



Wageningen - the city of life

Exploring greening interventions in the city centre of Wageningen

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Preface

Throughout this project, we have witnessed the strengthening of our group dynamics and the acquisition of valuable knowledge. Exploring the world of real-life assignments and engaging in project work for a commissioner has been an engaging experience for all of us.

We want to thank Barbara Tempels, Clemens Driessen, and Lisanne Struckmann for their input during the project. Their insights have been highly valuable to our understanding and progress.

We would like to thank Robert Frijlink and Elianne Rookmaaker for their cooperation, support, and contribution to our project. Their involvement and assistance have been vital in our development and the project's progress.

We would also like to express our thanks to all the participants who assisted us in acquiring knowledge, allowing us to make informed decisions.

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Abstract

This report shows how challenges such as urban heat stress, water management, human wellbeing, attractiveness and biodiversity can be handled in the city centre of Wageningen. Currently, the city centre of Wageningen contains a lot of paved areas that will be influenced by climate change, affecting the liveability of the city centre heavily. This report emphasizes the need for a collaborative and integrated design to make the city centre a pleasant and liveable place for residents, visitors and entrepreneurs. This means that stakeholder preferences and needs are prevalent in the new designs created within this project. Expert knowledge, interviews, street surveys and existing policies helped to form the ideas suggested in this report.

4 The interventions proposed in this report are based on the easy to implement 'pick-and-mix' approach, where (sets of) guidelines can be implemented all over the city centre in different typologies. The report includes examples of how the different guidelines can be implemented on the Market Square, the Hoogstraat and the Salverdeplein. This project aims to create a mix of interventions that the entrepreneurs can independently undertake and interventions in which the support of the municipality is required. This will create a combination of easy to implement and more ambitious interventions.

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Introduction

In this chapter, the area of the city centre of Wageningen will briefly be described, along with the various problems that this area faces. Based on these problems, the main research question along with the sub research questions will be introduced. After this, the deliverables that will be generated in this project will be discussed.

AREA DESCRIPTION

Wageningen, a vibrant city in the province of Gelderland in the east of the Netherlands, is known as the city of life sciences (fig. 1). Nestled between the towns of Ede, Veenendaal and Arnhem, Wageningen has a diverse population, with 40,960 inhabitants of whom a quarter are students (Allecijfers, 2023). Over the past three decades, the city has experienced significant growth, with a 25% increase in population since 1995. However, this rapid expansion has created immense pressure on the city centre, demanding careful attention to address the diverse needs and desires of its residents while simultaneously providing space for housing, recreation, urban nature and other essential facilities.

The project was assigned to us by the association for entrepreneurs of Wageningen (SOW), thus, their perspective was a leading factor in the project. Consequently, our plans will revolve around improving the city and its attractive features. Due to the growing pressure on the city, there is a need for innovative solutions that promote the alliance between urban development and the natural environment. Through these solutions, a better living environment will be created. Entrepreneurs can benefit from these solutions as it can increase the number of visitors to the city centre of Wageningen and visitors reside there for a longer period of time. This increase in visitors also increases the number of potential customers for the entrepreneurs.

The city centre of Wageningen serves as a focal point and symbolic representation of the city itself: a bustling hub where locals and visitors can gather, shop, and work. Nevertheless, the area faces numerous challenges that significantly affect its functionality and overall appeal. On days when there is no market or no other event, the city centre can feel somewhat empty. During these dormant days, outdoor seating spaces remain unoccupied and shopping streets are deserted. In response to these circumstances, our commissioners have tasked us with presenting plans that will revive the city centre of Wageningen, transforming it into a sustainable, comfortable and attractive city centre. By tackling issues such as heat stress, water-related problems and promoting biodiversity it will ensure that the city centre will be futureproof.

To achieve these objectives, there will be a focus on urban nature and exploring innovative approaches to integrate more natural elements specifically in the city centre of Wageningen. By making Wageningen future-proof, we aim to create a more pleasant and liveable environment, thereby enhancing visitor experiences and encouraging them to spend extended periods of time enjoying and exploring all that the city has to offer.

Incorporating urban nature is not new in Wageningen, as numerous projects organised by the municipality, or the entrepreneurs have already taken place. A prime example is the Plant4Daagse, a four-day event dedicated to greening the city centre highlighting the positive impacts of vegetation in urban areas (Gemeente Wageningen, 2023). Additionally, to promote the integration of urban nature in existing structures, residents, entrepreneurs and organisations can receive compensation for implementing features such as green roofs, green gardens, green façades or green borders between plots (Gemeente Wageningen, 2021). These examples show that Wageningen has a proactive approach towards integrating urban nature and can serve as an inspiration for other neighbourhoods in Wageningen and even other cities striving to improve their urban environment with natural elements.

However, there is a need for a comprehensive and integrated plan, bringing together inhabitants, entrepreneurs and the municipality to improve the liveability of Wageningen city centre. This is vital considering the importance of battling the effects of climate change, especially considering the estimated increases in temperature and rainfall intensity (KNMI, 2014).

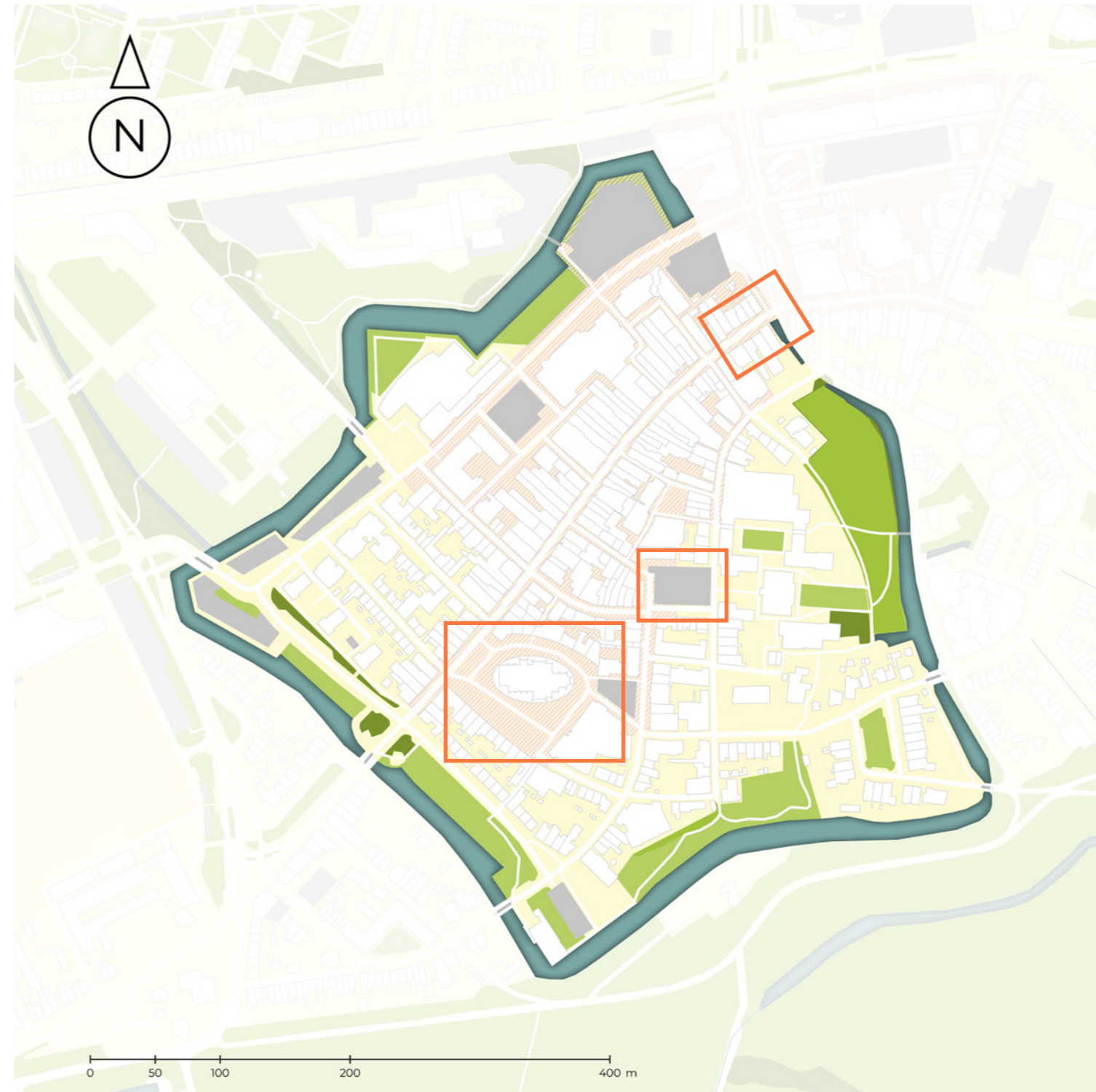
PROBLEM STATEMENT

During discussions with the commissioners, several challenges related to the site were identified. These challenges are as follows:

One of the key challenges is the lack of identity in Wageningen. Currently, the city lacks a distinct character that truly represents its unique attributes beyond being known as a “student city” or a “city of freedom.” Due to the diverse range of residents in Wageningen, the city has a unique meaning for each person, which leads to the absence of an overall identity that captures all these aspects. Therefore, there is a need to create an overall identity that all residents will be able to resonate with. It is important to incorporate Wageningen’s identity into the designs and visually convey the story of the city, showcasing its diverse features and creating a sense of place at the street level.

Another challenge is the absence of vegetation in the city centre. Despite being surrounded by rich natural landscapes such as the Veluwe, Binnenveld, and floodplains, the connection with nature is noticeably absent in the heart of Wageningen. This absence of vegetation affects the city’s appeal, its ability to adapt to climate change and the overall biodiversity within the centre of Wageningen. Moreover, the lack of interconnection between the different urban nature areas within the city centre causes for a deficient green network. There is an opportunity to integrate urban nature into the city centre, creating linkages between existing green spaces. This initiative will enhance biodiversity, mitigate the effects of the heat stress in paved areas and establish wildlife corridors (Beninde et al., 2015; Shahanan, 2015).

Ensuring that Wageningen is future-proof is another significant challenge. In addition to the lack of vegetation, discussions highlighted concerns about the quality of the environment, particularly regarding climate change and its potential impact. Areas exposed to direct sunlight may experience discomfort due to heat stress, while fully paved sections are prone to flooding during intense rain showers (Ochoa-Rodríguez et al., 2022). This will not only create great discomfort for inhabitants but will also lead to an increase in urban infrastructure damage and potential safety hazards. Addressing these issues



Legend

- Building
- Urban nature
- Built surface
- City centre
- Water
- Parking space
- Road
- Alley

Figure 1. Analysis map

General map of the study area, The orange rectangle indicate where the site designs are.

and preparing the city for future environmental changes is therefore essential. Human well-being in the city centre should also be enhanced as there is a need for access to urban nature. It is crucial to recognize that people's interaction with nature plays a vital role in stress relief. Research has shown that exposure to nature can improve attention, memory, and cognitive performance (Kaplan, 1995). The restorative value of vegetation plays an important role, and the challenge lies in creating urban nature that people can interact with to maximise the restorative effects (Weber & Trojan, 2018). Furthermore, the attractiveness of the city, particularly for visitors, emerged as a challenge. As mentioned in the introduction, there are areas in the city centre that lack liveliness when there are no events taking place. People who come to Wageningen to do their shopping do not stay for extended periods of time, but rather finish their tasks and immediately return home. This has an impact on local entrepreneurs who heavily rely on visitors. To encourage visitors to spend more time in the area, it is crucial to incorporate elements that enhance attractiveness, offer engaging activities, and create a comfortable environment.

The focus of this report will revolve around these five identified challenges: identity, biodiversity, future-proof, human wellbeing and attractiveness, prioritizing them in the final deliverables (fig.2) By providing recommendations and guidelines, the aim is to address these challenges effectively and contribute to the improvement and development of Wageningen.



Figure 2. Diagram
The five identified challenges of the city centre

RESEARCH QUESTIONS

To effectively address the aforementioned challenges, a main research question along with sub-questions has been developed to provide a clear direction and structure for the research process. The main research question for this project is:

“What urban nature interventions can be implemented to effectively address the environmental challenges and highlight the identity of Wageningen's city centre, while considering the stakeholder needs and preferences?”

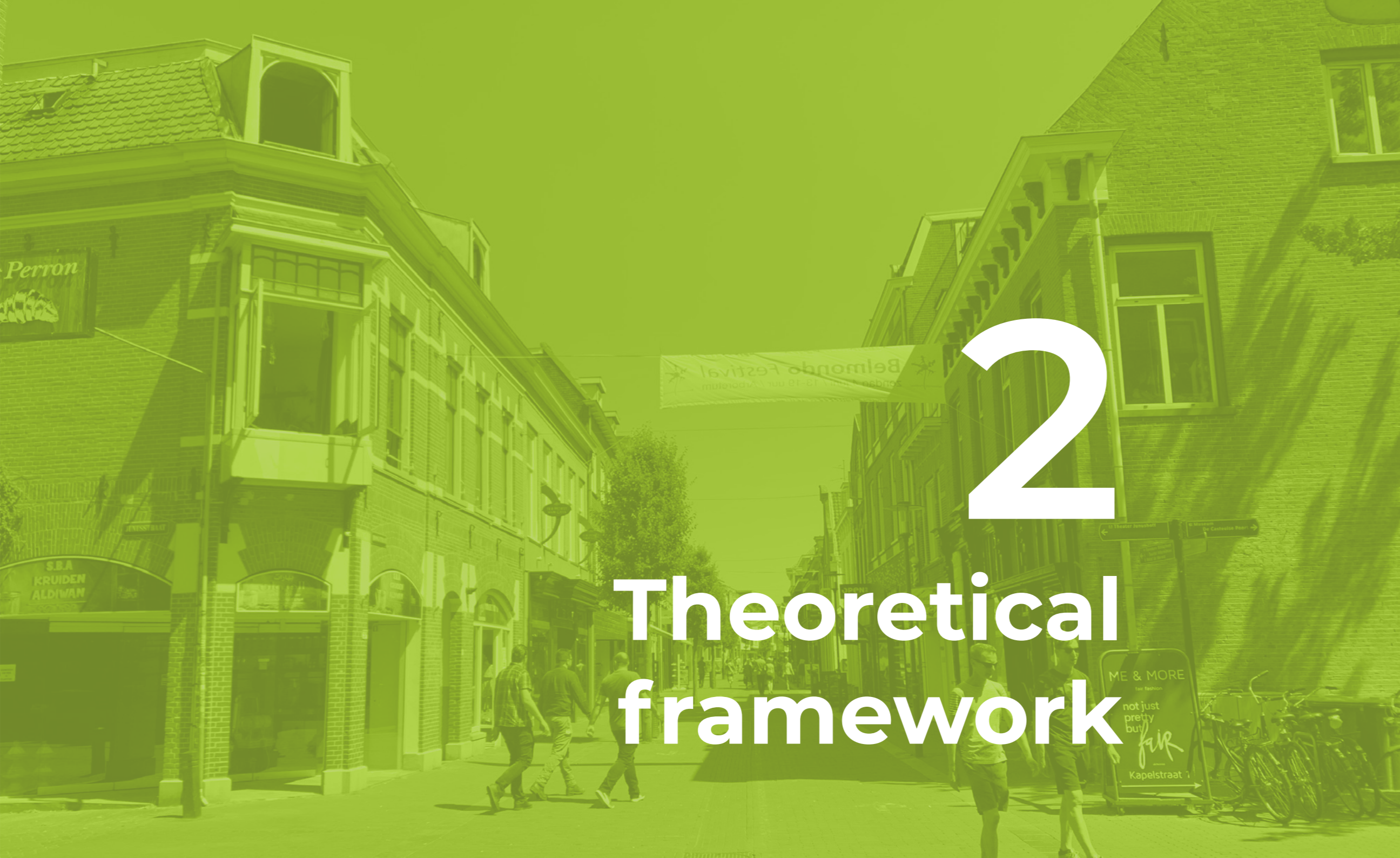
The main research question will be divided into multiple sub-research questions to guide the different phases within the project. The following sub-research questions will be touched upon:

1. “What are the specific environmental and social challenges in the city centre of Wageningen that need to be addressed through urban nature interventions?”
2. “What are the diverse needs and preferences of stakeholders regarding urban nature in the city centre of Wageningen?”
3. “What are the most suitable urban nature design guidelines that can be implemented in the city centre of Wageningen to tackle these environmental challenges, while taking into account the diverse needs and preferences of stakeholders?”
4. “What spatial interventions can be developed for the urban nature project in the city centre of Wageningen, ensuring the integration of green infrastructure with the existing urban fabric, preservation of historical buildings and creation of functional and inviting spaces for various user groups ?”

DELIVERABLES

In this report, we have identified five typologies, these are squares, side alleys, shopping streets, car parking and bike parking. For these typologies, we formulated nine guidelines that can be applied in a “pick-and-mix” manner to each typology. This offers flexibility, which was discussed with the commissioner and seen as the preferred approach for this assignment. To show how these guidelines physically take shape, we made three site designs of key locations identified in the city centre of Wageningen. These are: the Hoogstraat, the Market Square and the Salverdaplein. These site designs encompass various components, including a masterplan, cross-sections, and visuals, providing a holistic understanding of the proposed interventions. A video is also included in the deliverables. The video encompasses all the different identities discussed with stakeholders and serves as an introduction to the research we have done.

The appendices of this report include a list of often used terms and their explanation (APPENDIX A), the results of the street surveys (APPENDIX B) and the summary of the interviews (APPENDIX C), a list of plant species for each guideline and their characteristics (APPENDIX D).



In this chapter, the theoretical framework will be discussed. This framework serves as a base to further substantiate our research, as well as to show the various benefits that can be reached when this project is implemented.

URBAN NATURE

In this report, urban nature refers to outdoor spaces within the city that incorporate natural elements, providing an opportunity for both residents and visitors to experience and engage with the natural environment (Silva et al., 2018). These natural elements can range from street trees or small planting beds to urban parks (Remme et al., 2021). Urban nature is known to have positive effects on biodiversity, human well-being, economy, air quality, mitigating climate change effects, ecological connectivity and aesthetics (Ilkin et al., 2015; Sheets & Manzer, 1991; Wang et al., 2019; Oke et al., 2017).

SOCIO-ECOLOGICAL ALLIANCES

According to Gaston (2010), with half of the world's population residing in urban areas, the significance of nature in cities cannot be disregarded. Recognizing the inseparable relationship between humans and the natural environment (Marzluff, 2008), it becomes crucial to acknowledge the mutual benefits they offer. Studies such as Irvine et al. (2008) reveal that urban nature interventions can have a positive impact on both humans and biodiversity.

Urban nature contributes to aesthetic appreciation, where a high number of trees and the presence of flowers and water increases the aesthetic preference and can potentially influence stress restoration (Wang et al., 2019). According to Gunnarsson et al. (2017), city inhabitants value urban nature that is lush, high in biodiversity, varied, rich and includes natural sounds such as rustling leaves and birdsongs. Besides, urban nature also plays a significant role in shaping a place's identity and fostering a sense of belonging (Zlender and Gemin, 2020).

Urban nature plays a vital role in enhancing human health and well-being (Kwon et al., 2021). Even without direct contact with nature, individuals with

a view of green vegetation are 1.6 times more likely to experience better mental health (Gaston, 2010). Furthermore, these urban nature interventions contribute to improved physical health by alleviating fatigue and reducing stress levels (Gaston, 2010; Nutsford et al., 2013). They also serve as facilitators for social interactions (Coley et al., 1997) and have a positive cognitive influence, as stated by Taylor et al. (2001) and supported by the Field Studies Council (2023). Urban nature positively affects human well-being by providing opportunities for physical activity (Remme et al., 2021), reducing chances of obesity, diabetes and mental illnesses (Shanahan, 2015).

Next to the benefits for humans, urban nature also improves the biodiversity in cities by increasing the number of natural elements and maintaining the ecological structures that can be used as habitat islands (Ilkin et al., 2015). These habitat islands improve the ecological network that wildlife uses within urban areas (Schwartz et al., 2014). Socio-ecological alliances also indicate that ecology can benefit from human interactions. In urban areas, plants and animals are often faced with problems caused by humans, such as habitat fragmentation, pollution and limited available land (Dearborn & Kark, 2010). Therefore, sustaining the socio-ecological alliances is vital, through preservation of the urban biodiversity, people can positively influence the biodiversity levels. Beninde et al. (2015) researched how to influence biodiversity levels in urban settings, they concluded that an increase in habitat islands and a network of corridors have the strongest positive effects.

Furthermore, urban nature provides biophysical ecosystem services. These reduce health risks by improving the air quality, reducing the urban heat-island effect and preventing flooding during peak rainfall events (Shanahan, 2015). Natural elements in an urban environment can therefore help mitigate the negative effects of climate change. By creating shade and blocking solar radiation, vegetation can decrease the surface temperature as well as the Physiological Equivalent Temperature (PET) (Oke et al., 2017), evapotranspiration via plants also helps to cool down the air (Brown et al., 2015). Urban nature can also improve air quality through carbon sequestration, capturing and storing CO₂ from the atmosphere into the plant, and removing

particulate matter (PM) through the absorption of PM on the leaves (Leung et al., 2011).

In addition to these benefits, urban nature also has a significant impact on reducing violence, with a potential decrease of over 50% (Kuo & Sullivan, 2001). Therefore, promoting and incorporating nature in urban areas not only enhances the quality of life for individuals but also contributes to creating safer communities.

ECONOMIC-ECOLOGICAL ALLIANCES

By incorporating nature, urban areas undergo a perceptible transformation, becoming more appealing and attractive to residents and visitors alike (Sheets & Manzer, 1991). This enhancement in aesthetics and ambience has a direct positive impact on the commercial setting of cities (BNG, 2020; ANK, 2019). However, the benefits of integrating urban nature extend far beyond mere visual appeal.

The introduction of urban nature within urban landscapes has the potential to significantly contribute to the cooling capacity of cities, leading to a reduction in energy costs. Additionally, the presence of urban nature on and around buildings influences the energy demand. During the summer the vegetation acts as insulation, reducing the need for air conditioning. Similarly, in winter, the vegetation helps retain the heat within the building, minimizing heat loss and energy consumption (Leung et al., 2011). It is worth noting that the shade provided by a single tree can be equated to the cooling effect generated by ten air conditioners, underscoring the immense potential of vegetation in mitigating urban heat (De Natuurverdubbelers, 2020).

Moreover, urban nature initiatives have been found to improve water regulation and management. Studies conducted by Yao et al. (2015) indicate

that the introduction of nature in urban areas leads to a reduction in runoff and a more balanced peak discharge, effectively minimizing the economic and environmental risks associated with flooding and water-related issues. Notably, the implementation of urban nature also has a significant impact on property values. Housing prices in areas adorned with nature witness an average increase of 5% to 18% when compared to houses devoid of such elements (Cook, 2017; De Natuurverdubbelers, 2020). This upward trend in housing prices further emphasizes the value and desirability associated with living in close proximity to nature within urban settings. Rents may increase but the revenues from urban nature counterbalances this increasing price, by an increased number of people entering the shops and reduced energy bills (Sustaineurope, 2019). Next to that, an increase in urban nature and green perception will generate a greater job satisfaction amongst employees (Gilchrist et al., 2015).



3

Methods

This chapter will discuss the methods that are applied to answer our various sub research questions. Here, we will discuss our chosen methodology of 'Research for Design' and how this methodology will serve as a guiding approach. The various steps of our research will be discussed, as well as what data will be retrieved from our various methods applied.

RESEARCH FOR DESIGN

This project incorporates the methodology of "Research for Design", which involves using research outcomes to inform and enhance the design process (Van Den Brink et al., 2016). Research for design is doing research before the design is made, to substantiate all choices made within the design. By talking to stakeholders, doing policy analysis, conducting site analyses and implementing their input in the design, an evidence-based design is ensured. By combining the knowledge of both planners and landscape architecture a comprehensive design can be created.

METHODS FOR DATA COLLECTION AND DATA ANALYSIS

The methodology of this report helps to answer the main and sub-research questions. Both data collection methods, as well as data analysis methods, are discussed. The sub-research questions are formulated in a way that guides the research process from analysis towards the final design. A concise overview of the output, data collection methods and data analysis methods can be found in table 1.

Sub-research question	Output	Data collection methods	Data analysis method
SRQ1	Challenges and opportunities for Wageningen city centre, concerning environmental aspects	- Literature review; - Commissioner walk-along interview; - Site observations; - website consultation	- Literature review; - Online source analysis; - Environmental scanning, - Research for design; - Stakeholder interviews
SRQ2	List of stakeholders and their preferences and views on Wageningen city centre. Views and perceptions on the Identity of Wageningen	- Interviews; - Surveys; - Observations; - Expert consultations	- Stakeholder interviews; - Online source analysis,
SRQ3	List of greening guidelines suitable for Wageningen	- Literature; - Reference projects	- Literature review, - Online source analysis, - Stakeholder interviews
SRQ4	Spatial interventions suitable for Wageningen	- Interviews; - Expert consultations; - Workshops	- Literature review; - Online source analysis; - Stakeholder interviews

Table 1. Research overview
Overview of the output, data collection methods and data analysis methods

Regarding the first sub-research question, the primary focus lies on analysing the project area and gaining familiarity with the challenges faced in Wageningen. This will mainly be done by doing a literature study and examining policy reports the municipality of Wageningen has made to address these issues, as well as numerous discussions with the commissioner. These meetings also allowed us to critically observe the project area.

The second sub-research question focuses on the needs and preferences of stakeholders in the city centre of Wageningen. Entrepreneurs, experts in the various themes and policy makers in Wageningen, who are interested in discussing the concept of 'urban nature in Wageningen' will be approached for one-on-one interviews. These interviews are important to gain a deeper understanding of what the wishes of the various stakeholders are for their city centre. To involve inhabitants and visitors in the project, a brief street survey on the Hoogstraat and the Markt was conducted. This was done by showing visitors images of urban nature and asking them to select the one that best represents Wageningen. From this survey, we gained a better understanding of stakeholder's view on the identity of Wageningen.

The third and fourth sub-research questions adopt a design-oriented perspective. The third question focuses on a design that combines the challenges found in the first sub-research question and the interests and preferences of the stakeholder found in the second sub-research question. Additionally, relevant literature is used to justify design choices for the final design and the design guidelines. The outcome of the third research question provides a list of existing urban nature design guidelines that are suitable for Wageningen. Urban nature design guidelines are in the case of this report existing measures that are used to implement more natural elements. Additional design guidelines are used in spaces where urban nature design guidelines cannot be implemented. These guidelines will address the city's (environmental) challenges and align with the results obtained from the stakeholder interviews.

The fourth and final sub-research question builds upon the third sub-question and incorporates the existing urban fabric of Wageningen city centre and

creates inviting spaces for various user groups while preserving the history of Wageningen. This phase also considers other important aspects necessary for the design, resulting in the final design proposal for different areas. Together, these four sub-research questions effectively address the main research question (fig. 4). This main research question combines the efforts to combat the environmental challenges identified during the analysis phase, meet the needs and preferences of stakeholders and incorporate interventions that encompass the city's identity, historical context and urban fabric.

Research for Design

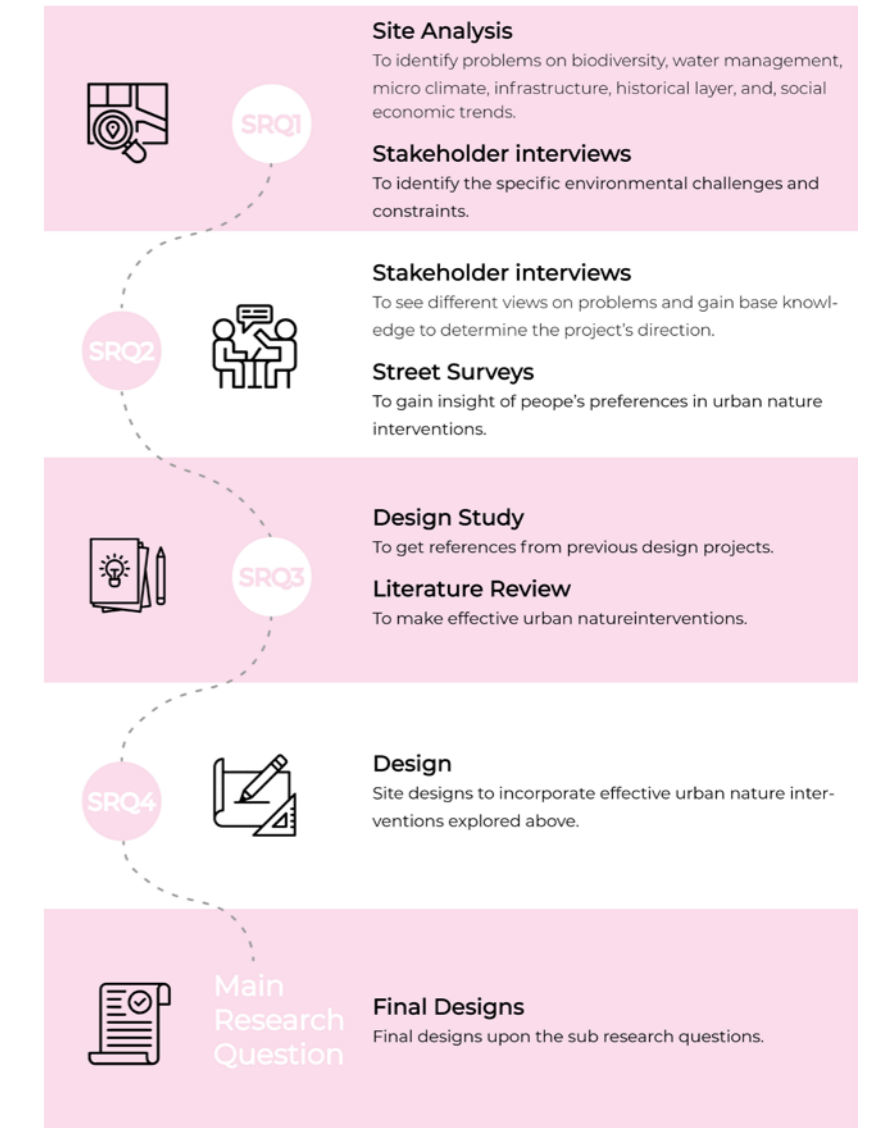


Figure 3. Phasing of the research
Research steps required for each SRQ



4

Analysis

This chapter will serve as the base for our design interventions. During this phase of the project, numerous methods will be applied, such as interviews, site analysis and policy analysis to gather information. These findings will inform our design decisions and help us address the identified challenges. By conducting a thorough analysis, we aim to gain a deep understanding of the current situation and develop well-informed strategies for our design approach.

INTERVIEW ANALYSIS

A diverse mix of entrepreneurs, urban planners, ecologists and people from the municipality were interviewed to provide insightful knowledge to base our designs on. In the interviews we discussed the different ideas we had, the feasibility of these ideas and suggestions that stakeholders have for the city centre. For a more detailed analysis of the meetings with the stakeholders see Appendix C

SITE ANALYSIS

WAGENINGEN CITY CENTRE

The city centre of Wageningen faces several pressing environmental challenges that hinder its functionality, sustainability, and ability to reflect the unique identity and character of the city. A site analysis was performed to identify the challenges including a lack of biodiversity and urban nature, heat stress, inadequate water management, infrastructure, and the conservation of historic monumental buildings.

LACK OF URBAN NATURE

Urbanisation is often associated with the main cause of biodiversity decline (McKinney, 2008). The scarcity of urban nature and the resulting decline in biodiversity within the city centre causes a problem for its ability to meet the needs of its inhabitants effectively. The absence of adequate vegetation within the city centre not only affects the aesthetic appeal but also has significant implications for the well-being of its inhabitants. It limits opportunities for relaxation, recreation, and the creation of a harmonious urban environment. Studies have revealed that within the city centre, a considerable 64% of residents aged 18 to 65 face a moderate or high risk of anxiety or depression (allecijfers.nl, 2021). The lack of adequate urban nature exacerbates these risks, as access to nature has been proven to have a positive impact on mental well-being, stress reduction, and overall life satisfaction (Nutsford et al., 2013).



Figure 4. Analysis map showing the urban nature and the trees in the city centre of Wageningen.

As the urban population is predicted to double by 2050, it is crucial to consider the possibility of enriching biodiversity in urban areas (World Bank, 2023). According to the Bevingingenrapport (Gemeente Wageningen, 2022), the city centre of Wageningen has opportunities for urban nature interventions. The city centre currently has a lack of urban nature and an abundance of paved areas (fig. 4), offering a chance to remove the pavement and replace it with urban nature.

URBAN HERITAGE

Incorporating urban nature in Wageningen is not without its challenges, given the rich heritage of the city centre. Balancing functionality, heritage preservation, and the need for more vegetation presents a complex trade-off. Preserving the historic monumental buildings while integrating more urban nature and capturing the essence of Wageningen's identity requires



Figure 5. Analysis map showing the monumental buildings, city moat and road structure in the city centre of Wageningen.

careful consideration. The fortified city still has elements such as the historical monumental buildings, city moat and the bastions (fig. 5). These elements all contribute to the identity of Wageningen. It is essential to find innovative solutions that respect the architectural heritage and ensure that urban nature interventions do not compromise the functionality of the city centre.

EVENTS

The urban nature interventions must also be implemented in ways that seamlessly accommodate the existing events, such as Kingsday, the 5th of May celebrations, and the weekly market on Wednesdays and Saturdays. These events play a vital role in the social fabric of the city centre, and their continuity should be preserved while simultaneously enhancing the natural character of the area.

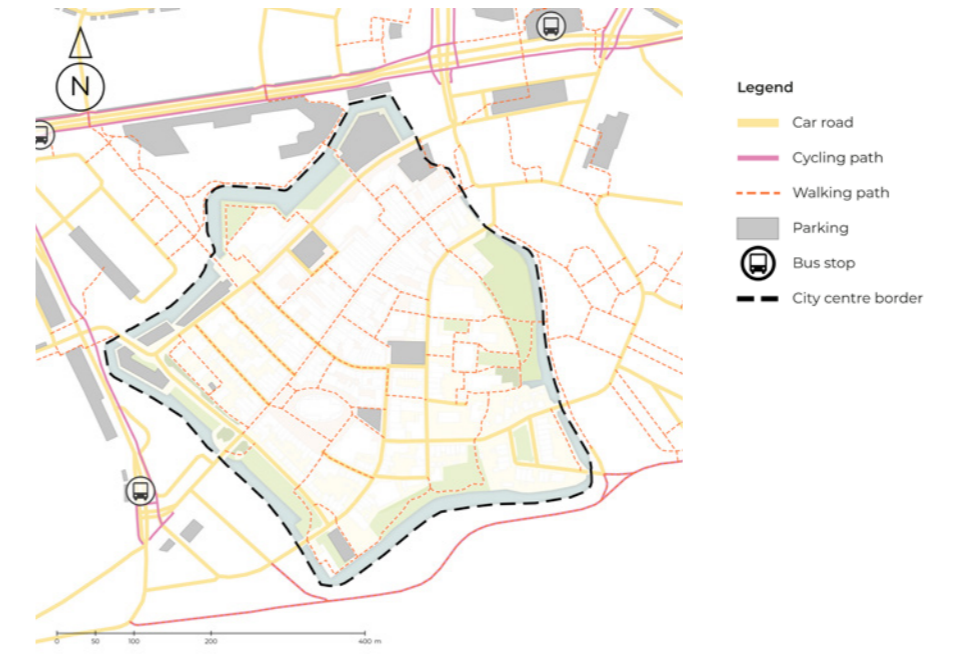


Figure 6. Analysis map showing the infrastructure in the city centre of Wageningen.

INFRASTRUCTURE AND CONNECTION

The infrastructure within Wageningen's city centre poses another multifaceted challenge that needs to be addressed to improve accessibility, promote sustainable transportation, and enhance the overall visitor experience (fig. 6). According to the commissioner, one prominent issue is the shortage of approximately 2,500 bicycle parking spaces, leading to inconvenience for cyclists and parked bicycles all over the city centre.

Additionally, there is a problem with car parking: while the current number of parking spaces may be considered sufficient, optimizing their distribution and accessibility is necessary. Studies show that people generally prefer to walk no more than 200 meters from their parked cars on their weekly shopping trips (Timmermans & De Bruin-Verhoeven, 2015). According to the commissioner, 60% of customers visit the city centre by car. Balancing the availability of parking spaces for cars, which is vital for the livelihood of local entrepreneurs, with the need to create a future-proof city centre with reduced car dependency, presents a delicate trade-off.

The current infrastructure at the Plantsoen also causes a barrier from the surrounding area to the Hoogstraat as this can be a very busy street during peak hours and is not very pedestrian friendly. Addressing these infrastructure and parking-related challenges is crucial to create a more functional, sustainable, and visitor-friendly city centre in Wageningen. By investing in bicycle infrastructure, optimizing parking availability and promoting pedestrian accessibility, the overall structure of the area will be enhanced.

ENVIRONMENTAL CHALLENGES

The escalating issue of heat stress further enhances the challenges faced by the city centre. As temperatures rise due to climate change, urban areas like Wageningen experience heightened heat levels, leading to discomfort, health risks, and reduced liveability (RIVM,2021). The increasing Physiological Equivalent Temperature (PET) values are a growing concern, especially in the market square and Salverdaplein (fig. 7). An estimate of the climate in 2050 shows even higher PET values leading up to 50 degrees Celsius (fig. 8) (Klimaateffectatlas, 2023). The absence of proper cooling mechanisms and insufficient urban nature contribute to the increase of this problem, making it crucial to implement innovative designs that promote heat mitigation and enhance the urban microclimate.

In addition to heat stress, the management of water resources represents a critical concern for the city centre. Climate change-induced factors such as increased rainfall intensity and the rising frequency of extreme weather events pose significant threats to the area's water management infrastructure. The city centre faces flooding issues, particularly in the market square and Salverdaplein, during heavy rainfall events (fig. 9). Insufficient drainage systems create the need for effective water retention and storage systems, to mitigate the risks associated with flooding and safeguard the functionality and safety of the city centre. According to KNMI (2014), future projections indicate a rise in temperature and an increase in rainfall frequency and intensity. These changes are expected to result in various problems, such as health concern due to heat stress (Bowler et al., 2010) or pluvial flooding. As a result, there is an urgent need to transform Wageningen city centre into a liveable environment to accommodate these changes and ensure its resilience in the future.

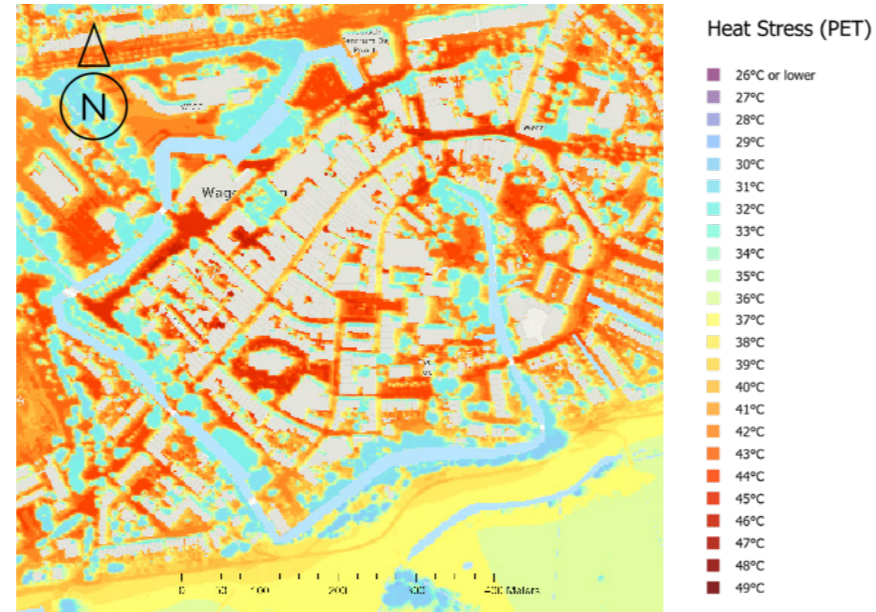


Figure 7. Analysis map showing the current PET in the city centre of Wageningen.

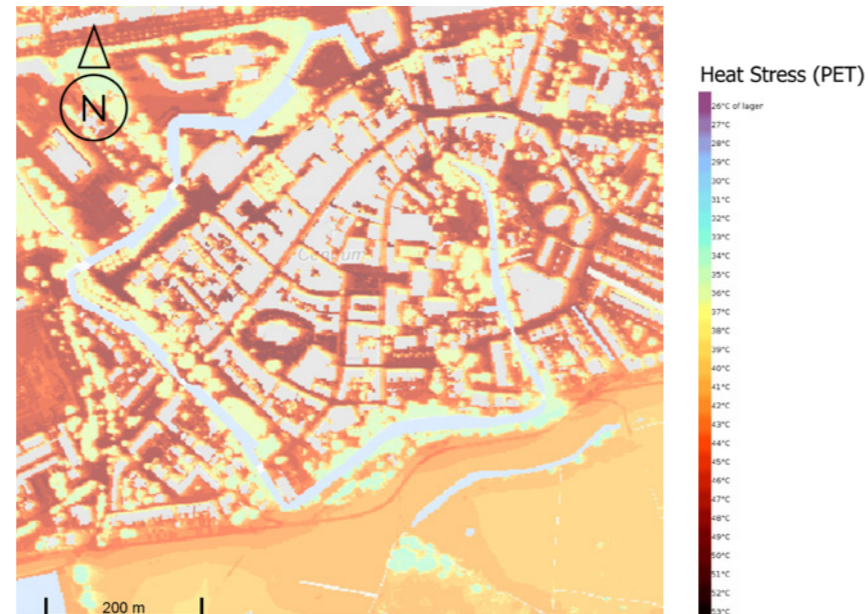


Figure 8. Analysis map showing the expected PET in the city centre of Wageningen in 2050.

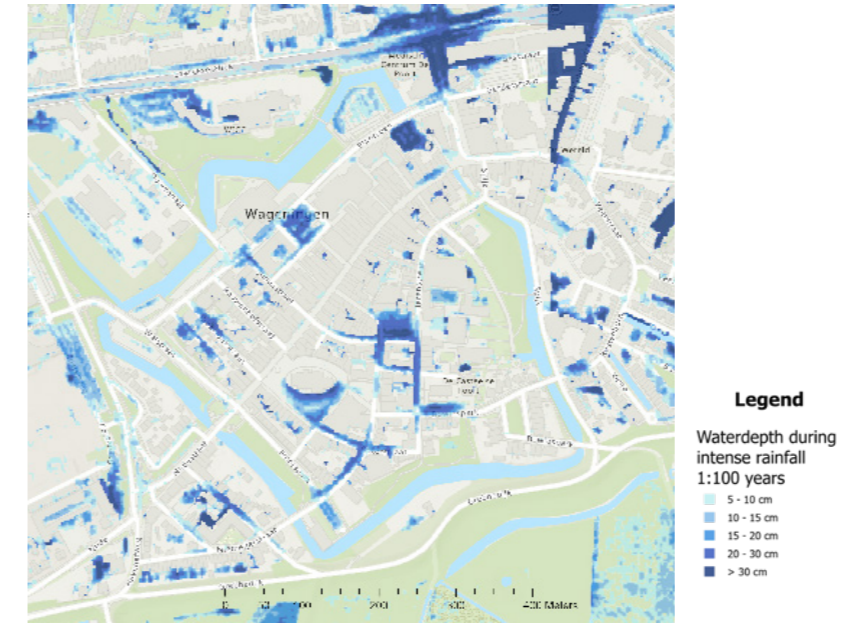


Figure 9. Analysis map showing the water depth during intense rainfall in the city centre of Wageningen.

KEY SITES

To ensure a comprehensive and targeted response to the challenges within Wageningen's city centre, it is decided to direct our attention to various key areas (fig. 10). The sites will be described, and their characteristics will be discussed.



Figure 10. Map showcasing the location of the key sites

HOOGSTRAAT

The Hoogstraat and its adjacent alleys is the first key site. The Hoogstraat is the main shopping street of Wageningen and is home to multiple local shops. The street is the commercial and social hub of the city centre which can be seen through the number of bikes that are parked in and around the street. The backbone of the city is during events such as Kingsday and the 5th of May an important stage for music and history. It is important that such events can still take place and that urban nature can improve the ambience of such events. Next to that the accessibility for shops is an issue that cannot be ignored, therefore the current cables and pipes are taken into consideration. Supply and export of goods must be possible, this will limit the possibilities of the Hoogstraat, but at the same time, it shows the challenge that Wageningen has to deal with.

The Hoogstraat is rich in monuments, and the opportunity for implementing nature to the monumental buildings is small. Therefore, it is important that during the design of the Hoogstraat, the monumental value and its restrictions are considered. By introducing natural elements to non-monumental buildings, we can enhance the greatness of the uncovered monumental buildings. Additionally, integrating urban nature in the form of green façades can further brighten and enhance the atmosphere of the street.

As mentioned earlier, the Hoogstraat boasts a vibrant atmosphere with a multitude of shops. Harnessing the entrepreneurial spirit can play a vital role in elevating the cityscape, fostering a welcoming ambience that entices visitors to spend more time in the city centre. By working together, entrepreneurs can delve into innovative ways to enhance biodiversity and enrich the overall visitor experience.

MARKET SQUARE

The bustling heart of Wageningen's city centre is the market square, which serves as a focal point for the community. Twice a week, the square comes alive with a market, filling every available space with market stands, equipment, and people. Unfortunately, the limited remaining space makes it challenging to incorporate urban nature into the area. However, introducing more urban nature could significantly enhance the biodiversity and visitor experience.

Currently, the market square's natural elements consist of movable planters, which are owned by entrepreneurs. These planters were introduced during the COVID-19 pandemic to maintain distance between tables and create a safe environment. However, their presence has led to an untidy and inconsistent cityscape. On the Market there are a handful of trees, surrounded by outdoor eating spaces. These trees have large canopies that create large areas of shade, making the outdoor seating areas more comfortable during hot summer days. On the days when there is no market, the square can become hot and unpleasant for visitors, the fully paved square offers little shade or natural elements that can allure people onto the square.

The market square is predominantly paved, which increases the risk of heat stress, especially considering the expected increase in temperature in future climate projections. This calls for the implementation of cooling measures to mitigate the heat. Additionally, the city anticipates an increase in rainfall intensity and frequency in the coming years, emphasizing the need to transform the city centre into a resilient and liveable space. The presence of cables under the market square will not restrict the possibilities for improving the market square.

However, making changes to the market square will pose significant challenges due to the presence of historic buildings, including the central church, which require adherence to strict regulations and guidelines.

SALVERDAPLEIN

Salverdaplein currently serves as a parking area featuring approximately 40 parking spaces primarily utilized by license-holders. However, the site analysis showed that Salverdaplein faces numerous challenges related to heat stress and water nuisance. Future climate change projections possibly will only worsen these effects this area faces challenges related to heat stress and future climate change projections raise concerns about water-related problems at Salverdaplein.

The square benefits from its location, with easy accessibility to the city centre and proximity to several parks. Moreover, the underground infrastructure surrounding Salverdaplein does not impose limitations, as the majority of cables and pipes are routed around the carpark rather than directly through it. This favourable circumstance opens up multiple possibilities for potential improvements and developments at the site.

Nevertheless, addressing these climate change related challenges and implementing effective mitigation strategies will be crucial to ensure the resilience of the square, while simultaneously protecting the surrounding environment from the potential impacts of heat stress and water-related issues.

PROBLEMS MAP

The challenges faced by the city centre of Wageningen (fig. 11) call for a comprehensive and integrated approach that addresses the various interconnected issues. Resolving the issues of a lack of biodiversity and urban nature, heat stress, water management, and preserving heritage and identity and car and bike parking represents a pressing challenge for the city centre of Wageningen.



Figure 11. Spatial problems in the city centre of Wageningen.

OPPORTUNITIES MAP

The concerns from the problems map are addressed in the opportunities map (fig. 12). On this map the side alleys and the Hoogstraat are used to connect the larger urban nature areas in and around the city centre by implementing more urban nature in the side alleys and the Hoogstraat and creating a wildlife corridor.

The current infrastructure is changed, the parking in the city centre will be centralised to reduce the amount of parking lots in the city. A good location for parking garages could be at the Gevangenetoren or the Gerdessstraat. As these areas are close to the Lawickse Allee where a lot of visitors enter the city centre. If this is realised it offers an opportunity to the Plantsoen to be transformed into a one-way street. This reduces the amount of traffic on this street and creates a more pedestrian friendly area.

The centralisation of the car parking creates more space for bike parking at the Beuningplein. This can reduce the amount of nuisance caused by bikes in the Hoogstraat and side alleys. It also creates more space for urban nature and meeting spaces for residents and visitors.

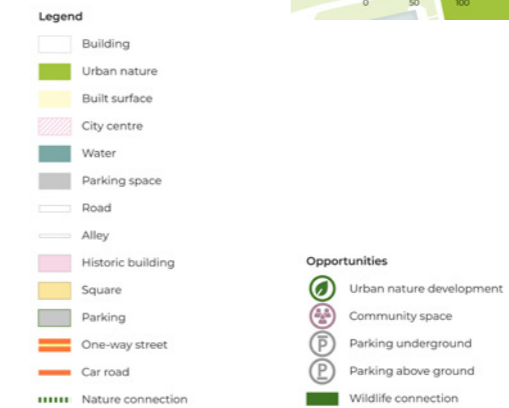


Figure 12. Opportunities in the city centre of Wageningen.

POLICY ANALYSIS

To align the proposed plans in this report with the future vision of Wageningen as a city, a thorough analysis of multiple policy documents is conducted. This analysis ensures that the policies outlined in these documents are appropriately integrated into the designs. The following policy documents are analysed:

- Aan de slag met de binnenstad (Gemeente Wageningen, 2015)
- Bevindingenrapport visie bebouwde kom (Gemeente Wageningen 2022)
- Gemeentelijk mobiliteitsplan Wageningen (Gemeente Wageningen, 2012)
- Restore stadsgracht project (SAB Nieuws, 2021)

From these documents ideas and outcomes are identified that are relevant to this study, as well as the desired outcomes and key objectives for the future of Wageningen.

30 AAN DE SLAG MET DE BINNENSTAD (2015)

The ‘aan de slag met de binnenstad’ project aims to strengthen the vitality of the Wageningen city centre. The project touches upon the diversity of the inhabitants and the different identities the city has, ranging from university-city to city-along-the-Rhine, to city-of-freedom. Every inhabitant, visitor, or entrepreneur has a different image of Wageningen and therefore thinks of Wageningen differently, this diverse image of Wageningen can be used to strengthen the city’s liveability. The project includes 7 strategies that aim to improve the liveability of Wageningen. Three of these focus on the city centre and are therefore taken into account in this project. These are: 1) strengthening the character of Wageningen and thereby promoting the city for tourists and other visitors. The many different identities can be used to create

a stronger character of Wageningen and show the history and story of the city. 2) Re-design entry points of the city centre. Currently, the city centre is seen as ‘hidden’ and first-time visitors do not know how to reach the centre. By making the entry points of the city centre more attractive, visitors can be guided into the city, making the experience of visiting Wageningen better. 3) Space for the bicycle. Wageningen has little space dedicated for bike parking, which causes bikes to be parked in small alleys and right in front of shops. By promoting centralised bike parking more space will free up in the city to walk and there will be less nuisance from parked bikes.

BEVINDINGENRAPPORT VISIE BEBOUWDE KOM WAGENINGEN 2045 (2022)

This report summarises the results of a survey done with inhabitants about their perception of Wageningen in 2045. Different themes were discussed, including housing, liveability, culture and sustainability. Some of the themes mentioned correspond with our report, therefore these are taken into account. The questions about vegetation and nature in the city received a majority of support. The majority of inhabitants want more vegetation in the city centre and use this to improve the entrances of the city centre. Moreover, the natural areas around Wageningen (de Enk, uiterwaarden and Binnenveld) could be connected to each other through the city centre. Opinions were divided on cars in the city centre. On the one side, removing cars would create the opportunity to put more emphasis on the history and the cosy and intimate parts of the city centre. Restoring the city moat was also seen as adding historical value to the city. On the other side, accessibility remains very important, as one person summarises, “urban nature is fine, but not at the expense of car accessibility” (p. 39).

GEMEENTELIJKE MOBILITEITSPLAN WAGENINGEN (2012)

The most important challenges identified in this document are: better connectivity around campus, increase connectivity of cyclists between Ede and Wageningen and better utilization of parking spaces in and around the city centre. Per 1000 inhabitants of Wageningen 385 people own a car. When this number is corrected for the students that live in Wageningen about 435 people per 1000 own a car (Gemeente Wageningen, 2012). Both these numbers are lower than the average of the Netherlands. However, we still see that Wageningen is very car-dependent and that many visitors go to the city centre to do their shopping by car. During these peak hours, there might be a shortage of parking spaces and the general division of cars on parking spaces is not in balance. One parking lot can be completely full while others are almost empty. By restructuring the parking spaces in the city centre this balance can be restored.

RESTORE STADSGRACHT PROJECT (SAB NIEUWS, 2021)

The restoration of the city moat is not necessarily a policy document, but it is an important plan of the municipality to make the entrance of the city centre more attractive and restore old heritage. The current dilemma is the question of how the restoration costs measure up against the benefits that the new city moat can bring to the city. For this report, we take into account that the city moat will be restored. The restoration of the moat can seamlessly follow the designs presented in this report. It is believed that this will indeed create a more attractive entrance to the city and help to advertise Wageningen to increase tourism. However, only restoring the city moat will not immediately affect the water quality nor biodiversity, more is needed than restoration to improve this.



5

Design

This results section will contain a comprehensive discussion of the nine proposed guidelines that serve as the guiding principles for our intervention approach. We also present the specific site designs for the three selected locations. Building upon the analysis conducted in the previous chapter, our team has developed tailored design interventions for each site. For each site, we will provide detailed descriptions, visual representations, and explanations of the proposed interventions.

DESIGN GUIDELINES

As a result of the third research question, a list of nine design guidelines is formulated. These guidelines all have an effect on the biodiversity, attractiveness of the city, wellbeing, heat stress or water management when implemented. The guidelines offer a flexible solution that can be implemented in an array of locations. Each guideline comes with numerous plant species that are recommended for that specific guideline, a comprehensive list that also includes information on the characteristics of the species can be found in APPENDIX D. The selected species are native, and several other factors are also considered in their selection, including maintenance requirements, growth speed, water needs, sun preferences, and their ability to attract or repel insects.

For explanations on the icons depicted on the guidelines below, see APPENDIX E.

GREEN FAÇADES

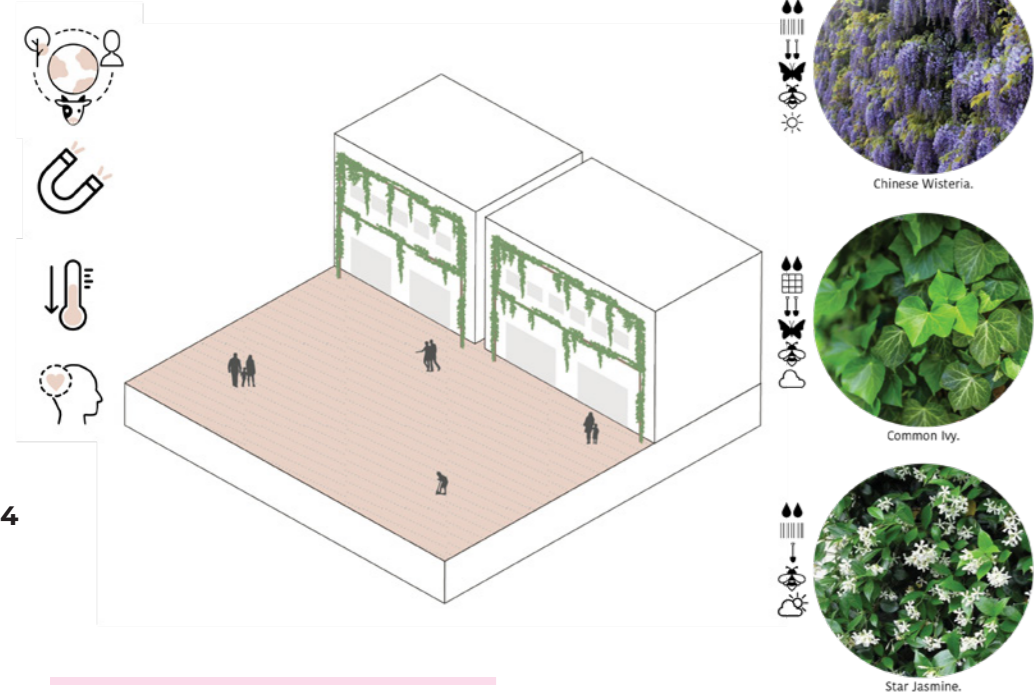


Figure 13. Design guideline green façades

GREEN FAÇADES

Green façades refer to the vertical growth of vegetation on the sides of buildings, transforming them into vibrant and lush green walls (fig. 13). Typically, climbing plants are used to cover large vertical surfaces, attaching their roots to plant beds or plant boxes fixed to the building's exterior (Collins et al., 2017). These living walls contribute to the creation of ecological habitats, enhancing biodiversity, conserving water, improving air quality, reducing noise levels, lowering energy consumption, and mitigating the urban heat island effect (Elgizawy, 2016; Bakhshoodeh et al., 2022). Compared to other shading structures, such as shade sails, green façades have been shown to significantly reduce temperatures inside buildings, with a potential cooling effect of up to 7 degrees Celsius (°C) (Mohammed, 2022; Oke et al., 2017; Brown et al., 2015). Furthermore, when compared to bare walls, the surface temperature difference of the wall can be as high as 13 °C with the presence of a green façade (Mohammed, 2022). To ensure the effectiveness of green façades in promoting biodiversity, expert knowledge is crucial (Elgizawy, 2016). Additionally, to preserve the historical value of buildings, it is essential to avoid direct attachment of green façades to the walls. Two viable options for maintaining historical integrity are the Modular Trellis Panel System and the Cable and Wire-rope System, as depicted in fig. 14 and fig. 15 (Elgizawy, 2016). These systems create a gap between the wall and the green façade, facilitating maintenance and preserving access to the underlying wall structure. For residents and entrepreneurs in the area the green façades also bring opportunities, as they can reduce the energy costs in summer and winter (Sheweka & Mohamed, 2012). Besides, the aesthetic value of the green façades can really make a positive impact on the streetscape of Wageningen.



Figure 14. Modular Trellis Panel System (Tournesol, 2023)

Figure 15. Cable and Wire-rope System (Timur & Karaca, 2013)

INFILTRATION BEDS

Infiltration beds are street-level planting beds designed to facilitate the infiltration of rainwater (fig. 16). These beds not only capture the water that directly falls upon them but also collect the runoff from the surrounding pavement, redirecting it towards the infiltration area. The primary objective of these beds is to effectively manage stormwater, alleviating water stress during heavy rainfall events. By capturing and redirecting rainwater, these stormwater plant beds contribute to reducing flood risks and improving overall stormwater management.

In addition to stormwater management, the practice of capturing rainwater in infiltration beds offers various economic and environmental benefits. It helps mitigate flood damage costs and enhances overall stormwater management strategies (Zhang et al., 2012). Moreover, these infiltration beds aid in purifying the captured water and provide valuable ecosystem services (Zhang et al., 2012).

INFILTRATION BEDS

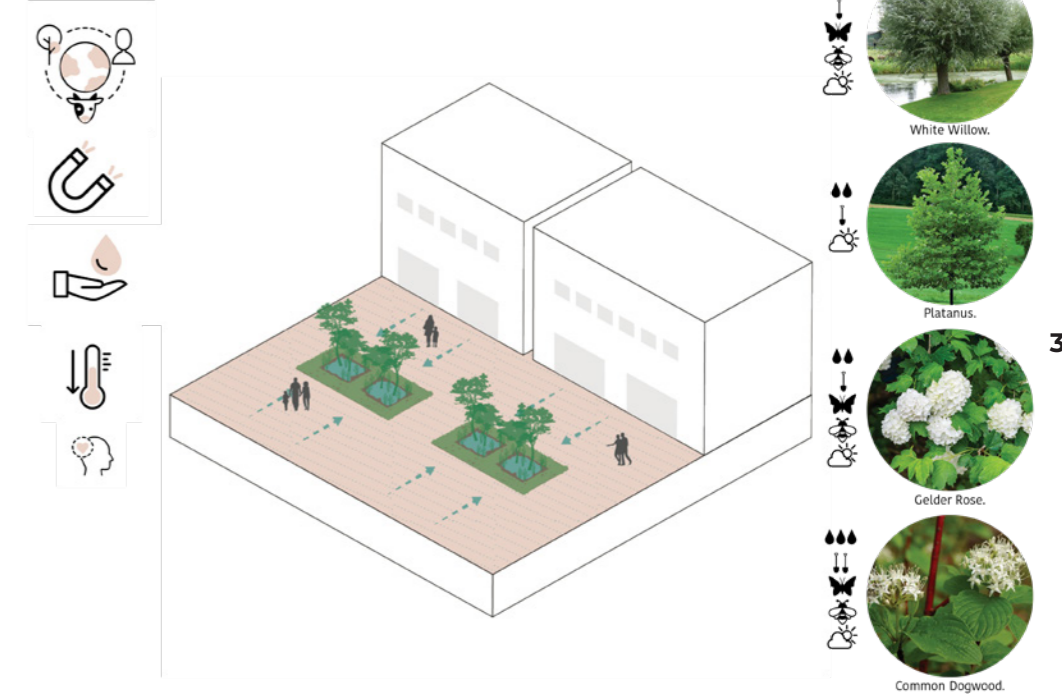


Figure 16. Design guideline infiltration beds



Figure 14. Modular Trellis Panel System (Tournesol, 2023)



Figure 15. Cable and Wire-rope System (Timur & Karaca, 2013)

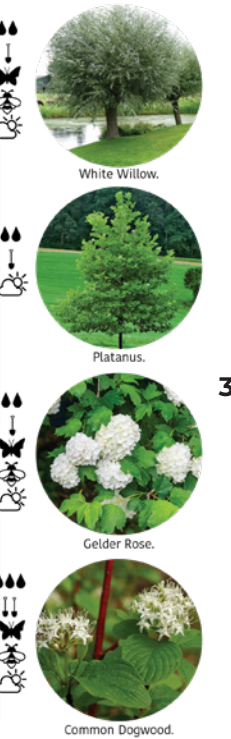


Figure 16. Design guideline infiltration beds

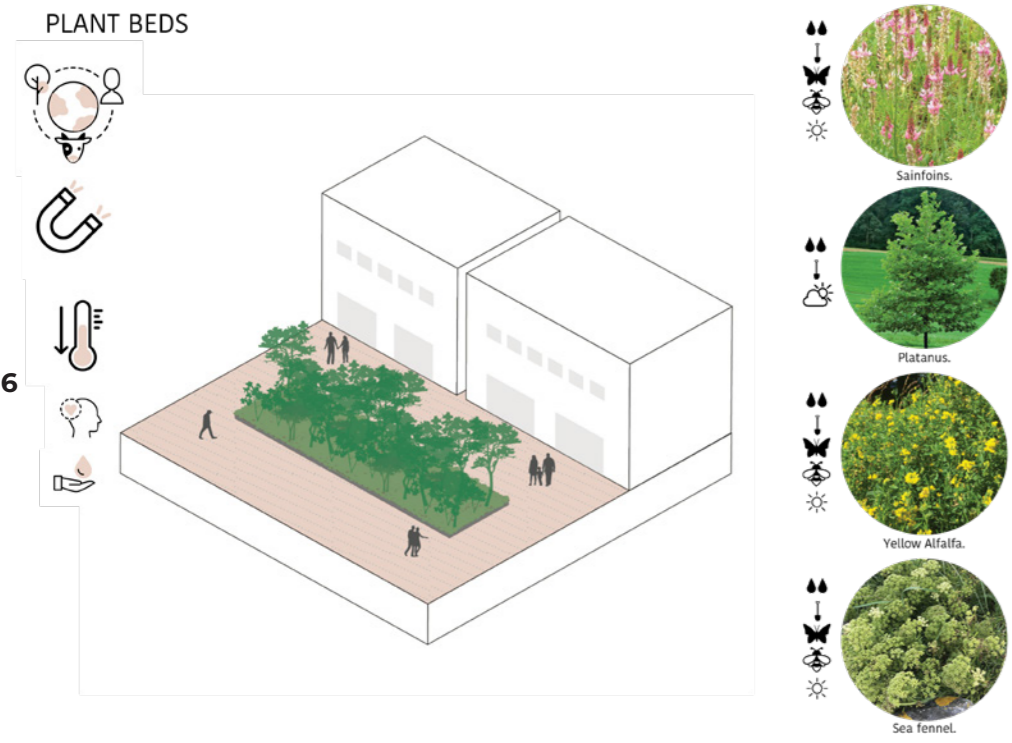


Figure 17. Design guideline plant beds

PLANT BEDS

Plant beds serve as dedicated spaces for urban nature, providing aesthetic enhancement, increasing biodiversity, and reducing heat stress and water-related issues (fig. 17). These plant beds offer an opportunity to introduce a variety of plant species, adding visual appeal and natural elements to the surrounding landscape (Smardon, 1988). By selecting plants that thrive in the local climate and are well-suited to the specific site conditions, these plant beds can contribute to the overall beautification of the area (Aronson et al., 2017).

If trees are added to the plant beds, it can have a significant effect on the temperature. Gill et al. (2007) showed that a large tree canopy can decrease the air temperature with 10.7 °C compared to no canopy or open air. Moreover, trees can also decrease the PET with a maximum of 10.5 °C (Lehnert et al., 2021). For smaller types of vegetation, that are lower to the ground, the maximum PET difference can be up to 2.3 °C (Lehnert et al., 2021).

FAÇADE GARDENS

Façade gardens, often referred to as small gardens in front of buildings, offer a means to transform paved areas into spaces with urban nature by replacing a row of stones with vegetation (fig. 18). The advantages of these gardens include their aesthetic appeal and the positive impact on physical and mental well-being, including stress reduction and increased relaxation (Franz, 2016). By implementing façade gardens, the streets acquire a greener ambience and biodiversity is enhanced, attracting insects depending on the types of greenery chosen (Wageningen University and Research, 2023). Implementing façade gardens is a simple task that can be undertaken by shop owners, residents and the municipality itself. Despite their modest scale, it is the cumulative effect of such small interventions that can bring about significant change (J. Frissel, personal communication, June 4, 2023). Entrepreneurs have the possibility here to deviate from the suggested plants we provided in the APPENDIX D, and choose plants they like to brighten up their shopfronts.



Figure 18. Design guideline façade gardens

GREEN ARCHES

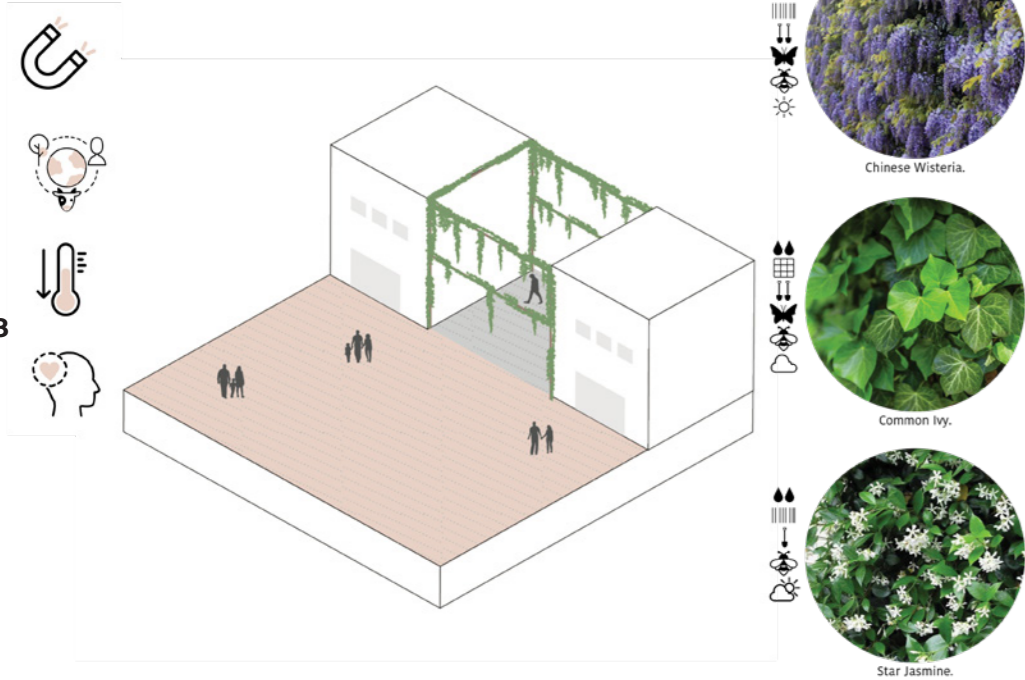


Figure 19. Design guideline green arches

GREEN ARCHES

The concept of green arches refers to unrestricted vegetation growing above a street (fig. 19). The plants are connected to a discreet structure of wires, concealed by the foliage they support. The presence of green arches offers multiple benefits. It creates some shaded areas, reducing heat stress within the street (Lenzholzer, 2015). Additionally, it contributes to a visually appealing streetscape, creating a cozy and inviting atmosphere. The vegetation in the overarching green serves as habitat for birds and a potential food source, enhancing biodiversity.

During the street survey, the imagery of the overarching green received a very positive response. Respondents considered it representative of Wageningen's identity and its association with freedom. The unrestricted growth of plants was appreciated, reflecting the city's spirit of liberty. The respondents also expressed admiration for the organic and slightly disorderly nature of the vegetation, finding it more appealing than a strictly uniform and modern appearance. Shop owners may find this guideline appealing as they contribute to a distinct Wageningen identity and create an inviting environment for visitors.

(MOVEABLE) PLANTERS

Moveable planters offer a flexible solution for locations that may have limited possibilities during certain events or periods but can benefit from added vibrancy during other times (Smith et al., 2021). These planters are easy to maintain and require minimal space, making them a practical option for enhancing the visual appeal of urban areas (fig. 20).

Mobile planters offer practical advantages for restaurant owners, making them a valuable addition to outdoor spaces. One of the benefits is the ability to provide seclusion or privacy, allowing guests to enjoy their dining experience in a more intimate setting. The mobility of these planters makes it easy to rearrange them, allowing for flexible seating arrangements. In addition to their functional advantages, mobile planters can also serve as an opportunity to incorporate edible plants, such as herbs, within the restaurant's outdoor space. By including these edible plants, restaurant owners can enhance the visual appeal of the area but also have a readily available supply of fresh ingredients. The herbs also improve the environment because they repel insects such as bees and wasp, making the outdoor seating space more pleasant (J. Frissel, personal communication, June 4, 2023). Entrepreneurs can choose what plants they want to put in these planters, as they can implement this guideline autonomously. Placing these planters around the all the various terraces in the city centre will create a harmonious and cohesive look, improving the attractiveness of the city centre.

When considering the purpose of planters, their impact on the streetscape becomes crucial. They can significantly enhance the appearance of the street environment, particularly in areas with limited space. For biodiversity reasons, plant beds are preferred over planters as planters create a confined space, where moving between the natural elements becomes difficult for animals. Moreover, planters are considered to be less sustainable due to their potential for breakage, requiring replacements. Additionally, their mobility makes them vulnerable to vandalism, further impacting their long-term viability (J. Frissel, personal communication, June 4, 2023).

(MOVEABLE) PLANTERS

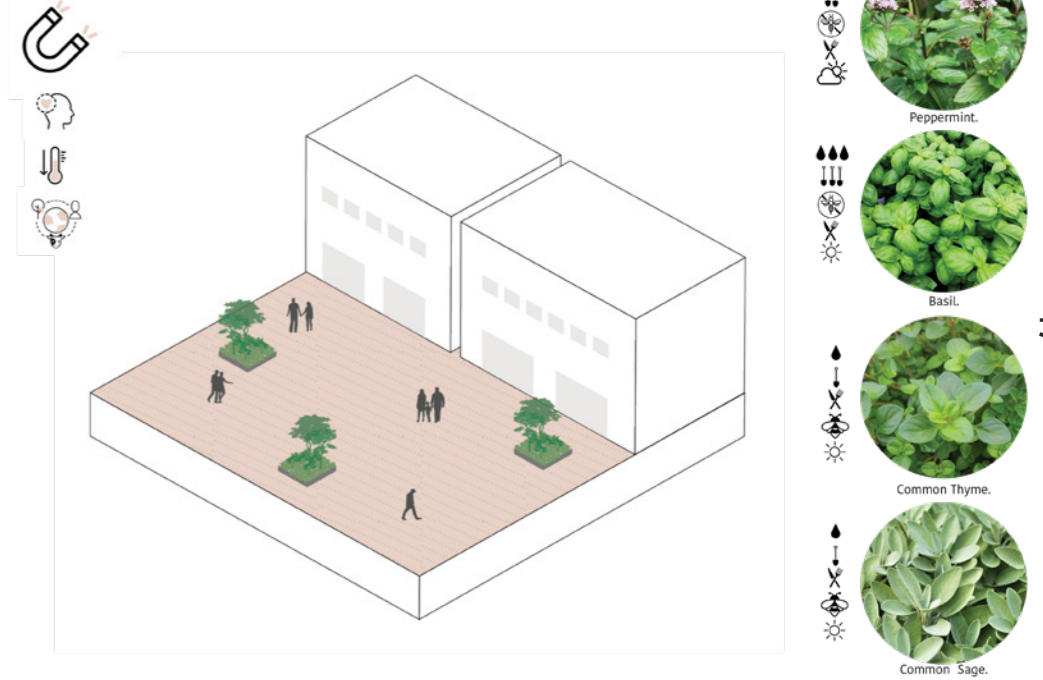
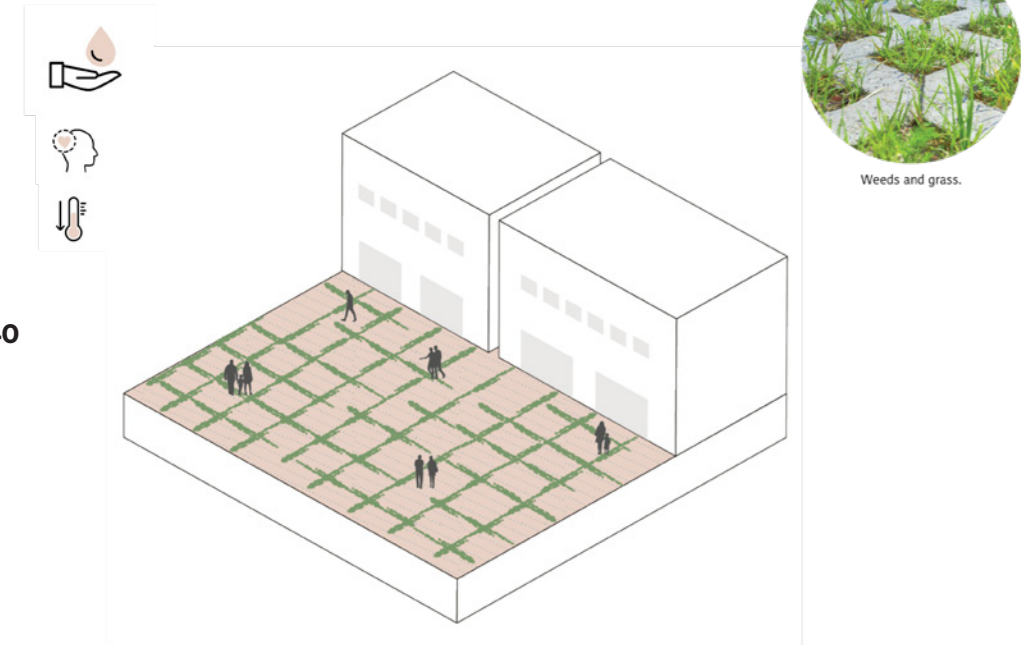


Figure 20. Design guideline (moveable planters)

PERMEABLE PAVEMENT



PERMEABLE PAVEMENT

Permeable pavement, a unique type of porous pavement, offers the advantage of allowing water to infiltrate and supports the growth of vegetation (fig. 21). This pavement is commonly used in areas such as parking lots. One of the key benefits of permeable pavement is its ability to reduce runoff. Unlike traditional impermeable pavements that often result in excessive stormwater runoff, permeable pavement facilitates natural infiltration into the ground. This feature helps mitigate the strain on stormwater drainage systems, minimizes the risk of flooding, and safeguards nearby water bodies from pollution caused by stormwater runoff (Zhang et al., 2012).

Additionally, the presence of permeable pavement in urban areas helps address heat stress. Traditional paved surfaces, particularly in densely populated cities, tend to absorb and retain heat, contributing to the urban heat island effect (Cheng et al., 2019). In contrast, the permeable pavement lowers surface temperatures with a maximum of 6.6 °C compared to fully paved streets (Cheng et al., 2019). By mitigating urban heat stress, permeable pavement creates a more comfortable environment for both humans. No specific plant species are recommended for this guideline, as it is anticipated that weeds or grasses will naturally grow between the tiles if given the opportunity. Instead of choosing particular species, the focus is on allowing natural vegetation to emerge, fostering a more organic increase in biodiversity.

Figure 21. Design guideline permeable pavement

WATER ELEMENTS

Water elements are important for insects and other small animals such as birds because they provide a fresh water source (fig. 22) (J. Frissel, personal communication, June 5, 2023). A study on the direct effect on biodiversity, as stated by Lehnert et al. (2021), show that placing water features have a little effect on thermal comfort and heat stress. The water elements do offer benefits for improved human wellbeing and attractiveness. Next to that, the cleansing and freshening effects result in positive impacts on people's general experiences within urban space (Xiao et al., 2017).

The interviews showed that a small water feature can be very suitable for a square, because it can be incorporated into the stones on the street and can be turned off during events such as the market and festivals (APPENDIX A). It was said that the fountains can provide space for children to play in and cool down the environment during hot days (C. Steuten, personal communication, June 7, 2023).

WATER ELEMENTS

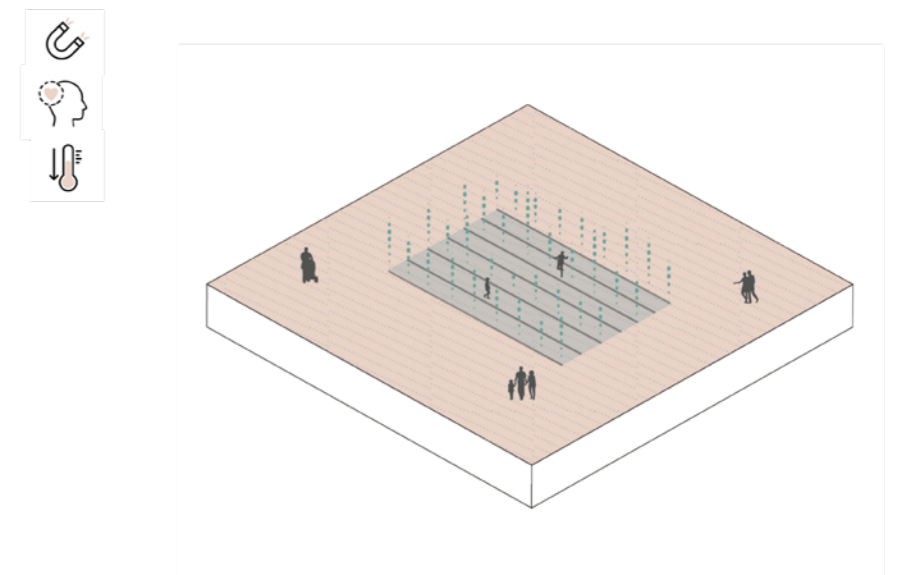
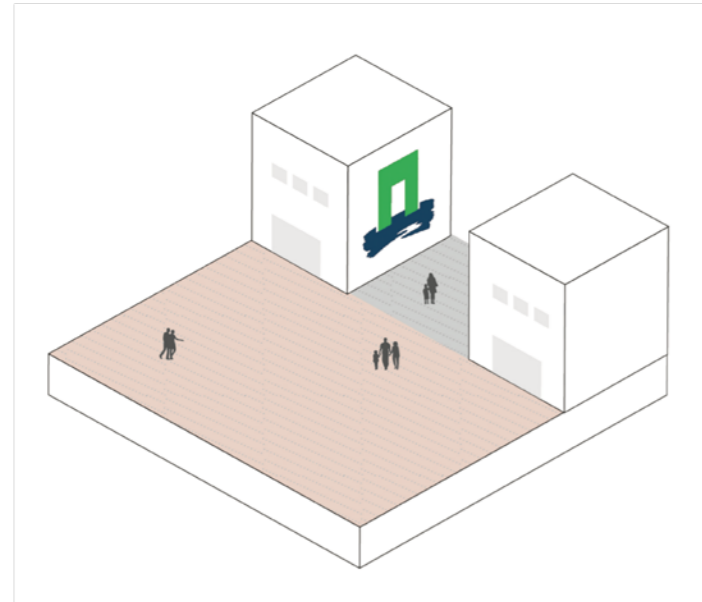


Figure 22. Design guideline water elements



MURALS

Murals can be used to show pieces of the past through different art mediums, becoming symbols of identity (fig. 23) (Rolston, 2010). Additionally, murals can serve as tourist attractions (Jażdżewska, 2017), holding the potential to create a city-wide tour in Wageningen. The murals can be used to tell a story about for example the rich history of Wageningen or the different identities. As can be seen in research from Poland, the murals created a lot of social attention. This is interesting for entrepreneurs and shop owners, because they can use a mural to brighten their property and become more visible on social media.

Murals do not have an impact on biodiversity, however they can show the identity of the city, as well as create an image of how the city focusses on biodiversity. Just the colour green conveys emotions of tranquillity, refreshment and relaxation (Cherry, 2022), and can have a positive influence on the human-wellbeing. It can help to convey a positive image of sustainability and eco-consciousness, possibly convincing people to think about their behaviour and becoming eco-friendly.

Interviews have also enlightened us that there is a specific spot in Wageningen allocated for people who would like to create graffiti art. This is at the harbour, where artists are free to use the space. This had the goal to decrease graffiti in unwanted spaces and guide graffiti artists towards a space which they can use freely (E .Rookmaaker, personal communication, June 5, 2023). It might be interesting to consider the possibility to include this existing project in the creation of new murals in the city centre.

Figure 23. Design guideline murals

TYOLOGIES

In this report, typologies are employed as general categories that are not tied to specific locations, including shopping streets, squares, car parking areas, bike parking zones and side alleys. Typologies serve as a framework for discussions on the site designs. Typologies are used to generalise areas to make it possible to design for the whole city centre, but at the same time be specific. In further chapters, the design guidelines will be discussed, and they will be connected to the different typologies. For the Hoogstraat, the Market Square and the Salverdaplein there will be a detailed design to show what it could look like if the design guidelines will be implemented for specific locations.

SHOPPING STREET

Shopping streets are defined by a main street and shops along the main street. In Wageningen city centre, Hoogstraat is the only street that is identified as a shopping street (fig. 24).

In order to apply urban nature interventions for this typology, green facades, facade gardens, plant beds, planters, and green facades are selected from the design guidelines.

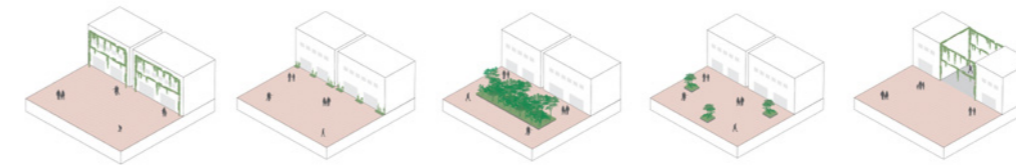
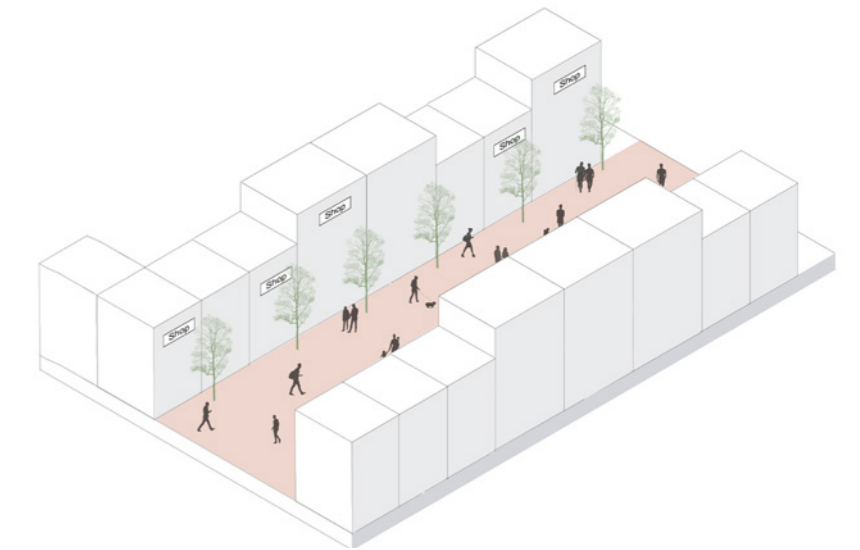
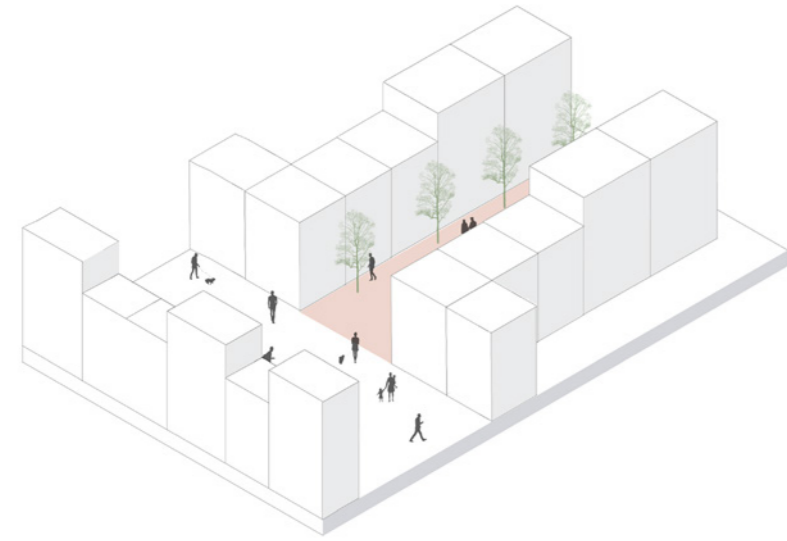


Figure 24. Topology shopping street with applied design guidelines





SIDE ALLEYS

Side alleys are defined by a narrow street, branching from wider streets, and buildings on the both sides of the street (fig. 25). In order to apply urban nature interventions for this typology, green facades, facade gardens, planters, green arches, and murals are selected from the design guidelines.

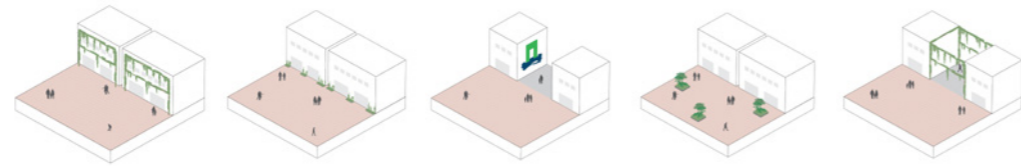
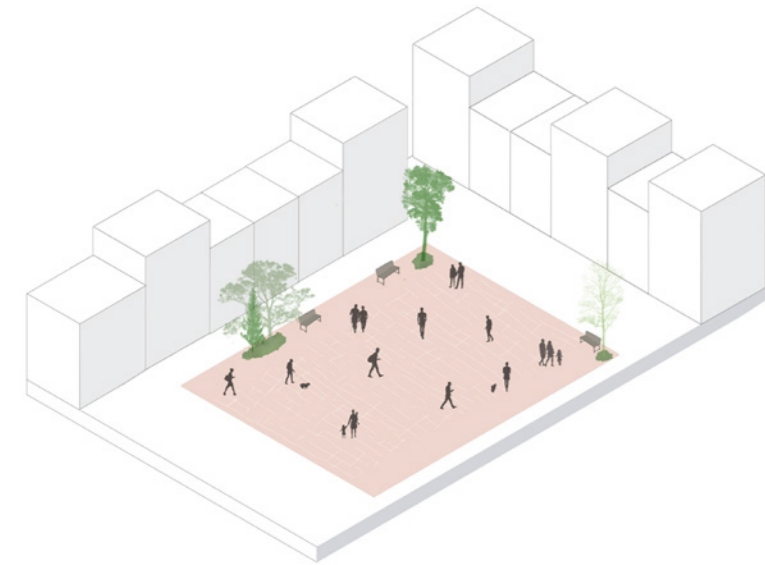


Figure 25. Topology side alleys with applied design guidelines



SQUARES

Squares are defined by an open space surrounded by buildings (fig. 26). In order to apply urban nature interventions for this typology, facade gardens, permeable pavement, plant beds, infiltration beds, planters, and water elements are selected from the design guidelines.

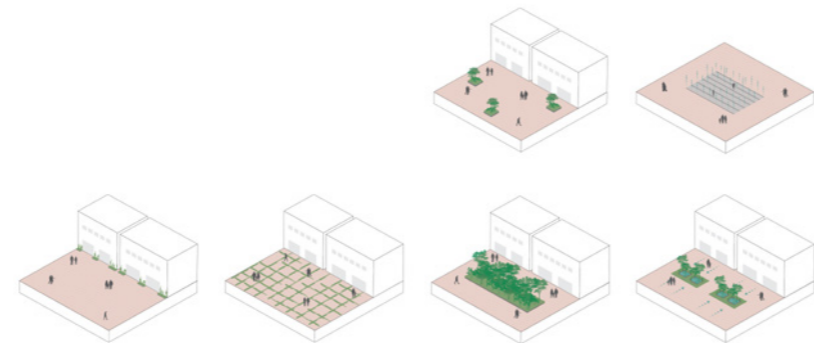


Figure 26. Topology squares with applied design guidelines

CARPARKING

Car parking is defined by an open space reserved for parking cars (fig. 27). In order to apply urban nature interventions for this typology, facade gardens, permeable pavement, plant beds, and infiltration beds are selected from the design guidelines.

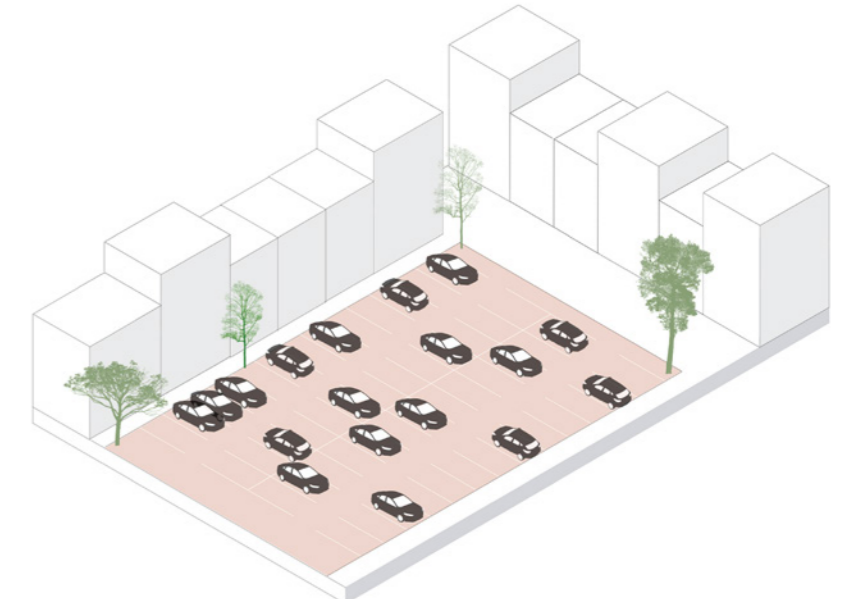
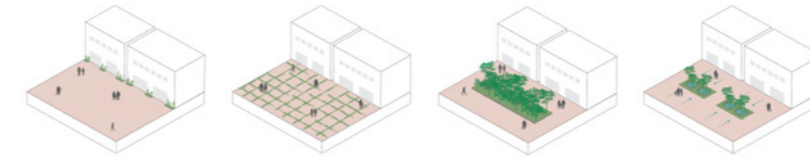


Figure 27. Topology carparking with applied design guidelines

BIKE PARKING

Bike parking is defined by an open space reserved for parking bikes (fig. 28). In order to apply urban nature interventions for this typology, facade gardens, permeable pavement, plant beds, and infiltration beds are selected from the design guidelines.

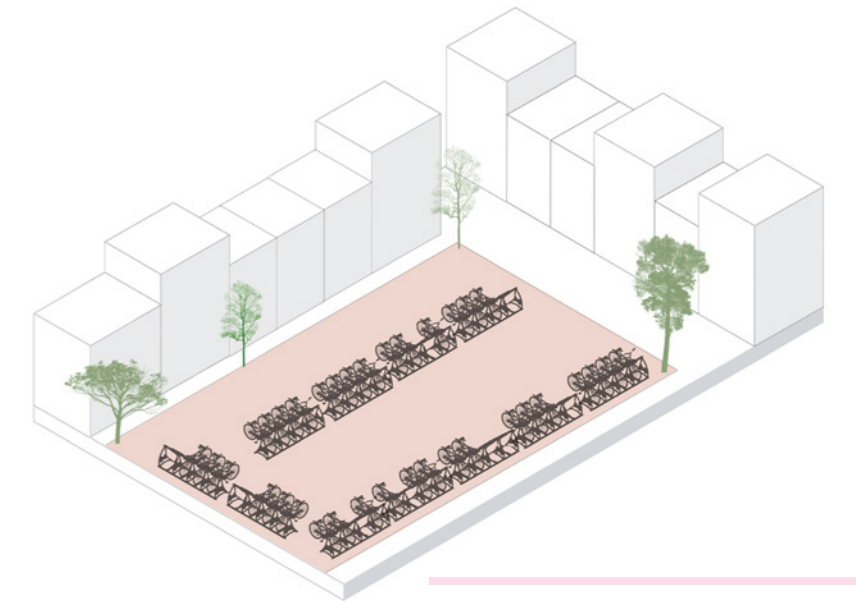
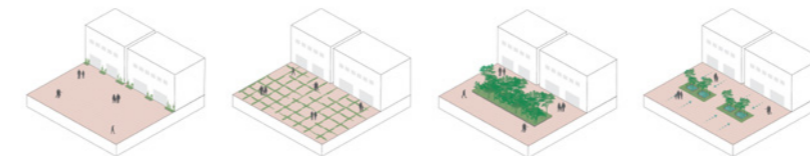


Figure 28. Topology bike parking with applied design guidelines

SITE DESIGNS

The following section presents the site designs for three distinct locations: De Hoogstraat, the Market square, and Salverdaplein. These site designs serve as illustrative examples showcasing how the various design guidelines can be implemented in four of the given typologies: shopping streets, side alleys, squares, and car parking areas. By combining different typologies with specific design guidelines, these site designs demonstrate practical applications and provide inspiration for other areas within the city centre of Wageningen. Each design offers a unique approach tailored to the characteristics and challenges of the specific location.

HOOGSTRAAT

The site design for Hoogstraat incorporates two different typologies: the shopping street and the side alleys. Several design guidelines are visible in the site design, including façade gardens, green façades, plant beds, and green arches (fig. 29).

This site design includes the enlarging of the current plant beds surrounding the trees that are already implemented in the Hoogstraat. This provides them with more room to grow and create space for wildflowers in the Hoogstraat. There is a small border around the plant beds to ensure that no bikes are parked against the trees. This small border does however allow for water infiltration due to small openings in the border. Infiltration of rainwater on location will also reduce problems elsewhere. These plant beds offer opportunities for vegetation and making the city centre more attractive. The plant beds will be implemented in such a way that the Hoogstraat is still accessible for trucks that supply the various shops (fig. 30).

The façade gardens are implemented in front of the buildings in the Hoogstraat. They will be implemented by removing a few rows of tiles in front of the shop windows, keeping the stores accessible whilst improving their overall attractiveness. These gardens will be maintained by shop owners themselves and can be implemented according to their personal wishes in



Legend



















- | | |
|---|--|
|  Building |  London plane <i>Platanus x hispanica</i> |
|  Monumental building |  Silver maple <i>Acer saccharinum</i> |
|  Pavement |  Sycamore maple <i>Acer pseudoplatanus</i> |
|  Grass |  Callery pear <i>Pyrus calleryana Chanticleer</i> |
|  Water |  White birch <i>Betula pubescens</i> |
|  Green façade |  American storax <i>Liquidambar styraciflua</i> |
|  Wild flowers |  Elm <i>Ulmus Columella</i> |
|  Hanging green |  White willow <i>Salix Alba</i> |
|  Façade garden | |
|  Plant bed | |

Figure 29. Site design for the Hoogstraat

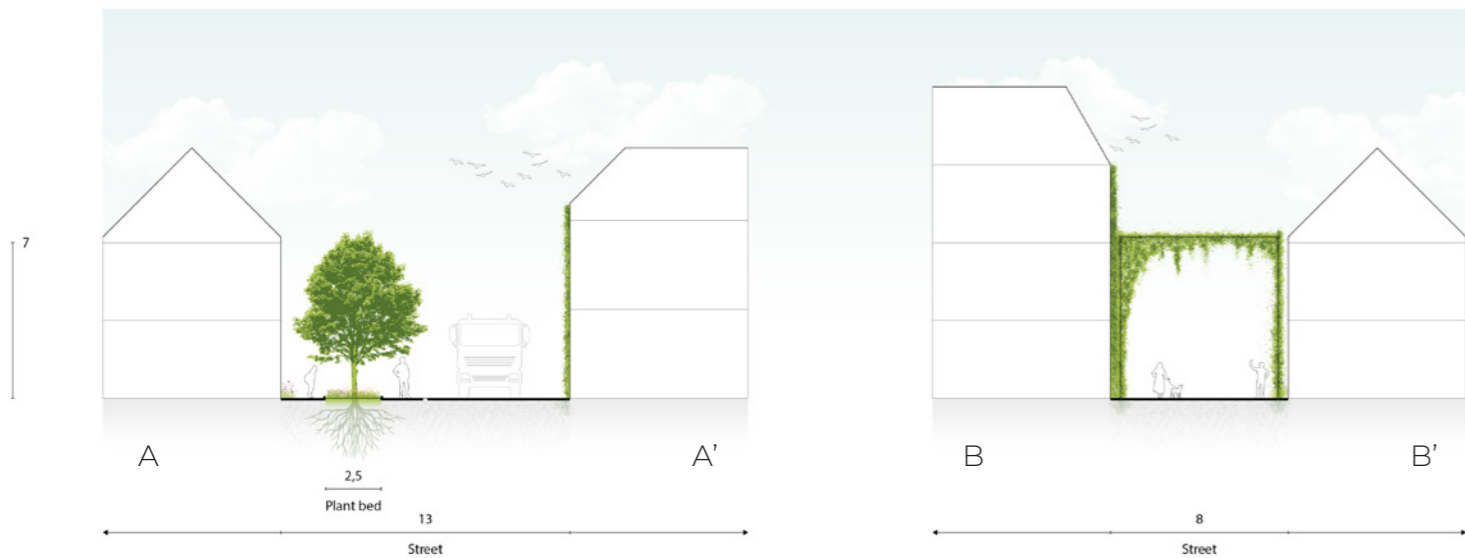
maintenance, colours and height of the plants. Green façades are positioned in front of non-monumental buildings. Monumental buildings will be kept free of green façades. This differentiation in design highlights and preserves the historical significance of the monumental buildings while also creating space for urban nature (fig. 31). Adding diverse types of vegetation can improve biodiversity and create corridors for wildlife.

Furthermore, green arches add a unique and eye-catching feature to the streetscape. These arches can be adorned with climbing plants, creating a green canopy above the pedestrian realm. They serve as visual markers and create a distinct identity for the Hoogstraat and the side alleys. The green arches are placed between the top floors of the buildings, creating an attractive sight whilst still being high enough for trucks to pass underneath. Plant species will be selected based on their growth speed, with the preference for slow growing species to limit the maintenance on these arches.

Figure 31 Visualisation of the Hoogstraat



Figure 30 Cross section of the Hoogstraat



Additionally, the municipality is currently working on a proposal for the city moat. In this project, we decided to take these plans into consideration when creating a design for the Hoogstraat. We see the implementation of the city moat as an improvement not only for the green blue network of the city, but also to tie in the historicity and heritage, whilst creating an attractive and central entry point for the Hoogstraat. As can be seen in the final masterplan (fig. 29), the city moat will generate a central green boulevard at the beginning of the Hoogstraat, connecting the new green infrastructure with the surrounding parks.

MARKET SQUARE

The Market Square in Wageningen is classified as a square typology. The site design is carefully planned to preserve its functional role as the central gathering point for the community and its historical character. Specifically, the design aims to maintain the square's capacity to host a market twice a week and other events, where market stalls and a vibrant crowd bring the space to life. The site design takes great care in preserving the historical significance of the Market Square, including its central church and monumental buildings. Several features from the design guidelines are visible in the site design, such as façade gardens, green façades, plant beds, and permeable pavements (fig. 32 & 33).

Façade gardens are incorporated in front of the monumental part of the municipal building. Here, various plants can be implemented, just like at the Hoogstraat. By implementing vegetation close to surface level, the monumental front of the town hall is preserved yet creates a natural and colourful appearance. A green façade will be implemented at the newer part of the town hall, to highlight the contrast between the old and the new parts of the building. This green wall will have a significant cooling effect on its surroundings and will be an eye-catching element on the market square. Applying a large green façade on the front of the town hall will also reflect the progressive and nature-inclusive character of the municipality.

On the oval space surrounding the central church, permeable pavement and plant beds are implemented that will give the church a natural and distinctive appearance. By introducing urban nature to the predominantly paved square, the design helps mitigate the effects of climate change such



Legend

















-  Building
-  Monumental building
-  Pavement
-  Road
-  Market square
-  Permeable pavement
-  Green façade
-  Wild flowers
-  Façade garden
-  Moveable planter
-  Bench
-  Bike stand
-  London plane | *Platanus x hispanica*
-  Crimson lime | *Tilia europaea euchlora*
-  Sycamore maple | *Acer pseudoplatanus*
-  Sainfoins | *Onobrychis*

Figure 32. Site design for the market square

as heat stress and water runoff, making the square more resilient to future challenges. The application of plants around the church will also attract more attention towards the church and highlight the heritage connected to the market square. The church is accessible via a paved path to ensure the access for disabled people and the side entrances of the church are accessible by paths of permeable pavement that gradually transitions into plant beds. The inclusion of urban nature around the church, which incorporates seating spaces, provides shade and places to rest while also enhancing the attractiveness of the Market Square (fig. 34). Plant beds with trees are strategically placed in front of the restaurants on the southwest side, creating canopies over the outdoor seating areas and providing shade. Planting these trees will make the market square a more pleasant space for people to visit and stay. This addition of vegetation enhances the biodiversity, reduces heat stress, water nuisance and enhances the appeal of the square while still allowing space for market stalls.

Figure 34. Visualisation of the market square



Figure 33. Cross section of the market square



SALVERDAPLEIN

Salverdaplein is classified as a carpark typology. For Salverdaplein, two designs scenarios have been explored. "The Salverdaplein" design is created within the spatial limitations of the area and is therefore easier to implement and keeps most of the parking spaces that are currently there. Next to that, there is an "out-of-the-box" design which presents a more intensive implementation of urban nature. This scenario renames the parking place to "Salverdapark".

SCENARIO 1: SALVERDAPLEIN

The site design for the Salverdaplein incorporates the typology carparking. Several design guidelines are visible in the site design, including permeable pavement, plant beds, façade gardens and infiltration beds (fig. 35). The main objective of this design is preserving functionality and implementing easily achievable interventions. Carparking is therefore still possible at Salverdaplein. A main intervention is that a large portion of the paved area is replaced by permeable pavement. This design intervention aims to address the existing water infiltration issue at Salverdaplein by improving the total area of infiltration, while promoting sustainable water management practices. Additionally, new bike stands are implemented to address the biking problems in the city centre. Like the car parking, this bike parking space is also paved with permeable pavement to improve the water infiltration capabilities of the site. To further address the issues of water infiltration, the south side of the parking square is transformed into infiltration beds. As this is the lowest part of the site, water flows downwards and is captured by the beds, decreasing water runoff and water nuisance in the area.

Introducing new trees in the plant beds in the area between the provides parked cars and bikes with shade during hot weather and gives the parking area a greener appearance. Trees that are currently present stay in the area. These changes reduce the available parking spaces to fifteen spots. This decrease of parking space is compensated by the proposed parking garages at Gevangentoren and Gerdestraat near the Lidl.



Legend













-  Building
-  Monumental building
-  Pavement
-  Road
-  Cycling road
-  Wild flowers
-  Façade garden
-  Permeable pavement
-  Bike stand
-  London plane | *Platanus x hispanica*
-  Silver lime | *Tilia tomentosa*
-  Sycamore maple | *Acer pseudoplatanus*

Figure 35. Site design for the Salverdaplein

Urban nature is also implemented at the Bassecour, across the street from the Salverdaplein, and is a transition zone that extends from Salveraplein. Connecting these areas creates a green connection towards the Torckpark that encourages people to explore the various spaces in the city centre. The Herenstraat partly becomes a bike street, starting at the northern corner after the entrance to the car park.

SCENARIO 2: SALVERDAPARK

Salverdapark is approached from a more ambitious point of view that explores larger urban nature interventions (fig. 36). In this scenario, the site is perceived as a square typology and includes the following guidelines: permeable pavement, plant beds, infiltration beds, and water elements.

The infiltration beds allow for more infiltration of precipitation and decrease the water nuisance. Along with the plant beds, these infiltration beds reduce the heat stress in the area due to the shade they provide and the evapotranspiration of the plants. The plant beds in the northern area of the park are designed with a slight elevation, creating a welcoming space that embraces visitors. Furthermore, the planting in these elevated plant beds is strategically designed to block the view of the entrance to the private parking area underneath the building and effectively conceal the less visually appealing buildings behind it (fig. 37).

In the design, there is space for children to play on the grass and play with the water feature in the shape of the city moat to cool down (fig. 38). There are also benches that provide people with spaces to rest and enjoy the shade on a hot summer day as well as benches in the sun when the temperature is lower. The new design includes seven disabled parking spaces on the southern side of the park. These were still included in the design to keep the accessibility of the area for disabled people.



Legend

- | | |
|---------------------|---|
| Building | London plane <i>Platanus x hispanica</i> |
| Monumental building | Crimson lime <i>Tilia europaea euchlora</i> |
| Pavement | Sycamore maple <i>Acer pseudoplatanus</i> |
| Grass | White willow <i>Salix Alba</i> |
| Road | Guelder rose <i>Viburnum opulus</i> |
| Cycling road | Yellow alfalfa <i>Medicago falcata</i> |
| Water | Sainfoins <i>Onobrychis</i> |
| Wild flowers | Common dogwood <i>Cornus sanguinea</i> |
| Bike stand | |
| Bench | |
| Bench | |

Figure 36. Site design for the Salverdapark

The Bassecoeur, across the Herenstraat, is included in the design to promote the use of this area as well to improve the connection between the city centre and the Torckpark. The implementation of the Salverdapark is used to increase the connection from the city centre towards the Torckpark. To ensure the safety of pedestrians and cyclists when crossing to the Bassecour area, a bike street is implemented, where cars are considered visitors. This design approach discourages car usage on this road and creates a safer environment for cyclists and pedestrians.

Figure 37. Cross section of the Salverdapark



Figure 38. Visualisation of the Salverdapark





6

Discussion

This chapter will interpret the results of this project and dives into the realisation of the proposed guidelines and touches upon the limitations of this study.

The findings of this report are specifically applicable to the city centre of Wageningen, but they can serve as a valuable reference for other cities with necessary adjustments. While the general design guidelines can be implemented elsewhere, it is crucial to customize the actual design according to each location's unique characteristics. Moreover, the design guidelines add much new natural elements to the city centre, which increases the demand for maintenance of the vegetation. The recommended vegetation in APPENDIX D are all relatively easy to maintain. This decision was made to make the upkeep and maintenance accessible for everyone, so that this can be done by inhabitants, homeowners and entrepreneurs themselves. However, it is strongly advised that guidelines such as the green arches in the Hoogstraat or side alleys, are the main responsibility of the municipality. It is therefore recommended to include these guidelines in the municipal 'Groenplan'. Nonetheless, entrepreneurs and inhabitants should get the opportunity to implement the proposed guidelines themselves, as it will add to the enthusiasm awareness and provides a great learning-opportunity of the positive effects of urban nature.

The collected data from the interviews and discussions is incorporated in the report, and therefore includes valuable insights from various sources including entrepreneurs, visitors, residents, municipality board members, and ecology experts. Although it was not feasible to interview every individual, the validity of the design was ensured by involving multiple stakeholders with diverse backgrounds. Furthermore, the research for design method employed in this study emphasizes conducting thorough research prior to the actual design phase. While this approach is logical given the available time frame, it is important to note that if more time was available the results would have been further discussed with stakeholders.

Not implementing this plan could lead to water-related problems on main squares and streets. Next to that, issues such as urban heat stress, which

would negatively impact the city's attractiveness for visitors. It is important to prioritize these interventions to mitigate potential challenges and ensure a sustainable and vibrant urban environment in Wageningen. However, before implementing the site design of the market square, research must be conducted on the effect of increased infiltration in the oval around the church and its impact on water nuisance in the basement. This was not possible to do during this project due to time constraints and a lack of expertise in this field. Moreover, this report is also limited in that it does not provide an overview of the costs related to the implementation of the guidelines or the site designs.

RECOMMENDATIONS

The various typologies provide opportunities for pilot locations where the initiatives proposed in this report can be implemented. One such potential pilot location can be the Riemsdijkstraat, which is a side-alley of the Hoogstraat and may be interested in serving as a pilot location. By showcasing the suggested implementations, this street can serve as an example to other streets, demonstrating how these interventions can enhance the liveability of both the street and the surrounding neighbourhood.

7

Conclusion

The main research question at the end of this chapter is answered by making use of the sub-research questions.

“What are the specific environmental and social challenges in the city centre of Wageningen that need to be addressed through urban nature interventions?”

The analysis revealed environmental challenges related to heat stress, water nuisance, and biodiversity loss, exacerbated by climate change. Other challenges in the city centre environment are inadequate bike parking spaces and inefficient car parking utilization. The social challenges are the diverse perceptions of Wageningen’s identity, along with the preservation of historical buildings in the city centre.

Our research demonstrates that urban nature interventions can address these challenges. By incorporating natural elements, biodiversity can be enhanced while mitigating the effects of climate change. Centralizing bike and car parking areas allows for the integration of urban nature without compromising car space, and additional bike parking is provided. Urban nature also contributes to an overarching identity of Wageningen as the “city of life,” offering aesthetically pleasing elements that combat the identified environmental challenges. To preserve and showcase monumental buildings, urban nature is implemented in the surrounding areas rather than directly on the buildings themselves.

2. What are the diverse needs and preferences of stakeholders regarding urban nature in the city centre of Wageningen?

Interviews with entrepreneurs, experts, and policy makers showed us that stakeholders found car parking and accessibility of the city centre very important. Consequently, removing a substantial number of car spaces to

make room for urban nature was neither feasible nor desirable. The market square, considered vital for the centre, was identified as a challenge due to limited space for interventions when the market is there. Shop accessibility of the shops was also important for the entrepreneurs. The wishes of the interviewed stakeholders aligned closely; thus, consensus can be easily reached. This is also because the stakeholders all agreed on the same goals regarding urban nature in Wageningen. The main difference found that the municipality inclined towards long-term solutions while entrepreneurs favoured short-term, easily implementable interventions that give quick results.

3. What are the most suitable urban nature design guidelines that can be implemented in the city centre of Wageningen to tackle these environmental challenges, while taking into account the diverse needs and preferences of stakeholders?

Nine design guidelines are composed, which can be implemented on different typologies. The design guidelines are: green façades, façade gardens, permeable pavement, plant beds, infiltration beds, (moveable) planters, green arches, murals and water elements. These design guidelines are based on the interviews with stakeholders and literature research. Seven of the guidelines involve an increase in urban nature, while the other two are based on other preferences of stakeholders.

4. What spatial interventions can be developed for the urban nature project in the city centre of Wageningen, ensuring the integration of green infrastructure with the existing urban fabric, preservation of historical buildings and creation of functional and inviting spaces for various user groups?

Four site designs on three different locations in the city centre were made. These site designs give a clear overview of what the design guidelines look like when implemented on the different typologies. By doing this the urban fabric is taken into account, as well as the previously identified challenges regarding space for the market and other events, accessibility of the shops and monumental buildings. The visuals of the site designs show how small and

relatively simple interventions can make a street or open square come alive, showcasing Wageningen's unique identity: city of life. With these guidelines, Wageningen will become a vibrant and inviting space that resonates with both locals and visitors, reinforcing Wageningen's reputation as a 'green city' and reinforcing its residents' pride in their hometown. An attractive city centre, where people would like to stay for extended periods of time, which can increase the revenue for entrepreneurs. Overall, these small interventions aim to create a stable presence of urban nature in the city centre, providing habitats for (small) wildlife and increasing the biodiversity.

Main research question: What urban nature interventions can be implemented to effectively address the environmental challenges and highlight the identity of Wageningen's city centre, while considering the stakeholder needs and preferences?

In summary, by implementing the proposed urban nature design guidelines and site designs, Wageningen's city centre can effectively address environmental challenges, showcase its identity, as the city of life. While also meeting the needs and preferences of stakeholders. This will result in a lively city centre appreciated by entrepreneurs, inhabitants and visitors, as well as contribute to Wageningen's reputation as a green, healthy, and sustainable city.

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Appendices

Appendix A Overview of terms used

Urban nature design guidelines: provide a framework for the application of urban nature interventions which can be applied to several areas.

Typologies: a classification according to a general type of urban structure.

Site design: The combination of the visual products of the whole design on a smaller scale. Including a masterplan, cross-section and visual of the area.

Physiological equivalent temperature (PET): a measure that combines temperature, humidity, air movement, and radiant heat to assess overall human thermal comfort in a specific environment. It provides a single value representing perceived thermal sensation. PET is used to evaluate thermal conditions and their effects on individuals' well-being and is commonly used in building design and urban planning.

Masterplan: map made of the new design.

Cross-section: visual representation of a vertical plane cut through the landscape that shows the details about measurements and elevations within a site design.

Urban fabric: refers to the physical structure and arrangement of a city, including buildings, streets, public spaces, and infrastructure that shape the overall character and functionality of the urban area.

Green infrastructure: refers to a network of natural elements that are strategically planned and designed to provide environmental, social, and economic benefits in urban areas. It includes features such as parks, green spaces, urban forests, wetlands, green roofs, and permeable surfaces. Green infrastructure helps mitigate climate change, improve air and water quality, enhance biodiversity, promote human well-being, and provide recreational opportunities for communities.

Carbon sequestration: refers to the process of capturing and storing carbon dioxide (CO₂) from the atmosphere, typically through natural or artificial means, to mitigate its impact on climate change. It helps reduce the concentration of greenhouse gases by locking carbon away for long periods, such as in forests, soils, or geological formations.

Particulate Matter (PM): Particulate matter refers to tiny solid or liquid particles suspended in the air. These particles can vary in size and composition and are often categorized based on their diameter, with smaller particles posing a greater risk to human health as they can penetrate deep into the respiratory system. PM can originate from various sources such as vehicle emissions, industrial processes, construction activities, combustion of fossil fuels, agricultural practices, and natural sources like dust and wildfires.

Appendix B: Results street surveys

Hoogstraat



Person	Picture A	picture B	Picture C	Picture D	Picture E	Picture F	male/female	Comments
1	6	3	4	5	2	1	female	F is the nicest. It is important that people show initiative themselves and have authority. Picture F might however be more difficult to maintain
2	4	1	2	6	5	3	male	Identity of freedom can also be translated in the way that the plants are growing. It should not be too modern. Blauwe regen is a good plant to use for the hanging plants. Trompet bloem flowers orange in may, during kingsday and may 5th. Is there a way to make the maintenance voluntary. Identity of Wageningen: very social, left wing, sustainability. Kiwi plants might be nice, connect the agriculture identity (fruit or nut trees)
3	5	1	6	3	4	2	male	F is too narrow, B makes it more cosy, D is more spatial.
4		1		2			male	Need to create more green around the trees in de Hoogstraat
5		1	6	2			male	
6	5	1	6	2	4	3	male	It should not be too modern and sterile. It needs to be playful. There shouldn't be too much maintenance. Highlight the older and beautiful facades. Near the library, everything should be green.
7	4	1	5	6	3	2	male and female	Benches are very nice. The more wilder looks more natural. Wageningen is 'gezellig' tot drink coffee and walk around, nice terraces. Monumental buildings are very nice, especially also the ones from after WW2, put green on the ugly facades.
8	4	1	5	2	6	3	female	Green is very important. C is too uniform. Plants against the walls is very nice. B is achievable. F is better than C for Wageningen
9	3	1	5	4	2	6	male	Modern is nice. A is too modern. E is very nice because of the planters. D is too controlled. F is too wild. C is too bare
10	1	2	4	3	5	6	female	A is the coolest. F is messy. In some spaces modern looks can be very nice, makes it also look like campus. C is more for a neighbourhood. Green walls at Junushof
11	3	1	2	6	4	5	female	Picture F is too wild. B can be applied in side alleys. A looks too much like a shopping mall. The birds in the side alleys in the bushes is very nice
12	3	4	5	6	1	2	female	Calm green will fit nicely into the city centre. Street is currently boring. Campus is very green but not connected to the centre. Maintenance is very important. Everyone has to join, otherwise it won't work.
13	6	3	5	4	1	2	female	Moat in Arnhem is very nice. Green facades. For the Stadsbrink picture D is very nice. A is too modern, but the idea is very nice for the side alleys
14	5	1	2	3	4	6	female	F for the side alleys, identity: green, not too modern, atmosphere
4,08333333 1,57142857 4,38461538 3,85714286 3,41666667 3,41666667								

Market

vergroening Wageningen

Markt



Person	Picture A	Picture B	Picture C	Picture D	Picture E	Picture F	Picture G	Gender	AgeIndicatio	Comments
1	4	5	7	3	1	2	6	Male	Elderly	
2	4	2	7	3	1	5	6	Female	Middle	
3	1	1	7			1		Male	Young	
4	2	4	7	1	3	6	5	Female	Young	
5	3	5	6	1	2	4	7	Female	Middle	
6			1			7		Male	Elderly	
7	1					2		Female	Middle	
8	1	3	7	2	6	4	5	Female	Young	
9	6	5	1	4	2	7	3	Male	Young	
10	2	1	1	6	5	3	7	Male	Middle	
11	7	2	2	2	2	1	7	Female	Elderly	
12		6	6	3	2	1		Female	Elderly	
13										
14	3	7		1	2		7	Female	Elderly	
15	5	4	7	2	3	1	6	Female	Elderly	
16	5	4	7	2	3	1	6	Female	Young	
17					1	1			Young	
18		7			1		7	Female	Young	
19		7	1		1			Male	Young	
20				1	2			Male	Elderly	
21				1	2			Female	Elderly	
22	1	3		7	6	2		Female	Elderly	
23								Male	Elderly	Waste of money on this place
24					2	1	7	Male	Middle	The wilder the better
25					2	1	7	Female	Middle	
26								Male	Young	
27	7	6	4	2	3	1	5	Female	Young	
28	3	6	7	4	2	1	5	Male	Young	
29	3	4	7	5	1	2	6	Female	Young	
30										Less stones, more green
31	4	6	7		1	2		Male	Young	
32	5	6	7		1	2		Male	Young	
33						1	7	Female	Young	
	3,7222222	4,7	5,705882353	2,94117647	2,375	2,56521739	6,41176471			

Appendix C Summary of the interviews

Employee Municipality Wageningen

Underground parking is a wish, but the municipality does not own real estate where this would be suitable. Vertical parking spaces can be used here that the upper floors can be removed when the demand for parking spaces decreases. The municipal councils want to make the city centre special and use the diversity that the city has to offer.

Identity: Life

Employee Municipality Wageningen

Entrepreneurs are not considered in the climate –adaptation plans. Parking and traffic play a big role in Wageningen, be creative with parking garages at e.g. Junushoff or Gevangenentoren. Parking with green, permeable pavement needs sunlight to grow, how will it grow if there is a car parked on it all day?

Reach the entrepreneurs by explaining what nature and urban greening can do for them: attract more visitors to the shop/restaurant, make the area more comfortable etc.

Water is a fun element to play with on the market square. It is flat on the ground, so it does not hinder the market stands. Children can play in it and it cools them down, also important for insects. A water element will also draw people in which can be interesting for restaurant owners

Trees are difficult to place, you have to take into account the soil type and the underground infrastructure. They can also cost €10.000-€20.000. Planters have the risk of drying out.

Interesting area: wall of Antonios. Currently a grey wall you see as you enter the city.

Entrepreneur

Saw issues in the Hoogstraat: too few trashcans, lack of green, bicycles parked unorganized. Entrepreneurs think the municipality works against them, possibly due to the different views they have. The municipality think more long-term, while the entrepreneurs often think on a shorter term. Present greening as an attraction and focus on the benefits it can bring. Do think about (youth) vandalism.

Identity: gezelligheid, attractive, busy

Employee Municipality Wageningen

When introducing green in the city, think about who is going to maintain it. Plants can also create a nuisance (leaves on the street). Multifunctionality of green is important. Wageningen and parking will always be a problem, parking towers are a suitable solution but will it be paid off? The investment might be too large that there will be no profit.

Identity: there is no single identity. One part of Wageningen is highly educated. But also, there is low economic status part too. They tend not to understand the character of Wageningen. Wageningen is colourful.

Employee Municipality Wageningen

The municipality wants to cluster parking in parking garages or towers. These can be adapted so they can change to the demand of car parking. If you want to build a parking garage at the Lidl, you could combine it with new housing, and include other things to lift up the space. However, housing and other projects will decrease the space available for parking. The Gevangenentoren seems suitable for a parking tower.

Think about how sustainable it is that the Markt needs to be empty for 2 events per year. Is that still the case in the future? can't the market go to another place in the centre? What has the priority? Events and market or greenery and attractiveness? There is no right answer.

We have the perspective of the entrepreneurs; therefore, we need to think about what the entrepreneurs find important and deem that as our priority.

Try to strive for sidealleys that have their own identity and are different from one another, that would make a strong story.

Employee Municipality Wageningen

There is little space available for greenery, elements that need little space are therefore more suitable.

Identity: sustainable, climate, small but orderly city, innovative ways to look into the future

WUR Ecology Expert

Movable urban green is interesting. Be consistent in the elements that you use and use different plant species to create diversity, do think about height/size of the vegetation. Use native plants. Use the different heights, also up the building, for vegetation. Maybe 10 cm off the building, with a frame the vegetation can grow. Incorporate light posts to add more height.

(One big tree better than 3 small ones). Green can be used to emphasize monumental buildings. Make places where people can sit. By connecting the green spaces you can create a network. More green is needed on salverdaplein, maybe also combine it with green bike parking.

Identity: university and that makes the place nice. But it's not green enough. There should be more green.

Entrepreneur

Entrepreneurs have little knowledge of greenery and heat stress, they are not on the same page as the municipality/researchers etc.

Issues of Wageningen: not a bustling, too little parking spaces, not attractive. Entrepreneurs are heavily dependent on visitors who come by car.

Entrepreneurs have a direct and principal point of view, use the design to be informative and concrete to convince entrepreneurs.

Identity: Wageningen is mostly WUR, there is a skewed relationship between students/youth/inhabitants. Wageningen does not have one identity?

Entrepreneur

Not having cars in the city is bad for the entrepreneurs. But the current situation can be changed. Salverdaplein can become a park because people can walk a little bit further. Wants to see more trees on Salverdaplein and more flowers or bushes in front of shops. Dislikes the bicycles parked everywhere in the street. Likes that there are no big chain shops in the centre, prefers local shops.

Entrepreneurs do sometimes participate in different projects, but it is always the same people, more (diverse) entrepreneurs need to participate or need to be reached out to.

The more green the better.

Close to the shop there is a mural, it was cheap to make but it took 2-3 years to get approval. The mural was received very positively, it is a nice way to show the identity of Wageningen, it stops vandalism or unwanted graffiti, and it promotes more art and artists in Wageningen.

Entrepreneur







Entrepreneurs want people to be able to access their shops and do not want dirty shoes in their shops. The traffic is important for the entrepreneurs because they heavily depend on people that come by car to Wageningen. Therefore, parking spaces are also needed, if parking is centralised there needs to be a concrete plan. Optimize the ways people come to the city centre.

Green should not become an obstacle, create mud or be slippery. Bigger entrepreneurs are more interested in sustainability. In general, greening is not of interest for entrepreneurs. To reach them, talk about the benefits of greening for them. Make becoming sustainable and climate adaptive design attractive for the entrepreneurs.






Identity: the life of the students should be visible in the city centre, with certain cafés or shops. Wageningen is very different from Veenendaal or Ede.

Appendix D: List of recommended plant species for each guideline

Green Façades

Name	Picture	Structure required	Maintenance	Attracts	Soil condition	Light preference	blooming	winterproof	Max. height	Colour
Chinese blauweregen <i>Chinese Wisteria</i> (<i>Wisteria sinensis</i>)		Vertical stainless steel cables	Clipping: 2x a year	Bees and butterflies	Nutrient rich and permeable soil	sunny	Blooms 2x a year	Yes, but loses leaves	10 m	Purple blue
Sterjasmijn <i>Star Jasmin</i> (<i>Trachelospermum jasminoides</i>)		Vertical stainless steel cables	Clipping: 2x a year	Bumblebees and flies	All soils, permeable	Half shade/ sunny (slow growing)	May-September	yes	4 m	white
Klimop <i>Common Ivy</i> (<i>Hedera helix</i>)		Trellis panel system	Clipping: 2x a year	Butterflies, bees, small insects etc.	All soils, not too wet	Half shadow, shadow, sun Fast growing	September-oktober	yes	20 m	/
Hop <i>Common hops</i> (<i>Humulus lupulus</i>)		Trellis panel system	Very low maintenance Dies in fall, so needs to be clipped back Average water need Fast growing	butterflies	Nutrient rich	Sunny Fast growing	summer	Yes but loses leaves	10 m	green
Vuurdoorn <i>Orange Firethorn</i> (<i>Pyracantha coccinea</i> 'Orange Glow')		Trellis panel system	Clipping: 2x a year	birds, butterflies and bees	Nutrient rich, permeable	Half shadow/ sunny	may	Yes	3 m	White flowers, orange berries
Aalbes / Rode bes <i>Red currant</i> (<i>Ribes Rubrum</i>)		Wall trellis	Pruning in February- march	birds	Not too wet	Sun or half shadow	Flowers early in spring, berries June-july	yes	0.5 m	Red flowers and red berries

Infiltration beds

Name	Picture	Maintenance	Attracts	Soil condition	Light preference	blooming	winterproof	Max. height	colour	Water need
<i>Boerenhortensia</i> <i>Bigleaf Hydrangea</i> (<i>Hydrangea macrophylla</i>)		Once per year in march		Can sustain wet soils, Half-shadow, sun needs moist soils during droughts		Yes, June-september	yes	80cm	Blue-pink-purple	high
<i>Moerasspirea</i> <i>Meadowsweet</i> (<i>Filipendula ulmaria</i>)			Flies, bees and beetles	Needs wet soils, can survive droughts in summer		Yes, June-august and september-october		1.2m	White / green	
<i>Kornoelje</i> <i>Common Dogwood</i> (<i>Cornus</i>)		Needs regular cutting to remain the red branches and leaves	Pollinators	All, can sustain wet and dry circumstances	Sun or shadow	May-june	Yes	250-300 cm	White flowers in summer, red branches and leaves in winter	high
<i>Seed mix 'G3</i> <i>Bloemrijk grasland - natte grond'</i> <i>Consists e.g. garden angelica, wintercress, marsh-marigold etc.</i>		Mow 1 time a year	insects	Wet soils	sunny	April-october	Yes, some species	180 cm	Pink, white, yellow etc.	high
<i>Gelderse Rose</i> <i>Guelder Rose</i> (<i>Viburnum opulus</i>)		Low maintenance	Pollinators	Moist but well drained soils	Shade or sun	Spring and summer	Yes but loses leaves	4-5 m	White flowers	average

Plantaan
Plane
(*Platanus hispanica*)







Low maintenance / Dry and wet soils Shadow or sun may Yes 40 m but can be kept smaller Green yellow average/low

Witte wilg
White willow
(*salix alba*)



Grows fast, but doesn't need to be cut every year Bees and butterflies Wet and moist soils Half shadow april yes 20-25 m Yellow flowers average

Plants beds






Name	Picture	Maintenance	Attracts	Soil condition	Light preference	blooming	winterproof	Max. height	colour	Water need
Esparcette <i>Sainfoins</i> (<i>Onobrychis viciifolia</i>)		Low maintenance	Bees, butterflies, bumblebees	Sandy soils	sunny	May-august	yes	70 cm	Pink flowers	average
Sikkelklaver <i>Yellow alfalfa</i> (<i>Medicago falcata</i>)		Low maintenance	Bees, butterflies, bumblebees	Sandy poor soils	sunny	May-september	yes	50 cm	Yellow flowers	average
Zeevenkel <i>Sea fennel</i> (<i>Crithmum maritimum</i>)		Low maintenance	Bees, butterflies, bumblebees, flies	Sandy soils	sunny	July-october	yes	50 cm	White flowers	average
Zandraket <i>Thale cress</i> (<i>Arabidopsis thaliana</i>)		Low maintenance but only 1 year	Butterflies, bees	Sandy soils	sunny	April- may	No	30 cm	White flowers	average

Plantaan
Plane
(*Platanus hispanica*)



Low maintenance	/	Dry and wet soils	Shadow or sun	may	Yes	40 m but can be kept smaller	Green yellow	average/low
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Façade gardens

Name	Picture	Structure required	Maintenance	Attracts	Light preference	Blooming	Winter proof	Max. Height	Colour
Kogellook <i>Roundheaded leek</i> (<i>Allium Sphaerocephalon</i>)		ground	low	Bees, butterflies	Halfshade, sun	March- august	No	15cm-85cm	White, yellow, pink, purple, red, blue
Trompetklimmer <i>Bower vine</i> (<i>Campsis</i>)		Against wall	average	Bees, butterflies	Halfshade/ sun	August- september	Yes	40cm-60cm	Red, orange, Yellow
Amerikaanse sering <i>Blueblossom</i> (<i>Ceanothus thyrsiflorus(s)</i>)		ground	low	Bees, butterflies	Sun	May- september	Yes	50cm	White, pink, blue
wilde kamperfoelie <i>Common honeysuckle</i> (<i>Lonicera periclymenum</i>)		Climbing on a structure (wood)	2 times a year	Night butterflies	Sun, half-shade	June-october	Yes, even has little leaves already in winter	3 m	White, red yellow
Stalkaars <i>Denseflower mullein</i> (<i>Verbascum densiflorum</i>)		ground	average	Bees, butterflies	sun	Late spring – early summer	yes	2m	Yellow, white, pink, purple

Maagdenpalm
Periwinkle
(*Vinca minor*)



ground

Very low

/






Shadow, half-shade, Spring and summer sun yes

5-10cm or 10-20cm Blue, purple

Green arches

Name	Picture	Structure required	Maintenance	Attracts	Soil condition	Light preference	blooming	winterproof	Max. height	Colour flowers	Water need
Chinese blauwereggen <i>Chinese Wisteria</i> (<i>Wisteria sinensis</i>)		Vertical stainless steel cables	Clipping: 2x a year	Bees and butterflies	Nutrient rich and permeable soil	sunny	Blooms 2x a year	Yes, but loses leaves	10 m	Purple blue	average
Sterjasmijn <i>Star Jasmin</i> (<i>Trachelospermum jasminoides</i>)		Vertical stainless steel cables	Clipping: 2x a year	Bumblebees and flies	All soils, permeable	Half shade/ sunny (slow growing)	May-September	yes	4 m	white	average
Klimop <i>Common Ivy</i> (<i>Hedera helix</i>)		Trellis panel system	Clipping: 2x a year	Butterflies, bees, small insects etc.	All soils, not too wet	Half shadow, shadow, sun Fast growing	September-oktober	yes	20 m	/	average
Hop <i>Common hops</i> (<i>Humulus lupulus</i>)		Trellis panel system	Very low maintenance Dies in fall, so needs to be clipped back Average water need Fast growing	butterflies	Nutrient rich	Sunny Fast growing	summer	Yes but loses leaves	10 m	green	average
Vuurdoorn <i>Orange Firethorn</i> (<i>Pyracantha coccinea</i> 'Orange Glow')		Trellis panel system	Clipping: 2x a year	birds, butterflies and bees	Nutrient rich, permeable	Half shadow/sunny	may	Yes	3 m	White flowers, orange berries	average
Aalbes / Rode bes <i>Red currant</i> (<i>Ribes Rubrum</i>)		Wall trellis	Pruning in February-march	birds	Not too wet	Sun or half shadow	Flowers early in spring, berries june-july	yes	0.5 m	Red flowers and red berries	average

(Moveable) planters

Name	Picture	Maintenance	Attracts	Soil condition	Light preference	blooming	winterproof	Max. height	colour	Water need	Edible
Pepermunt <i>Peppermint</i> (<i>mentha x piperita</i>)		Fast growing so requires separate planter or maintenance to prevent from taking over	Repels bees	Universal potting soil	Half shade, sun	June-august	Yes but loses leaves	0,5 – 1 m	Pink flowers	average	Yes
Basilicum <i>Basil</i> (<i>Ocimum basilicum</i>)		Fast growing, high maintenance	Repels insects	Universal potting soil	sunny	Late summer	No	45 cm	White flowers	High	Yes
Citroengras <i>Lemongrass</i> (<i>Cymbopogon citratus</i>)		Fast growing, requires a lot of water and sun	Repels insects	Universal potting soil Needs to remain moist	Sunny	/	No	75 cm	/	High	Yes
Knoflook <i>Garlic</i> (<i>Allium sativum</i>)		Low maintenance but needs to be replanted every year	Repels mosquitos	Universal potting soil	Sunny	/	Yes if planted in fall	30-60 cm	/	Low	Yes
Breedbladige tijm <i>Broad-leaved thyme</i> (<i>Thymus pulegioides</i>)		Low maintenance	Attracts bees	Universal potting soil	Sunny	Summer	No	2-30 cm	Purple flowers	In the beginning regularly, after they mature very low	Yes

Salie
Common sage
(*Salvia officinalis*)



Low maintenance

Attracts
bees

Universal potting
soil with some
sand

Sunny

spring

Yes, but during frost
needs to be wrapped

60 cm

Purple flowers Low

Yes

Appendix E: Icons in guidelines

LEGEND

BENEFITS*



*= Bigger icons represent bigger benefits

**= All plant species given are examples of species that can be implemented. These are not the only options.

PLANT** CHARACTERISTICS

