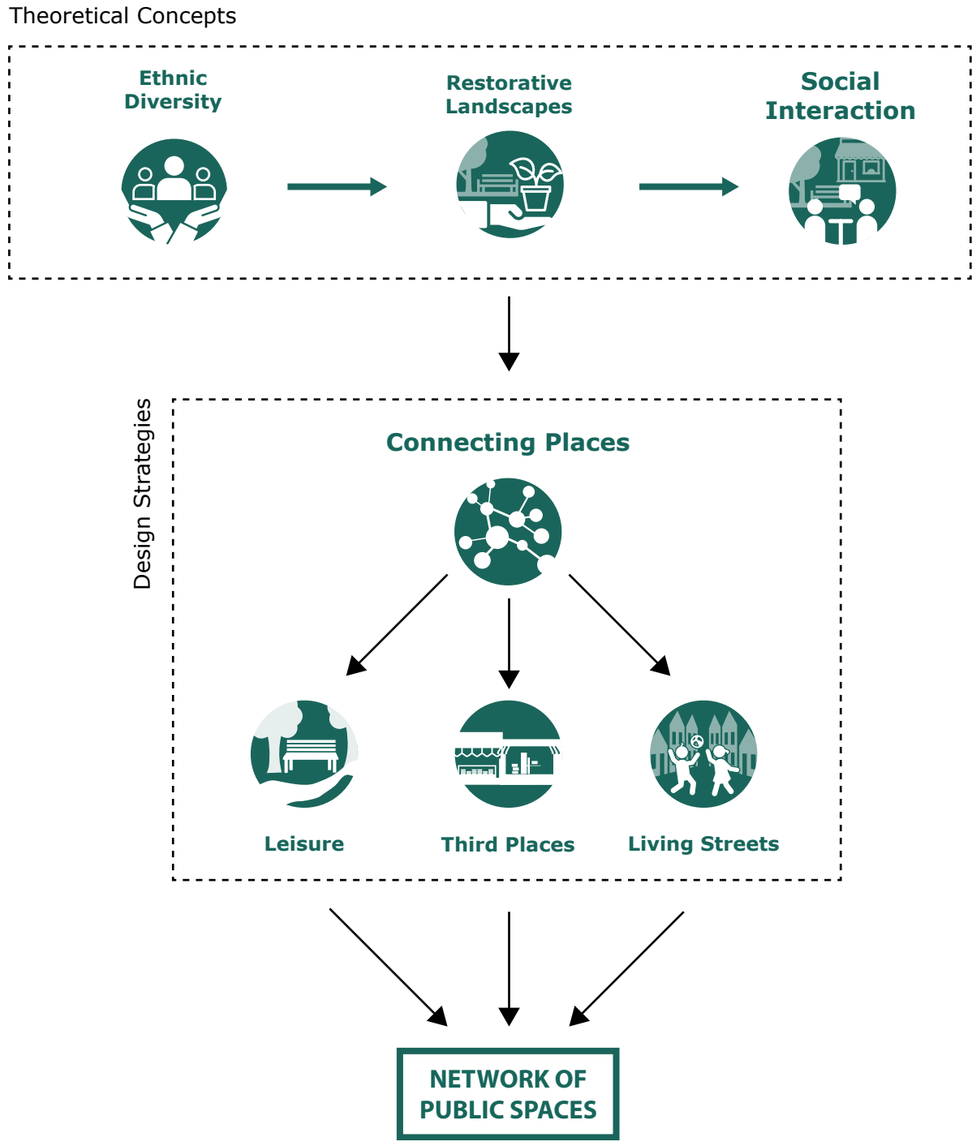



**Figure 46:** Conceptual Framework

## Adding Values

The proposed network comes in place to improve public space in South Rotterdam. The need of residents for a better neighborhood experience results in specific added values. Through the design strategies and later with specific design decisions for the selected interventions, I argue that such a network can increase the feeling of belonging, by allowing the realization of social capital, offer a safe environment by increasing social control, and provide quality public space with restorative characteristics.

**Feeling of belonging**

The proposed strategies apply in different scales. They aim to connect inhabitants of the deprived neighborhoods with each other, and also create places in the network where they can share experiences, acknowledge their coexistence through social interaction, and communicate to make acquaintances and form social bonds. More specifically, the feeling of belonging is enhanced by creating conditions for the residents to appropriate the streets (Harteveld, 2020), express themselves, and form their environment, allowing more personal control of the space and improving the livability of their neighborhoods. (van Dorst, 2012)

**Safety**

The feeling of safety is very important for South Rotterdam since residents report that incidents are often taking place in public spaces. (Doff & Snel, 2022) Therefore, the proposed network addresses safety from the lenses of social control. As streets are strategically becoming livable spaces, more eyes are directed at them. The way Jane Jacobs phrases social control as "eyes on the streets", perfectly applies to this occasion. (Jacobs, 1992) Transforming streets into places where residents are welcome to activate, and domesticate, favors the attention given and the care for public space and its users. Also, the streets as shared livingrooms among the inhabitants increase accountability and hence it is becoming less likely to have such incidents.

**Quality Public Space**

In deprived neighborhoods, public space is usually neglected. This is the case in Rotterdam South too. Especially, with multi-ethnic neighborhoods and the presence of non-western ethnic minorities, it is important to acknowledge the behavioral patterns of the specific ethnicities and adapt to their needs. As mentioned already, the different scales of this network come to answer this need as well. The most accessible locations have a super diverse character and facilitate the coexistence of diverse users. However, in less central locations, like the street or the playground of the residential block, public space adapts and meets the need of the people that live there. More importantly, public spaces in all scales obtain quality by introducing new programs, also adjusted for the users by creating conditions for flexibility and appropriation.





# Design Principles

This project aims to integrate restorative environments in the city, to stimulate social interaction between different ethnic groups. In this respect, I curried a literature review to derive specific design principles that are organized into three categories, *landscape experience, improved well-being, and social interaction*. The purpose of those categories is to create environments that attract the residents through specific design elements, promote well-being by integrating restorative qualities and create spaces that facilitate interaction.

**Landscape Experience**

Landscape experience is discussed by Kaplan et al. (1998) for its relation to the effect on perception, arguing that natural elements can inspire a feeling of *being away,* by allowing our minds to travel and get our attention, even with a view of a tree from a window. They also suggest that nature-based settings provide *extent*, creating such sceneries that stimulate the imagination to the unlimited space and time. In their work, they analyzed the impact of landscaping on the *fascination* of users, where the environment engages the user, creating challenges and uncertainties, while remaining *compatible* with their expectations (Kaplan et al., 1998).

In addition, Meyer (2008) refers to the landscape from the perspective of sustainability. She supports that *aesthetics* go beyond appearance and encompass the formation of "poly-somatic sensory experiences" that reveal ecological processes. She also discussed the *performance* of the landscape that should reflect on the three pillars of ecology, society, and culture. Lastly, she argues that landscape experiences can raise *awareness* and inform regarding ecological processes while creating cultural impact, and forming new norms (Meyer, 2008).

**Improved Well-being**

The principles that improve well-being are adopted from the work of Roe and McCay (2021) who introduce a framework for restorative cities. They suggest that environments should integrate *green* and *blue* elements, by enhancing urban nature and strengthening the interaction between people and water elements, like canals, singels, fountains, etc. Urban infrastructure should promote an *active* lifestyle by improving accessibility to public transport and strengthening public space with distinct and wide pedestrian and cycling routes. Make navigation easy with landmarks and design, creating key attractors and safe pathways with lightning and frequent seating. They, further, propose to promote *sensory* experiences, benefiting from sound deriving from schools, playgrounds, nature, and animals, improving visual stimuli, and empowering pleasant smells in public spaces. At the neighborhood level, the city should be also *playable*, providing frequent small-scale playing infrastructure that engages curiosity and offers room for flexible play. Finally, restorative cities should stimulate *inclusivity,* creating spaces that can accommodate different groups through subdivided areas and ensuring natural surveillance, also encouraging social interaction to empower social connectedness and shared activities to create *neighborly* experiences (Roe & McCay, 2021).

**Social Interaction**

Social interaction is researched by different scholars, exploring the elements that contribute to engaging in shared activities. Mehta and Bosson (2010) distinguish four principles, including *shelter* that provides protection and can be structural (pergola) or natural (tree canopies). They also argue the importance of *seating* in public spaces, also supported by Gehl (2011), to create opportunities for socializing, especially during eating and drinking activities (Gehl, 2011; Mehta & Bosson, 2010). *Permeability*, in addition, is believed to encourage social interaction. Presenting the interior of shops and demonstrating products in the street, increase the understanding of the activity that takes place inside, and stimulates curiosity and interest. (Mehta & Bosson, 2010) Lastly, the *personalization* of public space, or domestication, as described by Harteveld (2020), creates a sense of belonging, through claiming territory, caring, and nurturing the surrounding environment (Harteveld, 2020; Mehta & Bosson, 2010).

## Design Elements

STRUCTURAL ELEMENTS
NATURAL ELEMENTS

| DESIGN PRINCIPLES | DESIGN ELEMENTS | Singular Elements | | | | | | | | | | Spatial Setting | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Tree | Bush | Mounds | Fountain | Water steps | Street Light | Bike Rack | Bench | Flexible Furniture | Artwork | Tree Canopy | Vegetables / Herbs Garden | Flower / Plants Garden | Water sprinklers | Water platform | Pergola | Urban Living Room | Workshop Space | Community Room | Playground | Skate park | Exercise Equipment | Dog park |
| Landscape Experience | **Being Away** (Kaplan et al., 1998) | ● | ● | ● | ● | ● | | | | ● | | ● | ● | ● | ● | ● | | | ● | | ● | ● | | ● |
| | **Extent** (Kaplan et al., 1998) | ● | ● | | ● | ● | | | | | | ● | | | | ● | | | | | | | | |
| | **Fascination** (Kaplan et al., 1998) | | | ● | | ● | | | | | ● | | ● | ● | ● | | | | ● | | ● | ● | ● | ● |
| | **Compatibility** (Kaplan et al., 1998) | ● | ● | ● | ● | ● | | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | **Aesthetics** (Meyer, 2008) | ● | ● | ● | ● | ● | ● | | | | ● | ● | ● | ● | ● | | ● | ● | | | ● | ● | ● | ● |
| | **Performance** (Meyer, 2008) | | | | | ● | | | | ● | | ● | ● | ● | ● | | ● | ● | | | | | | |
| | **Awareness** (Meyer, 2008) | | | ● | ● | ● | ● | | ● | ● | ● | ● | ● | ● | ● | ● | | | | | ● | ● | ● | ● |
| Improved Well-being | **Green** (Roe & McCay, 2021) | ● | ● | ● | | ● | | | | | | ● | ● | ● | | ● | | | | | | | | |
| | **Blue** (Roe & McCay, 2021) | | | | ● | ● | | | | | | | | | ● | ● | | | | | | | | |
| | **Sensory** (Roe & McCay, 2021) (Meyer, 2008) | ● | ● | ● | ● | ● | | | | | ● | ● | ● | ● | ● | | | | ● | | ● | ● | | |
| | **Neighborly** (Roe & McCay, 2021) | | | ● | | | | | | ● | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● |
| | **Active** (Roe & McCay, 2021) | | | ● | | | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ● | ● | ● | | ● | ● | ● | ● |
| | **Playable** (Roe & McCay, 2021) | | | ● | ● | | | | | ● | | ● | | | ● | | | | | | ● | ● | ● | ● |
| | **Inclusive** (Roe & McCay, 2021) | | | ● | | ● | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Social Interaction | **Shelter** (Mehta & Bosson, 2010) | ● | | | | | | | | | | ● | | | | | ● | | ● | ● | | | | |
| | **Seating** (Mehta & Bosson, 2010) (Gehl, 2011) | | | | | ● | | | ● | ● | | | | | | ● | | ● | ● | ● | | | | ● |
| | **Permeability** (Mehta & Bosson, 2010) | | | | | | | | | | ● | | | | | | | | ● | ● | | | | |
| | **Personalization** (Mehta & Bosson, 2010) (Harteveld, 2020) | | | ● | | | | | | | ● | | ● | | | | ● | | ● | ● | ● | ● | | |

**Figure 47:** Design principles

# Connecting Places

### The benefits of connecting places

A network of public spaces can contribute to making public life in South Rotterdam more vibrant. By creating an attractive pedestrian network, people can be motivated to walk or step outside their houses, where there are more chances for them to engage in shared activities. Gehl (2010) describes that a high-quality physical environment increases the possibility of optional activities, such as stopping to enjoy nature or dragging a chair out of your house to sit in the sun or social activities, that include interaction and communication among citizens (fig.48) (Gehl, 2010). Key locations to connect in a network of public spaces are the ones that already accommodate interaction. Parks and squares offer space for the community to gather, engage in recreational activities and promote diversity, while local businesses provide opportunities for residents to interact, build relationships and form a sense of identity (Jacobs, 1992). The connections of the network, the streets, change character when physically altered to connect places. They become a "line of exchange along which two areas are sewn together" (Lynch, 1990). It is, therefore, critical to consider the network of public spaces, not as different locations that are interconnected, but more as continuous extended public space, that promotes walkability in the city, strengthens public space, and creates conditions that facilitate social interaction.

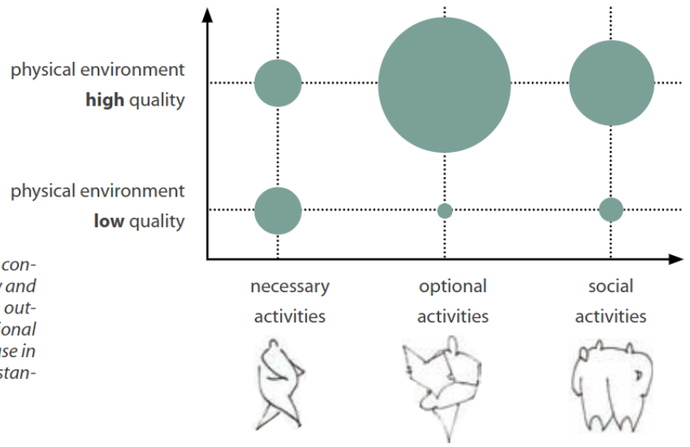
### Ethnic Co-accessibility

To integrate into the formation of this network the manifestation of ethnic diversity in public spaces, I need to encounter the ethnic groups in the area and the proximity of their place of residence to locations that are part of this network. To do so, I investigate the participation of different ethnic groups in public space, by measuring their co-accessibility in selected locations. Co-accessibility is used by Milias and Psyllidis (2022) to measure the degree to which different age groups have access to the same locations. Similarly, ethnic co-accessibility is introduced in this project to measure the degree to which different ethnic groups have (walking) access to the same leisure places, such as parks and playgrounds. Studies have shown that migrants develop a sense of attachment to natural environments in proximity to their residence and are more likely to walk to urban parks if in short distance (Peters et al., 2016). Therefore, this network comes to integrate such environments that not only introduce restorative qualities in public space but by doing so, encourage and motivate individuals to walk greater distances to reach urban parks. Ethnic co-accessibility can indicate which places have the greater potential for equal participation of different ethnic groups, increasing the possibilities for inter-ethnic social interactions.

### Third Places

To increase the opportunities for social interaction and to ensure the viability of the network and the movement along this, I also included third places. Third places are the locations that promote communication and social interaction, like café, shops, community centers, etc. (Mehta & Bosson, 2010) which create foundations to foster a community (Jeffres et al., 2009). Third place, compared to home (first place), and work/school (second place), concern the development of an individual's identity by self-expressing in public settings. For marginalized groups, though, Leittman (2021) argues that "collapsed places" can become a multi-functional hybrid place which is the overlap of first, second, and third places. Such places usually refer to institutionalized populations or people who can not physically participate in separate places, and thereby form a "collapsed place" (Littman, 2021). In this project, I investigate third places based on Oldenberg & Brisset's third place theory, which concerns the locations described previously.

Milias and Psyllidis (2022) refer to third places as activity locations and they argue that they are a "key component of spatial age segregation". Under the same line of thought, activity locations can be critical in tackling ethnic segregation in an area, hence integrating them in the formation of the network of public spaces.




*Graphic representation of the connection between outdoor quality and outdoor activities. An increase in outdoor quality gives a boost to optional activities in particular. The increase in activity level then invites a substantial increase in social activities.*

**Figure 48:** Quality of physical environment and consequent activities (Gehl, 2010)

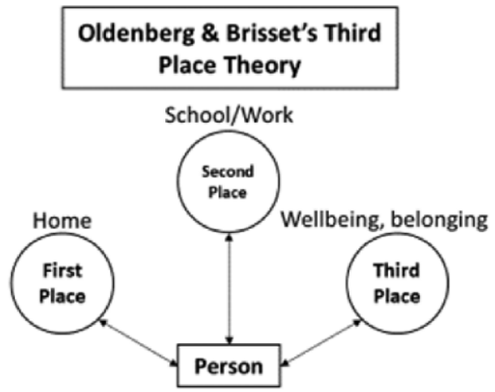



**Figure 49:** & Brisset's third place theory versus "collapsed place" theory (Littman, 2021)

**Connecting Places - Methodology**

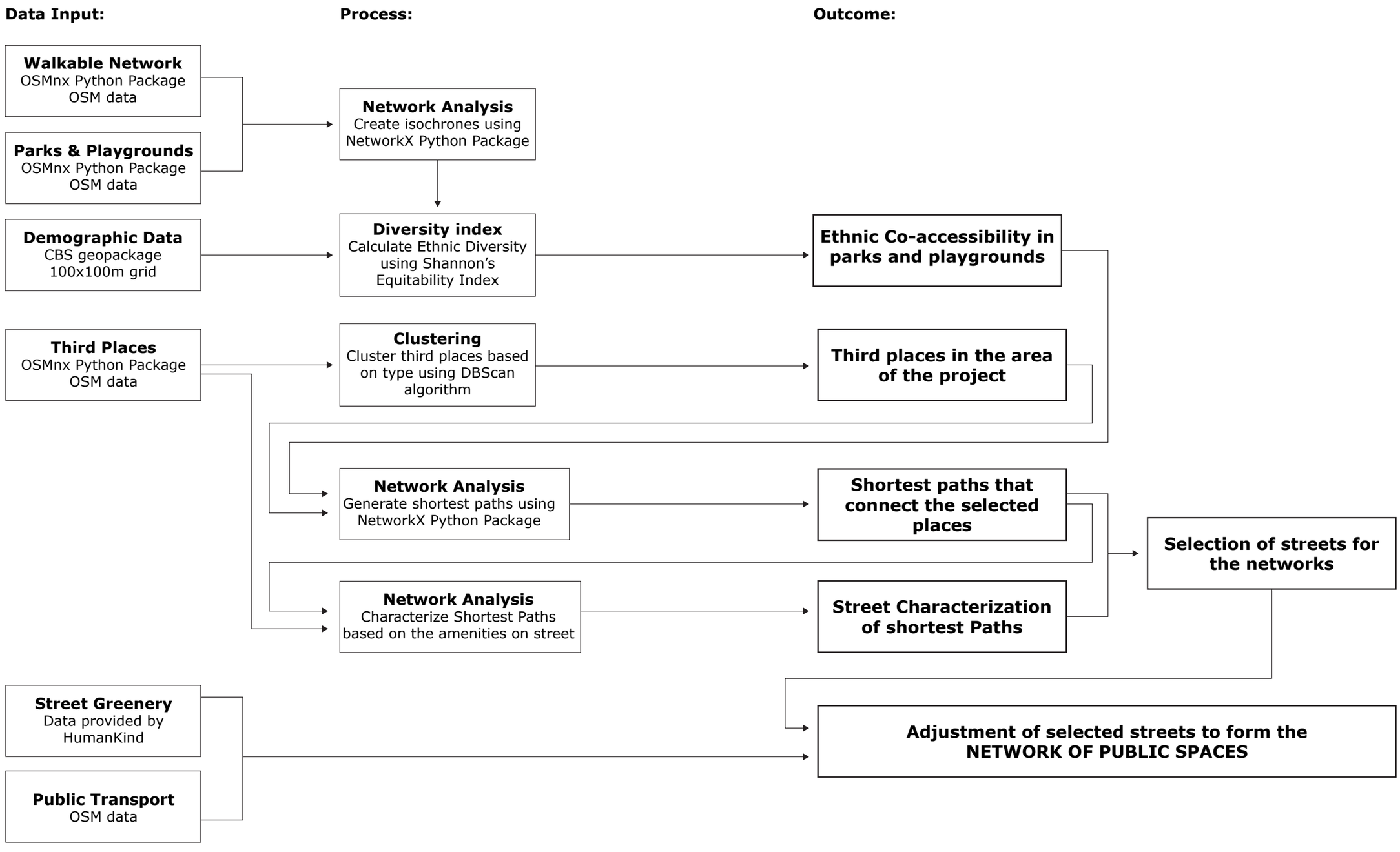



**Figure 50:** Connecting Places - Methodological Diagram



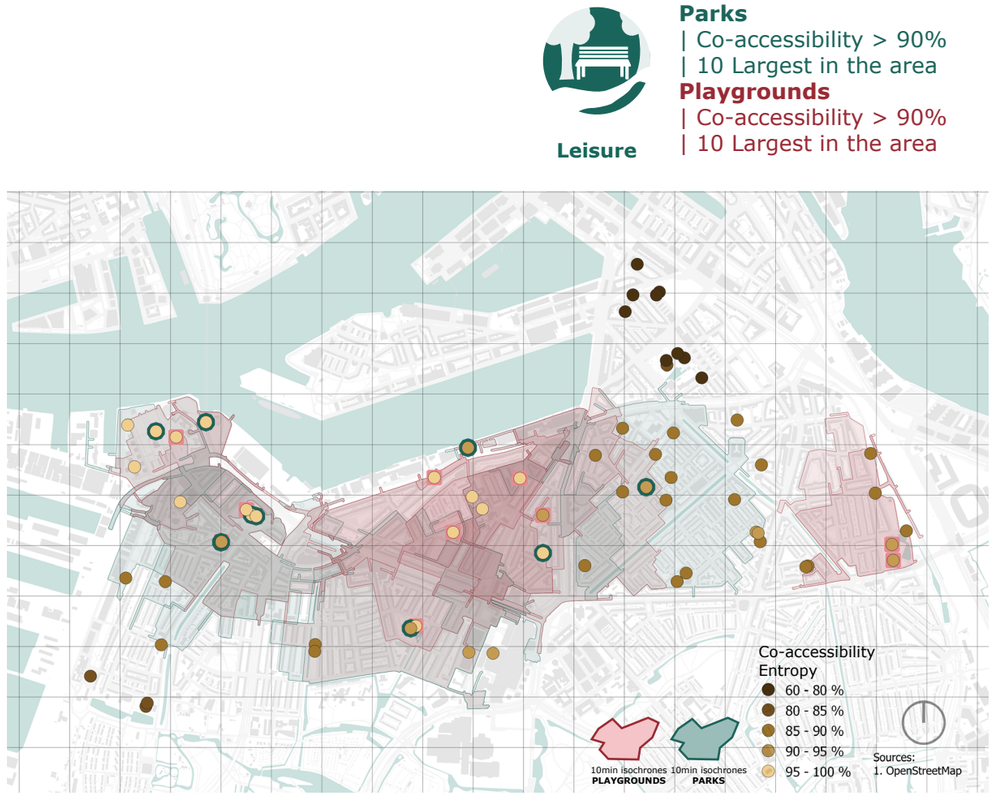

**Figure 51:** Ethnic Co-accessibility Diagrams

## Ethnic Co-accessibility

To measure the ethnic co-accessibility of the selected neighborhoods' parks and playgrounds, the methodology proposed by Milias and Psyllidis (2022) was followed. OpenStreetMap, an open-source mapping platform, with worldwide geographic data (OpenStreetMap contributors, 2015) was used to retrieve the pedestrian network, as well as parks and playgrounds in the administrative boundaries of the six neighborhoods, namely Oud Charlois, Carnisse, Tarwewijk, Bloemhof, Afrikaanderwijk, and Hillesluis. These data were extracted using the OSMnx python package, developed by Boeing (2017) to acquire and analyze networks (Boeing, 2017).

For each location (park or playground), an isochrone was generated for a 10min walk from the location, to determine the population that lives in proximity to these locations. CBS geographic data (Centraal Bureau voor de Statistiek, 2020) was used to collect spatial demographic information, specifically the ethnic background of the population, namely Dutch, Western, and Non-Western. Hence the demographic information that intersected with the isochrones was isolated and co-accessibility was calculated using Shannon's Equitability Index (Milias & Psyllidis, 2022), resulting in a classification of the locations according to the ethnic diversity calculated.

The map shows all parks and playgrounds in the selected neighborhoods, differentiated based on ethnic diversity. From these locations, the ten largest parks and ten largest playgrounds accessible by an ethnicity-diverse set of people (ethnic diversity of more than 90%) were selected to be part of the network.



**1. Selection of category**



**2. Define clustering criteria**



**3. Find centroids**

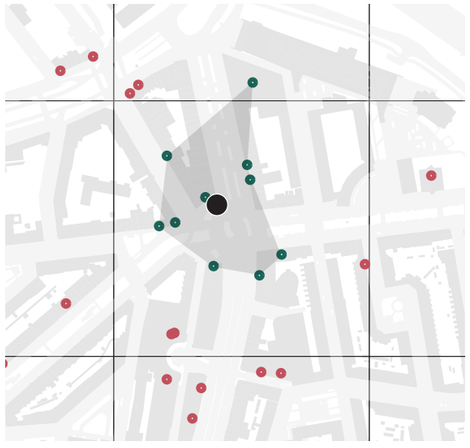


**Figure 52:** Clustering Third Places Diagrams

## Third Places

Third places, as explained previously, contribute to strengthening the sense of belonging and creating social connections (Oldenburg, 1991). They are introduced in the formation of the network by identifying clusters of them. Specifically, I distinguish third places into Shops & Sustenance and Culture & Public Buildings.

To create the cluster, I first retrieved the locations of third places, using the OSMnx python package (Boeing, 2017), and assign them to each category based on their type. In the Shops & Sustenance category, I included all the locations tagged by OSM as amenities, like bar, café, fast_food, etc., and shops, such as car_repair, dry_cleaning, kiosk, etc. In the Culture & Public Buildings category, I added locations like library, community_center, etc.

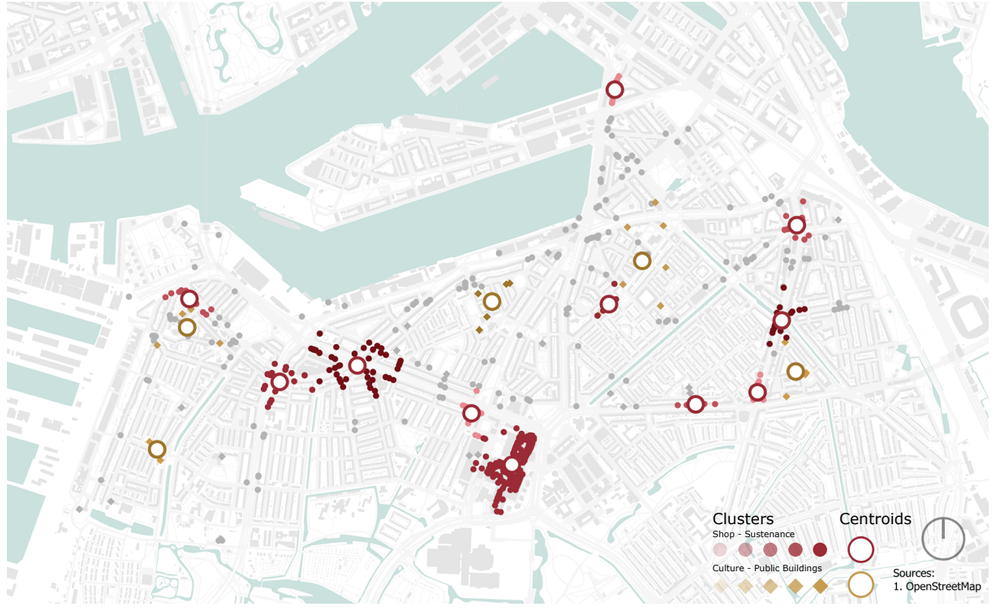
Afterward, using the DBScan, a density-based clustering algorithm (Hahsler et al., 2019), and defining the selected criteria for each category, the different clusters were separated. For each cluster, a centroid was found, which is later used to generate the network. To select the criteria for each category, I experimented based on their distribution in the urban fabric. Looking into the resulting centroids, I selected the criteria that spread in the area and at the same time, create clusters, small enough to be walkable over short distances. Consequently, defining a 100 m radius for Shop & Sustenance with a minimum of 10 amenities and a 200 m radius for Culture and Public Buildings with a minimum of 3 places.

In the map below, the resulting clusters are shown, with the centroids calculated across the area and the locations that were excluded in the clustering process.

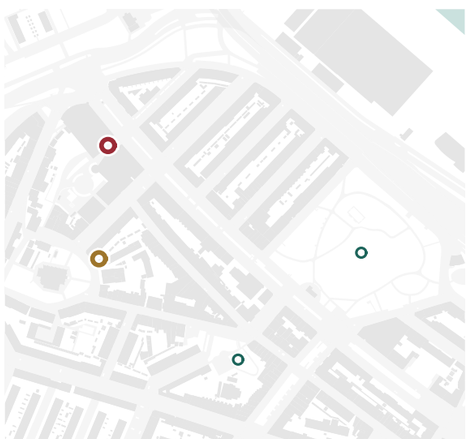
**Third Places**

**Shops & Sustenance**
| Min. Distance = 100m
| Min. Number = 10

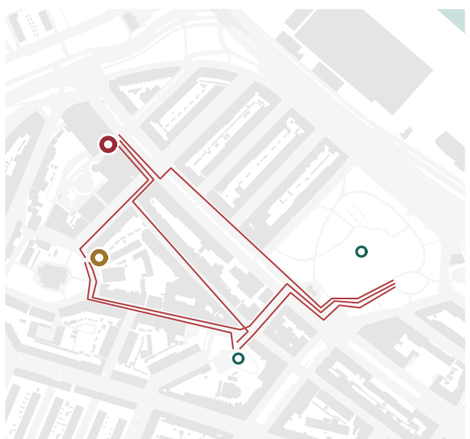
**Culture & Public Buildings**
| Min. Distance = 200m
| Min. Number = 3



**1. Selection of origins and destinations**



**2. Generate shortest paths on walkable network**



**3. Differentiate street segments repetition**

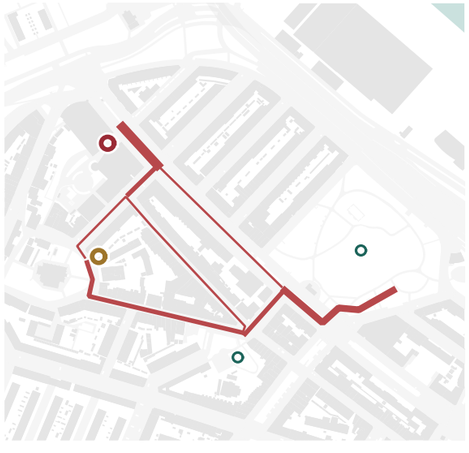


**Figure 53:** Generating Shortest Paths Diagrams

## Shortest Paths

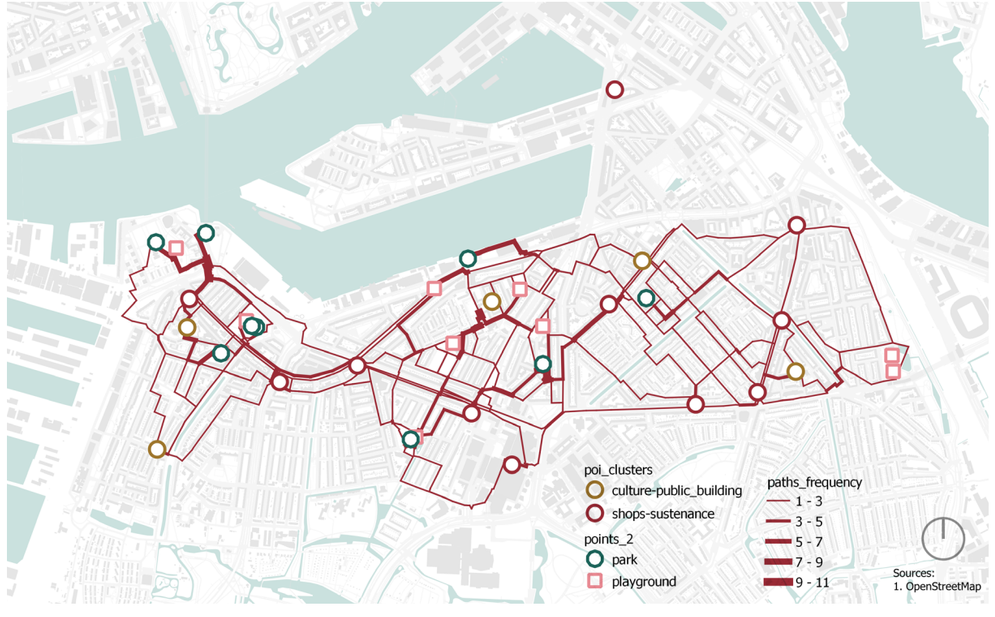
After collecting the locations that consist of the public spaces of the network, namely the parks and playgrounds, and the clusters' centroids, I proceeded in generating the shortest paths that connect those places. Using NetworkX, a Python package for analyzing graphs (Hagberg et al., 2008), I connected each of those places with the others, following the pedestrian network retrieved in the previous step, and kept all the shortest paths created whose lengths were less than 800 m (15 min walk), since people are more likely to walk in destinations that are in less than 15 minutes walking.

The set of the resulting shortest paths was then exploded into street segments and for each street segment I calculated how many times were used as the shortest path. By doing so, I was able to distinguish the street segments that are more convenient when connecting places. These streets have the potential to be more vibrant since they serve multiple movements and therefore the opportunities for social interaction are increased.

As illustrated in the map, the generated shortest paths are dense in some areas, creating three sub-regions. However, in the next steps, a selection of these paths will mitigate this effect and will equally distribute the network across the neighborhoods, to ensure access to the network for all pedestrians.

**Identify streets with potential to be most vibrant**

**Living Streets**



**1. Selection of generated shortest paths**



**2. Identify amenities along the paths**



**3. Extend the activities of the amenities on the street**

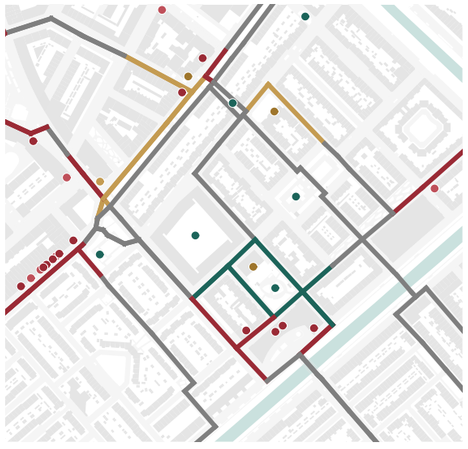


**Figure 54:** Street Characterization Diagrams

## Streets characterization

Street characterization is a strategy proposed here, following the principles defined by Mehta and Bosson (2010) regarding third places. They argue that third places, stimulate social interaction when they are personalized and permeable, among others (Mehta & Bosson, 2010). Therefore, by using this method, I advocate for extending the activities, taking place inside these locations, into public spaces (streets), strengthening public life, and making the streets more attractive.

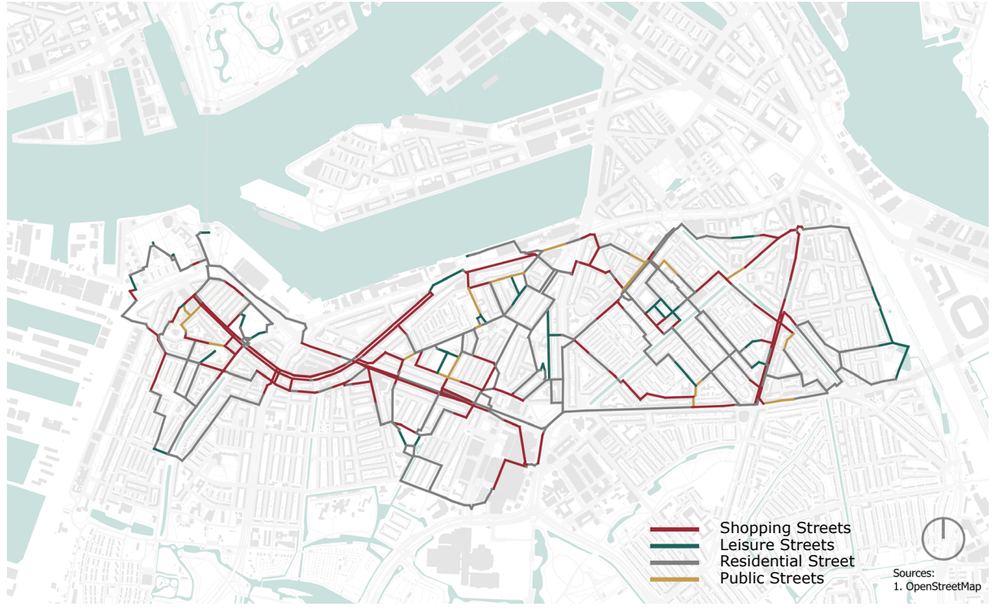
To achieve that, I used the locations selected and the shortest path generated in previous steps, to assign the activities of these locations to the streets. To do so, each street was characterized by the adjacent activity, organized into four categories, shopping streets, leisure streets, public streets, and residential streets. Shopping streets are those where one can find amenities that belong to the category of Shops and Sustenance, while Public streets are the ones adjacent to Culture and Public Buildings. Leisure streets were assigned due to their connection to leisure places (parks and playgrounds) and residential streets are the ones that didn't meet any of those criteria.

In cases where streets were assigned multiple categories, a prioritization distinguished the ones that are most pivotal for maintaining the diversity of qualities in the network. For example when a street was adjacent to a park, but has also a shop on it, the street was assigned as Leisure. Otherwise, most of the streets would likely have at least one shop and therefore be named Shopping Street.

The street characterization gives an approximation of the qualities that could be integrated into the design of the street to contribute to the aim of the project. However, fieldwork analysis can reveal other needs in that street and require adjustment of the network's plan.

**Identify streets change of qualities along the path to become more attractive**

**Living Streets**



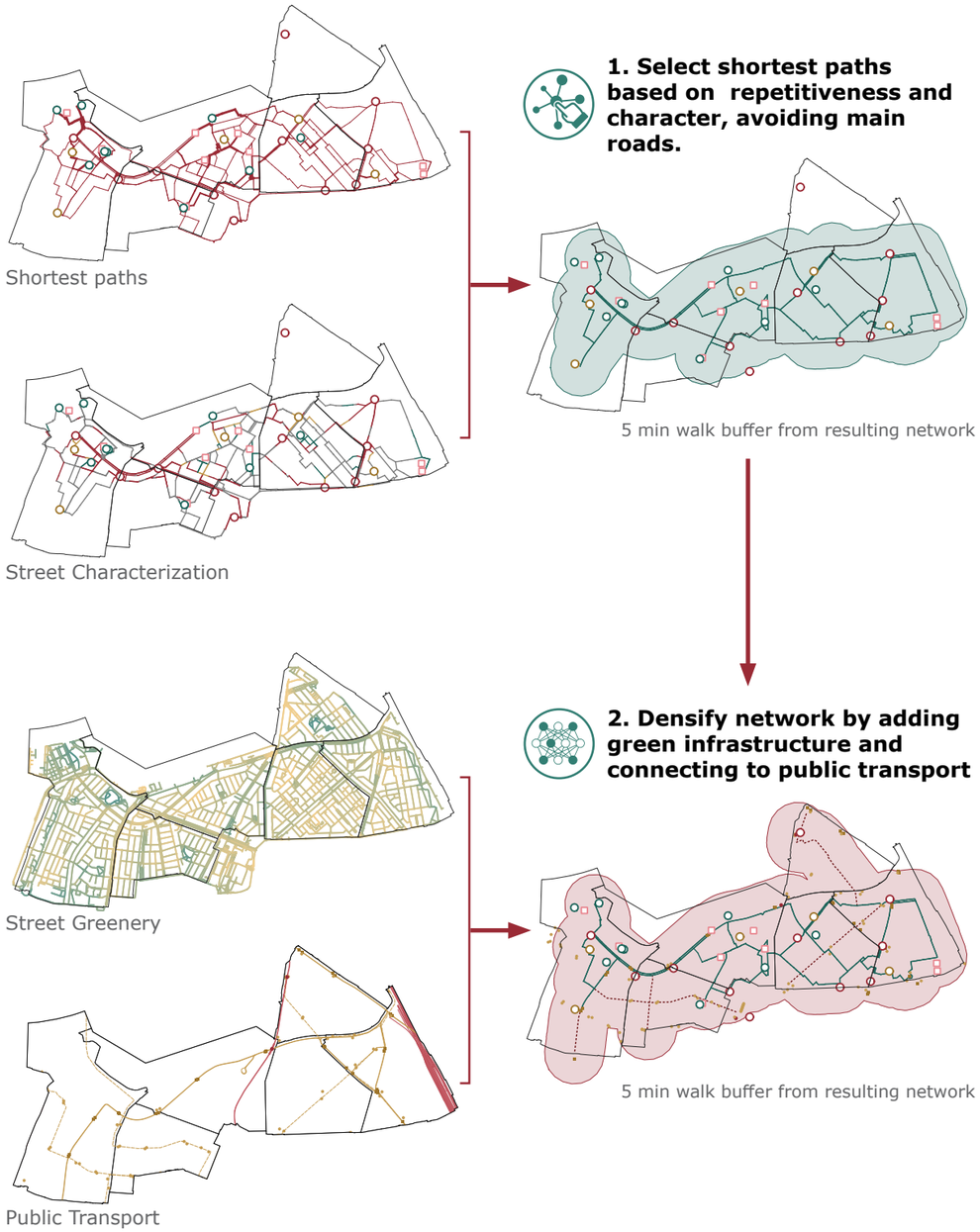
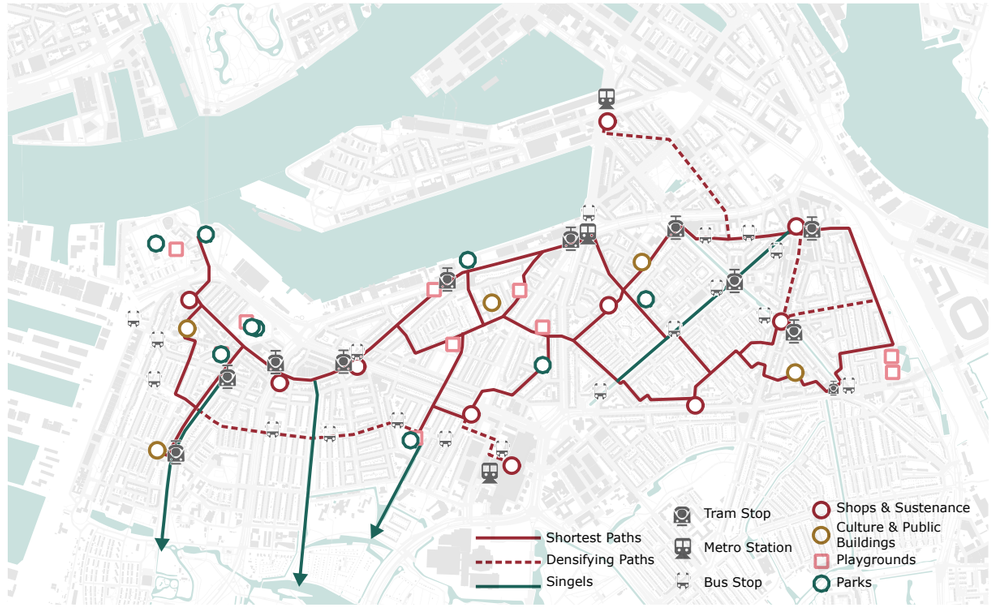



**Figure 55:** Adjustments Diagrams

## Adjustments and optimization

After collecting the data in the previous steps, I developed the network by defining specific criteria, informed by literature, and data-driven analysis. Firstly, using the generated shortest paths that connect the places of interest, I made a selection of the street segments that are most repeated in shortest paths, taking into account the street characterization as well. The resulting network consisted of continuous paths where one can experience different qualities, bringing together streets with residential qualities, streets with amenities of shops, café, restaurants, etc., and streets with present cultural and public buildings. As shown in the diagrams, the network developed at first was tested regarding its accessibility by creating a buffer of 300 m, which corresponds to a 5-min walk (Milias & Psyllidis, 2021). The outcome of this study, suggests that the network is not widely accessible in a 5-min walk and requires additional streets to improve the accessibility.

Therefore I proceeded by adding two more criteria, which are essential for the scope of the network. By analyzing the street greenery, I included, in the network, restorative qualities, such as the singels in the area, to increase accessibility in restorative environments, besides parks and playgrounds, that were added initially. Also, to encourage a more active lifestyle and motivate people to walk, I ensured the connectivity of the network to public transport. By improving the pedestrian experience with public transport, there is a greater possibility for the residents to make use of it, hence, decreasing the need for cars in the area, and therefore reducing the negative impact of traffic on well-being (Roe & McCay, 2021). Again, after the adjustments in the network, a buffer of 300 m was created, which resulted in better coverage of the network for the area, giving better access to the restorative network to the majority of the residents in the six neighborhoods.



## Network of public spaces

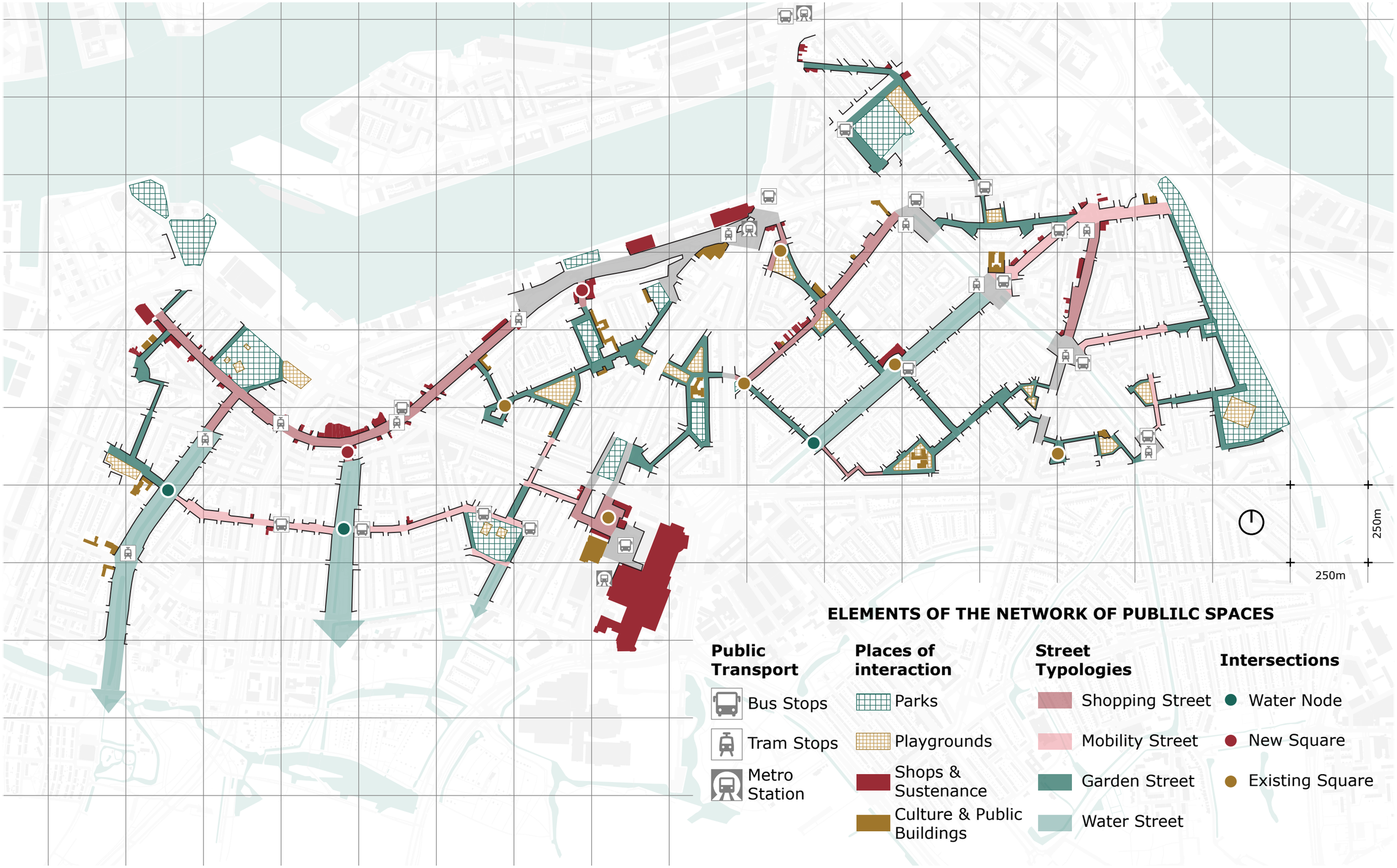
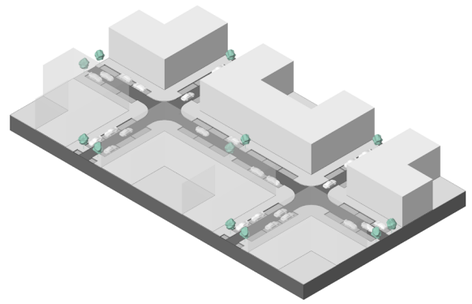
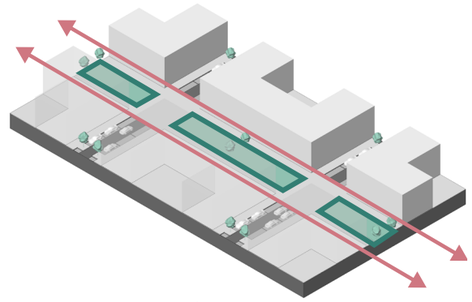



**Figure 56:** Map of the network of public spaces

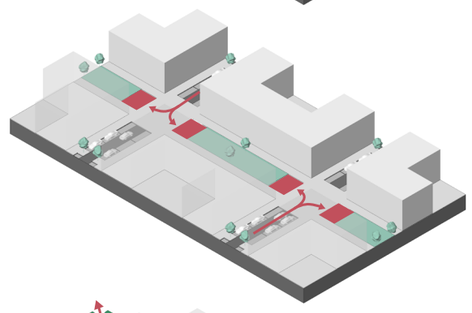
## Street Typologies



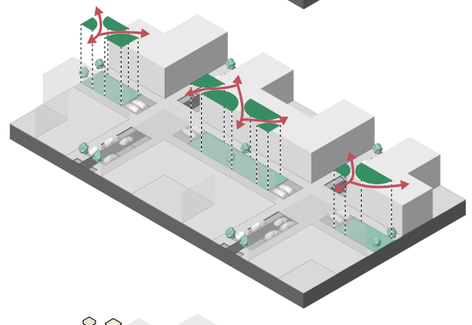
**1. Define distinct zones of continuous pathways and shared gardens**



**2. Provide parking at the edge of the street.**



**3. Create subdivisions in the garden using organic pathways.**



**4. Introduce street's program through co-creation processes with the residents.**

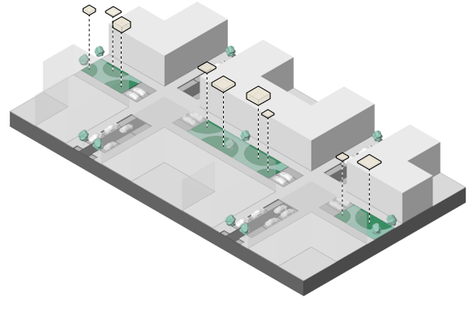


**Figure 57:** Garden Street Typology Diagrams

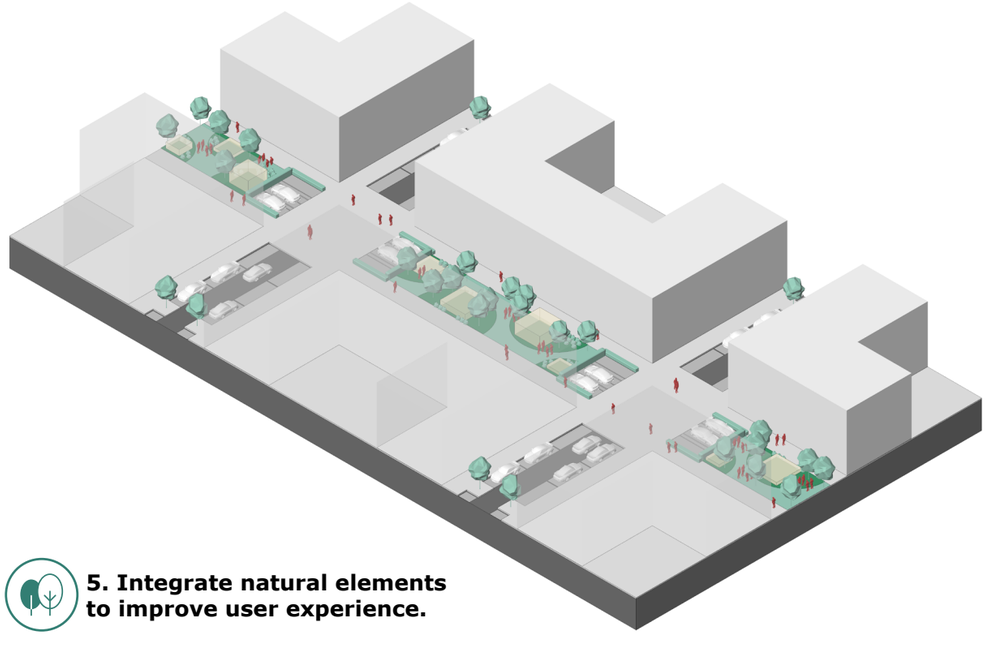
### Garden Street

Garden streets in the network are designed to provide a pedestrian-friendly environment that facilitates interaction and shared experiences among the residents. The distinction of the street in separate zones creates a transition from private to public spaces, allowing the residents to form their place according to their preferences and therefore, improving the perceived livability of the street (van Dorst, 2012). Parking places are located at the edge of the street, to mitigate the need for cars in the area, while the sidewalks are wide enough to accommodate the movement of the public.

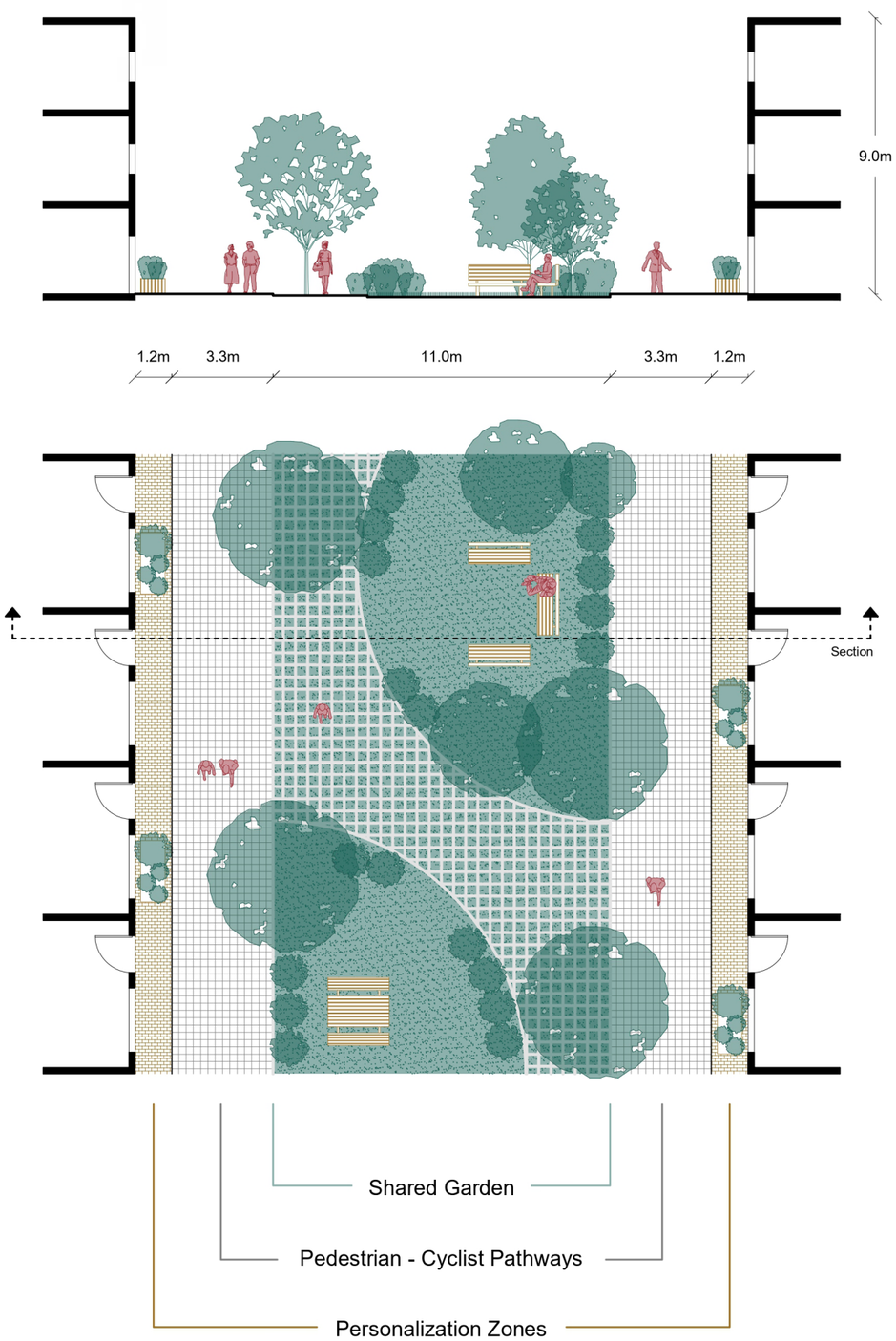
At the same time, pathways are created to encourage pedestrian flows in the shared garden and subdivide it into diverse places. Roe and McCay (2021) argue that subdivisions of public spaces motivate the participation of diverse social groups in the same place. This way, more opportunities are created for inter-ethnic social interactions and civic engagement in public life.

The program of the subdivisions derives from participatory processes of co-creation. To ensure the sustainability of the project, residents are encouraged to decide the different activities they want to integrate into their streets. Through co-creation, a sense of ownership is formed, and the maintenance of public space is more likely to be taken care from the residents themselves. By deciding on the program, residents have also the opportunity to express their particular interests and their culture, demonstrating the diversity of ethnicities in the area and building feelings of belongingness and familiarity (Peterson, 2017).

Lastly, the intervention is enriched by natural elements (greenery) and street equipment (benches, lights, etc.). Integrating nature in the street creates a pleasant restorative environment that complies with the principles analyzed before. Living in a green environment can improve well-being, while street lights and vibrant streets can contribute to safer environments improving the pedestrian's experience (Roe & McCay, 2021).



**5. Integrate natural elements to improve user experience.**




## Personalization Zone

The personalization zone is introduced by FARO in their project at Ijburg in Amsterdam. Similarly, in the proposed intervention, personalization zones create a threshold between the private building and the shared garden. The specific zone is wide enough to fit selected furniture, like a bench or a chair, for the residents who wouldn't like to socialize in the shared garden. Control over social interactions is important to establish a livable environment that answers to the needs and expectations of diverse users (van Dorst, 2012).



**Figure 58:** Block 25 Haveneiland, IJburg, Amsterdam, by FARO (source: https://faro.nl/projecten/blok-25-haveneiland/)

## Gardening

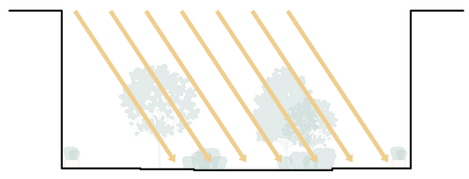
Gardening is an activity generally welcomed by a diverse population. In the project Jardin d' Eole by Michel Corajoud, individual gardening pots are placed for the interested residents, creating a place for shared interests and interaction. Furthermore, interaction with green is argued to be very beneficial to well-being (Roe & McCay, 2021) and creates room for a multi-ethnic population to grow species from their origin country, expressing their own culture.



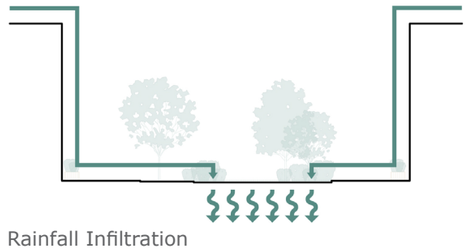
**Figure 59:** Les Jardin d' eole, Paris, France, by Michel Corajoud (source: https://www.baladesauxjardins.fr/visite-guidee-du-jardin-deole/)

## Environmental Conditions

The design of the garden street also takes into account the environmental conditions. As a place with a strong presence of natural elements, it is important to position the species according to their need for natural sunlight to ensure their survival. Also, the flooding risk in the area requires relieving the sewage system during rainfall. Hence, semi-permeable and permeable surfaces contribute to the infiltration of the water, by directing the slope of the paved surfaces into the shared garden.

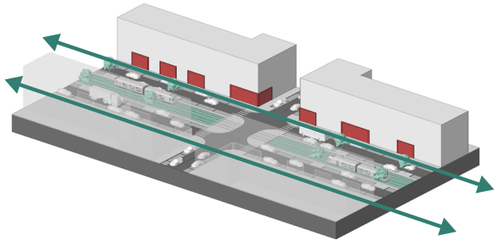


Natural Sunlight

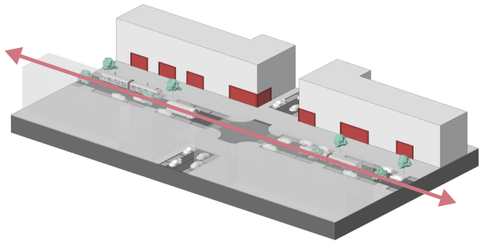


Rainfall Infiltration

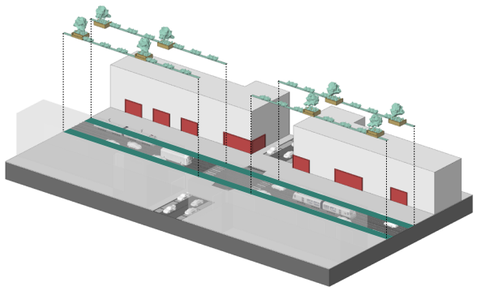
**1. Continuous pedestrian paths**



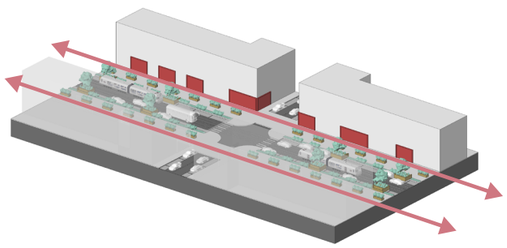
**2. Shared traffic road for cars and tram**



**3. Integrate green and seating**



**4. Define distinct zones**



**5. Encourage domestication of personalization zone**

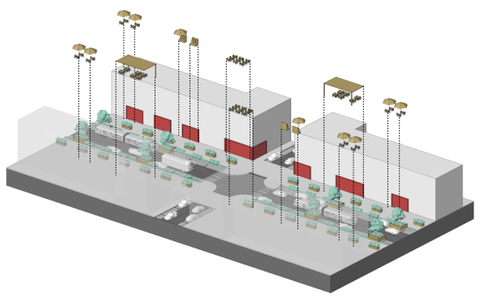


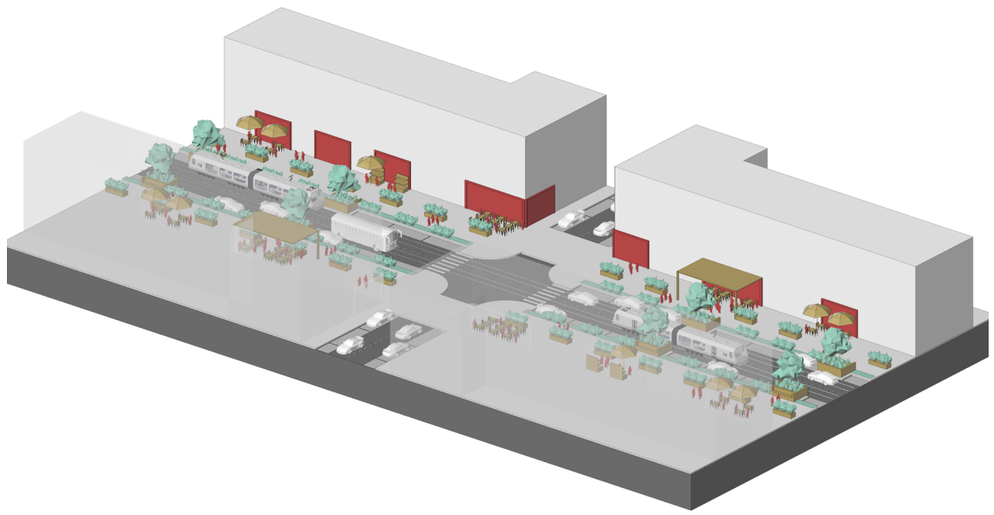
**Figure 60:** Shopping Street Typology Diagrams

## Shopping Street

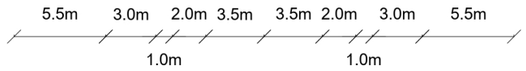
The typology of a shopping street is introduced in the streets of the network that the tram passes by and a cluster of third places is found. By establishing a continuous pedestrian path, I ensure that pedestrians have safe and convenient access, encouraging walking and active transportation. The continuous paths contribute to a pedestrian-friendly environment that promotes interactions through engaging in shared activities, such as walking or sitting (Gehl, 1999). Also, the shared traffic road for cars and trams, creates room for widening the sidewalk, while it reduces the traffic in the street. It fosters the use of public transportation and reduces the speed of cars, hence reducing the sound and air pollution in the area.

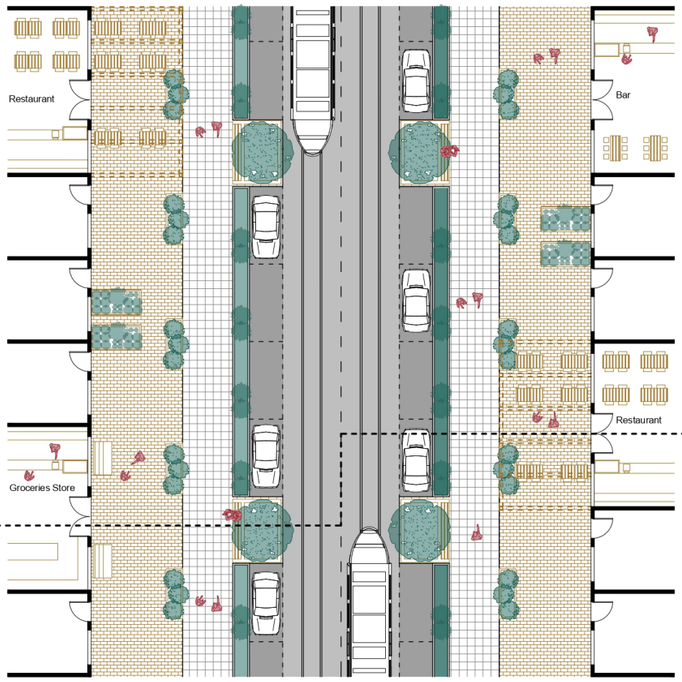
The integration of greenery in the shopping streets creates an aesthetic and attractive environment, but also improves the microclimate of the street, contributing to the air quality and providing shade. By strategically placing benches, seating areas, and outdoor furniture, I encourage people to gather, rest and engage in conversations, fostering social connections and a sense of community.

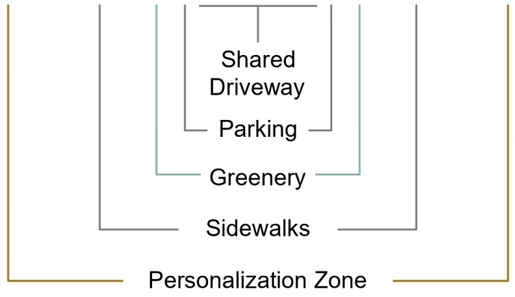
The distinct zones in the shopping street, create room not only for pedestrians but also for local businesses to appropriate public spaces. The personalization zone is proposed to encourage local businesses to customize the street and foster a sense of ownership and community pride. This way, local businesses are strengthened, improving the local economy (Jacobs, 1992). In addition to the businesses, the personalization zone creates opportunities for residents to engage in small-scale activities, like gardening, installing decorative elements and outdoor furniture, or hosting local events that promote interaction and strengthen community ties.








**Extended Sidewalks**

Widening the sidewalks and allowing local businesses to domesticate public space creates a vibrant environment that contributes to social interaction between residents. In a multi-ethnic neighborhood, the domestication of public spaces by ethnic-related businesses can create a sense of identity and stimulate ethnic diversity in the area.

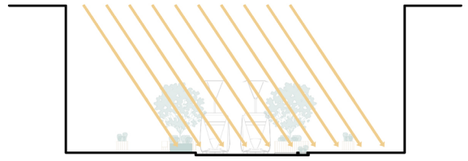
At the same time, a vibrant street is perceived as a safe environment, with "eyes on the street" (Jacobs, 1992), and can create more opportunities for conversations, improving social connections and social ties amongst residents.



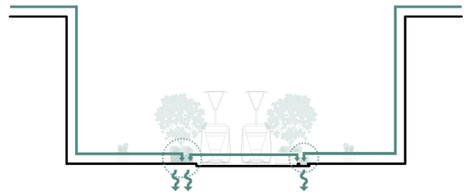
**Figure 61:** Resort hotel by the Dead Sea in Jordan and "The Cappucino strip", Freemantle, Australia (Gehl, 2010)

**Environmental Conditions**

In the residential street, sunlight is important for creating a comfortable environment. Especially, in The Netherlands, where the sun is usually absent, outdoor furniture should be placed strategically, to exploit the good weather. Also, the proposed green zones are conveniently placed on the median of the road with the sidewalk, to collect the rainfall from both sides and reduce the water that ends up in the sewer.



Natural Sunlight



Rainfall Infiltration

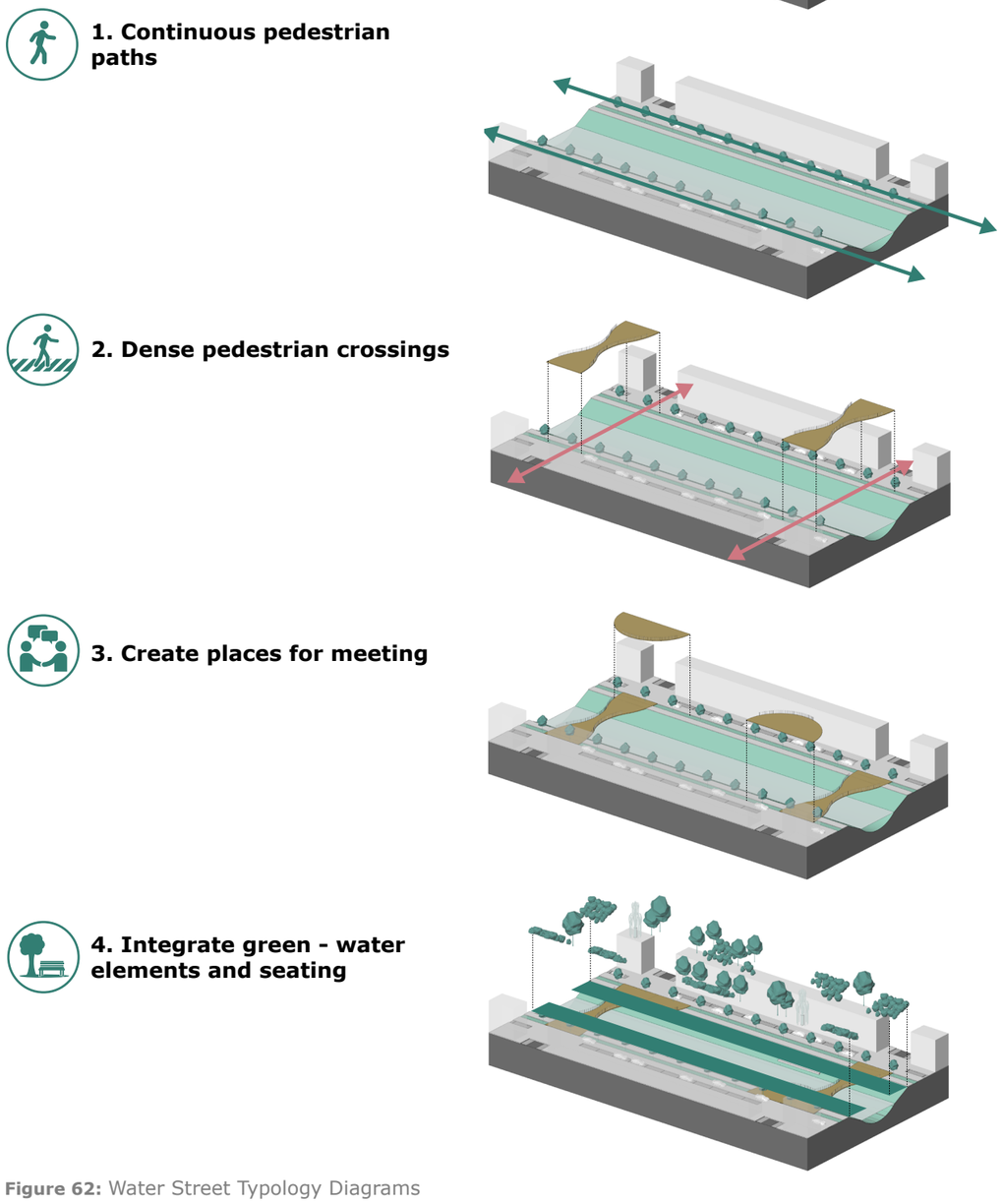



**Figure 62:** Water Street Typology Diagrams

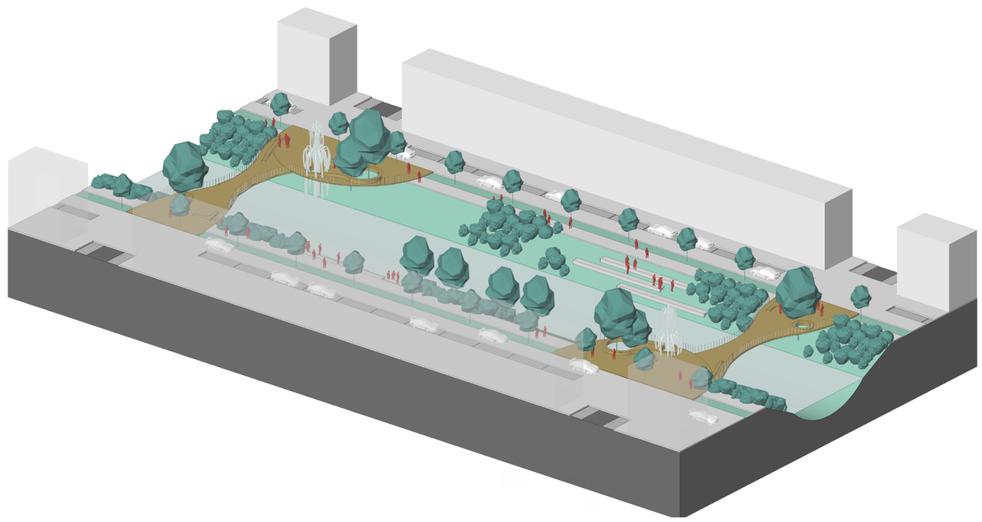
## Water Street

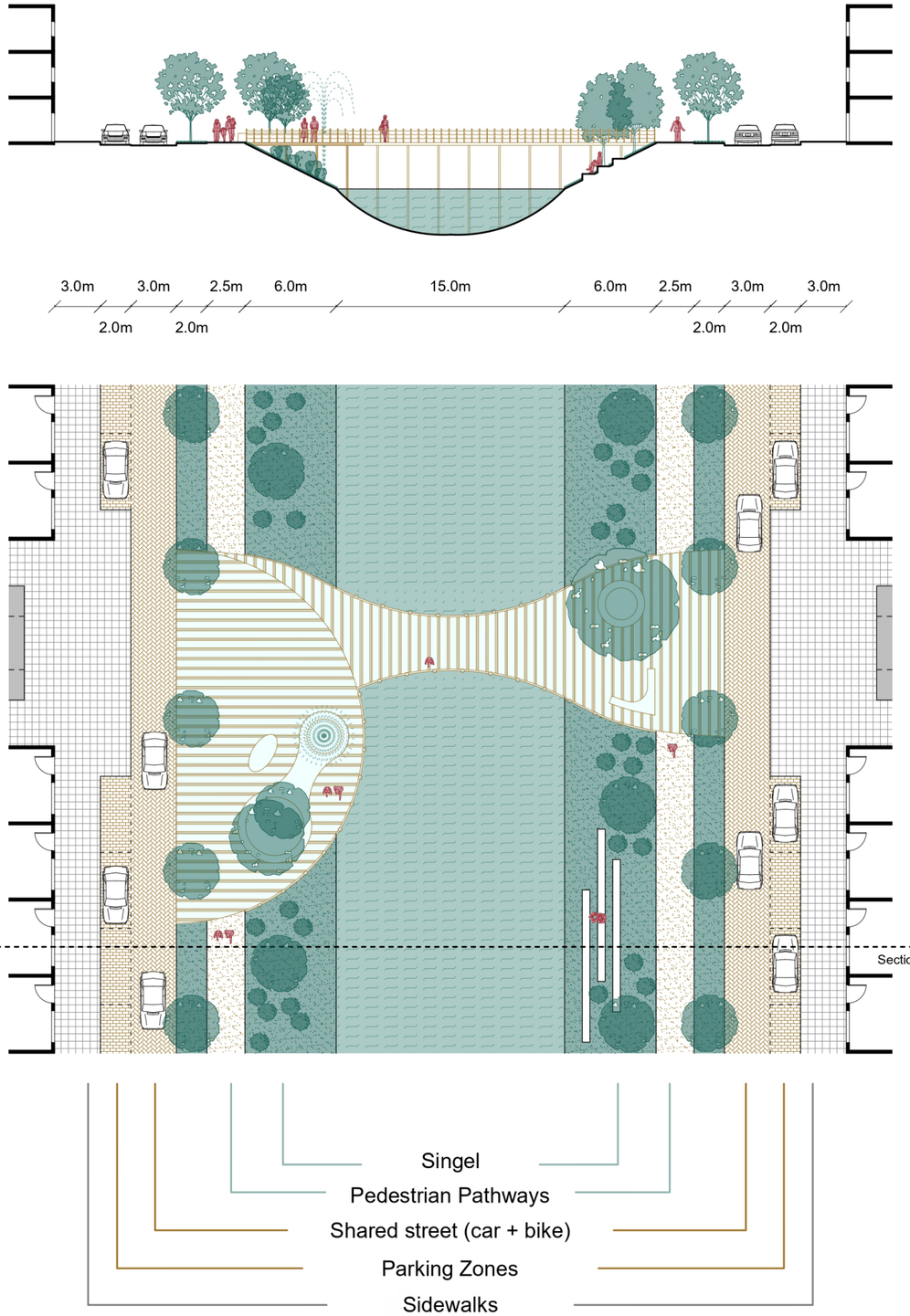
Water streets are characterized by the presence of singel in the area, providing the network with the existing restorative effect of water bodies and nature. The strategy along the singel is to incorporate continuous pedestrian paths that provide access to its banks. This allows people to engage with the water and experience its calming effects. Exposure to natural environments, such as water bodies, has proven to have positive effects on well-being, reducing stress and improving mental health (Roe & McCay, 2021).

However, singels in the area seem to interrupt the pedestrian network, since crossings are mostly found when they are convenient to the traffic network. Therefore, I propose to densify pedestrian crossing, by creating wooden bridges with adjacent platforms that are equipped with seating arrangements, such as benches and outdoor furniture. Such platforms create focal points for meeting and socializing along the singel, while encouraging pedestrians to pause, interact, and enjoy the surroundings. Gehl (2010) has found that a high-quality physical environment motivates people to engage in options activities, such as stepping outside to enjoy the weather or take a walk.

Water fountains on the crossings can function as orientation elements. Kaplan et al. (1998) argue that landmarks can give a sense of legibility in restorative environments and when they are organized in distinct areas can create coherence and an understanding of a place. This is achieved, also, through the design of the crossing platforms that offer a wide view from the center of the singel that helps pedestrians to understand the structure of the environment and get directions.

In addition, greenery along the singel should be strengthened. Generally, water bodies in cities improve biodiversity, and the integration of natural elements can contribute to this direction while improving the sensory experience that can benefit well-being (Roe & McCay, 2021) and lead to awareness of the landscape's performance (Meyer, 2008).






**Interaction with water**

Water has a restorative effect on an individual's well-being, creating a calming atmosphere and providing a source of visual and auditory interest. The sound of flowing water has been shown to reduce stress levels and promote relaxation (Pouso et al., 2021).

By integrating green elements along the singel and incorporating vegetation such as trees, shrubs, and flowers, the street typology becomes an oasis of nature that offers opportunities for residents and visitors to engage with the environment, fostering a sense of tranquillity and connection with nature.

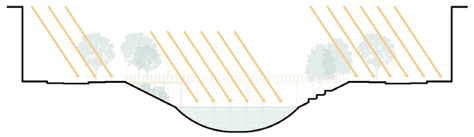




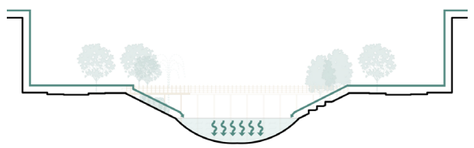

**Figure 63:** ElastiCity, Kees Lokman, Ivy Wang & Nash Waters (source: https://agencyarchitecture.com/project/elasticity/)

**Environmental Conditions**

The singels provide a wide street profile, allowing the sunlight to reach the ground in most of its area. It is, thus, an opportunity to introduce social spaces along the singel and take advantage of the sunlight, for residents to experience a sunny day in nature. In the case of rainfall, singels can be beneficially used as water detention areas, collecting the water from rooftops and streets and therefore, reducing the amount of water in the sewage system.

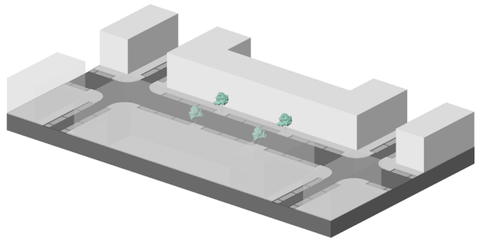


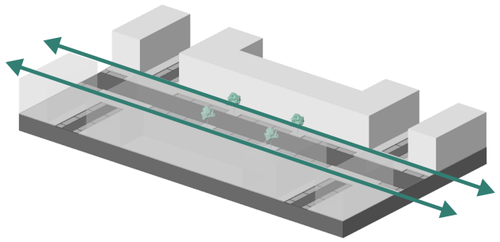
Natural Sunlight



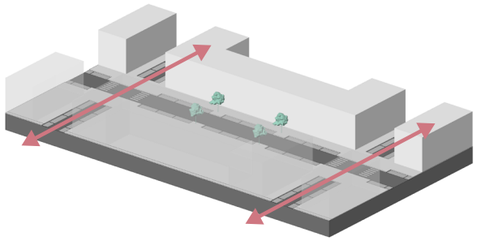
Rainfall Infiltration

**1. Continuous pedestrian paths**

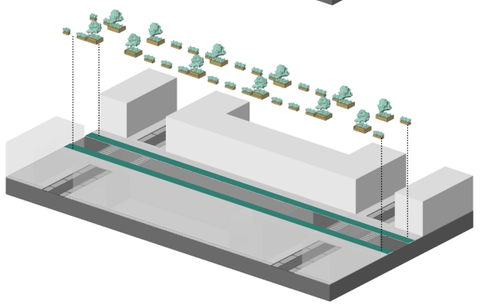




**2. Dense pedestrian crossings**



**3. Integrate green and seating**



**4. Promote PRKLT Project**

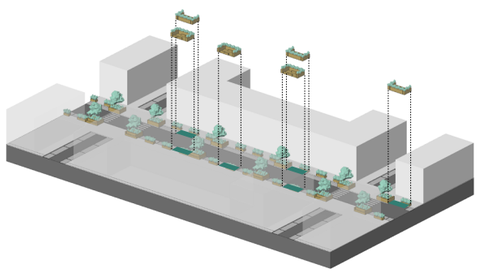


**Figure 64:** Mobility Street Typology Diagrams

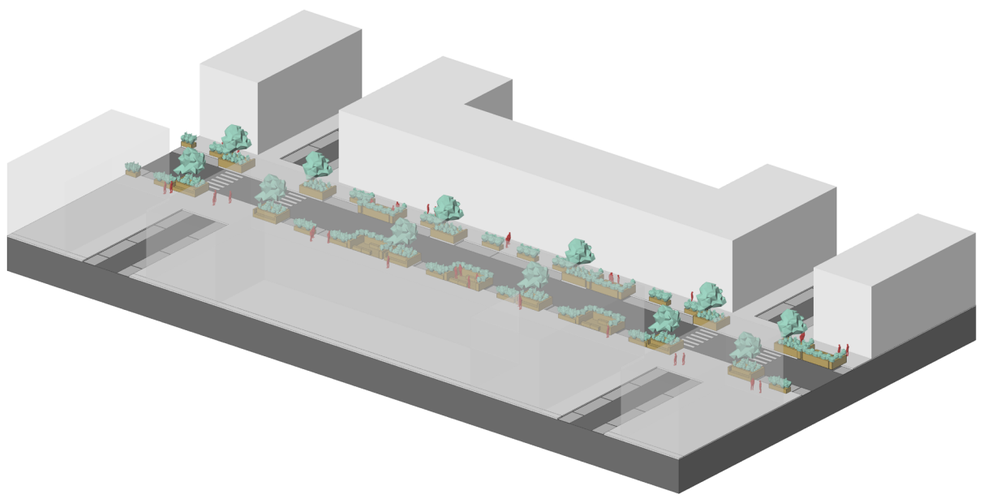
## Mobility Street

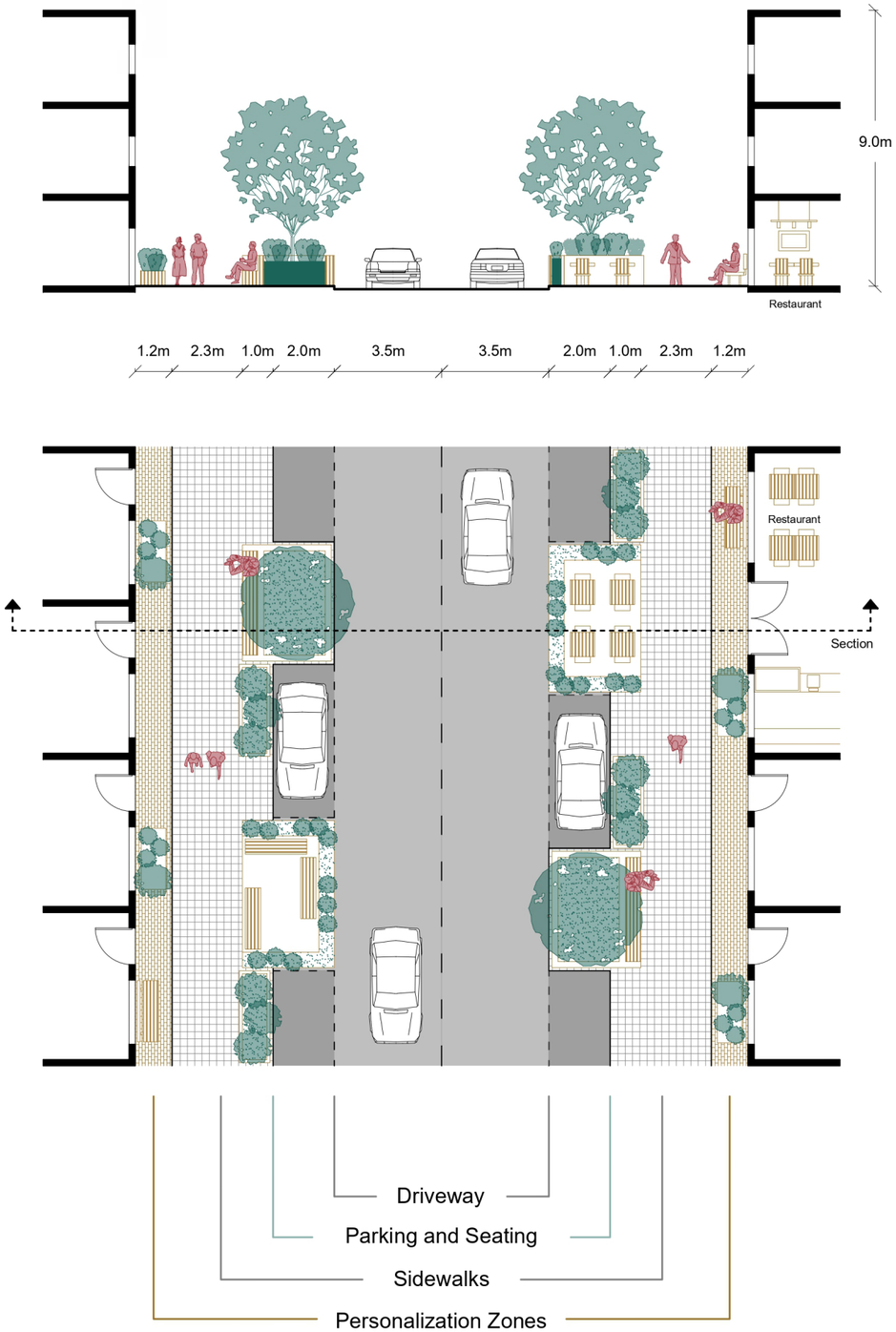
The mobility street typology is introduced in the network to improve connectivity and accessibility of pedestrians. The interventions proposed here, have the minimum impact on the streetscape. Specifically, it is proposed that a continuous pedestrian path with the existing sidewalk width can be achieved by elevating the sidewalk on the car turning. This strategy prioritizes pedestrians, creates a safer environment for walking, and separates the pedestrian from the vehicles, contributing to pedestrian flow within the streets.

Despite the minimal intervention, incorporating natural elements can significantly enhance the streetscape of this typology. By integrating trees, plants, and green features along the path, the environment becomes more pleasant and inviting. Natural elements provide shade, improve air quality, and create a connection with nature, increasing overall well-being(Roe & McCay, 2021).

In combination with street furniture such as benches and seating arrangements, mobility street can promote interaction, and create spaces for pedestrians to pause, rest, and communicate with others.

Finally, encouraging the appropriation of parklets for local businesses and residents can lead to a street that is more vibrant, inclusive, and supportive of local businesses and the needs of the residents. Repurposing parking spaces not only reduces the appearance of cars, but also extends the pedestrian realm, providing additional space for seating, outdoor dining, or community activities. Parklets offer an opportunity for local businesses to expand their operations and create an inviting atmosphere for customers. They also provide a gathering place for residents, promoting social interaction and a sense of community, while introducing also a sense of ownership and familiarity.






## Parklet Examples





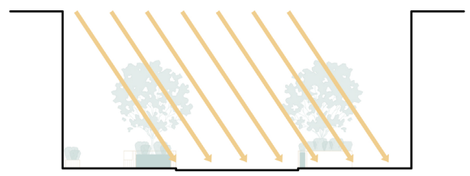




**Figure 65:** Parklet decking examples (source: https://rotterdamsedromers.nl/2018/05/18/parklet-rotterdam-maken-straatbeeld-leuker/)

## Environmental Conditions

The environmental conditions can influence the design of the parklet. Usually, the frequent rain in The Netherlands can lead to the need for protected places where people can socialize without being restricted by the weather, while on sunnier days, a pergola or a tree can provide shade and create comfortable conditions for the user.



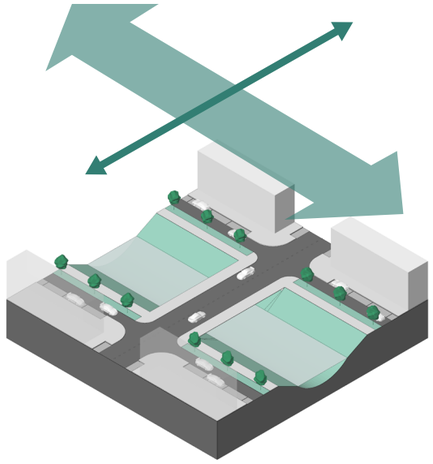
Natural Sunlight



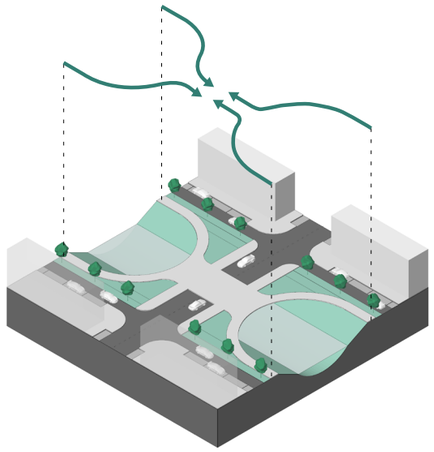
Rainfall Infiltration

## Intersections

**1. Identify water nodes in the intersection of singel with network's streets**



**2. Connect paths with a safe pedestrian crossing**



**3. Place platforms for activities beside the water**

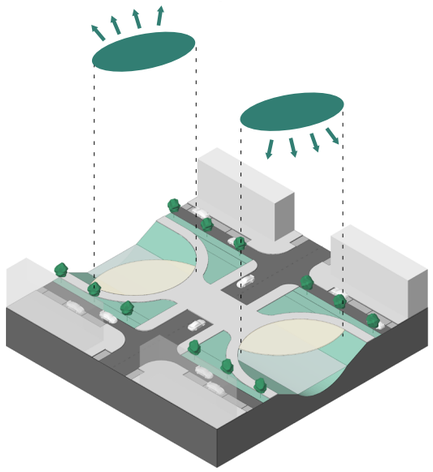


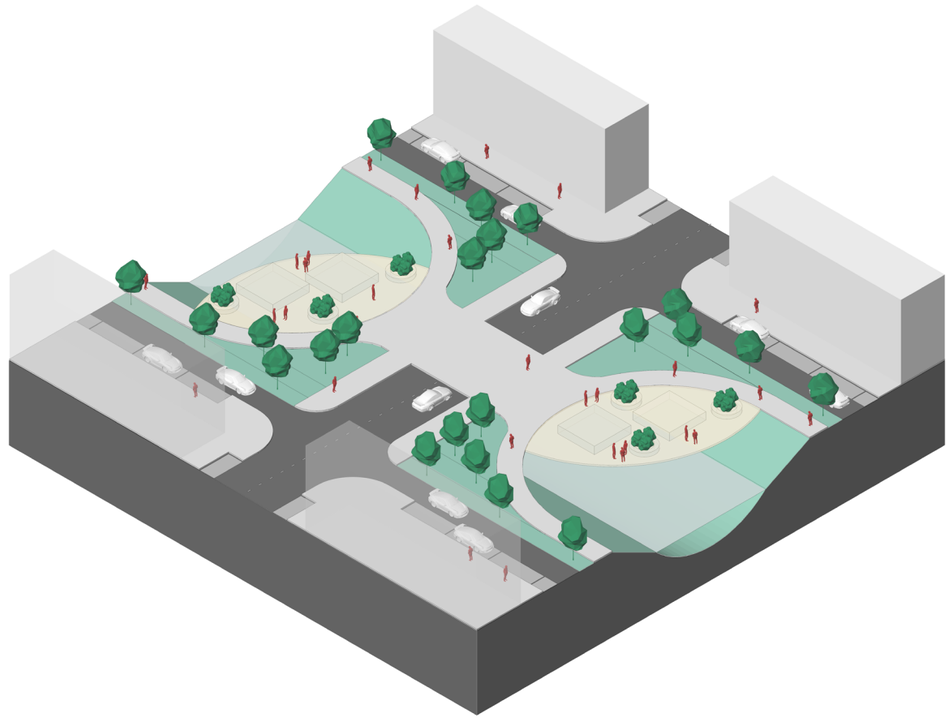
**Figure 66:** Water Node Typology Diagrams

## Water Nodes

Water nodes are found when the network of public spaces intersects with singels in the area. The purpose of water nodes is to increase opportunities for shared activities of diverse populations to take place along the water body. The main strategy, here, is to create a safe crossing between the two sides of the singel, by connecting the paths on the two banks of the singel and elevating the street level to the pedestrian level. This method prioritizes the crossing of pedestrians by decreasing the speed of cars, creating a safer passage through the singel.

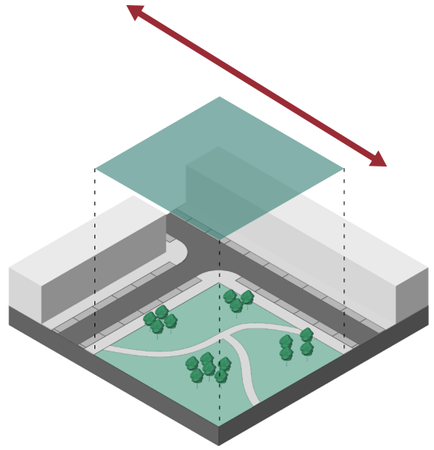
On the two sides of the crossing, it is proposed to create two platforms that accommodate space for diverse activities with adjustable furniture that can be arranged according to the needs of the users. These platforms offer a view of the singel, improving the restorative effect of interacting with nature and giving room for strengthening social ties among the residents.

The platforms can be equipped with different elements, such as pergolas, benches, vegetation, etc., and be organized in subdivided areas to facilitate the coexistence of different social groups. Therefore, promoting interaction and participation in public life enables the potential for building feelings of trust and belongingness.

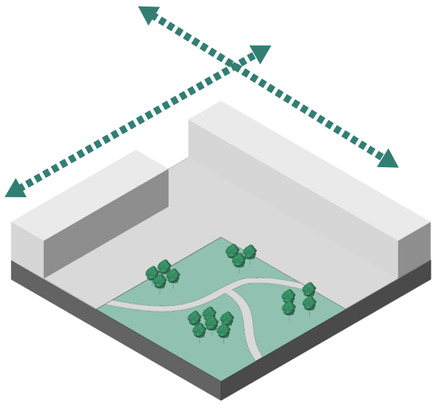


**4. Facilitate interaction by integrating nature and seating**

**1. Locate parks and playground along the network**



**2. Pedestrianize streets around the park or playground**



**3. Expand the area of the leisure place**

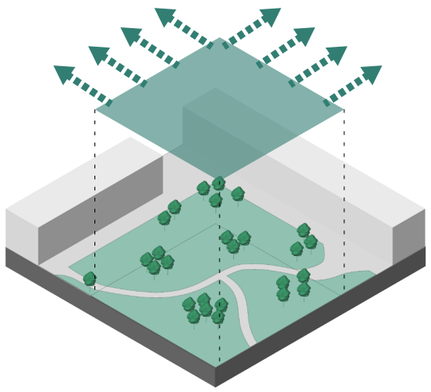


**Figure 67:** Parks and Playgrounds Typology Diagrams

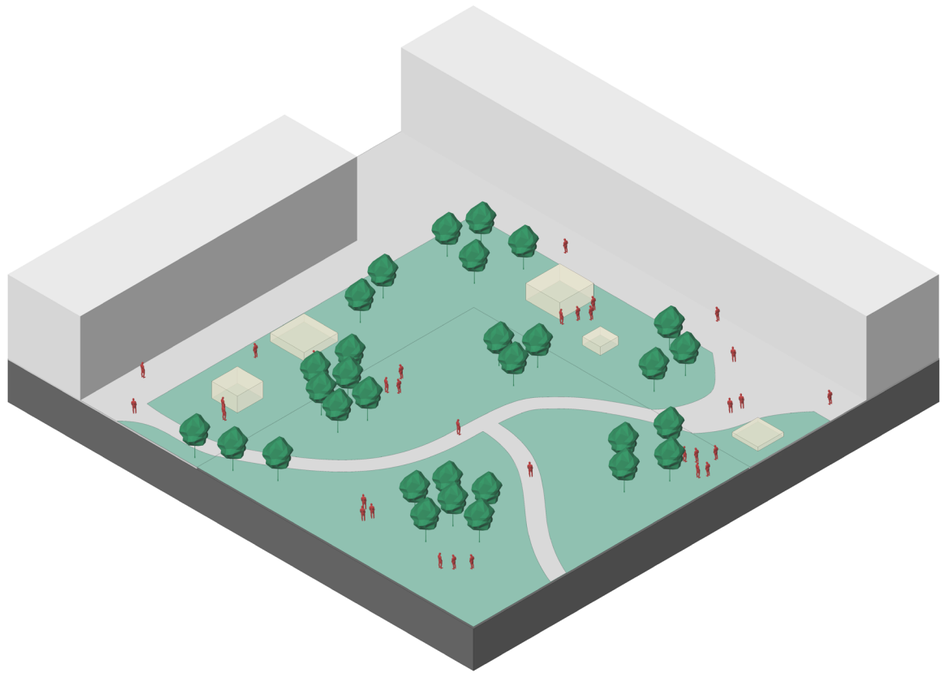
## Parks and Playgrounds

The network of public spaces is initially formed to motivate accessibility in existing parks and playgrounds with the potential for inter-ethnic social interaction. However, the project doesn't propose the redesign of these leisure locations, but rather their efficient connection to the network.

To achieve this, I propose to pedestrianize the streets surrounding the leisure place, to create a safe environment for the pedestrian, reduce the negative impact of traffic, such as sound and air pollution and create room to expand the activities of the park or square into the street.

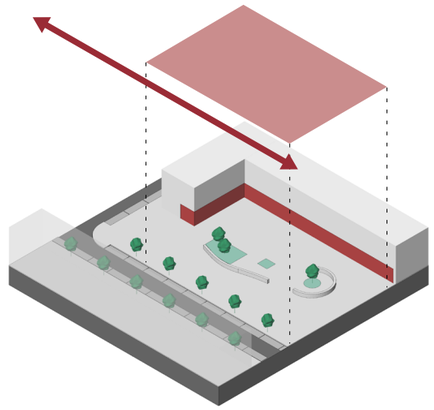
To encourage the pedestrian to engage with the activities of the location, I propose the continuation of the existing pathways to the street. Such a strategy can motivate the pedestrian to enter the area, as a shortcut to a destination, or to make a detour and enjoy the restorative characteristics of the place.

The expansion of the park can be enriched by integrating more nature and seating arrangements, as well as other programs that can be decided through co-creation processes with the residents of the area. Therefore, facilitating the interaction between diverse populations creates a sense of ownership and engagement with public space.

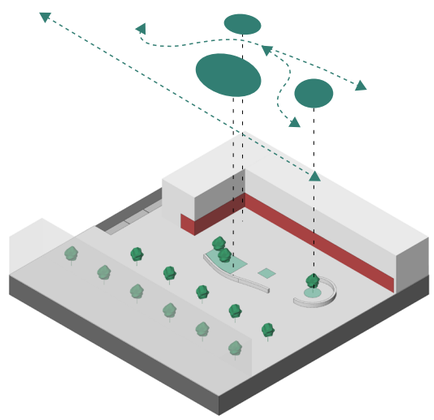


**4. Facilitate interaction by integrating nature and seating**

**1. Locate squares along the network**



**2. Analyze social behavior and pedestrian movement**



**3. Expand the area of the leisure space**

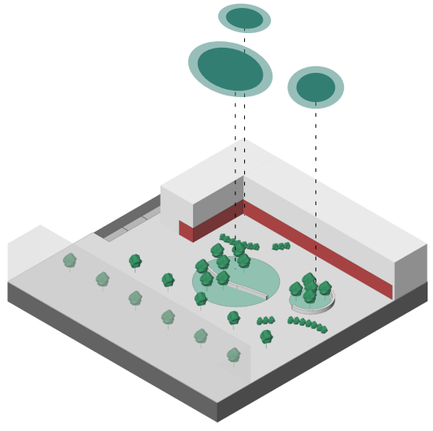


**Figure 68:** Existing Square Typology Diagrams

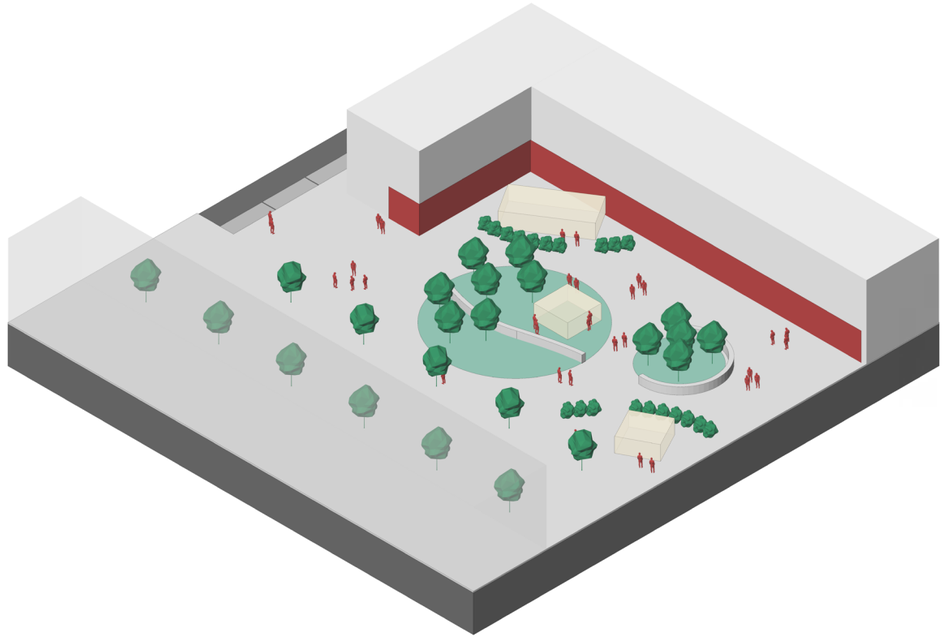
## Existing Squares

Where the network of public spaces intersects with existing squares it is important to analyze the current situation taking place in the site. Hence, understanding how the existing square is formed, what is the perception of the residents regarding the current square and what are their aspirations.

Afterward, by fieldwork and observations, it is essential to unveil the pedestrian movements in the area, see how people use the place, the routes they are using, and the subdivision of places that are formed from the pedestrian traffic. It is also critical to observe how the square serves the needs of different social groups and the way social behavior changes according to the design of the square.

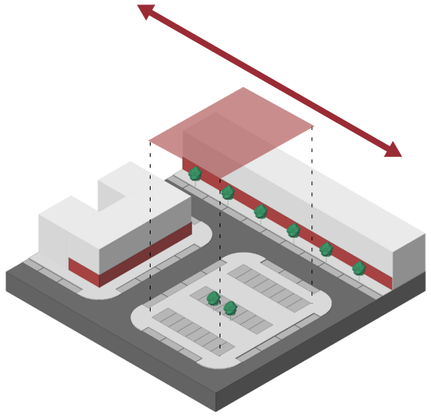
After understanding the conditions of the existing square and identifying the opportunities for intervention, I propose to strengthen the qualities that are already available and beneficial. For example, expanding green areas, improving a small playground, or enriching a seating area.

Finally, the intervention in the existing square can be complemented by integrating natural elements, such as trees that provide shade, or water elements that contribute to more comfortable environmental conditions.

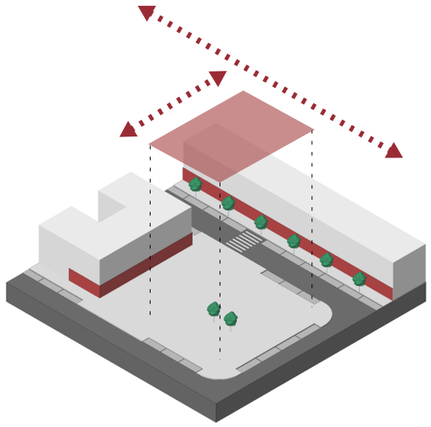


**4. Facilitate interaction by integrating nature and seating**

**1. Identify parking places along the network that are surrounded by amenities**



**2. Pedestrianize streets and connect to the network**



**3. Subdivide areas to encourage different social groups in the square**

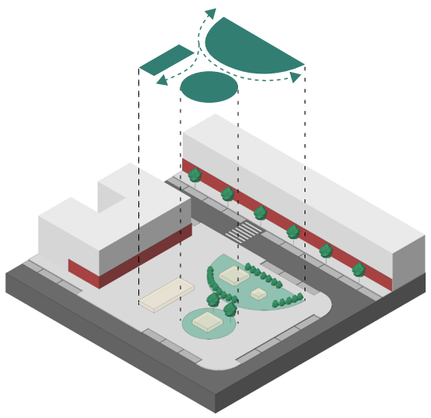


**Figure 69:** New Square Typology Diagrams

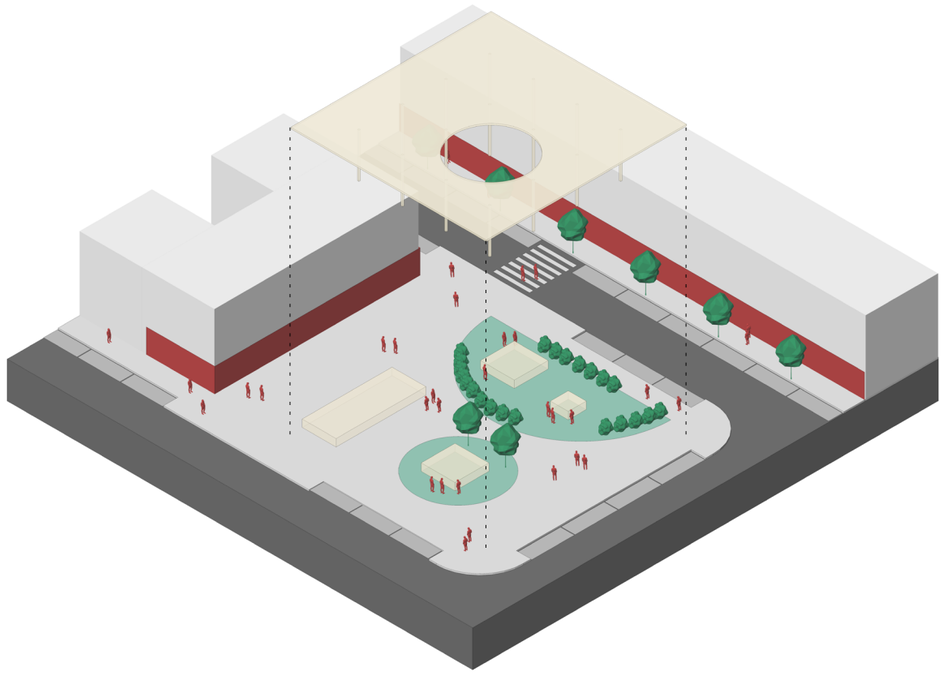
## New Squares

The case of a new square is proposed at the intersection of the network with parking places that are surrounded by amenities such as shops, cafes, restaurants, etc. Designing a square can contribute to flourishing local businesses but also exploiting of their attractiveness to stimulate social interaction.

The square needs to be easily accessible to pedestrians by pedestrianizing adjacent streets if possible and creating safe pedestrian crossings to the sidewalk across the street. By doing so, we ensure the connectivity of the square to the network of public space and therefore motivate the resident to visit the place.

The square should follow the principles introduced before, by subdividing the area into distinct sections where diverse groups can co-exist and interact with each other. To create the subdivisions, pathways can flow inside the square, creating shortcuts for people that pass through and increasing the movement of pedestrians inside the square.

The intervention is completed by a pergola as a unifying element that creates a statement of a shared place that welcomes everyone, promoting diversity and inclusion in public space.



**4. Create a pergola (shelter) as a unifying element**

# INTERVENTIONS

The purpose of this chapter is to illustrate the applicability of the design strategies in the urban space. The selected sites are demonstrating the different qualities that are proposed in the network, creating directions toward designing restorative environments that enhance social interaction amongst diverse ethnic groups. The program of the interventions is presented as an option that could be differentiated through co-creation processes with the residents.


**TEST BED 1: LIVING STREETS**

Ethnic Co-accessibility on site

Fieldwork

Current Environment

Proposed Program

Proposed Restorative Environment

Views

**TEST BED 2: ENHANCING INTERACTION**

Ethnic Co-accessibility on site

Fieldwork

Current Environment

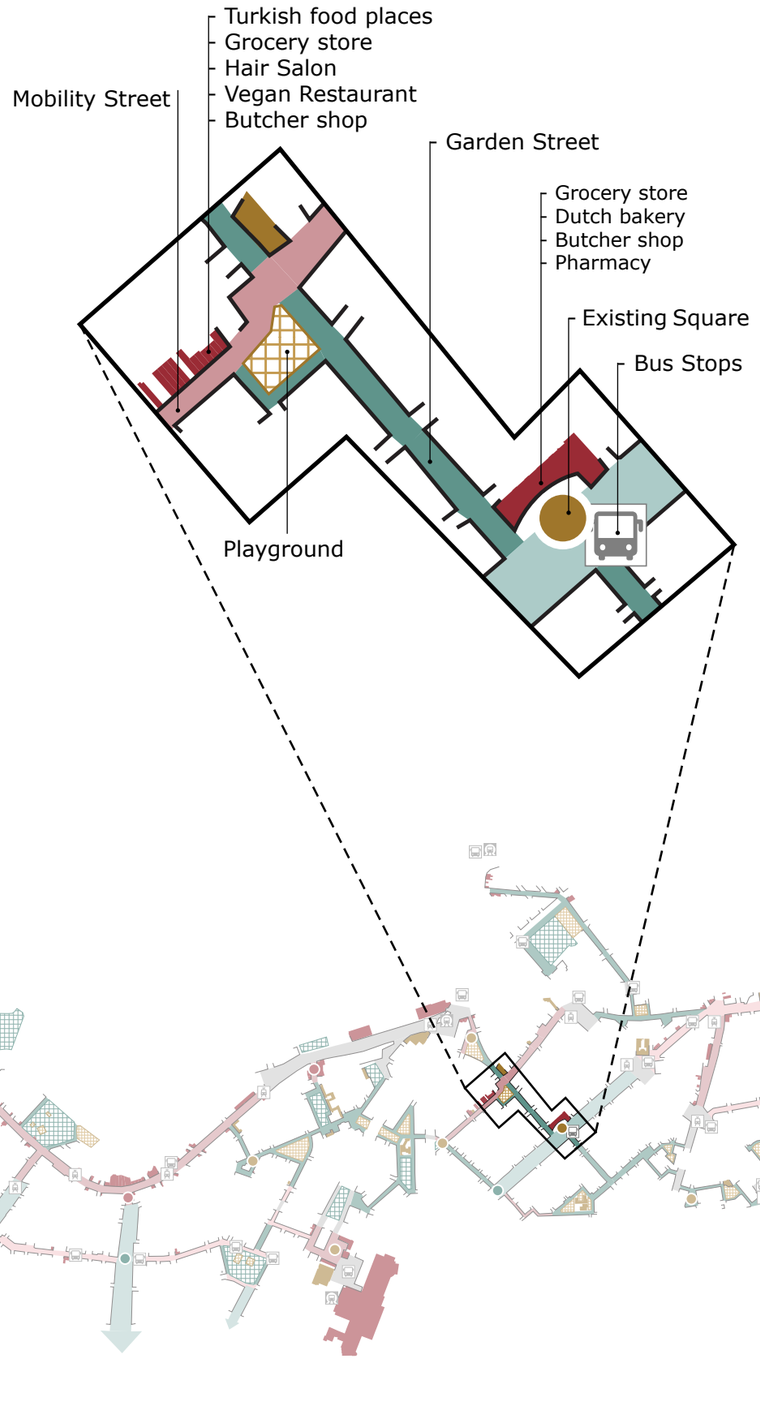
Proposed Program

Proposed Restorative Environment

Views


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# Testbed 1: Living Streets

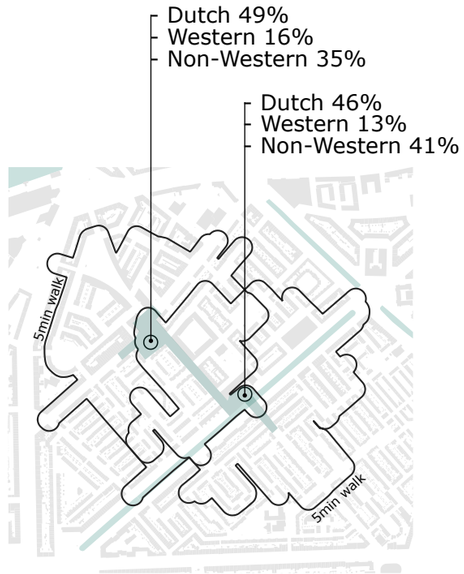


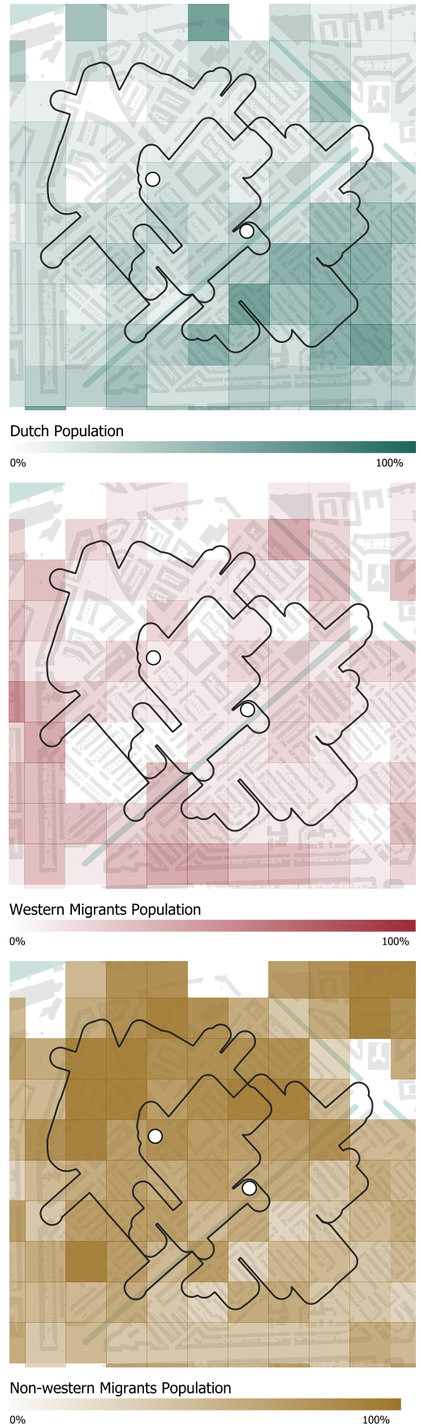

## Ethnic Co-accessibility on site

For the first test bed, a street is selected that connects an existing playground and an existing square. Analyzing the demographic data of the area, at a distance of 5 minutes walking from these locations, ethnic segregation is evident. However, the extent of co-accessibility of diverse ethnicities shows potential for increased inter-ethnic social interaction.

The goal of this intervention is to motivate the different ethnicities to engage in public life in the network, therefore proposing a restorative environment with an enriched program in garden street, as well as the existing square and the playground that can accommodate the needs of diverse users.

The current places in the area (grocery stores, butchers, ethnic food places, etc.) create a destination for pedestrians and through the interventions proposed, the public space is enriched to encourage shared activities and participation in public life, therefore increasing the potential for interaction of diverse ethnic groups.



## Fieldwork

**Site Analysis**



Appropriation of the sidewalk by shop owners to place seating for personal use.






The street is currently dominated by cars. However, front yards are evident in certain cases, while the street has several trees on one side.



A public square, surrounded by commercial activities that attract a diverse population.




Appropriation of the sidewalk by shop owners for seating to accommodate customers.





The singel functions as a place of relaxation, with people sitting at the benches on the bank of the singel. The water feature provides a nice view but also stimulates the sense of hearing.

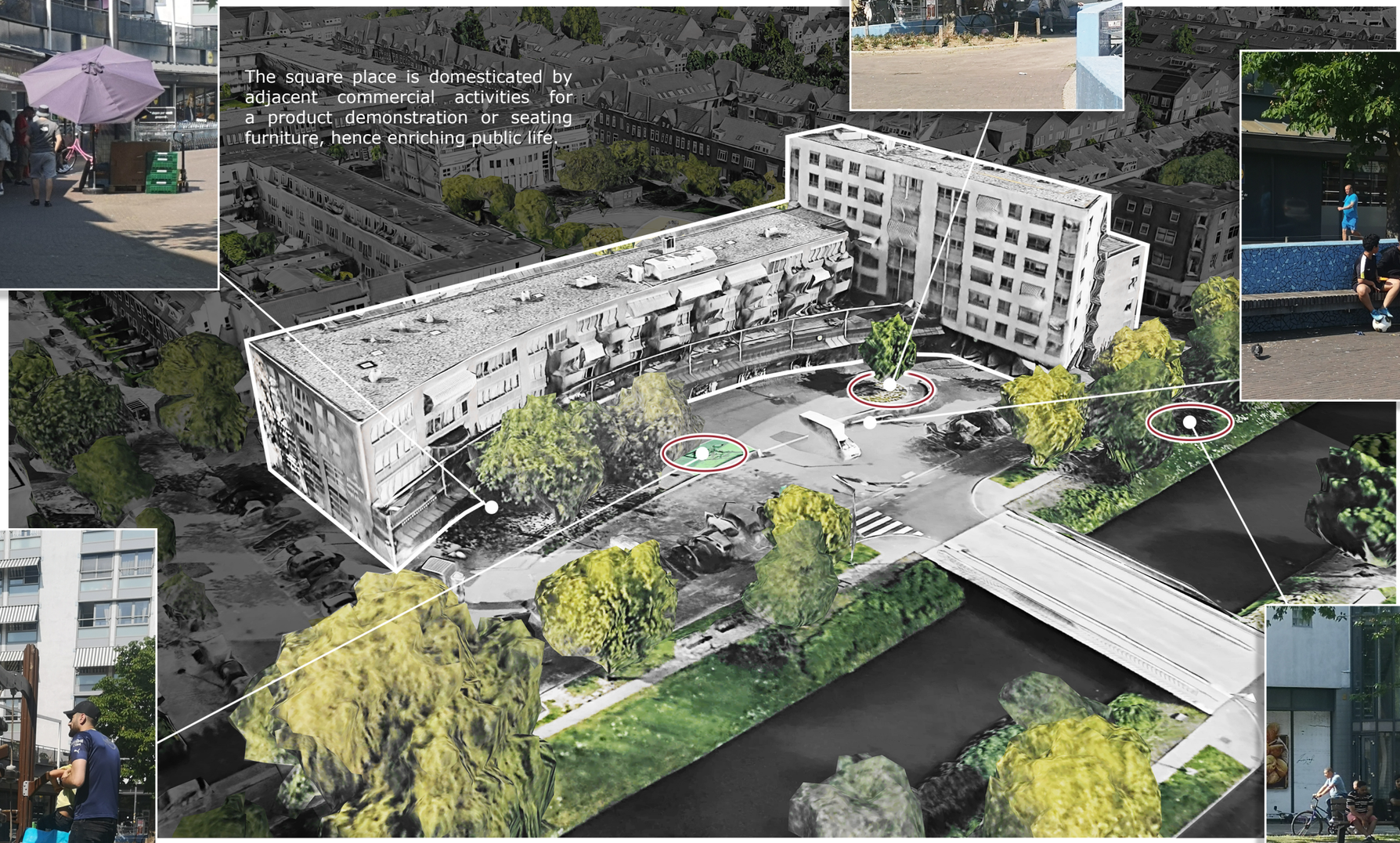
**Square Observations**





The square’s arrangement creates subdivided places that accommodate diverse social groups. In the images, a group of elderlies is illustrated under the tree, while a group of teenagers has located on a bench.

The square place is domesticated by adjacent commercial activities for a product demonstration or seating furniture, hence enriching public life.







A small playground at the square gives parents the option to engage their children and spend more time in the square, creating more opportunities for social interactions.

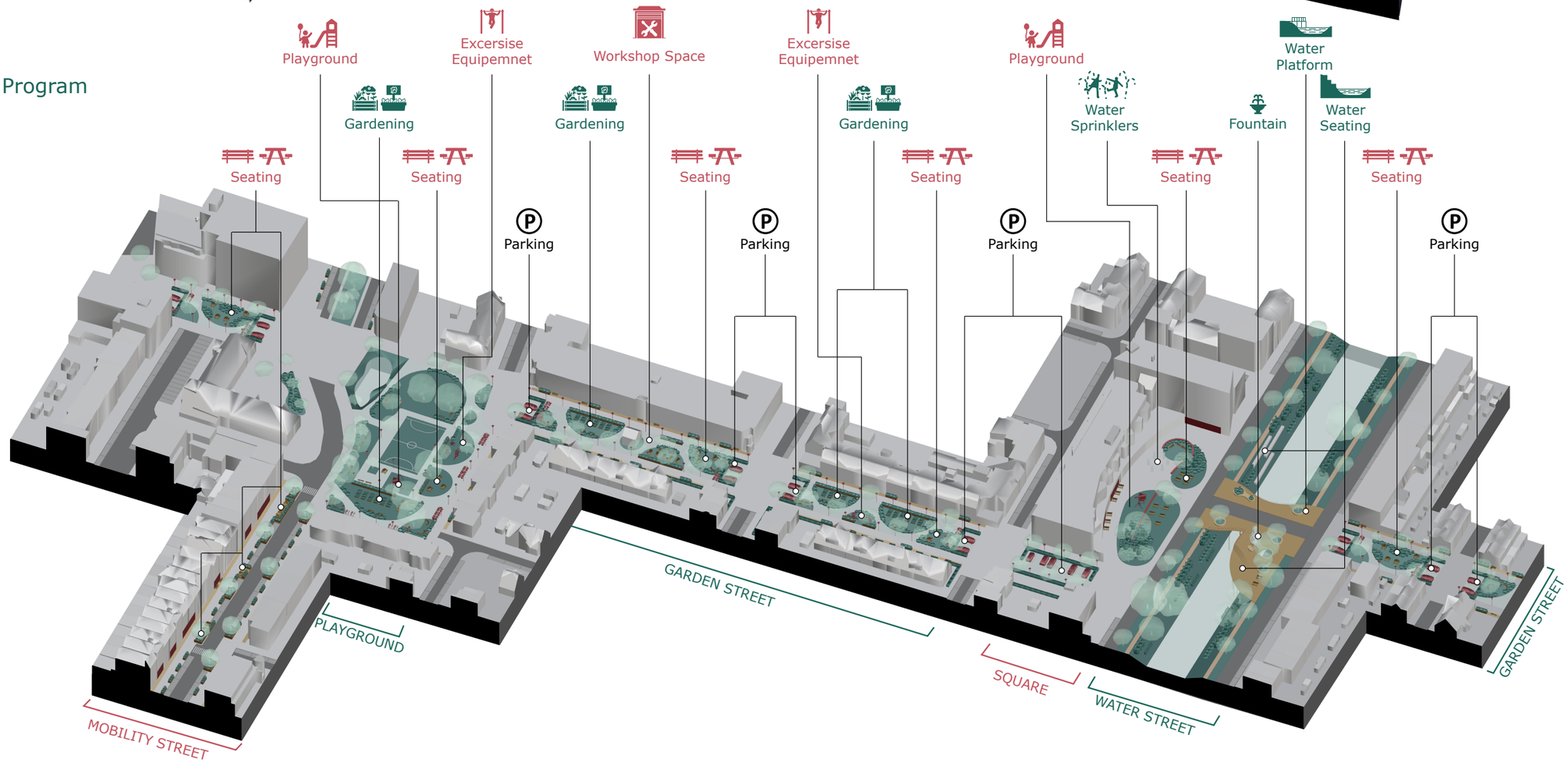
The shade from the trees along the singel creates a pleasant environment for residents to interact with nature and socialize in a restorative environment.



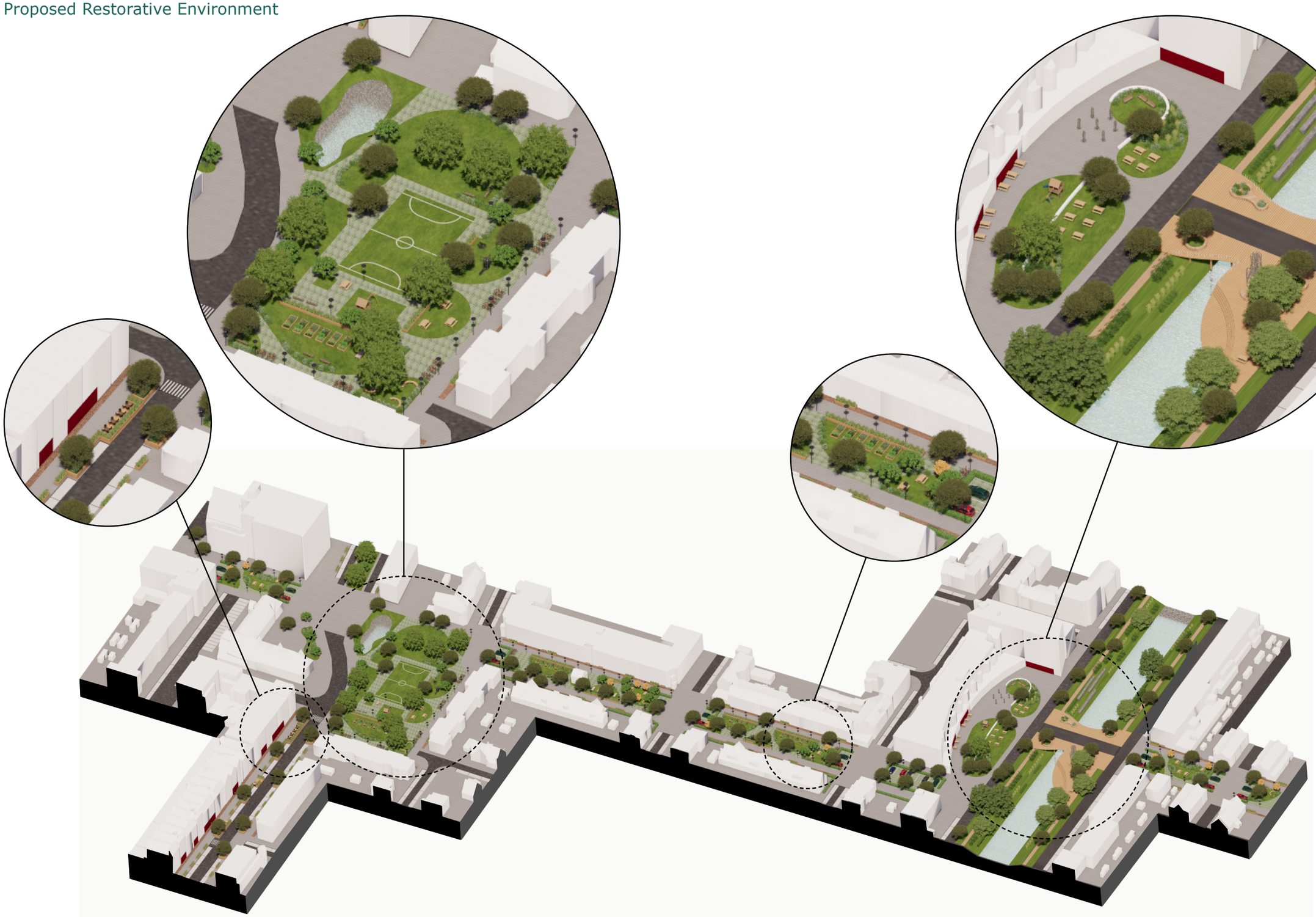
## Current Environment



## Proposed Program



## Proposed Restorative Environment



## Views



**Playing at the square**



**Embracing water**



**A restorative park**

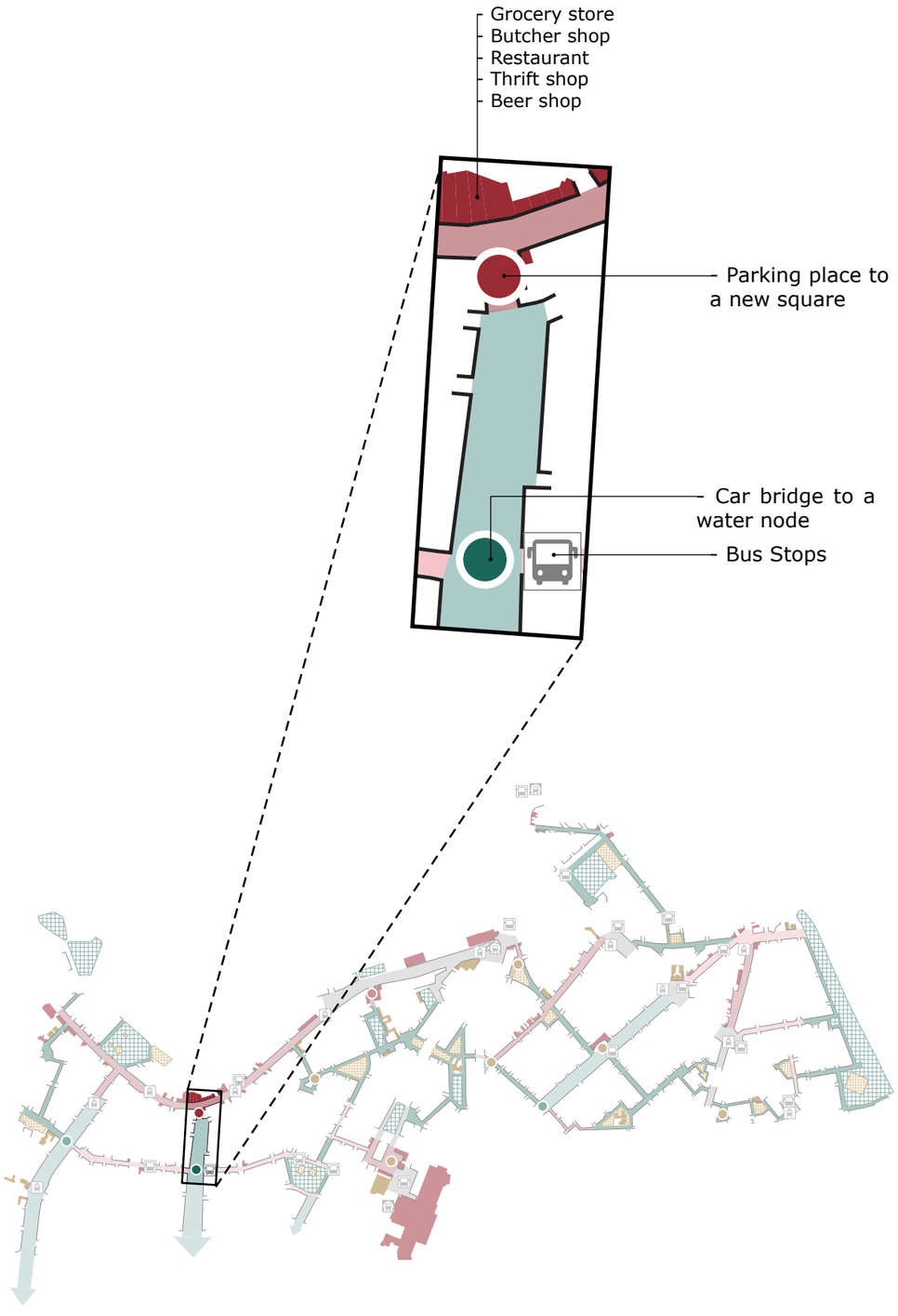


**Place of meeting**



**Gardening**

# Testbed 2: Enhancing interaction

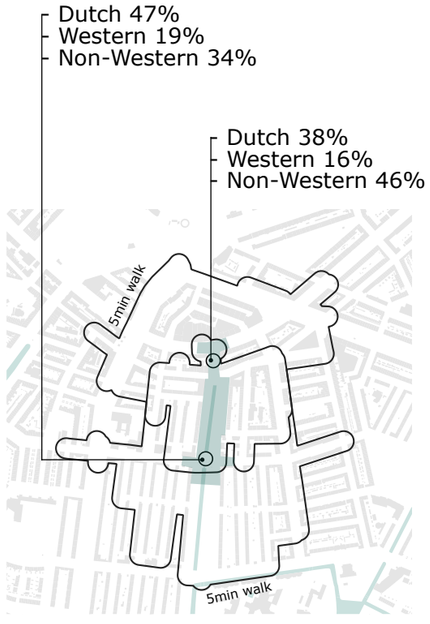


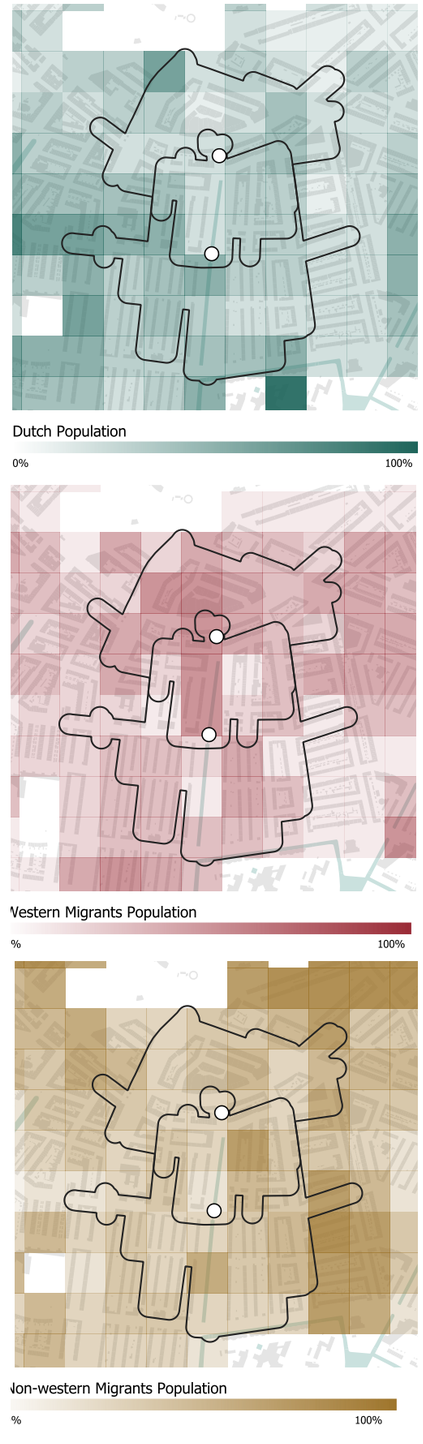

## Ethnic Co-accessibility on site

The second location is selected in the intersection of a singel with a shopping street in the network of public spaces. Once again, the demographic data analysis shows potential for inter-ethnic social interaction, and the availability of third places along the shopping streets creates a destination that motivates people to visit the location.

Therefore, it is proposed to create a new square at the intersection as a transitional space between the restorative environment along the singel and the vibrant character of a shopping street.

The singel is enriched with the water node, a place for shared activities with interaction with the water, providing an environment for residents to adjust according to their needs but also an entry point to the adjacent pathways that lead to the square.



## Fieldwork

**Site Analysis**



Parklets are already used in the area to strengthen local businesses and create outdoor spaces for socializing.



Along the street, a variety of different shops are found, including grocery stores that attract diverse populations.



The pathway along the singel offers a pleasant walk near the water and improves the experience of pedestrians.

The current space is occupied by parking lots and the pavement is completely solid, which makes the micro-climate very discomfort.



The park is completely fenced and is connected to the pedestrian network through specific entrances, reducing the opportunity for easy accessing the park.



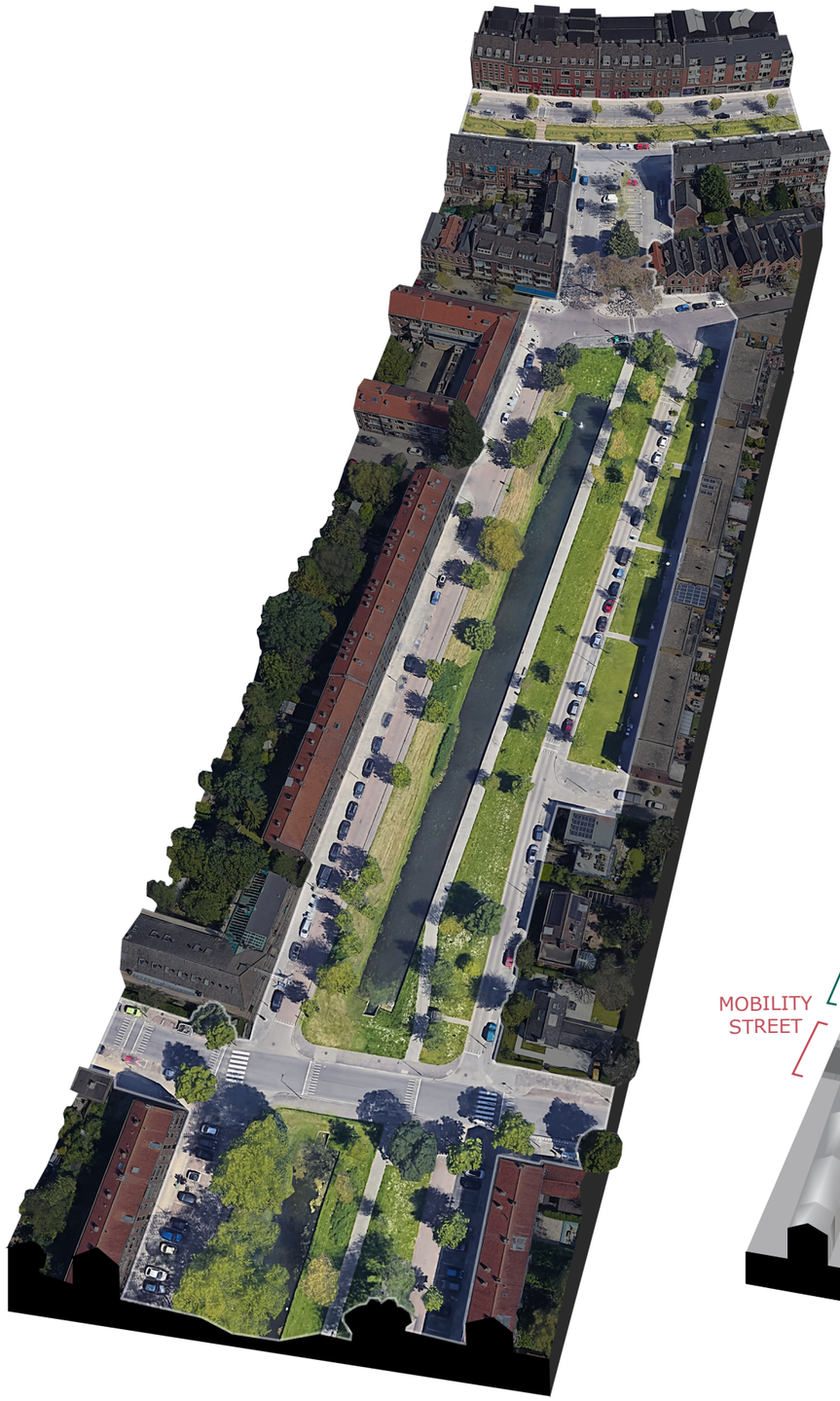
Accessibility to the singel is not pedestrian friendly. Car streets interrupt the pedestrian network and create unsafe environments for walking.



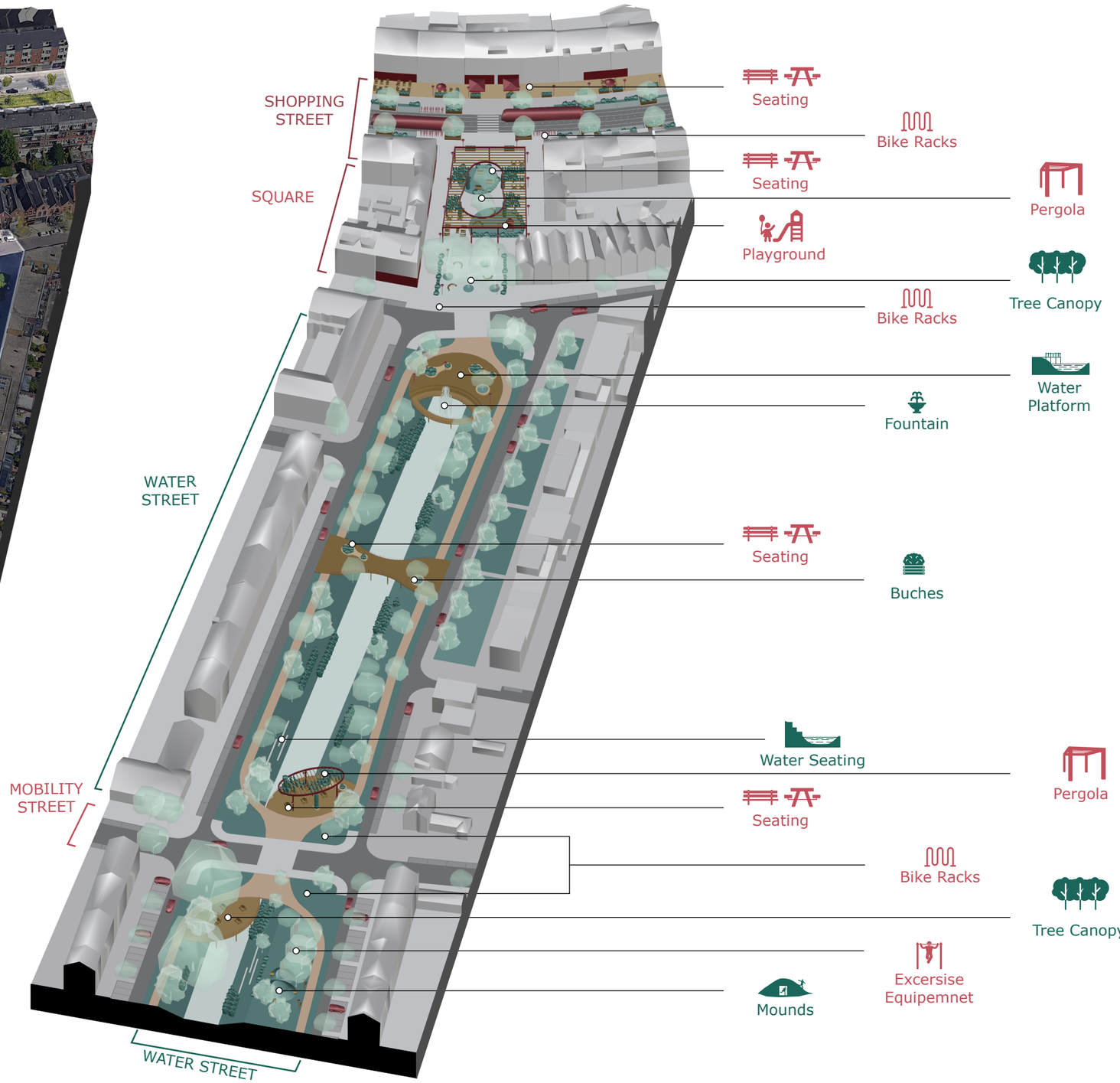
Local businesses are found on many streets, but the sidewalks are very narrow, making it difficult for the stores to place seating outdoors.



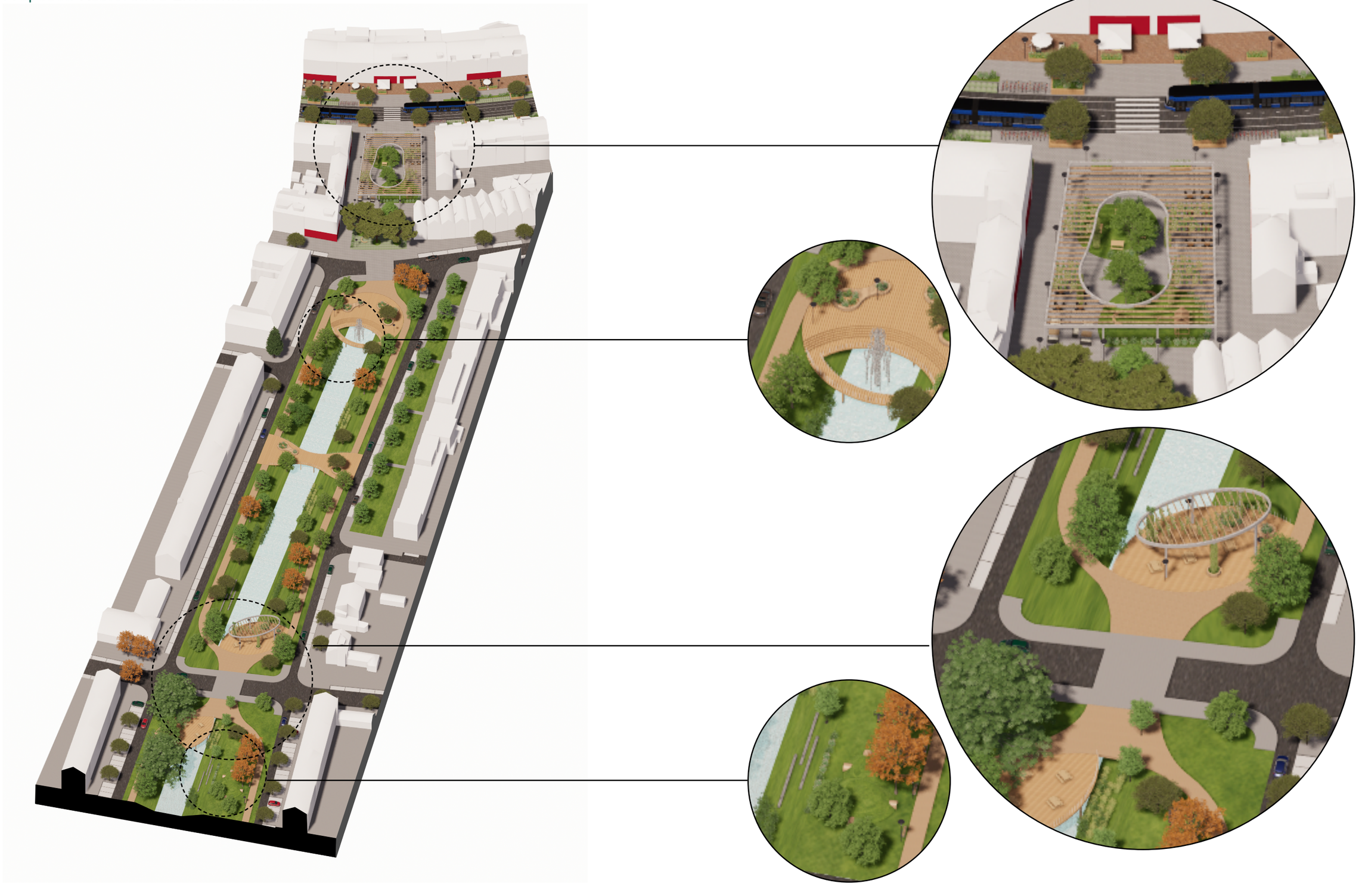
## Current Environment



## Proposed Program



## Proposed Restorative Environment



## Views



**A meeting square**



**Green canopy**



**Shopping Street**



**Multifunctional platform**



**Exploration playground**



**Transitional Space**



# CONCLUSIONS

The last chapter aims to revisit the whole thesis progress. Here, I present the conclusions of both research and design and answer the research questions. The limitations of this research are presented with a discussion on further efforts and explorations. The project is completed by a reflection that elaborates on all the duration of the graduation year.


**CONCLUSIONS**

**EVALUATION**

**REFLECTION**

The graduation project

Relevance

Methods and Argumentation

Relation to urbanism and Cities of the Future

Research and Design

Transferability of the project

**ETHICAL CONSIDERATIONS**

Participatory Design

Gentrification

Territorialization

**DISCUSSION**


Generated using AI, by Microsoft Bing Image Creator, powered by DALL-E

# Conclusion

This project aimed to identify the opportunities of public space in dense urbanized environments to foster inter-ethnic social interaction. In a multi-ethnic neighborhood, such as South Rotterdam, I take advantage of the availability of data to explore a multi-methods approach and inform urban and landscape design with computational methods. To do so, I used publicly available data sources, such as OpenStreetMap and CBS to conduct a network analysis of the walkable street network and understand the accessibility of different ethnic groups in places of leisure (parks and playgrounds) and connect them with third places that, based on literature, foster social interaction. By generating the shortest paths that connect those places, I selected the streets that are more convenient for the pedestrian and have the potential to be more vibrant, including in the proposed network restorative environment in the area (singels) that are shown to improve well-being and connecting the network to public transport, to encourage pedestrian movements.

The proposed network of public spaces consists of different typologies of streets and intersections. Garden streets create a shared living space in the public realm for residents to engage in public life and are designed with integrated restorative elements to promote well-being and motivate movement along the network. Shopping streets are proposed to support local businesses and attract people to visit and interact with each other. By appropriating public space in shopping streets, local businesses create a vibrant environment and create the conditions for initiating conversation, creating social ties, and feeling of trust among the residents. Water streets are primarily included in the network for their restorative characteristics and consist of the singel in neighborhoods. Along the water street, one can interact with nature and find places for relaxation and shared activities. Finally, mobility streets come to improve accessibility to the network by improving the pedestrian experience, providing a safe environment to walk with integrating nature. Along the mobility street, the repurposing of the parklets is proposed to encourage residents and local businesses to personalize public space and create shared places for interaction, by placing outdoor furniture and natural elements.

Another element of the network of public spaces is the intersections. Water nodes are proposed at the intersection of the network with the singels, where platforms are designed to create room for shared activities and increase the interaction between humans and nature. The pre-selected parks and playgrounds are the second type of intersection and are suggested to be integrated into the network by expanding their area in the adjacent streets and continuing their paths to motivate pedestrians into the leisure place. Where the network meets an existing square, the intervention is to identify the particular opportunities of the square and integrate more natural elements, improving its restorative effect, while new squares are proposed at parking places that are surrounded by local businesses. At the new squares, an introduction of new places is proposed to facilitate the co-existence of diverse social groups and support local businesses.

In general, the methodology introduced in this project brings together three disciplines, urban design, landscape architecture, and urban analytics, to gain insights into the opportunities of integrating data-driven methods in such projects. Concluding, the use of data, especially in a multi-ethnic context, can provide valuable information for decision-making and the network analysis can reveal scenarios that otherwise might have been missed. In the context of South Rotterdam, where the lack of public space is evident, I argue that there is great potential in strengthening public space by redefining the streetscape to accommodate shared places for diverse populations to interact, express themselves, and create conditions for healthy behaviors that promote ethnic diversity.





# Evaluation

## Urban Design:

### RQ1 What is the relation between the urban environment and neighborhood experience?

The relationship between the urban environment and the neighborhood experience is inextricable. The environment impacts not only the well-being of the individual but can also influence the formation of social capital and the creation of a feeling of belongingness, familiarity, and connection to the neighborhood. Restorative environments have been shown to improve well-being but also improve perceived livability.

### RQ2 What design principles contribute to encouraging participation in public life?

To encourage participation in public life, urban projects should focus on integrating restorative environments into the urban landscape. By doing so, not only the experience is improved but also more opportunities are created for social interaction. Hence, increasing the chances for developing social ties and feelings of trust among residents, creating conditions for community engagement and shared activities in public spaces.

## Landscape Architecture:

### RQ3 How to implement nature-inclusive designs to promote well-being?

Nature-inclusive designs have been proven to positively impact well-being. However, it is essential to ensure accessible urban nature in proximity, to motivate people to interact with nature. Also, nature-inclusive designs should integrate social places, that facilitate residents' activation through the diverse program and incorporate elements that trigger fascination, are attractive, and promote human-nature interaction.

### RQ4 How restorative environments can contribute to increasing social interaction?

Restorative environments can be implemented in different forms. In this project, I argue that a restorative environment can contribute to increasing social interaction by integrating programs and elements that attract citizens' participation, such as community gardens, or exercise equipment. By strengthening public space with restorative elements and social activities, we can increase accessibility in restorative landscapes.

## Urban Analytics:

### RQ5 How to improve accessibility to public spaces to enhance ethnic diversity?

A data-driven spatial analysis of the demographic data in the area, combined with the analysis of the pedestrian network gave insights into the potential of ethnic co-accessibility in South Rotterdam. To improve accessibility the network is formed based on the shortest path, hence facilitating pedestrian trips, and designing the street to increase the opportunities for social interaction along the network and not only the existing places.

### RQ6 How to identify places that foster interaction in the urban fabric?

To identify those places, I curried a literature review that suggested public spaces, such as parks, playgrounds, and squares, and places that foster interaction, but also third places, such as cafes, restaurants, and libraries that attract diverse populations. I adopted these places as the nodes of the network of public spaces and the interventions on the streets enriched the potential for interaction across the network.

# Reflection

## Graduation project

The preliminary results of the graduation project showcase a network of public spaces designed to transform streets into livable public spaces for multi-ethnic communities. By providing this network, this project aims to empower public life and promote social interactions, ultimately leading to improved feelings of trust and belonging. Integrated with the scope of this network is to increase social control, by having more "eyes on the streets", thus reducing awkward and unwanted behaviors and enhancing safety in public spaces.

The process of the project emphasizes a mixed-methods approach for both research and design, bringing together different disciplines to create a comprehensive and innovative solution. The process is constructed by combining data-driven research for spatial analysis, literature exploration for theoretical and empirical background, and computational approaches to design with research and design on the micro-scale. The interdisciplinary approach draws on the expertise of urban design, landscape architecture, and urban analytics, enabling a more holistic and integrated design process.

The planning of the project focuses on scalability, allowing the project to be implemented on a larger scale while ensuring that it can be phased effectively. The project's scalability also considers different user groups. On the micro-scale (the street) key stakeholders are the residents of the adjacent blocks, allowing more control over their environment while sharing ownership and accountability for their street (public space). On the other hand, activity and leisure locations answer to the macro-scale of urban space. These places as super-diverse are selected for their potential to promote ethnic diversity, increase acknowledgment of different communities, and manifest the multi-ethnic city.

**Mentors, sessions, and feedback**

Throughout the graduation year, I had the pleasure to collaborate with three inspiring mentors, each of whom provided valuable insights and feedback that led to this project. Having available three mentors from different disciplines was very interesting, motivating, and challenging at the same time. The most difficult part for me was to differentiate my expectations from each one in the process. At the same time, it was difficult to communicate and integrate the different approaches.

However, the feedback I had during the sessions and also during the official presentations were significant, always to the point, and when needed open to clarification The one-by-one sessions helped me to manage the feedback and gave me the time to process the discussion and plan the next steps of my project. Equally important were the presentations that allowed me to bring the mentors together, present my progress, have a comprehensive discussion, identify possible conflicting points of view, and move forward.

In this process, I learned very useful skills that will guide me throughout my professional and academic career. The two facets of the project -research and design- led me to learn a methodology for structuring research and also a way of working and experimenting with design, the one coming to complete the other and vice versa. I also learned how to value diverse input and make effective decisions based on the overall view I had for my project, as well as communicating my ideas and structuring my thinking.

## Scientific and Societal Relevance

**Scientific Relevance**

Introducing computational design and urban analytics in urban and landscape design comes with its limitations. However, it also offers unique opportunities to explore relations between data that are not readily available. For example, using urban analytics, I was able to calculate the potential for ethnic diversity in activity locations and leisure spaces, which helped me to design a more inclusive network of public spaces. Additionally, the computational design offers the opportunity of exploring non-conventional ideas, reflecting on and evaluating them. By using computational tools, I was able to stimulate and test different design scenarios, which allowed me to select the best options and create a more effective final design.

Despite these advantages, the limitations of computational design should also be considered. Not everything can be integrated into data, let alone expressed in a street network. In this project, I couldn't incorporate all the data and had to filter the street network to result in a final design. Furthermore, the lack of updated data, such as missing links (pathways, bridges, street crossings), could result in unexpected outcomes. Using computational design could also constrain creativity, limiting the range of design options considered. For example, I was unable to explore non-network-based solutions, such as opening the ground floor of a building to create a pathway or constructing a bridge to cross a single.

Overall, computational urban design is promising, but it requires expertise and experience to realize its full potential. In this project, I was only able to use a specific tool that manipulated network data. However, I believe that computational urban design can also integrate other forms of data and exploration to better optimize the process and result in innovative designs and approaches.

**Societal Relevance**

Multi-ethnic cities are increasingly common worldwide and ethnic integration plays a crucial role in creating cohesive and thriving communities. In South Rotterdam, neighborhoods are facing challenges related to deprivation and ethnic residential segregation due to increasing migration. Embracing ethnic diversity is therefore a priority for this community.

To address this issue, this project proposes a network that aims to increase social inter-ethnic interactions while transforming public space to better accommodate shared activities, strengthening feelings of trust and belongingness among the community. However, in projects of such social importance, the design of public spaces should not only be informed by theoretical knowledge but also by the perspectives and needs of the users themselves.

While the literature has provided an understanding of the effect of the environment on subjective well-being and the qualities that should be integrated into the design to encourage participation in public life, the diversity of the users requires a more nuanced approach. Unfortunately, I was unable to contact potential users of the project to gain insights from them.

Nevertheless, the design strategies proposed in this project include opportunities for adjustment in the environment and propose a variety of options future users can consult. By considering the unique needs and expectations of the community, the design can better accommodate their preferences and facilitate more effective inter-ethnic interactions.

## Methods and Argumentation

**Literature Review**

The literature review is distinguished into three main categories, theoretical knowledge, empirical research, and reference projects. The understanding of the theoretical concepts implicated in this project was very important to comprehend the issues I had to deal with. Specifically, researching the meaning of social cohesion and its expression in deprived neighborhoods that face ethnic residential segregation provided insights towards interpreting information I gathered from data and witnessed in the area. Also, realizing the different effects of the environment on subjective well-being and the potential of restorative environments to improve the neighborhood experience formed directions for the design.

The literature on empirical research aimed in providing knowledge and learning from the conclusions of other researchers that dealt with ethnic minorities, in The Netherlands and abroad. Furthermore, several empirical research concerned Rotterdam South explicitly described the experiences, expectations, and

perspectives of existing residents in the area. This information was very valuable in forming the problem field and research aim of this thesis.

The reference projects that I studied during the development of this project helped to create a vision for the network of public spaces. Also, they presented potential spatial qualities that could be implemented in Rotterdam South. More importantly, realized projects helped me to evaluate the design and reflect on what options could work or not.

**Data-driven Analysis,**

**Network Analysis**

The Netherlands has extensive availability of data. The integration of a data-driven analysis method in an urban project is inevitable. Data offer the opportunity to read the site from different angles, untangle the complexity of the urban environment, and overlay information that informs strategic decisions. In my project, I used data to read the site, and also, manipulated data to unveil nuanced knowledge. I combined demographic data from CBS and spatial data from OpenStreetMaps to analyze ethnic co-accessibility in selected locations. I additionally performed network analysis to determine the most accessible locations that were considered in the network of public spaces.

Using data for spatial analysis has great potential and the integration of urban analytics methods in urban studies is tremendously beneficial and valuable.

**Fieldwork & Observations,**

**Informal Discussions**

Sensing the place comes with visiting the site. Unfortunately, I was unable to perform fieldwork as much as I would like, but the times I went there, I witnessed the qualities of public space and the behavior of people. Observing social behavior and discussing with the people in the field is a method widely used for urban studies and it is irreplaceable, especially for designing public spaces. Having discussions was only possible once during a field trip. Lack of available time and difficulties in task scheduling resulted in a missing opportunity of integrating more empirical knowledge from the experiences of the actual users of public space. I tried to mitigate this loss by studying literature on those ethnicities in other locations in the Netherlands or even from Rotterdam South. However, I urge future planners and designers to ensure a bottom-up input on urban projects that can validate data and provide valuable insights.

**Computational Urban Design**

I used computational approaches to form the network of public space. This method can be very helpful when dealing with complex systems. In this case, I made use of tools that manipulated network data to analyze and filter the walkable network of South Rotterdam and integrate accessibility requirements in the selection of streets. Additionally, I overlayed the walkable network with demographic data to calculate ethnic co-accessibility in desired locations and find the places with the most potential for ethnic diversity and make more evidence-based decisions.

**Research by design**

Research by design was used to define the design strategies of this project. By studying different design options and reflecting on their impact I was able to select the most effective solutions that answer to the needs of the different characters of connections and junctions in the network. Additionally, research by design guided the different adjustments implemented in the network to complement the outcomes from computational methods.

## Relation to urbanism and Cities of the Future

My graduation project argues the potential of public space in improving social cohesion and manifesting diversity in multi-ethnic cities. To explore this fascination I selected the studio City of the Future, a multi-disciplinary research group that creates opportunities for collaboration with other professions. The character of the studio allowed me to challenge myself, by including in my mentor team, experts from different disciplines.

The involvement of Urban Analytics mentors aims to help me experiment with urban analysis and computational approaches in design, using tools that are traditionally part of urban analytics methods. As an urban planner and during the Master in Urbanism program I didn't have efficient interaction with data-driven analysis and design, which potentially can be used to better understand the complex urban environment and result in more effective design decisions.

Additionally, in my multidisciplinary mentor team, I included a landscape architect. As mentioned before, urban nature is critical for Rotterdam South, and for improving subjective well-being. My collaboration with a landscape architect gives insights regarding the design tools and the framework for integrating nature in the city, not only in the sense of green space but also as an environment that creates experiences and has restorative characteristics and social impact.

Finally, my mentor from urban design comes to complete the team, as a negotiator between different disciplines, but also as an oversight of my work and my process. Just as in practice, urban designers come across multiple professions that they need to collaborate with. I firmly believe that the "City of the Future" research group offers me the advantage to grow as a capable urbanist. One that can collaborate and make the best out of the knowledge from different parties, all in benefit to an improved urban environment.

## Research and Design

This project is a result of a combined research and design process. These two components intertwined throughout the formation of the network of public spaces in both conceptual and practical manners. Theoretical research and exploration of qualities through reference projects informed the design strategies while the desired spatial qualities and design of spaces guided the research.

Moreover, the process included a back-and-forth study of the different scales. While progressing with the network design, I designed streets with different capacities to inform the selection of streets in the network. This way, I was able to reflect on the qualities of the streets I aimed for and respectively take decisions on the network.

The two elements of urban design come to inform and evaluate each other. Research on site-specific and theoretical topics informs the design, while the design requires to answer the need unveiled from the research and be evaluated as such.

## Transferability of the project

As mentioned already, multi-ethnic cities are widely found worldwide, and integration challenges are consistently presented in public life and expressed in public space. It is therefore important to bring to the forefront of urban design the need for promoting ethnic diversity with urban redevelopments.

The methodology proposed in this thesis is easily transferable in any city that has available demographic spatial data. In The Netherlands, this data cover the national territory, which means that using open-source network data and demographic data, such an approach can be replicated in a similar-context urban environment.

Furthermore, from a theoretical and spatial perspective, an exploration is presented of environments that promote well-being, encourage public life and social interaction, and stimulate social cohesion. The design strategies alone can be extremely beneficial in forming social capital in a community and integrating nature to improve the neighborhood experience.

## Ethical Considerations

### Design for them without them

Public space is nothing without the users. Hence their involvement in the design process is critical to result in a successful, sustainable, and resilient design. For this project, the inputs and involvement of residents were not the primary objectives, and therefore the final design should not be considered ideal.

While a project of this magnitude requires a top-down approach that considers multiple aspects of the built environment, the individual interventions should be informed by the citizens and potential users. For this reason, the design strategies offer a catalog of different design elements that can be selected and updated or improved to meet the need and preferences of the users. Sharing accountability of public space is essential to ensure the livability of the project.

Also, certain design decisions will likely meet reactions from the residents. For example, reducing parking space and pedestrianizing streets is usually a topic that finds disagreement. I tried to mitigate that by not removing cars totally, but rather reducing parking lets. However, the population of the area is very attached to cars and it would need a process of co-creation and continuous discussion to help them envision a different quality for their streets and the experience in general.

### Gentrification

Low-income deprived neighborhoods, like South Rotterdam, are susceptible to gentrification when implementing urban redevelopments. The transformation of public space aims to create an attractive and safe environment. Such areas are usually attracting more economic activities after improvements in the built environment and the existing residents are negatively impacted. Already, the National Program for Rotterdam South, which introduces urban redevelopments, policy changes, and other programs, creates conflicts between existing residents and newcomers.

With this project, I tried to mitigate the possible effects of gentrification, by maintaining the use of cars in the area and by proposing a flexible and adjustable design of public space that welcomes the diversity of the area. Also, I developed the network based on the existing economic activities, to strengthen their role in the area. However, the implementation of this network might result in more amenities establishing along the network, due to its potential of attracting more population.

### Territorialism

Currently, public spaces in South Rotterdam are reported to be dominated by specific ethnic groups, making others feel unwelcome and excluded. Territorialism refers to the appropriation of public space in such a way that negatively impacts the experience of other people.

This project suggests the formation of garden streets, amongst other elements. Garden streets are mainly designed by and for nearby residents. However, still accessible to the public, their design should ensure a welcoming and inclusive environment. Trying to mitigate that, I proposed a modular approach to designing these streets, one that encourages diverse sub-units in the shared streets that can relate to the diverse need of potential users.

It is, though, possible that these streets can be privatized. Such actions can be avoided by involving the whole community in the project and clearly communicating the ambitions towards an accessible, safe, and attractive public network that promotes walkability, social inclusion, and ethnic diversity.

## Discussion

The current project proposes the formation of a network of public spaces to foster inter-ethnic social interaction. The design strategies consist of a variety of different qualities that create the conditions for diverse social groups to formulate a different program of public space and transform the streetscape according to their needs and aspirations. However, in this project, the scope was not to create a co-creation methodology which is essential for the success of such an intervention. I, hereby, urge future researchers to elaborate on the opportunities for multi-ethnic groups to collaborate on the design process of a street. The relationship between methodology toward co-creation processes and the current project is inextricable, to ensure the creation of a sense of belongingness, familiarity, and trust between neighbors.

Furthermore, the proposed design strategies, introduce the materiality of pavement and use of greenery as an element of rainfall water infiltration. However, this project does not deeply research the technical requirements that are necessary for its implementation. An open question remains on the actual impact of the selected materials and it is possible to be altered if future research proves so.

Finally, the proposed restorative elements, which mainly consist of vegetation and water bodies, require an elaborated understanding of the environmental conditions and the species that can flourish in such environments. If it were for this project to be implemented, the contribution of environmentalists and landscape architects would be significant to ensure that the proposed environments can perform well in the area.

# APPENDIX


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**LIST OF FIGURES**

**CODING SCRIPTS**

Ethnic Co-accessibility

Clustering Third Places


Generated using AI, by Microsoft Bing Image Creator, powered by DALL-E

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# Coding Scripts

## Ethnic Co-Accessibility

In [1]:
```
import pandas as pd
import osmnx as ox
import networkx as nx
import matplotlib.pyplot as plt
import geopandas as gpd
from shapely.geometry import Point
from shapely.geometry import LineString
from shapely.geometry import Polygon
from shapely.geometry import MultiLineString
from pyproj import Proj, transform

%matplotlib inline
ox.__version__
```

Out[1]:
```
'1.3.0'
```

In [2]:
```
pd.set_option('display.max_columns', None)
pd.set_option('display.max_rows', 50)
```

### 1.Create graph of walking network

In [3]:
```
place_name = [
    #"Katendrecht, Rotterdam, South Holland",
    "Afrikaanderwijk, Rotterdam, South Holland",
    #"Kop van Zuid - Entrepot, Rotterdam, South Holland",
    "Oud Charlois, Rotterdam, South Holland",
    "Carnisse, Rotterdam, South Holland",
    "Tarwewijk, Rotterdam, South Holland",
    "Bloemhof, Rotterdam, South Holland",
    "Hillesluis, Rotterdam, South Holland",
    #"Zuiderpark, Rotterdam",
    "Zuidplein, Rotterdam, South Holland",
    #"Vreewijk, Rotterdam, South Holland"
]
```

In [4]:
```
G = ox.graph_from_place(place_name, network_type='walk')
G = ox.project_graph(G, to_crs='epsg:28992')
```

In [5]:
```
# find the centermost node and then project the graph to UTM
gdf_nodes = ox.graph_to_gdfs(G, edges=False)
x, y = gdf_nodes["geometry"].unary_union.centroid.xy
```

In [6]:
```
travel_speed = 4.5  # walking speed in km/hour
# add an edge attribute for time in minutes required to traverse each edge
meters_per_minute = travel_speed * 1000 / 60  # km per hour to m per minute
for _, _, _, data in G.edges(data=True, keys=True):
    data["time"] = data["length"] / meters_per_minute
```

### 2. Import coaccess datasets for 10 min walking distance

In [7]:
```
# Load the GDF files for thee 3 timeslots
gdf_in = gpd.read_file('exports/poi_coaccess_10min_2021.gpkg')
```

In [8]:
```
# Create a gdf with only the parks
gdf_park = gdf_in[gdf_in['subcategory'].isin(['park'])].copy()
gdf_park['source'] = '10'
# Select the parks with ethnic diversity > 90%
gdf_park2 = gdf_park[gdf_park['EI_ethnic'] > 0.9].copy()
# Select the 10 largest parks
gdf_park3 = gdf_park2.sort_values(by='area', ascending=False).head(10).copy()
```

In [9]:
```
# Create a gdf with only the playgrounds
gdf_play = gdf_in[gdf_in['subcategory'].isin(['playground'])].copy()
gdf_play['source'] = '10'
# Select the playgrounds with ethnic diversity > 90%
gdf_play2 = gdf_play[gdf_play['EI_ethnic'] > 0.9].copy()
# Select the 10 largest playgrounds
gdf_play3 = gdf_play2.sort_values(by='area', ascending=False).head(10).copy()
```

In [10]:
```
# Merge gdf with selected parks and playgrounds
gdf_max = pd.concat([gdf_park3, gdf_play3])
```

In [11]:
```
gdf_max = gdf_max.reset_index(inplace=False)
gdf_max = gdf_max.drop('index', axis=1, inplace=False)
```

In [12]:
```
# add a column with nearest node
gdf_max["nearest_node"] = gdf_max.apply(lambda row: ox.nearest_nodes(G, row['x'],
```

In [13]:
```
fig, ax = ox.plot_graph(
    G, show=False, close=False, edge_color="#999999", edge_alpha=0.2, node_size=0
)
gdf_max.plot(ax=ax, color='red', markersize=50)
plt.show()
```



### 3.Create isochrones for each point based on max EI_ethnic

In [14]:
```
def make_iso_polys(G, gdf, edge_buff, node_buff, infill):
    isochrone_polys = []
    for i, row in gdf.iterrows():
        center_node = row['nearest_node']
        r = int(row['source'])
        subgraph = nx.ego_graph(G, center_node, radius=r, distance="time")

        node_points = [Point((data["x"], data["y"])) for node, data in subgraph.no
        nodes_gdf = gpd.GeoDataFrame({"id": list(subgraph.nodes)}, geometry=node_p
        nodes_gdf = nodes_gdf.set_index("id")
```

```
        edge_lines = []
        for n_fr, n_to in subgraph.edges():
            f = nodes_gdf.loc[n_fr].geometry
            t = nodes_gdf.loc[n_to].geometry
            edge_lookup = G.get_edge_data(n_fr, n_to)[0].get("geometry", LineStrin
            edge_lines.append(edge_lookup)

        n = nodes_gdf.buffer(node_buff).geometry
        e = gpd.GeoSeries(edge_lines).buffer(edge_buff).geometry
        all_gs = list(n) + list(e)
        new_iso = gpd.GeoSeries(all_gs).unary_union

        # try to fill in surrounded areas so shapes will appear solid and
        # blocks without white space inside them
        if infill:
            new_iso = Polygon(new_iso.exterior)
        isochrone_polys.append(new_iso)
    return isochrone_polys
```

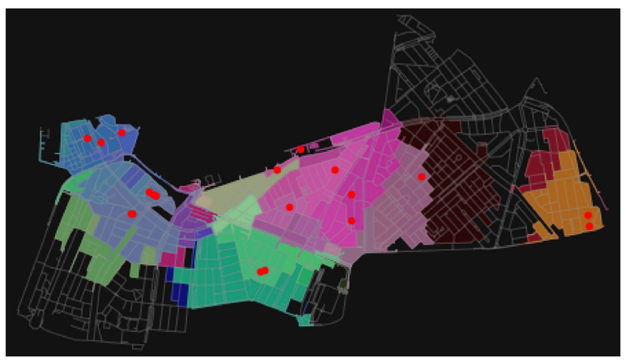
In [15]:
```
# make the isochrone polygons
isochrone_polys = make_iso_polys(G, gdf_max, edge_buff=5, node_buff=0, infill=True
gdf_isochrones = gpd.GeoDataFrame(geometry=isochrone_polys)
```

In [16]:
```
import random

def get_random_colors(gdf):
    length = len(gdf)
    colors = []
    for i in range(length):
        r = lambda: random.randint(0, 255)
        color = '#{:02x}{:02x}{:02x}'.format(r(), r(), r())
        colors.append(color)
    return colors
```

In [17]:
```
iso_colors = get_random_colors(gdf_isochrones)

# plot the network then add isochrones as colored polygon patches
fig, ax = ox.plot_graph(
    G, show=False, close=False, edge_color="#999999", edge_alpha=0.2, node_size=0
)
gdf_isochrones.plot(ax=ax, color=iso_colors, ec="none", alpha=0.6, zorder=-1)
gdf_max.plot(ax=ax, color='red', markersize=20)
plt.show()
```



## 4.Load CBS data for Rotterdam

In [18]:
```
cbs_rot = gpd.read_file('data/cbs_vk100_2021_rot.gpkg')
```

In [19]:
```
# Calculate population using the data from CBS
num = cbs_rot._get_numeric_data()
num[num < 0] = 0

cbs_rot['dutch'] = round((cbs_rot['percentage_nederlandse_achtergrond']/100)*cbs_r
cbs_rot['western'] = round((cbs_rot['percentage_westerse_migr_achtergr']/100)*cbs_
cbs_rot['non_western'] = round((cbs_rot['percentage_niet_westerse_migr_achtergr']/
cbs_rot['tot_ethnic'] = cbs_rot['dutch'] + cbs_rot['western'] + cbs_rot['non_weste

cbs_rot['children'] = cbs_rot['aantal_inwoners_0_tot_15_jaar']
cbs_rot['adults'] = cbs_rot['aantal_inwoners_15_tot_25_jaar'] + cbs_rot['aantal_in
cbs_rot['elderlies'] = cbs_rot['aantal_inwoners_65_jaar_en_ouder']
cbs_rot['tot_age'] = cbs_rot['children'] + cbs_rot['adults'] + cbs_rot['elderlies'
```

In [20]:
```
# Isolate the information that are relevant
cbs_rot_clean = cbs_rot[['crs28992res100m', 'tot_age', 'children', 'adults', 'elde
```

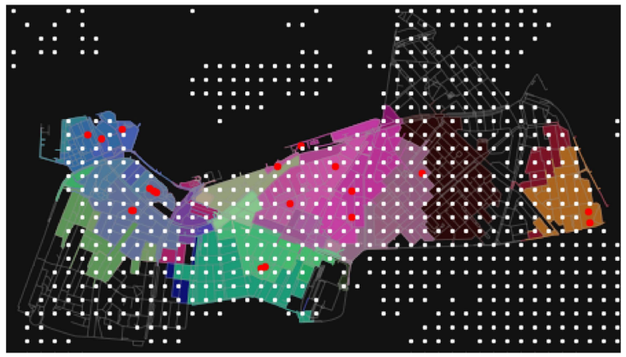
In [21]:
```
# create centroids for each cbs grid of 100x100m
cbs_rot_clean['centroid'] = cbs_rot_clean['geometry'].centroid

#isolate x,y coordinates for QGIS
cbs_rot_clean['lon'] = cbs_rot_clean['centroid'].geometry.x
cbs_rot_clean['lat'] = cbs_rot_clean['centroid'].geometry.y

# find each nearest node to several points, and optionally return distance
cbs_rot_clean['nearest'] = ox.nearest_nodes(G, cbs_rot_clean['lon'], cbs_rot_clean
```

In [22]:
```
# Convert the DataFrame to a GeoDataFrame with point coordinates
geometry = [Point(xy) for xy in zip(cbs_rot_clean.lon, cbs_rot_clean.lat)]
gdf_cbs = gpd.GeoDataFrame(cbs_rot_clean, geometry=geometry, crs='epsg:28992')
```

In [23]:
```
# plot the network then add isochrones as colored polygon patches
fig, ax = ox.plot_graph(
    G, show=False, close=False, edge_color="#999999", edge_alpha=0.2, node_size=0
)
gdf_isochrones.plot(ax=ax, color=iso_colors, ec="none", alpha=0.6, zorder=-1)
gdf_max.plot(ax=ax, color='red', markersize=20)
gdf_cbs.plot(ax=ax, color='white', markersize=5)
plt.show()
```



## 5.Create a GDF for each isochrone_id with the cbs data

In [24]:
```
# create a list to store the result dataframes
result_dfs = []

# iterate over the isochrone polygons
for i, isochrone in gdf_isochrones.iterrows():
    # select the points within the isochrone polygon
    points_within_isochrone = gdf_cbs[gdf_cbs.within(isochrone['geometry'])]

    # create a new dataframe with the points and isochrone information
    result_df = points_within_isochrone.copy()
    result_df['isochrone_id'] = i

    # append the result dataframe to the list
    result_dfs.append(result_df)

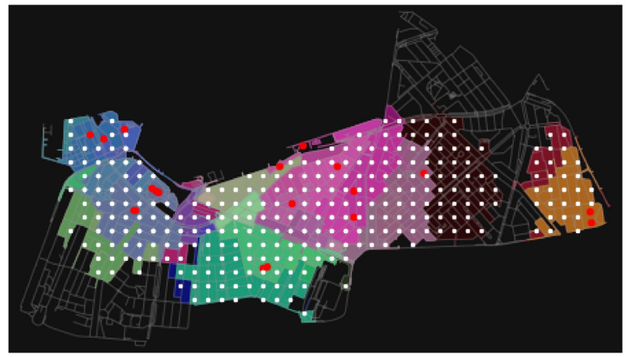
# concatenate all the result dataframes into one
result_gdf = pd.concat(result_dfs, ignore_index=True)
```

In [25]:
```
# filter the points with isochrone_id = 5
result_gdf_filtered = result_gdf[result_gdf['isochrone_id'] == 0]
```

In [26]:
```
# plot the network then add isochrones as colored polygon patches
fig, ax = ox.plot_graph(
    G, show=False, close=False, edge_color="#999999", edge_alpha=0.2, node_size=0
)
gdf_isochrones.plot(ax=ax, color=iso_colors, ec="none", alpha=0.6, zorder=-1)
gdf_max.plot(ax=ax, color='red', markersize=20)
result_gdf.plot(ax=ax, color='white', markersize=5)
plt.show()
```







## 6. Export data to csv for visualization in QGIS

In [27]:
```
gdf_isochrones.to_file('exports/Paths2/isochrones_2.shp', layer="isochrones")
result_gdf.to_csv('exports/Paths2/cbs_in_isochrones_2.csv')
gdf_max.to_file('exports/Paths2/points_2.gpkg')
```

## Clustering Third Places

In [19]:
```
import geopandas as gpd
from sklearn.cluster import DBSCAN
import numpy as np
import pandas as pd
from shapely.geometry import MultiPoint
```

In [20]:
```
# Load the GeoDataFrame with points
gdf_1 = gpd.read_file('exports/pois_south_rot.gpkg')
```

### Cluster shops and sustenance

In [21]:
```
gdf = gdf_1[(gdf_1['category'] == 'shops') | (gdf_1['category'] == 'sustenance')].
```

In [22]:
```
# Set the epsilon (distance) and minimum samples parameters for DBSCAN
epsilon = 100 # meters
min_samples = 10

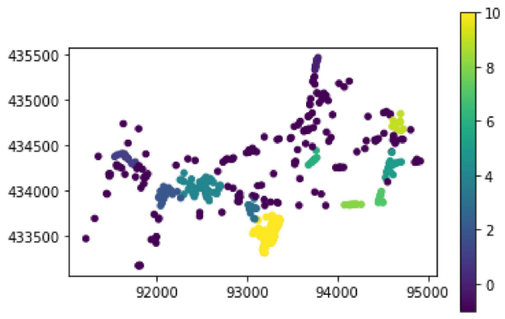
# Create a numpy array of the point coordinates
X = np.array(gdf.geometry.apply(lambda p: [p.x, p.y]).tolist())

# Run DBSCAN
db = DBSCAN(eps=epsilon, min_samples=min_samples).fit(X)

# Add a column to the GeoDataFrame with the cluster labels
gdf['cluster'] = db.labels_

# Plot the clusters
gdf.plot(column='cluster', cmap='viridis', markersize=20, legend=True)
```

Out[22]:
```
<AxesSubplot:>
```




In [23]:
```
gdf = gdf.sort_values(by='cluster')
gdf['label'] = gdf.apply(lambda row: str(row['cluster']) + '_shops&sustenance', ax
gdf.head(3)
```

Out[23]:

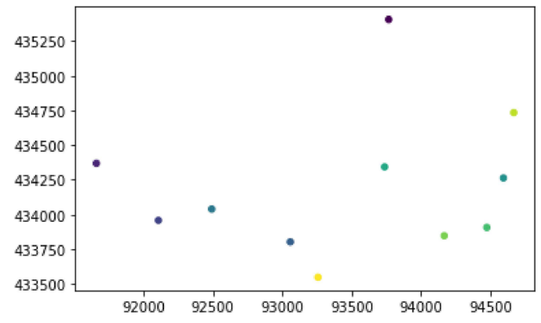
| | id | area | subcategory | category | geometry | cluster | label |
|---|---|---|---|---|---|---|---|
| **9** | 1449093993 | 0.0 | marketplace | sustenance | POINT (93826.484 435062.412) | -1 | -1_shops&sustenance |
| **433** | 4806646775 | 0.0 | car_repair | shops | POINT (94416.168 434563.192) | -1 | -1_shops&sustenance |
| **434** | 4974011502 | 0.0 | supermarket | shops | POINT (94620.758 434605.782) | -1 | -1_shops&sustenance |

In [24]:
```
clusters = list(set(gdf['cluster'].tolist()))
gdf_centroids = gpd.GeoDataFrame()
for c in clusters:
    gdf_c = gdf[gdf['cluster'] == c].copy()
    c_sum = len(gdf_c)
    point_geoms = gdf_c['geometry'].tolist()
    multipoint_geom = MultiPoint(point_geoms)
    centroid = multipoint_geom.centroid
    cluster = {'cluster': [c], 'quantity': [c_sum]}
    gdf_new = gpd.GeoDataFrame(cluster, geometry=[centroid])
    gdf_centroids = pd.concat([gdf_centroids,gdf_new])
```

In [25]:
```
gdf_centroids = gdf_centroids.dropna(subset=['cluster'])
gdf_centroids = gdf_centroids.drop_duplicates()
gdf_centroids = gdf_centroids.iloc[:-1]
```

In [26]:
```
gdf_centroids.plot(cmap='viridis', markersize=20, legend=True)
```

Out[26]:
```
<AxesSubplot:>
```




In [27]:
```
gdf_centroids['x'] = gdf_centroids.geometry.apply(lambda p: p.x)
gdf_centroids['y'] = gdf_centroids.geometry.apply(lambda p: p.y)
gdf_centroids['type'] = 'shops-sustenance'
```

### Cluster public buildings

In [28]:
```
gdf_pb = gdf_1[(gdf_1['category'] == 'culture') | (gdf_1['category'] == 'public_bu
```

In [29]:
```
# Set the epsilon (distance) and minimum samples parameters for DBSCAN
epsilon = 200 # meters
min_samples = 3
```

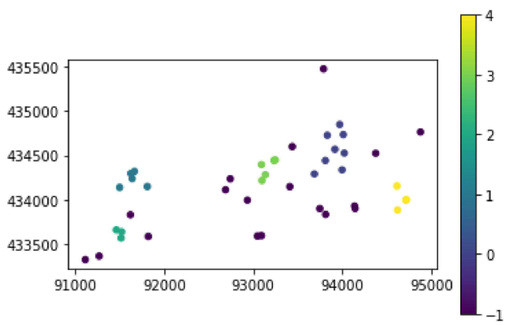
```
# Create a numpy array of the point coordinates
X = np.array(gdf_pb.geometry.apply(lambda p: [p.x, p.y]).tolist())

# Run DBSCAN
db = DBSCAN(eps=epsilon, min_samples=min_samples).fit(X)

# Add a column to the GeoDataFrame with the cluster labels
gdf_pb['cluster'] = db.labels_

# Plot the clusters
gdf_pb.plot(column='cluster', cmap='viridis', markersize=20, legend=True)
```

Out[29]: <AxesSubplot:>




In [30]:
```
gdf_pb = gdf_pb.sort_values(by='cluster')
gdf_pb['label'] = gdf_pb.apply(lambda row: str(row['cluster']) + '_culture&public_
gdf_pb.head(3)
```

Out[30]:

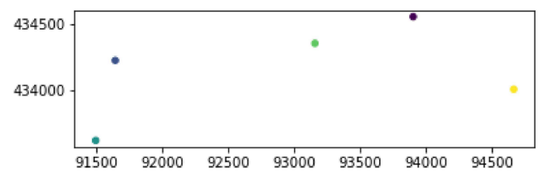
| | id | area | subcategory | category | geometry | cluster | |
|---|---|---|---|---|---|---|---|
| **10** | 1716900872 | 0.000000 | kindergarten | public_building | POINT (93787.847 435471.134) | -1 | -1_culture&pu |
| **405** | 353416351 | 1805.289435 | school | public_building | POINT (94874.931 434760.827) | -1 | -1_culture&pu |
| **397** | 2787527955 | 0.000000 | community_centre | culture | POINT (94371.448 434523.155) | -1 | -1_culture&pu |

In [31]:
```
clusters2 = list(set(gdf_pb['cluster'].tolist()))
gdf_centroids2 = gpd.GeoDataFrame()
for c in clusters2:
    gdf_c = gdf_pb[gdf_pb['cluster'] == c].copy()
    c_sum = len(gdf_c)
    point_geoms = gdf_c['geometry'].tolist()
    multipoint_geom = MultiPoint(point_geoms)
    centroid = multipoint_geom.centroid
    cluster = {'cluster': [c], 'quantity': [c_sum]}
    gdf_new = gpd.GeoDataFrame(cluster, geometry=[centroid])
    gdf_centroids2 = pd.concat([gdf_centroids2,gdf_new])
```

In [32]:
```
gdf_centroids2 = gdf_centroids2.dropna(subset=['cluster'])
gdf_centroids2 = gdf_centroids2.drop_duplicates()
gdf_centroids2 = gdf_centroids2.iloc[:-1]
```

In [33]:
```
gdf_centroids2.plot(cmap='viridis', markersize=20, legend=True)
```

Out[33]: <AxesSubplot:>




In [34]:
```
gdf_centroids2['x'] = gdf_centroids2.geometry.apply(lambda p: p.x)
gdf_centroids2['y'] = gdf_centroids2.geometry.apply(lambda p: p.y)
gdf_centroids2['type'] = 'culture-public_building'
```

## Save merged_gdf

In [35]:
```
merged_gdf = pd.concat([gdf_centroids, gdf_centroids2], ignore_index=True)
points_merged = pd.concat([gdf, gdf_pb], ignore_index=True)
points_merged.head(3)
```

Out[35]:

| | id | area | subcategory | category | geometry | cluster | label |
|---|---|---|---|---|---|---|---|
| **0** | 1449093993 | 0.0 | marketplace | sustenance | POINT (93826.484 435062.412) | -1 | -1_shops&sustenance |
| **1** | 4806646775 | 0.0 | car_repair | shops | POINT (94416.168 434563.192) | -1 | -1_shops&sustenance |
| **2** | 4974011502 | 0.0 | supermarket | shops | POINT (94620.758 434605.782) | -1 | -1_shops&sustenance |

In [36]:
```
merged_gdf.to_csv('exports/Paths2/poi_clusters.csv')
points_merged.to_csv('exports/Paths2/poi_clusters_all.csv')
```

In [ ]:
```
```


rotterdam
neighborhood
social
spaces
space
network
diversity
segregation
cohesion
city
population
people
public
life
streets
impact
quality
ethnicities
immigrants
accessible
greenery
spatial
place-
area
shared
health
stressors
approach
benefits
challenges
opportunities
transport
environment
safe
proximity
parks
walk
data-driven
understanding
how
landscape
conditions
feelings
trust
attractive
identity
discussion
resulted
inclusive
character
countries
walking
variety
hillesluis
ucl
cover
segments
architect
collaborate
cdc
fieldwork
workshop
thriving
jeffres
urgent
toward
due
helped
parking
political
surrounding
processes
graduation
intertwined
pollution
input
metrics
concentration
integrating
transforming
principles
propose
denton
suriname
type
created
pleasant
evenness
must
facing
following
industrial
derived
adults
related
throughout
establish
organized
model
impacts
gain
currently
complex
implemented
appropriating
belongingness
conflicts
ekkel
safer
early
professionals
results
wide
high
war
efforts
worsen
non-western
tolsma
adjust
garden
adjacent
benefit
six
river
change
interviews
tarwewijk
explore
foundation
like
facilitate
street
paths
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