



Mix to the Max, or Max to the Mix?

Research by design into how spatial qualities and characteristics shape the future of mixed-use business parks in the Province of South-Holland

(UV architecture, 2019)

COLOFON

Mix tot the Max, or Max to the Mix?
*Research by design into how spatial qualities and characteristics
shape the future of mixed-use business parks in the Province of
South-Holland*
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Graduation studio | Design of The Urban Fabric
Theme | 'How will we live together?'

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2022-2023

All images, diagrams and graphics are the authors own work unless stated otherwise

Preface

This thesis is written for the graduation of the master track Urbanism at the Delft University of Technology. This year's central question of the studio is: 'How will we live together?'.

This research is developed to answer that question on a specific topic: how the gradient between working and living in business ecosystems with a focus on construction materials can be shaped in the Province of South-Holland.

The result is a strategic framework with three example locations where the opportunities for the future of industrial sites are explored and how these can positively influence our living environment. With a policy recommendation, this design is translated into actions that could be accomplished.

Without my guidance at the Delft University of Technology, I would not have achieved this outcome. Therefore, I would like to thank my mentor team, Birgit Hausleitner, and Marcin Dabrowski. Their expertise, enthusiasm, and discussions gave me the opportunity to form my own opinion and seek answers to the questions that got my attention.

In addition, I appreciated the help from my supervisors in the Province of South-Holland. Their insights into how the province works and what that means for our living environment were key to this project. Their knowledge and visions inspired me. Therefore, thanks to Mariana Faver Linhares and Barend Jansen.

Furthermore, I like to thank all people I spoke to and invited me to see their standing points and motivation.

Lastly, my family, friends, and my boyfriend Joost have greatly supported me. They provided me with a loving place to study and kept me motivated by asking questions and giving

me their opinions. Thank you so much!

Abstract

The Province of South-Holland is one of the fastest-growing regions of the Netherlands. The metropolitan provides employment opportunities, has an (inter) national mobility network, and houses densely urbanised landscapes. Because of these benefits, the population keeps increasing. This reflects the need for an addition of 200.000 dwellings in the Province of South-Holland.

On the other hand, population growth also influences the economy. The urban qualities create a wished business climate, which is attractive to companies to settle. Currently, the province has some strong economic sectors. However, the economy should shift towards a more circular economy by 2050 which asks space for industry to develop and retain disruptive businesses nearby living environments. This research specifies business ecosystems with a focus on construction materials.

This socio-economic structure results in scarcity of land where the spatial pressure is high. The result is a tension between space for working and living. Innovative approaches to how to use space in a multifunctional way could shape the future of these companies. An underexposed opportunity to realise this multifunctionality is mixed-use strategies at business parks.

However, when creating these environments, liveability needs to be ensured. Nowadays, business parks are inaccessible for pedestrians, have a nuisance due to externalities of the industry, forbid buildings within the zones designated by environmental regulations, and do not provide a wide range of public spaces to meet each other. That is why mixed-use is not yet assigned as a possibility in these transition zones between disruptive businesses and living environments.

Therefore, this report research which spatial qualities and characteristics shape future possibilities for mixed-use strategies at busi-

ness ecosystems that focus on construction materials. By developing scenarios, the balance between providing a liveable environment and facilitating the circular economy in the Province of South-Holland by 2050 can be investigated.

Through interviews, literature, observations at specific locations, examples of projects, and research by design these future scenarios will come about.

The aim is to realise a strategic framework with guidelines that describes the different compositions of mixed-use possibilities and the role of the business parks in the circular economy on the regional scale.

In addition, this report uses example projects to give an indication of how this can be shaped. The focus lies in explaining how the business ecosystems of construction materials work in the province and at these specific locations. In addition, it creates insight into how to emphasise the urban qualities surrounding the business parks while suggesting site-specific opportunities for a balanced mixed-use area. These conclusions reflect on several scales so that the mixed-use not only affects the neighbourhood but also contributes to the city and even regional scale.

This design is then translated towards a policy recommendation as well, which can be implemented by the Province of South-Holland.

TABLE OF CONTENTS

Preface	I
Abstract	II
1. Introduction	
1.1 Personal motivation	10
1.2 Background of the term mixed-use	11
1.3 Introduction of mixed-use opportunities at business parks in the Province of South-Holland	20
1.4 Specific focus: business ecosystem of construction materials	30
1.5 Problem statement	38
2. Methodology	
2.1 Research questions	42
2.2 Conceptual framework	44
2.3 Methods	46
2.4 Intended outcomes	48
2.5 Analytical framework	50
3. Theoretical framework	
3.1 Differences in applying mixed-use strategies	54
3.2 What makes a place liveable?	56
3.3 Spatial and social preconditions for a viable circular economy	64
4. Learning from current strategies and collaborations	
4.1 Wishes on liveability and circular economy by mixed-use described by policy documents	74
4.2 Learning from references	80
4.3 Stakeholder analyses	86

5.	Analysing spatial qualities and characteristics of the example locations	
5.1	Spatial analyses on Binckhorst, the city center of The Hague	98
5.2	Spatial analyses on Lansinghage, periphery of Zoetermeer	126
5.3	Spatial analyses on Broekvelden, the village of Bodegraven	154
6.	Exploring the future business ecosystem of construction materials	
6.1	How does the future of the business ecosystem of construction materials look like?	186
6.2	Lansinghage: future example of a mixed-use and circular business park	199
6.3	What is the role of each business park on the regional scale and how do they work together?	228
6.4	Suggestion of engagement strategies to facilitate mixed-use strategies and a circular economy	238
6.5	What should be regulated to guide liveability and circularity at business parks in the Province of South-Holland?	242
6.6	How should these guidelines be implemented over time?	250
7.	Conclusion and discussion	
7.1	What are the main takeaways of this thesis?	256
7.2	What does this research contribute to?	260
7.3	Discussion	261
7.4	Personal reflection	263
8.	Bibliography	266
9.	Appendix	
A	Playing a serious game	278
B	Stakeholder framework	280
C	Role of A12 in the Province of South-Holland	284
D	Experiments on the road network	288
E	Stakeholders activation over time	292
F	Underlying maps for FSI, GSI, layers and OSR	296

‘That made me wonder why we do not optimally use the space we have.’

This chapter focuses on contextualising the problem this thesis will investigate. First, the key concepts and drivers of change, housing shortage and circular economy, are explained. In addition, the history of mixed-use is discussed, followed by the reasoning of why mixed-use can contribute to improving our city. The opportunities for the Province of South-Holland to address both transitions are explained by proposing three example locations. Lastly, construction materials are introduced. Understanding their material flows is important because there are many different companies located at these business parks, and it is unclear which are suitable to mix with dwellings. From these introductions, the problem statement can be extracted.

1.

INTRODUCTION



(Gemeente Den Haag, n.d.)

1.1 | Personal motivation

When I started my bachelor Bouwkunde in Delft it was quite hard to find a room. I did not join a student association, so their properties were not accessible to me. In addition, the rooms from DUWO have a long waiting list, and I still have no chance of a room after 5 years.

Therefore, I started a long search for a student house on my own. After a year I finally found a place where I felt happy and comfortable. In addition, a lot of my friends are dealing with the same problem. It is hard to find a place these days, due to the current housing crisis.

However, every time I biked toward the faculty, I saw these office buildings which were completely empty. That made me wonder why we do not optimally use the space we have. Why can we not make these areas more accessible and liveable? And who is responsible for this or can change the way we use the space right now?

That is why I wrote a motivation on this topic to the Province of South-Holland and several municipalities. When visiting the Province, I found out that they are wondering how they could make policies for mixed-use business parks to form a stronger economy and realise more dwellings in this compact province. That is where our collaboration started.

Personally, this was also an exploration into how the Province of South-Holland operates to see if their activities suit me. The education mostly shows urban designers in the private sector. However, I am more interested in governmental institutions. This research helped me find out what it means to work in the province.

1.2 | Background of the term mixed-use

1.2.1 | DEFINITION OF KEY CONCEPTS

To read easily through the thesis, a short introduction of the key concepts of the research is given.

Business ecosystem

A company itself could not be seen as a single industry but as a member of the business ecosystem that consists of different industries. Examples of organisations are suppliers, customers, government agencies, distributors and so forth. Together they can innovate, work competitively to support new products, coevolve and live up to the customers' needs (Moore, 1993; Moore, 1996).

Liveability

Liveability is defined by the following categories: densification, infrastructure for people, social safety and stability, and climate. With these concepts, a city or community's liveability can be measured (Mastura, Ab Ghafar, Ahmed & Keumala, 2017). This literature is mostly based on the social aspect, but within this thesis, the economy will also play a part. That reflects in the addition of environmental qualities and infrastructure for goods.

Mixed-use

Mixed-use originates from the mix of industrial and residential functions which are based upon the urban environment (Louw & Bruinsma, 2006). This mix can have three appearances, namely horizontal mixed-use, vertical mixed-use, and mixed-use over time. Combining industrial and residential functions asks us to rethink this socio-economic structure and liveability.

The province

The province is responsible for regional spatial planning. That means that they decide where cities can expand, roads need to be realised, business parks could be created, or nature should be protected. This also contains the maintenance of provincial roads and bridges. Besides, the responsibility for nuisan-

ce and healthy living environments lies with the province.

Furthermore, municipalities need to be supervised to prevent conflicts on the regional scale. This task applies to multiple topics, namely nature, water, landscape, environment, traffic, transport, economy, people's well-being, and culture. In that way, they provide an overview and holistic strategy.

In addition, they also convert national regulations assigned by the government into regional approaches and transfer these to municipalities (Rijksoverheid, n.d.b; B. Jansen and M. Faver Linhares, personal contact, 16-01-2023).

Circular economy

The circular economy is focused on better usage of resources. The linear chain is replaced by several loops that show how materials can be shared, reused, repaired, remanufactured, refurbished, recycled, and recollected to close the circle (Kennedy & Linnenluecke, 2022). This R-ladder describes a hierarchy of several strategies on how to deal with the circular economy (Potting et al., 2017). The goal of the government is to reach full circularity by 2050 (Rijksoverheid, n.d.a).

1.2.2 | WHAT ARE THE DRIVERS OF CHANGE?

The Province of South-Holland is currently dealing with a lot of challenges. This thesis will investigate three drivers of change that are conflicting but can be mitigated by the same strategy.

The first driver of change is population growth. The Province of South-Holland is popular for its highly urbanised landscape. The metropolitan provides a lot of employment opportunities, offers knowledge institutions and has a great (inter)national mobility network. In addition, it has the highest density and belongs to one of the fastest-growing regions of the Netherlands. Therefore, internal migration, the movement of people within the Netherlands, becomes attractive (Provincie Zuid-Holland, 2021; Provincie Zuid-Holland, 2020).

However, this is not the only cause of population growth. According to the NOS Nieuws and Centraal Bureau voor de Statistiek (2022), a record number of immigrants is reached in 2022. 29% of this immigration flow is attracted by our demand for workers from non-western European. The other 71% is caused by other developments, for example, the current war in Ukraine or the fact that immigrants postponed their crossing due to the corona pandemic. The result is that a part of these 191.000 persons needs to be housed in the Province of South-Holland (NOS Nieuws & Centraal Bureau voor de Statistiek, 2022).

These (im)migration flows immediately influences two other drivers of change, namely the housing shortage and retaining space for industries to become more circular.

The need for dwellings is characterised by population growth as stated above. In addition, the increment of single households affects the housing crisis as well.

Vereniging Delta Metropool (2022) claims that differentiation in building blocks

contributes to a better living environment. However, the Province of South-Holland consists mostly of single-family homes, while society asks for more single households (Jansen, 2020). According to Centraal Bureau voor de Statistiek (2021), this growth is mainly caused by the large generation of elderly that is born after the second world war. Nowadays, they live longer and due to divorce or widowhood, they live alone. In 2038 this part of the Dutch population is more than doubled. That is why the Province of South-Holland focuses on the elderly as a target group.

Besides, this housing strategy could also apply to starters and students because they all need proximity to amenities, their social circle and public transport. Simultaneously the surrounding neighbourhoods are positively influenced and become more resistant to climate change and loneliness (College van Rijksadviseurs, 2022; Vereniging Delta Metropool, 2022)

This demand makes the Province of South-Holland responsible for realising 200.000 dwellings by 2030. That means that they are liable for a fifth of the Dutch addition which reflects in an increase of more than 10% on their existing housing stock (Provincie Zuid-Holland, n.d.).

On the other hand, population growth influences economic dynamics. The province has a wide variety of strong economic sectors. Examples are the agriculture in Westland, governing bodies in The Hague, and the Port of Rotterdam. This entrepreneurship and knowledge exchange contribute to national, European, and even global production chains (Provincie Zuid-Holland, 2020).

Nowadays, this production chain is linear and characterised by transporting materials all over the world. However, the raw materials are getting scarcer which asks for a more independent production chain. Therefore, the European Union stated that the economy must become circular by 2050.

According to the Rijksoverheid (n.d.a) and Kennedy & Linnenluecke (2022) a circular economy creates closed resource loops, increases employment opportunities and encourages economic growth. Businesses that are crucial for the circular economy to succeed are waste processing plants, raw material processors and food production (Van den Berghe, Dabrowski, Ersoy & Van Bueren, 2019).

However, these companies also produce a lot of noise, and smell and attract trucks. This results in municipalities relocating industry to realise more dwellings. At the same time, these industrial functions are key to the economy and processes inside the city, thus they need to stay within proximity (Davis, 2020).

This is conflicting, especially when the residential function is combined with the industrial processes. Therefore, this thesis takes the standing point of retaining the space that specific companies need to contribute to the circular economy goals and realising dwellings. Therefore, the focus is on the business ecosystem of construction materials. Without these materials nearby, the realisation of dwellings is complicated and innovations of these materials influence the future of the mixed-use business park. Further explanation on this will follow in chapters 3 and 4.

In short, scarcity of land is a problem in the Province of South-Holland. To serve the population growth 200.000 dwellings need to be realised in the already dense urban fabric while keeping industry close to the city. The result is spatial pressure, see figure 1.1, and the wish for multifunctional use of space.

Overbevolking is wél een probleem



Klaar voor de start? Af. Als starter een koophuis zoeken voelt op de huidige woningmarkt soms als meelopen in een race. Om te winnen moet je een lange adem én diepe zakken hebben, plus een enorm deelnemersveld achter je laten.

Positie van koopstarter: niet dramatisch, wel lastig



KIJKEN, KIJKEN,
NIET KUNNEN
KOPEN



Bevolkingsgroei vooral in de Randstad



Bevolking eerste negen maanden van 2022 fors gegroeid door immigratie

Verder constateert het CBS dat het aantal geboortes in de eerste negen maanden is afgevlakt. Vorig jaar was er nog sprake van een 'coronababyboom' - er werden in tien jaar niet zo veel baby's geboren als vorig jaar - maar aan die groei lijkt nu een einde gekomen te zijn. Tegelijk was de sterfte naar verhouding hoog.

Figure 1.1: Drivers of change causing spatial pressure between residential and industrial functions (Tong, 2018; Stec groep, 2022; Jager, 2022, Hill et al., 2020; Freepik, n.d.; NOS op 3, 2017; Davidson, 2016; NOS nieuws, 2022; NOS nieuws, 2021; Binnenlands bestuur, 2019; Conijn, 2020; Agrivest, n.d.)

Gezocht: ruimte voor nieuwe industrie



Meer ruimte voor makers graag, maar waar?



- * SCARCITY OF URBAN LAND
- * PURCHASE RURAL LAND
- * FOCUS ON AGRICULTURAL LAND
- * CONVERT LAND USAGE

Er is veel meer nodig om grondstofverspilling in de Nederlandse economie tegen te gaan. In 2030 moet eigenlijk de helft van de voor de Nederlandse economie gebruikte grondstoffen worden gerecycled, in 2050 moet de economie helemaal circulair zijn. Dat concludeert het Planbureau voor de Leefomgeving (PBL) in een nieuw rapport.

'Overheid moet meer doen om verspilling grondstoffen tegen te gaan'

Ruimte voor bedrijventerreinen: topprioriteit voor next economy

Grondstoffen vaker, intensiever en langer gebruiken vermindert de genoemde milieuproblemen en kan de leveringszekerheid van grondstoffen verbeteren



1.2.3 | THE INTEGRATION OF INDUSTRIES IN THE CITY THROUGH TIME

Since the emergence of cities, living was combined with working. This was because of the resources a city provides to create a pleasant working place. Mixed-use was important for the urban environment to succeed because of the proximity to functions needed to stay close. This is caused by the fact that people needed to visit everything by horse or on foot. Small shops, ateliers, and dwellings have therefore cohabited (Van Mourik, 2011; Mualam, Salinger & Max, 2019).

Guilds were the main driver of the economy. However, it was not only focused on production and trading but also on gaining knowledge and creating the skills to develop upon old structures. With collective activity, the guilds could provide a socio-economic structure with support for the disadvantaged target groups, such as widows, the disabled, and the elderly. Strategic investments were focused on profit for a whole community that was affiliated with the guild (Hill et al., 2020). This great location of labour inside cities was attractive to companies, due to the access to the market and employees. Therefore, industrial growth increased simultaneously with population expansion.

These areas were still mixed-use, but due to the lift of the industry also the externa-

lities became way bigger. The use of coal as a fuel for industry polluted the air. The noise and smells were overwhelming, and this had a bad influence on public health. The life of a worker these days was limited, dangerous, and unsure (Hill et al, 2020). These nuisances and lack of protection for workers' health were the foundation of the switch towards zoning these industrial sites.

This resulted in a functional city where the four main cores (living, working, traffic, and recreation) were placed next to each other as a replacement for the mixed-use city (Grant, 2002; Louw & Hoppenbrouwer, 2005).

Next to a new spatial strategy of zoning functions, also the transportation changes. The introduction of the car made the spreading of functions possible. In that way, the once pedestrianised and proximate city shifted towards a car-oriented one and adds to the urban sprawl (Van Mourik, 2011).

However, in the first years living outside the city centre was only an opportunity for the wealthy part of the population. They could afford the new way of transport and built their house outside the city centre. After 1980 this new urban structure, now called suburbia, became the idyll for the working and living in an improved environment for the middle-class society.

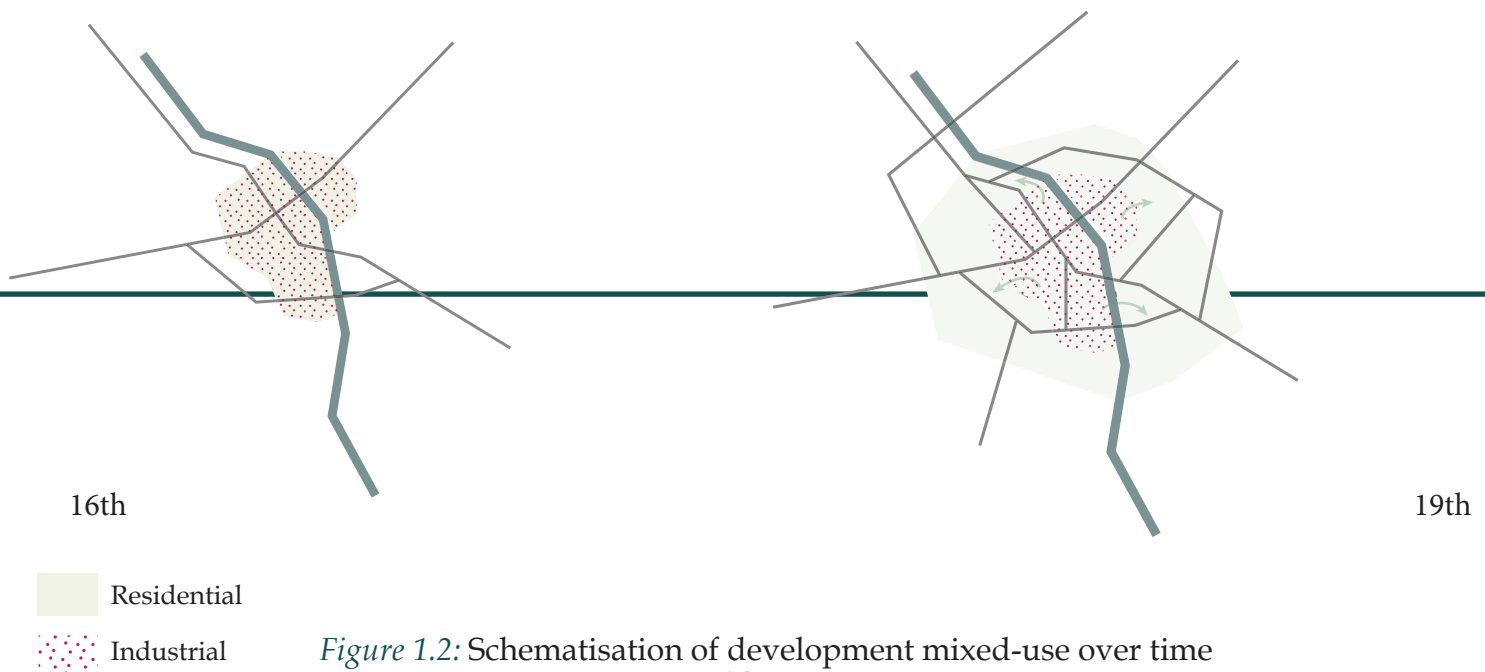


Figure 1.2: Schematisation of development mixed-use over time

On the other hand, the rise of workers' rights, unions, and improved living conditions led to increasing labour costs. Globalisation made companies move away from the city centre and competition made companies look for a place to cheaper production sites. In addition, environmental regulations were created to make manufacturers responsible for their own environmental impact.

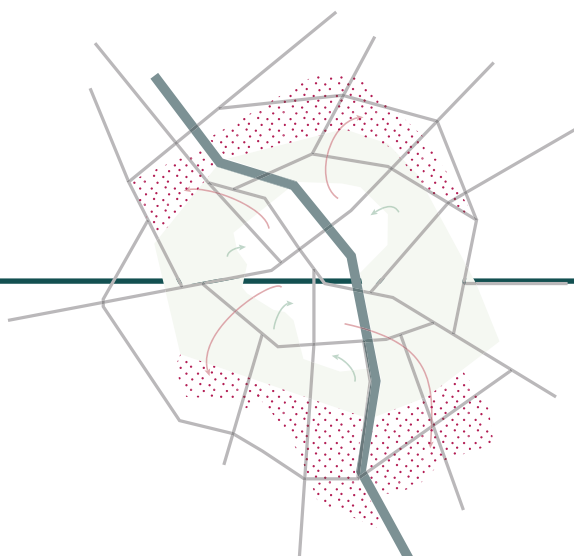
This causes companies to take their production outside the city centre and replaced themselves at the periphery. Vacancy, unsafety, and blighted land were the results inside the city. Next to the nuisance and bad working conditions, this led to a negative image of the industry (Hill et al., 2020).

Jane Jacobs (1961) states that a balanced mix of working and living results in a lively, attractive, and stimulating society. This made more and more urbanists reflect on the way of developing our cities and spatial planning started considering integrating functions. On the other hand, social and economic forces in our society still promote the division of land uses (Louw & Bruinsma, 2006).

This needs to change to overcome the spatial pressure caused by the need for industrial and residential land uses.

This scarcity of land can cause a transition into mixed-use cities again. However, no theory is written about what the right balance between working and living, intended outcomes or spatial strategies is to achieve a mixed-use site (Grant, 2002).

In addition, the future of our economy is steered by a transition towards a circular economy. These circular processes are known for taking up space and it is not clear yet how this will look (E. Terlien, personal contact, 20-12-2022). This contributes to the question of how the limited space in the Province of South-Holland should be divided.



1.2.4 | WHAT ARE THE QUALITIES AND CONCERNS OF MIXED-USE STRATEGIES

Because this thesis investigates what the opportunities are for mixed-use, it is also important to understand the qualities of mixed-use and what points of attention are.

A mixed-use area improves and adds value to our socio-economic structure, see figure 1.3.

This is for example expressed in the fact that functions are closer together and reduce commuter distances (Jansen, n.d.). Simultaneously, a mix of different functions provides an increment in employment opportunities and creates an independent economy which serves the local economy. With these close loops, a circular economy is easier to realise. The result is an innovative, future-proof, and adaptive economy (De Zwarte Hond & Provincie Zuid-Holland, 2021; Van Gessel-Dabekaussen, 2018).

In addition, on the building block scale, thinkers and doers work together which creates a condition where companies can excel. This knowledge exchange is not the only thing that can be shared. Mixed-use also stimulates sharing costs, energy, and materials which contributes to the circular economy as well (Jansen, n.d.; College van Rijksadviseurs, 2019).

In addition, mixing working and living has an influence on the social layer of our society.

For example, it realises a healthier, diverse, and inclusive environment. This is caused by the fact that amenities, health care, and education are within proximity. By introducing living inside an industrial site, social control and therefore safety gets a boost. Especially during night-time, when the sites are mostly unoccupied, mixed-use can contribute to a safer environment (Jansen, 2020). This proximity does not only serve the new mixed area but also boosts the surrounding neighbourhoods.

Furthermore, climate adaptive imple-

mentations make the area more resilient and realise a lively environment where there is enough space to meet your colleagues, neighbours, and friends. This creation of a liveable neighbourhood also adds to the reduction of pressure on the housing market (College van Rijksadviseurs, 2019; De Zwarte Hond & Provincie Zuid-Holland, 2021).

However, critically looked there are also challenges while creating a mixed-use site. Sometimes mixed-use affects industrial processes in a negative way.

For example, when adding dwellings, the value of the land will increase. Industrial functions can therefore not always afford to further develop. In addition, companies are not as protected as residents. When residents have nuisances of the industrial processes, it can result in the fact that the industry had to leave first. This is in line with the standing point of municipalities that rather relocate businesses than invest in resources to make them less nuisance (Jansen, n.d.).

To keep industrial functions nearby the consumers and therefore the city itself, the Province of South-Holland needs to balance working and living. This means involving (future) residents, creating transparency, and realising zones where nuisances are allowed (Provincie Zuid-Holland, n.d.)

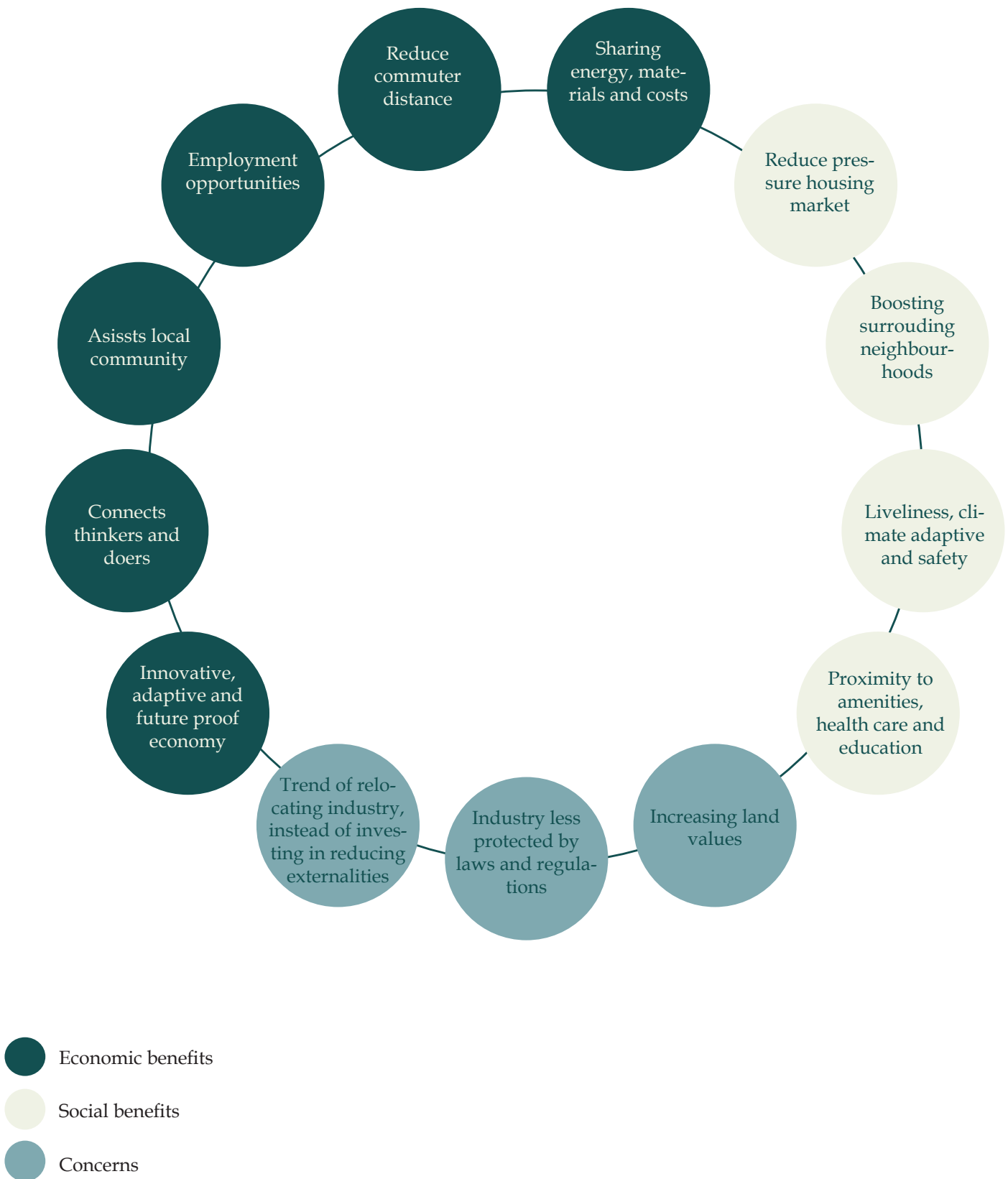


Figure 1.3: Socio-economic benefits and points of attention of mixed-use
 (Based upon figure from De Zwarte Hond & Provincie Zuid-Holland (2022), edited by author)

1.3 | Introduction of mixed-use opportunities at business parks in the Province of South-Holland

1.3.1 | ENVIRONMENTAL FACTORS DETERMINE THE MIXING DEGREE

As said before, the segregation of functions was, among other things, emphasised by environmental factors. These regulations make sure that the industry became responsible for its own environmental influence.

Nowadays, there are different classifications of industry based on the environmental regulations that were initiated in the 90s. Most of these environments are not as polluted and do not cause as many nuisances as back in the day. However, not all industry is suitable to mix with living (Glas, 2010; Gedeputeerde Staten, 2021).

To protect the industry and provide a nuisance-free environment to live in, the environmental factors are determined to see which industry can be mixed with dwellings. There are six categories based on the research from the Cities of Making (Hill et al., 2020). Figure 1.4 shows the gradient between living and working.

Factors 1 and 2 are the least polluted and disruptive companies. For example, a bakery in a neighbourhood or offices combined with dwellings like the Zuidas in Amsterdam. Concluding, these industries can already form a relatively good synergy between working and living.

The opposite is the industry with environmental factors 5 and 6. These are not suitable for mixing with dwellings, because of the externalities they produce. An example is the Port of Rotterdam (De Zwarte Hond & Provincie Zuid-Holland, 2021; Rijkswaterstaat,

n.d.). However, they can form a mix between education facilities and public spaces like a campus or park. This thesis will only focus on mixed-use and therefore not deal with this category of industry.

That leaves the industry with environmental factors 3 and 4 open for discussion. Most of the time these locations are business parks, see figure 1.5.

1.3.2 | STAGES OF PRODUCTION OF BUSINESS ECOSYSTEMS AT BUSINESS PARKS

So what businesses are located at these business parks in the Province of South-Holland?

Primarily they are intended to provide businesses aimed at manufacturing raw materials, providing storage of materials, and producing, processing, repairing, collecting, and distributing goods (Vereniging van Nederlandse Gemeenten, 2019). Most of the time, this asks for big plot sizes, and locations close to infrastructure that forms connections (inter) nationally and asks for the ability to produce nuisances.

These characteristics cause a certain distance to the living environment. However, the products and processes at these locations are important to facilitate the circular economy.

This is caused by the fact that they operate as an ecosystem. James Moore (1993) was the first person who wrote about these business ecosystems.

According to him, a company itself



Figure 1.4: Gradient of living towards working (De Zwarte Hond & Provincie Zuid-Holland, 2021 edited by the author)

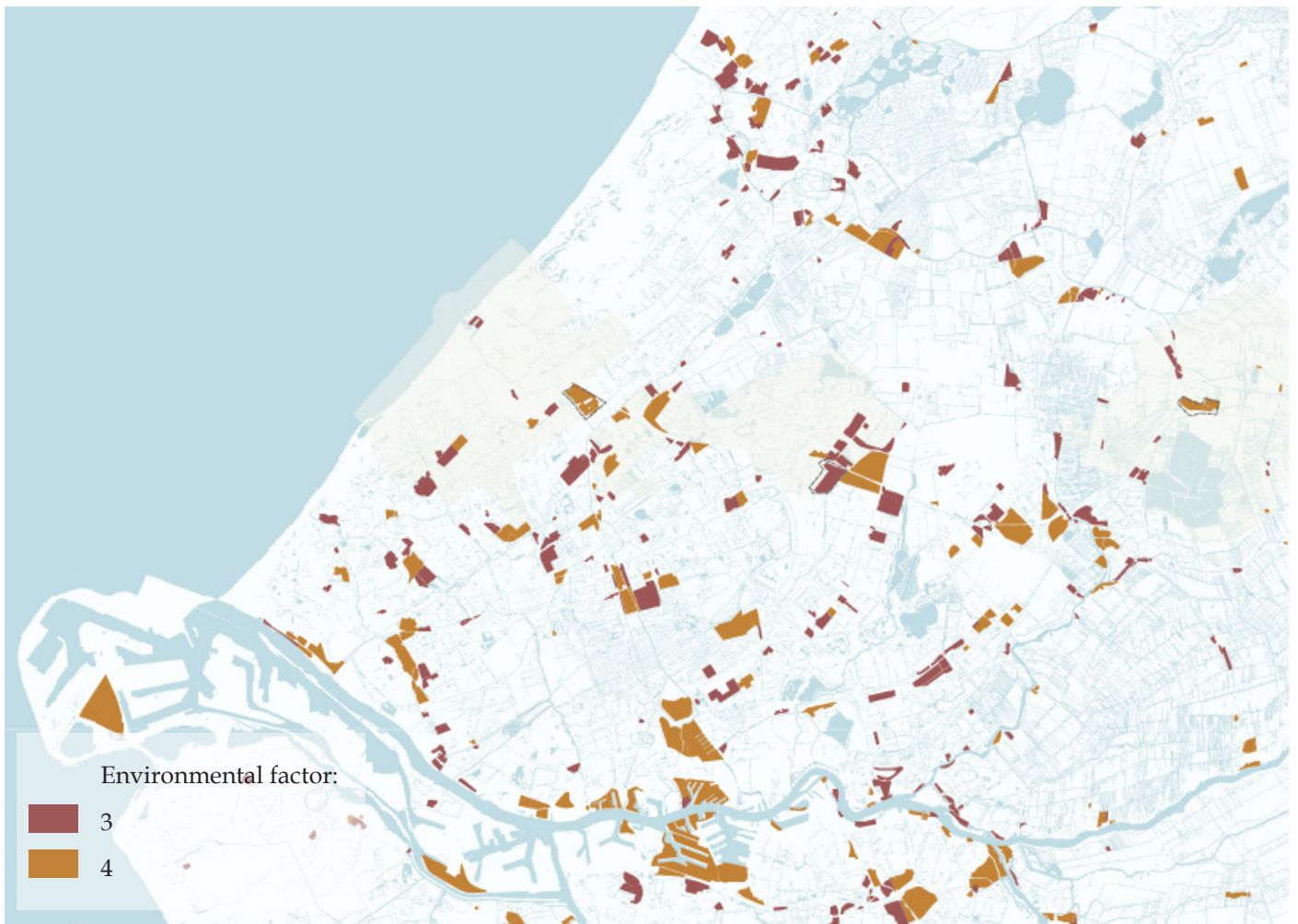


Figure 1.5: Network of business parks with environmental factor 3 and 4 (Scale 1:200000, 50% reduced)

could not be seen as a single industry but as a member of the business ecosystem that consists of different industries. Examples of organisations are suppliers, customers, government agencies, distributors and so forth. Together they can innovate, work competitively to support new products, coevolve and live up to the customers' needs.

Besides, the context of the business ecosystem is crucial. The idea is that companies connected to the business ecosystem affect and are affected by others, while itself

provides a flexible and adaptable appearance to survive (Moore, 1996).

On the other hand, when the ecosystem thrives, the flow of ideas and talents causes new collaborations which can address social and environmental challenges while exchanging knowledge and expertise. Additionally, the costs of products can be reduced, which broadens access for new consumers as well (Hayes, 2021).



1.3.3 | INTRODUCING EXAMPLE LOCATIONS OF MIXED-USE OPPORTUNITIES

The surface of South-Holland consists of 3% of the category of industry with an environmental factor 3 or 4. Business parks are responsible for 33% of the income and employment opportunities of the Province of South-Holland (Provincie Zuid-Holland, 2020). Of this network, 90% is occupied and contributes to the regional market. Therefore, according to Van Gessel-Dabekausen (2018), 15% of the economy of the Province of South-Holland is dependent on the industrial processes at business parks.

That is why the province has designated them as important (Provincie Zuid-Holland, n.d). Especially the business parks next to the A12 are marked as crucial by the Province of South-Holland (2020), see figure 1.6.

The province wants to support municipalities with their approach to make business parks more accessible and sustainable with the highway as a logistic hotspot in between. This chain of employment opportunities should grow and innovate simultaneously.

In addition, the Province of South-Holland is dealing with the question of living can be added at the industrial sites with factors 3 and 4, because of the industrial functions that are located there and the need for dwellings (Provincie Zuid-Holland, n.d.).

Due to the knowledge gap and uncertainties of mixed-use possibilities in combination with the opportunities for a circular economy, this thesis will only focus on industrial sites with environmental factors 3 and 4 (business parks) with a specific focus on companies that are related to the material flow of construction materials.

Because of this network's scale, it is impossible to discuss every business park. This thesis will therefore provide a strategy for the Province of South-Holland and zoom in on three example locations to give an exploratory design. The three research locations are:

- 1) *Binckhorst at the city centre of The Hague*
- 2) *Lansinghage at the periphery of Zoetermeer*
- 3) *Broekvelden at the village of Bodegraven*

This choice of these three locations is based on the difference in the urban fabric and economic position in the province. These urban qualities and characteristics will be further explained and analysed in chapter 5.

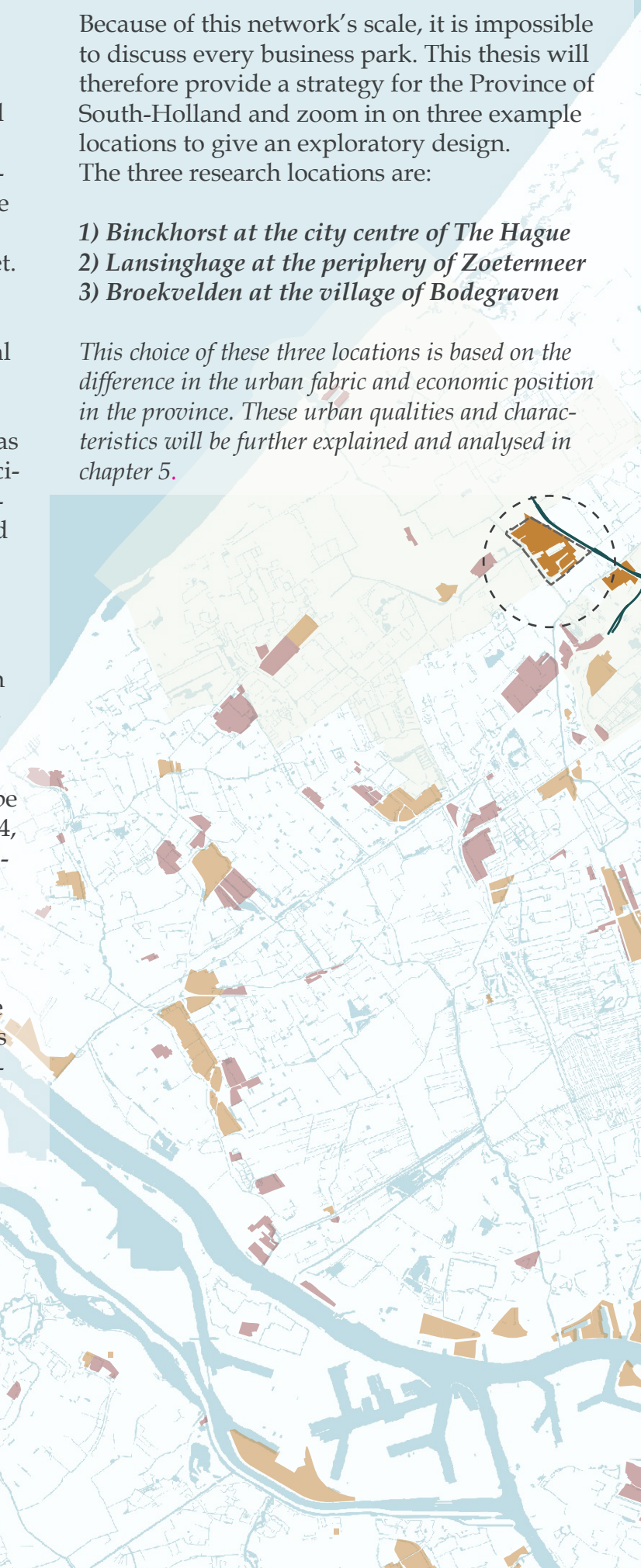
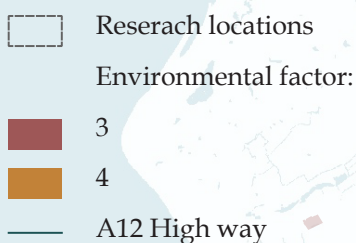




Figure 1.6: A12 functioning as the spine of the business parks that are essential according to the Province of South-Holland
(Scale 1:200000, 200% increased)

Which locations correspond to the example locations mentioned?

The business parks operate as a network in the Province of South-Holland. Each business park has another function. In figure 1.7 this variation in industrial areas is shown. Additionally, the spatial qualities, like for example the accessibility and surrounding landscapes, differ for each example location. With these specialities, the Province of South-Holland covers every aspect of the economy for each different landscape.

In the first place, Binckhorst has an exceptional spatial quality, namely the fact that this business park is water-bound. The relation between this industrial site and the Port of Rotterdam is formed by the water which gives Binckhorst a strategically chosen location. Next to the connection via water, also the two train tracks, the A4 and A12 make this place greatly accessible.

In addition, Lansinghage has two sides. One is more focused on the connection with the agricultural and recreational sectors, while the other provides a connection towards the built area. Because of the train track and the A12, this place is easy to reach for employees and residents.

Besides, the strong network between cities results in opportunities to form a knowledge infrastructure with educational facilities like the TU Delft, Erasmus University and Leiden University.

The last example project, Broekvelden, forms a contrast to the other locations. This business park does not contribute to an urbanised landscape but forms a living and working place within the green oasis formed by meadows and polders. Broekvelden is accessible by train and the A12. In that way, the village of Bodegraven is as well connected to the rest of the Province of South-Holland.





Figure 1.7: Network of different business parks serving the economy of the Province of South-Holland
(Scale 1:200000. Based upon IBIS dataset, edited by author)

Different spatial qualities linked to the surrounding urban fabric.

More zoomed-in on the city scale shows the relation between the business parks and their surroundings. The reason to choose these different locations is their context.

First, the business park is at the most urbanised location, namely Binckhorst. This industrial site is located next to the city centre which provides proximity to dwellings, offices, commercial facilities, and educational institutions. This lively environment creates facilitates spaces to meet up with friends or spend your lunch break with your colleagues.

Besides, it gives opportunities to merge the mixed-use with the high density of the rest of the city.

However, currently, there is a sharp grain that segregates the residential areas from the industrial functions. Binckhorst operates as an island in between the residential areas. A smooth transition is desired.

That is why Binckhorst can lean on the facilities that the urban landscape has to offer and improve this network by applying a mixed-use strategy.

The second business park is Lansinghage. This area is located at the periphery of the city. It becomes clear that Lansinghage, therefore, does not take advantage of surrounding facilities as Binckhorst does.

On the other hand, the place is still embraced by several functions, such as education, agriculture, and commercial areas. Furthermore, the industrial site has already a fine gradient towards the residential area on the west side. This is shown in the plot sizes that become smaller as the residential area begins.

Finally, the village of Bodegraven. This village developed from the riverside towards the south. The old city centre provides enough

facilities for the village, see chapter 5, but does not reach Broekvelden. The density is low and there are already relatively a lot of spaces designed as public spaces like the sports field and the park. Just like Binckhorst, this industrial site creates a partition between the working and living.



Figure 1.8: Binckhorst close to dense city centre which offers a lot of functions (Scale 1:20000, 25% reduced. Data set: Urban Atlas 2018)



Figure 1.9: Lansinghage surrounded by industrial functions (Scale 1:20000, 25% reduced. Data set: Urban Atlas 2018)



Figure 1.10: Broekvelden separated from low density residential area (Scale 1:20000, 25% reduced. Data set: Bestand Bodemgebruik 2017)

- Greenery
- Industrial
- High density
- Medium density
- Low density
- Very low density

What types of industrial processes are settled at the example locations?

Next to the accessibility, context, and function of the business park, also the expertise of the companies located there is important. This causes insight into what businesses should be attracted to become circular and form a liveable environment.

Starting with Binckhorst it becomes clear that this business park houses a lot of different industrial processes.

Next to the diverse number of companies spread over the site, there are also a lot of buildings that serve multiple businesses. These companies under one roof can form opportunities for a strong socio-economic structure which facilitates the circular economy, see chapter 3.

At the regional scale, Lansinghage is labelled with the same type of industry, namely a mixed business park.

Even though there is a mix of industrial processes, the placement of these companies is more thought through and fits the surrounding landscapes. For example, the east side contains the most disruptive companies which gradually flow over into shops and offices to the residential area of Rokkeveen.

In the end, the mixed environment creates opportunities for employees and residents to exchange knowledge, realise circular loops and facilitate spaces to meet each other.

Broekvelden is the opposite of these previous two. The business park has expertise in the distribution of food products, mostly cheese, see chapter 5. There are some shops and offices, but they are mostly situated next to the distribution halls.

In addition, there is no gradient as Lansinghage shows. This means that this industrial site has different needs and must be better researched on the infrastructural aspect.

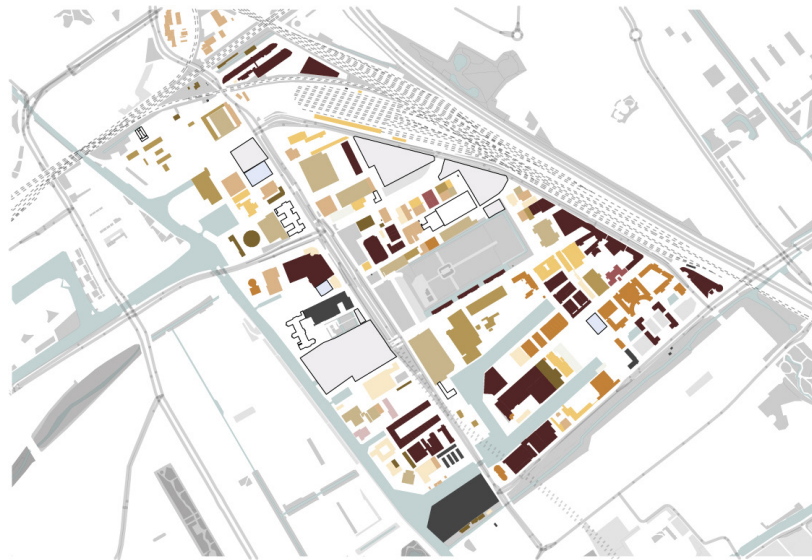


Figure 1.11: Mix of different companies under one roof
(Scale 1:6000, 40% reduced)



Figure 1.12: Smooth gradient from disruptive businesses towards residential area
(Scale 1:6000, 40% reduced)

- Manufacture
- Distribution
- Vehicle maintenance
- Offices
- Shop / service
- Storage
- Catering industry
- Multiple companies
- Education
- Sport
- Vacant
- Transformation

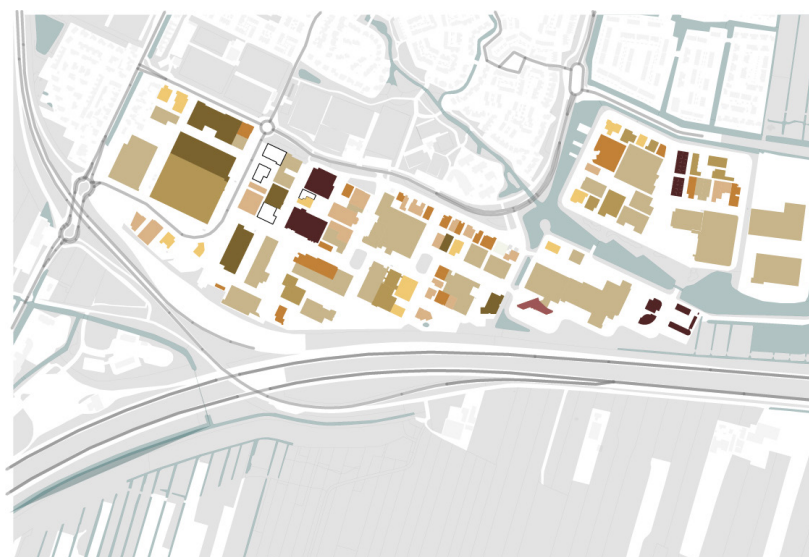


Figure 1.13: Expertise focussed on distribution of food products
(Scale 1:6000, 40% reduced)

1.4 | Specific focus: business ecosystem of construction materials

Because there are many companies located at the business parks, it is unclear which businesses can be mixed and which cannot. Some are located within a high environmental factor, without needing these environmental regulations. They can be excluded from this research because they are already suitable to mix with dwellings. In addition, the remaining functions differ from waste processing to the food industry. To get a clear recommendation which is directly related to the realisation of dwellings this thesis chooses a specific focus, namely the business ecosystem of construction materials. Questions of manufacturing, processing and future usage are central in this specific focus.

1.4.1 | WOOD AS A SUSTAINABLE CONSTRUCTION MATERIAL

When looking at the first construction material, wood, it is important to note down that most of the timber is imported from European forests. The trade all over the world towards The Netherlands and their usages are summarized in figure 1.14 developed by Probos (2020).

Wood can be classified in three different ways. Firstly, is wood from pruning and the landscape. This is something this research does not focus on.

The second is wood that is processed into chipboard, sawn timber, and the residual waste from these processes. This can be used during the process and recycling stage of the circular economy, see chapter 3.

The last form is already used wood as constructive parts, demolition timber, pallets, and again residual waste. These are interesting when rethinking, reusing, or recycling this construction material (Dank, Van Meurs, Van Tessel, Reitsema, 2021).

Residual timber can for example be recycled into heat for dwellings and industrial processes. 75% of the residual wood that is turned into heat at biomass plants is from Dutch production (Milieudefensie, 2020).

Additionally, the timber can be reused

in beams, façade covering, floors, stairs, indoor panelling, window frames, doors and so on (Centrum Hout, 2005). That makes wood an easily recyclable raw material.

With climate goals as a target for the future, wood can contribute to achieving these goals. Nieuwsuur (2021) even claims that without building in wood, climate goals can never be reached. New developments make sure that even high-rises can be constructed.

However, this is not done commonly yet, because the methods are unknown and bring a lot of uncertainties. Investors therefore rather invest in other construction materials.

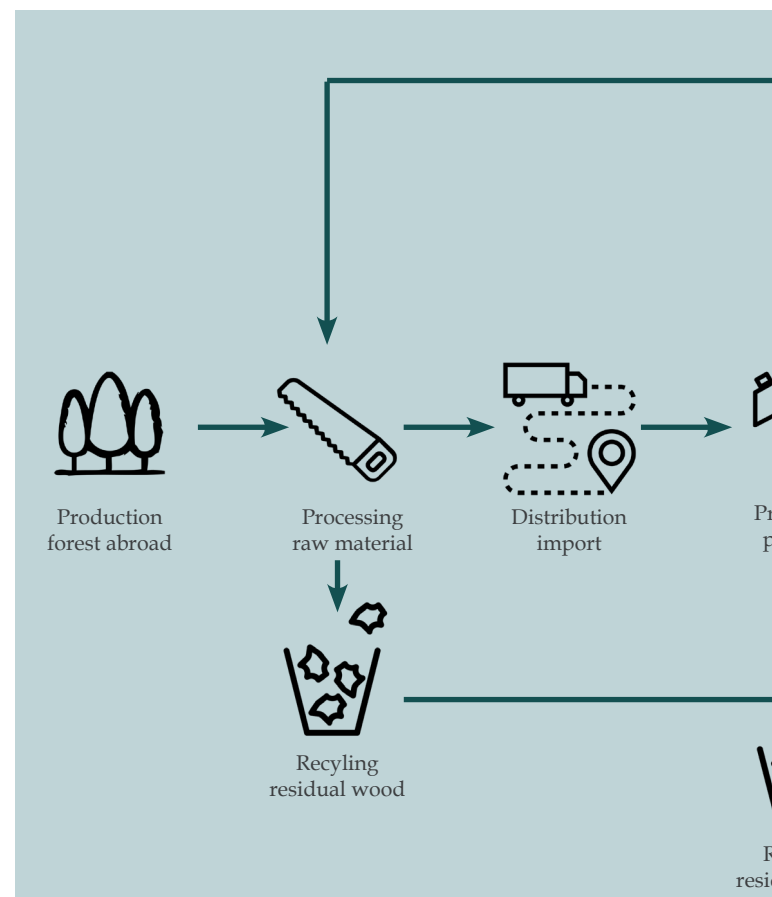
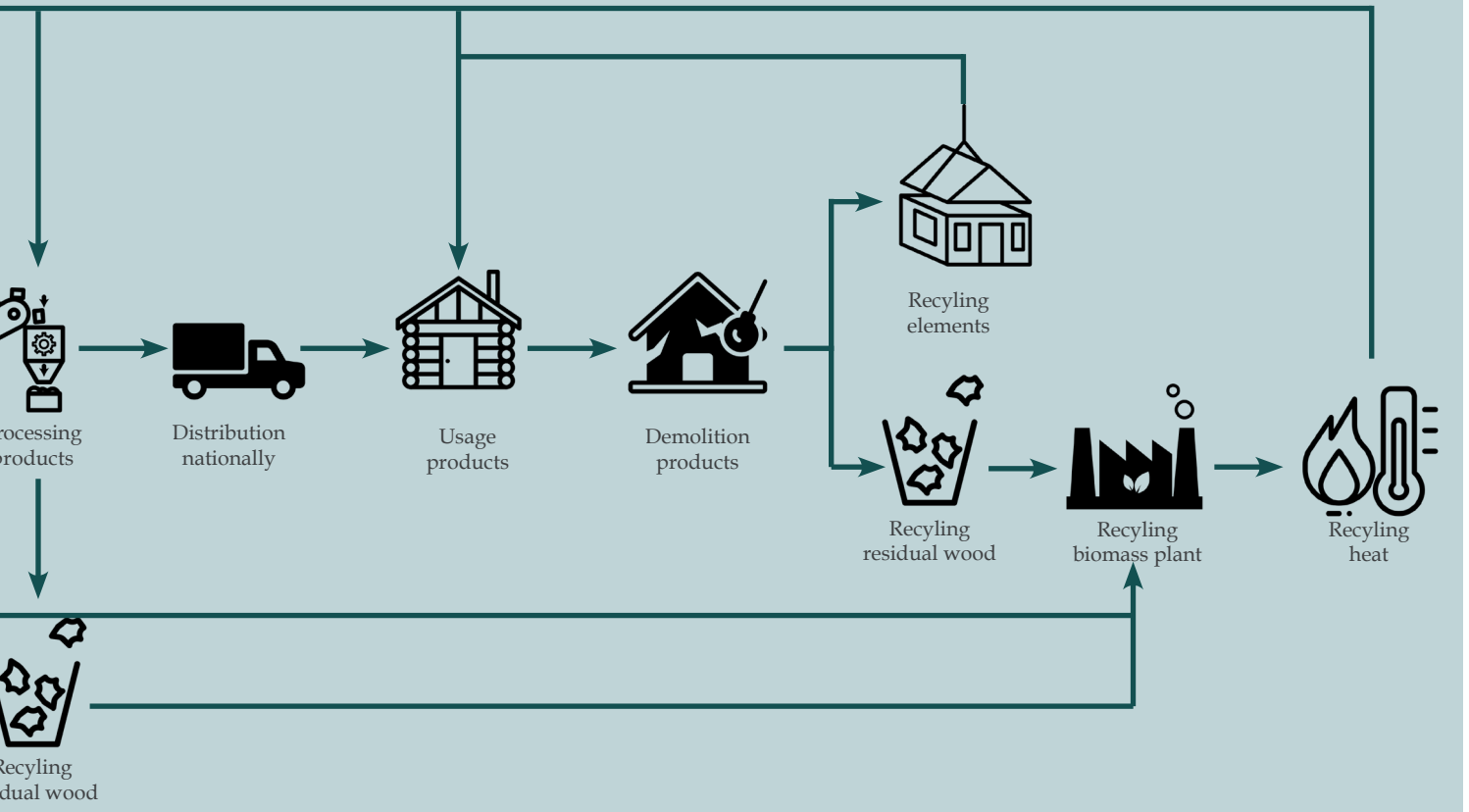
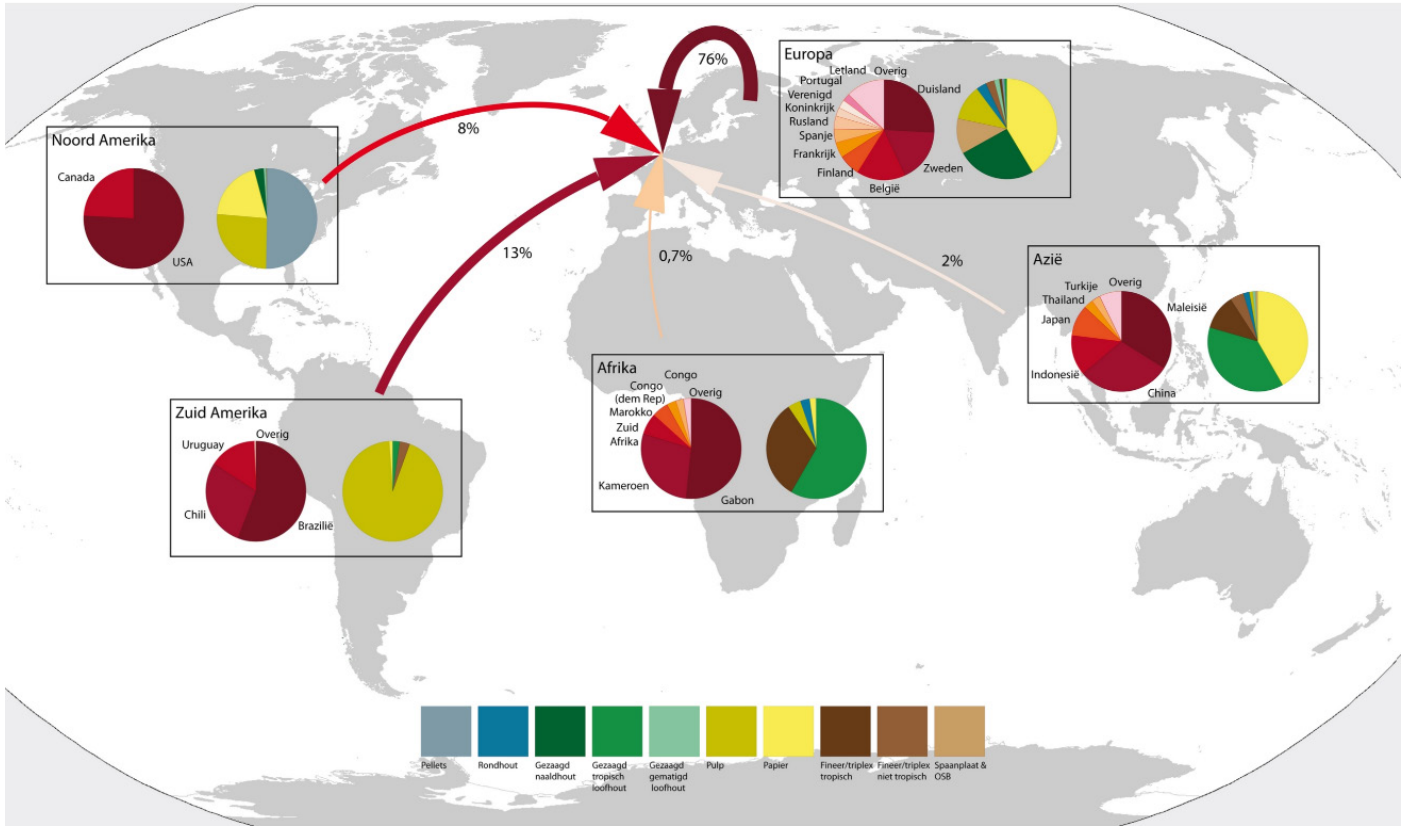


Figure 1.15: Material flow of the construction material (Icons extracted from the NounProject, n.d.)

Figure 1.14: Import different forms of wood to The Netherlands (Probos, 2020)



wood

1.4.2 | CONCRETE WITHIN PROXIMITY

Currently, the most used construction material in The Netherlands is concrete. This raw material is produced in the Netherlands itself because the manufacturing needs to happen in proximity (30 km) to the construction site (Cobouw, 2022). The already locally oriented network is therefore important to the circular economy. In figure 1.16 the concrete plants of South-Holland are illustrated. This image shows that the example locations of this thesis are in proximity to concrete producers.

However, the manufacturing of concrete is not very sustainable. It is split from limestone, which produces a lot of CO₂ emissions (Meijs ingenieurs en uitvoering, 2021). Not all the stony residual waste can be reused and therefore the production of concrete contributes to 60% of the worldwide waste flows.

That is why the CO₂ emissions are charged. The result is increasing prices of concrete which can influence the use of the future of this construction material.

Additionally, the demand for concrete is shifting from pouring concrete at the construction site to the use of prefab elements (Cobouw, 2022). The standing point for this thesis is therefore that in the future, the demand for concrete remains but in another form.

Furthermore, concrete is mostly used in constructive elements, foundations, floors, and walls.

When speaking of recycling concrete to realise a circular economy, there are some innovations already. For example, the prefab elements can be reused in other dwellings because there are easily destructible. Also, the concrete can be demolished on-site. These small elements can be recycled in walls or cycle paths (IDDS, n.d.).

Lastly, the used concrete can be crushed to produce new concrete. Nowadays, 30-50% of the granulate can be mixed with recyclable concrete. However, recycling needs to be done nearby the construction site (Profis-

hop, 2022).

Additionally, the concrete will not be as strong as the primary one (Meijs ingenieurs en uitvoerders, 2021). An article written by Profishop (2022) states that recycled concrete has a strength class beneath C30/37. Therefore, this renewable concrete is mostly used in foundations and not in constructive elements.

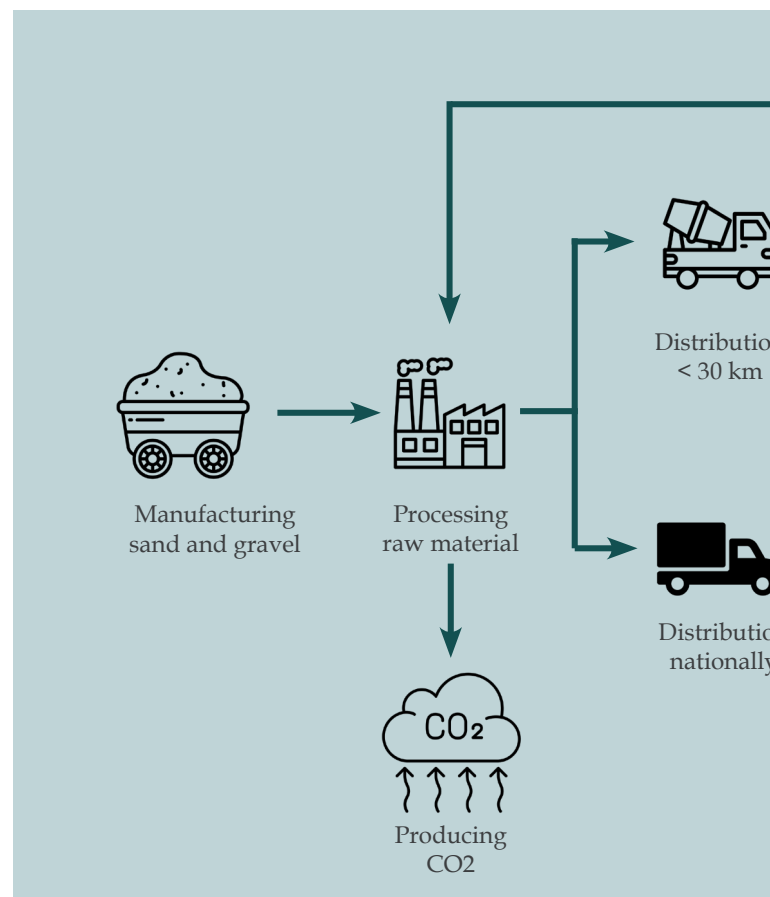
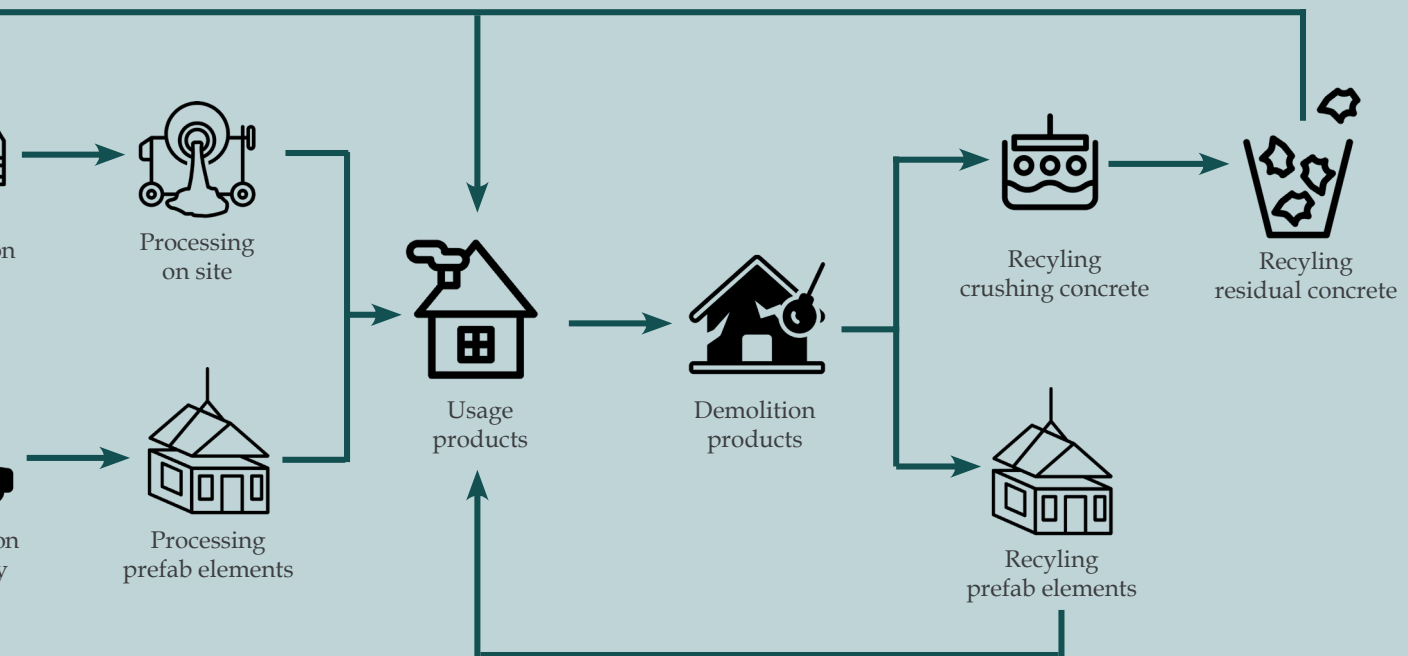
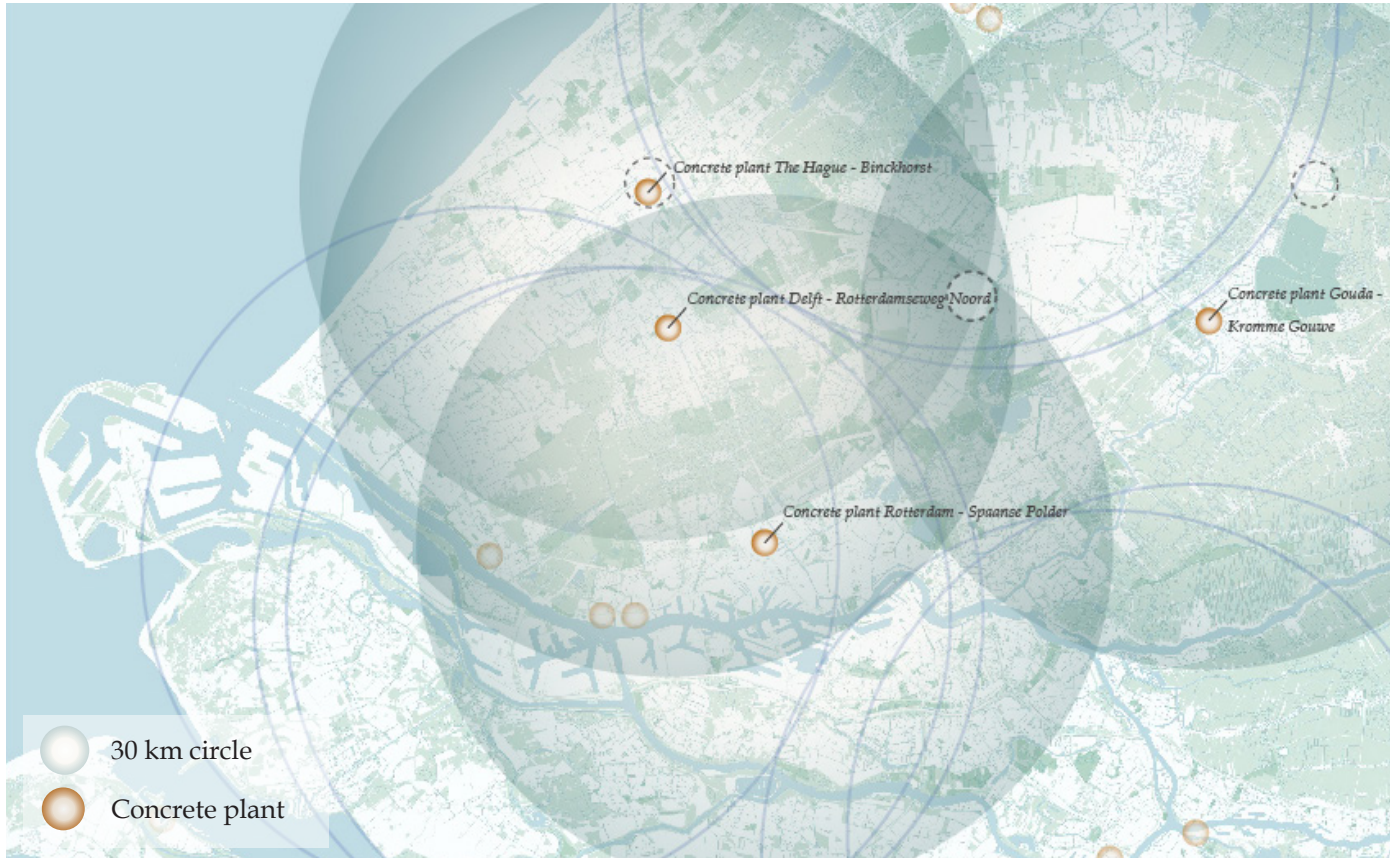


Figure 1.17: Material flow of the construction material (Icons extracted from the NounProject, n.d.)

Figure 1.16: Concrete plants serving the example locations and Province of South-Holland (Scale 1:200000, 50% reduced)



concrete

1.4.3 | CLOSING THE LOOP OF THE METAL PRODUCTION

This thesis looks at the production of metals like steel and aluminium because they are the most common when speaking of construction materials.

The resilience of steel

In the Netherlands, the processing of steel is done by Tata Steel. Tata Steel is located in IJmuiden but is part of the Tata Steel group which is operating worldwide. In 2021 Tata Steel Group was even nominated for the 10th place of biggest steel producers (Worldsteel Association, n.d.).

The raw materials are imported from, mostly, Singapore and manufactured at Tata Steel IJmuiden. Within this process, 63% of the products used in production are becoming steel. The residual products can be reused in other products such as cement, production of heat or as input for the chemical industry. The result is only 3% of actual waste (Tata Steel, 2019).

Steel is mostly used in the constructive elements of dwellings. However, also the window frames, reinforcement for concrete and elements from installations can be made of steel.

As stated by the Worldsteel Association (n.d.) and Tata Steel (2019) this material is incredibly sustainable. They even claim that it is 100% recyclable. The products do not lose their strength and therefore the production of steel can be reduced in the future.

In addition, new steel already exists of 30% recycled steel. This is partly caused by the ease with which residual steel can be recovered from any waste stream due to its magnetic characteristic (Worldsteel Association, n.d.).

Furthermore, Tata Steel keeps on innovating its processes of manufacturing steel. The introduction of a new production process allows Tata Steel to decrease the CO₂, NO₂ and SO₂ emissions by at least 20%. This Hilsar-

na process can even be used to reuse residual steel into new steel. In that way, a circular loop is created (Tata Steel, 2020).

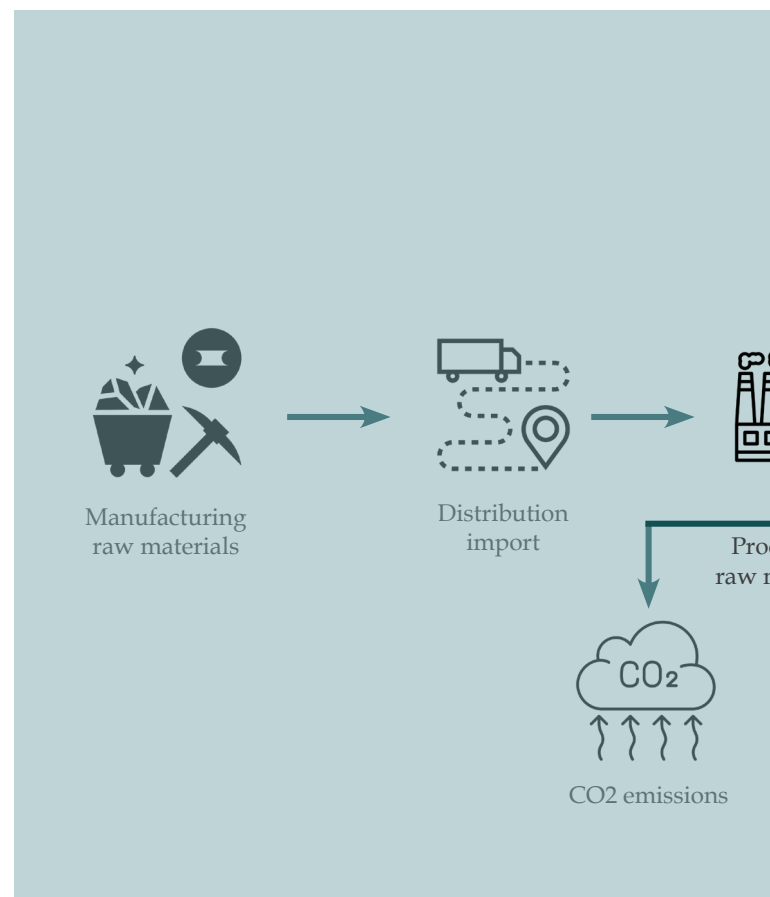


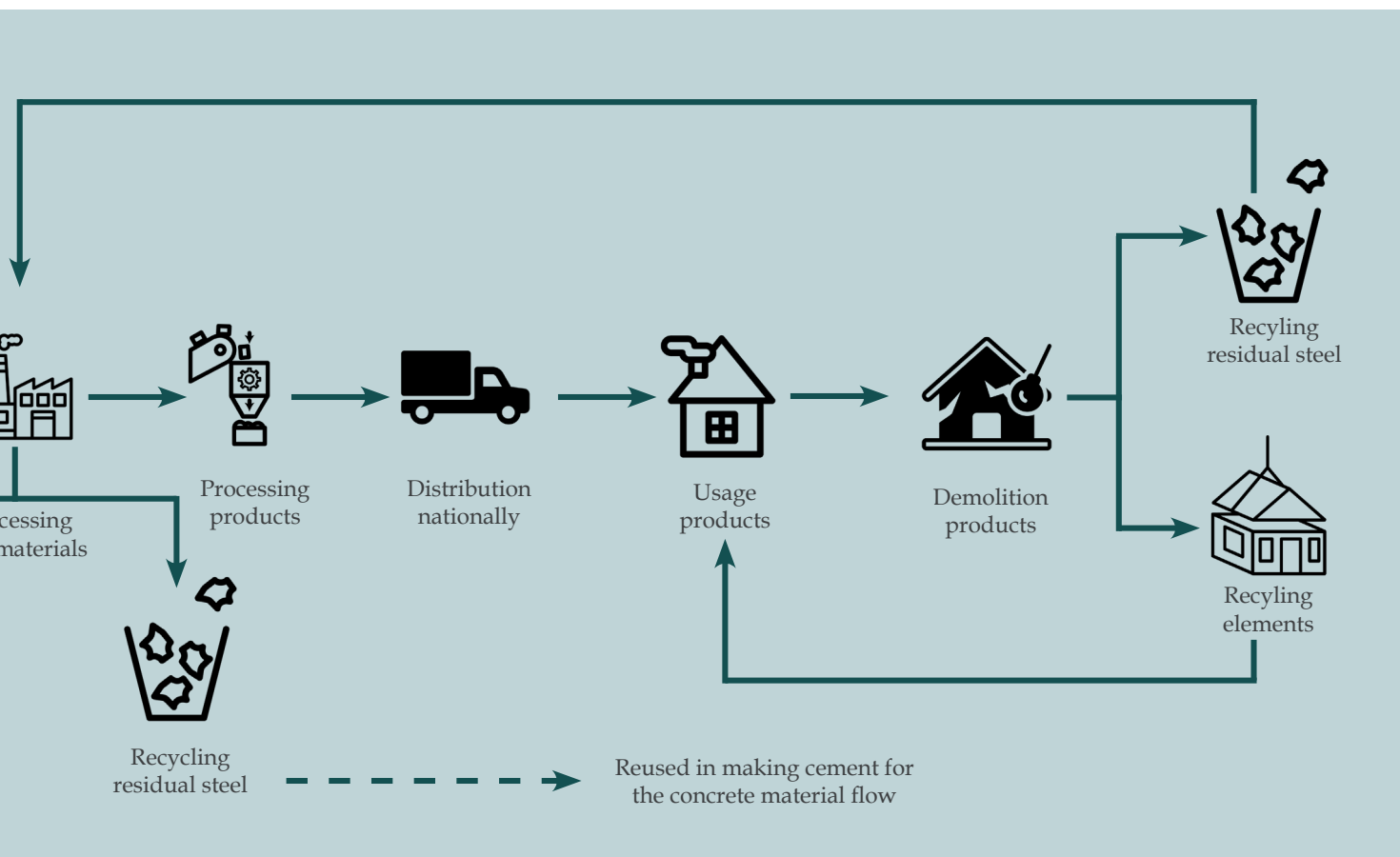
Figure 1.19: Material flow of the construction material (Icons extracted from the NounProject, n.d.)

Figure 1.18: Steel facts to better understand the opportunities (Worldsteel association, n.d.)



Steel production % split

	2000	2021
China	15.2	52.7
Europe	24.7	10.5
India	3.2	6.0
North America	15.8	6.0
Russia & Other CIS + Ukraine	11.7	5.5
Other Asia & Oceania	12.6	4.9
Japan	4.2	4.9
South Korea	5.1	3.6
Africa & Middle East	2.9	3.5
South America	4.8	2.3



steel

Aluminium: weatherproof and reusable

Lastly, another metal that is frequently used in constructing dwellings is aluminium. This material is the most common metal on our planet. However, the production of aluminium costs a lot of energy. Therefore, aluminium is manufactured in places where the settlements are cheap. That means that The Netherlands must import aluminium from other countries.

The factories make sure that they heat up containers to 1000 degrees Celsius. Next to the heat, the electric tensions inside the containers extract the aluminium from other materials. The liquid form starts to sink to the bottom of the tank where it can be easily excluded from the rest.

Additionally, heating up aluminium so that goes to its liquid form has another function, namely the fact that it creates opportunities to apply it in different ways (Comhan Holland Aluminium, n.d.).

The most common form in construction is the realisation of window frames. The material has a low density and is lightweight, while strong, tough, and elastic. Furthermore, doors, façade covering, and climate installations can be made of aluminium.

When looking at the circular possibilities, it becomes clear that the lifespan of aluminium in the construction sector is around 60 years. The low maintenance and little influence of weather circumstances make the materials attractive to use (Comhan Holland Aluminium, n.d.).

Besides, the metal can be recycled and reused in new forms. However, as said before, the production of aluminium is an energy-demanding process which asks for more sustainable energy. The recommendation given by Comhan Holland Aluminium (n.d.) is to import aluminium from countries that develop sustainable energy next to providing an affordable location.

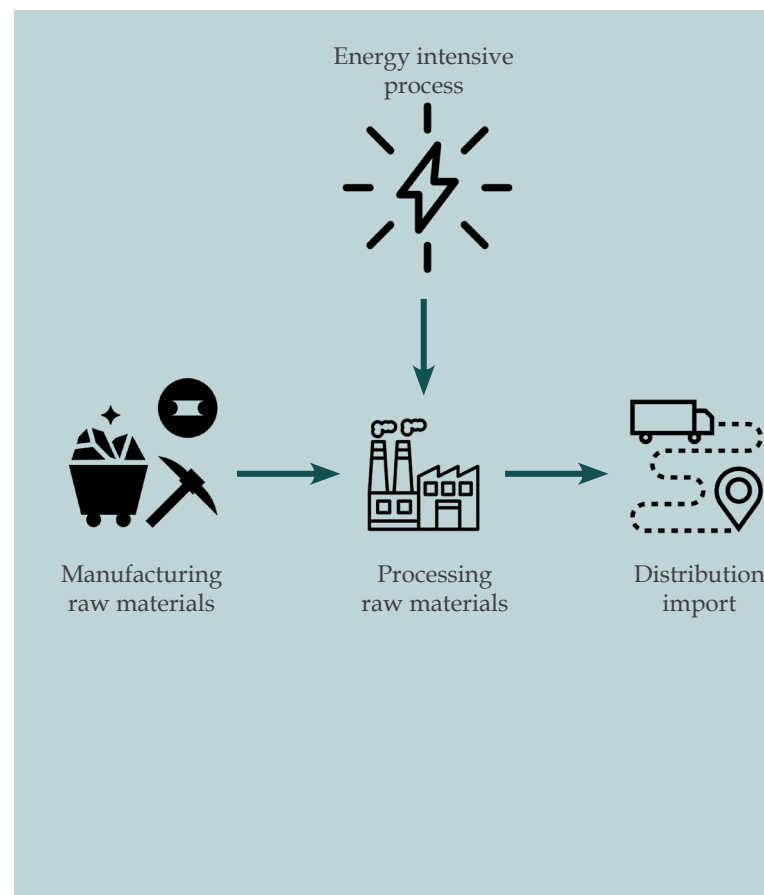
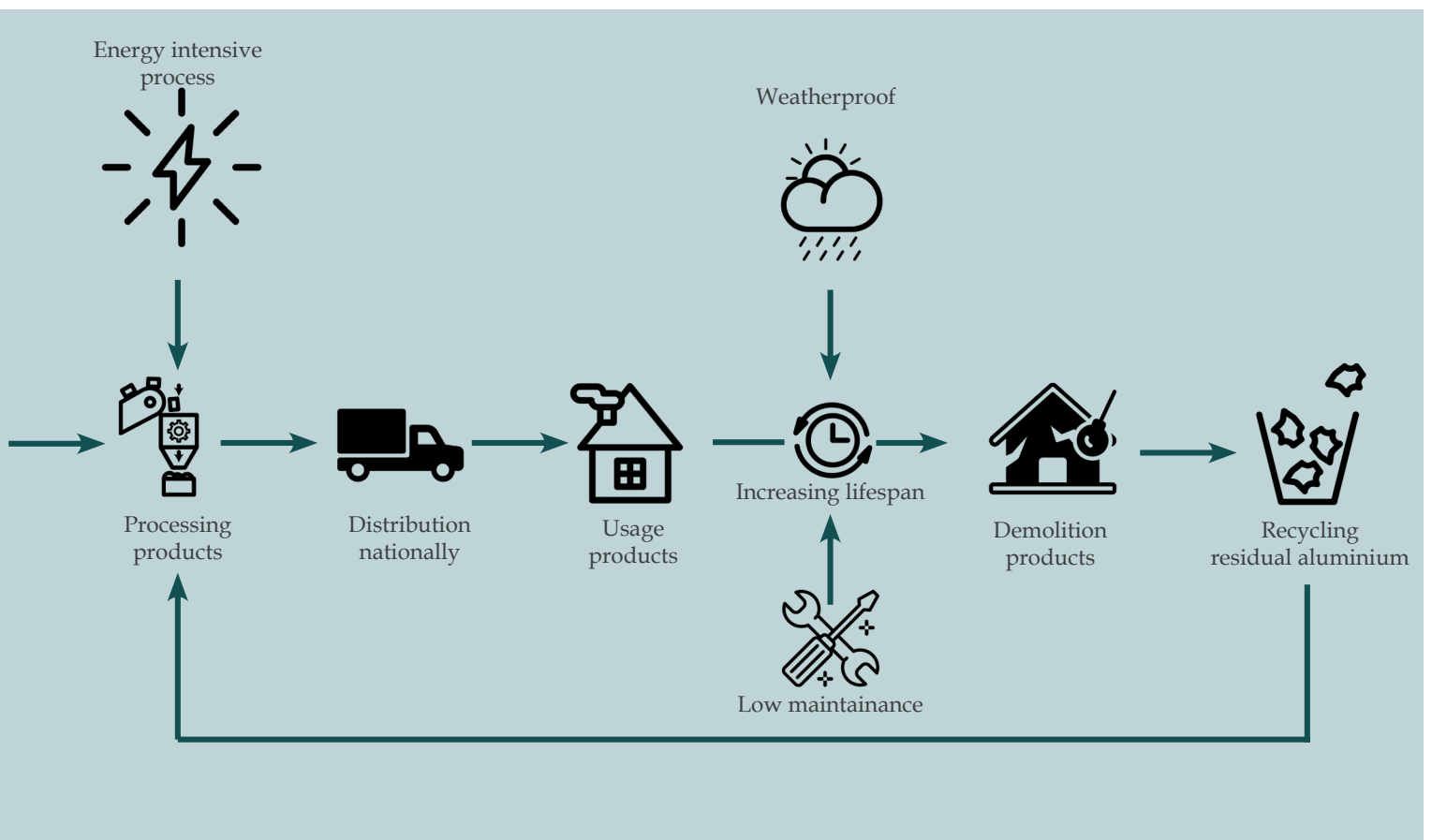


Figure 1.21: Material flow of the construction material (Icons extracted from the NounProject, n.d.)

Figure 1.20: Production of aluminium is energy-demanding (RTL nieuws, 2021)



aluminium

1.5 | Problem statement

Back in the day mixed-use was crucial for cities to succeed. However, with the attendance of heavy industrial processes, this changed. Industrial functions were separated from the residential areas. This structure is still maintained today.

At the same time, the metropolitan structure of the Province of South-Holland attracts people, but also creates a loved business climate. Due to the population growth, demand for housing, and space needed for industry, there is a scarcity of land. The wishes for the urban landscape and qualities are conflicting. Therefore, this asks for multifunctional use of space. This causes the need of reconsidering which mixed-use strategy urbanists should apply nowadays.

The introduction already shows that mixed-use contributes not only to the optimal use of space but also to the socio-economic structure.

However, not every industrial site can be mixed, and industry should be better protected towards the advent of dwellings in their space. According to the Province of South-Holland (2020) especially mixing living and working at business parks along the A12 with environmental factors 3 or 4 brings in uncertainties. These business parks provide a lot of spaces for companies that are not really bound to the qualities and characteristics that the locations have to offer. Therefore, the business ecosystems that are there now should be reviewed to see what should remain at the business parks.

The focus of this thesis will be on the business ecosystems that deal with construction materials because these serve both the conflicting drivers of change and play an important role in achieving a circular economy by 2050.

On the one hand, construction materials are needed in proximity to the city where they are used to build the dwellings. However, these businesses produce a lot of nuisances which makes it hard to combine them with

dwellings.

The main point of discussion is the right balance between working and living, the potential for a circular economy at business parks and how this contributes to the liveability of different urban fabrics in the Province of South-Holland.

‘This frames the context of the problem, theories, approaches, and the aim of this project.’

This conflict and problem statement are the ones encouraging this thesis to further dive into mixed-use strategies and circular economy. Chapter 2 describes the research questions and provides a conceptual framework to see how the main concepts relate to each other, and which methods need to be used to formulate an answer. This leads to the intended outcomes through multiple scales. Finally, the analytical framework is used to put this in perspective. This gives insight into the main and side issues.

2.

METHODOLOGY



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2.1 | Research questions

MAIN RESEARCH QUESTION

How do spatial qualities and characteristics of business ecosystems with a focus on construction materials shape the future possibilities of mixed-use business parks in the Province of South-Holland by 2050?

sub question 1

What different mixed-use strategies are there and how could they be applied in the Province of South-Holland?

The aim is to understand the different possibilities of mixed-use in relation to their surrounding urban fabric to derive guiding principles for future scenarios.

sub question 2

How do spatial requirements frame the liveability of mixed-use business ecosystems with a focus on construction materials?

The aim is to define liveability and convert this to liveability at business parks. These elements form guiding principles for the policy recommendation and analysis later.

sub question 3

What spatial preconditions shape a viable circular economy?

The aim is to extract a better understanding of the spatial and social impact of the circular economy in the Province of South-Holland.

sub question 4

How do the wishes and challenges of stakeholders influence the applied mixed-use strategies?

The aim is to create participation among stakeholders to create a future-proof and adaptive society/neighbourhood.

sub question 5

What are future scenarios for mixed-use business parks and construction materials?

The aim is to understand what the future of the companies, facilities and processes at business parks are and what should be considered in the design.

Approach to answer the research questions

The approach is to answer the research questions by using multiscale analyses. This means that various situations and interrelations of space in different scales are addressed.

This thesis focuses on the regional scale because the business ecosystem exists of multiple business parks collaborating in the province and the materials are traded worldwide.

In addition, the city scale is used to map out the current facilities and urban landscape surrounding the example locations. The example location itself could be seen as a neighbourhood where horizontal mixed-use could be analysed and on a building block scale the vertical mixed-use is researched. The usage of construction materials can also play a role here to see how the city uses them.

These different scales have spatial overlap but also conflicts.

Therefore, multi-scalarity points out the hierarchical relationship between urban strategies.

Additionally, the interrelation of spaces describes the connection between different spaces. Because this thesis deals with mixed-use areas it is important to understand the way industrial and residential functions are related.

Currently, the business parks occur as islands of industrial processes within the residential neighbourhoods, or they are out-casted to the periphery of the city. This means that the interrelation of spaces is not there yet. When shaping the liveability and facilitating the circular economy at mixed-use business parks the relationship between these functions should be improved.

Aim of the research

The aim of the research is to investigate different scenarios in which mixed-use is applied to shape liveability or facilitate the circular economy in a business ecosystem that focuses on construction materials.

These should be done through various scales to provide the Province of South-Holland with a holistic approach.

Due to the urban qualities of the place which attracts the companies in the first place, the difficulty of moving these processes, the need for proximity to the city and the replacement regulations, this thesis has the standing point of keeping as much space for the industry.

This can positively influence the opportunities for a circular economy while providing mixed-use transition zones between working and living.

In addition, the companies that are related to the business ecosystem of construction materials must improve their accessibility, become denser and facilitate public spaces to live up to the needs of future residents and employees. This contributes to the liveability of the space.

2.2 | Conceptual framework

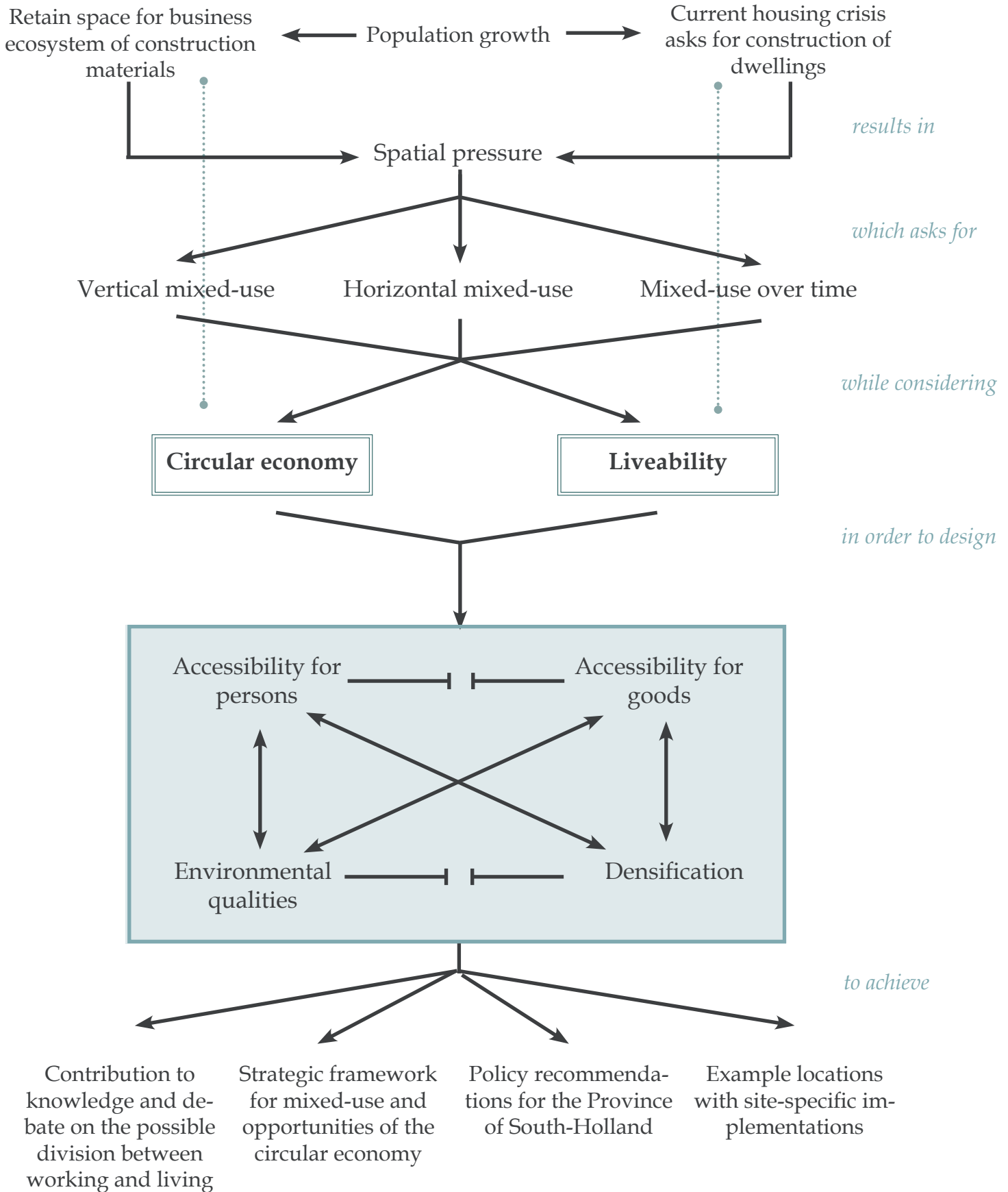


Figure 2.1: The relationship of concepts forming the structure of this thesis

Figure 2.1 shows the relation between the different concepts discussed in this thesis. This frames the context of the problem, theories, approaches, and the aim of this project. The conceptual framework forms a narrative which helps structure the report and creates an understanding of the connection between the different elements.

First are the three main drivers of changes that influence the urban fabric. The result is a scarcity of land, so innovative and multifunctional use of space is necessary. This can be found in mixed-use strategies like vertical, horizontal, and mixed-use over time.

To understand how this socio-economic structure should be shaped, theories on circular economy and liveability are converted to define guiding principles that concern mixed-use on business parks.

The elements which can be influenced by urban design (densification, environmental qualities* and accessibility for people and production) are embraced by social safety and affection to ensure that future residents are willing to live here. However, not all these elements form synergies, for example, the conflict between infrastructure for goods and persons or the spaces needed for environmental qualities and densification.

The result of this thesis should contribute to the knowledge and debate on the possible division between working and living. With a strategic framework a holistic approach on what mixed-use strategies should be applied for the province to facilitate liveable environments and the circular economy. Site-specific implementations are used to explain these strategies in example projects in relation towards the opportunities of companies related towards construction materials. To implement the results of this thesis a policy recommendation is given to the Province of South-Holland.

**Environmental qualities are not only based on the climate and nuisances but also on the other elements influencing the environment people live in. For example, accessibility to amenities, connection towards the rest of the province, and public places to meet with colleagues and friends. Environmental means 'surrounding' here instead of implying sustainability only.*

2.3 | Methods

I | OBSERVATIONS ON SITE

With a field trip, the conditions of the industrial sites can be researched. This is done by looking at the behaviour of people, taking photos, and using your senses. These comments are presented in an image to convey an opinion of the current situation of the industrial sites.

Aim:

Contextualise liveability, circular economy, and mixed-use concepts in example locations in the Province of South-Holland. Gain first impressions and potential implementations of the business parks.

II | LITERATURE REVIEW

Literature is used to develop a theoretical understanding of the main concepts like business ecosystems, mixed-use, liveability, and circular economy, in the thesis. This operationalisation is applied to find a knowledge gap and therefore, see what the scientific and social relevance of the project is.

Aim:

Make the definitions of business ecosystems, mixed-use, circular economy and liveability concrete and convert this to applicable concepts for business parks in the Dutch context.

III | INTERVIEWS

Speak to experts in the field to see what their opinions are. Find overlaps, but also contradictions to get a critical view of mixed-use business parks. Interviews contribute to finding the knowledge gap and first ideas on how to deal with these questions.

Aim:

Gain inside information and standing points from different stakeholders. Create an understanding of the meaning and desired outcome of circularity, liveability and mixed-use at business parks.

IV | MULTISCALAR MAPPING

Helps to understand the structures and networks across scales. For example, in that way, maps can be made to illustrate observations,

analyses or reflections. This contributes to a holistic view of possibilities of realising liveability at mixed-use industrial sites and makes sure that the design will fit within a broader context.

Aim:

Mapping out different concepts at the scale of the Province of South-Holland, the structure of business parks along the highway A12 and zoom in on three examples of project locations, namely Binckhorst, Lansinghage and Broekvelden. Mapping green structures, vacancies, industrial processes, movement of people and so forth shows the opportunities for adding dwellings at industrial sites.

V | STAKEHOLDER ANALYSIS

This analysis indicates the main goals and actions of actors, now and in the future. Their roles, interests, influence, and relations are reflected on various scales to see conflicts, improvements, weaknesses, and synergies.

Aim:

Create an understanding of the interests and challenges of different stakeholders that contribute to the processes at mixed-use business parks to see how they influence participation in mixed-use business parks.

VI | DOCUMENTS AND POLICIES REVIEW

The government, province and municipalities create policies that work as spatial planning instruments to achieve goals that contribute to the drivers of change on multiple scales. Examples are strategic frameworks, structure plans, environmental regulations, and area plans. These rules, subsidies and policies are used to get a clear understanding for each stakeholder on what is wished for by that specific governmental institution.

Aim:

Consider the policies and visions of the Province of South-Holland, because they will be helped by this thesis if this corresponds with their statements as well.

VII | TREND ANALYSIS

Reflecting on historical and current data of the example projects and concepts discussed in this thesis to establish insight into future trends.

Aim:

Mostly this will be used to see what the appearance of mixed-use areas looked like before and to predict future changes. In addition, it is used to map the development of different industries in the Province of South-Holland over time and see how these change in the future.

VIII | RESEARCH BY DESIGN

Using design to discover potentials and expose underlying problems at the example locations. Concepts extracted from the literature are implemented to assess what solution fits the existing context best. These explorations create a better understanding of the location, formulate new insights, and help illustrate a desired outcome for liveability at mixed-use business parks in the Province of South-Holland.

Aim:

Derive and assess design options for mixed-use business parks to provide a starting point for future scenarios. In addition, this technique is also used to create innovative and out-of-the-box ideas that fit the prospected future of the Province of South-Holland.

IX | REFERENCE PROJECTS

Extract design principles from references that fit the example locations to extract guiding principles that fit the broader context.

Aim:

Take inspiration from several developments around mixed-use areas, circular economy sites and places where the liveability is increased. Design guidelines can be derived from this and added to the example projects. It also contributes to the strategic framework which gives a holistic strategy for the whole Province of South-Holland.

X | SCENARIO CONSTRUCTION

Operationalise of the future scenarios of liveability at mixed-use business parks to extract possible, probable, and desirable futures. In that way, strategies and designs can be realised to create a specific and viable outcome for the Province of South-Holland.

Aim:

Observe trends such as digitalisation, local economy, and degree of mixed-use to see how this influences the socio-economic structures in the future.

2.4 | Intended outcomes

The aim of this thesis is to provide three instruments to realise a balanced mixed-use business park.

What becomes clear from the previous chapter is that there are several instruments that can be applied to realise a mixed-use and liveable environment. This is defined by literature, policies, and interviews, see chapter 4 and 5.

However, these aspects need to be brought together. Therefore, this thesis will provide a **strategic framework**.

Within the strategic framework, different elements of the guiding principles and stakeholder analysis will be linked at several scales to create a holistic strategy for the Province of South-Holland. This shapes the spatial implementations next to the timeline in which they should be completed.

In that way, the first step towards a liveable business park where the circular economy focused on construction materials is provided.

In addition, **example locations** provide a more detailed recommendation on three research business parks. References will be used to give an indication of what the spatial implementations could look like.

Using scenario and strategy construction different possibilities for the example projects can be suggested. A collage can guide the looks of the future mixed-use business parks at specific locations.

Additionally, the business parks that have the same urban qualities, shall be presented to show the influence of the mixed-use approach in the whole province.

The three research locations are Binckhorst in the city centre of The Hague, Lansinghage at the periphery of Zoetermeer and Broekvelden in the village of Bodegraven.

Lastly, the Province of South-Holland would

like to make policies on this topic as well. However, there is no clear description of what a balanced mixed-use business park is and how this can be achieved.

In addition, it is not sure how the circular economy needs to find its place inside the province, how much space this takes and what the design behind this looks like.

Therefore, this thesis wants to provide a **policy recommendation** on this topic.

With these three intended outcomes, this thesis recommends the Province of South-Holland what they should implement to realise well-balanced mixed-use business parks that facilitate the liveability and circular economy by 2050.

2.5 | Analytical framework

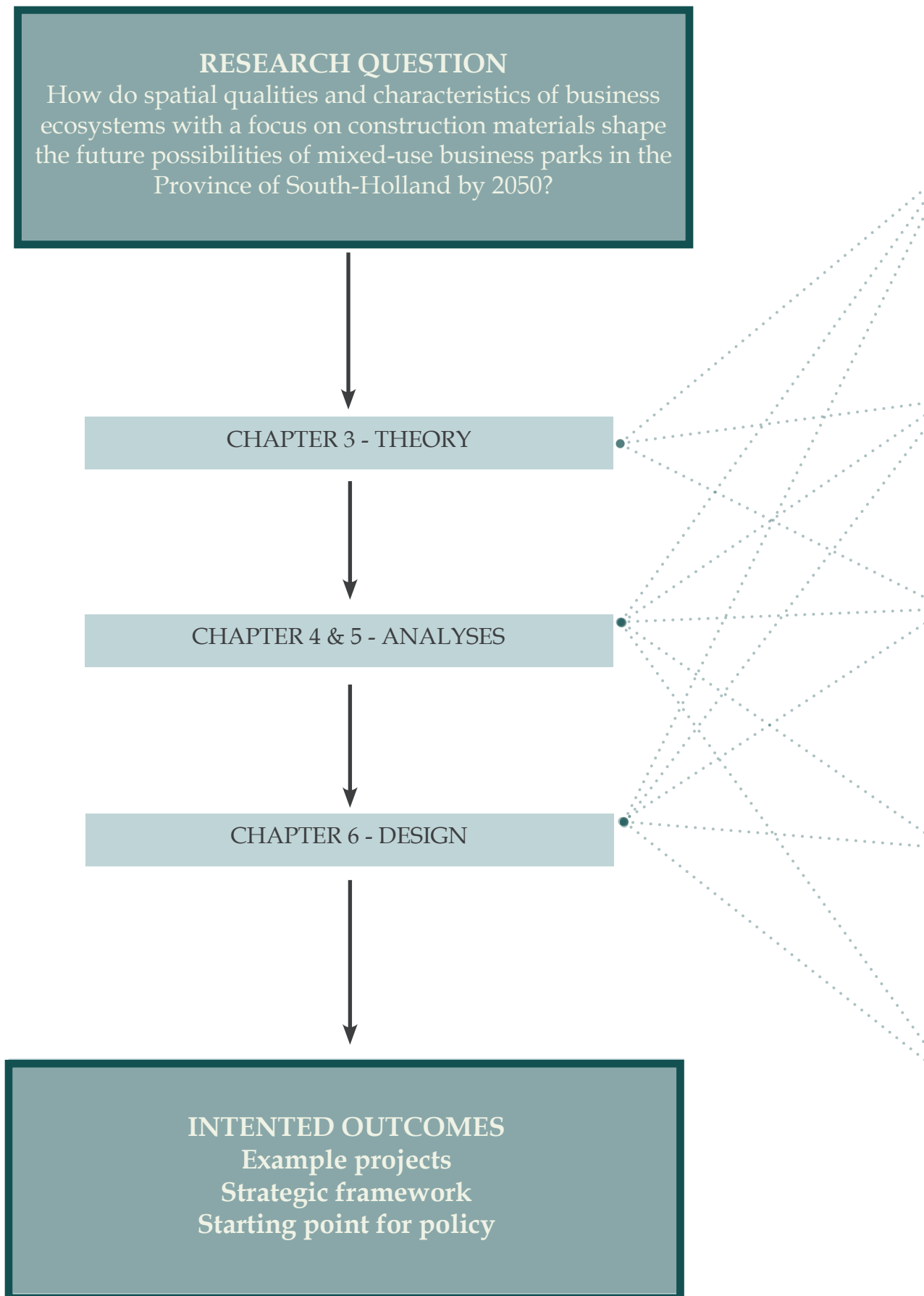


Figure 2.2: Analytical framework to divide main and side issues

Observations on site I
 Literature review II
 Interview III
 Multiscalar mapping IV
 Stakeholder analysis V

Documents & policy review VI
 Trend analysis VII
 Research by design VIII
 Reference projects IX
 Scenario construction X

sub question 1

What different mixed-use strategies are there and how could they be applied in the Province of South-Holland?

II III IV VI VII
 VIII IX X

sub question 2

How do spatial requirements frame the liveability of mixed-use business ecosystems with a focus on construction materials?

I II III IV VI
 VII VIII IX

sub question 3

What spatial preconditions shape a viable circular economy?

II III IV VI VII
 IX

sub question 4

How do the wishes and challenges of stakeholders influence the applied mixed-use strategies?

II III V VII

sub question 5

What are future scenarios for mixed-use business parks and construction materials?

II III IV VI VII
 VIII IX X

Figure 2.2 shows the relation between the research question, sub-questions, methods and intended outcomes. The meaning of the analytical framework is to better understand

the connection between different parts of the problem.

'A combination of these three types provides a desirable mix where every function gets served best by the environment they are located in'

The third chapter focuses on the theories behind the concepts of mixed-use, liveability and circular economy. Next to the literature, it is important to see how this reflects on the context of this thesis. For example, the theories about liveability are mostly written about cities and communities, so this needs to be transformed to use this at business parks.

3.

THEORETICAL FRAMEWORK



3.1 | Differences in applying mixed-use strategies

Multiple land use originates from the demand for land while there is already a limited supply. Traditionally these claims were formed by the housing and industry. A solution is created by mixed-use to realise dense cities while protecting the environment.

However, in the late 1990s, this changed, and functions as economic, cultural, and ecological sectors started claiming spaces for leisure, recreation, and nature. Mixed-use, as a solution based on the urban environment, could not form the right answer to these demands. Therefore, multiple land use is realised as an integrated policy which increases the efficiency of land in urban and rural areas on various scales (Louw & Bruinsma, 2006).

On the other hand, it is not yet discussed what the appropriate balance between working and living is, what the intended outcome should be and what the spatial strategy behind this could look like (Grant, 2002).

Therefore, this thesis focuses only on the mix between working and living and therefore speaks of mixed-use instead of multiple land use.

According to Grant (2002), mixed-use can be used as a planning instrument to intensify the cities. She claims that there are three conceptual levels which describe the possibilities of mixed functions to develop our urban environment.

Firstly, she describes how the current land use can be intensified. For example, residential areas can become denser by adding a mix of housing typologies. This results in a more diverse and inclusive community. However, Louw and Hoppenbrouwer (2005) state that in the Netherlands, this is not seen as part of mixed-use strategies, because it is still one type of land use that is increased instead of a mix between different land uses. This thesis will therefore not investigate this conceptual level.

The second conceptual level is increasing the diversity of land uses by mixing compatible uses to create synergies. This fits the companies with environmental factors 1 or 2 that are easy to mix with industrial functions. For example, residential areas could be mixed with offices or commercial facilities, without causing a conflict.

Louw and Bruinsma (2005) specify this even further and claim that this can form a mix between different types of land uses or create more floor space through the construction of high-rise buildings. When speaking of mixing working and living, this can be referred to as horizontal mixed-use and vertical mixed-use. An overview of different applications is given in the learning form reference subchapter 4.2.

Lastly, Grant (2002) mentioned the integration of segregated uses. Back in the day heavy industry was zoned from residential areas. However, in the current situation industry becomes cleaner, smarter, and produces fewer nuisances. That means that there are some possibilities for mixing functions that were meant to be segregated in the first place.

This thesis has the standing point of mixing these functions with the same approaches as the second conceptual framework. Horizontal and vertical mixed-use should be possible, but the restrictions caused by environmental factors need to be handled more innovatively.

Louw and Bruinsma (2005) complement these three conceptual frameworks with a fourth element, namely the use of a site over time for different functions. In that way, the locations could first be completely industrial and change towards residential. However, this element is not linked to mixed-use yet.

So, when segregated functions are integrated three elements occur in the different applications of mixed-use, namely grain, density and permeability (Rowley, 1996).

The first one refers to the way various elements of functions are mixed in an area. For example, when there is a hard transition from industrial processes to a neighbourhood this can be defined as a sharp grain. The number of users and amount of mixed functions results in the density of that space. Lastly, permeability described the opportunities and accessibility of pedestrians at a location.

When projecting these elements on business parks, it becomes clear that they are not fitting the elements of a mixed-use area yet, see chapter 5 for analysis.

There is a sharp grain because the business parks have mostly one function, namely industry and therefore they occur as an island between other functions. The infrastructure network connects them to the rest of the surroundings. On the other hand, this also emphasises the boundary between living and working instead of mixing them. The opportunity for mixed-use is to create a smooth gradient between the heavy industry and residential areas.

Business parks do not have a high density. Most companies are one or two stories high and embraced by a lot of paved, unoccupied spaces. This leaves room to apply vertically and horizontally mixed-use to create a denser neighbourhood.

Lastly, business parks are lacking in permeability. Some places are not accessible for pedestrians due to the heavy traffic that is needed to transport goods and fenced-off territories serving the industry only. Sidewalks are missing and safe crossings could be improved. When adding dwellings to such locations, it is important to consider rerouting infrastructure for goods and public transportation.

To conclude, mixed-use is only focussed on the mix between industry and residential areas. Literature shows that there are several levels of mixed-use which could not all be applied in the Dutch context. However, horizontal, and vertical mixed-use are already used in environments with less disruptive industries. This thesis investigates if this could be implemented at business parks as well.

Furthermore, the elements that structure the mixed-use are not yet visible at business parks. The grain, density and permeability possibilities can be further researched. Further analysis on this is done in chapter 5.

3.2 | What makes a business park liveable?

To create mixed-use between living and working, it is important to see what conditions contribute to a more liveable business park. Therefore, the literature on liveability is reflected and projected on what it means for business parks. In addition, this chapter looks at what densification strategies there are for the Province of South-Holland, what environmental qualities need to be considered, how this contributes to networks inside the province, and how to ensure social safety and stability.

3.2.1 | FRAMING THE ELEMENTS OF LIVEABILITY AT MIXED-USE BUSINESS PARKS

According to Lissandrello (interview Ramboll, 2022), liveability is a human-centred concept. Our inventions make the world we live in now. To change to a more liveable environment, she claims that we need to change to a car-free society to create more space for the people, which refers to the permeability described by Rowley (1996). Realising pedestrian and bike routes, playgrounds and parks contribute to this new human-centred city.

In addition, changing our accessibility is also important. However, this is a concept not only focused on mobility, but also on fresh water and food, a place to live, and education (Ramboll, 2022).

In short, accessibility for everyone at the socio-economic, political, environmental, and social levels contributes to liveability. On the other hand, a well-functioning environment and vice versa contribute to multiple facilities, such as medicine, geography, agriculture, transportation, architecture, and planning (Mastura, Ab Ghafar, Ahmed & Keumala, 2017; Buys, n.d.).

To get a grip on what this means to several levels in our society, the report of Easton, Saldais, Dumovic, Carrodus, and Machar (2016) makes a clear distinction between four elements of liveability and how they influence a place and the people that live there. In addition, according to the theory of Mastura, Ab Ghafar, Agmed, and Keumala (2017), there is a hierarchy of these elements, see figure 3.1.

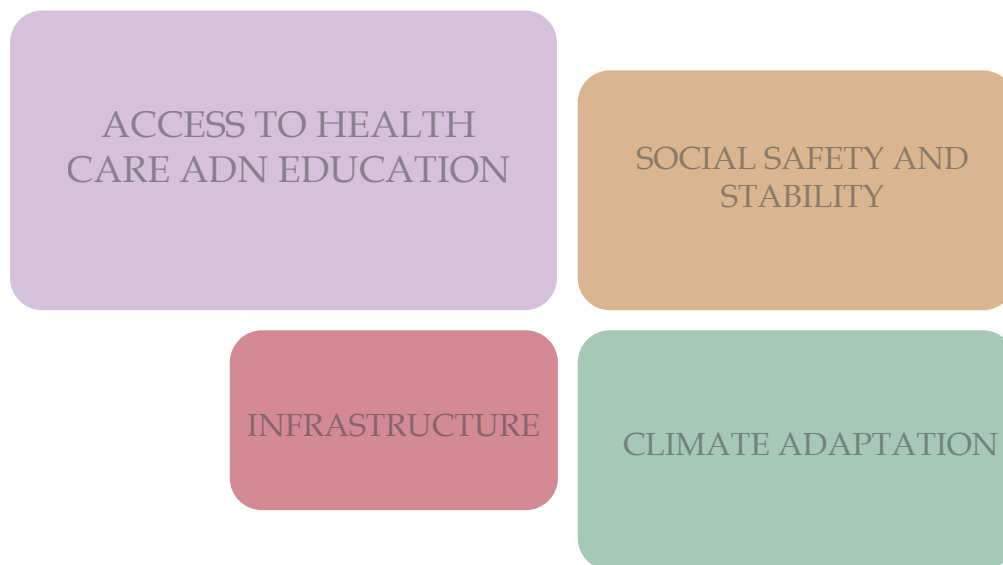


Figure 3.1: Hierarchy of liveability factors in cities and communities according to Mastura, Ab Ghafar, Ahmed and Keumala (2017)

Firstly, the element that influences liveability is the **infrastructure** of a city. This plays a role in what way and how fast people can get somewhere. The more options there are, the higher the accessibility. The infrastructure is determined by the frequency of public transport and comfortable way of travelling. Not only mobility is part of the infrastructure, but also the communication and electricity systems play a part here.

Additionally, **climate adaptation** has a bit more influence on the liveability of a place. Mild temperatures, trustworthy water management, and low risks of weather-related disasters cause an improvement in liveability.

Social stability and safety are as important as the climate adaptation of a place. People value feeling safe and stable in their living environment. Therefore, this adds to the attraction of a place for people to settle. Unsafety is mostly measured by vacancy and the crime rates of an area. When there is more social control, this is perceived as a safer and more stable environment to live in. An example of the lack of social stability and safety is given by Easton, Saldais, Dumovic, Carrodus, and Machar (2016) is the situation during a war.

The last element influences liveability the most, namely **access to health care and education**. A network of doctors, hospitals, access to fresh food, and rehabs contributes to a living site. In addition, the connection to educational facilities is needed to gain, exchange, and develop more knowledge.

The literature is based on measuring the liveability of communities and cities. However, this thesis looks at mixing residential and industrial functions, and therefore the hierarchy and elements themselves should differ a bit, see figure 3.2.

For example, the infrastructure is more influential than stated in the literature, because in mixed-use sites it does not only serve the people, but it is also responsible for the transportation of goods.

Furthermore, what is not named in the theory of Mastura, Ab Ghafar, Ahmed, and Keumala (2017) is the influence of the **environmental qualities** of a space. Pollution, noise, smell, and access to clean air and water are examples that contribute to this. Buffers between industrial and residential functions need to be created to leave space for companies to develop while realising a healthy and safe living environment (Jansen, n.d.). This

can be merged with climate adaptivity.

In addition, the literature assumes that liveability will be measured in residential areas. Meanwhile, this thesis has the standing point of a space with mostly industrial functions. Therefore, also densification of dwellings needs to be added to this element to measure liveability at mixed-use sites.

To conclude, the hierarchy described by the literature should differ and changes some elements. This report derives therefore the following four categories:



Figure 3.2: Hierarchy of liveability factors adjusted to mixed-use business parks



1. **Densification** to see what facilities need to be added next to dwellings to offer enough access to fresh food and water, health care and education.



2. **Environmental qualities** that deal with nuisances, environmental factors, nature, and climate adaptivity



3. **Infrastructure** contains the mobility, accessibility, and networks of a mixed-use area towards the rest of the province for people and goods.



Social safety and stability are expressed in crime rates, social control, public spaces, and vacancy.

* Icons are extracted from TheNounProject (n.d.)

Elements that should be considered while adding dwellings

In the Province of South-Holland, there is a decline in how dense cities are built (Gedeputeerde Staten, 2021). This contradicts the prosperity of the population growth and the current housing crisis.

In addition, critically looking at the development of these locations, shows that the occupied space is increased, while the employment opportunities are declined. In short, business parks take up more space but do not provide more working spaces (Van Gessel-Dabekausen, 2018).

Therefore, a new way of planning our living environment is needed and can be found by mixing living and working together.

Van Mourik (2011) claims that there are four main components that need to be considered while mixing an industrial site with residential functions.

Firstly, the site must contain more than two functions. Housing and working will therefore not be enough. Facilities for sports, education or health care can be added to make the space more diverse. A more diverse mix of functions results in multiple land use and increases the efficiency of land in urban and rural areas on various scales (Louw & Bruinsma, 2005).

Furthermore, the mixing should not only be done horizontally but also vertically. This means that functions can be smartly placed on top of each other to make sure that there is space left for other functions.

In addition, to create environments where multiple activities can be hosted, it is important to realise flexible usage. This makes the more plan future-proof.

Lastly, mixing different functions can give conflicts in using facilities and reduces the safety of the space. Therefore, timeframes can be introduced to give priority to specific

functions. In that way, the different functions do not bother each other.

Another thing that has to do with a balance is the division between working and living in such mixed-use areas. Even though there is not yet an answer to this question, there are some reports that make an informed guess.

Research written by the Province of Utrecht (n.d.) claims that different ratios of percentages form other urbanisation strategies. For example, from 20% on it is important to adjust the mobility network and bring in new facilities. The most extreme, but still realistic intensification of an area is according to the Province of Utrecht (n.d.) by creating 50% dwellings and 50% industry.

Another study done by Glas (2010) states that the division between working and living had to be 40-60. However, this report was written for a residential area instead of a location where the industry is already the largest function.

This thesis has the standing point of keeping as much space for the industry that is needed to create a circular economy as possible, so it must be critically overviewed if the theory of Glas (2010) can be used to densify business parks.

Differentiation in the accessibility of goods and persons

As explained in the previous chapters, there is a need for more space and dwellings at locations such as business parks. The question arises of where to realise this space. According to College van Rijksadviseurs (2022), more space for greenery and dwellings can be created by replacing infrastructure and parking lots.

However, this affects the accessibility, and therefore the transport facilities, of the area for people and goods. For example, roads need to be rerouted to make sure that the residents are not harmed by the nuisance of trucks, inhabitants need other forms of transportation than goods and parking lots should be decreased to reduce the number of paved areas (Jansen, n.d.)

This causes a shift to a transportation system where bikes, pedestrians or public transport is crucial for the transportation of persons. On a bigger scale accessibility for residents asks for shared mobility and an improvement in public transportation (College van Rijksadviseurs, 2022).

On the other hand, the current mobility network is important for the transport of goods too. Business parks should be connected to highways, waterways, or train tracks to trade their goods. Not all products can be traded over long distances, so the connection towards consumers and therefore residential areas should be ensured (Van den Berghe & Verhagen, 2021).

This means that when mixed-use is applied at business parks the transportation network should be adopted. A distinction between routes for residents and goods needs to be made to prevent conflicts to happen. The literature written about Reuring, Ruis and Rust can offer a framework here. According to College van Rijksadviseurs (2019), this can be used to

zone functions based on how they use their infrastructure and building configuration.

For example, Reuring (commotion) refers to urban liveliness, which means that there are multiple housing types combined with a high level of facilities that are already used to commotion. Ruis (noisy) allows more nuisances. This forms spaces for industries that produce smell, and noise and attract a lot of traffic. Housing can be mixed, but mostly these dwellings are directly connected to the workspaces. Within all these activities there is also a need for Rust (quiet). This addresses environments where silence is wished to live and work.

A combination of these three types provides a desirable mix where every function gets served best by the environment, they are located in.

Strengthens the social layer of the business parks

To make sure that the mixed-use places are accepted and form an attractive environment it is crucial to consider the social aspect of the strategic framework.

The literature points out that crime rates are important when measuring the safety and stability of a place. According to Jansen (2020), business parks are mostly unsafe during nighttime. There are no persons present during those hours. Therefore, there is no social control.

Besides, there are vacant buildings or wastelands. These are attractive for criminal activities. When adding dwellings, this will change and contributes to a more liveable environment.

In addition, when densifying the area, there will be more amenities and facilities available. This boosts the quality of that location, but also of the surrounding neighbourhoods (Jansen, 2020).

These new functions also reduce the commuter distance, make knowledge exchange possible and create more employment opportunities. That makes the place attractive for people to settle down (College van Rijksadviseurs, 2019; De Zwarte Hond & Province Zuid-Holland, 2021).

Not only the future residents can profit from these new facilities. It can also serve the employees of business parks. During the observations at the field trips, see chapter 5, the behaviour of people is recorded. It became clear that most activities find a place at the parcels of the companies themselves. However, during lunch or after work hours there is no public space to gather and communicate with each other.

These public places should be recon-

sidered and added when designing business parks. This gives the business something in return when they must deal with the added living environment and helps to make the place inclusive and attractive for every stakeholder.

3.3 | Spatial and social preconditions for a viable circular economy

As described above, there are four factors that influence the liveability of a place. However, this thesis also investigates the importance of the industry at these locations. According to Davis (2020) keeping production close to the city is necessary to strengthen the economy. The proximity of material flows results in a more local and circular economy. That is why production is the most important activity of a city (Davis, 2020).

Therefore, the economic success and opportunities of a circular economy in mixed-use areas count as a fifth category that contributes to balanced mixed-use.

3.3.1 | FROM LINEAR TO CIRCULAR

To measure the possibilities, it is important to get a clear view is meant by the circular economy.

In order to do so, the current situation should change. The linear production process processes materials which can be used and then turn into waste. According to Van den Berghe and

Verhagen (2021), this linear economy is universal and characterized by shipping materials all over the world. A circular economy is really needed because access to raw materials is getting scarcer.

As shown in figure 3.3 the Netherlands already took some steps to create national agreements to focus on the task at hand.

However, in collaboration with the European Union, the Dutch national government decided that the economy must become 100% circular before 2050. With the intermediated step of the reduction of 50% of the raw materials by 2030, the Dutch government has the incentive to fulfil this task (Rijksoverheid, n.d.).

The last document published by the Province of South-Holland describes what can be done in their province to achieve a circular economy. They suggest spatial implementations and divide the province into several circular profiles, see chapter 5.

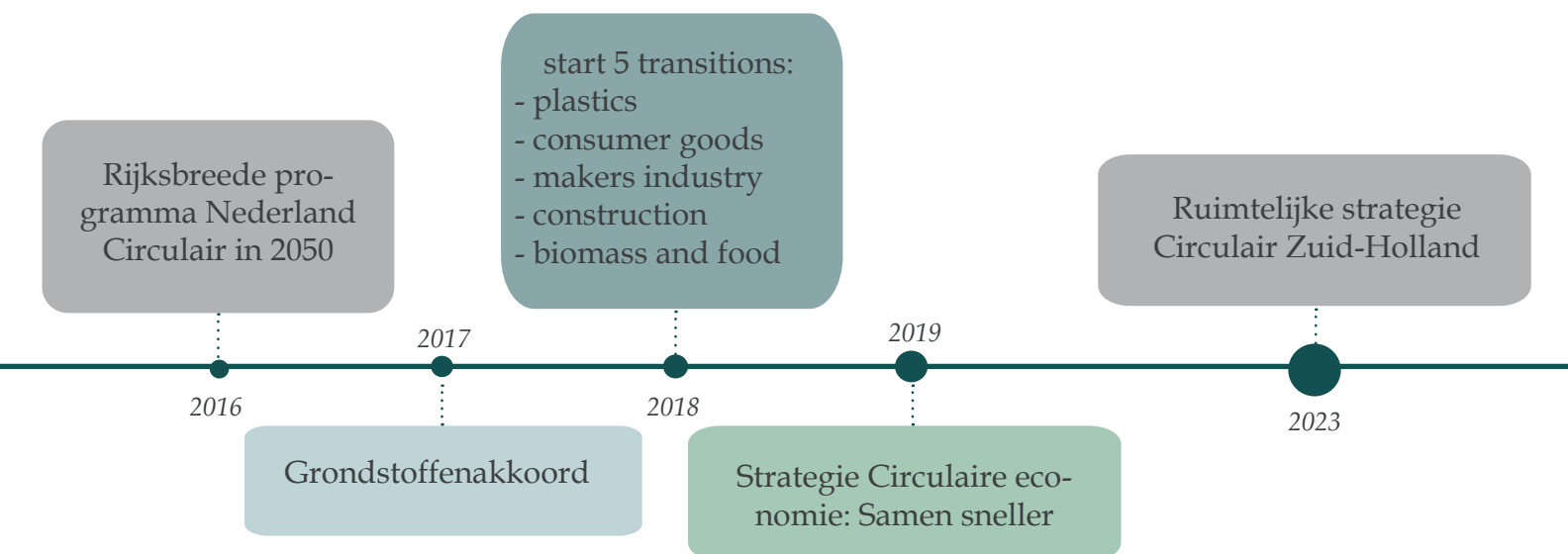


Figure 3.3: Different agreements on national and European scale to accomplish a circular economy by 2050

However, it is not always clear what strategy is used to implement this new economy for the inhabitants.

In order to gain a better understanding of these opportunities, Potting et al. (2017) created 10 strategies to change the linear economy into a circular one. This is also referred to as the R-ladder, see figure 3.4.

The hierarchy of these strategies described the influence they have on the change towards a circular economy. As becomes clear from this ladder there are several possibilities to deal with materials and products. In short, with a circular economy, the better use of resources is central

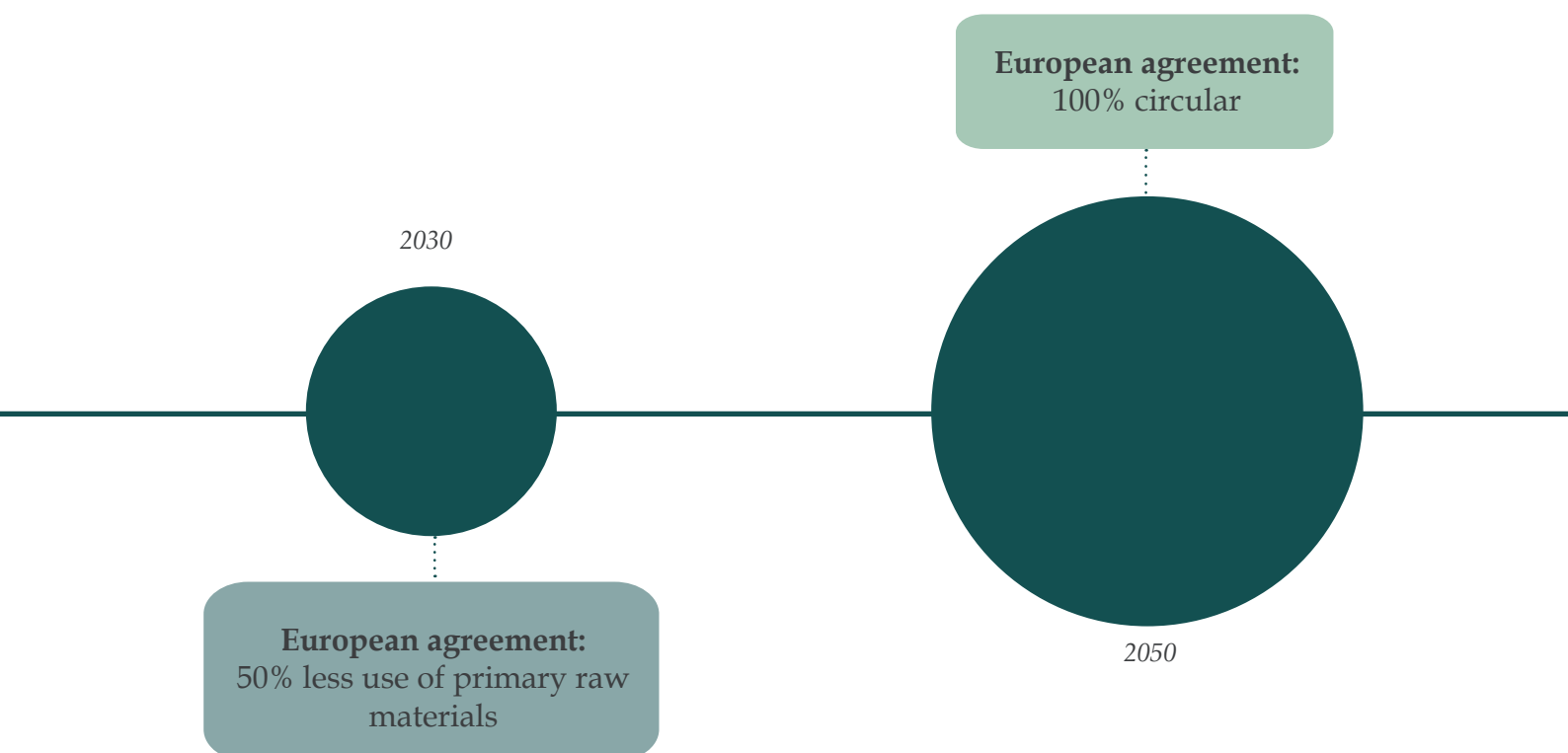
These strategies are used in the research to form a better phasing from the linear towards the circular economy.

For example, the lowest strategies, are also easier to implement. That means that when starting with strategies, the business parks could be easier transformed.

Once this is started, Rethinking and Reduce strategies are important. These create awareness and understanding of what needs to be done. Because the business parks are already transformed, they offer opportunities to simply implement the higher strategies.

In addition, these strategies help improve the environmental condition so of the companies. In the end, this causes even more opportunities to combine industry with dwellings.

Therefore, the R-ladder does not only contribute to a circular economy but also provides opportunities for mixed-use.



The strategies are applicable in certain stages of production. Figure 3.5 shows how these strategies relate to the production process. The loops show some kind of summarising actions that refer to the strategies on the R-ladder.

Firstly, rethinking and redesigning the production and resources makes them more efficient which creates a loop that is narrowed down. Sharing products is an example of this.

In addition, slowing down the resource loops can also make an economy more circular. Reusing, remanufacturing, and repairing resources increases the longevity of products.

Besides, closing the resource loops by recycling the waste after production can produce new products (Kennedy & Linnenluecke, 2022).

Furthermore, a mix of diverse types of activities needs to be ensured. Businesses need to be combined to provide a wide range of different functions (Davis, 2020). However, not only different companies should be ensured also various actors and products should be considered, for example, suppliers, innovators, ICT, distributors and so forth (Kennedy & Linnenluecke, 2022).

Besides, taking the material flows into our own hands creates an independent economy (Van den Berghe, Dabrowski, Ersoy & Van Bueren, 2019).

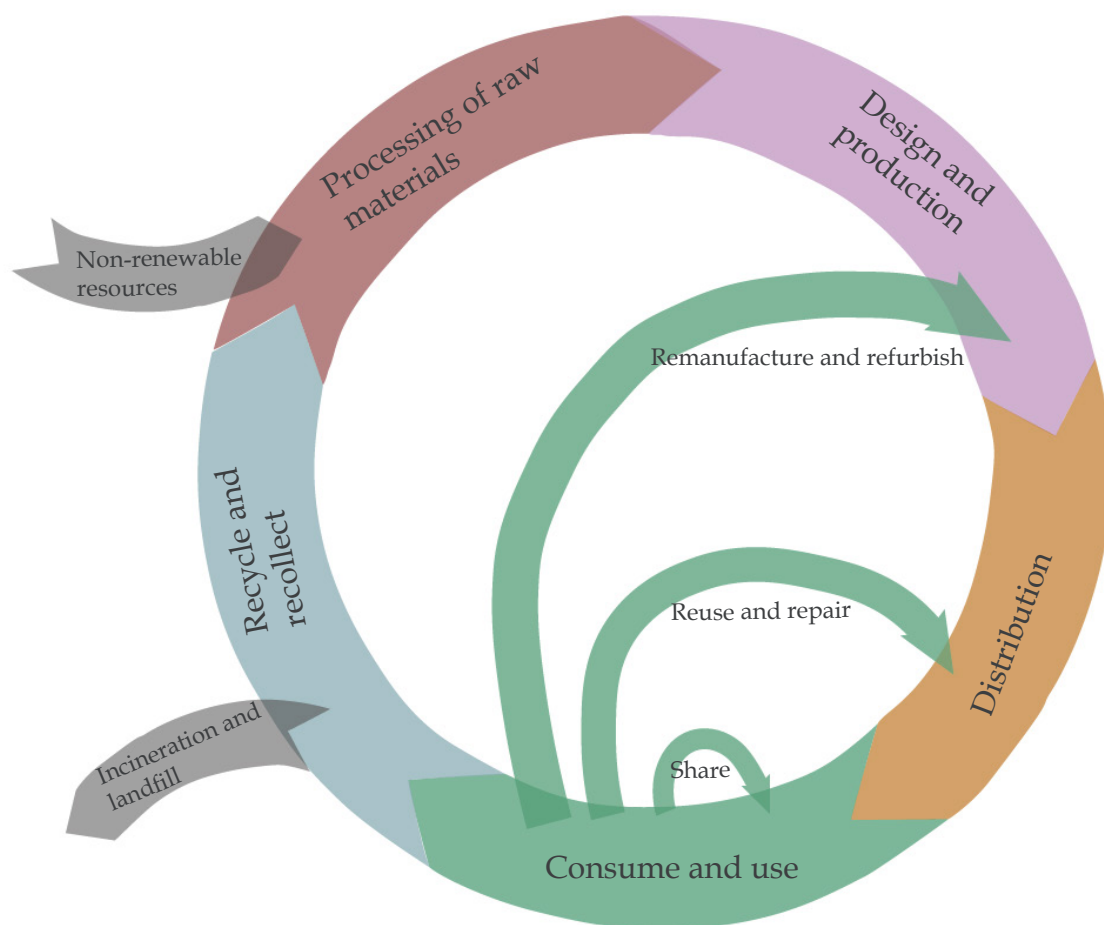


Figure 3.5: Diagram of the circular economy system (Confédération Suisse, 2019; edited by author)

To conclude, the agreements and circular strategies help to create a circular economy which is needed before 2050. When functions are combined, opened up to the public and aware of their points of improvement, the R-ladder strategies can reduce the waste streams like there are now within the linear economy. This helps to reduce the spatial pressure and creates even more space for other functions such as storage of prefab elements, constructing dwellings, public spaces for knowledge exchange, and vegetation to strengthen biodiversity.

REFUSE

Realise products that are no longer bound to their function or can be applied in multiple ways.

RETHINK

Design products that can be shared with more people because of the multiple functions it has

REDUCE

Decrease use of raw materials or improve the efficiency of production machines.

REUSE

Develop products that have the same function but are used by a different owner

REPAIR

Restore broken products to their original state.

REFURBISH

Renovate old products to make them updated to the current use

RE-MANUFACTURE

Reuse different parts of the working product to realise comparable products

RE-PURPOSE

Create a new function with components of old products

RE-CYCLE

Realise new products by reusing the old material

RECOVER

Generate energy by incinerating the materials of former products

Figure 3.4: The hierarchy of the R-ladder (Potting et al., 2017; edited by author)

3.3.2 | WHAT SPATIAL IMPLEMENTATIONS ARE RELATED TO CIRCULAR ECONOMY?

Even though the circular economy is mostly communicated via these kinds of diagrams, it is also important to notice that it is enabled by spatial decisions and influences the spatial aspect of urban developments.

For example, a circular economy contributes to **local production and regional processing**. Production and processing need to take place in proximity to where it is consumed. A good example that this thesis focus on is the manufacturing of concrete that needs to take place within a range of 30 km to where it is used.

Additionally, this means that the money is reinvested in the local community and therefore the local purchasing power will increase (Hill et al., 2020). The relationship between consuming and producing needs to be balanced to provide for the local community. This contributes to the wish to mix industrial with residential functions because it brings the consumers closer to production. With more localised loops, the logistics and use of space can be optimized (Van den Berghe & Verhagen, 2021).

On the other hand, the **site-specific elements** of a company are crucial to consider when designing for a circular economy (Van den Berghe, Dabrowski, Ersoy & Van Bueren, 2019). For example, some industrial processes occur near water, and therefore, need to be located next to it (K. Van den Berghe, personal contact, 6-12-2022). Others produce and process materials that are needed close to the city like waste processing plants or raw material processors (Van den Berghe & Verhagen, 2021).

Most of the time, these companies are in business parks where they could make noise and attract a lot of trucks. It can be strategic to **place them next to infrastructure** because this

also produces noise and in that way, goods can be distributed easily (Hill et al., 2020).

Clustering nuisances, and thus companies, contributes to innovation, competition and collaboration between different functions while increasing employment opportunities and concentrating on environmental issues (Verga & Khan, 2022). Clustering companies based on their function is called **micro-zoning** (Hill et al., 2020)

In addition, this reflects on the possibilities for liveability and mixed-use at these places as well. Nowadays, business parks are not well accessible for residents and provide no safe space to stay. When designing the strategic framework for liveability at mixed-use business parks the companies that contribute to a circular economy could be clustered together with their infrastructure network. This creates spaces that are created for residents and employees to meet each other while keeping the industry that is needed to serve the city.

Furthermore, a circular economy makes it possible to **share and optimize the infrastructural facilities, costs, and materials** (Hill et al., 2020). Business parks suit this best because they are mostly aimed at producing, processing, repairing, installing, storing, distributing, or collecting goods at one site (Vereniging van Nederlandse Gemeenten, 2019). These are all dependent on a good working infrastructural network where logistics are fluent. However, the infrastructure should be rerouted to provide a safe mobility network for goods as well as for people when this is mixed with residential functions.

When it comes to sharing materials, the close loop of circularity can also play a vital role. An example is reusing existing construction materials where demolition and reconstruction are spared, see introduction of material flows.

Also using vacant buildings can contribute to this and even realises space for residential functions. Additionally, this retains the historical values of an area and therefore, its identity (Verga & Khan, 2022).

It does sound like circular economy processes take place at one location. However, Van den Berghe and Verhagen (2021) make clear that a circular economy does not exist in one place but is a process with **a network**. Industrial processes are now mainly on a smaller scale and therefore lack a holistic strategy. Verga and Khan (2022) state that when the scale of the circular economy gets bigger, the strategies on how to deal with them become more abstract and vaguer. Therefore, a spatial plan and policies are necessary to structure the circular economy.

That is why this thesis does not only look at example projects but provides a strategic framework for all business parks in the Province of South-Holland. This focuses on the business ecosystem that deals with construction materials at these business parks because in the future they will still be needed and even need to be reinforced, especially when looking at the opportunities for a circular economy and the population growth with its demand for more dwellings. An informed guess is that each example project deals differently with the functions related to construction materials, due to their differences in the urban landscape.

3.3.3 | HOW COULD THE CIRCULAR ECONOMY CONTRIBUTE TO THE SOCIAL LAYER AS WELL?

As explained before, back in the day the industry was zoned out of the city. That results in a city with a system for human and social aspects. However, after decades this shifted towards a city where material flows are more important. When introducing dwellings into a working area it is important to look at this socio-economic balance again (Van den Berghe, Dabrowski, Ersoy and Van Bueren, 2019). In addition, the economy is not neutral. It has a social purpose where social relations, values and norms form a basis. The social layer is needed for the processes of recycling and to prevent from excessive use of materials. Decisions on what materials should be reused, reduced, or recycled could be made on the social aspect of it and need to be maintained (Moreau et al., 2017).

To do so, focusing on an industry that is already settled somewhere and **building upon these existing structures** is important. This will provide a mix of technical, social, and economic factors which combined form the basis for a circular economy. Mixed-use strategies can be used to form this balance between the different aspects of the circular economy to ensure a liveable environment as well.

Secondly, **stimulating innovation** is also important. Sharing knowledge and experiences lead to innovative ideas and skills. Divers' employment can contribute to various job typologies, education tracks and future-proof economies. Skilled workers and creative thinkers need to collaborate to find ways to create circular loops or reduce waste (Hill et al., 2020).

The business parks fit in there because the companies settle there already have various possibilities due to their wide range of activities such as producing products, distributing goods, and gaining knowledge.

Important types of business for the social aspect of the circular economy are social enterprises, cooperatives, and communities of makers. These support the disadvantaged, keep equity, and provide valuable services. This makers industry ensures that money is pooled to invest in technology and space for small production and customised products (Hill et al., 2020).

Examples of **makers industries** are traditional crafts, but also high-tech firms. They provide a lot of social working places in combination with people that have a university background. This wide variety in the social layer creates an attractive economic environment where businesses want to settle, employment opportunities stay stable and business parks are independent (Prins, 2022).

Nowadays, these companies are lacking in business parks. This thesis, therefore, has the standing point of retaining this type of companies at business parks to make sure that not only spatially, but also socially the industrial processes are independent and future-proof.

However, according to Wuyts and Marin (2022) these innovation-oriented spaces, that contribute to circular solutions, consist of so-called skilled employees with similar standing points who collaborate with stakeholders that provide the financial part. That is where they lack the mix of different worldviews, wishes, qualities and needs of people that are invisible.

Wuyts and Marin (2022) refer to them as '**nobodies**'. These nobodies are playing a hidden role within the centre of the circular economy, namely repairers, maintainers,

caretakers, cleaners and so on. Their work is on a small scale and therefore, is not always recognized in the bigger picture while their activities are important for the maintenance of materials and for slowing down the material flows in the circular economy.

On the other hand, 'nobodies' are more exposed to the risks that occur by reducing materials flows in the circular economy. This is caused by the lack of political power to oppose such hazards. In addition, literature shows that when employees experience disadvantages due to their social categorisation they will be more exposed to environmental injustice. That means that there are not equally protected by health care, education, environmental laws and regulations, housing laws and employment opportunities (Wuyts & Marin, 2022).

The recognition of the roles 'nobodies' play in the circular economy is necessary to complete the task of the industry must become completely circular.

Retaining space at the mixed-use business parks for the expression of art and possibilities for (future) residents to engage is further explained in chapter 5 and 6

To conclude, to provide a mixed-use business park where liveability is ensured and a circular economy is the future, there are some conflicts that need to be dealt with.

Nowadays, business parks are inaccessible for pedestrians, do not provide enough public space and cause nuisances. Liveability could therefore be measured and improved by four elements derived from literature, namely densification, environmental qualities, infrastructure and social safety and stability. These four elements form a hierarchy where infrastructure and environmental qualities weigh the most at mixed-use business parks. That is because some industrial processes that are now located there could not provide a safe and healthy living environment and the transportation of people is different from the goods which causes conflicts as well.

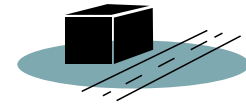
On the other hand, by 2050, these business parks must contribute to the circular economy, which asks for space to develop and proximity to the city centre. Local production and consumption create closer loops. However, spatial, and social aspects need to be balanced. Site-specific elements like access to water and infrastructure for goods are important. It is crucial to understand that the circular economy is not only defined by these different notes but is the network of how they work together and that all stakeholders should be engaged, even though there are not so visible.

In short, the urban plan of mixed-use business parks must deal with spaces for people and spaces for production, while there is already a scarcity of land. This literature can be used to provide guidelines for policies and the strategic framework and policy recommendations in chapter 6.

CIRCULAR ECONOMY



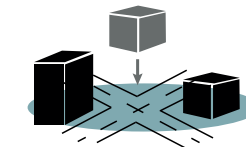
Work together as a network



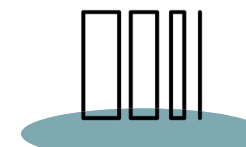
Close to infrastructure



Embrace site specific qualities



(Re)use existing structure



Provide transition
(Rust, Ruis, Reuring)



Facilitate slow traffic



Adding amenities

LIVEABILITY

* Icons are extracted from TheNounProject (n.d.)

‘This creates a better understanding of for example the configurations of mixed-use, the innovative implementations of environmental regulations, and the future of (biobased) construction materials’

Next to the literature, there are also a lot of policy documents based on the liveability and circular economy at mixed-use sites in the Province of South-Holland. Together with references these concepts are explained in this chapter. In the end, the stakeholder analysis is done to see what stakeholders have power and interests in mixed-use and circular business parks. Some collaborations are lacking which causes conflicts. This asks for engagement strategies to strengthen the stakeholder network.

4.

LEARNING FROM CURRENT STRATEGIES AND COLLABORATIONS



4.1 | Wishes on liveability and circular economy by mixed-use described by policy documents

When speaking of the densification strategies the province created a strategy on how to densify from 2021 to 2040. Mixed-use areas will play an important role according to this report.

The recommendation is to realise 30.000 of the 200.000 needed dwellings at mixed-use sites with a **density of 50 dwellings per hectare** (Gedeputeerde Staten, 2021). These dwellings need to be **affordable and fit the demand of society**. To ensure accessibility it is important to create dwellings next to public transport. These networks need to be expanded into the city centres. In that way, the facilities that are already there can also serve the new environments. This all must be done with a view to a future-proof city. Climate change, energy transition, access to fresh food and so on are key elements that need to be considered (Province of South-Holland, n.d.).

However, dwellings could not be added everywhere. To provide a liveable environment while retaining space for industries to develop a circular economy the **environmental factors** are designed to create a buffer. They deal with nuisances caused by businesses in the form of smell, noise, and trucks (Rijkswaterstaat, n.d.).

Each business gets an environmental factor based on its activities. These regulations form a framework for what distances dwellings and businesses must keep when they are placed next to each other.

According to the Vereniging van Nederlandse Gemeenten (2019) and Rijkswaterstaat (n.d.), there are four noise zones and three small zones. The noise zones are based on the intensity of sound that is produced by the businesses, see table 1. This is also time related.

The buffers to prevent nuisances of smells are expressed in European odour units per cubic meter of air. This is assessed with the same value for the entire day, see table 2.

Spatially these presented distances differ when mixing industries with a residential neighbourhood or with an already mixed environment, see figure 4.1 and 4.2.

Tabel 1: Regulations concerning noise zones (Vereniging van Nederlandse Gemeente, 2019; Rijkswaterstaat, n.d.)

Noise regulations	Environmental factor	07:00-19:00	19:00-23:00	23:00-07:00
Noise zone 1	1 and 2	45 dB	40 dB	35 dB
Noise zone 2	3.1	45 dB	40 dB	35 dB
Noise zone 3	3.2	50 dB	45 dB	40 dB
Noise zone 4	> 4	55 dB	50 dB	45 dB

Tabel 2: Regulations concerning smell zones (Vereniging van Nederlandse Gemeente, 2019; Rijkswaterstaat, n.d.)

Smell regulations	ouE/m ³
Smell zone 1	0,5
Smell zone 2	0,5
Smell zone 3	1

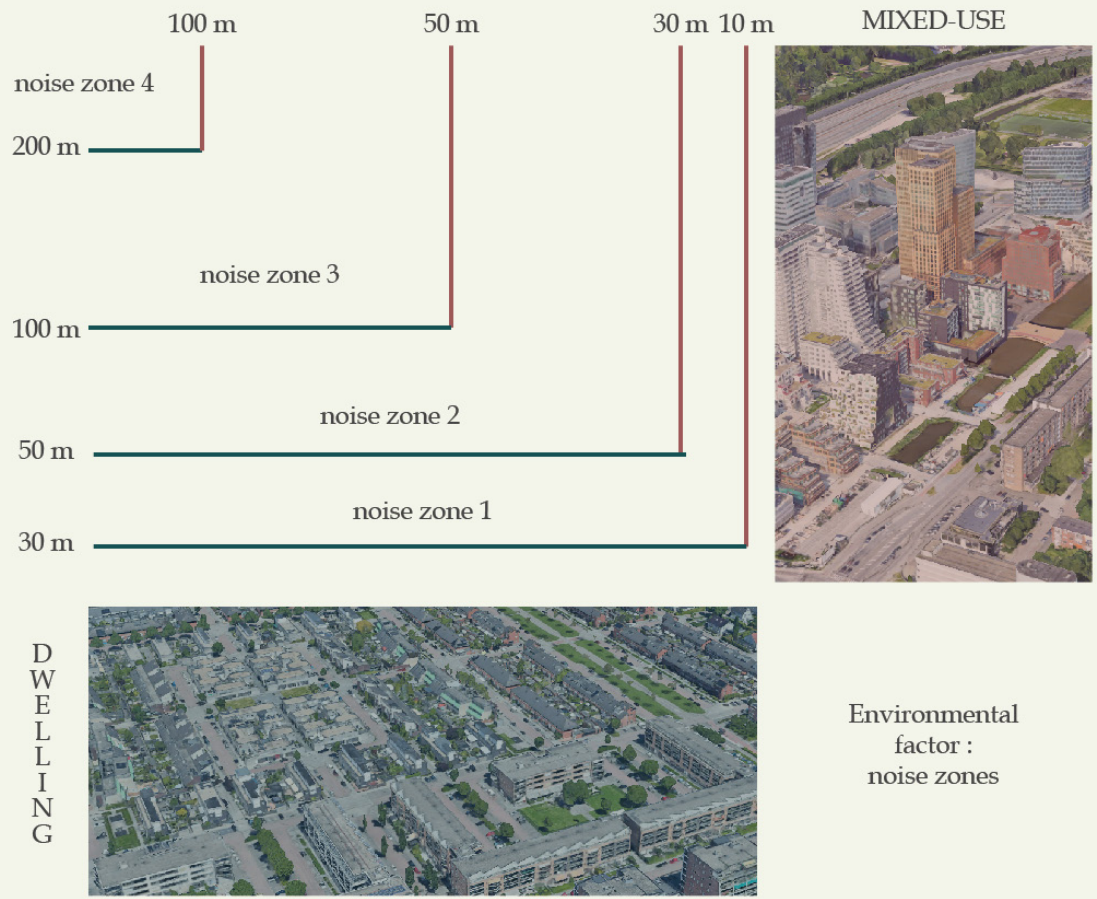


Figure 4.1: Noise zones between industry and living based on environmental factors (Based upon illustrations from Vereniging van Nederlandse Gemeenten, 2019, edited by author)

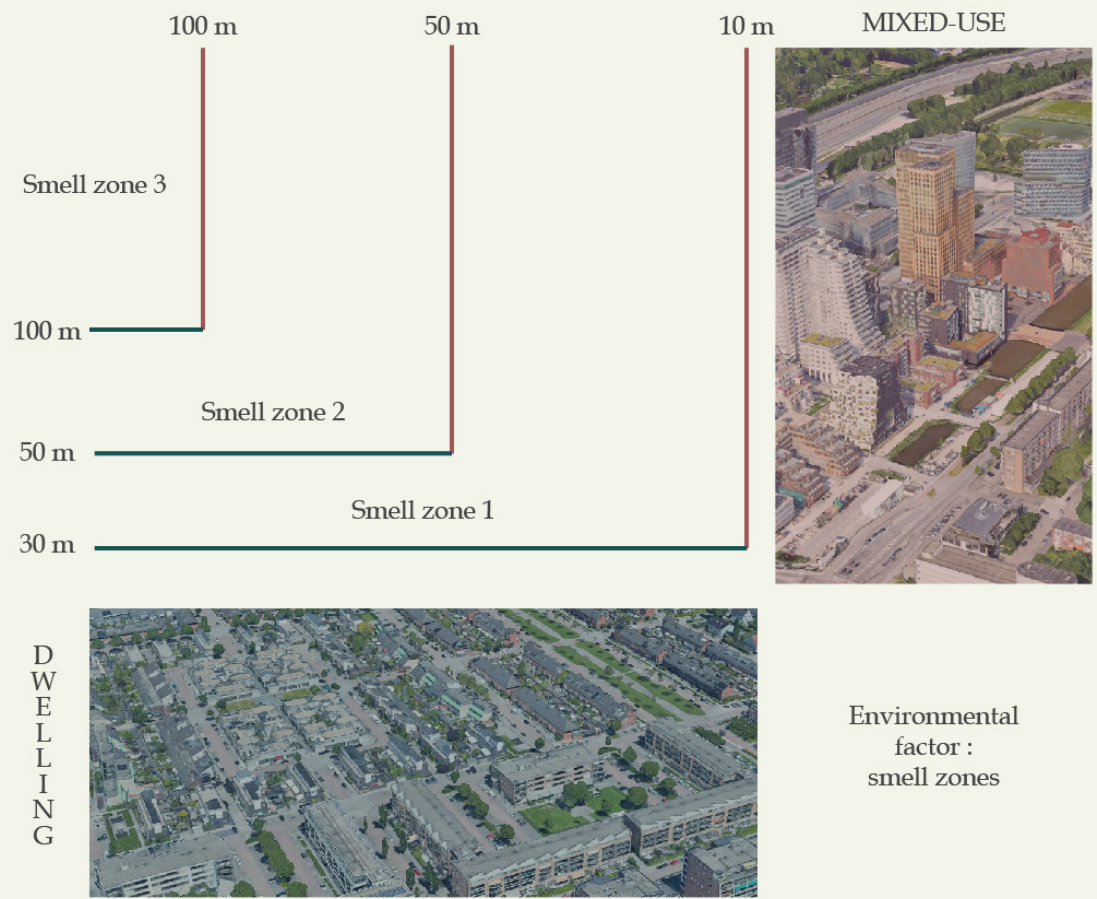


Figure 4.2: Smell zones between industry and living based on environmental factors (Based upon illustrations from Vereniging van Nederlandse Gemeenten, 2019, edited by author)

These environmental regulations ensure an acceptable living environment while protecting the companies the space companies for their activities. This is necessary because mixing with dwellings increases the value of the land. These land prices will become too expensive for companies to further develop (Jansen, n.d.).

In addition, according to Jansen (n.d.), companies only have the protection of these environmental buffers, while residents can fall back on several laws. This causes the industry mostly must leave first.

Furthermore, municipalities rather relocate industries than invest in ways to make them more sustainable and less nuisance (Jansen, n.d.).

This last action is not always necessary, because there are locations assigned for these businesses. According to Terlien (personal contact, 20-12-2022), almost 90% of these locations are occupied by companies with a lower environmental factor than the space prescribes. In addition, he states that companies with environmental factors 1 and 2 are not suitable for business parks because they can easily mix within the city itself.

In short, business parks should only house companies with environmental factors 3 and 4.

Furthermore, the buffers formed by environmental factors could be discussed. The distances described in the policy documents do not always match the situation and there are more innovative ways of looking at the buffers between industry and dwellings, see chapter learning from references.

Where the literature aims on keeping the industrial activities like waste processing plants, raw materials processers and makers industry, policy documents written by the Province of South-Holland (2020) state that **logistics** are important to reinforce.

Currently, this sector provides 95.000 jobs and has an added value of nine billion eu-

ros. Therefore, the province wants to support this sector while improving sustainability.

On the other hand, when mixed-use is applied at the business parks this can affect the logistics as well because the transportation routes should be rerouted to also serve the residents. This must be done smartly to still support the logistics sector.

In addition, this road and train network adds to the accessibility of the mixed-use areas. The locations **near train stations with international connections** could serve more residents and therefore a higher density (College van Rijksadviseurs, 2019).

Furthermore, the Province of South-Holland (2019b) claims that creating international connections via infrastructure strengthens the economy. However, this thesis looks at the possibilities of creating a circular economy where local production and regional distribution are key. That means that the transportation of goods focuses on connecting on a regional scale instead of internationally.

To see how this circular economy emphasises the expertise and opportunities of the landscape around them the Provincie of South-Holland, Ecorys and BVR (2023) created five circular profiles, see figure 4.3.

The first one, the **circular green port profile**, focuses on exchanging knowledge, cultivating, and creating spaces for recreation. Buffers between protected nature and urban processes are needed. Also, public spaces are needed to engage people in this knowledge exchange.

In addition, the **circular peat-meadow profile** building upon existing landscape-cultural heritage is wished. Circular clusters could be formed in recreational facilities, energy production and cultivation of food. Spatial implementations are for example promoting locally produced products by introducing thrift shops for food or realising shared gardens.

The **circular port industry profile** concentrates on makers industry, port industry and logistics. Due to the unique facilities and high environmental factors, the companies located here could produce noise, and smell and cause nuisances by transportation.

Furthermore, the **circular urban profile** gives more attention to the accessibility of places. This profile serves proximity to facilities, connection by public transport and opportunities for high densification. Central locations need to be established to offer services and products. Simultaneously, the distribution must become centralised and structured to function within the buzzy city life.

Lastly, the **circular delta profile** is focused on making closed agricultural loops and a biobased economy. Access to fertile soil and water creates opportunities for this environment.

This thesis focuses on the example locations and therefore investigates the circular urban

profile, the circular green port profile, and the circular peat-meadow profile. This divides the business parks into different groups where each location asks for other implementations to embrace and reinforce the specialities, also described as spatial links, see figure 4.4. The spatial links shown here are filtered in a way that they fit this research. The rest of the spatial links can be found in the report written by the Provincie of South-Holland, Ecorys and BVR (2023).

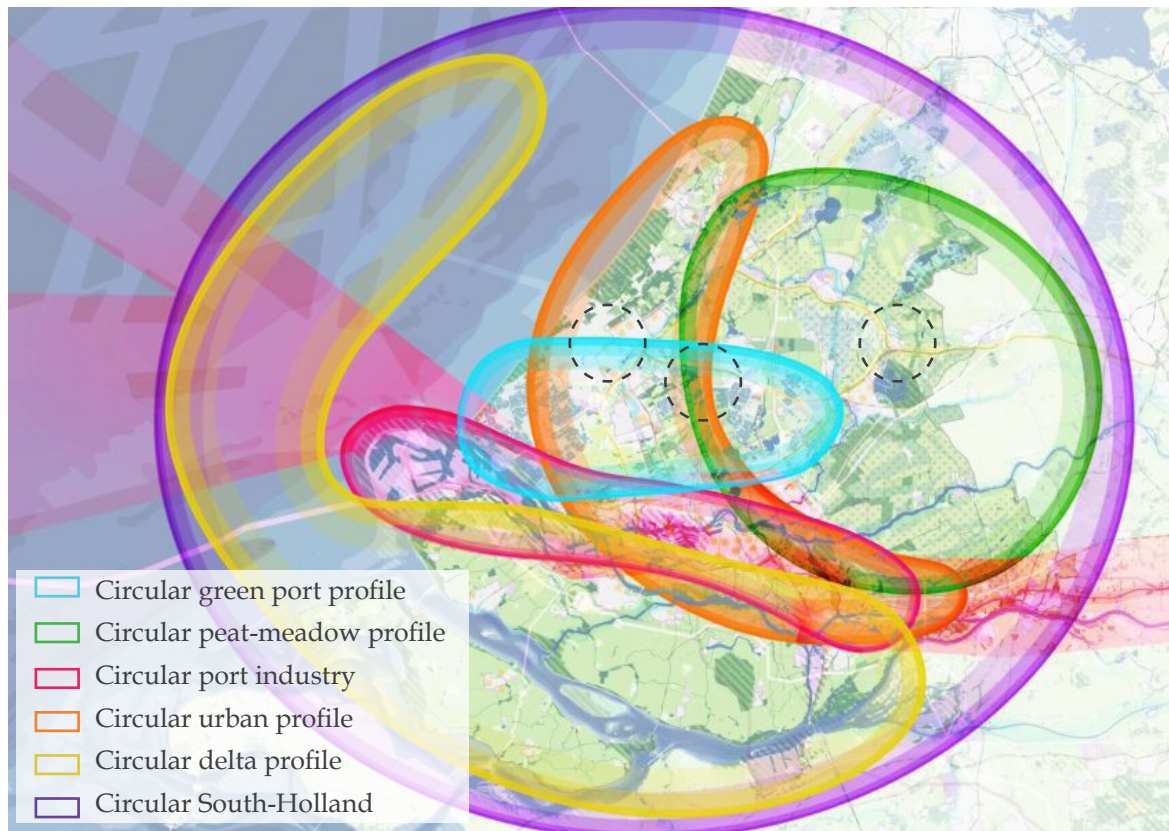


Figure 4.3: Circularity profiles within the Province of South-Holland (Provincie Zuid-Holland, Ecorys & BVR, 2023)



Distribution and return hub:
Large amounts of raw materials, waste or biobased materials can be distributed or stored.

XL

Argi-park:
Agricultural function close to urban areas where consumers, education and green-blue structures are nearby.

XL

Processing (biobased) materials:
Residual flows are collected and processed into usable materials.

L

Storage and distribution:
Medium amounts of raw materials, waste or biobased materials can be distributed and stored

L

(Raw) material hub Bulk:
Storage and transfer location where large quantities of (raw) materials are collected and sorted.

L

Living lab:
Centre for innovative companies, governments, knowledge and educational institutions that are focused on the circular economy.

S

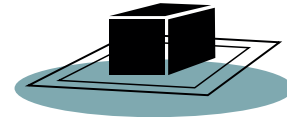
Figure 4.4: Spatial links connected to their circular profile (Provincie Zuid-Holland, Ecorys & BVR, 2023)



CIRCULAR ECONOMY



Heavy vehicles for transportation of goods



Environmental factor buffer



Density: 50 dwellings per ha



Circular economy by 2050



Innovation and knowledge exchange



Close to public transport



Inclusive and affordable housing

LIVEABILITY

* Icons are extracted from TheNounProject (n.d.)

Urban mining zone + construction hub:

Extraction of raw materials and prefab elements from built urban areas in order to reuse.

XL

Circular urban hub:

Urban form of a distribution and return hub where there is room to store, separate, sort and wash returned materials from the city.

L

(Raw) material hub Small:

Storage and transfer location where small quantities of (raw) materials are collected and sorted.

M

Circular craft centre:

Social workplaces, repair cafés and demolition halls open for public to store, collect and reuse their goods.

S

4.2 | Learning from references

This chapter focuses on learning from references. This creates a better understanding of for example the configurations of mixed-use, the innovative implementations of environmental regulations, and the future of (biobased) construction materials.

What are the configurations of mixed-use strategies?

The mix between functions can have several implementations and outcomes. Reference projects can serve to gain a better understanding of the mixed-use strategies described by the literature.

First, there are options to vertically apply mixed-use. In that way, dwellings can be combined with other functions on top of each other. Therefore, they could share the costs and maintenance of this project (Louw, 2015).

A familiar example is De Rotterdam designed by OMA, which contains a mix of living, working and leisure shown in figure 4.5.

A reference that is not directly referred to as **vertical mixed-use** is the conceptual level of increasing the intensity of land uses (Grant, 2002).

For example, when designing a more localized supply chain that fits the wishes of a circular economy a mix between the functions that are in the business ecosystem, namely distribution centres, manufacturers, processors, and retailers, can be arranged. In that way, functions that are already used to noise and trucks are combined and do not experience more nuisances (KSS Architects, 2021).

An example is the old milk factory in Zurich. From its origin, this building houses several stages of the manufacturing of milk. Production, processing, and distribution were located on top of each other, see figure 4.6 (EM2N Architekten AG, 2014).

Even though this is not a form of mixed-use (because industrial and residential functions are not mixed) it influences the opportunities for horizontal mixed-use.

As a result of combining functions vertically, there will be more space unoccupied on the ground floor. This can then be transformed into housing, new amenities or public space like parks, also known as **horizontal mixed-use**. That adds a new dimension to the social layer and can form a connection towards the rest of the city (KSS Architects, 2021).

In figure 4.7 the network of shopping streets in London illustrates a way of mixed-use functions next to each other. These traditional commercial streets reach through the whole city, where working and living are combined with other facilities such as education, health care and leisure. The combination of social, economic, and cultural functions attracts employees, residents, tourists, and company owners to London (Carmona, 2021).

Lastly, Louw and Bruinsma (2005) describe **mixed-use** where functions differ **over time**. Their research refers to former industrial sites that change into residential areas.

However, this research wants to focus more on timeframes for infrastructure to divide the transportation for goods and people. In that way, trucks can enter a certain road within a specific timeframe which clears the way for other road users.

In addition, the different functions over time can also be used within buildings. An example can be found at my former high school, Cals College Nieuwegein, see figure 4.8. During the day this building is used for educational purposes and offers places to study. On the other hand, in the evening it is open to sports clubs, workshop spaces, musical rehearsals and so forth. In this way, the building is used during the whole day instead of being partly vacant. This contributes to the optimal use of space as well.



Figure 4.5: Vertical mix of working, living and leisure in Rotterdam (Arquitectura Viva, n.d.; Own work, 2022)

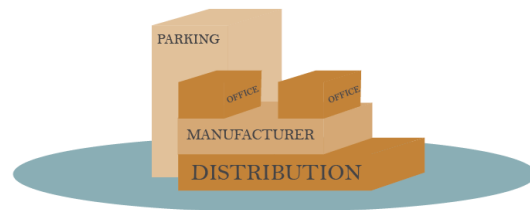
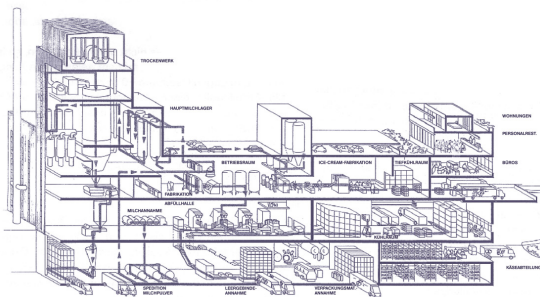


Figure 4.6: Vertical mix of industrial facilities at Kulturboulevard (EM2N Architekten AG, 2014; Own work, 2022)

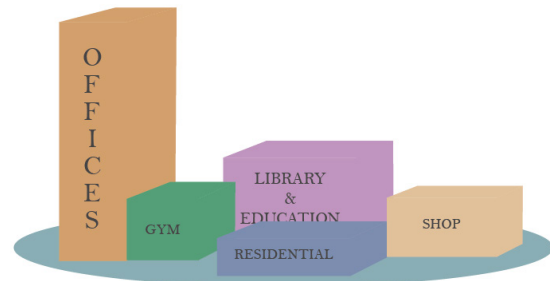
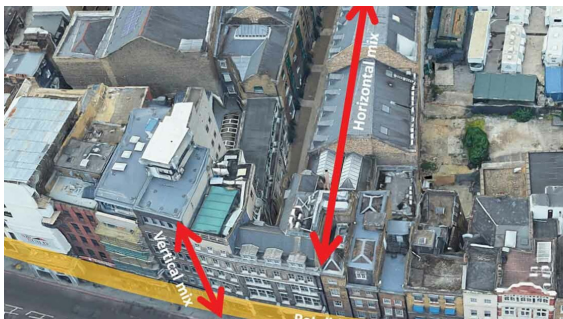


Figure 4.7: Horizontal mix of working, living and leisure in London (Carmona, 2021; Own work, 2022)

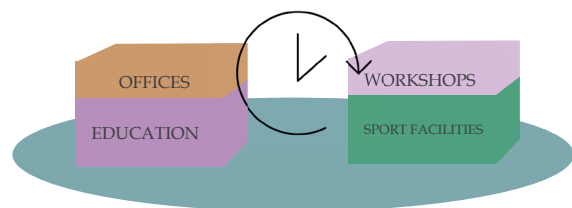


Figure 4.8: Mixed-use over time (indebuurt.nl, 2022; Own work, 2023)

Deal innovatively with environmental regulations

When applying the mixed-use strategies environmental regulations are used to provide a buffer between the industrial and residential areas. However, these do not always have to be the distance that is suggested by Rijkswaterstaat (n.d.) and Vereniging van Nederlandse Gemeenten (2019).

For example, **timeframes** can be introduced. The companies settled within environmental factors 3 and 4 are not producing noise and smells all day. Therefore, they could make some arrangements as well in what timeframe they produce externalities (B. Jansen & E. Terlien, personal contact, 2022).

In addition, **not all smells are a nuisance**. An example can be found in the Manner chocolate factory in Vienna. However, the smell coming off is not a nuisance. The factory itself also contributes to the socio-economic benefits, namely it provides employment opportunities, strengthens circularity, and keeps productions close to the consumers (Brandt, Gärtner & Meyer, 2017).

Besides, within mixed-use areas nuisance producing businesses can be clustered. This is called **micro-zoning** (Hill et al., 2020). These companies can be placed inside each other buffers because they are already used to the externalities.

Lastly, **vertical zoning** can be a solution. According to Terlien (20-12-2022, personal contact) functions as storage or parking can be placed in between the manufacturing and living. This forms a buffer in height between the divergent functions. An example where also two functions are placed on top of each other is in Quartier Massena in Paris. Figure 4.9 shows the open space between the industrial halls and apartments on top. This layer of air makes sure that no nuisance can be transferred.

Concluding, different analyses can be done to see which implementations fit next to the environmental regulations. A critical view of the distances presented by Vereniging van Nederlandse Gemeenten (2019) is necessary to reduce the spatial pressure.



Figure 4.9: Buffer between vertically mixed-use (Fieldtrip Paris 07-09 nov 2022)

What is the future of construction materials?

The future of construction materials is quite broad. Therefore, this subchapter provides a couple of ideas about what can be possible in the future.

However, the references show that there are two main ideas on how to make construction materials future-proof.

The first one has to do with producing **prefab elements**. When doing so, the construction is easier demountable, reusable, and standardised in production. In that way, the lifespan of the elements is longer and the demolition plan for each building is the same. When connecting this to the developments of digital tools that prospect when elements need replacement, the construction becomes future proof. This also asks for IT departments close to the production process (Stimuleringsfonds Creatieve Industrie, 2021).

An example is the factory from Van Wijnen that produces a complete dwelling kit

by printing the concrete into prefab elements. This way of constructing dwellings contributes to an efficient production process and becomes circular. Van Wijnen Groep (n.d.) claims that with this production process, the construction of one dwelling can cost one day instead of 60 days.

However, the prefab elements are produced in Friesland and are quite big, so the transport to the Province of South-Holland forms a point of attention.

Secondly, **biobased materials** can provide a circular way of constructing dwellings. A shift from concrete and steel to wooden constructions can offer a solution. This material is a CO₂ storage of itself which makes sure that the emission of CO₂ is reduced. In addition, wood can be used in multiple parts of the dwellings, like window frames, doors, floors, stairs, furniture and so on. In that way, the re-purpose opportunities of timber are various.



Figure 4.10: Factory that produces prefab elements for dwellings (Van Wijnen Groep, n.d.)

Besides, clay, flax and straw can be used in façade coverings or as isolation materials, see figure 4.11. The lightweight character of these materials makes vertical densification possible.

Lastly, there are some experiments on how to create bricks made of bacteria and fungi. The University of Utrecht claims in an interview with *Het Algemeen Dagblad* that the infrastructure to realise these bricks is already there, so it is just a matter of time before this can be fully used to realise dwellings. The benefit of fungi is that the material adapts to the shape that is given to it and can repair itself because it regrows.

On the other hand, it should be noted that the Province of South-Holland does not provide enough space to fulfil the demand for biobased materials. The province needs to rely on its (inter)national trading routes in order to reach the goal of becoming 100% circular by 2050.

In short, when learning from references it becomes clear that there are several more guidelines that could be added to the current policies and literature.

Speaking of mixed-use it is important to note that several configurations of mixed-use strategies should be used to balance working and living in the area. To protect each function the environmental factors, offer a buffer. However, these distances are not always fitting the context. Vertical zoning and criticism of the smells and other nuisances are needed to optimally use the space. This all focuses on the current situation. Thinking of the future, biobased materials and prefab elements can form a solution.



Figure 4.11: Usage of biobased materials as construction material (Stichting Bouwtuin, 2021)

CIRCULAR ECONOMY



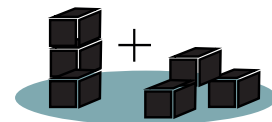
Adding timeframes and mixed-use over time



Vertical zoning



Micro-zoning were needed



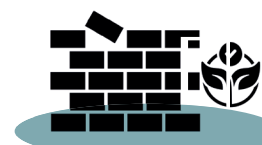
Balance between horizontal and vertical mixed-use



Critically view the nuisances



Usage of prefab elements



Introduction of biobased materials

LIVEABILITY

* Icons are extracted from TheNounProject (n.d.)

4.3 | Stakeholder analysis

This chapter will give insight into the different stakeholders and their relation towards each other. Firstly, the power-interest matrix is used to see which stakeholders are more influential and have more relevance to the challenge discussed. In addition, this can be illustrated in another diagram to combine their importance with the scale they operate at, and which theme is most related to their standing points. This gives a broad overview of the different values of the stakeholders. An overview is made and can be found in Appendix B.

4.3.1 | WHAT ARE THE INTERESTS AND POWER OF DIFFERENT STAKEHOLDERS RELATED TO MIXED-USE, CIRCULAR BUSINESS PARKS?

The Power-Interest matrix is used to gain a better understanding of how the stakeholders communicate and what their different standing points are. The hierarchy between different actors is important to consider while designing the strategic framework. Insight into their relations contributes to forming engagement strategies.

This matrix is realised through the lens of adding dwellings at business parks.

As shown in figure 4.12 most of the governmental institutions have the influence and the power to change something. That makes them the key players of this challenge, like the municipalities and departments of the Province of South-Holland.

However, as explained in Appendix B, the Department of Economic Affairs rather not have as many dwellings as possible at business parks, because they have the standing point of retaining this space for the industry.

Besides, the Department of Mobility is important because of the differentiation of infrastructure needed for goods and persons, but they are not always aware of that yet.

The municipalities are placed in this order because of their influence. A city like The Hague has more resources and money to

use, than for example a village like Bodegraven-Reeuwijk.

The private sector has less interest because they just want to develop dwellings or keep the industry, and therefore have no (specific) wishes for mixed-use areas.

Lastly, the stakeholders with fewer interests and less power. The academics fit here because they have no power or interest to directly change something. They do provide recommendations and investigate, like this thesis, what possibilities are. However, it is in the hands of other stakeholders to do something with this knowledge.

The residents from surrounding neighbourhoods do not experience big (dis)advantages, so, therefore, they are also placed in the bottom left side.

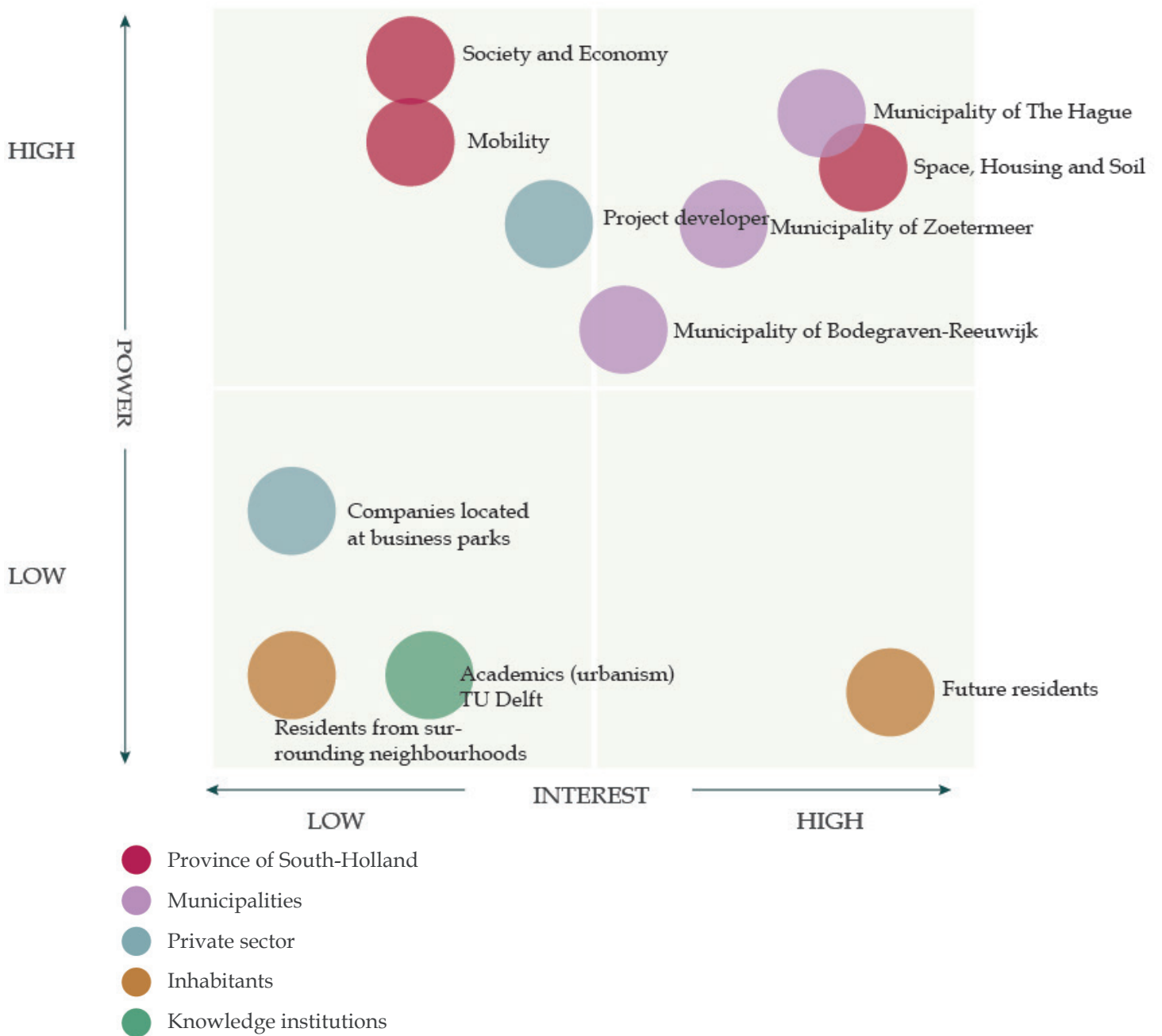


Figure 4.12: Power-Interest matrix based upon addition of dwellings at circular business parks

What needs to be noted is the fact that when the companies are steered by organisations, it can be possible that switch to a more powerful stakeholder. In figure 4.13 these different organisation structures are mapped with the IBIS dataset. The most common forms of organisation are entrepreneurial funds or business associations.

The first one focus on resources where all entrepreneurs contribute to a fund through a mandatory levy. Business associations are set up by employers and employee organisations from a particular industry. There are also a lot of business parks without a responsible organisation, of which example project Broekvelden is one.

However, when looking at the analyses from Kadaster and PBL (2020) property ownership differs even more, see figure 4.14. The municipality of The Hague has way more influence in the industrial area of Binckhorst than for example the municipality of Zoetermeer has on Lansinghage. Broekvelden and Lansinghage have more privately owned properties.

When applying mixed-use strategies, the municipality, project developer and housing

associations become stakeholders as well. That means that the organisation dynamics will change and should be thought through to overcome questions of maintenance and use of facilities.

Combining the information results for Binckhorst in a collaboration between the municipality of The Hague and the responsible entrepreneurial association.

On the other hand, for Lansinghage the business association is a very powerful and important stakeholder.

Lastly, the business park Broekvelden has no clear organisation. Property ownership lies with private organisations, but there is no organisation that can stand up against new developments.

The influence of the stakeholders and the timeframe they are operating in is discussed in the phasing in chapter 6.



Figure 4.14: Property ownership differs per example location and effects the power and interests of the companies located at these business parks (Data: Kadaster, edited by PBL, 2020)

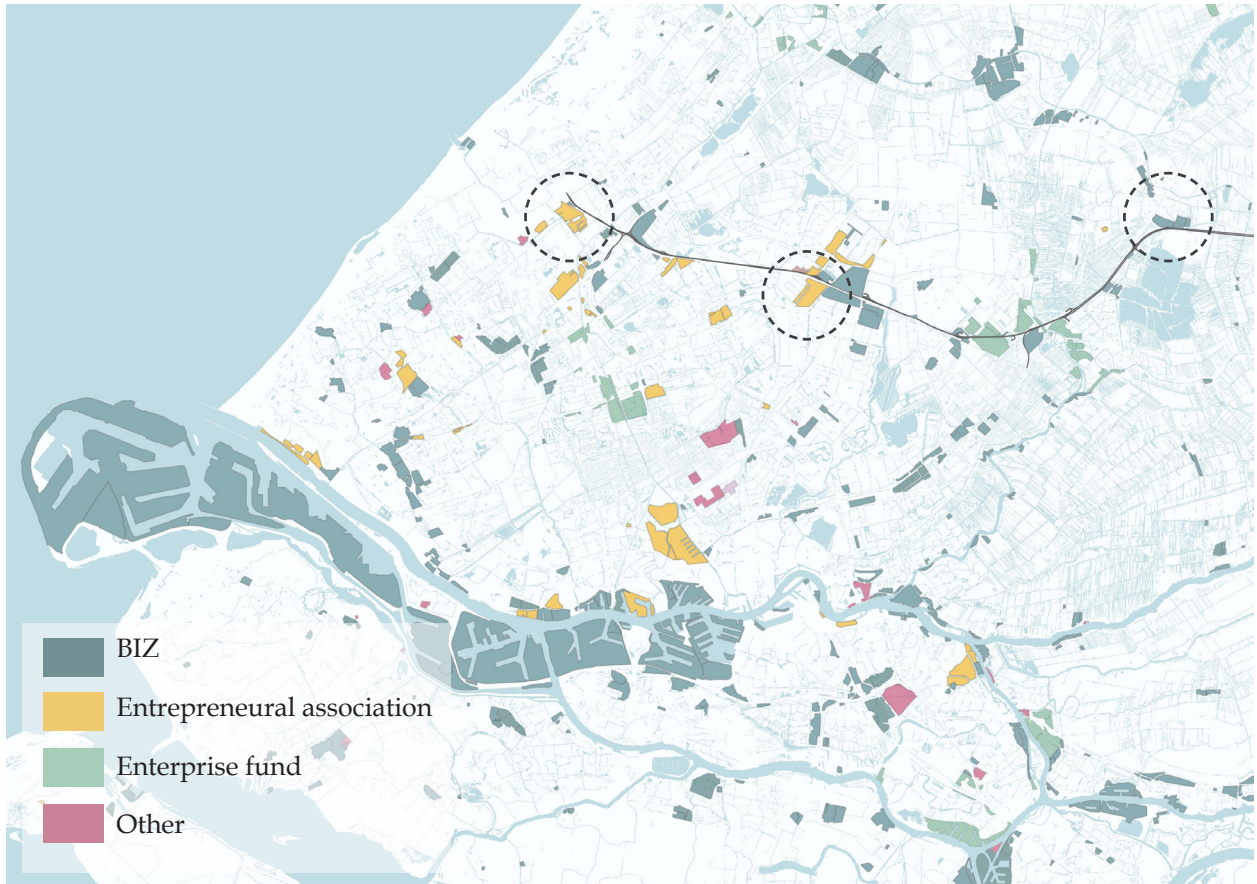
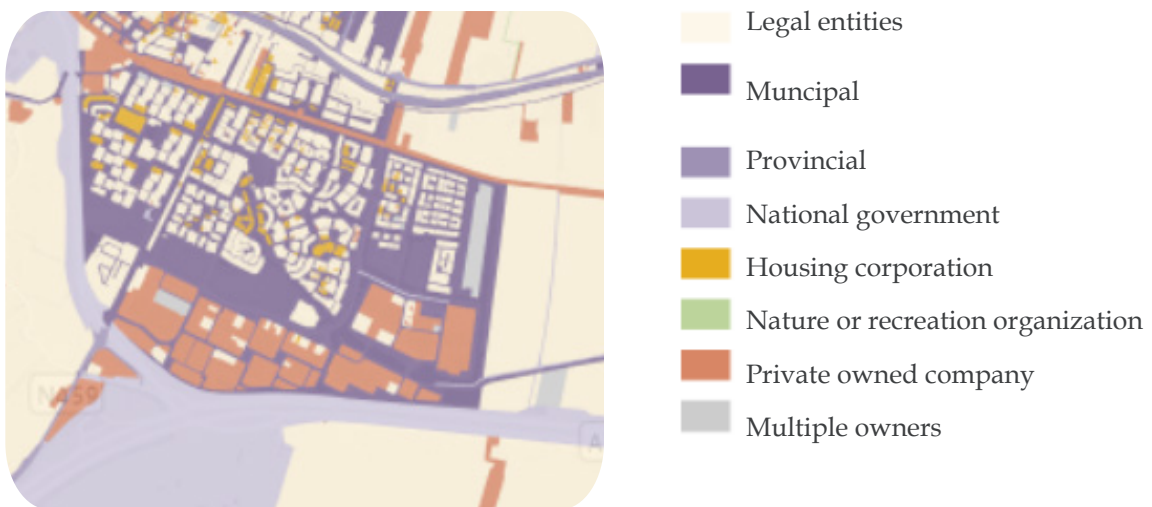


Figure 4.13: Presence of organisation that takes responsibility for the business parks (scale 1.2000000, 50% reduced. Based upon IBIS dataset)



Tensions between stakeholders' mixed-use approaches

Some examples of tensions between stakeholders are given to see how the power-influence matrix affects the implementation of mixed-use.

Firstly, the discussion on the usage of the waterfront. When looking at liveability, this could be used best to create dwellings with a nice view or a park which adapts to the current climate change (C. Forcagi, 08-12-2022, personal contact; Gemeente Den Haag, 2020).

On the other hand, this water is most of the time also needed for the industry to process and distribute their goods and therefore important to serve a circular economy (B. Hausleitner, 08-12-2022, personal contact)

Especially when looking at the transportation of big prefab elements. When using water instead of trucks, these elements can be easier transported with fewer externalities. Therefore, and because this thesis has the standing point of keeping the industry that is needed in proximity to the city, the standing point of keeping the waterfront (partly) available for the industry is chosen.

Another difference in opinions can be found in the way infrastructure is used. At business parks, infrastructure is now designed to transport goods instead of making them accessible for pedestrians and bikes as well. When the industry is mixed with housing, adjusting to this arrival of inhabitants is needed (College van Rijksadviseurs, 2019; B. Jansen, 2022, personal contact).

However, the industry is also relying on this network and should not be harmed by the addition of dwellings (B. Hausleitner, 2022, personal contact, Economic affairs Province of South-Holland, 06-12-2022, personal contact)

Rerouting the infrastructure and seeeeee the transportation routes can help to

solve this tension. In that way, a safer environment for residents is created, while the companies can still transport their goods.

Besides, is a discussion on the environmental buffers that are needed to protect the development options of the industry while making sure that the distance to residential areas is ensured (Gemeente Den Haag, 2020).

On the other hand, these buffers also limit the space to realise dwellings (Jansen, n.d.; E. Terlien, 20-12-2022, personal contact).

This is not always necessary, because not all industry is that harmful and there are other innovative implementations of mixed-use that deal with nuisance, see learning from references.

Lastly, there is a difference in the wishes of residents and companies that are already settled at the business parks. Businesses are afraid that the addition of dwellings will drive them away (Jansen, n.d.).

However, the growing population is in favour of realising dwellings to reduce the pressure on the housing market (Rijksoverheid, n.d.).

To conclude, there is already tension in the way the Province of South-Holland wants to approach mixed-use strategies. The Department of Space, Housing and Soil wants to be innovative and search for solutions, whereas the Department of Economic Affairs does not want to give up space that is exactly designed for the industry.

In addition, the thoughts of academics are most of the time the opposite of the municipalities and the Province of South-Holland. Municipalities are aiming to develop as many dwellings as possible, without considering a spatial plan behind this. Academics warn that this will affect the influence of the industry on our business economics. The province is divided between these two but does not form clear policies on how to handle this situation.

Companies and future residents are the last that have different opinions about mixed-use developments. Companies rather retain their business parks without merging with dwellings.

On the other hand, the housing shortage causes needs by residents to search for other ways to find a place to live and are therefore in favour of mixed-use.

4.3.2 | ADDING SCALE AND PREFERRED FOCUS

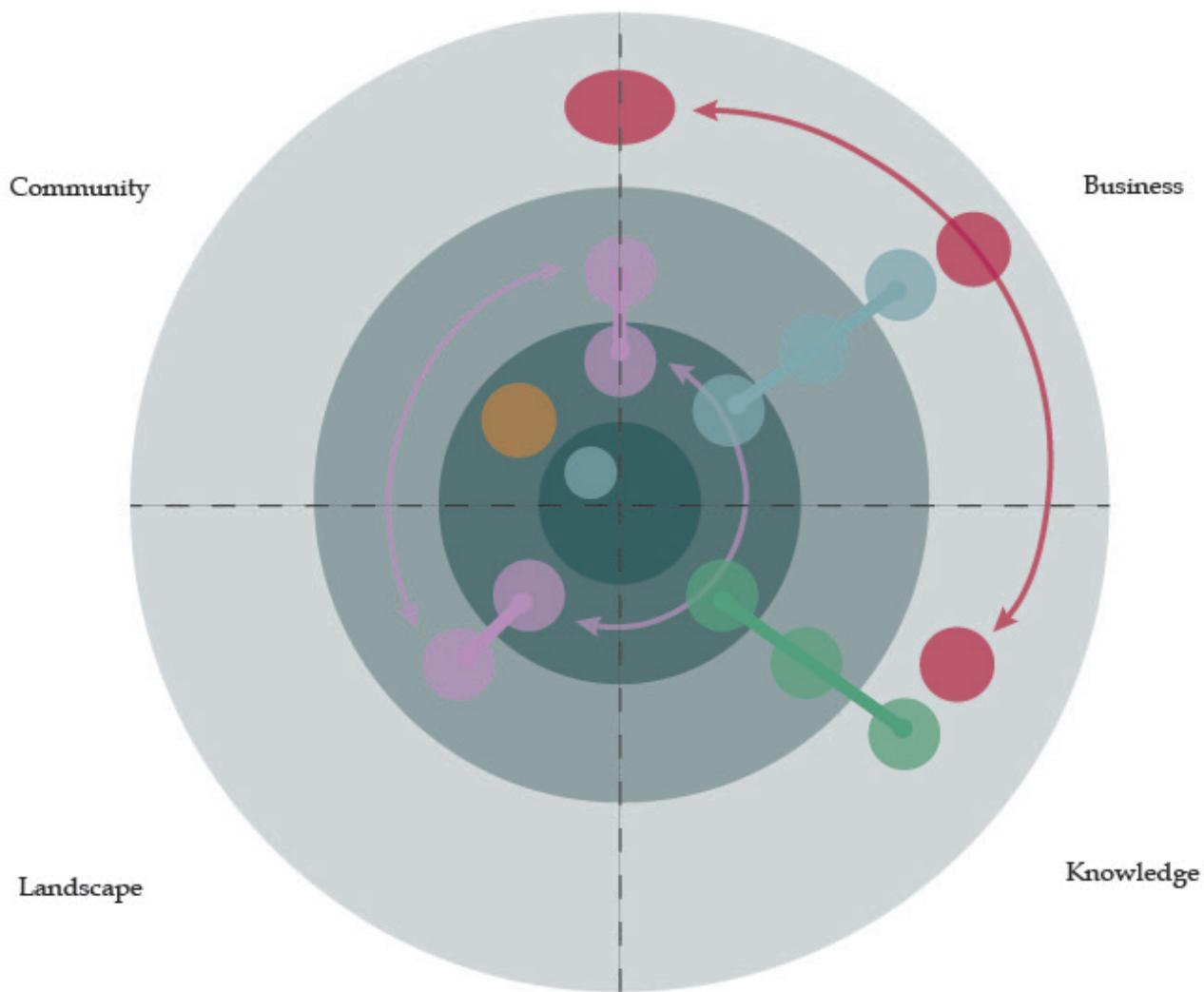
The relation of the stakeholders can be shown in another diagram to add the dimension of scale. This is important to see if the stakeholders can form connections to create holistic approaches on how to deal with the housing crisis and facilitate the circular economy.

In addition, figure 4.15 shows the four most common themes the stakeholders operate in. Community means creating public spaces and dwellings for the residents, Business has to do with retaining space for industries and facilitating the circular economy, Knowledge refers to the opportunities to use research in the approach of mixed-use and Landscape addresses the implementations needed to provide a healthy living environment by improving the green network.

The arrows indicate that the stakeholder operates within several themes when it comes to mixed-use strategies. That results in a strategy that does not serve one factor but can be applied to multiple.

The lines between the different scales show that some stakeholders function through the scales which creates a more holistic approach.

This analysis where stakeholders are placed in the theme and scale they operate in, shows three observations.



- Province of South-Holland
 - Municipalities
 - Private sector
 - Inhabitants
 - Knowledge institutions
- Building block
 - Neighbourhood
 - City
 - Region

Figure 4.15: Stakeholder framework based on scale and main focus

First, the stakeholders dealing with several themes at the time, figure 4.16.

Remarkable is the fact that it are also all the governmental institutions. This makes sense because they are responsible for the social, economic, and natural structures inside their region.

Additionally, they must work together. As explained in the introduction, the Province of South-Holland is responsible to approve policies and spatial plans of the municipalities. This hierarchy is also visible in the different scales they are operating in.

However, the responsibility of social, economic, and natural structures makes it also hard for them to focus on one topic and become very explicit in the strategy to solve this. Therefore, there are different departments which focus on a specific topic.

However, as shown in the tensions between stakeholders, this does not always contribute to forming a clear approach.

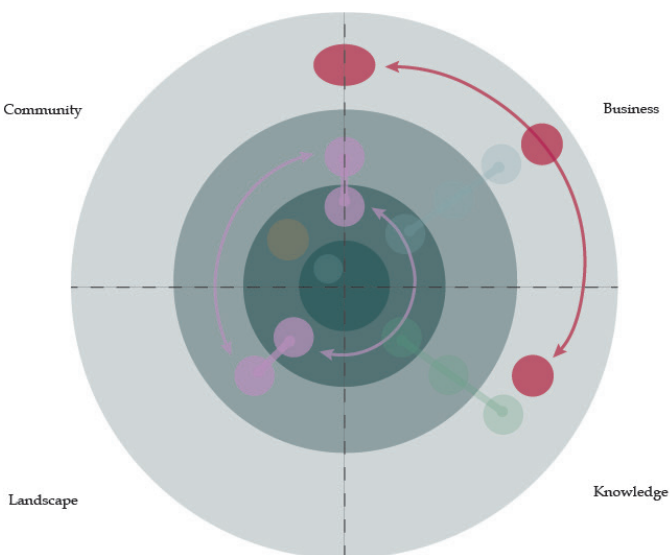


Figure 4.16: Observation 1 - Multiple focus points per stakeholder

The second observation, figure 4.17, is that some stakeholders function within several scales.

That is important because most of the time a spatial implementation also influences the other scales.

Again, the municipality plays a role, but also the knowledge institutions and companies contribute to this.

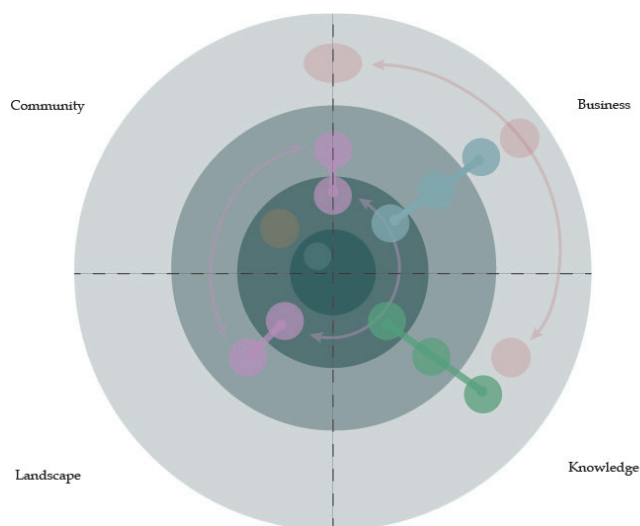


Figure 4.17: Observation 2 - Relations through the scales

The last observation is formed by the scale where almost all types of stakeholders are present, namely the neighbourhood scale.

Some of the stakeholders have connections towards other scales as well, see figure 4.18.

Only the Province of South-Holland is missing from this scale. On the other hand, they have some influence because they steer the municipalities.

Because of this observation, the example projects will be on the neighbourhood scale as well to cover as many needs and wishes as possible.

In short, what is notable is that the municipality appears in all three observations. This means that they play an important role in applying mixed-use strategies.

However, they were also appearing in the tensions between stakeholders. This indicates that there is a need for engagement strategies to make sure that the wished approach for liveability, circular economy and mixed-use is applied. These suggestions are made in chapter 6.

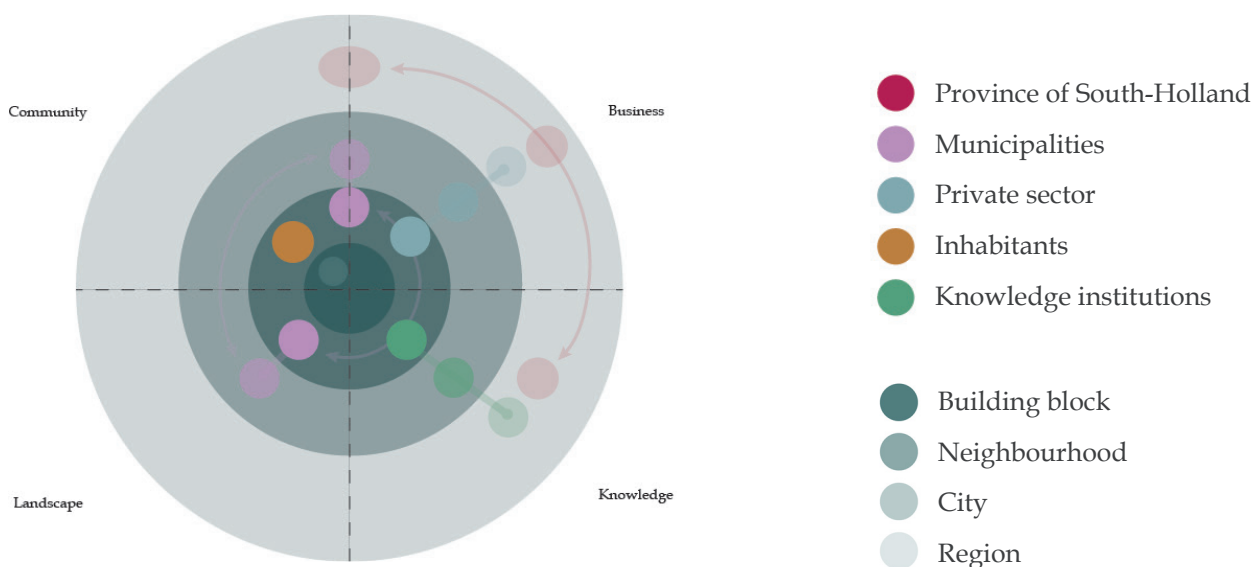


Figure 4.18: Observation 3 - Most stakeholders presented in the neighbourhood scale

‘What location is suitable to contribute to the circular economy while applying mixed-use strategies?’

As explained in the introduction, the example projects have different spatial qualities and characteristics. This chapter will analyse this into five components.

First, the history of the area is investigated followed by the observations on site. Thereafter the business park profile is discussed to see what companies are located there and how they look.

Next is an analysis based on the circularity of construction materials.

With this circularity in mind, the analyses on infrastructure are done based on the Rust, Ruis, Reuring theory as described in chapter 3. Additionally, this excludes places from mixed-use strategies and shows the opportunities for a balance between working and living. The last analyses contribute to this investigation into a liveable environment. Multiple qualities are researched to see if the business park can strengthen this network or should add facilities. This is repeated for all three example locations.

5.

ANALYSING SPATIAL QUALITIES AND CHARACTERISTICS OF THE EXAMPLE PROJECTS



5.1 | Spatial analyses on Binckhorst, the city centre of The Hague

5.5.1 | INDUSTRY EMBRACED BY LIVING

The Binckhorst is located in the middle of a polder structure that was used to win peat. As the years went by, it became way harder to collect this fuel. That is why in 1442 Delfland decided to build a quay next to the Trekvliet (water). A few years later, in 1446, a windmill was placed to transfer the water from the polder towards the Trekvliet. One windmill was not enough, so in 1459, the polder was split into two parts, namely Veenpolder and Binckhorstpolder (Unknown, n.d.).

At the beginning of the 20th century, the Binckhorstpolder still exists. The Binckhorstlaan was the only unpaved road going through this area towards the castle. The castle was the first settlement located in the Binckhorst. Nowadays the castle still stands and has become a national monument.

After 1907 the polder became part of the municipality of The Hague and the industrial area was born.

The start of this industrial function was by the realisation of the Gemeentelijke Gasfabriek at the Trekvlietplein. Their main production was focused on cars. The industrial site

enlarged and took over the polder structure (Unknown, n.d.).

At the same time, The Hague and Voorburg expanded towards each other with the Binckhorst in the middle.

The water (Trekvliet) was and still is, an important connection towards the Port of Rotterdam. This is used relatively often.

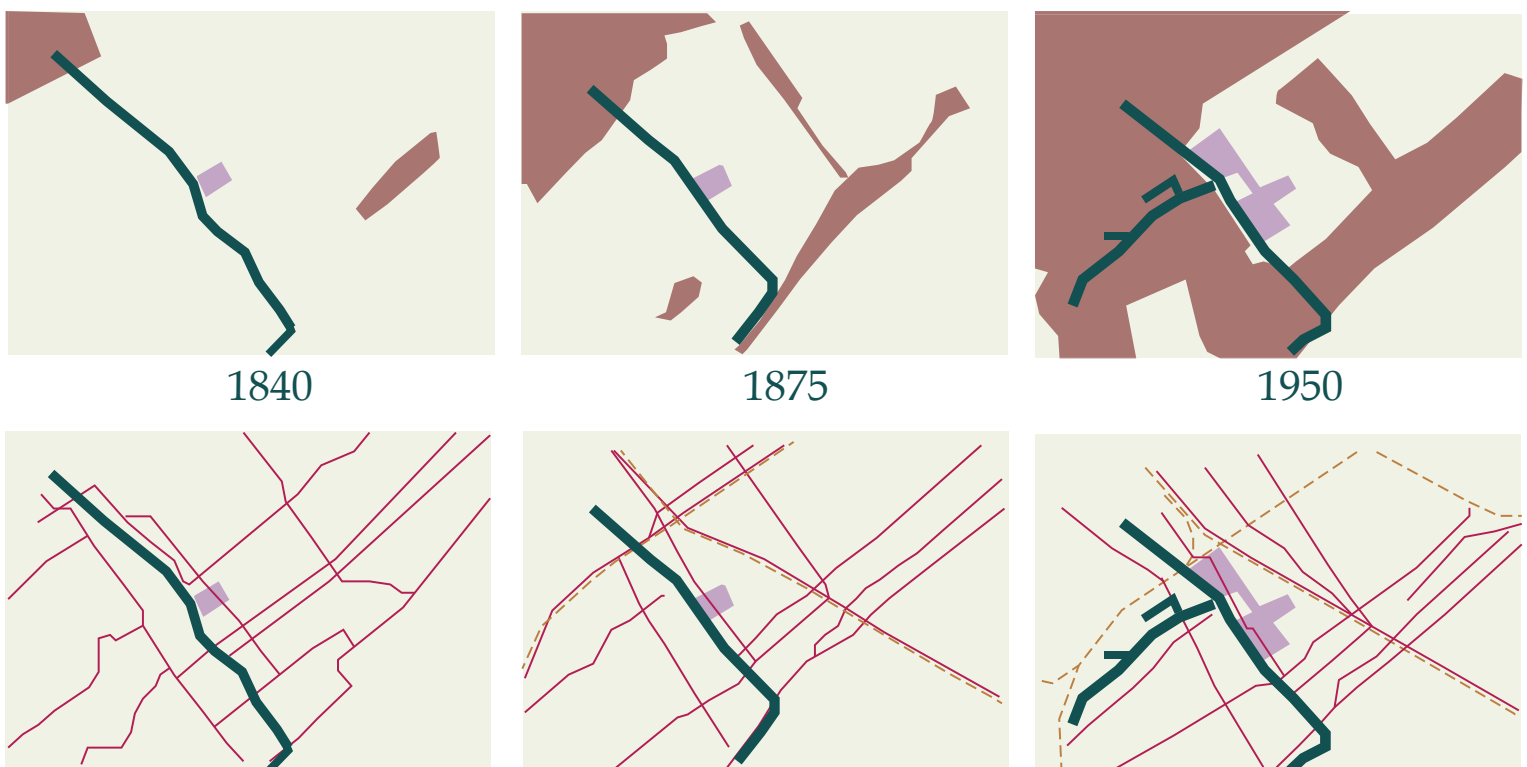


Figure 5.1: Development the urban fabric and infrastructure of Binckhorst through the years

For example, the waste processing plant and concrete producer transport a lot by water (Van den Berghe, personal contact, 06-12-2022).

However, the development of the accessibility of Binckhorst was not only determined by the Trekvliet. The first goods transportation via train in The Hague was formed in 1843. This was a train track designed by the Hollandsch Penning-Magazijn. The station, now known as Den Haag Hollandse Spoor, opened for inhabitants a few years later, namely in 1847.

Because of the slow innovation in the field of train networks, the inhabitants had enough time to get used to the nuisance the train brought. In that same year, the line was expanded towards Rotterdam and was therefore used more intensively (Unknown, n.d.).

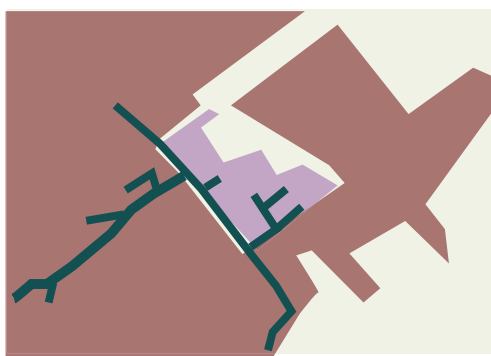
In 1870 a second train track was realised. The Hague opened a station for the line between Utrecht-Gouda-Den Haag named Rhijnspoorstation (Bezuidenhout, 2013a).

First, the train track was only used for goods. At the end of the 19th century, the train ope-

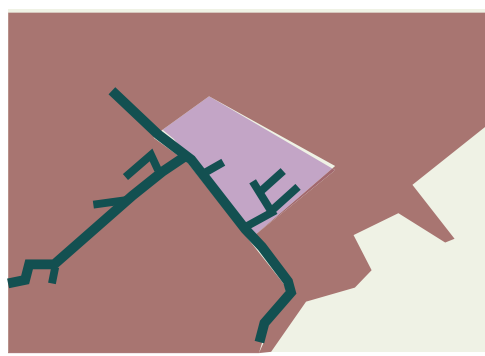
ned up for inhabitants as well.

Unfortunately, this connection was demolished and not used until the new station was built in 1976 (Bezuidenhout.nl, 2013b). At that time, the function of the train shifted completely towards the transportation of people. Goods from Binckhorst are no longer transported by train, but only use trucks and the waterways (Terlien, personal contact, 20-12-2022).

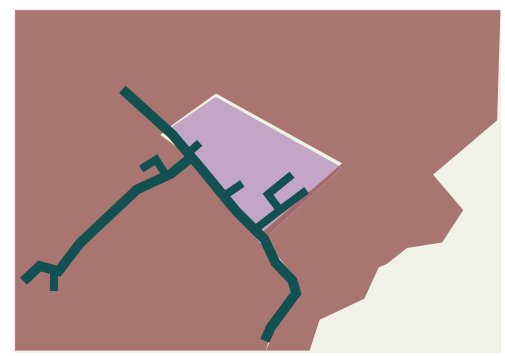
In short, The Hague was well connected towards the rest of the Netherlands and in proximity to the industry on Binckhorst. In 1953 the industrial area boomed, which results in an extra need for public transport in the form of bus lines at the Binckhorst itself. There was one bus coming from The Hague city centre towards this area daily. Later on, there were several bus lines, but nowadays this is cut down to two buses that go through Binckhorst (Unknown, n.d.).



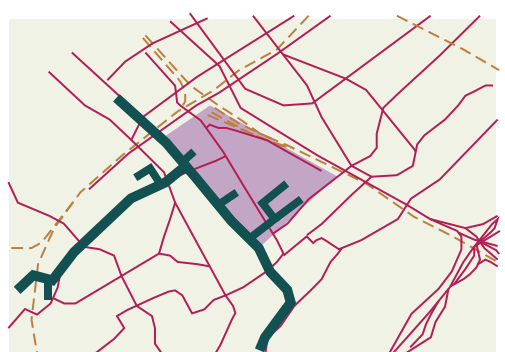
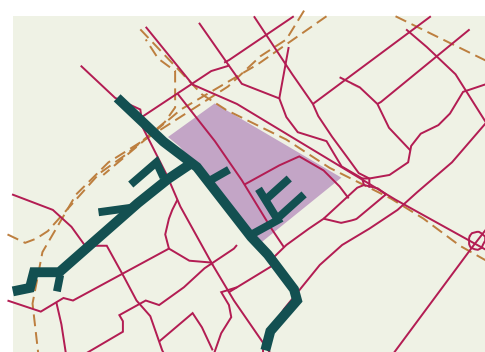
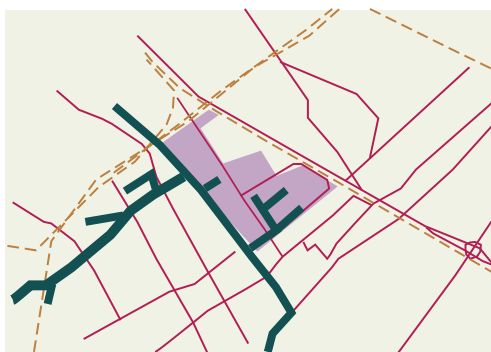
1960



1975



2022



Next to the public transport and waterways, also the road network was developed. As shown in figure 5.1 the rectangle around Binckhorst can be recognized from 1875 on. Over the years this expanded and added more sideways that connect The Hague, Voorburg and Rijswijk. The Binckhorstlaan plays a significant role. As said before, this road was the only one crossing Binckhorst. Today the road is almost enlarged into a highway and is put partly underground. The Binckhorstlaan is designed to serve the people coming in and out for their work or visiting The Hague. The Supernovaweg on the east side, following the train track, is created to manage the transport of goods and serve the industry (Terlien, personal contact, 20-12-2022).

In short, the industry shifted from car maintainers to a more mixed business park. Additionally, the trade via water and train shifted to transportation via the high and waterways.



Figure 5.2: Timeline with impressions of the Binckhorst (Pictures derived from Gemeente Den Haag (n.d.) and Unknow (n.d.))



5.1.2 | OBSERVATION: LOTS OF ACTIVITIES, BUT INACCESSIBLE

During the fieldtrip, different observations were made. The focus was on people's behaviour in the public space, accessibility for pedestrians and bikes (permeability), and the amount and use of green and unoccupied spaces which can be used differently (density).

When it comes to the behaviour of people, there were some contradictions. For example, the places that were inaccessible to people were polluted and not taken care of. Well,

other places that were in full view were painted and well-maintained. This shows that when there is no social control, the quality of the environment will decrease.

In addition, the public space created for people to meet each other was empty, while in the middle of the street, people were stopping to greet each other. That arises the question of people now use these public places and if these are accessible for everyone. When shaping the area, public spaces could be added to provide more spaces to meet.

During the observation on permeability, it became clear that at the big crossings, there was some guiding by traffic lights. However, deeper inside the industrial plants the fences were closed, and sidewalks became smaller and were taken over by grasses.

It needs to be considered that sidewalks will be used more often, and the movement of pedestrians should increase. This asks for a different view of the infrastructure there is now.

The grasses on the sidewalks were not the only vegetation at the Binckhorst. The cemetery of St. Barbara has a wide variety of plants and even water structures. The rest of the greenery is monotonous, inaccessible, and easily maintainable.

This could be reinforced by adding walking routes and connecting parks from surrounding neighbourhoods with the cemetery in the Binckhorst.

When it comes to unoccupied spaces, there are some wastelands. Some are full of sand and others have some grass on them. However, they are inaccessible, and the view is blocked by the fences. When proposing mixed-use at Binckhorst, these places can serve as land for horizontal mixed-use.

There were also vacant or badly maintained buildings. These could also be repurposed and in that way help reduce the pressure on the housing market.



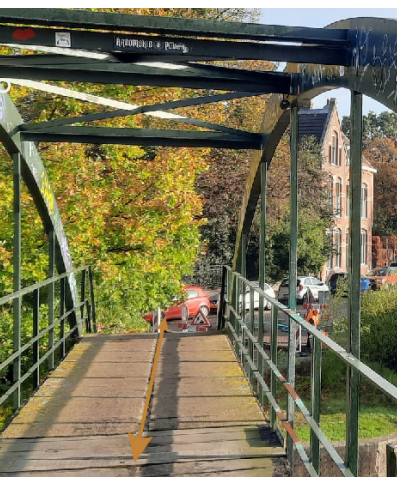
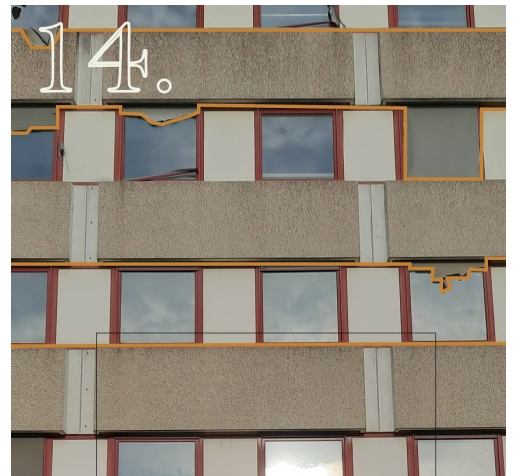


Figure 5.3: Selection of different photos taken during the fieldtrip (31-10-2022 and 06-12-2022)

5.1.3 | BINCKHORST PROFILE: CONSTRUCTION WASTE OFFERING A CHANCE FOR A CIRCULAR ECONOMY

The Binckhorst is designed to house disruptive companies with a high environmental factor. Therefore, this location serves a lot of employment opportunities and is well accessible. The density of the area differs a lot and leaves sometimes big open spaces which are unoccupied. In addition, the average height is between one and three layers with some exceptions of high rise.

Because of this amount of space and companies, there is also a lot of waste. However, most of this is transported via water towards the port of Rotterdam. The waterway is therefore very important in the development of this area.

The biggest waste flow contains construction materials. The waste is mostly recycled, distributed to other places, and burned to gain energy from it. However, the reuse part has a bigger influence on the R-ladder, so this reflects in points of improvement.

To achieve this, Binckhorst must offer a circular craft centre where people can bring and re-

pair their products while facilitating start-ups and high-quality and innovative companies.

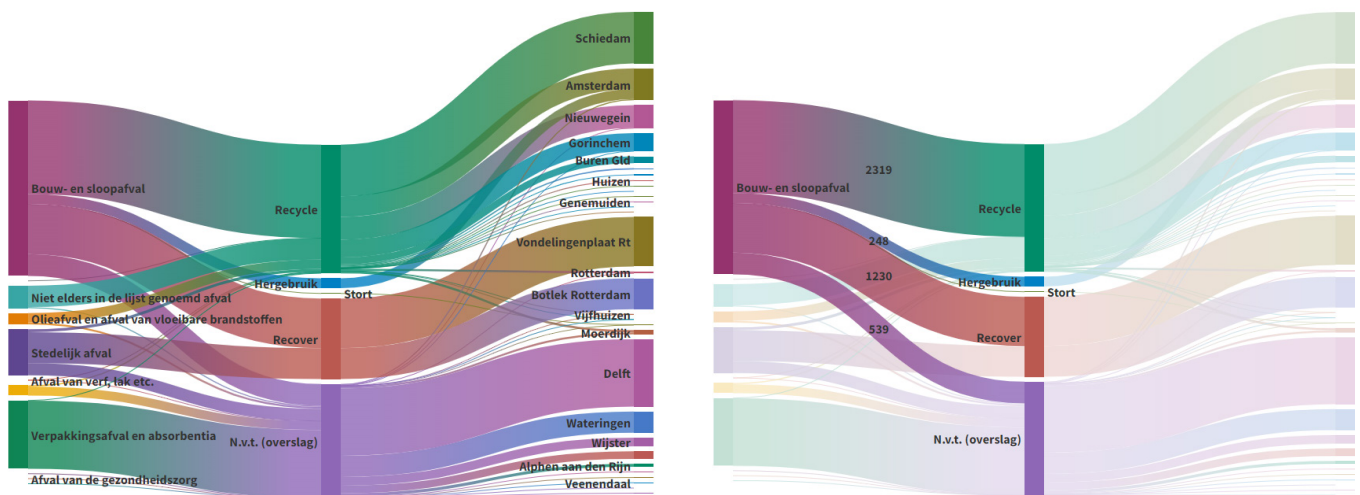


Figure 5.5: Waste streams Binckhorst with specific focus on construction materials (Provincie Zuid-Holland, Provincie Groningen, Provincie Limburg, Stec Groep, & New Economy, 2023)



CHARACTERISTICS

- Surface 80 hectares
- FSI: $\pm 0,0 - 0,5$
- GSI: $\pm 0,2 - 0,4$
- OSR: $\pm 0,5 - 5,0$
- Layers: $\pm 1-3$
- Approximately 89 companies with 5603 employees are located in Lansinghage.
- Environmental factor business park is 4.1
- Access via highway A12, A4 and N44. Train stations, Den Haag Centraal and Den Haag HS nearby. Additionally, the water towards Rotterdam plays an important role by transporting goods.

WASTE PROCESSING

- 8286 tons of waste per year
- 1424 trucks to distribute the waste
- Largest waste flow is the one of construction materials which are produced when dwellings are constructed or demolished.

Specific focus on construction materials:

- 248 tons to reuse
- 2319 tons to recycle
- 1230 tons to recover
- 539 tons to distribution
- 13 tons to dump

OPPORTUNITIES FOR A CIRCULAR ECONOMY

- | | |
|----------------|-----|
| • Reuse | 3% |
| • Recycle | 39% |
| • Combustion | 24% |
| • Distribution | 34% |
| • Dump | 0% |
- Spatial qualities and characteristics, like the connection via water, great accessibility and close to the urban landscape, should be reinforced.
 - Circular craft centers, start-ups and high quality industries could help shifting towards a circular economy.

Figure 5.4 Context of profile Binckhorst

(Dataset: CBS_buurten_2019; Provincie Zuid-Holland, Provincie Groningen, Provincie Limburg, Stec Groep, & New Economy, 2023)



Figure 5.6: Companies related to their construction material at the Binckhorst (Scale 1.6000, 50% reduced. Illustrations from fieldtrip 31-10-2022 and google earth, 2023)



Next to the urban processes, also Binckhorst itself has something to do with this relatively big construction material waste flow. Most companies deal with wood or a mix of all construction materials. The production process of wood offers enough possibilities to become more circular, so this report wants to find out how Binckhorst relates to this.

The plot sizes differ for each company, but most of them are relatively big. Especially the ones dealing with several construction materials have big spans and paved storage places next to them. They are close to the Binckhorstlaan, which is not even meant to serve for the transportation of goods. This arises the question if the infrastructure of Binckhorst offers the right thing.

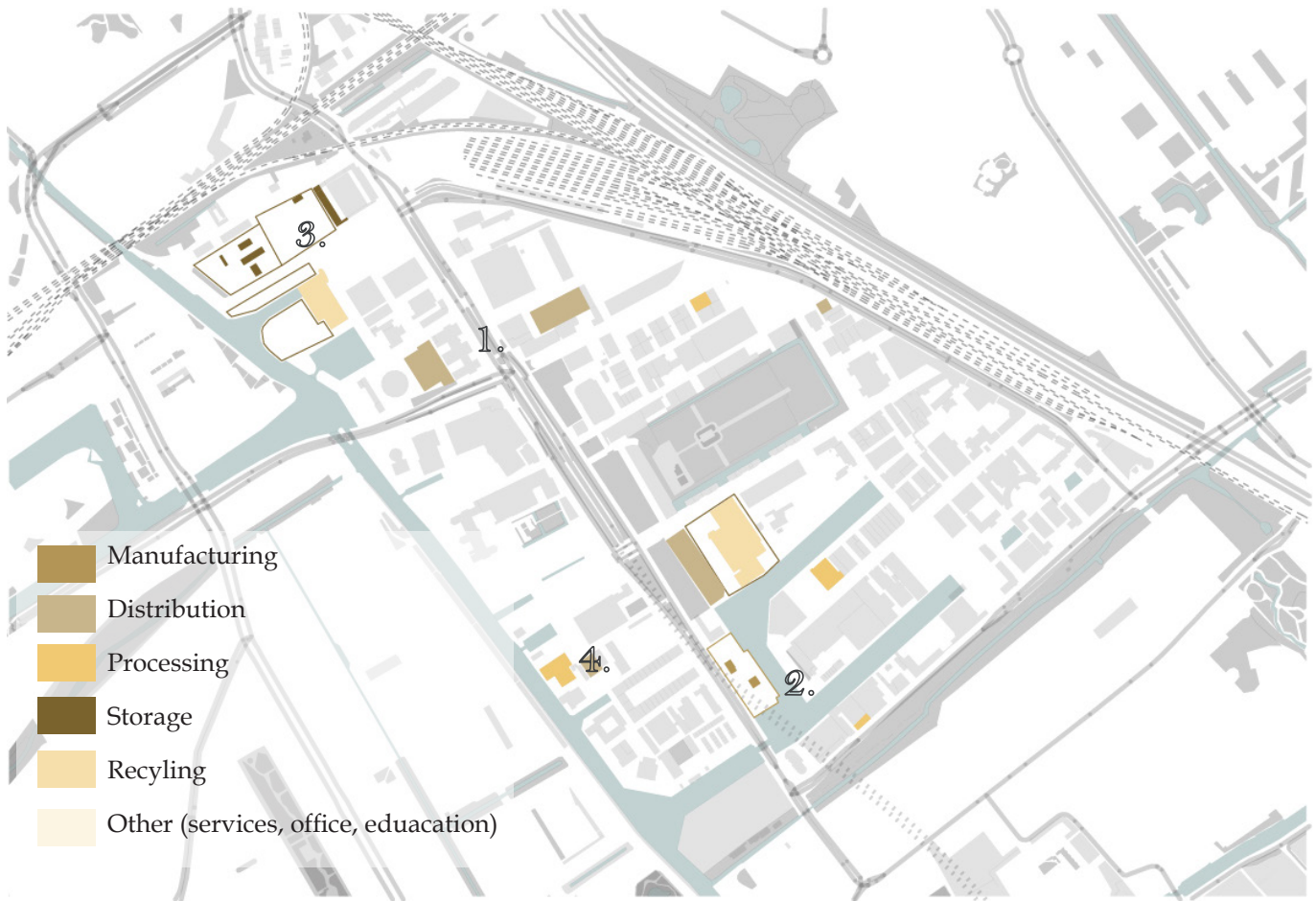


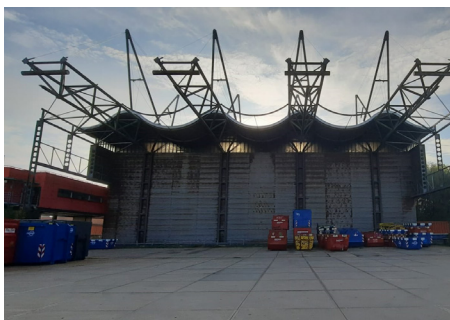
Figure 5.7: Companies related to their production stage at the Binckhorst (Scale 1.6000, 50% reduced. Impressions partly from fieldtrip (31-10-2022 & 06-12-2022) and collected from Hercuton, n.d., and Agnieska & de Haas, n.d.)



1.



2.



3.



4.

When looking at the production stages these companies are in, it becomes clear that each stage of the material flow is present.

The collection and manufacturing of materials take more open space than for example the processing. However, the plots of recycling and distribution are the largest buildings there.



Figure 5.8: What are the zones that need to be retained for industry at Binckhorst? (Scale 1.6000)



With the help of the data set provided by the Province of South-Holland and SBI codes, each company is illustrated with its environmental buffer. This creates three zones within the Binckhorst, see figure 5.8.

Firstly, zones 1 and 3 are containing mainly disruptive companies. They are focused on the collecting, manufacturing, and recycling of materials. These places are important to the city because it takes care of the waste originating from the urban processes and should therefore remain in proximity to the residential areas.

Besides, the connection towards the water and its relationship with the Port of Rotterdam should not be unnoticed. The result is that these places need the distances that the environmental factor facilitates. Due to the environmental qualities the transition towards a function like living is therefore not wished.

Secondly, a zone which is way smaller and does not consist of disruptive companies. Zone two is surrounded by a lot of open spaces which could form a base for new functions.

However, the transportation routes play an important role if dwellings want to be mixed with this kind of distribution centres.

However, the rest of the Binckhorst provides a great living space with proximity to the amenities the city has to offer and amazing accessibility. The result is that even though some zones are not suitable for mixed-use, they should be adapted to become accessible for future residents.

Furthermore, this contributes to the opportunities for a circular economy at Binckhorst. All stages of the production process are there, there is enough open space which can be reused, and the environmental qualities facilitate a nice business climate

5.1.4 | CONSTRUCTION DEVELOPMENTS FOCUSED ON THE EASTERN FLANK OF THE HAGUE

As becomes clear in the previous analyses, there is some space for the storage of biobased materials and prefab elements. To see which are needed where figure 5.9 is illustrated.

This map shows the buildings with a construction year before 1970 and an energy label higher than D because these outdated buildings will need to be replaced in the coming years. Besides, future construction developments are mapped to see where construction materials are also needed.

Firstly, the buildings with a low energy label are spread across The Hague. The city centre houses the older buildings.

Additionally, the new construction sites or renovations are planned in a line crossing the Binckhorst, see figure... Also, the outdated buildings at Binckhorst itself are planned to be demolished and rebuilt.

Next to these two developments and the fact that The Hague does not have many of these business parks, this business park is a great place to shortly store elements that could be reused elsewhere in The Hague. The biobased materials which can be used in for example isolation are mostly needed in the southeast side of The Hague, while prefab elements are more demanded in the north.

Besides, the connection with other business parks outside the city needs to be strengthened. In that way, the construction materials can be distributed throughout the rest of the region.



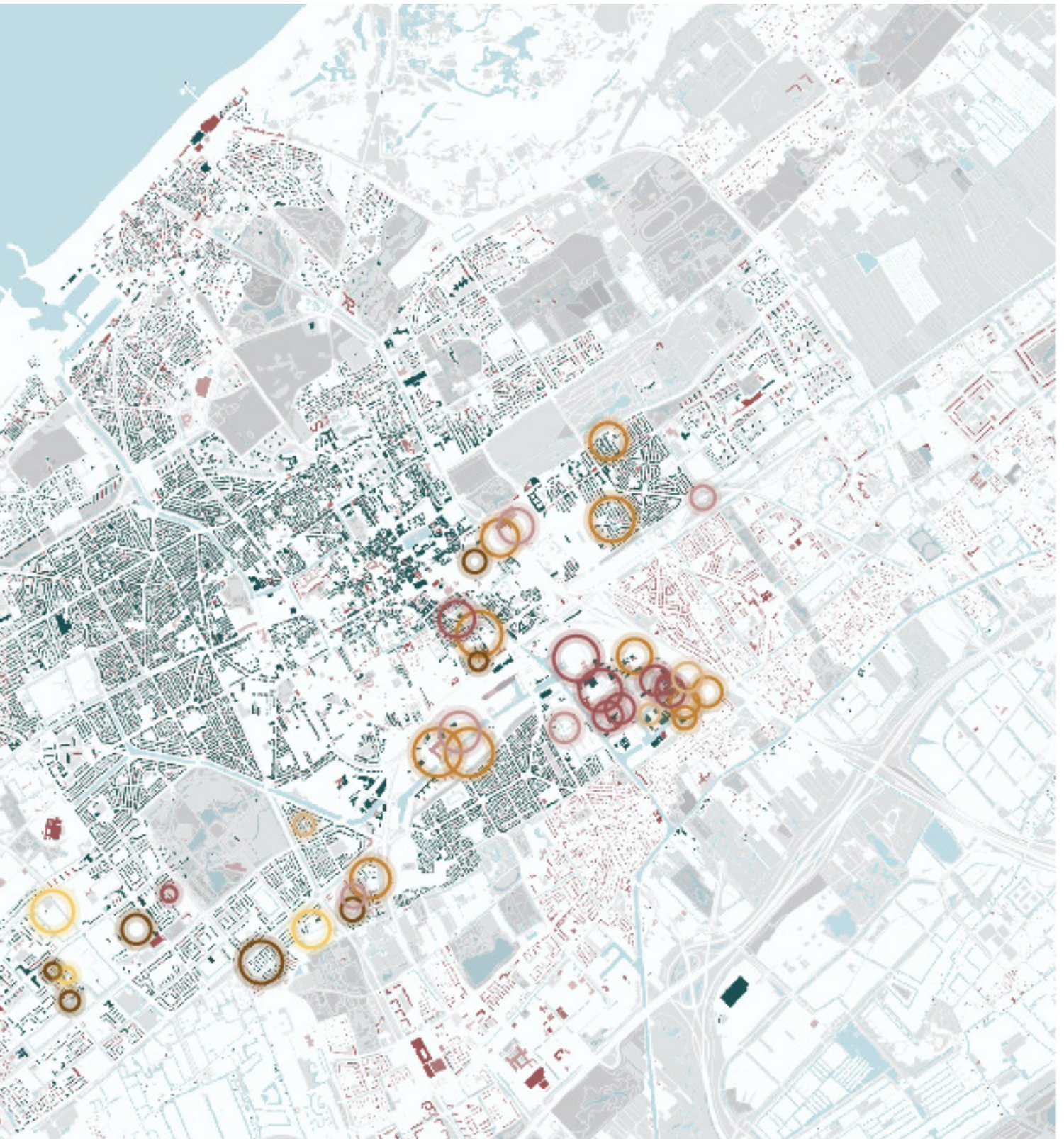


Figure 5.9: New developments mostly located at the eastern flank away from the older buildings
(Scale 1.50000)

5.1.5 | INFRASTRUCTURE MOSTLY SERVING 'REURING' AREAS

As discussed in the introduction and earlier analyses, the infrastructure can cause conflicts when mixed-use is applied. Therefore, these analyses focus on how they relate to the companies at the business park, how the infrastructure relates to the different users, and what kind of atmosphere they create.

What becomes clear is the fact that water is an important spatial quality for some companies. For ages, they are located next to the quay and transport products and waste to the Port of Rotterdam.

This way of transportation reduces the need for trucks, which gives opportunities for Binckhorst to separate the infrastructure.

Next to the water serving the industry also the Supernovaweg is designed for the transportation of goods, in this case via trucks. This creates a ring route around the business park and

leaves space for, for example, cars and bikes at the Binckhorstlaan. As figure 5.12 shows, this network connects shops, offices, leisure activities and so on.

An opportunity for this business park is to improve the slow traffic network. Right now, the connection via public transport is great. However, the road network at the Binckhorst itself could be better accessible for pedestrians and bikes. In that way, the islands of greenery form a starting point to reinforce the permeability.



Figure 5.10: Transportation of goods via water
(Scale 1.6000, 25% reduced)

Figure 5.11: Road structure assigned to transportation of goods by trucks
(Scale 1.6000, 25% reduced)



Figure 5.12: Car-oriented road network
(Scale 1.6000, 25% reduced)

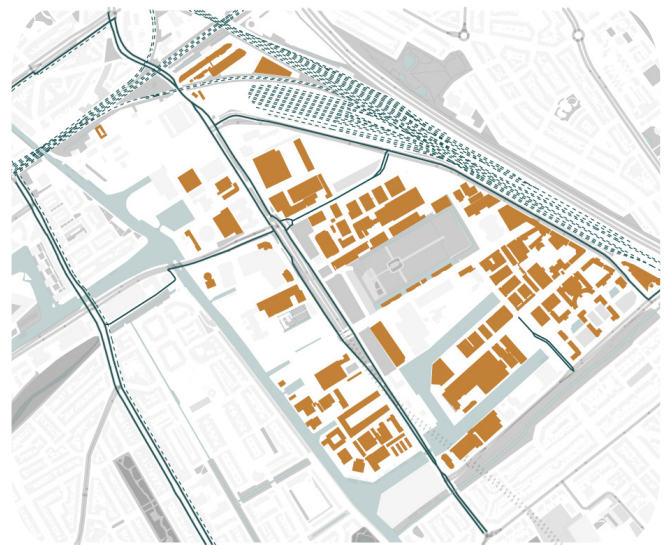


Figure 5.13.: Roads facilitating slow traffic
(Scale 1.6000, 25% reduced)



Figure 5.14: Infrastructure that is not suitable to mix (scale 1.6000, 50% reduced; based upon Ruis)

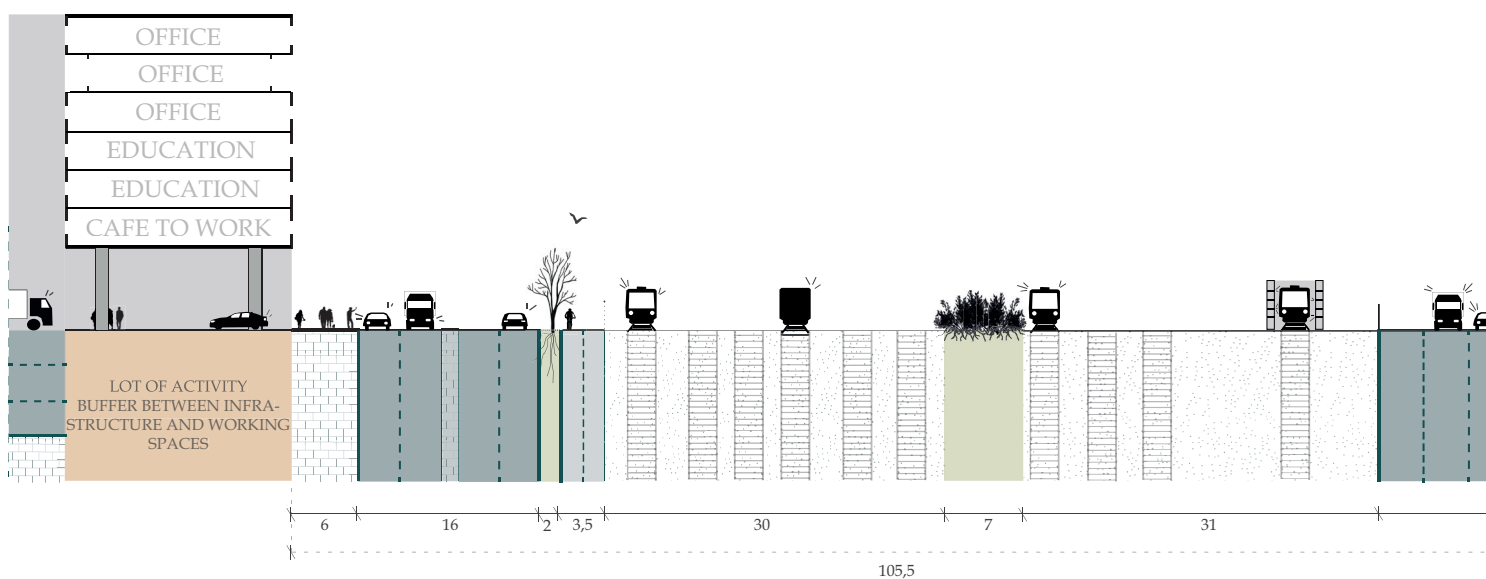


Figure 5.15: Section A Binckhorst- Supernovaweg, train track and high way (scale 1.500, 75% reduced)

As explained in the literature review, there is a division between rust, ruis and reuring when speaking of the infrastructure.

Figure 5.14 shows the 'ruis', which refers to the infrastructure connected to the noisy and disruptive industry. The circles formed by the environmental factor of the companies show where the nuisance businesses are.

As said before, the Supernovaweg and the water play an important role in transporting goods and waste from these locations. Together with the highway, these form a major thoroughfare, see figure 5.15.

Therefore, this network is mostly designed to connect the Binckhorst on a regional scale. People from the rest of the province can easily access this area for their work or to buy their products.

As shown in the section, some of the buildings work as a barrier between the noisy industry and infrastructure and the less disruptive processes on the other side. With arcades sightlines are created that show the passage of this area. With this structure, a lot of different road users can come together.

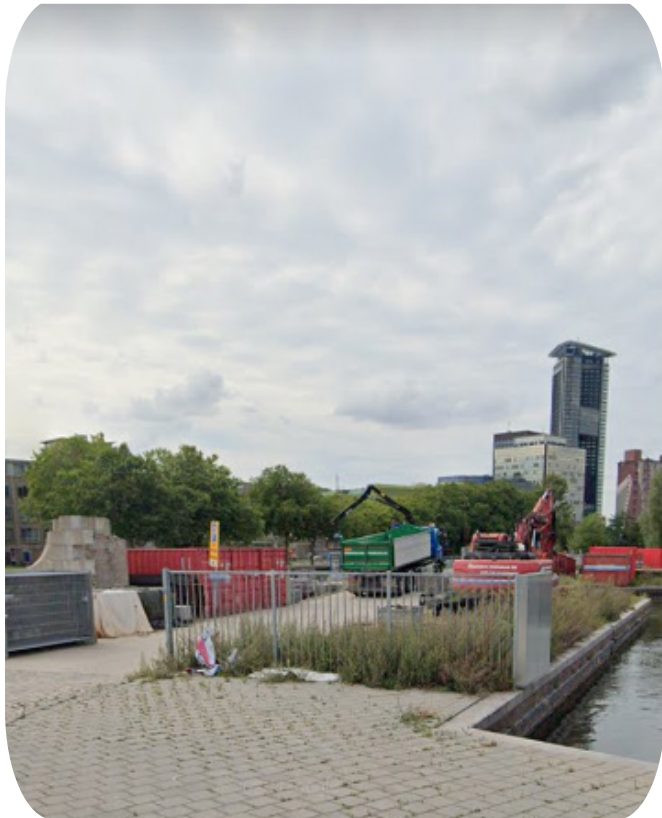


Figure 5.16: Spaces for storage and distribution connected (Photo 1, google earth, 2023; photo 2, field trip 31-10-2022)



Figure 5.17: Commotion determines infrastructure (scale 1.6000, 50% reduced; based upon Reuring)

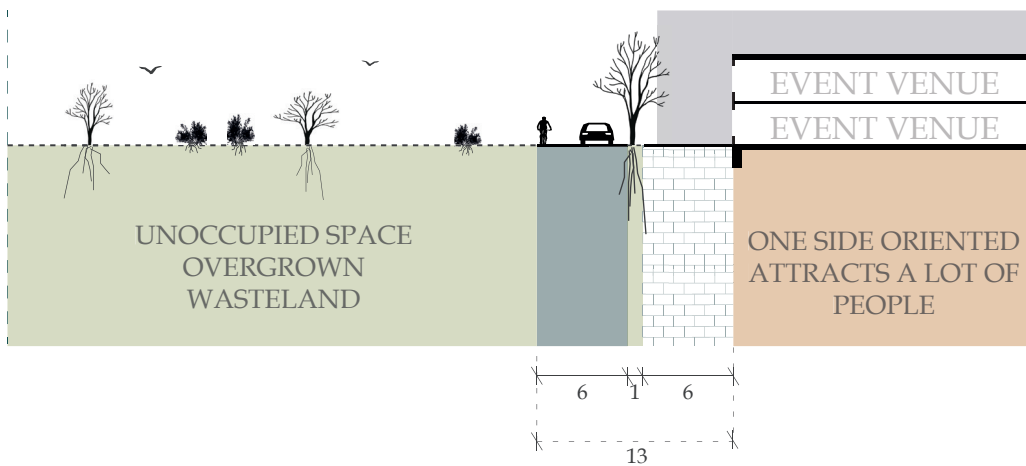


Figure 5.18: Section B Binckhorst- Under used spaces which can be transformed into an active environment (scale 1.500)

A different road structure is formed by the 'reuring'. These roads deal with the commotion of functions and can combine working and living.

The Binckhorstlaan appears as a spine in the centre of Binckhorst. The rest of the roads are connected towards this middle part. The orientation of the companies is sided towards the side streets, instead of Binckhorstlaan. That means that the street network itself creates already a hierarchy.

At the Binckhorst are some wastelands which could form opportunities for future design. These locations are mostly badly maintained as illustrated in figure 5.18. This creates an opportunity to develop new dwellings to apply mixed-use at the Binckhorst.

The companies next to these roads focus on

services, like sports, events, and workshops. Because this network serves different functions, the roads are classified for different users and are highly accessible.

Unlike the previous roads, these are designed to connect the Binckhorst on the city scale. Some are accessible for multiple vehicles, while others are focused on car use.



Figure 5.19: Access to multiple types of vehicles
(Photo 3 and 4, field trip 31-10-2022)

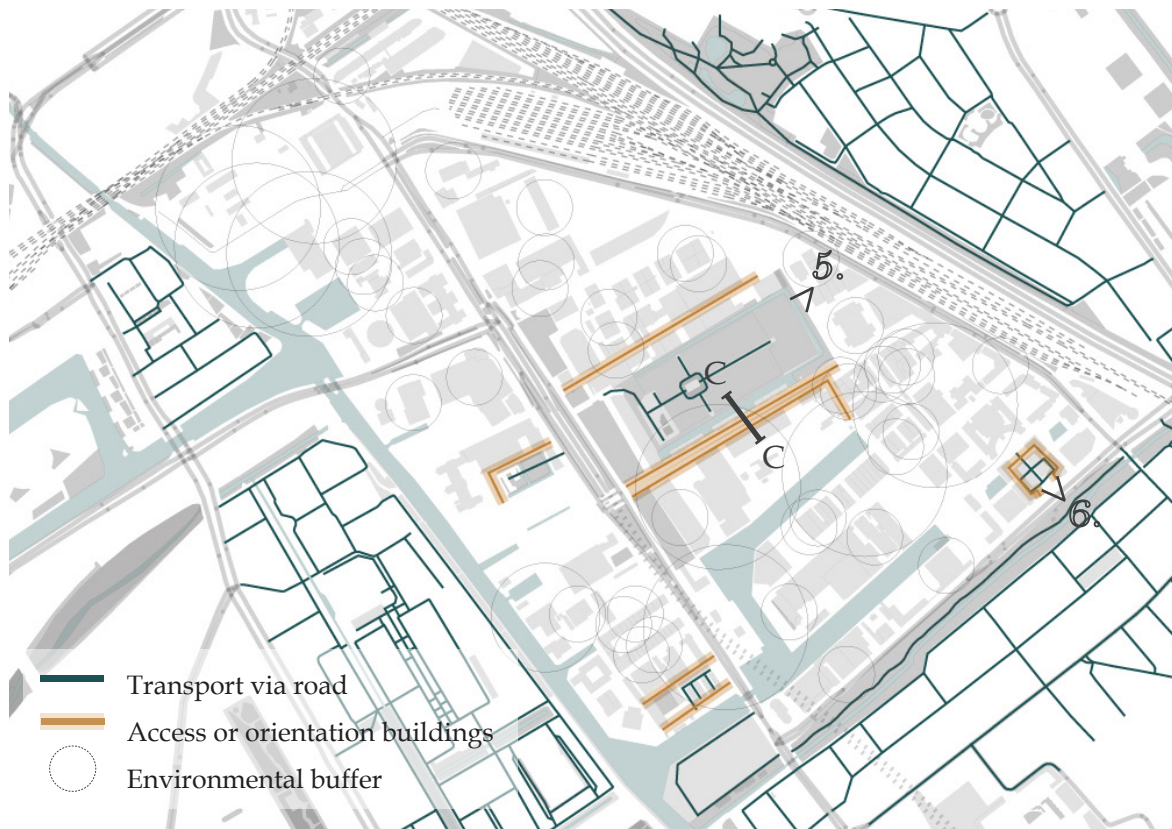


Figure 5.20: Places that ask for quietness and slow traffic (scale 1.6000, 50% reduced; based upon Rust)

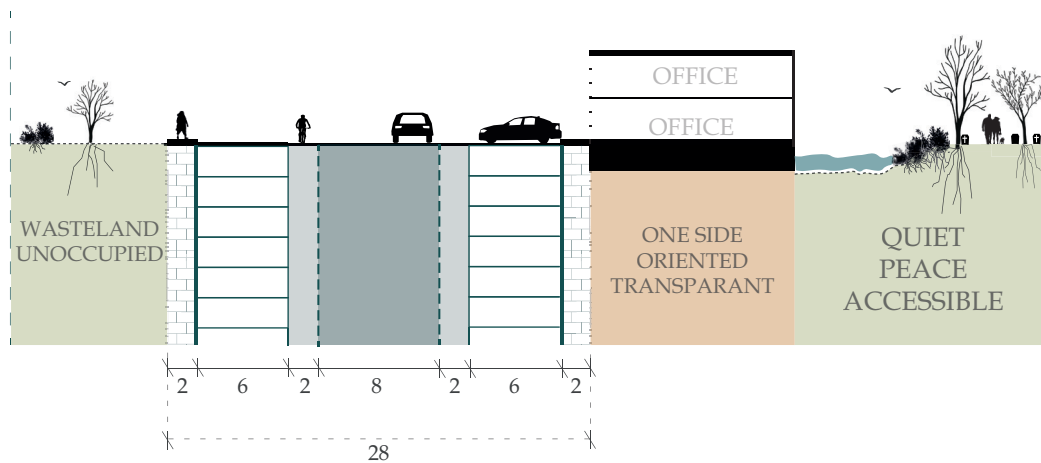


Figure 5.21: Section C Binckhorst- Separation facilitated by building (scale 1.500)

Lastly, the roads that are referred to as ‘rust’ are further away from the disruptive companies. They are mostly located in the greenery or in residential areas because they are designed to serve the living environment.

The separation of working and living is a must in this network. What is visible in figures 5.20 and 5.22 is that their locations are mostly reserved for for example the cemetery or the castle.

The orientation of the buildings plays an important role in the separation of the streets and the greenery. In that way, the cemetery stays accessible but also reserved.

These areas are not well connected so a new spatial plan for Binckhorst can reinforce these quiet surroundings.



Figure 5.22: Quiet areas separated by stairs or wall (Photo5 and 6, field trip 31-10-2022)

5.1.6 | RELYING ON THE REST OF THE HAGUE

Next to the analyses done on how Binckhorst relates to the (circular) economy, it is also important to see which environmental qualities the surrounding already has to offer and which should be reinforced.

Again, this can be linked to the zones constructed by the environmental factors which imply opportunities to meet with your colleagues.

On the other hand, also the connection towards the rest of The Hague needs to be researched to see what facilities there for future residents are.

As the introduction chapter already explains Binckhorst has access to all kinds of amenities that the city centre of The Hague has to offer.

However, when you want to walk around Binckhorst during a lunch break from work, it can be noticed that only the centre of Binckhorst greenery is situated and the south part offers places to grab lunch. Leisure activities such as events, the skate hall and art workshops are again located only in the south part of the business park.

On the other hand, Binckhorst is embraced by amenities. Due to the centrality of this business park shops, educational and recreational facilities, and offices are close by. This reflects in the fact that when the permeability of this location is improved, the industrial site can use the functions that The Hague has to offer.

Zooming out this slow traffic network already embraces the business park. The network spreads especially towards the city centre and the beach.

The network of amenities, infrastructure for pedestrians and bikes and transparency of the businesses contributing to the circular economy could be connected to these routes to not only serve the surrounding neighbourhoods of Binckhorst but the rest of The Hague

and surrounding landscapes as well.

In short, opportunities for Binckhorst lie in connecting the surrounding parks better with the green heart of this business park.

Furthermore, the north side of the area can benefit from adding more amenities or otherwise a slow traffic network towards the south side or rest of the city where these locations are already realised.



Figure 5.23: Patchwork of greenery
(Scale 1.6000, 50% reduced)



Figure 5.24: Regional slow traffic network connecting Binckhorst to the rest of The Hague
(Scale 1.50000, 50% reduced)

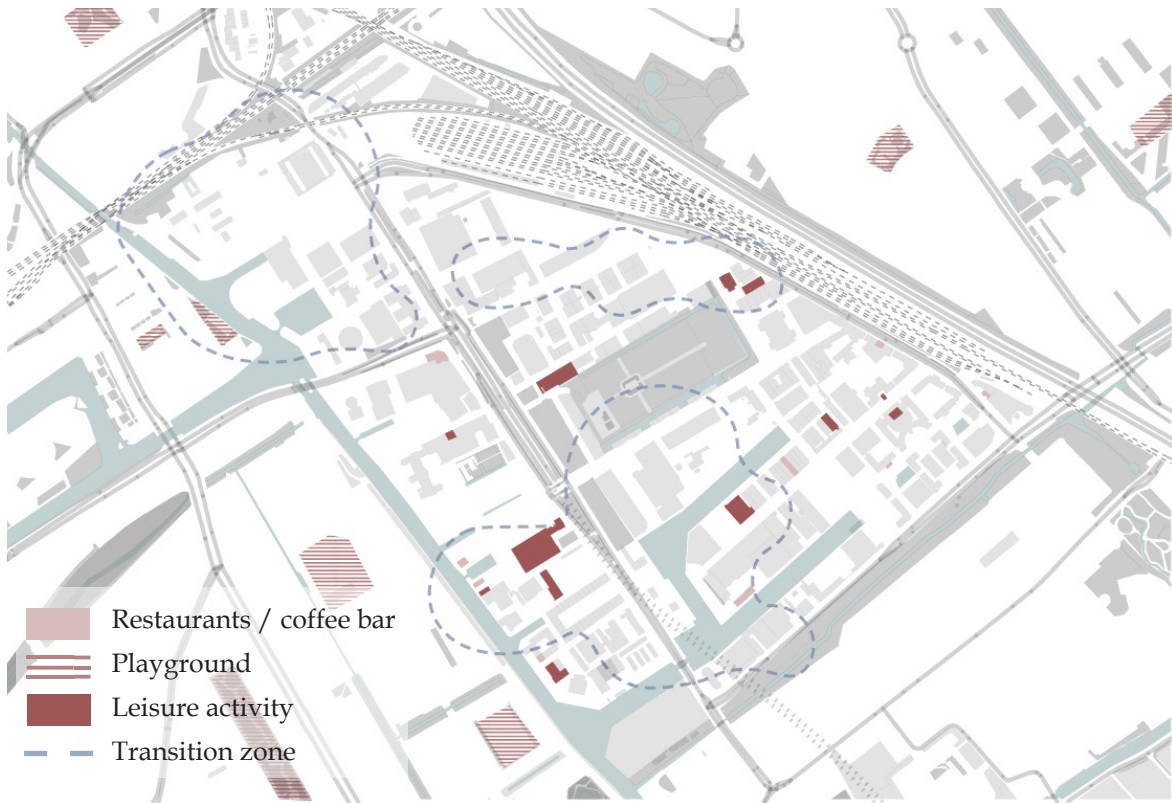


Figure 5.25: Meeting places related to zones within the Binckhorst
(Scale 1.6000, 50% reduced)

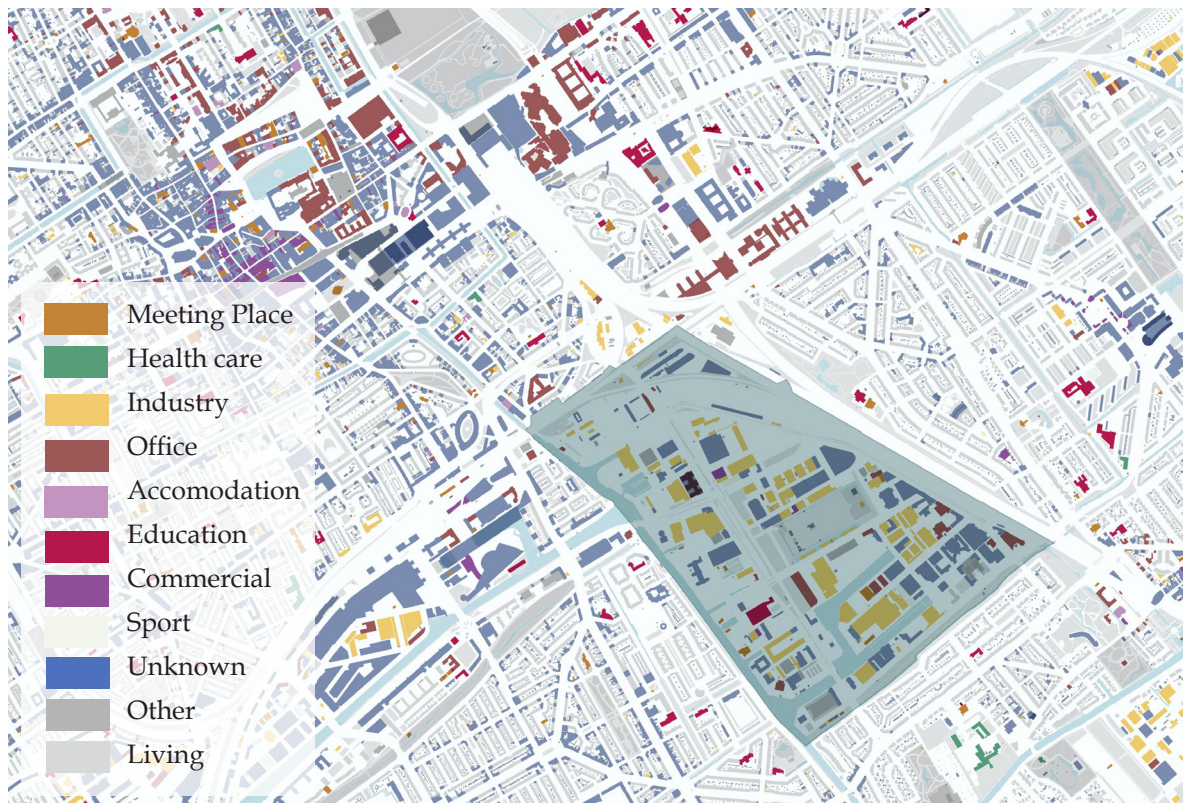


Figure 5.26: Amenities surrounding the Binckhorst
(Scale 1.15000, 50% reduced; based upon dataset BAG pand)

5.2 | Spatial analyses on Lansinghage, the periphery of Zoetermeer

5.2.1 | THE INFLUENCE OF WATER

The city of Zoetermeer originates from the lake Het Soetermeerse Meer. Because of this water, the main business was mostly driven by fishermen.

However, at the beginning of the 18th century, people started creating land by draining the Binnenwegsepolder with the help of the municipality of Rotterdam. Due to the lack of money, this could not be completed, resulting in the polder being full of water by 1750.

Again, they tried to drain the water, this time with the help of an artisan from Zoetermeer who offered his help in exchange for 2/3th of the created land. They completed the job which means that by 1770 Het Soetermeerse Meer was no longer a lake, but a place to settle down (Gemeente Zoetermeer, n.d.).

On the other hand, this results in a shift in industrial processes as well. The fishermen had no longer the place to develop their companies and with the arrival of the train station in 1870 the business ecosystem changed completely.

This train track connected The Hague and Utrecht with a stop on the station what we call no Zoetermeer Oost. In that way, Zoetermeer became an interesting place to house companies like Nutricia and Spar, and butter producers found their way to this location (Geschiedenis van Zuid-Holland, n.d.).

The second world war negatively influenced the accessibility of this place. They closed the station for inhabitants and used it for their practice.

However, after the war, in 1965, the station opened again. The name shifted to Zoetermeer Oost because the new station Zoetermeer was realised. In 2018 a third station, Lansingerland, improved the accessibility of Zoetermeer even more (Van Vlaardingen, 2020).

Next to the transportation via train, also the construction of highway A12 plays an important role. This allows trucks to enter the business parks like Lansinghage and reduce commuter distances. The emergence of the highway strengthens the connection towards the rest of the Netherlands.

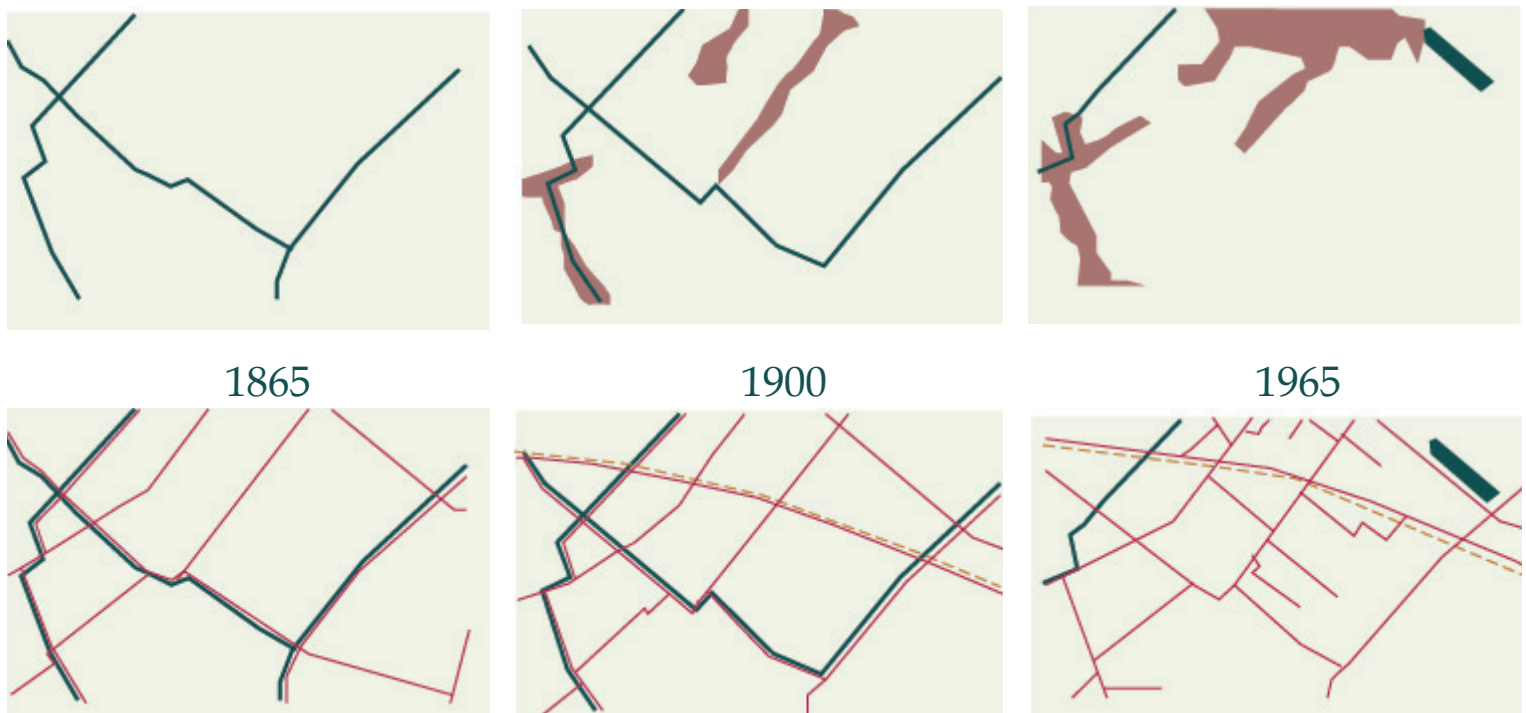


Figure 5.27: Development the urban fabric and infrastructure of Lansinghage through the years

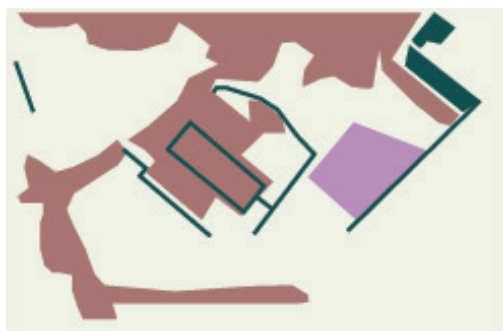
That same war and accessibility also affected the urban development of Zoetermeer.

This place was pointed out to be a 'groei kern'. This meant that right after the war there were 10.000 inhabitants, but by 1991 this expands to 100.000 (Geschiedenis van Zuid-Holland, n.d.).

This expansion mostly follows the structure of the former polders and creates a new city centre on the northwest side of Zoetermeer.

The latest expansion was Rokkeveen and Lansinghage around 1998. The reintegration of the water is remarkable in this neighbourhood. As said before, the lake played an important role in the emergence of Zoetermeer. In urban design for Rokkeveen, this origin comes back. The neighbourhood has several ditches that run parallel to the street network (Gemeente Zoetermeer, n.d.).

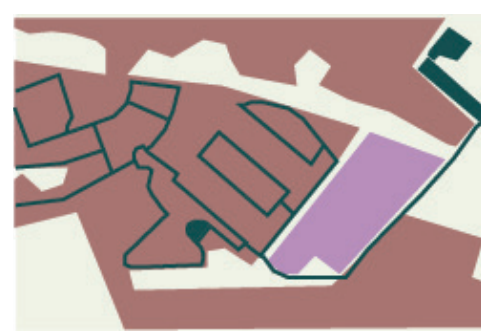
Next to the growth in residential and industrial areas, also agriculture started to pop up on the south side. In that way, the economy of Zoetermeer became more diverse and created a great working and living environment.



1998



2000



2022

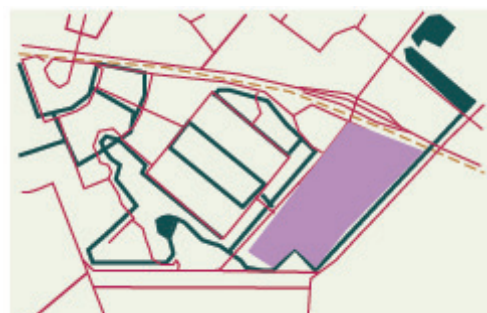




Figure 5.28 Timeline with impressions of Zoetermeer
(Pictures derived from Zoetermeer mijn stad, n.d. & Van Vlaardingen, 2020)



5.2.2 | OPPORTUNITIES TO CONNECT TO THE SURROUNDING AREAS

As said before, the observations of the field trip were based on people's behaviour, permeability, the quality of greenery and the opportunities to optimally use the space.

As becomes clear from walking through and around Lansinghage, the neighbourhoods embracing the area are full of amenities, activities, and places to meet. Playgrounds, small libraries, parks, sports, public transport, and educational facilities are located nearby. However, the business park itself does not add to this and forms an island on its own.

This provides opportunities to strengthen the relationship between Lansing-

hage and Rokkeveen by creating amenities that attract people to the business parks.

Secondly, the accessibility for pedestrians and bikes is disappointing. There are view sidewalks, but they just end out of nowhere. Besides, public transportation is no longer available.

This makes it clear that the infrastructure is designed for cars and trucks which asks for slow traffic to strengthen the place its permeability.

Just like Binckhorst the greenery at Lansinghage is easily maintainable. Grasses grow everywhere and are not diverse.

However, on the southeast side of the business park is a beautiful park. This contributes to the Weleda company which is located next to it and uses the park to teach people more about their eco-friendly products. As a response, the rest of the park also develops insect hotels, various vegetation and sightlines to provide a nice walk. This structure could be connected to other parks of Zoetermeer to reinforce biodiversity.

Lastly, there are not a lot of open paved areas, but still, some available space in Lansinghage is not used optimally. In addition, the height of the companies is almost everywhere the same.

These blind boxes of two high could be redesigned to improve the streetscape. In that way, also vacant buildings could be reused to create a nice atmosphere.

In short, that means that the observations may be different from Binckhorst, but the guidelines which should be followed to improve the areas are the same.



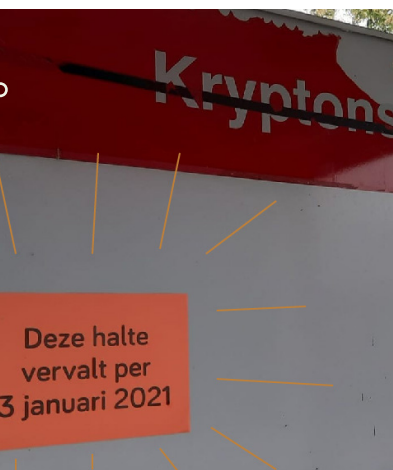


Figure 5.29: Selection of different photos taken during the fieldtrip (26-09-2022, 27-09-2022 & 28-09-2022)

5.2.3 | LANSINGHAGE PROFILE: FOCUS ON METAL INDUSTRY AND MIX OF FUNCTIONS

Lansinghage provides a lot of working employment for the city and offers spaces for heavy industry based on its high environmental factor. That is why the place does not have a lot of open space.

However, the average height of the buildings is 2 stories high, which means that the density of the area could be improved.

Important to point out is the fact that this location requires more trucks to transport their waste than for example Binckhorst. This is possible because of the great transportation network that connects Zoetermeer to the rest of the province.

On the other hand, this waste flow is not yet circular. Most of the materials are distributed to other locations where the waste will be processed. There is a part which Lansinghage recycles, but when it comes to circular strategies that are higher up at the R-ladder, like reuse and repair, the business park has a lot to improve.

Looking at the waste flow of construction materials, it becomes clear that this is the second-largest waste flow of Zoetermeer. Most part is again distributed to other places. This

brings the potency of reusing and recovering the construction materials even more when redesigning this business park.

When inhabitants and employees can gain more knowledge about this, the awareness and behaviour of people will be influenced. This can be done by adding circular craft centres, opening the plinth, and organising open house days with companies. This influences the rethinking, reducing, and refusing of the current waste stream.

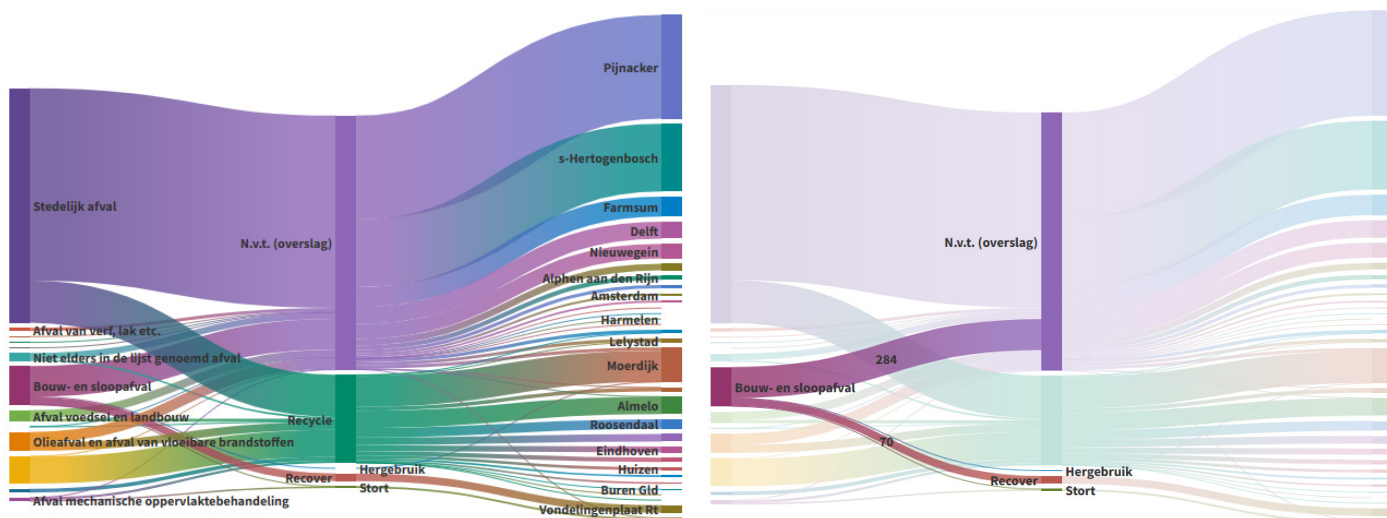


Figure 5.30: Waste streams Lansinghage with specific focus on construction materials (Provincie Zuid-Holland, Provincie Groningen, Provincie Limburg, Stec Groep, & New Economy, 2023)



CHARACTERISTICS

- Surface 66 hectares
- FSI: $\pm 0,0 - 0,5$
- GSI: $\pm 0,3 - 0,5$
- OSR: $\pm 0,5 - 1,5$
- Layers: $\pm 1 - 2$
- Approximately 100 companies with 5671 employees are located in Lansinghage.
- Environmental factor business park is 4.2
- Access via highway A12, N470 and train track Utrecht-The Hague

WASTE PROCESSING

- 3267 tons of waste per year
 - 1981 trucks to distribute the waste
 - Largest waste flow is urban waste which is produced by households and companies where the waste is comparable in nature and composition to waste from households.
- Specific focus on construction materials:
- 3 tons to reuse
 - 70 tons to recover
 - 284 tons to distribution
 - 4 tons to dump

OPPORTUNITIES FOR A CIRCULAR ECONOMY

- | | |
|----------------|-----|
| • Reuse | 0% |
| • Recycle | 25% |
| • Combustion | 2% |
| • Distribution | 72% |
| • Dump | 1% |
- Requires an efficient collection system, an effective sorting system and an appropriate infrastructure. The active involvement of citizens and businesses is also essential in management.
 - Circular craft centers and the further development of local initiatives can help to improve the circularity of this business park.

Figure 5.31: Context of profile Lansinghage

(Dataset: CBS_buurten_2019; Provincie Zuid-Holland, Provincie Groningen, Provincie Limburg, Stec Groep, & New Economy, 2023)



Figure 5.32: Companies with their expertise on construction materials mostly focused on metals (Scale 1.6000, 50% reduced. Impressions from fieldtrip (26-09-2022) and google earth, 2023)



1.



2.



3.



4.

So how do these companies relate to construction materials look like and on which materials are they focussed?

As shown in figure 5.32 most companies have a big plot size, are located more to the southeast side of Lansinghage and provide a lot of paved parking places. The buildings themselves have blind facades which do not show what kind of processes are taking place there.

Additionally, the height differs from 1 to 3 stories high which allows trucks to access the buildings.

The focus of most companies is on metals or a mix of different construction materials under one roof. This means that with the possibilities to form circular flows, the opportunities can differ but are somehow related to the metal industry. Places, where metals can be stored and moulded into other forms, are needed to facilitate a circular economy.

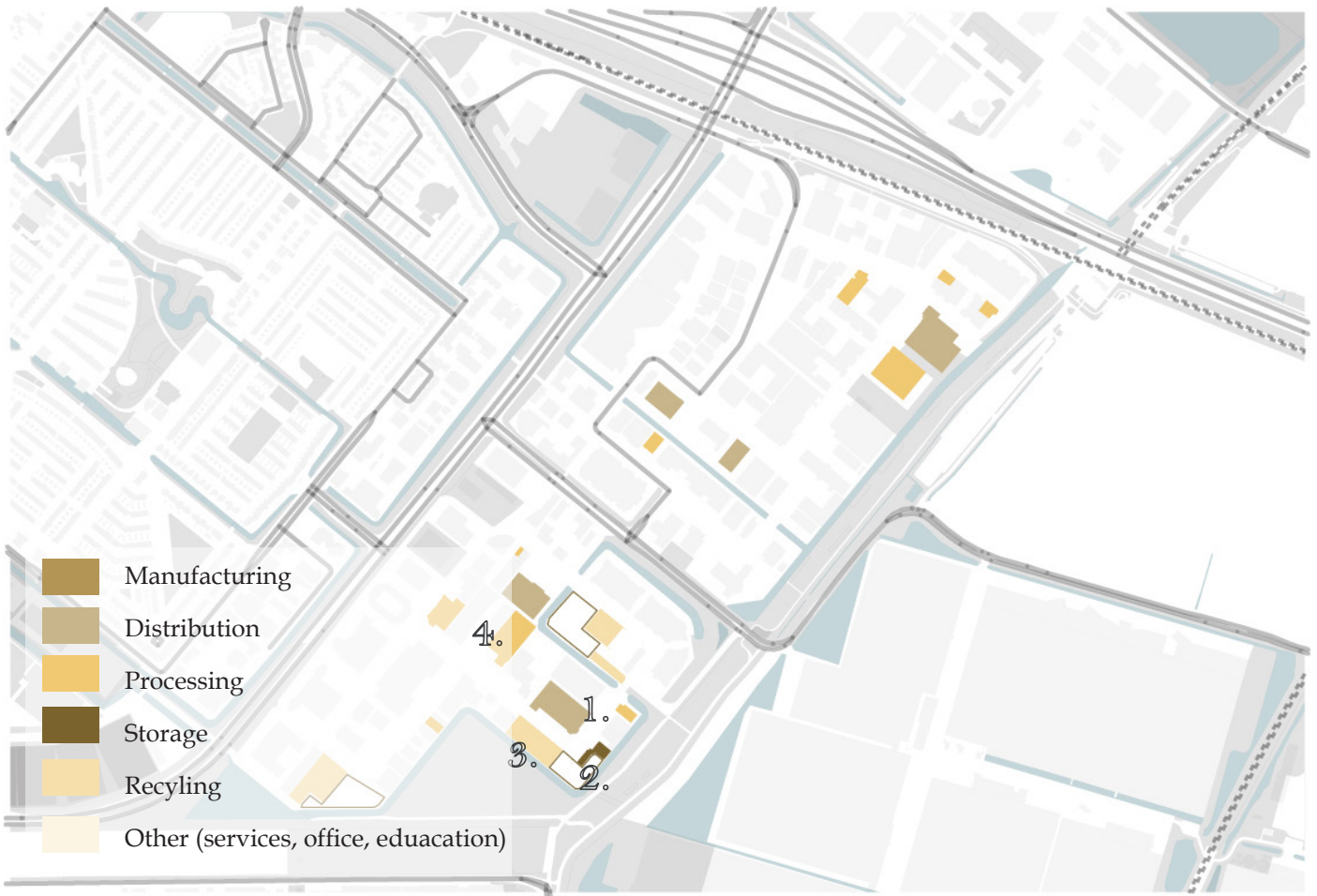


Figure 5.33: Stages of production process creating different industrial landscapes (Scale 1.6000, 50% reduced. Impressions partly from fieldtrip (26-09-2022) and collected from Daman, n.d.)



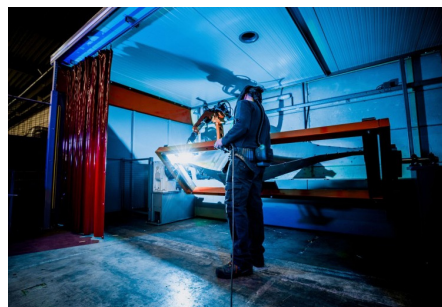
1.



2.



3.



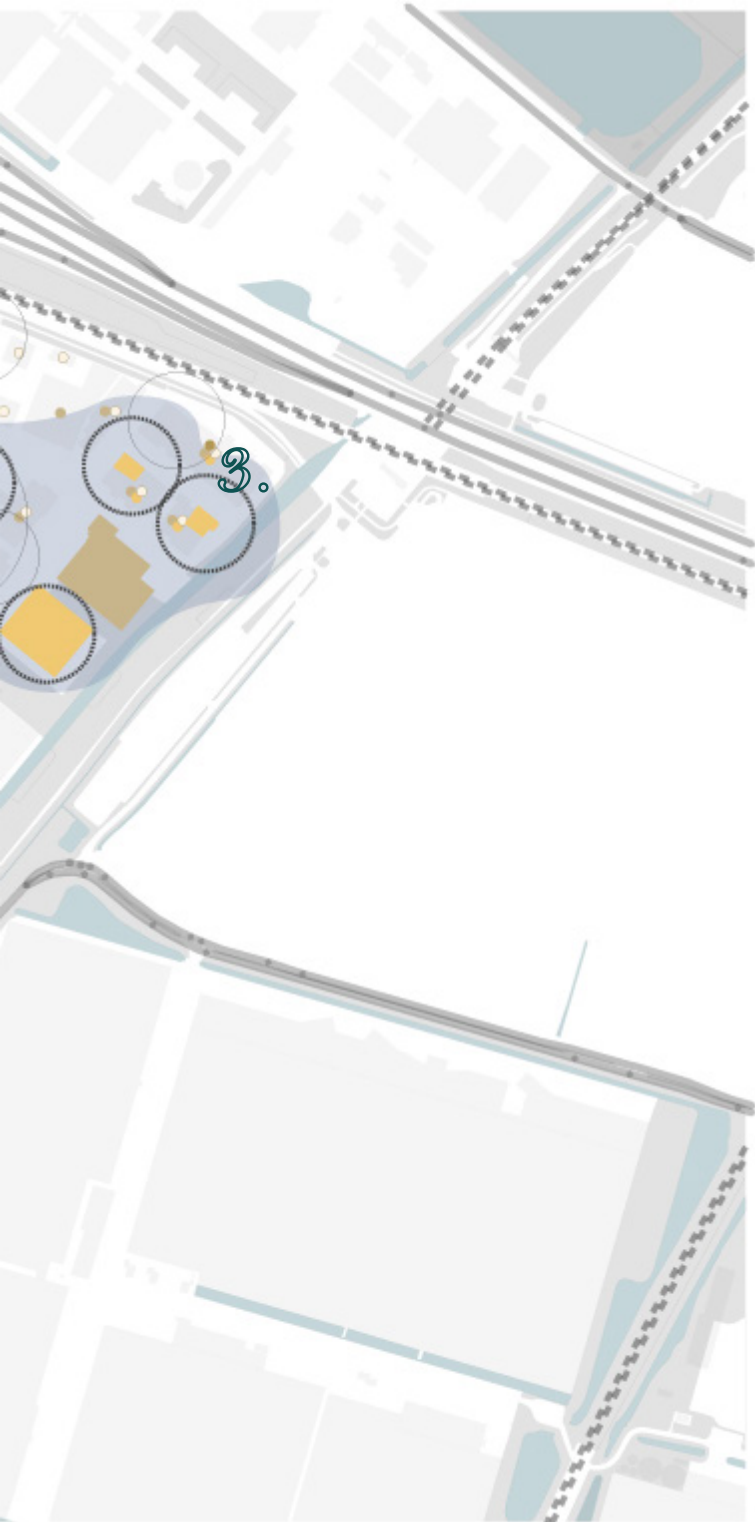
4.

To see if Lansinghage offers these stages of the production process, figure 5.33 shows the function of these companies.

What becomes clear is that these storage and processing places to facilitate a circular economy are there but are not equally spread over the business park. On the south side of Lansinghage, all stages of the production process are covered. However, on the north side, there is more of a focus on distribution and processing.



Figure 5.34: Environmental factors realising three transition zones at Lansinghage (Scale 1:6000. Based upon SBI dataset provided by the Province of South-Holland)



With the data set from the Province of South-Holland and the SBI codes of the companies, their functions can be combined with the circle that forms a buffer because of the environmental factors, see figure 5.34. The result is a division of three zones within the business parks.

As said before, the zone on the south side offers a wide variety of functions during the production process. Because of the different companies, this zone can realise more circular flows on its own.

However, these are also the most disruptive and inaccessible places. That is why this area is not suitable to mix with dwellings.

In the north, there are two zones constructed by environmental factors.

The one in the middle is smaller but causes a lot of nuisances by trucks because of its distribution expertise. Dwellings could be added, but the infrastructure needs to be rerouted to prevent conflicts between working and living.

The last zone is mostly focused on processing. This also causes nuisances, like noise and smells. Therefore, it is important that when mixed-use is applied, the dwellings are designed to deal with these externalities. Materials, positioning of windows, and creating buffers can help to mix working and living.

5.2.4 | WHERE ARE THE PREFAB AND BIOBASED CONSTRUCTION MATERIALS NEEDED IN ZOETERMEER?

To see which replacements of construction materials are needed in Zoetermeer, figure 5.35 shows the buildings with an outdated construction year and low energy labels. The result is very different from The Hague because Zoetermeer is relatively new.

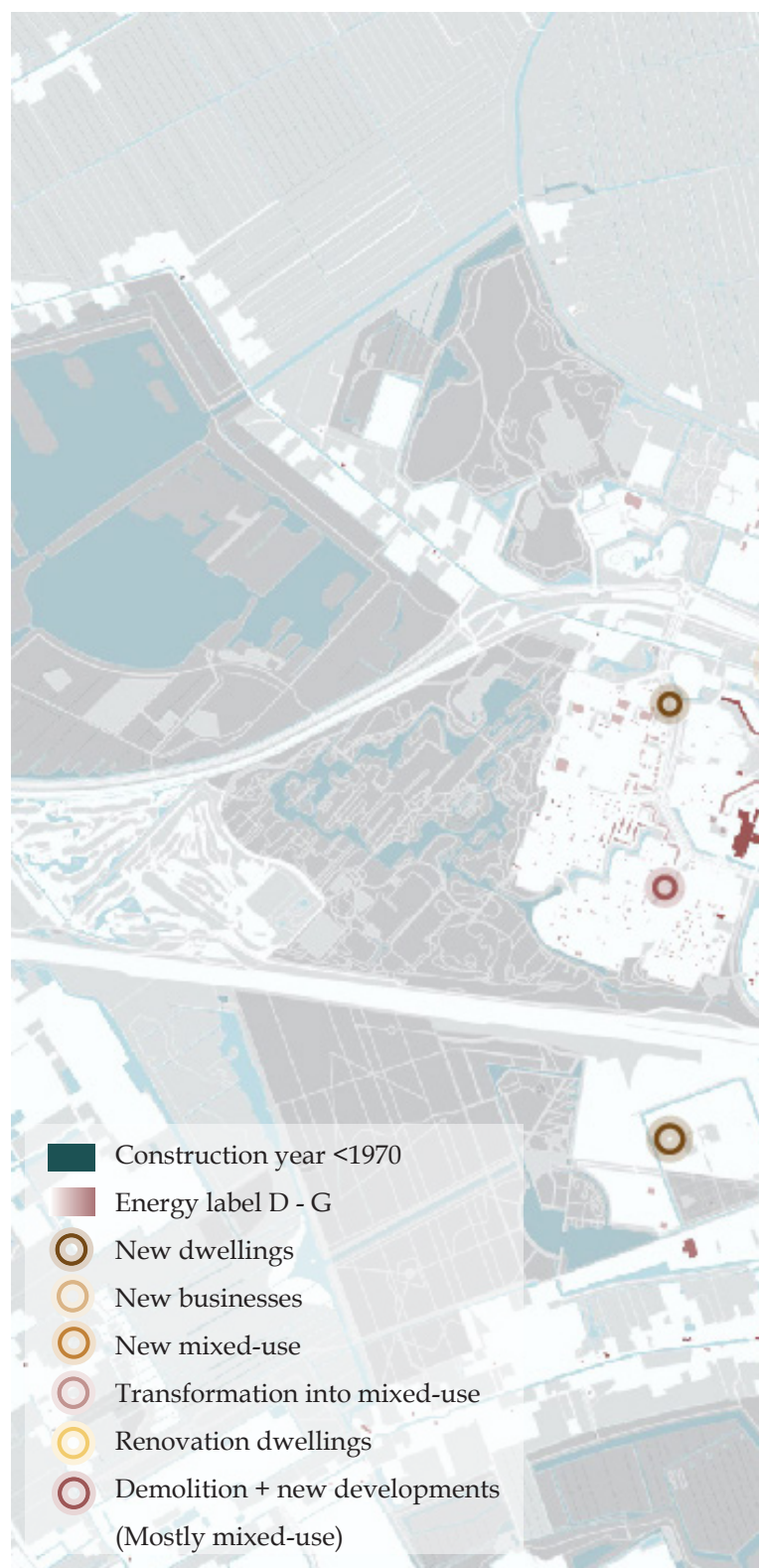
This reflects in future construction developments are well. These are focussed on developing new dwellings instead of renovating them. In the city centre demolition also plays an important role even though most outdated buildings are located more to the south.

Elements used for these new constructions cannot be fully provided by reusing older buildings from Zoetermeer.

Therefore, the city must be connected to the rest of the province. On the northeast side of Lansinghage, a big business park, Prima, focused on distribution can fulfil this role.

Lansinghage itself can improve the space for processing elements and products. In that way, they can be used in the rest of the city and the Province of South-Holland.

This should be combined with open facades, transparent processes, and knowledge exchange. Spaces like repair cafés, demolition halls and social working spaces are a must to create awareness and facilitate a circular economy.



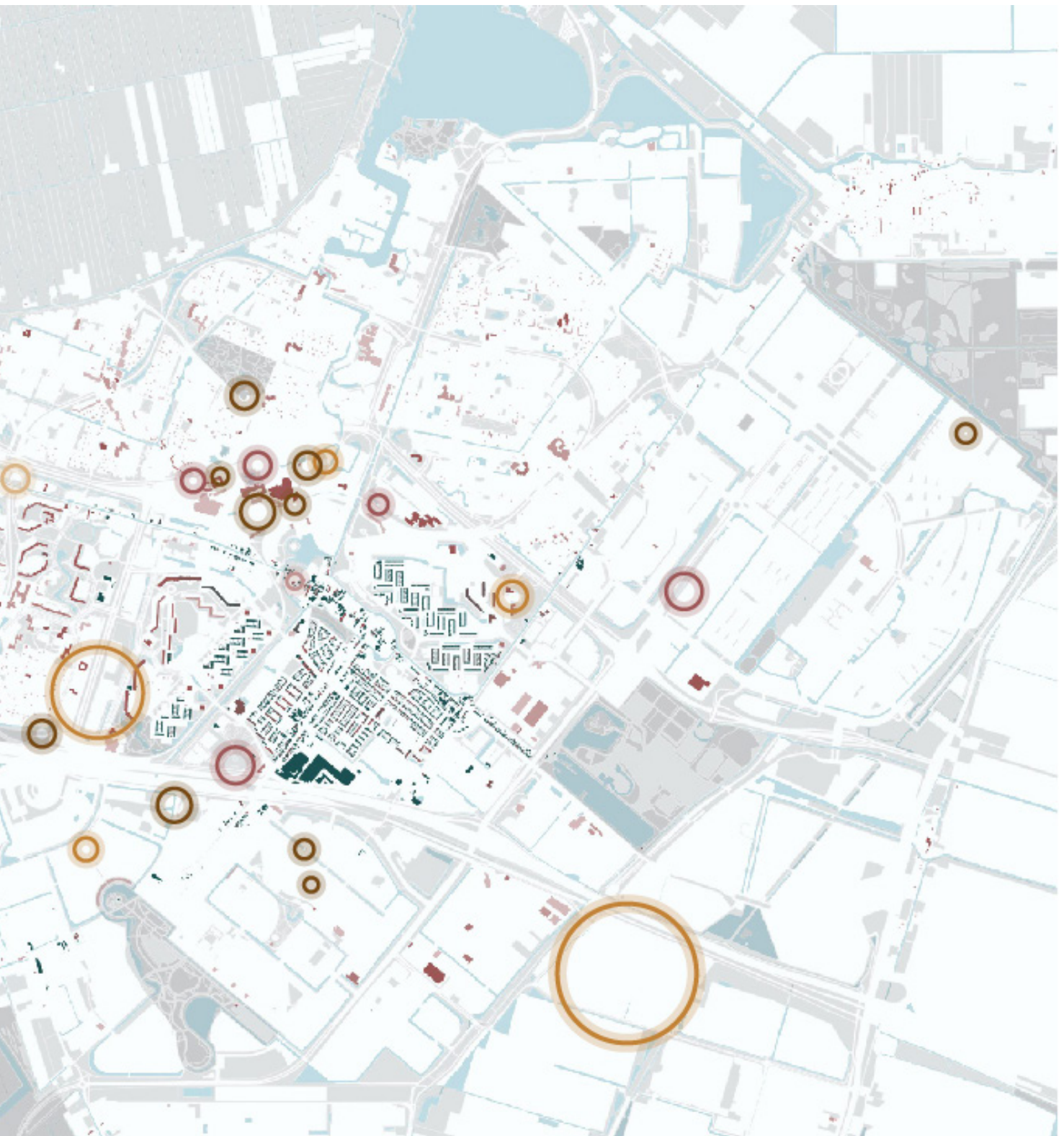


Figure 5.35: Future construction developments spreaded over Zoetermeer (Scale 1.30000)

5.2.5 | DIVISION BETWEEN SPACES FOR 'RUIS' AND 'REURING'

Infrastructure plays an important role when discussing places for a liveable environment and facilitating a circular economy. Unlike Binckhorst this business park is not water-bound, so does not have access via the water.

When looking at the companies that need access via trucks, figure 3.36 shows that almost everything is lightened up. On the west side, the business park is connected via the N470 towards the highway. The east side connects Lansinghage with the agricultural sector.

Distribution of raw materials, elements and products is a common activity.

Almost the same structure is shown when looking at roads designed for cars. The residential and industrial areas are connected via this network. The transition from the fine grain of the neighbourhood towards the big-

ger plot sizes of the business park is guided by this infrastructure.

However, some companies, like the Renewi location in the south, are not publicly accessible. Therefore, these companies are not shown here.

Lastly, there are also companies which could be interesting to visit by bike, public transport or by walking. Shops, offices, and commercial facilities are examples of this.

Figure 5.38 shows the mismatch between the number of companies and the infrastructure designed for pedestrians and bikes. Lansinghage is surrounded by this network, but it does not cross the area. This could be improved.



Figure 5.36: Companies relying on infrastructure designed for transportation via trucks (Scale 1.6000, 25% reduced)



Figure 5.37: Infrastructure creating access to companies via the car (Scale 1.6000, 25% reduced)



Figure 5.38: Business accessible for pedestrians, bikes and via public transport (Scale 1:6000, 25% reduced)



Figure 5.39: Sites of lansinghage that are not yet suitable to mix (scale 1.6000, 50% reduced; based upon Ruis)

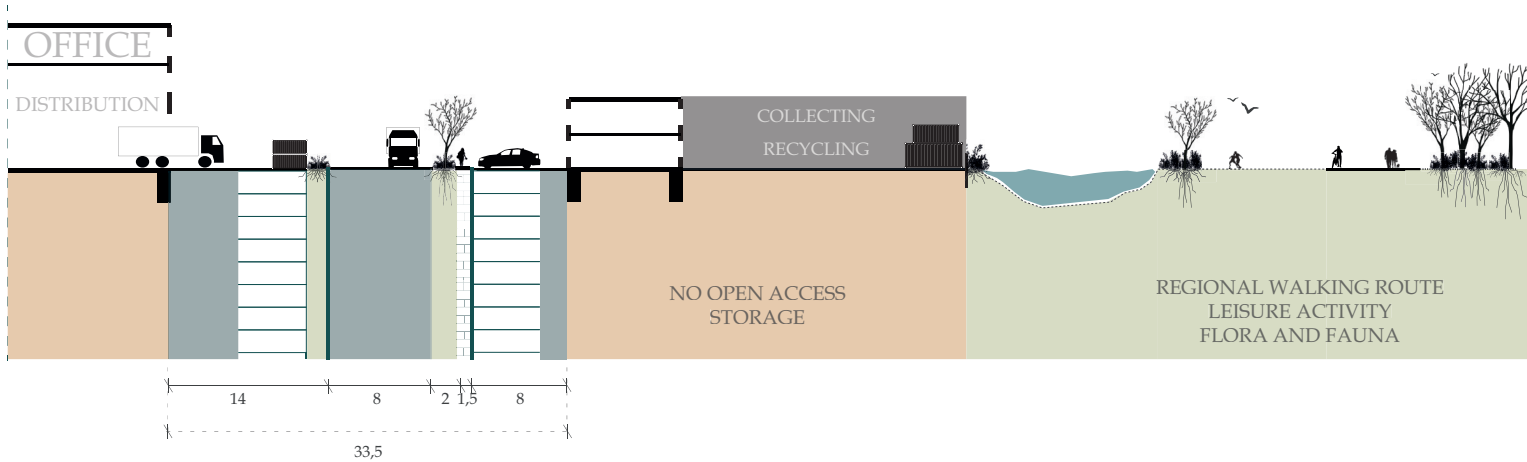


Figure 5.40: Section A Lansinghage - Industry demanding accessibility of trucks (scale 1.500, 75% reduced)

Most routes connected to Ruis are only accessible for trucks. There is some space for pedestrians and bikes, but these sidewalks can end without a warning. The business park seems a bit overwhelmed by the number of trucks coming in at the same time. As shown in figure 5.41 the trucks do not have enough space to make their turn.

Companies next to this network are dealing with the distribution, processing and recycling of materials and elements. This causes nuisances which can be combined with heavy trucks because they also produce externalities.



Figure 5.41: Lacking in space for trucks to turn
(Photo 1, field trip 26-09-2022; photo 2, google earth, 2023)

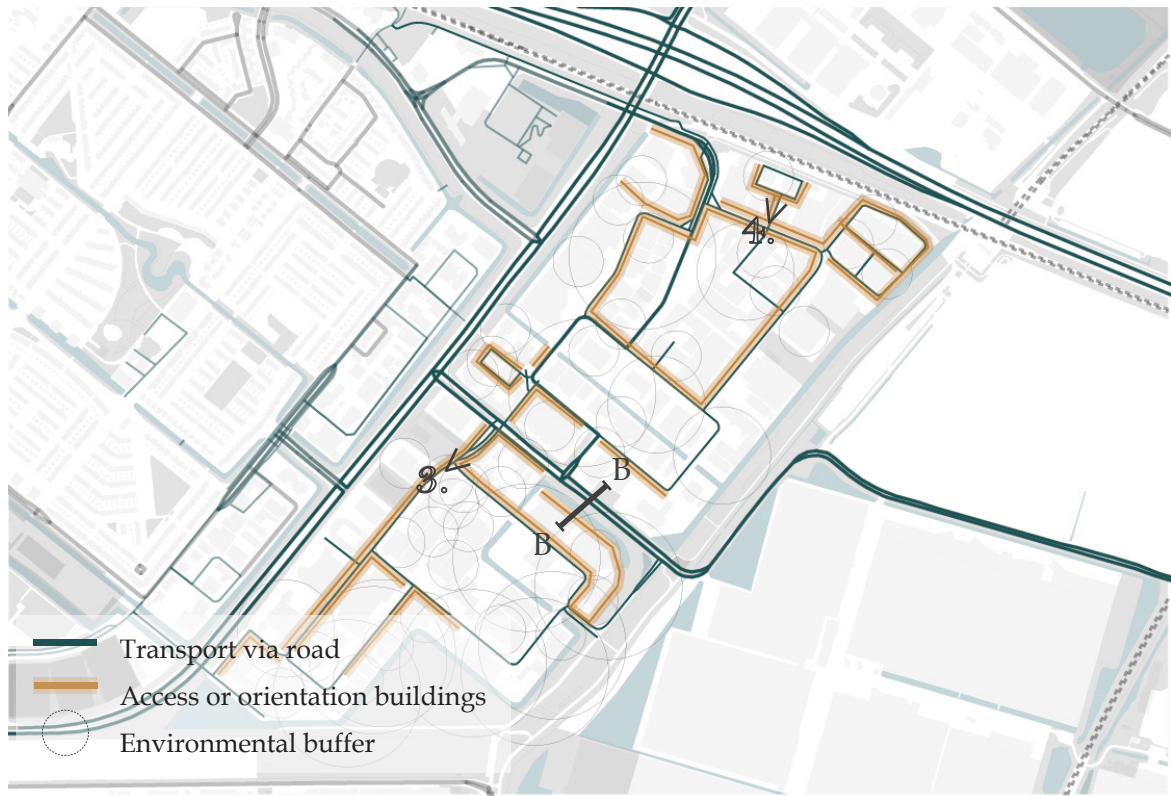


Figure 5.42: Infrastructure serving commotion in this area (scale 1.6000, 50% reduced; based upon Reuring)

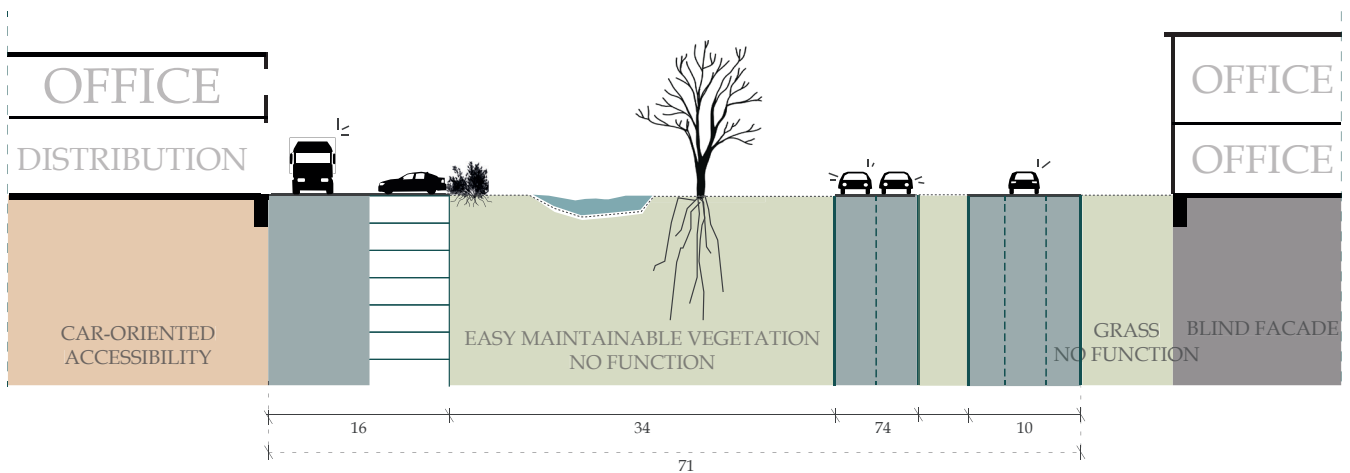


Figure 5.43: Section B Lansinghage- Lansinghageweg passing through the area (scale 1.500, 75% reduced)

Besides, there are places where dwellings could be mixed with for example shops and offices. These already attract people, so accessibility is high.

However, before dwellings could be added, the area must make some changes. For example, there are a lot of paved parking spaces, and the height is not optimally used, see figure 5.44. The greenery surrounding the companies is monotonous and most of the time not accessible to the public.

When this is changed, this business park can form a place where people want to spend their time.



Figure 5.44: Small businesses with a lot of visitors
(Photo 3, field trip 26-09-2022; photo 4, google earth, 2023)

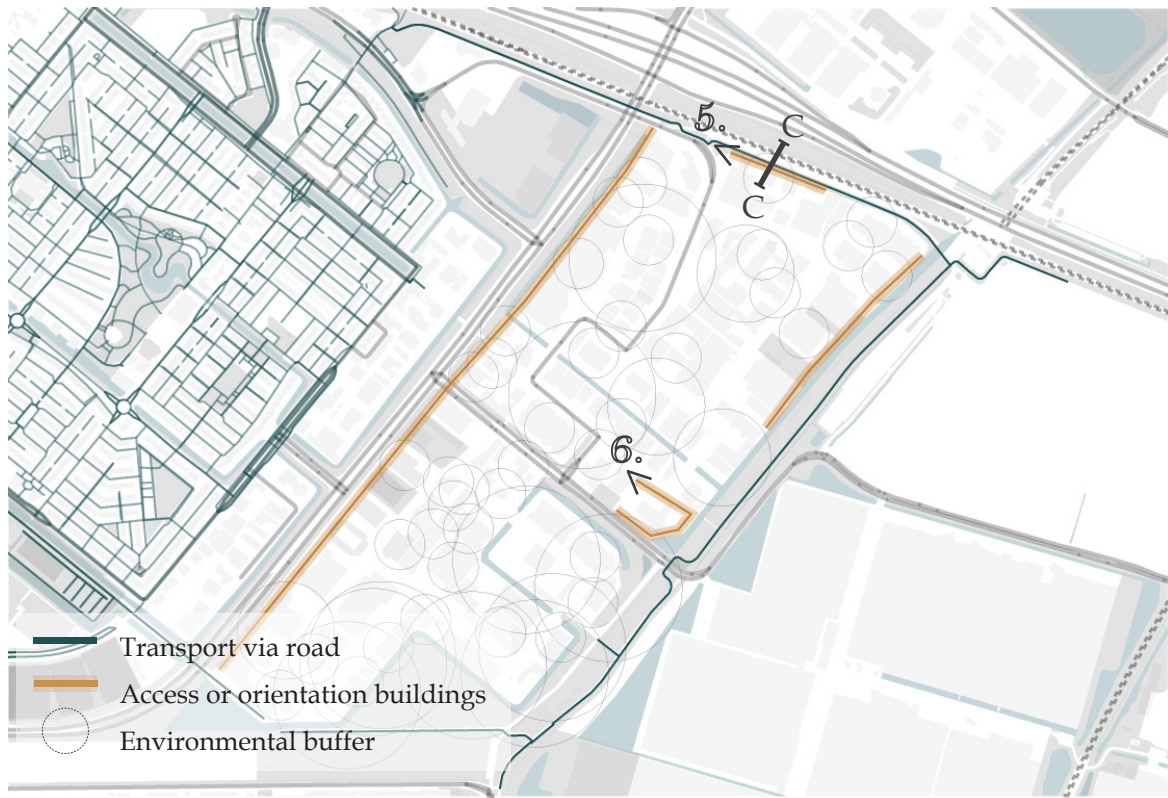


Figure 5.45: Infrastructure creating opportunities to form a walking network (scale 1.6000, 50% reduced; based upon Rust)



Figure 5.46: Section C Lansinghage - Mix of different types of vehicles throughtout the day (scale 1.200, 75% reduced)

The places connected to rust are most of the time for one type of vehicle. Sometimes, like on the north side of Lansinghage, this is a road with a timeframe. This road is occasionally used by for example the bus. These structures could be better connected and the surrounding neighbourhoods.

The orientation of the companies is also interesting. They are situated with their backs towards the roads. The windows cause a view of mostly green landscapes, while the entrances are on the other side. The effect is a quiet and calm atmosphere with the opportunity to embrace the green network that is already there.



Figure 5.47 Separated roads from the rest of the business park
(Photo 5 and 6, field trip 26-09-2022)

5.2.6 | LANSINGHAGE OCCURS AS AN ISLAND

As shown in figures 5.48 and 5.51 the green network does not only serve Lansinghage but also connects to the rest of the region because of the regional walking and bike routes. During the field trip observations, this park was already noted as having a spatial quality.

However, the structure could be better connected to the neighbourhood on the west side of this business park.

In that way, this serves as a place where people could meet, and which attracts inhabitants to visit the industrial area.

The amenities at the business park are not connected to this route and are outside the transition zones. This creates opportunities to improve public spaces.

Because of the peripheral location of Lansinghage this business park cannot fully use the surrounding amenities. That strengthens the need for facilities inside the business park.



Figure 5.48: Greenery embracing the business park Lansinghage (Scale 1.6000, 50% reduced)

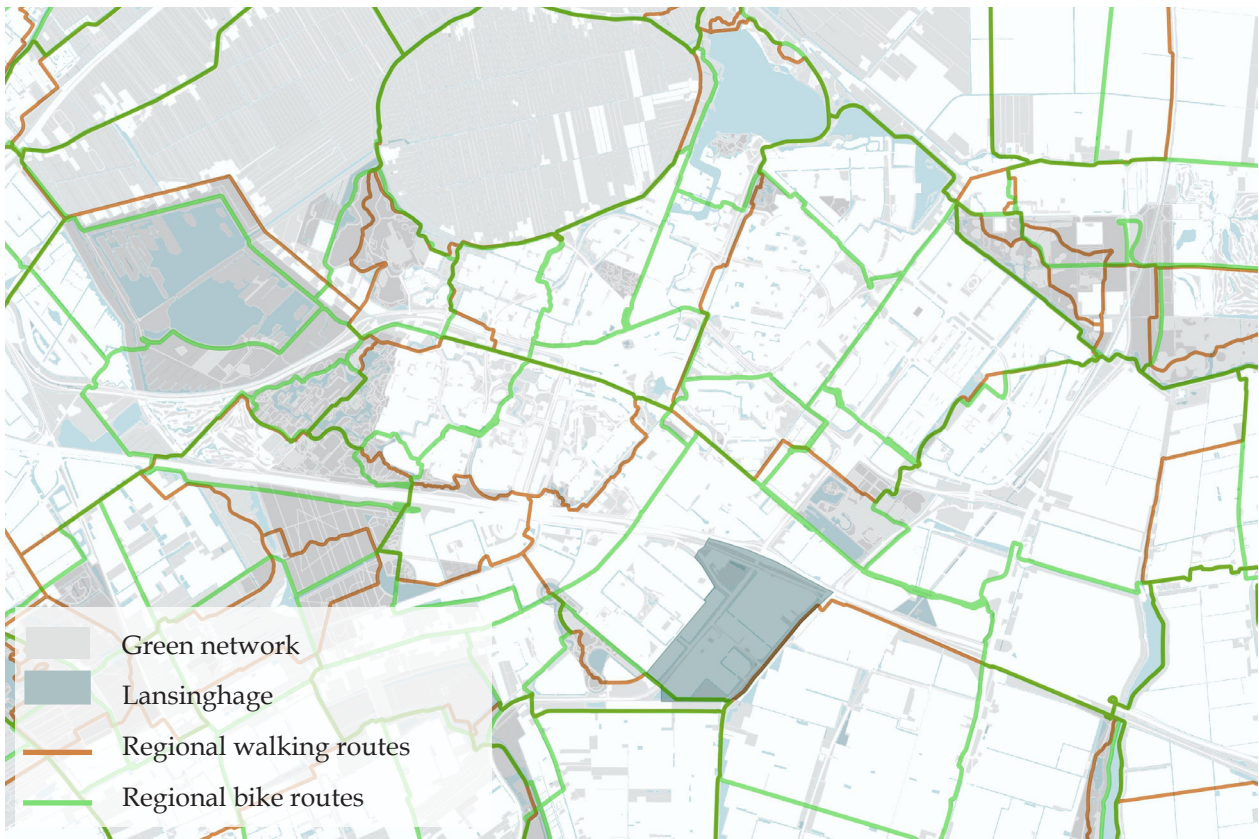


Figure 5.49: Regional bike and walking routes connecting Lansinghage to rest of Zoetermeer and surrounding areas (Scale 1.40000, 50% reduced)

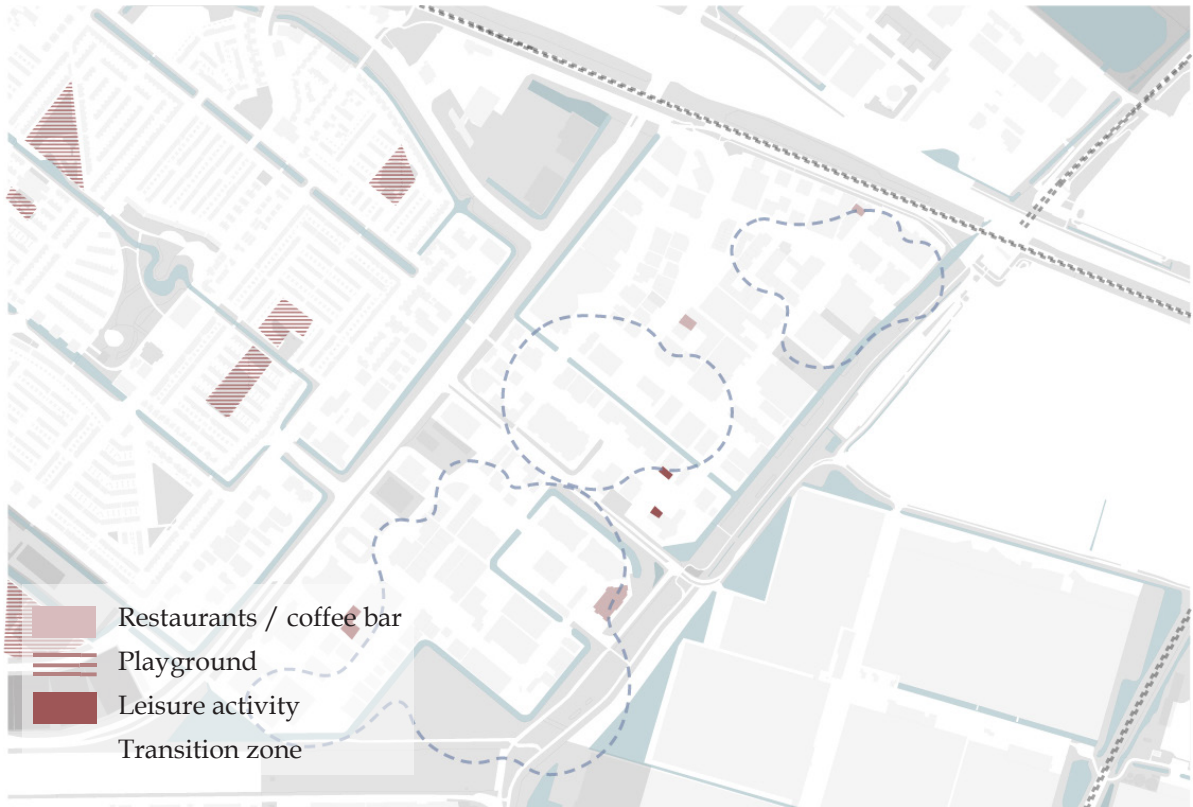


Figure 5.50: Lack of amenities at Lansinghage (Scale 1.6000,50% reduced)

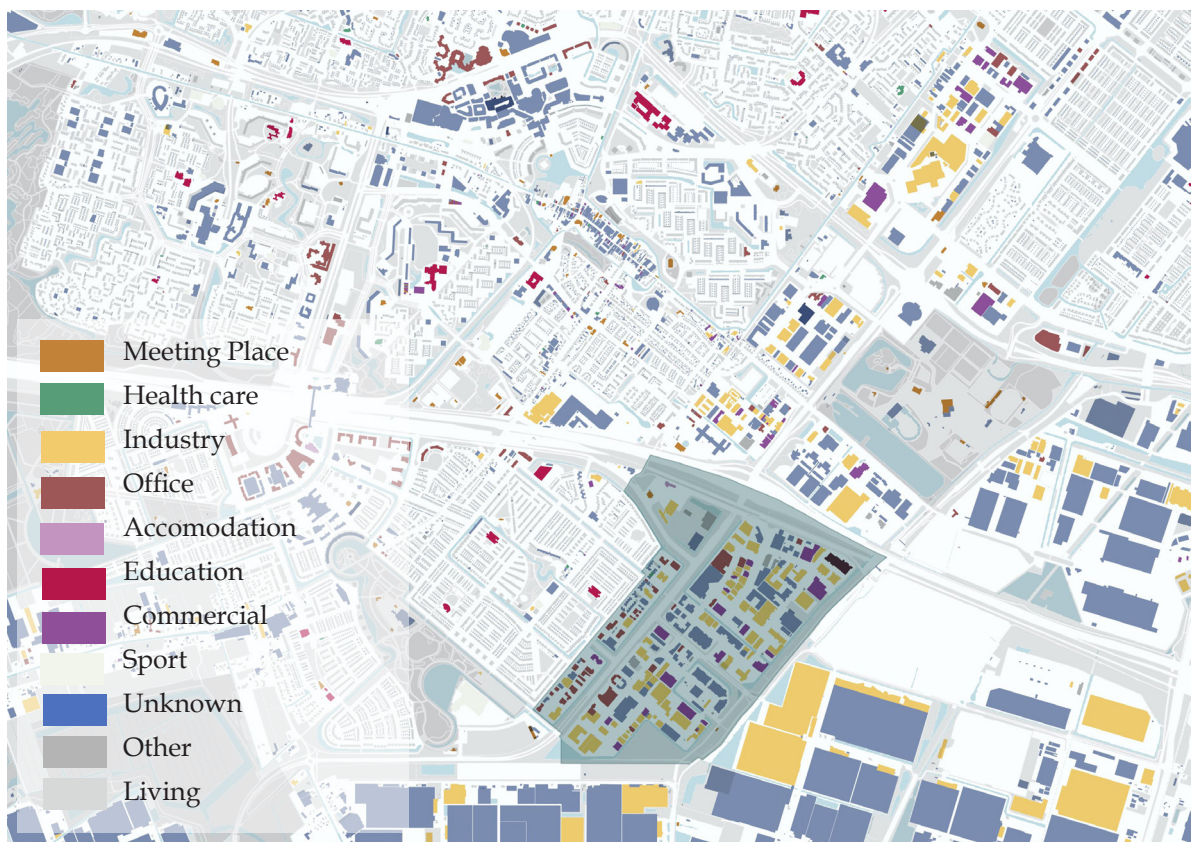


Figure 5.51: City centre to far away for Lansinghage to benefit from it (Scale 1.20000, 50% reduced; Based upon data set BAG panden)

5.3 | Spatial analyses on Broekvelden, the village of Bodegraven

5.3.1 | REBUILDING THE VILLAGE

The village developed at the edge of the river in the Roman empire. Living and working were mixed and spread along the riverbanks. Bodegraven had the task to serve as a guard post to watch out for opponents (Stichting Historische Kring Bodegraven, n.d.).

The next occupation was years later by the French. Unfortunately, the invading French armies destroyed the entire village in 1672.

This was not the only time that Bodegraven had to be built up from scratch. In 1870 a fire started in a bakery and burned the whole village down. Again, the village had to be flexible and started reconstruction (ReBo nieuws, 2021).

This resulted in the expansion of Bodegraven to the south side. The edges of the river became residential and places for the industry were placed outside the village.

Almost a century (1875-1960) the structures did not change, but by adding a train station in Bodegraven, the village started to develop again. The train track between Leiden and

Woerden connected Bodegraven to the rest of the Netherlands.

In that same year, 1882, Bodegraven became known for its weekly cheese market. The result: a long concatenation of cheese producers, distributors and outlets started to pop up along the river and train track with Bodegraven as a central place (Regionaal historisch centrum Rijnstreek en Lopikerwaard n.d.).

Additionally, the village also played an important role for the inhabitants of the Province of South-Holland during the second world war. This place was a local mobilisation centre for over 1000 soldiers.

Furthermore, the people from Rotterdam and other surrounding settlements came here to hide and flee from the unrest in the bigger cities. Bodegraven, therefore, can be seen as a safe space for some generations of our society (Regionaal historisch centrum Rijnstreek en Lopikerwaard n.d.).

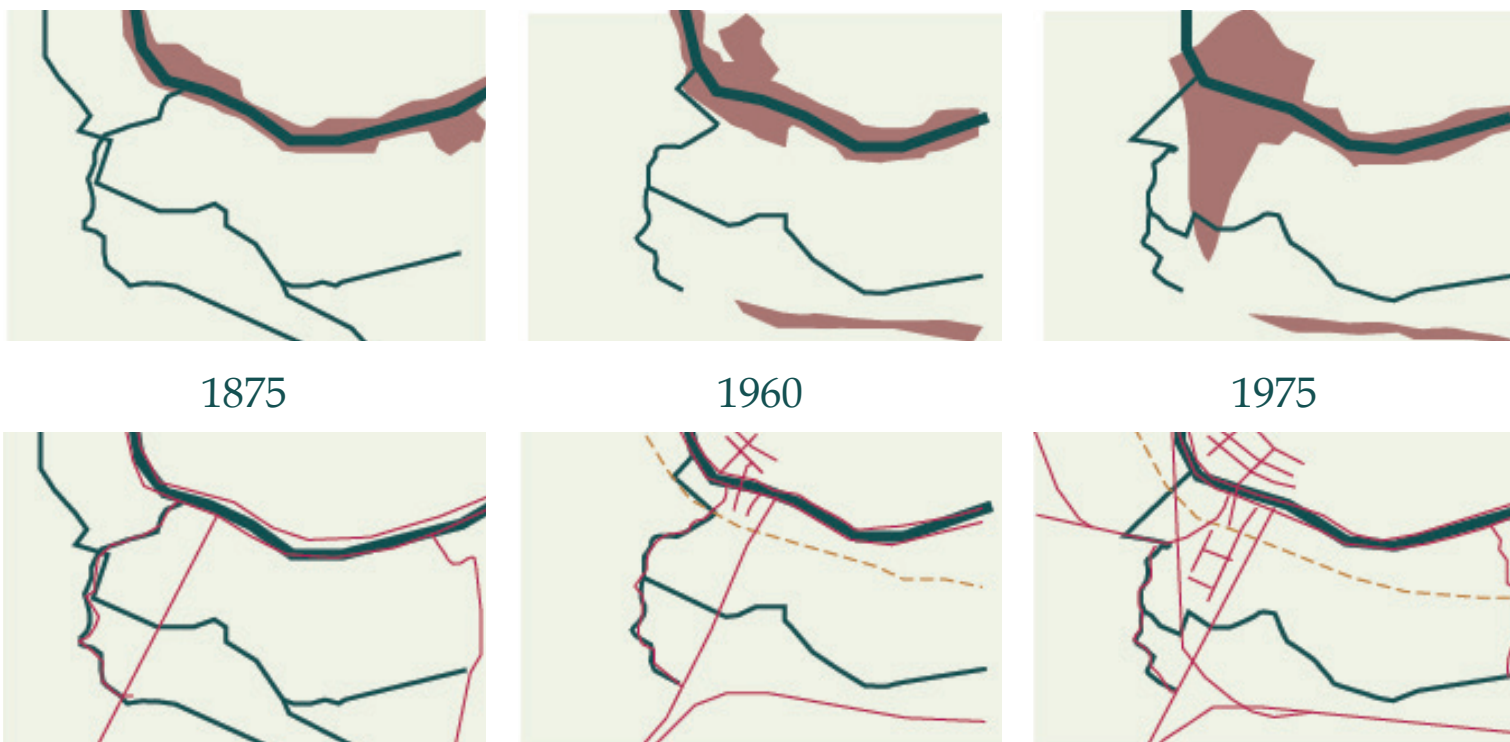


Figure 5.52: Urban expansion of Bodegraven through the years

After the war, constructing dwellings became way more important. There was space to expand on the south side of the train track, so that means the beginning of the neighbourhood Broekvelden.

At the beginning of this expansion, the road structure formed a systematic grid. Nowadays, the main roads are not crossing the residential environments that much but form a ring road around it.

Even though the history of the village of Bodegraven shows power and independence, it merged with the village of Reeuwijk in 2011 (Stichting Historische Kring Bodegraven, n.d.). This new municipality, Bodegraven-Reeuwijk, makes sure that there is enough space to live, work and recreate.



1985



2000



2022





Figure 5.53: Timeline with impressions of Bodegraven (Pictures derived from Regionaal historisch centrum Rijnstreek en Lopikerwaard n.d.; Stichting Historische Kring Bodegraven n.d.; ReBo nieuws, 2021)



5.3.2 | GREEN, OPEN AND SEPARATED

The field trip was focussed on the behaviour of inhabitants, the permeability of the place, the diversity of the green network and the optimal use of space.

The first observation was that people meet in surrounding neighbourhoods but the business park itself has only privately designed spaces to meet colleagues. On the other hand, the park crossing the business park on the east side contributes to leisure activities like fishing and walking. This can be seen as a spatial quality of Broekvelden.

Next to the park, also the ring road embracing the area provides spaces to walk and ride your bike. Some employees were biking towards their work. However, there is no road assigned to these vehicles and not all places are well maintained.

When it comes to the greenery of the business park again the park creates a qualitative good place to meet. The atmosphere of the park serves the employees during their lunch break or provides a place to walk your dog. In addition, the greenery of private parcels is also well maintained.

Lastly, there are not a lot of unoccupied spaces. One building is half destroyed and vacant. This can facilitate a new function in the future. Furthermore, some big, paved areas only serve trucks to drive on and off. Not everything can be accessed that easily. This creates opportunities for Broekvelden to improve its infrastructure network.





Figure 5.54: Observations during the fieldtrip to Broekvelden (24-02-2023)

5.3.3 | EXPERTISE IN THE DISTRIBUTION OF CHEESE

The first thing to notice is that Broekvelden is way smaller than the other two locations. This can be caused by the fact that the business park belongs to a village instead of a city. Even though the surface has fewer square meters Broekvelden almost has the same number of companies located here.

On the other hand, the average height of the companies is two stories high, which results in opportunities to improve the density of the area.

In addition, Broekvelden produces a lot of waste with a specific focus on biobased materials. This can form an opportunity to contribute to a circular economy, see further analyses. Meanwhile, the proportion of construction materials is almost negligible.

The biggest part of this waste stream is recycled. Figure ... does not tell where this recycling finds a place, but as will be shown in the coming analyses, Broekvelden itself does not provide such places. The assumption is that this is processed in Gouda or Alphen aan de Rijn.

The fact that Broekvelden does not recover its waste is a step in the right directi-

on. However, this should shift towards more circular strategies like the reuse of materials. This strategy is higher up at the R-ladder, so this would make the processes at Broekvelden more sustainable.

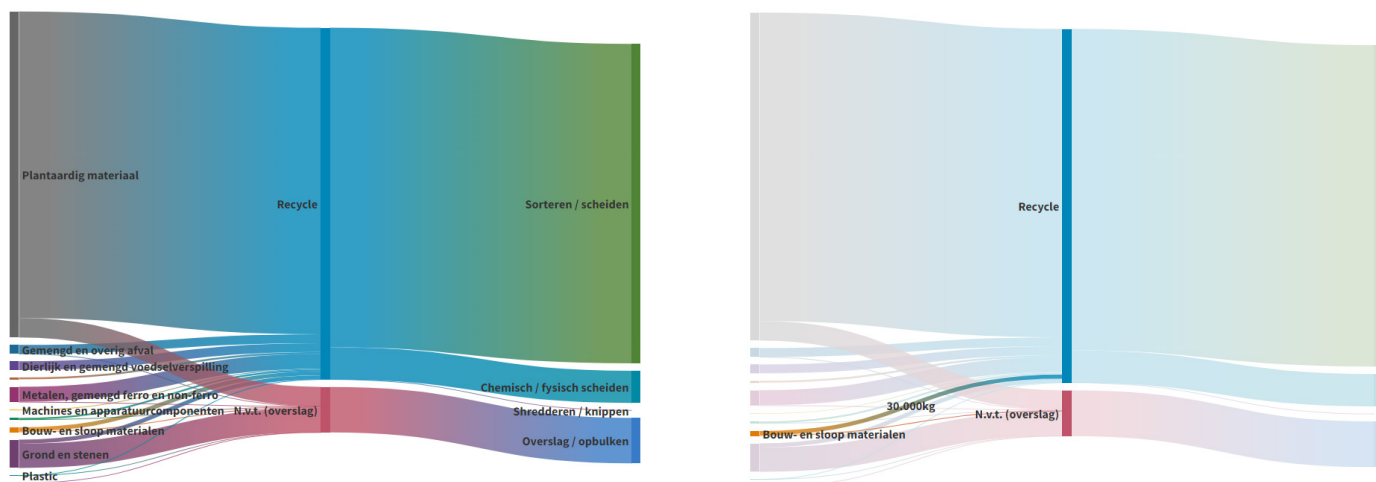


Figure 5.53: Waste streams Broekvelden with specific focus on construction materials (Provincie Zuid-Holland, Provincie Groningen, Provincie Limburg, Stec Groep, & New Economy, 2023)



CHARACTERISTICS

- Surface 26 hectares
- FSI: $\pm 0,5 - 0,75$
- GSI: $\pm 0,4 - 0,5$
- OSR: $\pm 0,75 - 1,5$
- Layers: $\pm 1 - 2$
- Approximately 86 companies with 2232 employees are located in Broekvelden.
- Environmental factor business park is 4.1
- Access via highway A12 and the N11

WASTE PROCESSING

- 2942 tons of waste per year
 - 313 trucks to distribute the waste
 - Largest waste flow is from biobased materials which is produced by the surrounding agricultural companies.
- Specific focus on construction materials:
- 30 tons to recycle
 - 5 tons to distribution

OPPORTUNITIES FOR A CIRCULAR ECONOMY

- | | |
|----------------|-----|
| • Reuse | 1% |
| • Recycle | 87% |
| • Combustion | 0% |
| • Distribution | 11% |
| • Dump | 0% |
- Could shift towards more reuse instead of recycle.
 - An asset is the fact that this business park does not dump or burn waste. That is a good step towards a circular economy.

Figure 5.54: Context of profile Broekvelden

(Dataset: CBS_buurten_2019; Provincie Zuid-Holland, Provincie Groningen, Provincie Limburg, Stec Groep, & New Economy, 2023)



Figure 5.55: Companies related to construction materials at Broekvelden (Scale 1.5000, 50% reduced. Impressions from fieldtrip (24-02-2023) and google earth, 2023)



1.



2.



3.



4.

The companies related to construction materials are focussed on different materials. The plot sizes do also differ. Some are relatively big and provide mostly room for parked cars and trucks. Some of these locations are fenced off and therefore not easily accessible. Other companies are focused on the distribution of cheese. This expertise causes traffic of heavy vehicles, a lot of transportation of goods and noisy roads.

In the future of the Province of South-Holland, this focus of Broekvelden can play an important role in the transition towards a circular economy.

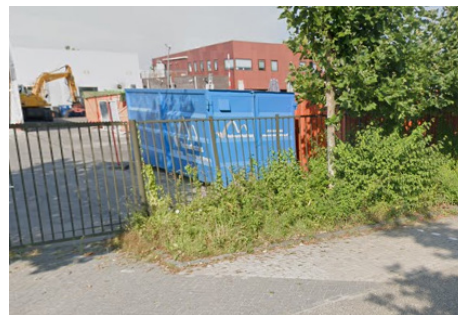
However, the mixed-use strategies are not suited here.



Figure 5.56: Companies related to the production process at Broekvelden (Scale 1.5000, 50% reduced. Impressions partly from fieldtrip (24-02-2023) and collected from Kraan en Roos construction B.V., n.d.)



1.



2.

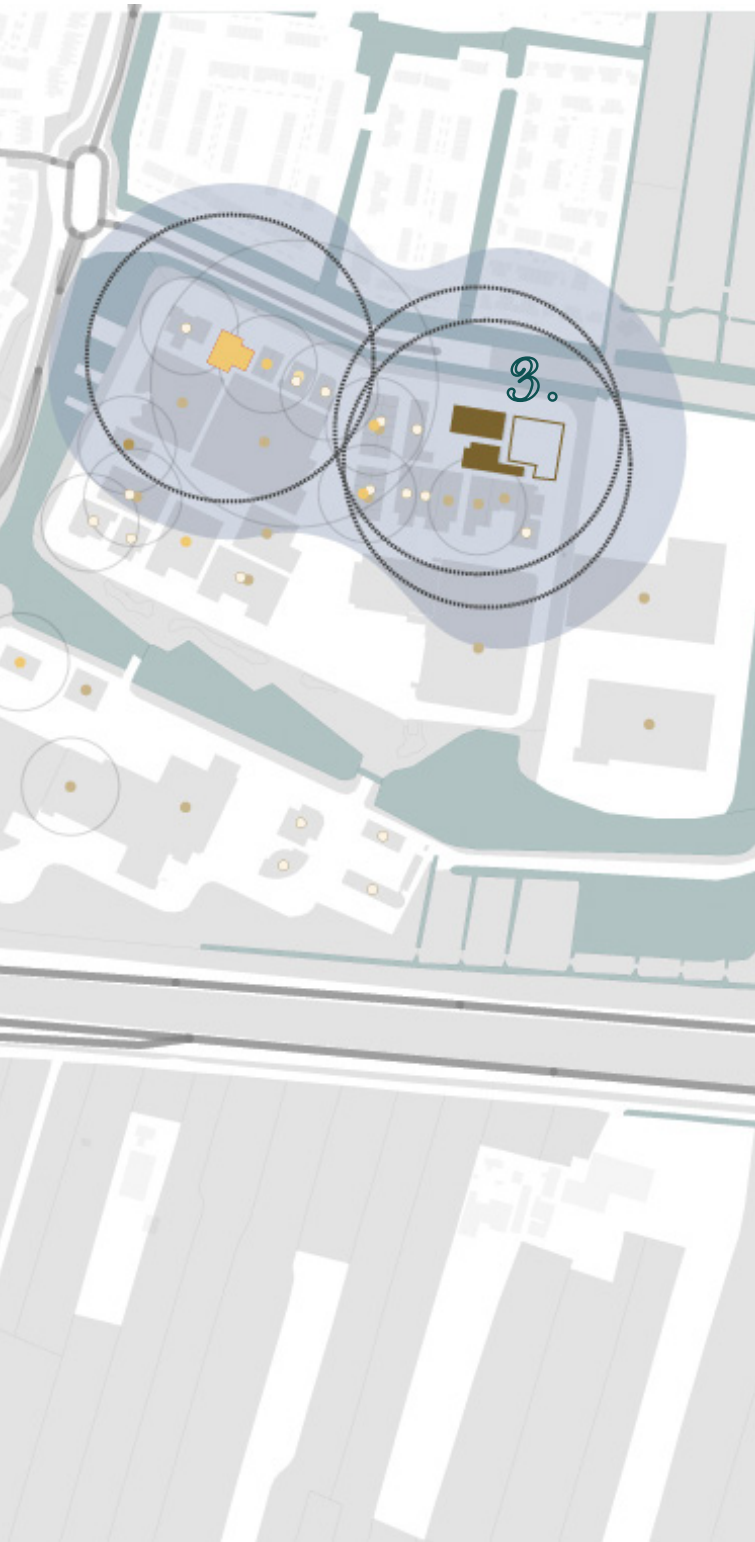


3.

Unlike the other two locations, Broekvelden does not offer all stages of the production process. The village is probably too small to recycle waste on its own. The waste is collected and can be stored here, but the recycling finds a place at Gouda or Alphen aan de Rijn. The companies located here are mostly distribution centres or offices. That causes a different profile and opportunities for mixed-use strategies than at Binckhorst and Lansinghage.



Figure 5.57: Environmental factors causing three transition zones at Broekvelden (Scale 1.5000)



With the help of the data set provided by the Province of South-Holland, the SBI codes and environmental factor creates different transition zones which should be retained for the industry, see figure 5.57.

Like set before, Broekvelden has the expertise of distribution, which is nowadays focussed on food production. Therefore, there are not a lot of companies related to construction materials.

However, the ones that are there produce a lot of nuisances. This in combination with a lot of transportation via other companies causes a business park which has three transition zones.

On the other hand, the rest of the companies also demand spaces to develop, store their products and innovate their processes.

This means that Broekvelden can better be used to facilitate a circular economy and not to mix with dwellings.

5.3.4 | MISMATCH OUTDATED BUILDINGS AND NEW DEVELOPMENTS

As explained in the historical overview of Bodegraven, this village expanded from the old centre towards the south side. This expansion is quite new. That is why these neighbourhoods are not outdated and have a relatively good energy label.

Remarkable is that despite the construction year and energy labels there are no demolition plans or renovations planned at the centre of Bodegraven, see figure 5.58. Only new developments are scheduled or already under construction.

The result is that Bodegraven does not have to store elements on its own but can store and distribute prefab elements and biobased materials towards surrounding cities.

Because of its connection towards the green heart and agriculture, this business park can have the purpose to distribute biobased construction materials throughout the province.

This focus point to serve as a distribution hub in the Province of South-Holland facilitates the opportunities towards the circular economy.





Figure 5.58: Little developments around constructing dwellings or businesses
(Scale 1:20000)

5.3.5 | CLEAR FOCUS ON TRANSPORTATION OF GOODS

The expertise of Broekvelden is focused on distribution. It is therefore not surprising that the road structure is mostly designed for trucks.

The ring road divides the residential and industrial areas with several branches to the different sides. This gives a clear distinction between the functions and guides the trucks to only access the business park.

Alongside the ring road, there is also a place for bikes and pedestrians. This is located on the residential side of the road.

Again, this network has branches towards the business park. However, the rest of Broekvelden does not provide separate infrastructure for bikes and pedestrians.

The park on the east side of the business park forms this connection the more. The park stretches itself from the neighbourhood down

to the industrial area. This space provides a nice atmosphere to walk your dog, lunch with colleagues and meet with friends.



Figure 5.59: Transportation via trucks is needed at Broekvelden
(Scale 1.6000, 25% reduced)



Figure 5.60: Road network for cars for the bridge between residential and industrial areas
(Scale 1.6000, 25% reduced)



Figure 5.61: Park stretches from residential area towards industry
(Scale 1:6000, 25% reduced)



Figure 5.62: Sites of Broekvelden that are not yet suitable to mix (scale 1.6000, 50% reduced; based upon Ruis)

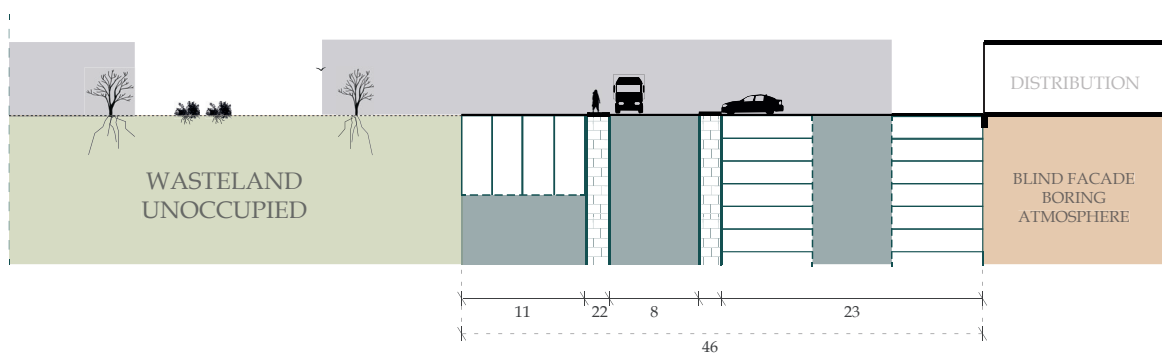


Figure 5.63: Section A Broekvelden - Lot of parking for cars and trucks (scale 1.500, 75% reduced)

As said before, the focus of Broekvelden is on companies related to distribution. This causes a lot of roads that are noisy and are designed for trucks. This Ruis network does not provide a place to mix with dwellings.

When looking at the opportunities for for example the wasteland drawn in figure 5.63 this should suit the disruptive companies surrounding it. Amenities or maybe storage space to facilitate the circular economy are wished for instead of dwellings.



Figure 5.64: Big blind facades focussed on transportation of goods
(Photo 1 and 2, field trip 24-02-2023)

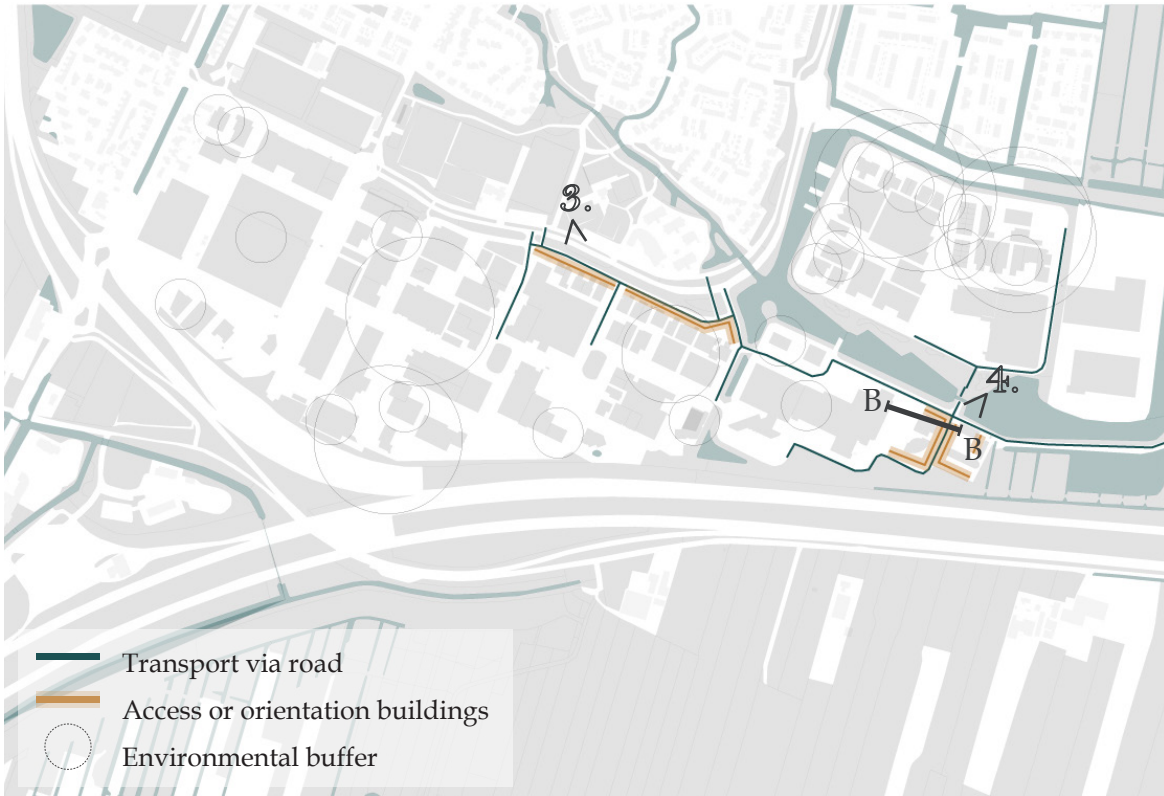


Figure 5.65: Sites of Broekvelden which can attract a lot of people (scale 1.6000, 50% reduced; based upon Reuring)

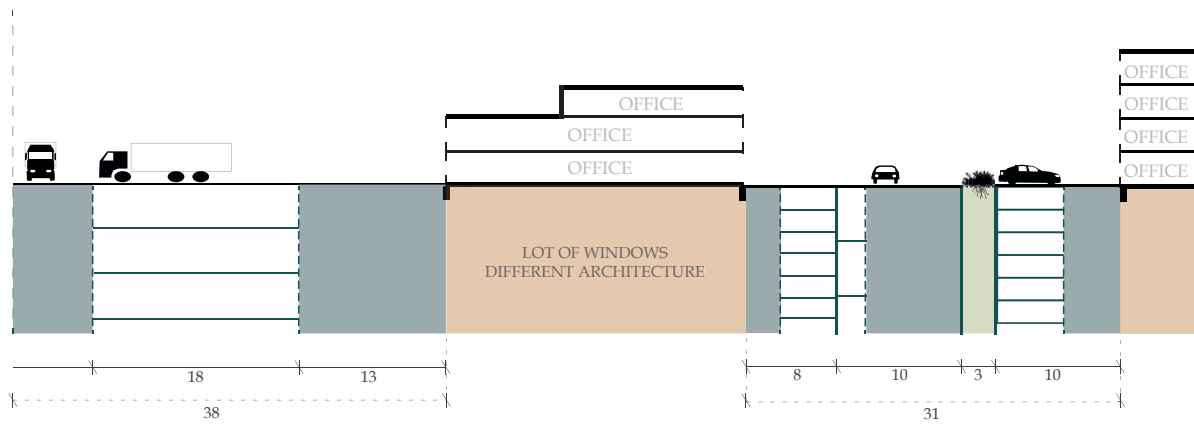


Figure 5.66: Section B Broekvelden - No infrastructure for slow traffic (scale 1.500, 75% reduced)

Reuring refers to places where industry and living are combined. However, this business park could better not be mixed with dwellings. That is why figure 5.65 shows places where the option is to add amenities to serve the employees, visitors, and inhabitants.

Nowadays, there is a lot of parking place, and the roads are designed to serve cars and trucks more than slow traffic. This can be an opportunity to make some places better accessible while adding functions.



Figure 5.67: Work at home and offices could be connected to attract inhabitants (Photo 3, field trip 24-02-2023; photo 4, google earth, 2023)

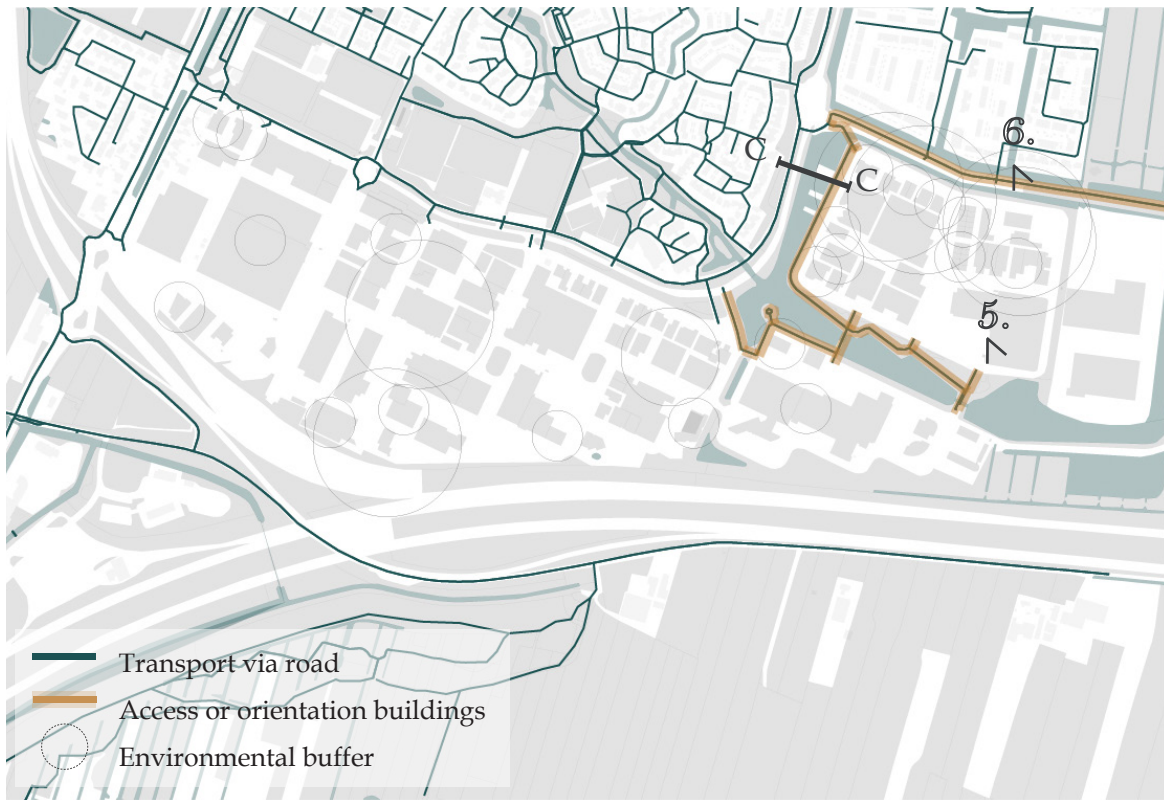


Figure 5.68: Sites of Broekvelden designed for residential use (scale 1.6000, 50% reduced; based upon Rust)

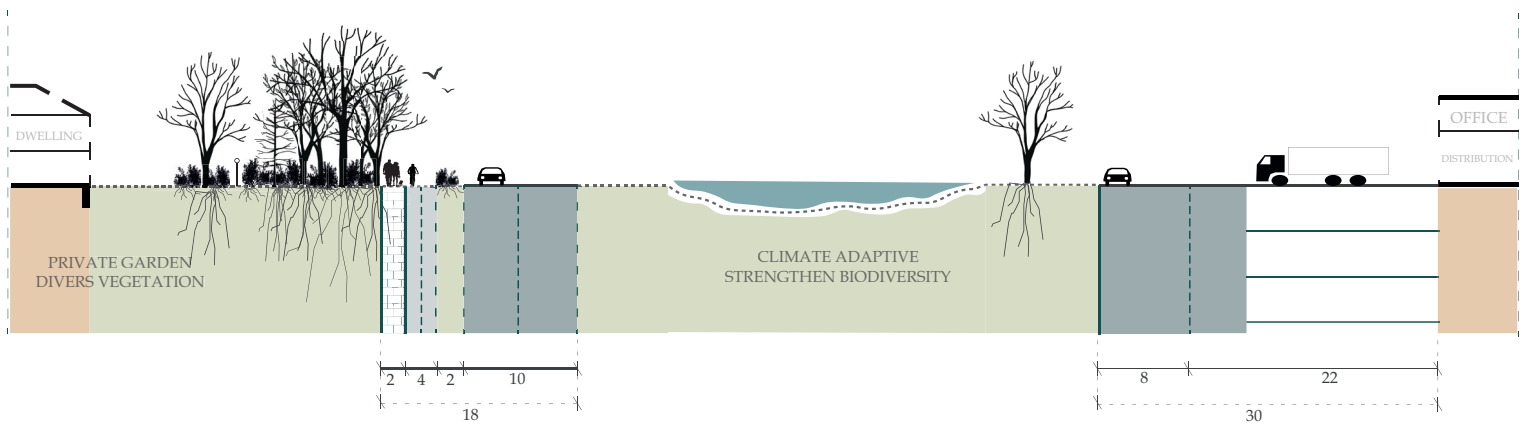


Figure 5.69: Section C Broekvelden - Large areas assigned to greenery (scale 1.500, 75% reduced)

The park forms the only Rust network at the business park. This area is designed for leisure activities and forms a public space. The vegetation is not yet very diverse. Most of it is grasses, water without plants and some trees.

The spatial quality of the park could be improved by upgrading the biodiversity and relating this to the upcoming biobased construction materials.



Figure 5.70: Park offers a lot of public space and contributes to water infiltration (Photo 5 and 6, field trip 24-02-2023)

5.3.6 | EMBRACING THE GREEN PROFILE OF THE SURROUNDING

Broekvelden is surrounded by nature and connects to this network with the park crossing the area. In addition, the regional walking and bike routes are related to this park as well, so that could attract people from the surrounding villages.

On the other hand, there are no activities to meet with people, exchange knowledge or grab lunch. The centre of Bodegraven provides some amenities but is too far away from the industrial area to serve the employees.

Because of previous analyses, the opportunities to implement mixed-use are wished. However, to improve the working environment amenities could be added. In addition, a knowledge centre on biobased materials would create more awareness towards the circular economy and attract people towards this area.



Figure 5.71: Green structure provides opportunities for connecting the business park
(Scale 1.5000, 50% reduced)

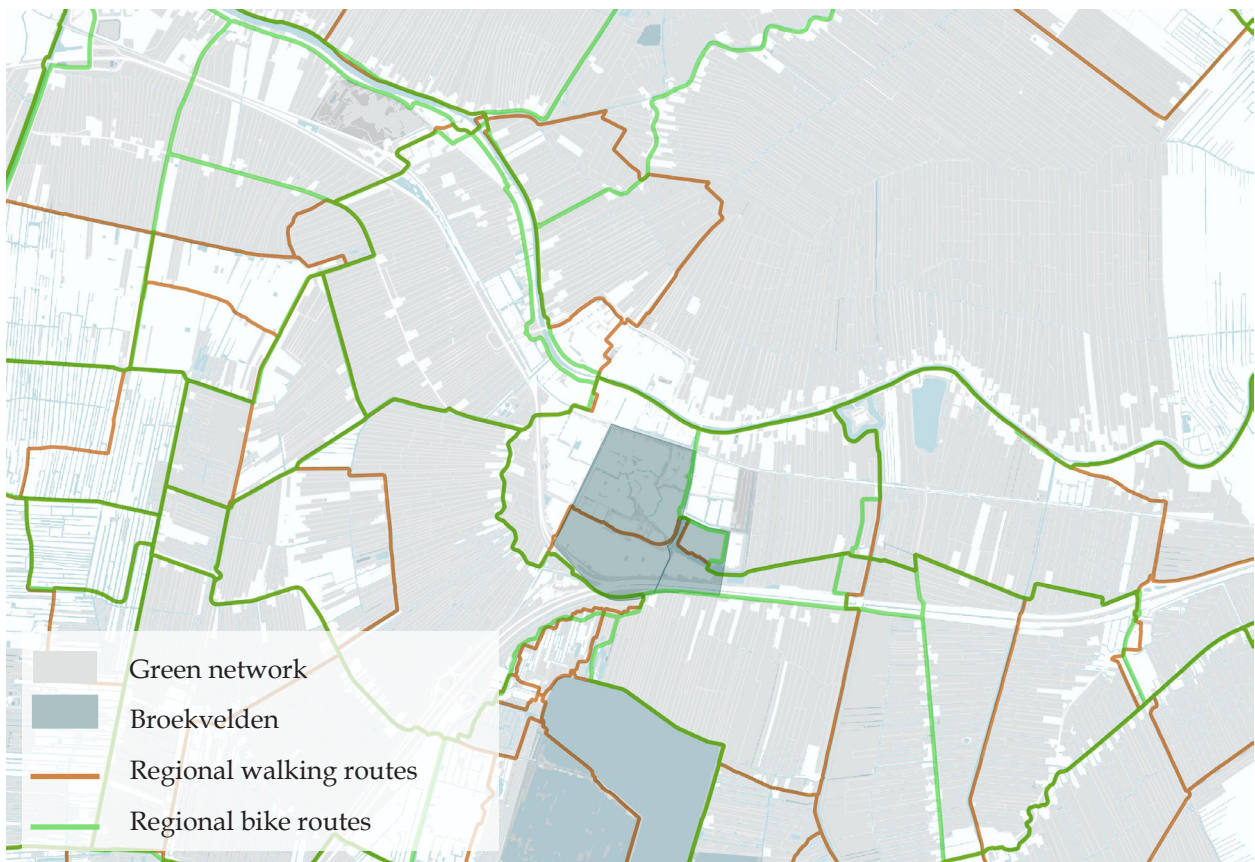


Figure 5.72: Regional walking and biking routes connecting Broekvelden with the green surrounding
(Scale 1.40000, 50% reduced)

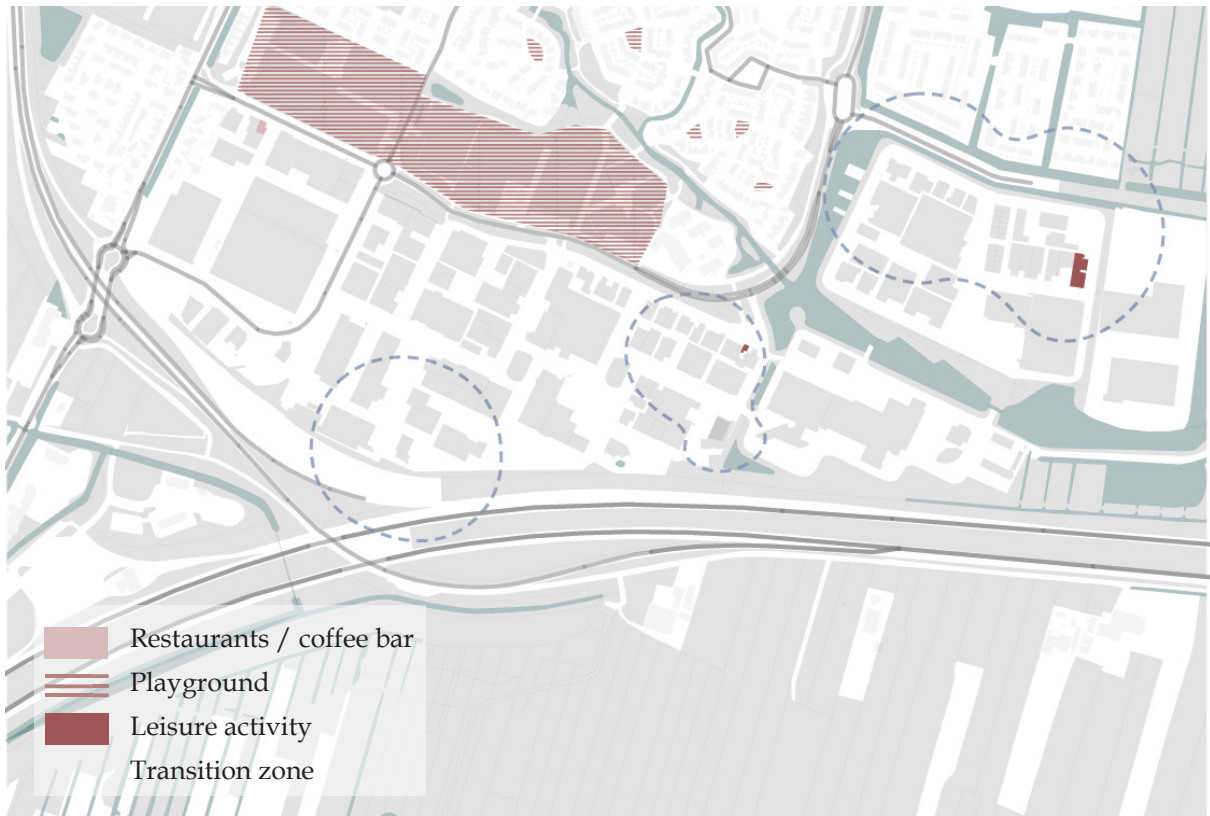


Figure 5.73: Lack in public spaces other than the park
(Scale 1.5000, 50% reduced)



Figure 5.74: Facilities concentrated in the north of Bodegraven
(Scale 1.20000, 50% reduced, based upon data set BAG panden)

Intrium conclusion: what location is suitable to contribute to the circular economy while applying mixed-use strategies?

The analyses show that several spatial qualities differ for each location. This is mostly caused by the different locations of the business parks and the companies that are settled there.

For example, Binckhorst offers a lot of opportunities for mixed-use strategies. This central business park can add to the amenities, labour market and high density of The Hague while contributing to a circular economy.

As figure 5.75 shows these plans are already set in motion. The municipality of The Hague made a framework for the Binckhorst to add 25000 dwellings and provide 30000 new jobs. Posad Maxwan won this design contest and developed the design shown in figure 4.27.

The plans of Binckhorst are mostly focused on adding dwellings, a mix of horizontal and vertical mixed-use, and removing industries. The first part, namely 5000 dwellings, is already approved in November 2021. This means that this transformation is warranted legally as well as planning-wise.

However, there are some concerns about this plan. For example, the waterfront is very important for the industry located there but is replaced by a park. In that way, they exclude companies crucial for a circular economy.

In addition, the south side will be replaced by dwellings, but nowhere is written where the industry that was located there will move to. Lastly, the suggested green corridor results in a more climate adaptive Binckhorst. On the other hand, the connection could be further developed to the northeast side to connect the greenery on both sides of the Binckhorst.

Therefore, this report advises diving deeper into the needs of companies that are related to urban processes and circular economy before replacing them. However, due to the multiple

design ideas that are already there and the fact that this is already set in motion, this thesis does not provide a new design plan for this location. The role of Binckhorst on the regional scale is discussed in chapter 6.



Figure 5.75: Design Posad Maxwan (Posad Maxwan, n.d.)

Another example location that is not further developed in the design chapter is the one of Broekvelden.

As becomes clear from the analyses this business park has expertise in distribution and has a lot of 'Ruis' in the area. This means that the place is not suitable to mix and could better strengthen the function it has right now.

In that way, Broekvelden plays an important role on the regional scale to complete the goal of 100% circularity. This is elaborated on in chapter 6.

The example project that has a lot more uncertainties is Lansinghage. The location is in between rural and urban landscapes, offers a mix of companies, provides amenities but not within proximity, and is connected via public transport and highways but does not have opportunities for slow traffic.

This causes the possibility for mixed-use strategies while facilitating the circular economy.

However, this needs to be done strategically to provide safe living spaces and retain spaces for companies to further develop. Therefore, chapter 6 targets this location to show an opportunity on how this business park could look like.

‘For example, a composition of centralised and decentralised industrial sites is important to form a network that serves the whole region’

Now that it is clear which example locations could facilitate mixed-use strategies and the circular economy, the design proposal could be done. To see how this business ecosystem could work in the coming decades, a future scenario exploration is done. After that, the possible, desirable, and probable outcomes are related to the results from the analyses and literature. These are reflected in the design for Lansinghage and a wished business ecosystem with four types of business parks on the regional scale. The chapter finishes with a policy recommendation and phasing whereby spatial qualities, stakeholders and regulations are named to shape the future of the business ecosystem of construction materials.

6.

EXPLORING THE FUTURE BUSINESS ECOSYSTEM OF CONSTRUCTION MATERIALS



WEBINARCEK

PL-TB-55

6.1 | How does the future business ecosystem of construction materials look like?

Scenarios can help sketch the future to extract possible, probable, and desirable implementations. The out-of-the-box ideas light out aspects of the future to create a specific and viable outcome. This thesis uses two axes to form different types of business parks to see their relation towards liveability and the circular economy.

Out-of-the-box ideas to explore future possibilities of business parks

This chapter investigates the different possibilities of future scenarios for the business parks in the Province of South-Holland.

Nowadays these places occur as islands inside urban and rural areas. However, different future scenarios can give insight into how these locations could operate on a regional scale.

The scenario construction, see figure 6.1, consists of two axes that are used to guide the future of the Province of South-Holland. In that way, the opportunities to deal with the ongoing conflicts of the pressure on the housing market or the need for a circular economy can be explored.

Firstly, the distinction between centralisation and decentralisation. The business parks have different orientations towards their surrounding landscapes. For example, are they located next to a city centre, at the periphery or in a rural landscape?

This affects the access to facilities, optimal use of space, dependency on the business parks, and distances designed by the environmental qualities.

On the other axis, the influence of high or low intensity of mixed-use strategies is put down. This differentiates places with expertise or business parks that deal with several industrial processes and functions. Additionally, the opportunities to mix working and living are explored.

The result is a difference in the rela-

onship between businesses and their surroundings, the collaboration between companies, and the accessibility of several traffic flows.

This scenario construction is used to see the best of the future of the region. This gives strategies on how to deal with the tensions, opportunities and needs of that specific location. Together with the conclusions from the literature review, interviews, and analyses a spatial plan can be made to see where which functions can be placed where to realise dwellings, where possible, and facilitate a circular economy.

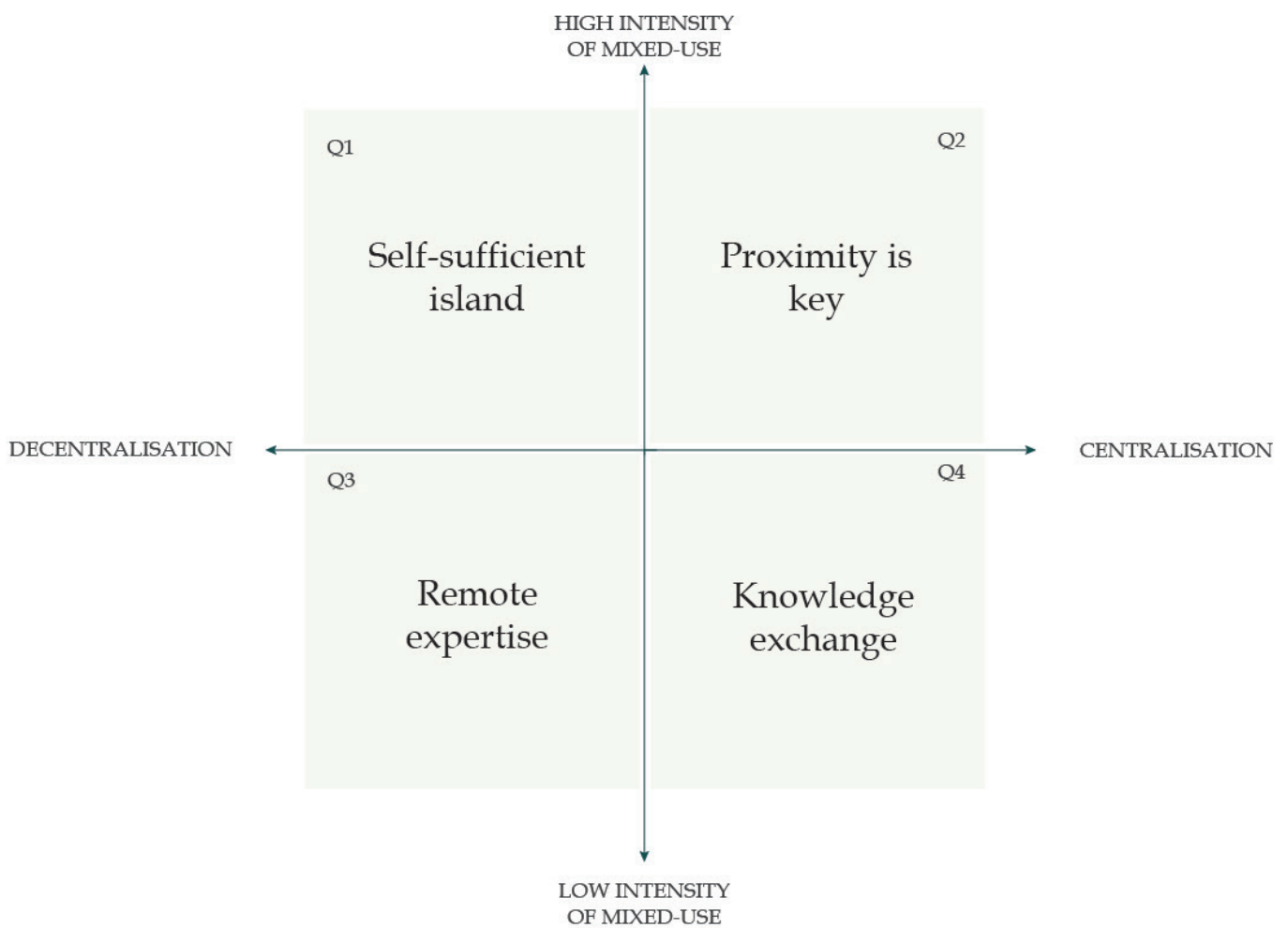


Figure 6.1: Future scenarios on the collaboration of business parks in the Province of South-Holland

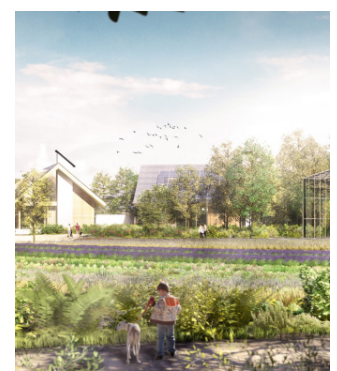
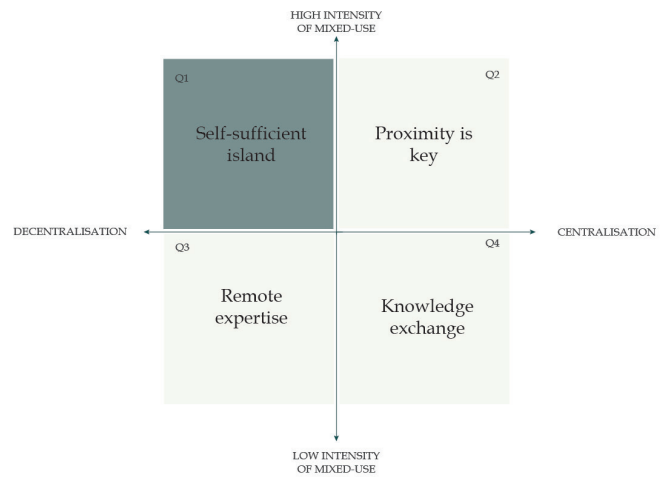
Scenario 1: Self-sufficient island

The first scenario deals with places that are in a decentralised location where the intensity of the mix is high.

The result is a business park which functions on its own. Due to the high intensity of the mix and the distance to amenities, this industrial site becomes autonomous. A mix of public and private spaces creates a location where residents, employees and visitors can meet each other while reserving space for companies to grow and become more circular. Clear regulations about what locations retain for industry and the strategy of micro zoning are a must. The local market creates smaller loops and an understanding of what needs to happen to become sustainable in the future.

The potentials of the scenario 'self-sufficient island' are the following:

- *Urbanisation with mixed-use:* A mix of vertical and horizontal mixed-use while retaining space for industrial processes. The community has to work together to keep the location self-sufficient.
- *Circular economy:* Focus on creating loops and a local economy within the business park. Providing shared workplaces, repair cafés and zones for disruptive industries.
- *Liveability:* Facilities are located within the business park to serve employees, residents and visitors.
- *Accessibility:* The locations have an infrastructure network that serves the functions within the boundaries of the business park. Branches connect this network towards the rest of the city and the region.
- *Influence on the regional scale:* The business parks in this scenario work as an independent neighbourhood which can form collaborations between surrounding areas. Living and working are combined to reduce commuter distance.



Reference case: Orchid City

Orchid City is developed to provide a self-sustainable environment that deals with education, health care, living and working. The balance between nature and industry is designed with the idea of harmony, autonomy, and resilience.

Figure 6.2: Orchid city, 2021

Strategies to deal with scenario Self-sufficient island

- *Urbanisation with mixed-use*: Facilitate a vertical and horizontal mix of dwellings, amenities and industries; enable access to shared working spaces that are open to the public.
- *Circular economy*: Create stimulus for the local economy; subsidies for greening industrial processes; regulate environmental factors to serve industries that are needed to facilitate a circular economy.
- *Liveability*: Design to protect the local community; connect the green network; create events to show the community the industrial processes that are happening there
- *Accessibility*: Improve infrastructure to serve multiple road users within the business park; steer to reduce commuter distances; provide a

fast traffic network to the rest of the region.
- *Influence on the regional scale*: Enable the locations to grow into independent locations that collaborate with each other.

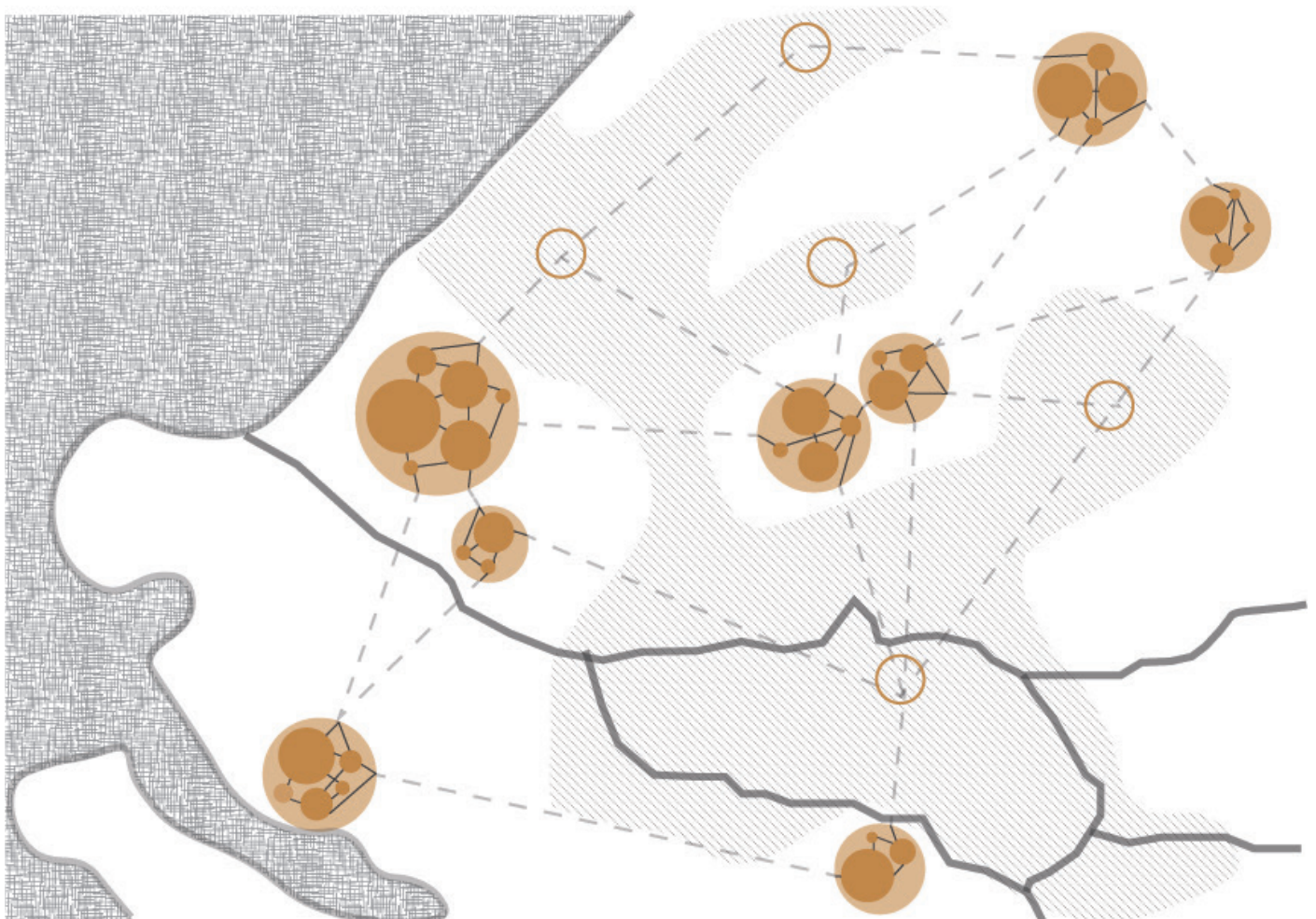


Figure 6.3: Islands of mixed-use business parks spreaded over the Province of South-Holland

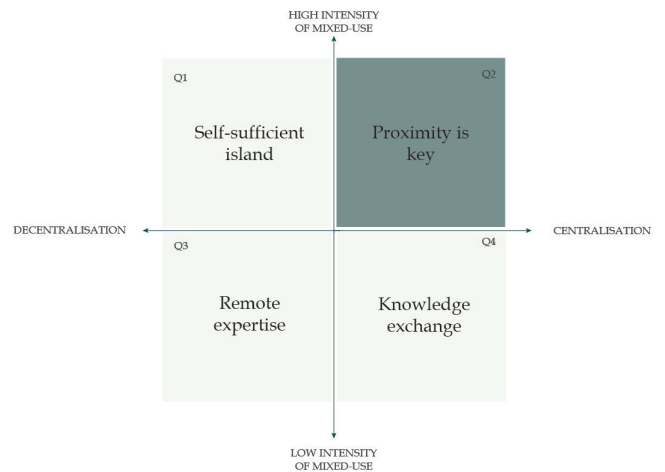
Scenario 2: Proximity is key

Unlike the first scenario, this one is in a central location with a high intensity of mixed functions.

Due to the central location, these areas have great accessibility to amenities, recreational facilities, and other businesses. The business park is well intertwined via multiple ways of transportation. Functions are combined with a smooth transition from working to living. Furthermore, open facades create insight into the processes of the industrial site and create awareness among residents from all over the city. Within the community hub knowledge can be exchanged. In addition, research into how companies can become less disruptive, and nuisances is needed to retain space for these industrial processes.

The potentials of the scenario 'Proximity is key' are the following:

- *Urbanisation with mixed-use:* A mix of vertical and horizontal mixed-use that connect and improve the spatial qualities that are already there. Central locations are established to offer services and products.
- *Circular economy:* Shared spaces like small makers industry, repair cafés, and demolition halls are key. Disruptive and nuisance companies are no longer part of the business park.
- *Liveability:* The fine mix of working and living matches the buzzy city life. Amenities, recreational and education facilities, and greenery are close.
- *Accessibility:* Due to the great transportation network products and materials can be processed somewhere else. The infrastructure at the business park focuses on smaller vehicles and slow traffic. Also, the connection via public transport becomes more important.
- *Influence on the regional scale:* Agglomeration of central locations that share facilities and are well connected by multiple forms of transportation.



Reference case: South San Francisco 2040 General Plan

Structures of mixed-use areas cross the city and connect the residential and industrial landscapes. A mix of horizontal and vertical addition of dwellings causes a diverse plan. The transportation of goods and persons is separated where needed to provide safe public spaces.

Figure 6.4: Raimi + Associates, 2022

Strategies to deal with scenario Proximity is key

- *Urbanisation with mixed-use:* Built upon existing urban structure; reuse vacant land to provide a vertical and horizontal mix; create central locations for amenities; realise a smooth transition from living towards working.
- *Circular economy:* Subsidy to improve the environmental conditions of companies; stimulate research into developments around the circular economy; open up facades to create awareness; policy-making to protect from nuisance industrial processes.
- *Liveability:* Facilitate a community hub; amenities, greenery and recreation close by living and working environment;
- *Accessibility:* Guide towards an intertwined network for several vehicles; improve public transport; strengthen the connection with pro-

cessing locations outside the metropolis.

- *Influence on the regional scale:* Shape an agglomeration which reuses the wastelands and strengthens the collaboration between different functions.



Figure 6.5: Agglomeration of mixed-use business parks serving the urban fabric

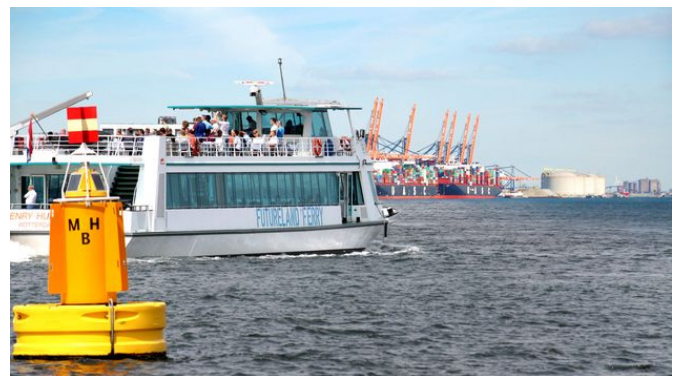
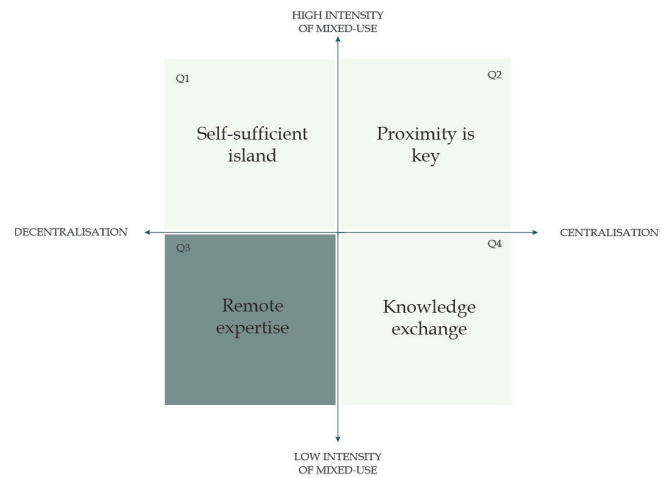
Scenario 3: Remote expertise

The third scenario, Remote expertise, is based upon decentralised business parks with a low intensity of mixed-use.

This reflects in a focus on industrial processes at the business park. Due to the distance from the living environment, this location can serve disruptive companies and offer transportation for heavy vehicles. The result is a business park which creates a place where industrial processes can be improved. In that way, the location can serve the rest of the region by providing the knowledge and activities they excel in.

The potentials of the scenario 'Remote expertise' are the following:

- *Urbanisation with mixed-use:* Mixed-use can only be applied at places outside the environmental factor buffers to form a transition towards the residential areas.
- *Circular economy:* Heavy industry that is needed to remanufacture materials and products finds its place at these locations. Companies have enough space to develop their circular economy ambitions.
- *Liveability:* The business park offers locations to share knowledge about their expertise. Learn-work locations could contribute to this structure. A smooth transition between the big nuisance industrial processes and the residential area is wished for.
- *Accessibility:* The business park is focused on proving an infrastructure network for heavy vehicles. At the edges of this location, residents should have options to reach the experience centres.
- *Influence on the regional scale:* Places where heavy industrial processes are formed close to the urbanised landscapes. These are necessary to facilitate a circular economy.



Reference case: Future land, Port of Rotterdam

The disruptive processes of the second Maasvlakte are not always public. However, using Future Land, this expertise is shared with residents, employees, and other companies. You can discover this world with your own eyes through the information centre.

Figure 6.6: Port of Rotterdam, n.d.

Strategies to deal with scenario Remote expertise

- *Urbanisation with mixed-use*: Facilitate a clear buffer between industrial and residential areas; distance to the living environment must be ensured; reuse an existing structure
- *Circular economy*: Protect companies against the addition of dwellings; reserve waterfront for companies when needed; centralise the logistic zones
- *Liveability*: Guide the knowledge exchange about the expertise of the business park; shape a pleasant working environment for the employees.
- *Accessibility*: Design infrastructure for heavy vehicles, and connection towards the visitor centres; roads are only used when someone needs to attend an activity at these locations.
- *Influence on the regional scale*: Create a net-

work of businesses that excel in their processes; business parks are there to serve the province.



Figure 6.7: Business parks occur as islands that focus on their own expertise

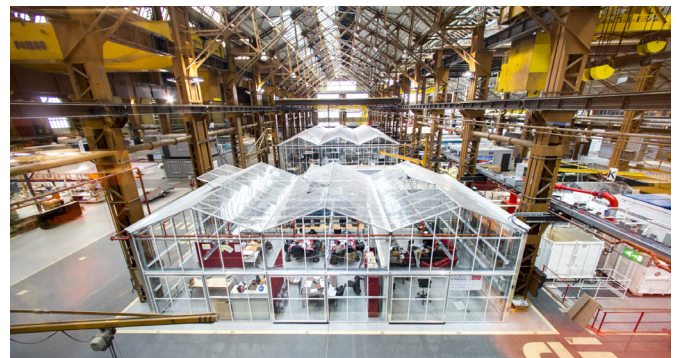
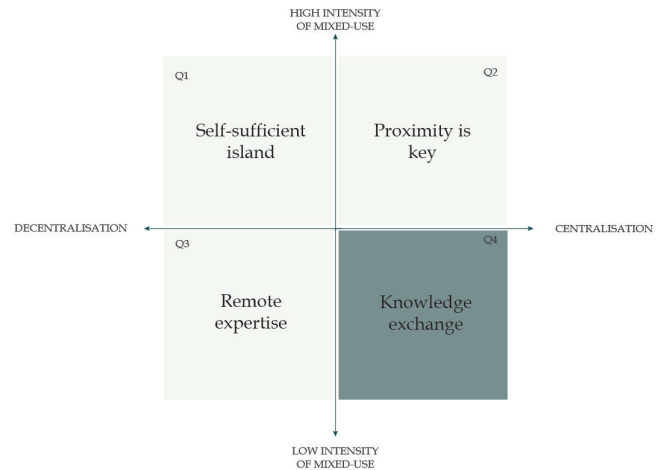
Scenario 4: Knowledge exchange

The last scenario deals with the business parks that have a central location and a low intensity of mix.

This structure again causes expertise in the industrial processes. However, due to the central location, this area is easily accessible for residents and visitors. Additionally, the low intensity of the mix realises spaces to experiment with new developments. Besides, this gained information can be shared via events and workshops. The infrastructure network of the urban landscapes makes sure that these locations are easily accessible for inhabitants of the whole Province of South-Holland.

The potentials of the scenario 'Remote expertise' are the following:

- *Urbanisation with mixed-use:* A mix of functions is only serving the companies. Dwellings can only be added at the edges of this business park to provide a smooth transition towards the surrounding neighbourhoods.
- *Circular economy:* Innovation and places to experiment with new processes provide developments to become more circular. Opening up to the public creates awareness that influences rethinking and reducing the waste stream.
- *Liveability:* The business park provides new amenities and create a safe space to exchange innovative ideas.
- *Accessibility:* The industrial site can use the infrastructure provided by its central location. The visitors can use public transport or bike, while also industries use the road network to transport their products.
- *Influence on the regional scale:* Add to the knowledge infrastructure where there is enough space to innovate for companies and their employees. Creating awareness while providing spaces to keep industry close to the city is key.



Reference case: RDM Rotterdam

This location has expertise in the Port industry. It offers space for innovation via technical education, high-quality test facilities and field labs. This makes it the place to stimulate and develop innovative solutions for the smart port of the future.

Figure 6.8: RDM Rotterdam, n.d.

Strategies to deal with scenario Knowledge exchange

- *Urbanisation with mixed-use*: Provide a mix of high-tech, makers industry and shared working places; open up learn-work environments; steer to no addition of dwellings.
- *Circular economy*: Facilitate spaces to experiment, test and exchange with new industrial processes; regulate spaces designed for industry; bet on the possibility to rethink and reduce the waste streams.
- *Liveability*: Stimulate research and innovation; provide spaces to share knowledge; create a nice working environment.
- *Accessibility*: Separate the road structure designed for heavy vehicles from the public buildings; guide slow traffic opportunities; connect to other business ecosystems with a more decentralised location.

- *Influence on the regional scale*: Keep industrial processes close to the place where it is used; add to the knowledge infrastructure.

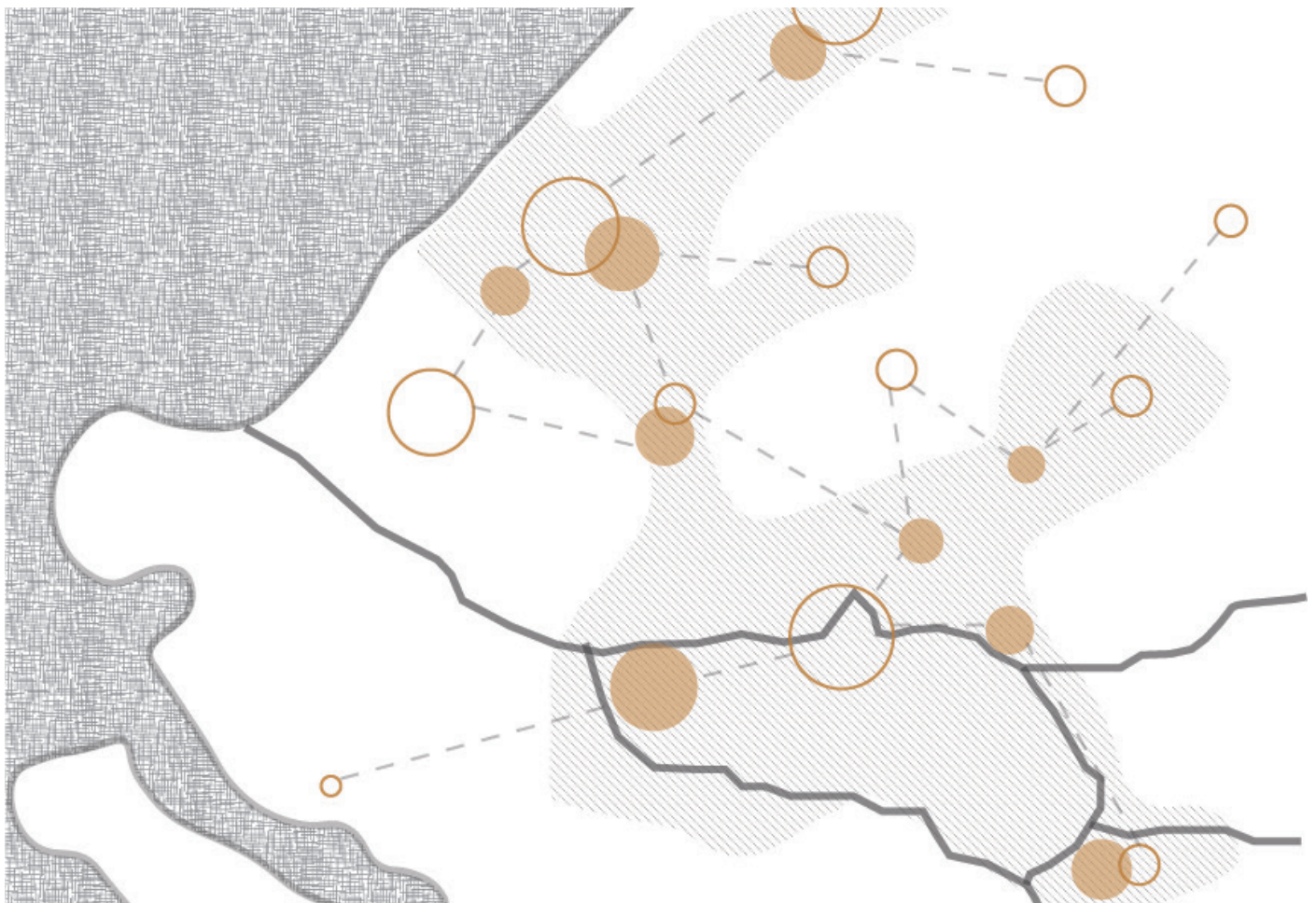
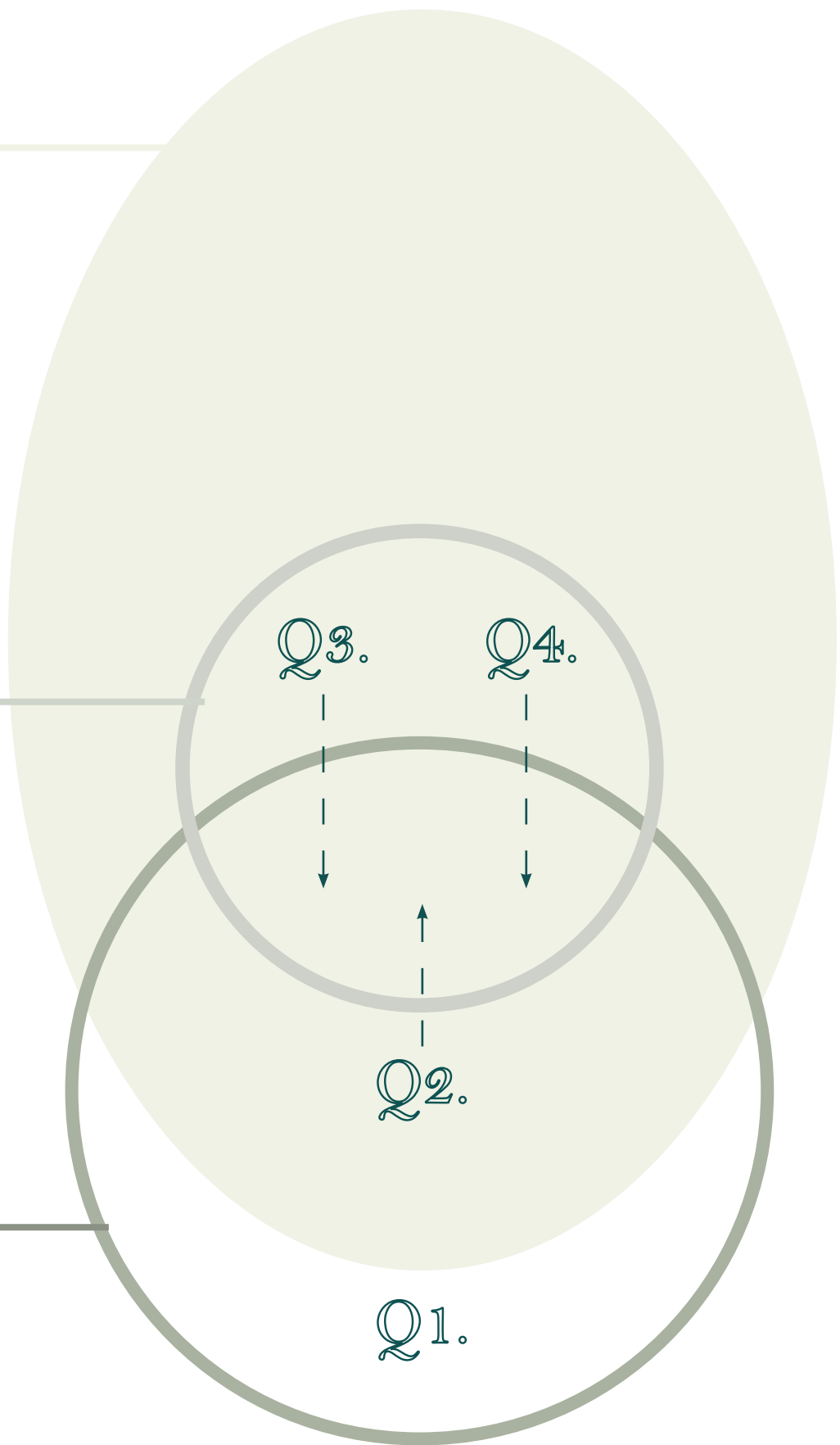


Figure 6.9: Islands with disruptive businesses inside the urban fabric

POSSIBLE

PROBABLE

DESIRABLE



Q1.

The first scenario sounds **desirable**, because of the independent and therefore resilient communities that are realised. However, this future could probably not be achieved, because the locations are too far away from the amenities that are needed in proximity. In addition, the central locations are neglected in this structure. With the socio-economic structure of the metropolis of The Hague-Rotterdam, this is not very possible.

On the other hand, the mix between working and living is something which can be aimed for. As well as the shared working places, local economy and a separate infrastructure network.

Q2.

Secondly, the scenario focuses on central locations that provide a high-intensity mix. This is **desirable** due to the current housing crisis and **possible** as well because of the already existing urban fabric that is located here. However, there is a need for some regulations and simulations to make sure that this future scenario becomes probable.

Examples of what is needed are more research on how to improve the environmental conditions of the industrial processes, protection for and from the nuisance industry, guidance in road usage and facilitating public spaces.

Q3.

Scenario 3 is focused on industrial sites that occur as an island without accessibility towards city life. That refers to a **probable** and **possible** situation because nowadays the business parks work like this as well. On the other hand, with the future transitions and housing shortage in mind, not all these locations could work like that. Desirable is to retain spaces for industry, sometimes zoned out of the urban landscape, but also connect this to the residents that need the expertise that is situated here. Opening facades, creating events and facilitating slow traffic in some parts could help to make this scenario more desirable.

Q4.

Just like the third scenario, this scenario is **probable** and **possible**, but not yet desirable. Again, this business park structure is already partly there now. It serves as a place to share expertise, innovate industrial processes, and add to the knowledge infrastructure. However, the low intensity of the mix does not prepare us for the transitions we are facing in the coming years. To make this scenario more desirable, the addition of dwellings and flexible usage of environmental factors is wished.

In short, there are elements of each scenario which play an important role in the future of mixed-use business parks that contribute to a circular economy.

For example, a composition of centralised and decentralised industrial sites is important to form a network that serves the whole region. The heavy industry needs a place outside the residential area and space to develop caused of the environmental conditions.

However, some locations should bring processing close to the city where the components and products are used. A smaller loop between mining and processing helps to achieve the goal of becoming more circular.

Additionally, there should be places that remain for industrial processes only, without the dwellings disturbing this. Otherwise, it is not possible to become 100% circular by 2050.

On the other hand, the business parks that could deal with a high intensity of mixed functions are important to create awareness among inhabitants and reduces the pressure on the housing market.

With these scenarios in mind, the design for the example project of Lansinghage could be made.

Later, a strategic framework of the business park network in the Province of South-Holland is given to see, how these different types created by the probable, possible and desirable scenarios, relate to each other and their spatial qualities. This gives a holistic approach to which industrial sites could be mixed with dwellings and which should only serve the circular economy.

6.2 | Lansinghage: future example of a mixed-use and circular business park

As explained in the future scenario construction several points need to be dealt with to serve a fitting future to reduce the pressure on the housing market while facilitating a circular economy. In this subchapter, the location of Lansinghage is redesigned to see what spatial qualities and characteristics should be reinforced to achieve these goals.

The location of Lansinghage is at the periphery of Zoetermeer which provides opportunities to house noisy companies while adding a living environment that connects to the rest of the city.

The questions that arise when looking at the spatial qualities and characteristics are shown on the next two pages. Some implementations are more focused on the processes that are located at the business park itself, like providing a separate infrastructure route for heavy vehicles and keeping spaces in the south to serve the economy.

Other qualities and characteristics that are reinforced are there to create a better connection towards embracing landscapes. Like, as providing amenities, focusing on a smooth gradient between living and working, and linking the green network. Besides, the new mobility hub located at the current station of Lansingerland links the area on a regional and city scale. This makes the place attractive to live and work because of its high accessibility.

In addition, opening the facades of companies and facilitating spaces for innovative companies to share knowledge are needed to create awareness among inhabitants about the circular economy goals.

Furthermore, places like the circular urban hub, circular craft centre, processing hub and urban mining can be hosted at this business park.

Lastly, the new green park not only connects the business park with the residential Rokkeveen but also serves as a space to experiment with new biobased materials. Visitors and residents can see the materials with their own eyes which again contributes to the rise

of the R-ladder. Together this creates more opportunities to become 100% circular.

All these implementations are formed on the base of questions. Therefore, the next pages show the six functions that need to be added and seven spatial qualities that could be reinforced.

This combined form the implementations that could be done at Lansinghage creates a liveable environment while facilitating a circular economy.



What network should remain to facilitate the heavy industry?

This network is designed to serve the heavy industry that is needed for the economy while protecting the living environment by realising a safe and separated infrastructure network. Experiments on this road network can be found in Appendix D.

Where should knowledge exchange find place?

The innovation lab is a place where innovative companies come together to exchange knowledge. This is connected to the green corridor where future biobased materials are cultivated and work as a public visitors' centre.



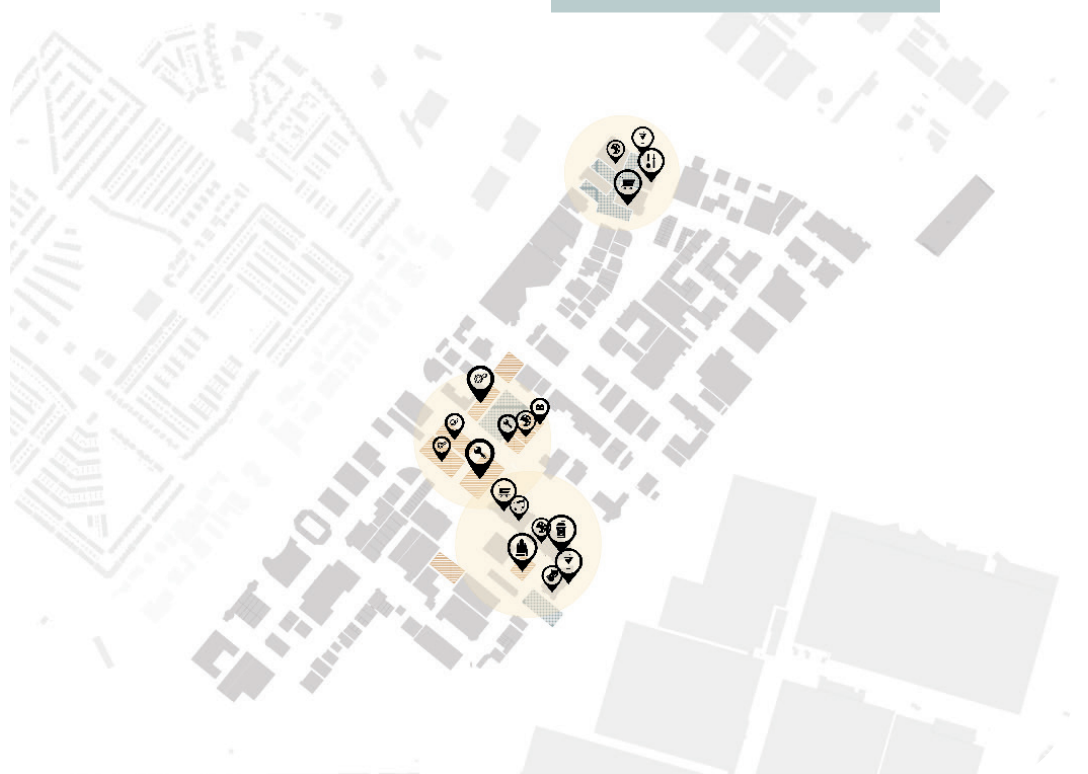


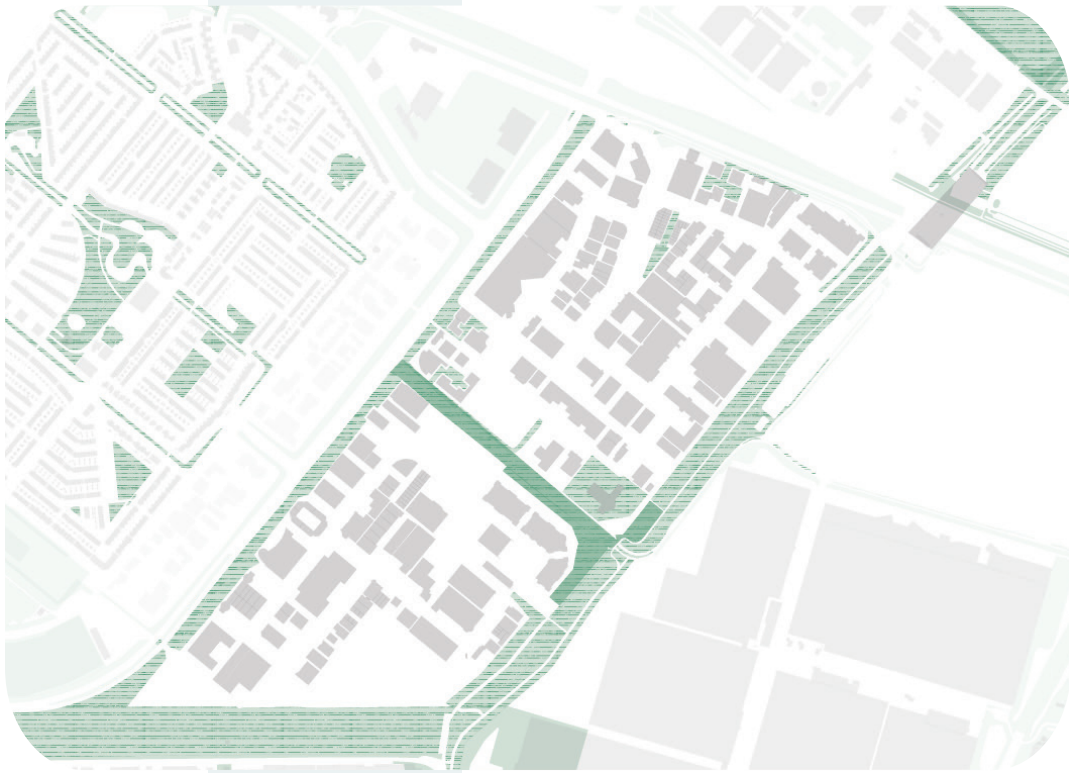
What is the opportunity of station Lansingerland?

The mobility hub consists of the new station Lansingerland which connects the mixed-use business park on a regional scale with the train track and regional walking and bike routes while making the place accessible to the rest of Zoetermeer by the tram and bus line. Furthermore, this creates opportunities to work inside Lansinghage without living there.

Where are amenities needed to serve the employees, visitors and residents?

Some companies are oriented in such a way that they can form a public space where people can relax, meet with friends and colleagues, follow workshops, get their groceries, and contribute to the circular economy by tinkering with their products in a repair café or DIY hall.





How could the green structure be strengthened?

Adding a green corridor in the middle of the business park creates an opportunity to connect the park on the west side towards the smaller greenery inside the residential area.

How much space could be designed for urban mining?

On the south side, 3,1 hectares is available to serve as a storage place for urban mining. Recycling companies are already located next to this.

However, this place serves as a temporary one. On the other side of the highway, the business park Prisma fulfils this task in the business ecosystem on a regional scale.





What is the gradient between living and working?

Lansinghage provides a smooth gradient in plot sizes, facilitating the transition from industrial towards residential areas. Smaller spans can form the base for mixed-use strategies. The south enables opportunities to become 100% circular.

How does the green corridor respond to its surroundings?

With the arrival of the new green structure, the companies located next to these switch their orientation towards this park. Entrances are linked to this greenery to attract visitors. Additionally, the new park forms the entrance of the future mixed-use business park.





How many open spaces should remain for industrial processes?

To develop the circular processes that are required in the future of this business park a certain space needs to be preserved. In this scheme, approximately 13 hectares are assigned to that (that's about as much space as half the industry). This could be a bit more because not all private terrain is counted in.

What facades could become more attractive to walk by?

Creating awareness among inhabitants is needed to achieve a higher level at the R-ladder. The effect of open and attractive facades is to show what industrial processes are influencing the socio-economic structure. In addition, it forms an attractive environment to visit.





What roads should become more active?

When adding dwellings into the area, new roads should be designed to form attractive streets to walk through. The companies located next to these could open their doors and form a public street where shops are easily accessible.

What private space do the future residents have?

Next to the new public additions, it is also important to make sure that some space is only indicated for the new residents. This can for example be a private garden, collective space, or a courtyard.



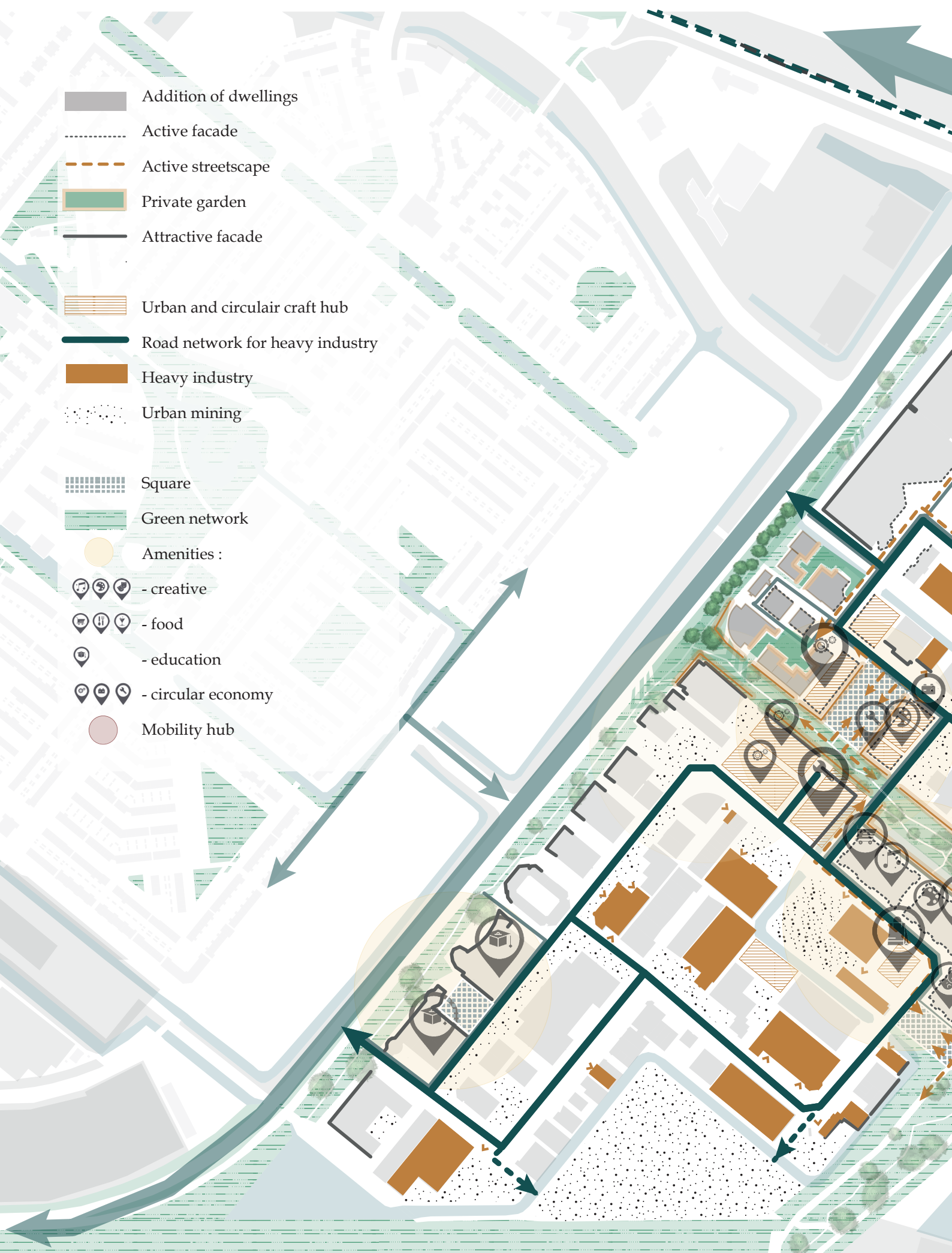


How could the dwellings be protected against the noisy infrastructure?

Even though the dwellings are not located in the environmental zones, there is still a nuisance caused by the roads and train tracks. To protect the dwellings a bit against the noise and view, rows of trees are introduced.

These functions and spatial qualities are combined in the spatial framework designed for Lansinghage on the next page.

Furthermore, zoomed-in locations are used to show the future of the business park. Sections give impressions of the changing usage of the road network and the relation between the buildings and their surroundings.



■ Addition of dwellings

⋯ Active facade

--- Active streetscape

■ Private garden

— Attractive facade

▨ Urban and circular craft hub

— Road network for heavy industry

■ Heavy industry

⋯ Urban mining

▨ Square

▨ Green network

● Amenities :

🎵 - creative

🛒 - food

🎓 - education

♻️ - circular economy

● Mobility hub

Figure 6.10: Combined version of the new functions and improved spatial qualities at Lansinghage



This new square in the north of Lansinghage is transformed from a fenced-off, paved area into a public place. Earlier this place was used to supply the embracing industries. Streets assigned to heavy vehicles were needed to transport goods into the business park.

However, with the arrival of dwellings on both sides of this place, the structure asks for something else. Dwellings are added on the smaller companies with busy streets connecting towards the square. Next to the vertical mixed-use strategy, also horizontally there is some densification planned.

This place is no longer preserved for trucks but is also accessible for pedestrians and bikes. This new north provides a nice and warm welcome to the industrial mixed-use site of the business park.

To attract people to this location, it is needed to open up facades, introduce walk-in workplaces and facilitate small shops. In this case, the current situation is used to provide something new.

In addition, the streets are greenified which together with the active facades results in a more pleasant living environment. In that way, people can jog, get drinks or follow a workshop in this public location.

Because of its location, this place is also suitable to facilitate a waste collection point. According to the Province of South-Holland (2023), this is an important structure which is needed to improve a circular waste stream on a bigger scale.

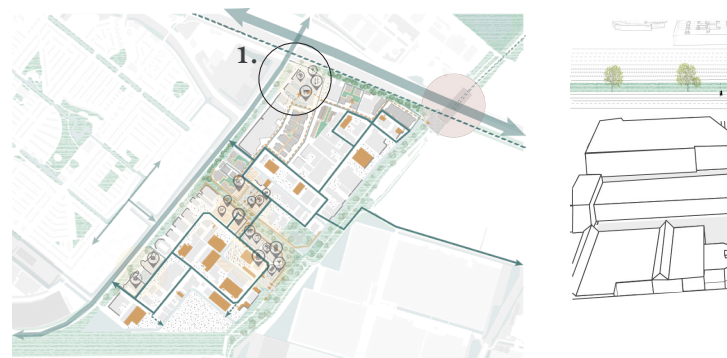


Figure 6.12: From closed-off business terrain towards a lively public space

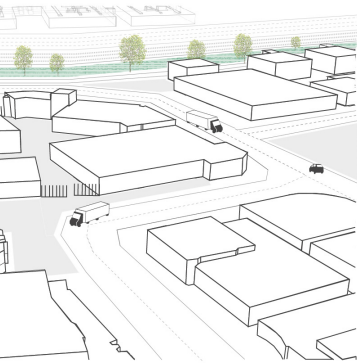
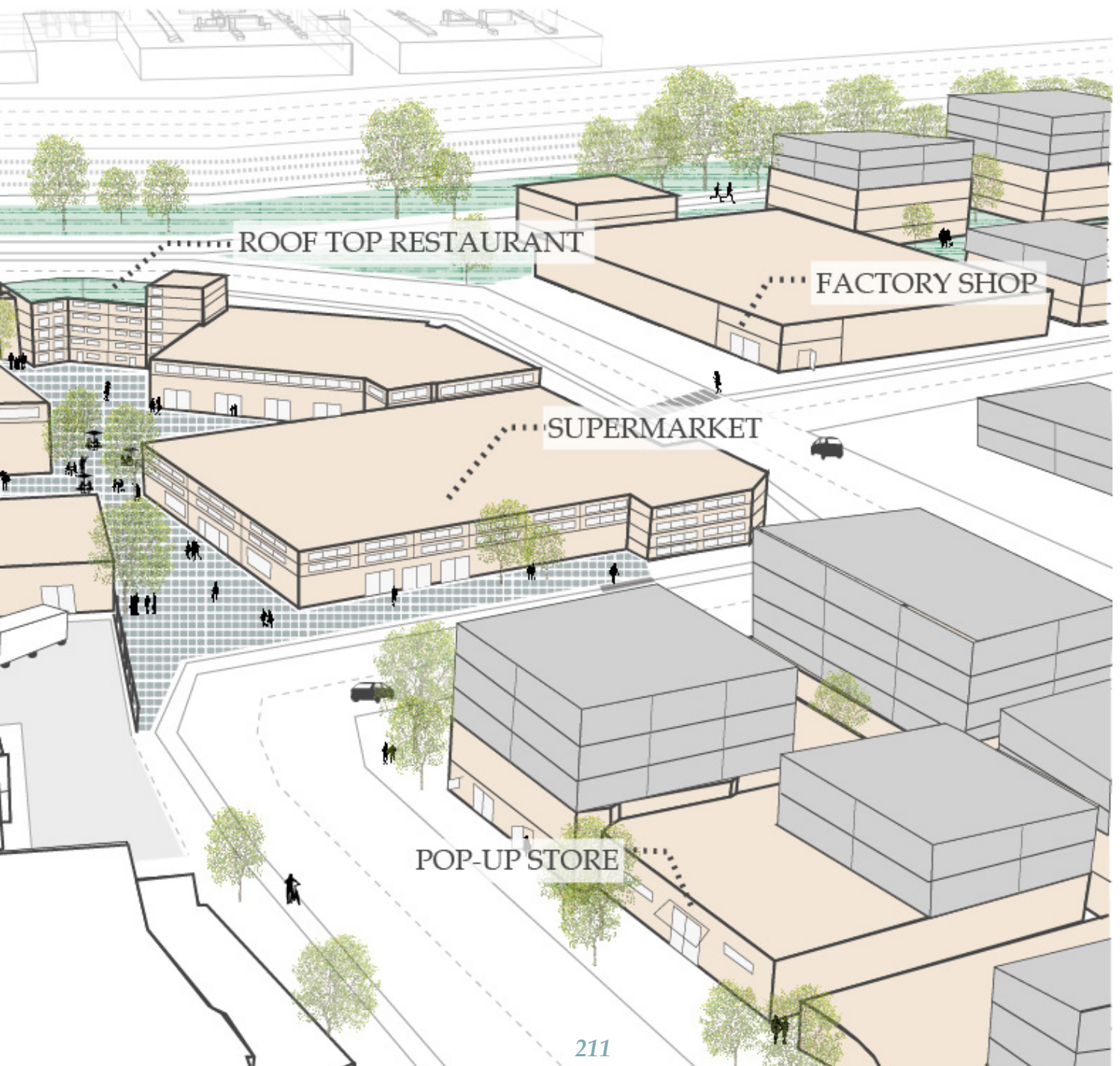


Figure 6.11: Context and current situation of the first zoom-in location (Google earth, 2023)



Nowadays, the station Lansingerland is not optimally used. The stop is assigned to the train and the tram, and this station can become a mobility hub as well. In that way, the new mixed-use business park is better accessible on the city and regional scale.

The solar panels on the roofs with smaller spans are generating solar energy, but this needs to be stored somewhere. The answer can be found in the addition of electric cars and bikes. Next to the fact that it improves the mobility hub it also could work as an energy buffer (TU Delft, 2023). The effect is less emissions and more shared public transport.

Due to the cause of the nuisance by the train, highway and industry, this place has less addition of dwellings. However, to provide a new living environment, the dwellings are located away from the industries and close to the mobility hub.

A green buffer of trees reduces the noise from the major thoroughfare. This is connected towards the park on the east side of the business park. With the new implementation of open facades, this becomes a more attractive walking route which contributes to the regional bike and walking network.

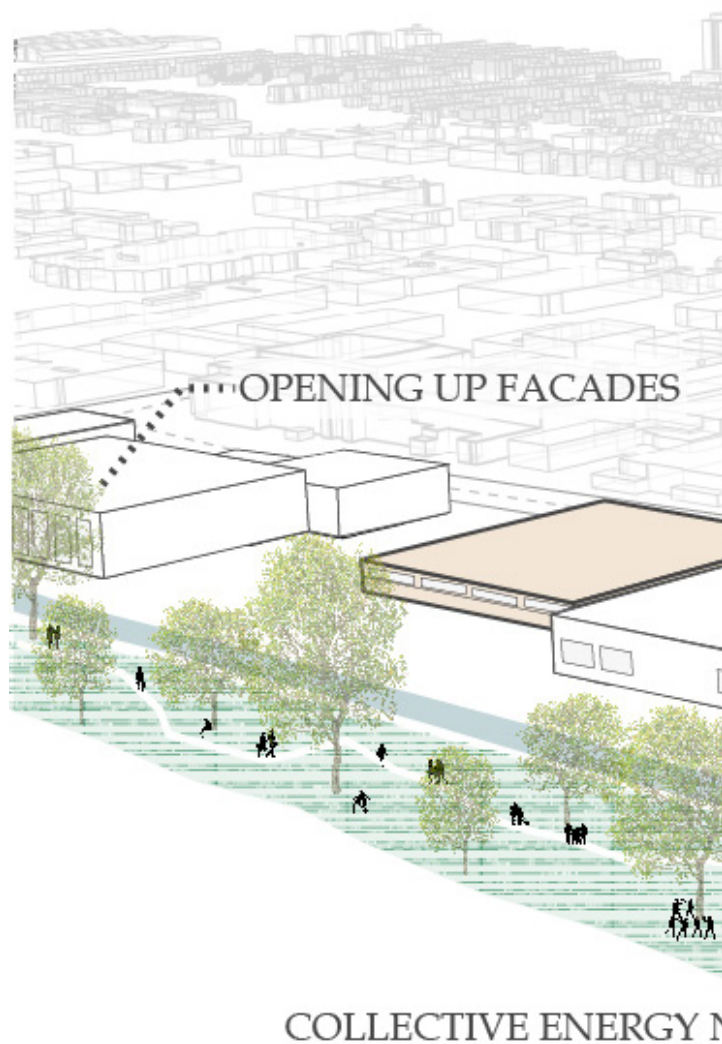
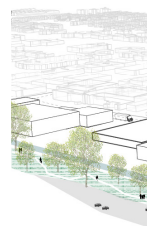
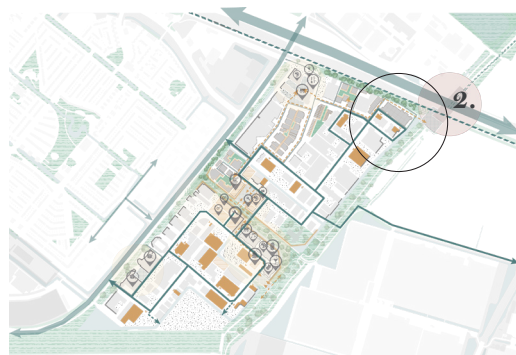


Figure 6.14: Opening to the rest of the city and regional by improving the accessibility for multiple road users

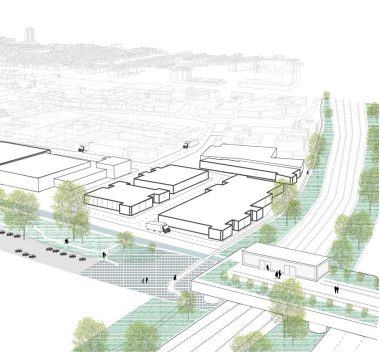
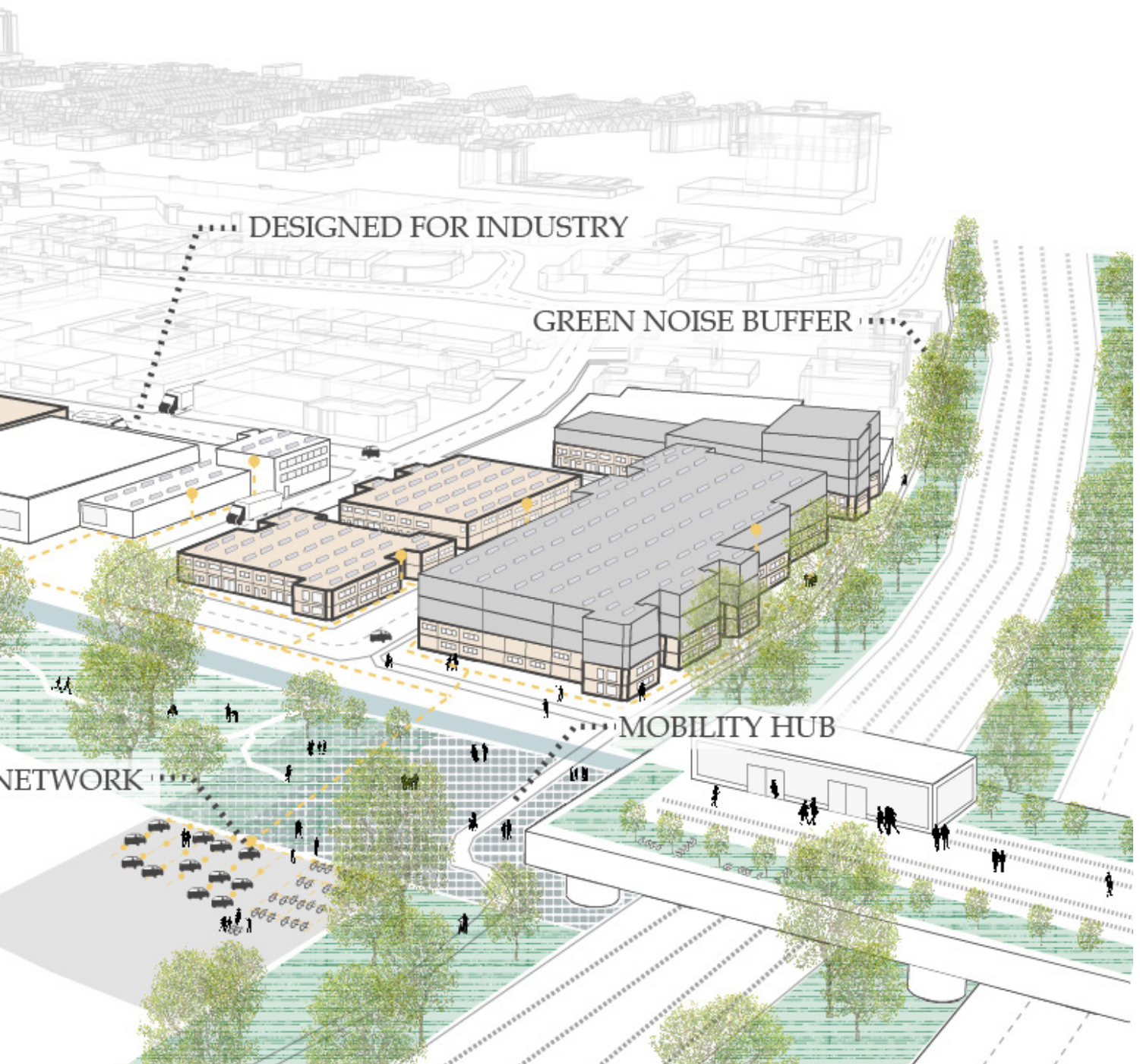


Figure 6.13: Context and current situation of the second zoom-in location



The third zoom-in is taken at the new circular hotspot. This place is divided by the park to retain a space that is solely used by companies and one that is more open to the public.

The north side provides, therefore, facilities like a repair café, disassembly hall, DIY spaces and social workplaces. These are publicly accessible with a square in the front to meet up with colleagues, bring your products or access the mixed-use area.

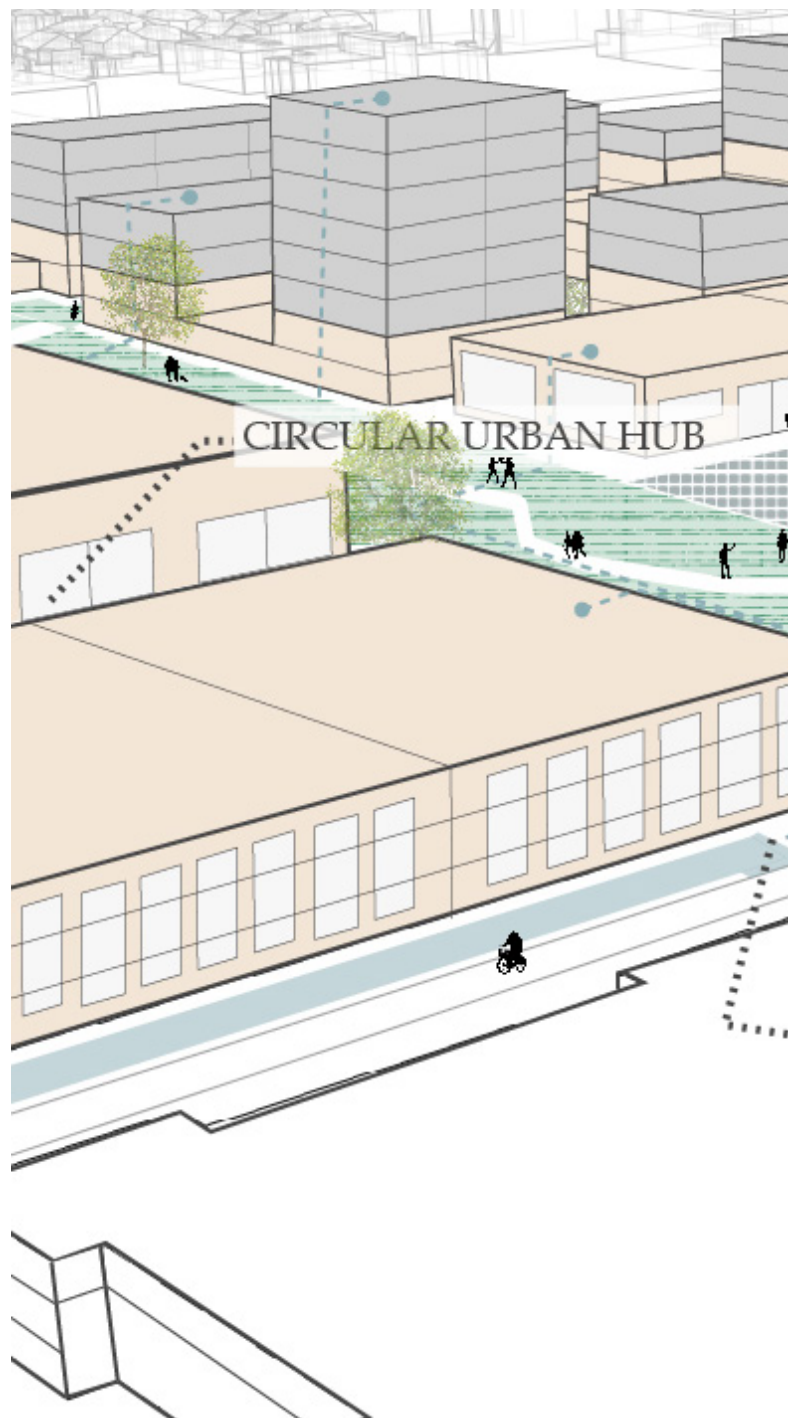
On the other side of the park, the circular hub is more focused on the storage, separation, sorting and processing of materials and products. Therefore, this area is connected to the transportation route for heavy vehicles as well.

The place that was once the Lansinghageweg is now transformed into a park. This green corridor has several functions.

Firstly, this connects the green structures surrounding the business park to the residential area of Rokkeveen. This creates a new entrance focused on slow traffic.

In addition, the vegetation of the park is connected to the research that is done by the living lab. New biobased materials can be tested and draw attention towards new construction materials.

Lastly, it is important to separate rainwater from the wastewater sewage system. The park can form a natural water basin that slowly infiltrates the water into the ground. Besides, the park is located next to the ditches which contribute to the green-blue network at Lansinghage.



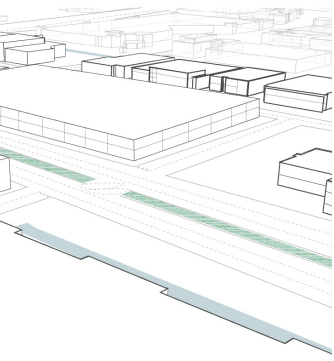


Figure 6.15: Context and current situation of the third zoom-in location

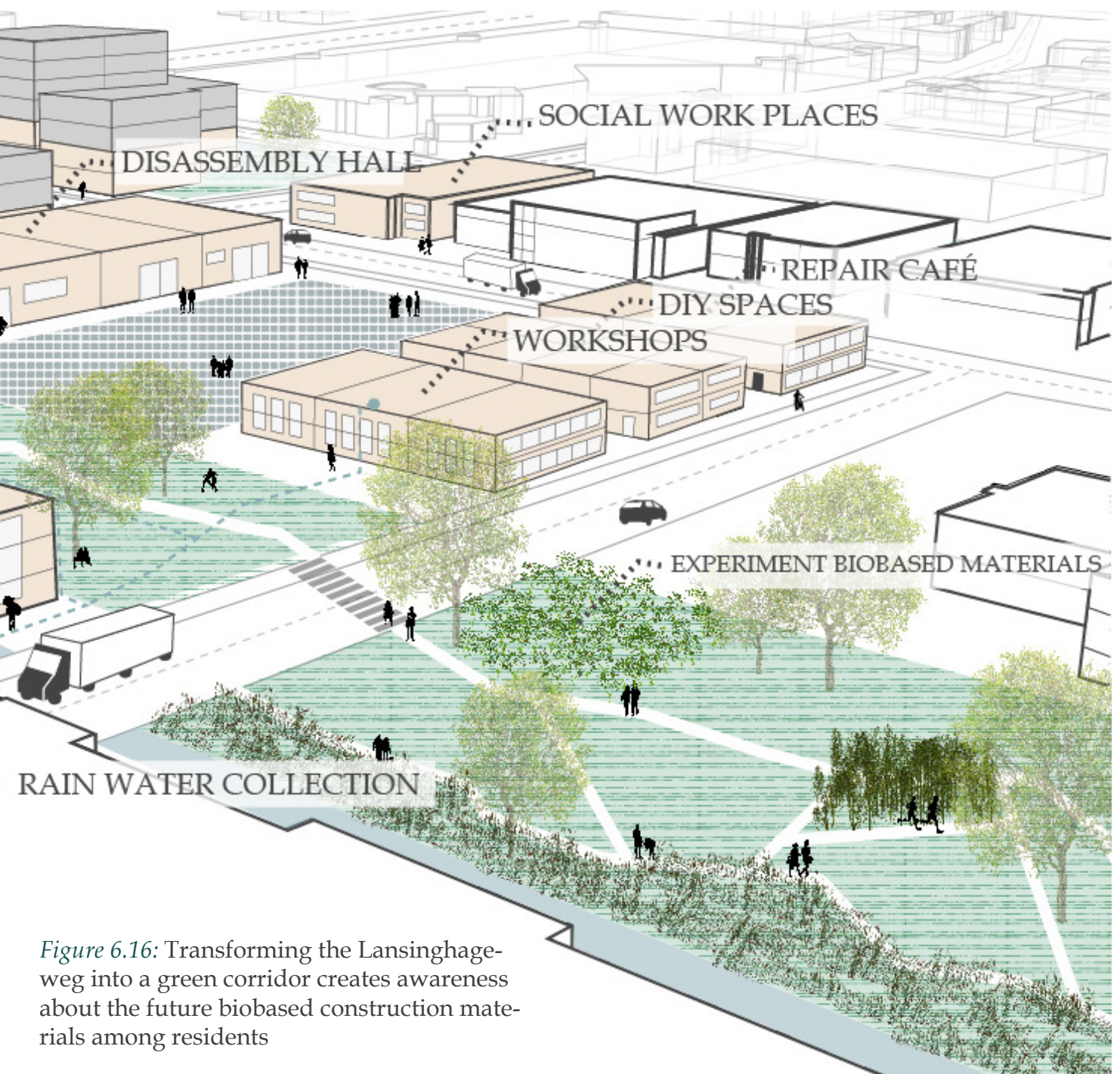


Figure 6.16: Transforming the Lansinghageweg into a green corridor creates awareness about the future biobased construction materials among residents

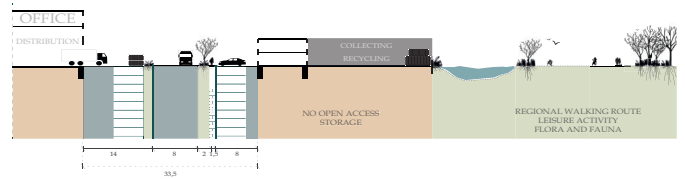
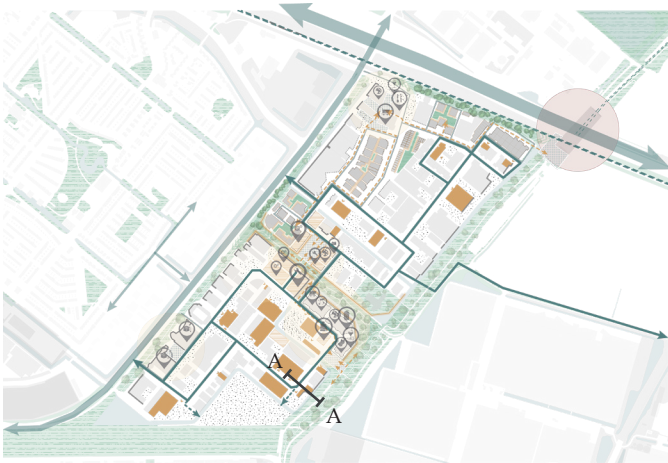


Figure 6.17: Section before implementations of urban mining hub (25% reduced)

The sections are chosen to show the relationship between the streets, facades, and buildings. It gives an atmosphere as well.

Section A.2 shows the new implementation of the urban mining hub on the south side of Lansinghage. The functions of this location stay relatively the same, because of the retaining of space for industrial processes. This is needed to reach the goal of becoming 100% circular.

The urban mining hub is not publicly accessible, due to the safety and nuisances. However, the park provides views of this industry. In that way, the people walking by can still get a feeling of the processes that are going on there.



Reference case: Circular urban mining VolkerWessels

The Circular urban mining hub of VolkerWessels is located at the periphery of the city to provide necessary building materials when needed. The entire logistic process of the construction chain is monitored and coordinated from this location.

Figure 6.19: VolkerWessel, n.d.



Figure 6.18: Relation between heavy industries and the new urban mining hub (75% reduced)

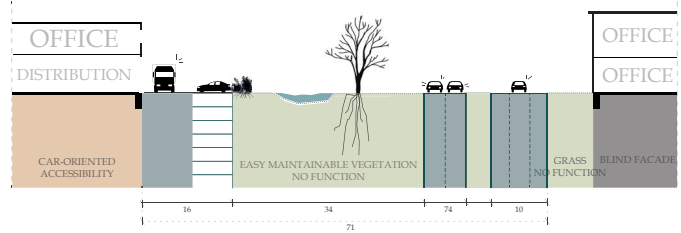


Figure 6.20: Previous section of Lansinghageweg (25% reduced)

As already shown in the zoomed-in illustrations the function of the road crossing Lansinghage transforms into a green corridor.

Whereas the orientation of the buildings was first focused on the street network, this now differs into a public entrance at the park side of the buildings. With the addition of new amenities like a restaurant, coffee bar, thrift shop and workshop spaces, this area changes into a lively area.

The streets that were assigned to transport goods are now opened up and form terraces where you can meet with your friends. Asphalted materials are replaced for pedestrianised and climate proof areas.

The effect is a place that does not only serve the economy, but also contributes to a liveable environment.



Reference case: Merwedekanaalzone Utrecht

The park ensures the green anchoring of the new city district with its surroundings. The favourable location of the new centre of Utrecht makes it an ideal testing ground for innovative mobility concepts and provides a high-quality public space. Furthermore, the water system can be linked to the park to make it climate adaptive as well.

Figure 6.22: Unknown, n.d.

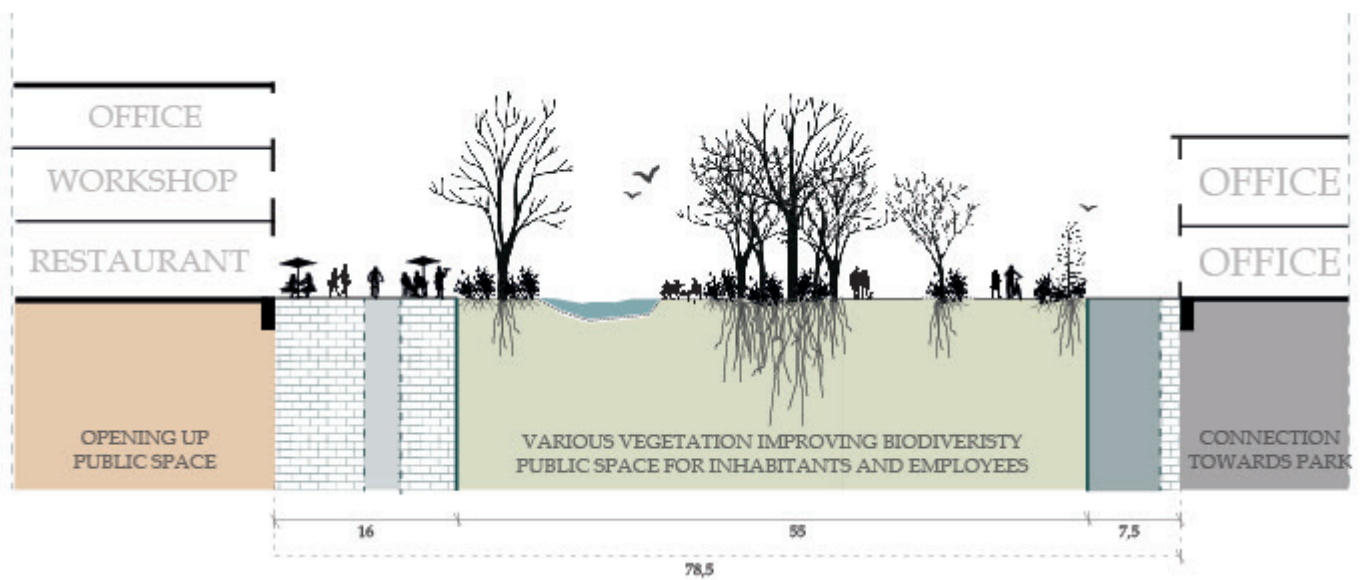


Figure 6.21: Creating a public space from instead of a major thoroughfare (75% reduced)

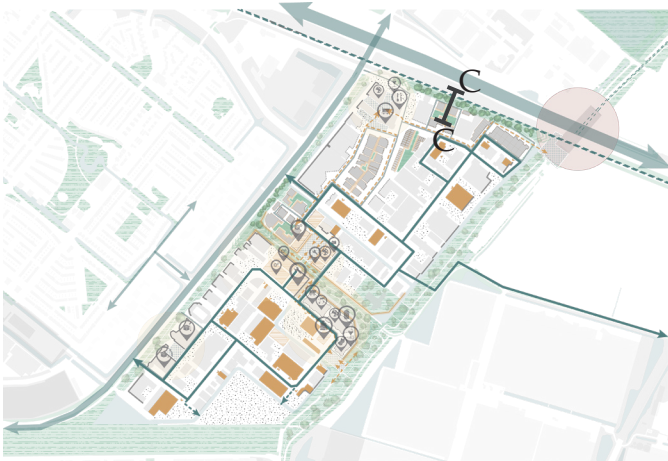


Figure 6.23: Previous section of offices next to the train track (25% reduced)

The last section shows the implementation of a vertical mixed-use strategy. The small spans and functions of the companies can be mixed with dwellings. The orientation of these houses is turned away from the highway and train track.

The courtyards between the mixed-use industries form a collective space which is designed for the employees and residents.

However, on the other side of the buildings, the infrastructure is placed. The already existing arcade forms a perfect place to wander through the shops while separating the traffic.

The division between the bike route and the bus line also adds to this safer environment. A green buffer provides some extra protection against the noisy infrastructure.



Reference case: Novacity

The orientation of dwellings and companies should differ to protect both functions. In that way, vertical mixed-use could be applied while facilitating a circular economy.

Figure 6.25: Bouwmeester maître architecte, 2019

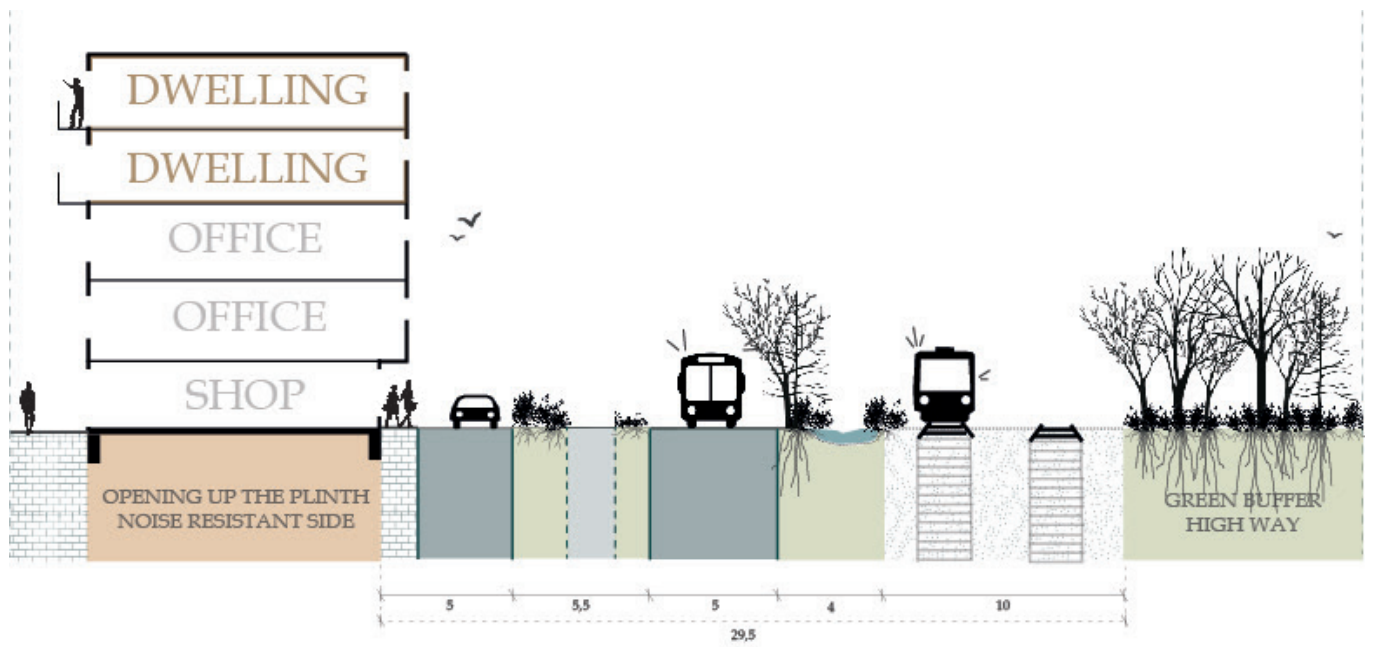


Figure 6.24: Shaping the orientation and green buffer to protect from noisy infrastructure (75% reduced)

- Zone 1: Primary working at disruptive industries
- Zone 2: Public industries forming gradient between working and living
- Zone 3: Mixed-use
- Zone 4: Green corridor

- Merging roads
- Roads assigned for industries
- Roads assigned for mixed-use
- Roads assigned for slow traffic

- Active facades
- Attractive facades
- Orientation entrances for trucks





The spatial design from above shows the addition of different functions and qualities towards the area. However, to make a clear distinction between the areas this new plan has, a 'kavelpaspoort' is made to show the rules of each location.

Figure 6.25: Kavelpaspoort assigning the different atmospheres of Lansinghage

The first set of rules can be extracted from the primary working area. This is focused on spaces for industries to develop their industrial processes and improve their circularity. This reflects in the need for space and wide streets. The turning radius of a truck has a maximum of 12 meters. Therefore, this road is much wider than the ones that only other vehicles have access to.



Next to the width of the street, also the height of the entrances is important. When the supply is delivered, the trucks must come close to the building or even enter it. That reflects a minimum height of 5 meters. The plinth does not have to look attractive but is just functional for the processes that happen there.

Lastly, the backside of the buildings has some free space most of the time. This causes opportunities to expand the building. However, there must be land available to cross with smaller equipment like a forklift truck to transport some materials.

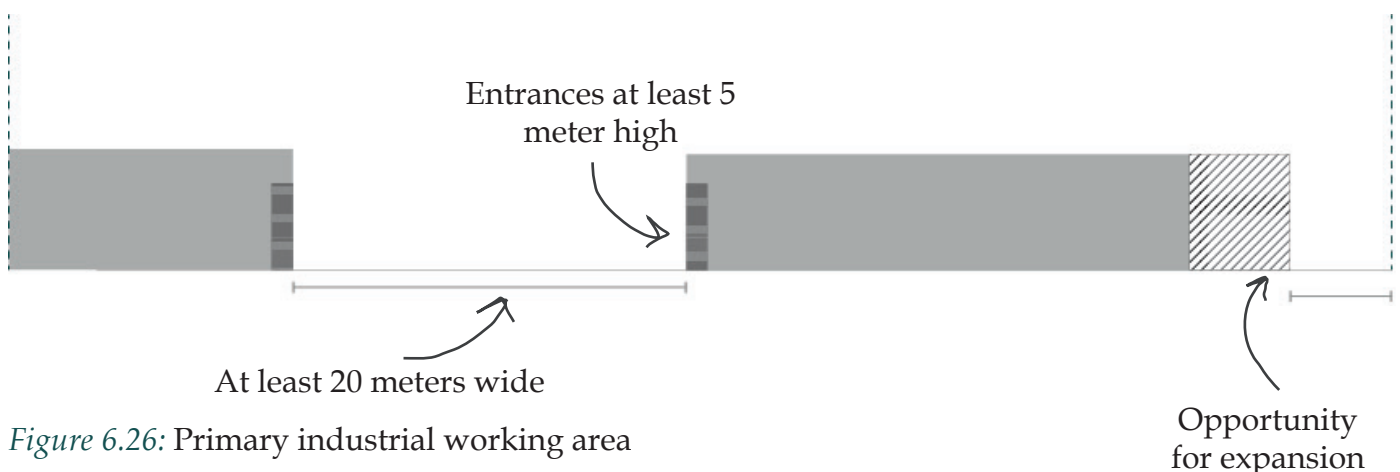


Figure 6.26: Primary industrial working area

Another relation between a road and a building can be found in mixed-use areas. This road network is accessible for cars, bikes, and pedestrians. That means that it does not ask for the same width as the first example. However, they should facilitate separation between different lanes.

The fact that these streets are now available for inhabitants and visitors means that the plinth should become more attractive. The shops that are located here could benefit from more transparency in their buildings, wall art could be an option, or the addition of vegetation.

The vertical addition of dwellings does not come with a minimum height. Of course, the destination plan gives insight into these rules. This thesis recommends looking into the surrounding fabric and creating in that way a smooth gradient between the residential areas and the business parks.

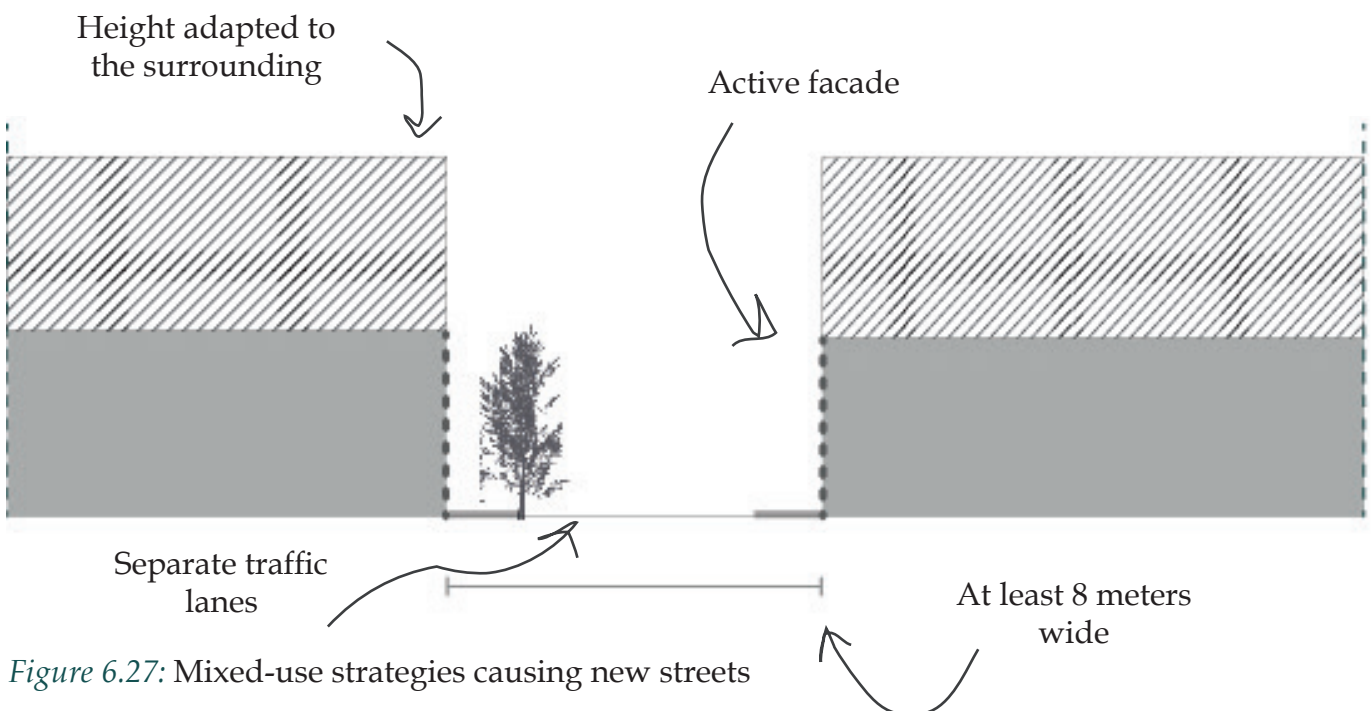


Figure 6.27: Mixed-use strategies causing new streets

The third set of rules has to do with the new private backyards that are designed for future residents and employees. These are only accessible by bike or for pedestrians. Therefore, the passage can stay small, between 2 and 4 meters. The facilities that the backyards have to offer are for example playgrounds, a shared vegetable garden, or a nice sitting place.

The facades do not have to refer to the industrial processes that are happening in the companies located there, but an attractive material or green façade is wished to make the atmosphere a bit better. This is realised with the participation of the surrounding residents.

Lastly, to gain sunlight inside these backyards it is necessary to design dwellings with a different shape. In that way, the sunlight can access the gardens. If this is not facilitated, these areas become dark and unsafe.

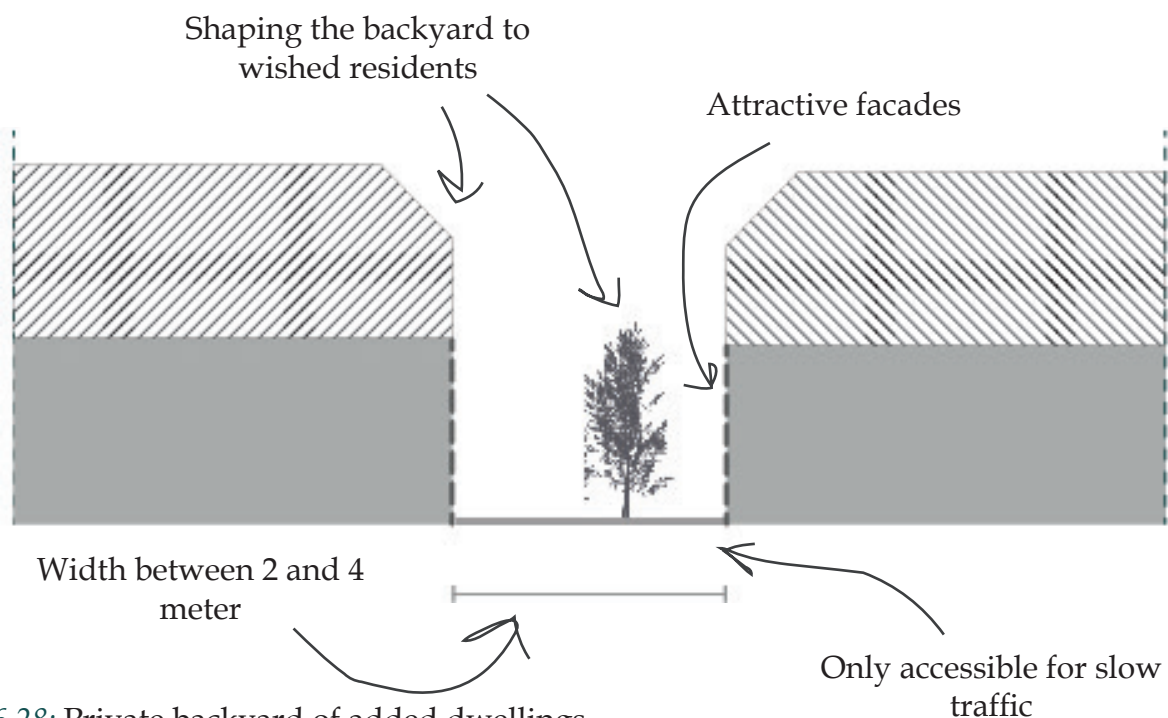
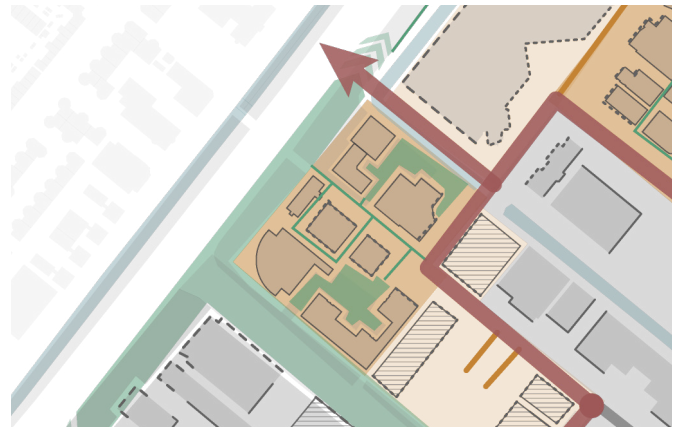


Figure 6.28: Private backyard of added dwellings

The last element that needs some regulations is the crossing where different traffic lanes come together. To ensure a safe environment it is important to separate the traffic lanes. The wider street adapted to the trucks will continue and the adjacent streets need to give priority to this.

Additionally, the streets that are in the mixed-use zone have attractive and active facades. Sidewalks are embracing these companies which makes it the perfect place to walk around and meet your colleagues.

On the other side of the road are the companies that are not mixable with dwellings. These also provide attractive facades but are not connected to the sidewalks or bike routes. The orientation of the entrances is always on the side where the road is located.

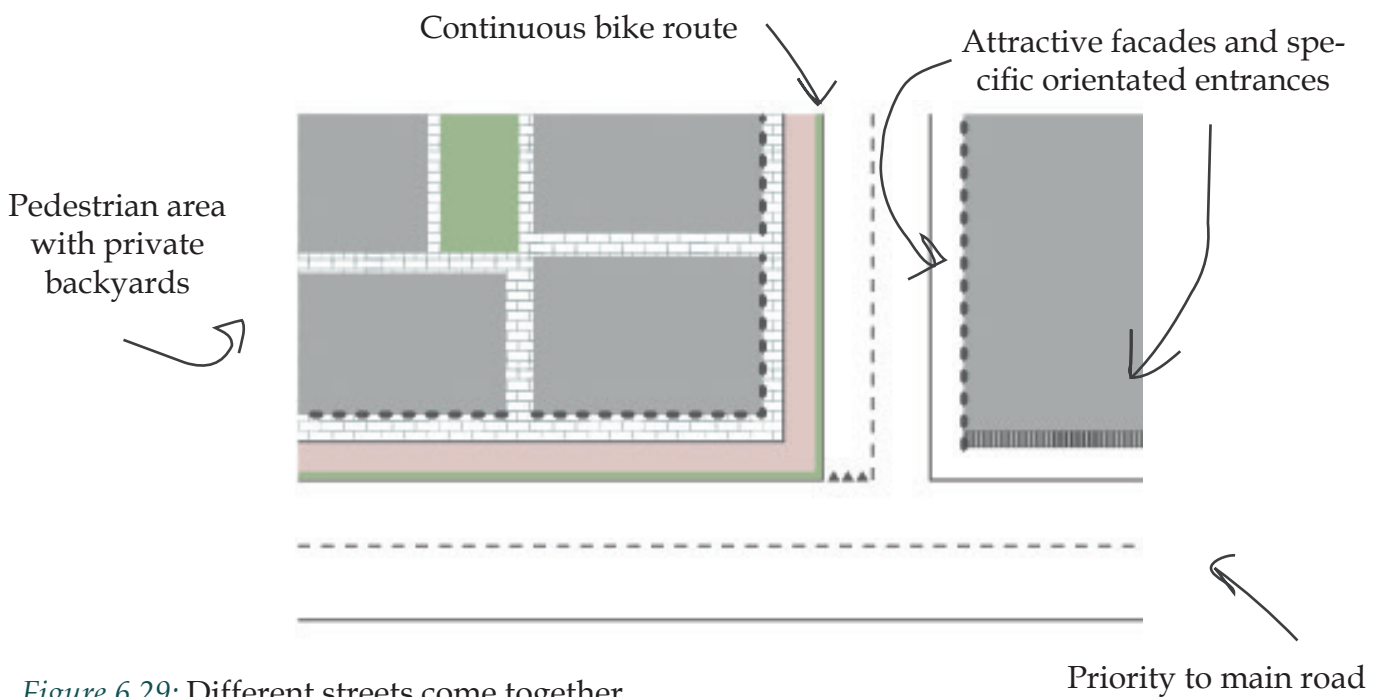


Figure 6.29: Different streets come together

6.3 | What is the role of each business park on the regional scale and how do they work together?

As previous chapters describe, there is a division in business parks that are suitable to mix, and which are not. This forms a concatenation of business parks with different functions within the Province of South-Holland.

Figure 6.30 shows the four groups that could be distinguished based on their spatial qualities and characteristics and how they relate towards the mixed-use strategies.

The opportunities to mix industrial processes with dwellings are the highest in the middle of the province and inside the cities.

At the edges of the province, the business parks become more focused on the processing, distribution, and mining of materials. This causes disadvantages for adding dwellings and is therefore marked as not mixable.

In the northeast side of the province distribution and processing hubs are in proximity. This is caused by the transportation via the roads.

On the other hand, the Port of Rotterdam and water-bound business parks in the south are focused on manufacturing and processing components.

In short, the current conflicts between space for housing and industry could be dealt with by steering towards a business ecosystem where both are framed. This proposed network serves different landscapes, central and decentralised locations, transportation routes and the urban fabric.

In that way, it becomes clear which areas could be mixed and which should only focus on industrial processes. The four groups of this business ecosystem are further explained in the following pages.





Figure 6.30: Business ecosystem of construction materials in relation towards possibilities of mixed-use strategies
 (Scale 1:200000)

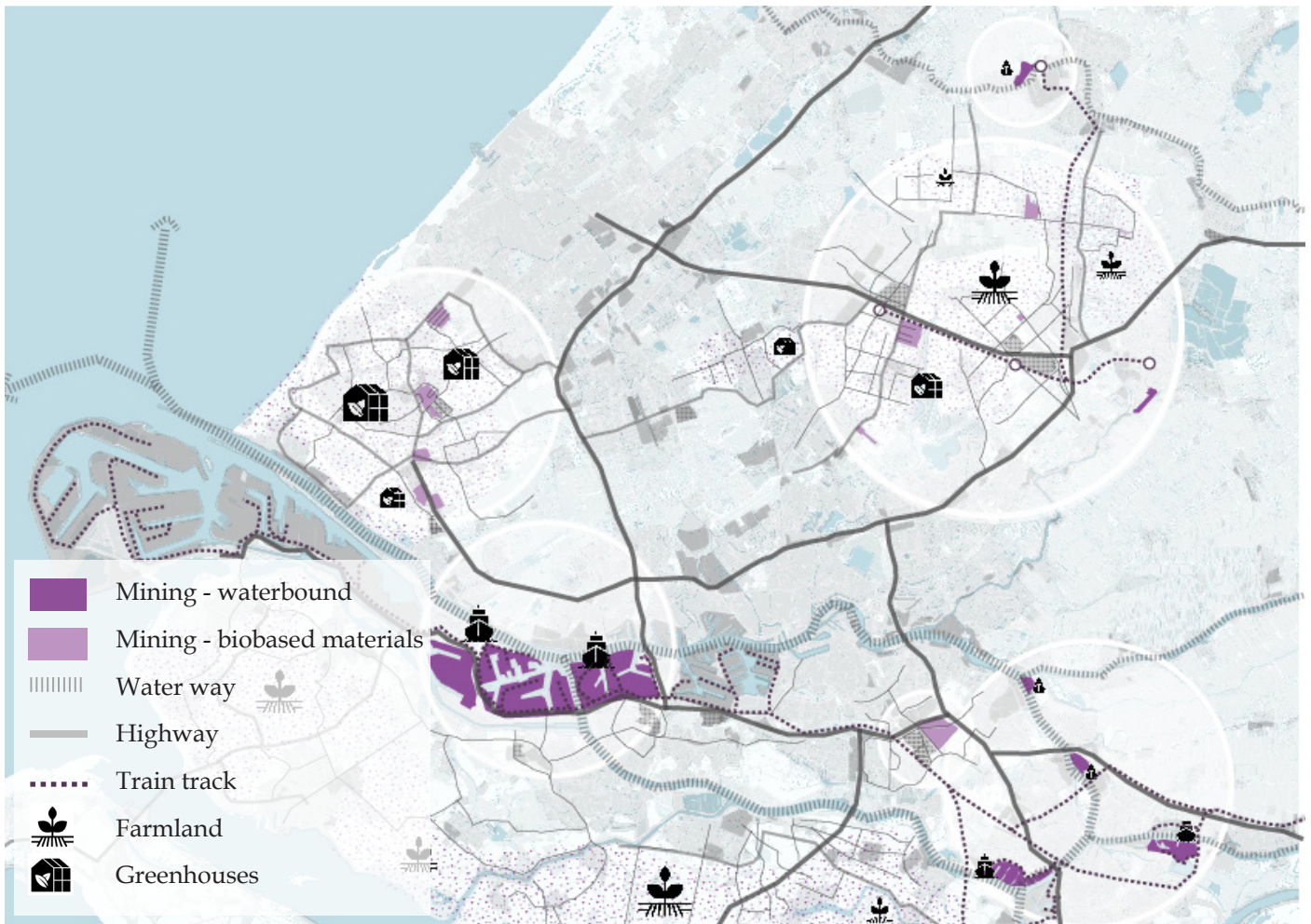


Figure 6.31: First group: Not mixable business parks that focus on the manufacturing of components that are needed in the circular economy (Scale 1.200000, 50% reduced)

The business parks close to mining locations

The first, not mixable group, is one of the business parks facilitating spaces to mine components and materials. The main accessibility of these locations is by water or via trucks. They will transfer the components from these locations to the distribution parks located next to the urban and rural landscapes.

As shown in figure 6.31 this group consists of two types, one focussed on importing materials via water-bound business parks and the other focusing on the production of biobased materials.

The first one creates places which can

house noisy and nuisance industries. The Port of Rotterdam already has this function and is therefore not suitable for mixed-use.

The other type is always located next to farmland or greenhouses. In that way, the circular loop stays small. The question arises if we can deal with the shift to biobased construction materials on our own, but research shows that this is not possible. The Netherlands could be self-sufficient for the current housing stock, but with future developments, this is no longer an option (Wageningen University, 2021).

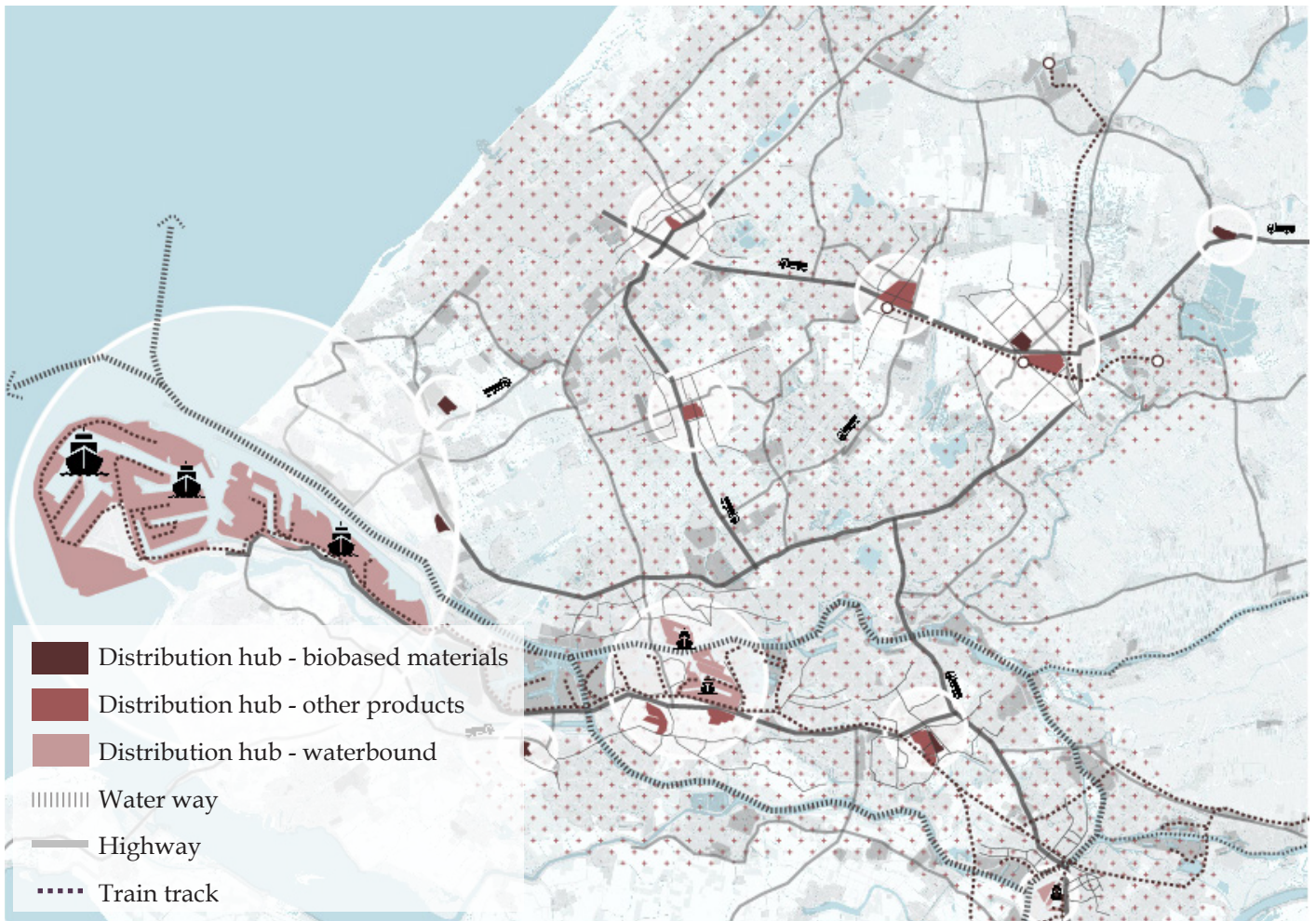


Figure 6.32: Second group: Not mixable business parks related to the distribution of (raw) materials, components and products (Scale 1:200000, 50% reduced)

The distributors

Secondly, the group of distribution hubs. These are also not suitable for mixed-use, due to the roads that need to be assigned as “ruis”, see example project Broekvelden. These business parks form an important link between the other groups because they are in the middle of all processes. Therefore, proximity to the urban fabric is needed while keeping distance to provide space for processing, storage, and manufacturing. The difference between the distribution and mining is that distributors are connected to all other business parks, while the other group is close to the cultivating, but

A distinction is made between the

water-bound business parks, locations that are related to biobased material production and the remaining distribution hubs.

The Port of Rotterdam plays an important role when it comes to the import and export of materials.

Other business parks are more relying on road networks like highways and N-roads.

Lastly, the materials, components and products can be transported via the train tracks. Because of this spread needs the network has several hubs.

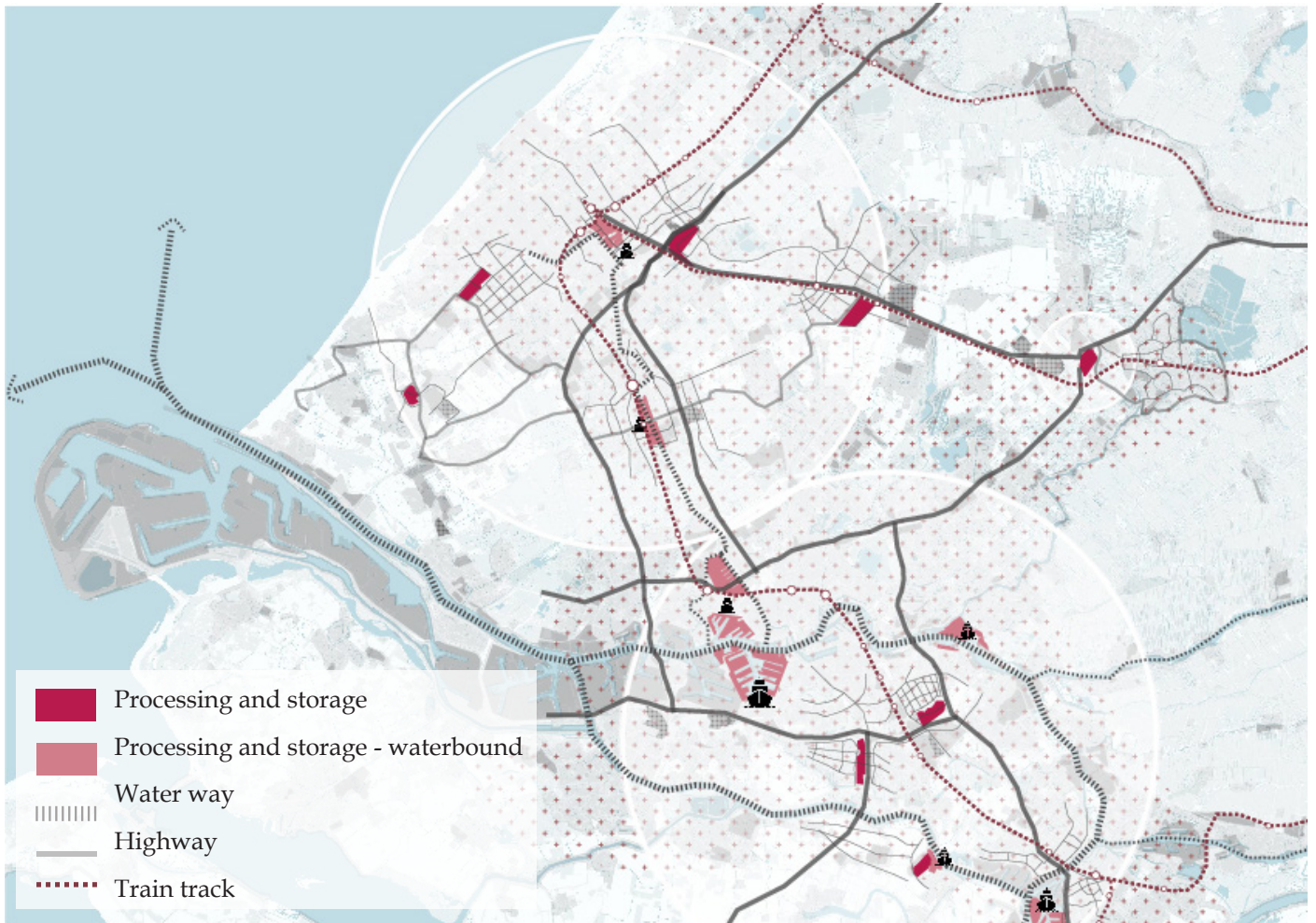


Figure 6.33: Third group: Mixed functions serving a the addition of dwellings through the region (Scale 1.200000, 50% reduced)

The mixed processing hubs

Then a group which can be mixed with dwellings, if the industry that is needed for the urban processes is protected. This group of processing and storage hubs needs the users of the products close by.

Therefore, these locations are in proximity to the urban fabric. Examples are the example projects Binckhorst and Lansinghage.

The transportation network differs a bit as well. A fast network of highways connects the region, while the business parks should also provide opportunities for slow traffic entering the location. These bike and walking routes

should stretch to the centre of the cities. Public transportation plays an important role as well. That is caused by the fact that this group needs to be accessible for pedestrians as well.



Figure 6.34: Fourth groep: Innovative companies contributing towards mixed-use strategies and the circular economy
(Scale 1:200000, 50% reduced)

The innovative industry hub

Finally, the group of innovative high-tech business parks. Nowadays, this group is not that large, but all future mixed-use business parks could save space for a living lab to connect to this hub.

In terms of mixed-use strategies, this place is also suitable to mix. There needs to be space to experiment with new industrial processes, but most of the areas are not filled with heavy industry.

The high-tech hub lies in the centre of the province which makes it easily accessible. This reflects in the opportunity to travel by public transport, car or by bike. This highly accessible centre forms therefore the perfect place to exchange knowledge, innovate industrial processes and experiment with new environmental conditions.










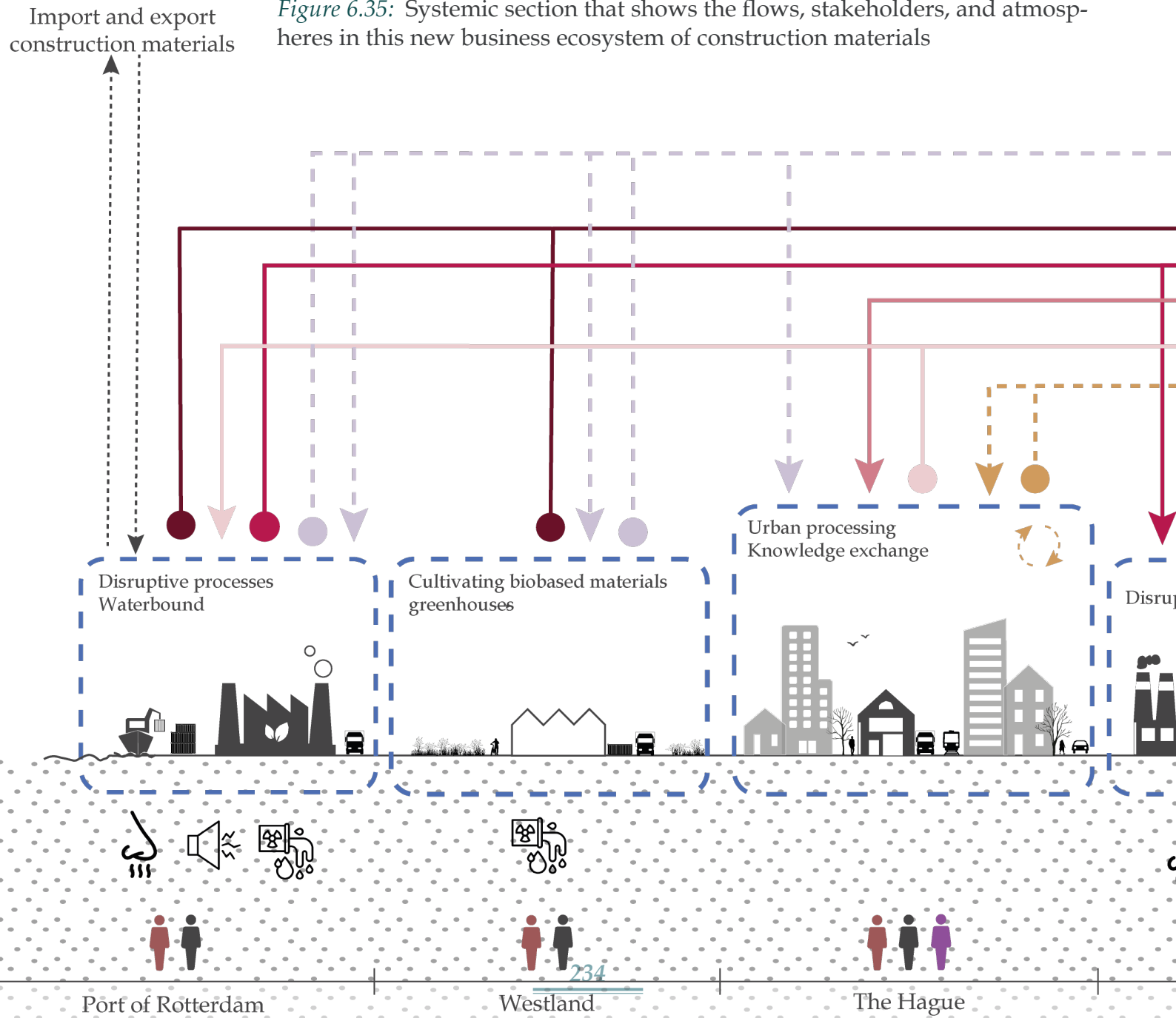
-  Mining and import raw materials
-  Processing and storage of raw materials, components and products
-  Useage of products
-  Processing and stroage of secondary raw materials and reused products
-  Reuse of products within the urban landscape
-  Residual heat, water and energy from processes
-  Companies
-  Governmental institutions
-  Residents

Figure 6.35: Systemic section that shows the flows, stakeholders, and atmospheres in this new business ecosystem of construction materials



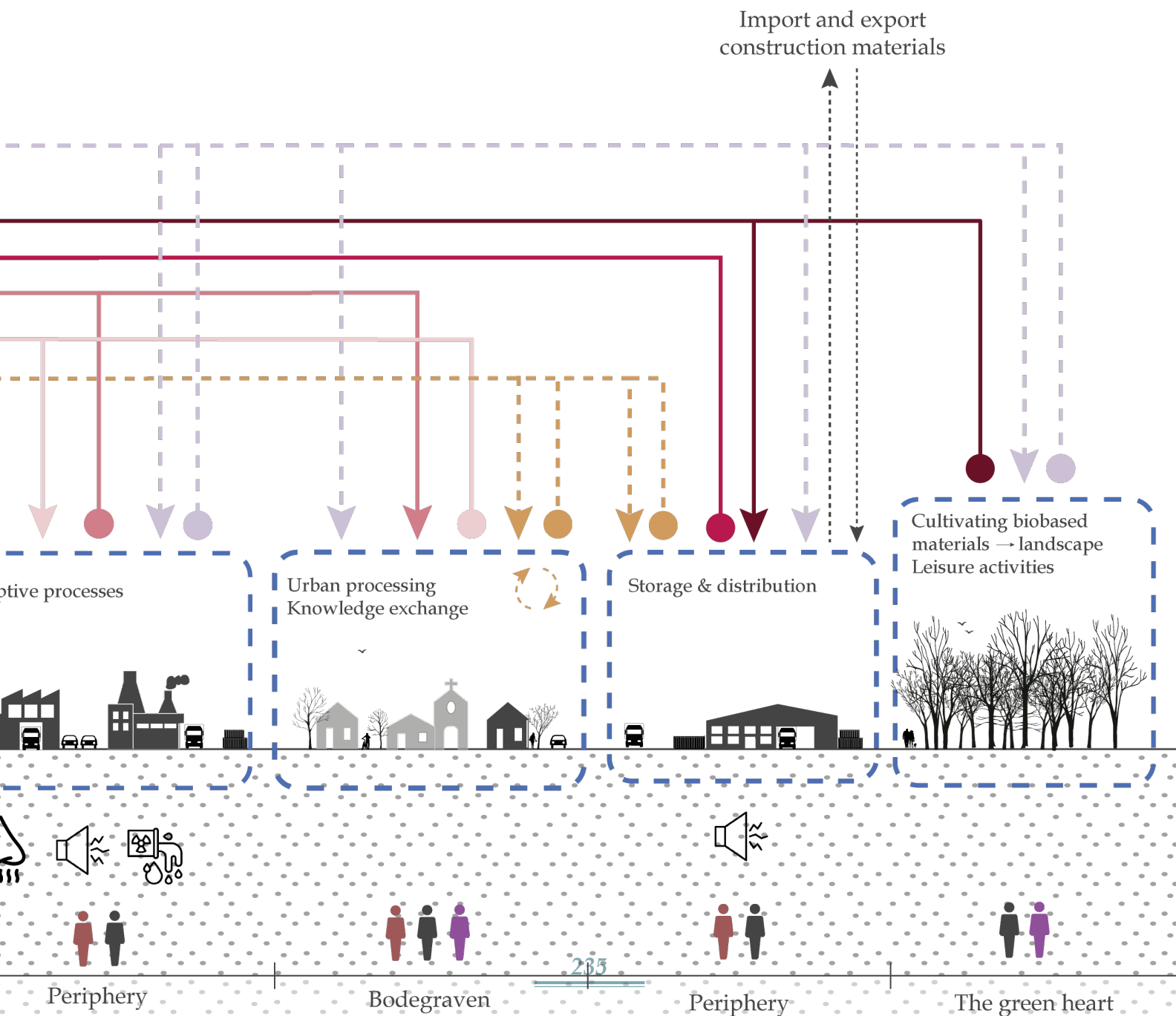
In the systemic section, figure 6.35, the flows in this network are shown. This gives more insight into the relation and atmospheres of the business ecosystem as shown in the previous maps.

Furthermore, the main stakeholders that are related to each environment are illustrated. This shows that governmental institutions are always related to different systemic flows.

When there are nuisances in the form of noise, smell, or pollution this is mostly related to the industries themselves and the governmental institutions. The residents are

active in the cities and villages as well as at locations of recreational facilities.

Import and export of construction materials is as much as reduced. However, not everything can be produced in the Netherlands. Therefore, a smaller part must be imported and exported.



An example of the construction materials wood is elaborated to give insight into the systemic section and collaboration within the network of business parks.

The Netherlands, and especially the Province of South-Holland, does not have enough space to produce the wood needed to construct 200.000 dwellings.

Therefore, the timber is imported via the Port of Rotterdam. The mining of wood can also be done at the landscapes at the edges of the province. From these locations, the components are distributed to the distribution parks.

This wood is not yet useable to construct dwellings. When the timber is needed, this will be transported from the storage business parks towards the processors. These are close to the city so that the manufactured products can be directly used.

On the other hand, these processes should remain some distance from the living environment. In that way, they can process the materials without causing a nuisance.

The wood is now formed into products like for example window frames, dormers, floors, and beams. The landscapes where this is needed are within the cities and villages.

By adding urban craft centres and creating knowledge about circularity, the elements of products can be reused within the urban fabric.

If products are not yet needed or need more adaptation, these can be distributed again towards the storage and processing hubs.

At these sites, the products can be remanufactured and repaired when it needs disruptive industries. These processes cause a lot of heat and require water. Therefore, these places are important in the circularity of residual heat and water. The flat roofs of these locations provide options to mix with solar

panels. The generated energy can be reused for industrial processes or closer towards the cities and can be transformed into energy for electric cars.

The high-tech business parks are the once that experiment with these implementations. In that way, the products are not only reused, but the processes to do so cause circularity as well.

Once the wood is not able to be transformed into something else anymore, for example, because it is already processed into small fibres or polluted, it can be distributed towards the Port of Rotterdam where a biomass plant incinerates the materials. This causes again a heat which can be reused in the industrial processes at the harbour.

The residual waste can also be used as organic fertiliser at greenhouses and farmlands.

6.4 | Suggestion of engagement strategies to facilitate mixed-use strategies and a circular economy

As becomes clear from the tensions named in subchapter 4.3, there is a need for engagement strategies. This will help to find the balance between wishes, needs, opportunities, and threats that occur with this suggestion designs for the business parks and the regional business ecosystem.

For example, the different departments in the Province of South-Holland and municipalities could be more engaged with each other to form a better discussion.

Currently, they are not always collaborating and communicating which results in their own opinions and strategies on how to handle things. Some departments want to address the pressure on the housing market, while others focus more on the possibilities of a circular economy. The opportunity is to strengthen the interrelation of the different departments because the two spatial conflicts discussed in this thesis are also related.

Furthermore, the academics, province and municipalities could inform each other better on what is needed from their point of view and how this can be achieved. The spatial planning and research background of most academics can help the municipalities and province by indicating what the hierarchy of implementations could look like and what the outcomes are. In that way, governmental institutions are better prepared for what is coming.

Lastly, the relationship between companies settling at business parks and the (future) residents could be strengthened. Nowadays, businesses are wary of the addition of dwellings.

However, they could be informed better to see the standing point of the residents and to gain information on benefits for them as well.

On the other hand, the (future) resi-

dents then must accept that they will be living next to sometimes nuisances producing companies. A spatial design can substantiate the wishes of both stakeholders. Also, participation and transparency help to understand the decisions that are made within the process.

These implementations to strengthen the engagement of various stakeholders influence the outcomes of the Power-Interest matrix and stakeholder framework that is based on scales and themes.

Figure 6.37 shows that the province is more located in the high power and high influence quadrant because they form more unity now.

In addition, the companies that settle at business parks have a better understanding of the benefits for them when mixed-use is realised. Therefore, they are also placed a bit more on the high-interest side.

Besides, the academics have a little more power, because their research can serve the choices that municipalities and the province have to make.

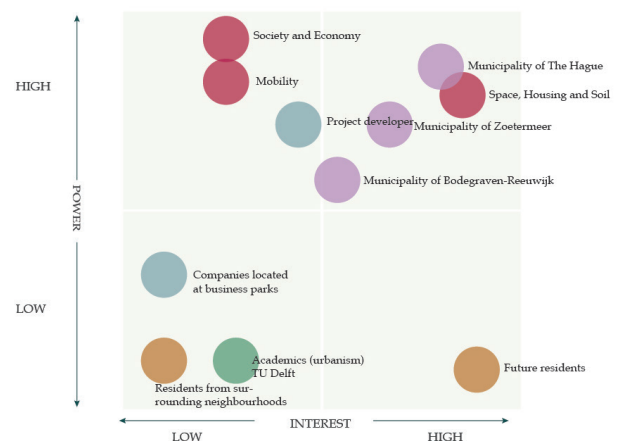


Figure 6.36: Current situation as discussed in chapter 4.3

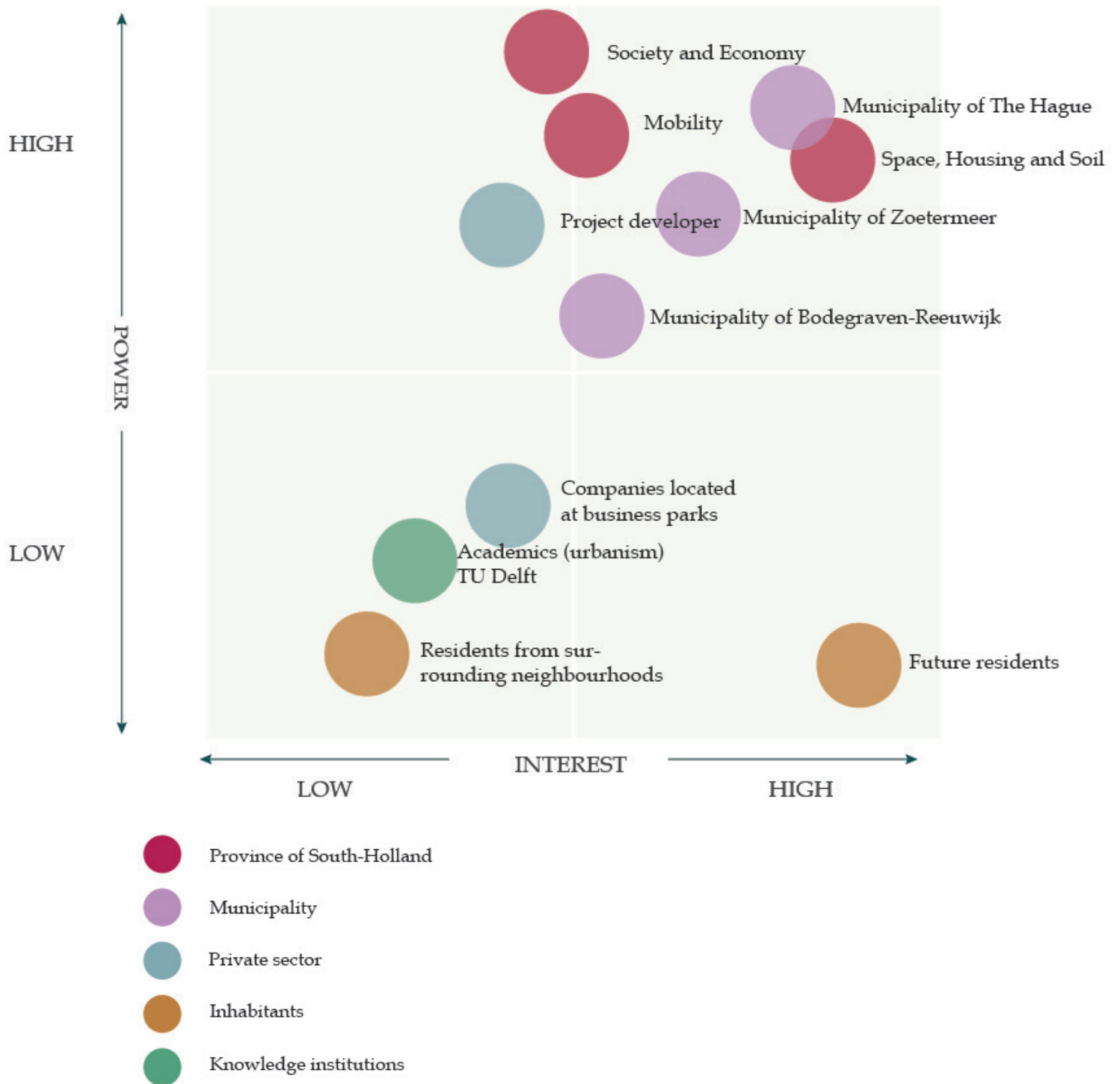


Figure 6.37: Wished Power-Interest matrix based upon addition of dwellings at business parks while facilitating a circular economy

Next to the fraternization of the departments of the municipality and the province, also the relation towards the themes and the scales stays important.

In figure 6.39 this engagement between the different scales and topics is improved. The dotted lines form wished connections described by the engagement strategies. In that way, the Province of South-Holland is better connected to the municipalities. Which gives them more insight into the activities on the neighbourhood scale. This helps with providing a spatial framework which assigns spaces for industry and living, see policy recommendation.

Additionally, this contributes to a fitting approach for each municipality. Not every city has the same opportunities due to differences in population, financial opportunities, and the current housing market. The Province of South-Holland should gain an understanding of these differences and provide a suitable solution.

Furthermore, the stakeholders that are active in the neighbourhood scale form their turn also stronger relations. This is the scale where the implementations have the most impact.

With the insights from the knowledge institutions the municipality, private sector and inhabitants could operate better together and form a strategy that fits their needs. This adds to the wish for open house days, events and knowledge exchange. The stimulation of this policy is also described in the next subchapter.

Lastly, academics influence the province, private sector, and municipalities to inform them about the opportunities there are when mixed-use strategies are applied to facilitate a liveable environment and circular economy. This includes indications on which areas could be mixed with dwellings, what the wished business climate is for the future economy and how these can be balanced based on their

specific spatial qualities and characteristics.

Funding to promote circularity can help to form a better understanding and motivation for companies to make this step.

Besides, regulations on climate adaptivity, public spaces, biodiversity and environmental conditions steer the stakeholders into the right position. The policy recommendation of the next subchapter elaborates on this as well.

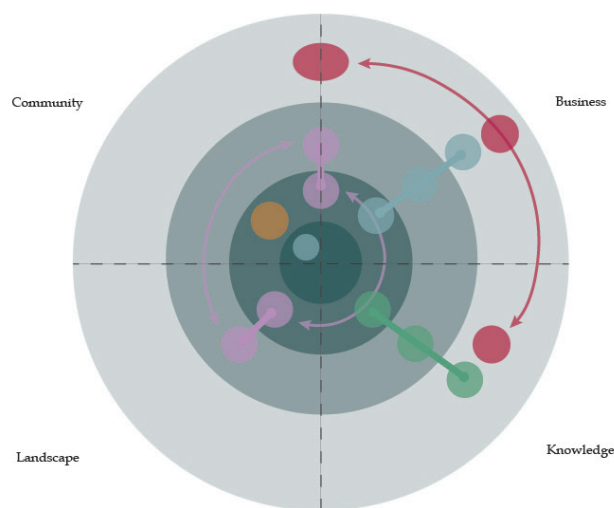


Figure 6.38: Current situation as discussed in chapter 4.3

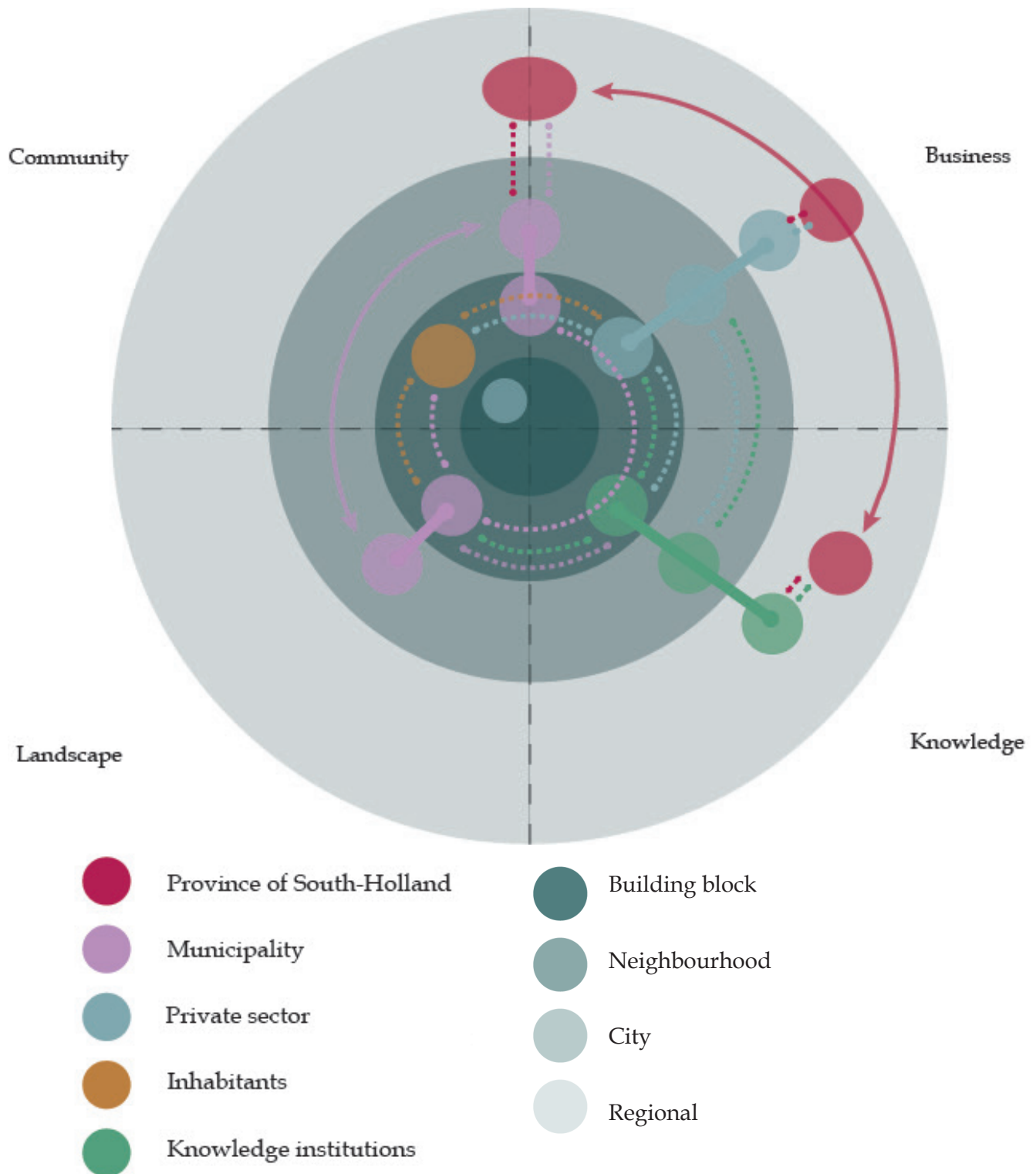


Figure 6.39: Conclusion what should be achieved by stakeholders to form a holistic approach

6.5 | What should be regulated to guide liveability and circularity at business parks in the province of South-Holland?

After all the analyses and spatial recommendations, it is also important to note down what role the Province of South-Holland could play to implement these outcomes. In figure 6.40 a framework with the current active guidelines is shown.

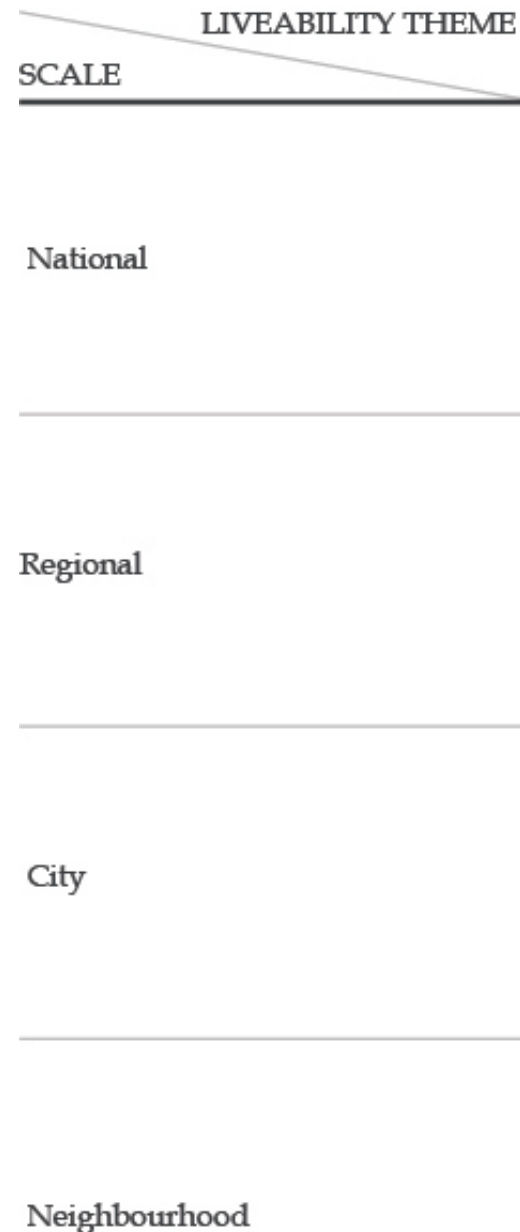
However, not all elements of creating a liveable environment are included.

As stated before, business parks are nowadays not greatly accessible for pedestrians and bikes. Policies on infrastructure at the neighbourhood scale contribute to a safer and more inclusive living environment.

In addition, there are no guidelines on how to deal with the circular economy on a smaller scale. According to literature and interviews, the circular economy causes a need for storage space and local material flows. These could be better structured with policies.

Lastly, the lack of policies on environmental qualities. As claimed in the literature, references and observations for field trips, the business parks are nowadays paved, grey and do not serve the biodiversity. Regulations on public spaces with access to green can be added.

Additionally, there are way more solutions for applying mixed-use than dealing with buffers. These can all contribute to forming better transition zones between working and living.



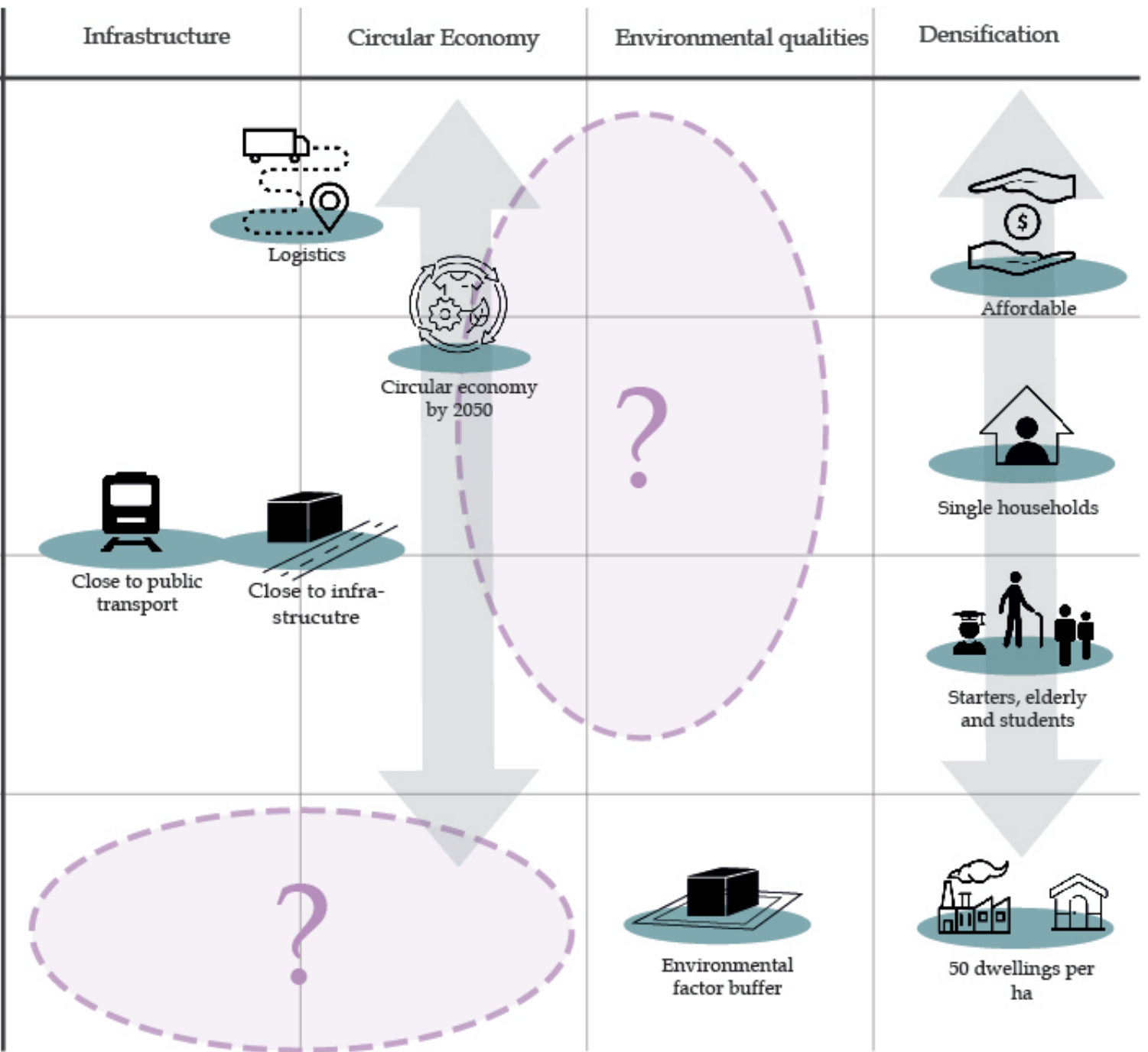


Figure 6.40: Currently lacking policy framework that deals with circularity and mixed-use business parks

LIVEABILITY THEME
SCALE

National

Regional

City

Neighbourhood

- Literature and policies
- Observations during fieldtrip and spatial analysis
- Interviews and references

To fill up the gaps between the existing policies, there are some recommendations, see figure 6.41. These are based on the information gained from literature, observations during the field trip, interviews with several stakeholders, and spatial analyses. The diagram shows these guidelines related to the scale and the theme they operate in.

With these new implementations, the conflict between spaces for dwellings and circular economy can be approached.

On the next page, several starting points for policies are given. Some ask for a new regulation, while others support the need for events and subsidies.

The stakeholders could implement these guidelines to form a strong vision of the future of the business ecosystem with a focus on construction materials.

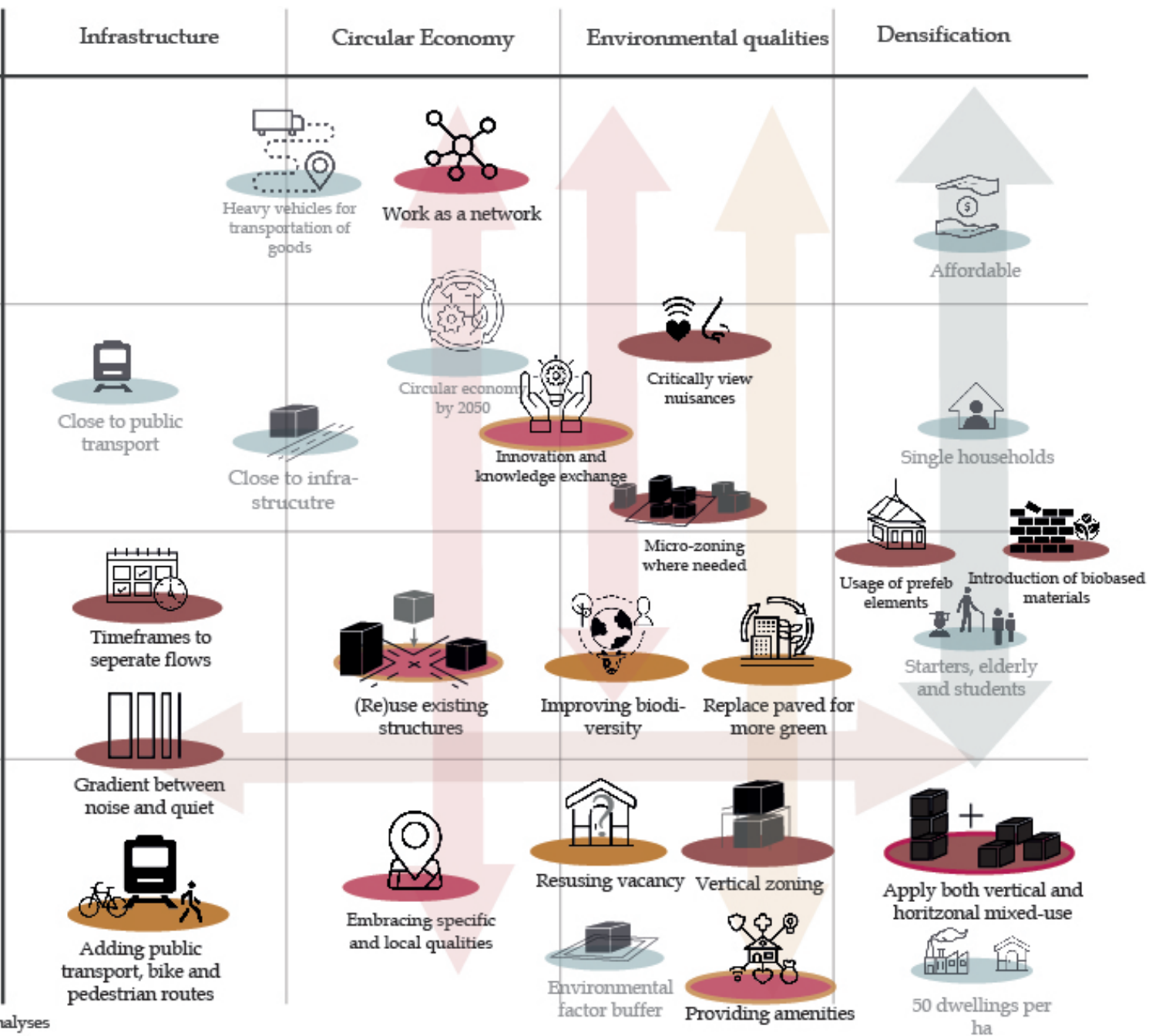


Figure 6.41: Implementing all the guidelines derived during this research to create regulations, funding and events on liveability and circularity at business parks

1] *Protect spaces for industry*

Why: This first recommendation refers to the statements that are made about the need for production close to the city and industrial processes that facilitate a circular economy.

Without spaces for these companies to grow these goals are unfeasible. The business parks that are pointed out in the strategic framework should be protected against the addition of dwellings.

Especially, the business parks that are water-bound need this access to the waterways. In addition, the current spatial qualities and characteristics that are there should remain and be strengthened to fit the context of the future business ecosystem.

How: Guidelines related to this first policy recommendation are for example using existing structures, providing a gradient between noise and quiet areas, critically viewing the nuisances, working as a network within the business ecosystem and micro-zoning where needed.

Who: The Province of South-Holland should form regulations that deal with the whole business ecosystem of construction materials.

Target: This affects the choices that municipalities can make at business parks and the developments that companies can undergo.

2] *Provide an indication of spaces assigned to dwellings and industry by a spatial framework*

Why: Mixed-use strategies ask for innovative ways to combine industrial processes with a living environment. In addition, it needs to be clear what areas should retain for industrial processes. To make sure that this does not cause conflicts between the different stakeholders, it is important to come up with a spatial framework.

How: This research shows that there are several underexposed implementations, such as reusing vacancy, applying vertical zoning, adding timeframes, and providing places of micro-zoning. A specific theory thesis used to analyse the opportunities is Rust, Ruis and Reuring.

Who: This depends on the property and land ownership. For example, in The Hague, the municipality has the job to provide such a spatial framework, whereas Lansinghage is supported by an entrepreneurial association.

The municipality should come up with the plan in the end, but a collaboration between them, the companies and (future) residents is needed to fulfil this task.

Lastly, the spatial framework should be checked and approved by the Province of South-Holland to be sure that the overall business ecosystem keeps functioning.

Target: The companies located at these business parks could benefit from the spatial framework because it gives them spaces to develop and innovate. Additionally, the (future) residents profit from the improved living environment.

3] *Regulate access for different vehicles*

Why: Due to the addition of dwellings the road structure needs to be changed. These new flows of materials, persons and products cause an urgency of separating the infrastructure. The companies rely on a clear and highly accessible supply chain while public transport and slow traffic facilities are important for employees, visitors, and partners.

How: A smooth transition between residential and industrial areas can be shaped by this regulation. Specific improvements are, for example, adding public transport and slow traffic facilities, introducing time frames to separate the traffic flows, and providing a smooth gradient between 'rust' and 'ruis'.

Who: The municipality should overlook which streets should remain for industries and provide other opportunities for other road users. Besides, the connection towards the rest of the city, or region, should not suffer.

Target: The ones that are affected by this are the companies, employees, and future residents.

4] *Improve climate adaptivity, biodiversity, and public spaces*

Why: This policy recommendation is the last regulation. It is based on the need for more vegetation that serves climate adaptivity, strengthens biodiversity, and provides a public space. Nowadays, these locations have a lot of paved areas that serve the industrial processes and storage of materials.

However, when introducing a new spatial plan and infrastructure network, this creates spaces that could be transformed into greenery.

How: Guidelines that could help to steer this are replacing paved areas for open soil, adding diverse vegetation, introducing slow traffic opportunities, and providing new amenities. Simple regulations like gaining more floorspace when greenifying are needed to persuade companies to give in some spaces.

Who: Again, the municipality should take this into account while designing a spatial framework. This reflects in the connection towards embracing neighbourhoods and providing spaces for more inhabitants than only at the business park.

Target: Just like the previous regulation this one targets the companies, employees, and future residents.

5] *Funding to promote circularity*

Why: Improvement of industrial processes is needed to make them less nuisance. To reach this, funding for innovation, education, efficiency, and improving the environmental conditions is wished.

For example, by introducing new subsidies companies could take some more risks and produce prototypes which can be tested at the business park itself. Connecting this to the educational facilities helps to provide new skills and learn about the future of industrial processes. Lastly, the attendance of technology can for example serve the local economy. This is all needed if the goal of 100% circular by 2050 must be achieved.

How: Work-learn spaces could be integrated into the business parks and the connection towards the high-tech centre could be strengthened.

In addition, research into new construction materials is needed. Places, where this can find place, are urban processing hubs, circular craft centres, living labs and so forth. All these new implementations fit a certain landscape and contribute to the circular economy.

The focus should be on optimising material flows, managing the waste streams, creating awareness, taking advantage of local spatial qualities, improving distribution chains, and retaining space for the storage of materials.

Who: The national government should come up with new financial resources to promote the circular economy.

Target: The main target is the disruptive companies that should improve their footprint. Furthermore, the (future) residents, employees, visitors and entrepreneurial associations are affected by this policy.

6] *Facilitate events for knowledge exchange and education*

Why: Informal and public spaces should be facilitated for companies and inhabitants to discuss the current transitions. The urgency of these locations lies in the fact that if one link in the circular loop is not working, the rest will also not be passed through.

Furthermore, these events create more awareness about the transitions that the Province of South-Holland is currently dealing with. That influences the Rethink and Reduce that are high up at the R-ladder.

How: Collective strengths via knowledge exchange are needed to provide new qualities. Community hubs, shared working places and visitor centres are examples of spatial implementations that contribute to this.

Examples of these events could be open house days, opening facades, festivals, workshops and so forth.

Who: Companies are the ones that could open their doors and welcome visitors. However, the entrepreneurial association is the one that should have the overview and form a holistic approach.

Target: The (future) inhabitants, employees, visitors, and even other companies are the ones that could benefit from these events and opportunities to learn from each other

6.6 | How should these guidelines be implemented over time?

Because the drivers of change have a specific period in which they must reach goals a suggestion is made in this subchapter. For the addition of dwellings 2030 is an important dot on the horizon. This same date and 2050 are important to complete the implementation of a circular economy.

The pursuit of 200.000 dwellings in 2030, is not feasible at business parks because there must be other implementations first before housing could be added. Therefore, this phasing gives an indication.

At the regional scale, the existing expertise of business parks is chosen to reuse, so that structure could be taken over immediately.

Therefore, this timeframe focuses on the design and stakeholders of the example design from Lansinghage. This scale also influences the city and regional scale. In that way, this can form an example for the rest of the business ecosystem.

The first implantations are based upon putting Lansinghage on the map. The station Lansingerland becomes a mobility hub that connects the business parks on a regional scale. Next to public transport, the regional walking and bike routes are strengthened by strengthening the green network. The improvement of accessibility on the regional scale attracts residents, visitors, and employees into the area.

Simultaneously the living lab is designed. This causes more insight into the developments around the circular economy and environmental conditions. Next to the fact that this knowledge is needed to deal with the drivers of change, it is also important to attract investors. Once the trust in these new urban strategies is there, these could enable the densification, new amenities, and circular hubs financially.

Besides, the events hosted by industries, shared working spaces, and critically viewing the environmental conditions are

there to create more awareness of the transition the Province of South-Holland is dealing with. That contributes to the highest circular strategies on the R-ladder, namely Rethink and Reduce.

After these first steps, there is the need to separate space for living and working. A spatial framework is wished to protect industrial processes, guide the infrastructure, and explore mixed-use possibilities. First, industries should be protected by using micro-zoning as a technique. Then slow traffic opportunities could be added, because of the separation of different traffic flows in the first stage. Together with the arrival of dwellings in this area, amenities should be placed. These do not only serve the residents but also provide a public space for employees to meet or visitors to take a break.

Once the place attracts more people, the atmosphere of some streets and buildings should change as well. Opening facades, house walk-in days, creating active streets and shaping the plinth are examples of implementations that connect the industrial processes towards the living environment. This structure must be retained so that others can take Lansinghage as an example.

The last phase is related to this as well. The circularity is already brought to attention by the insights into the industrial processes and the living lab. However, to become 100% circular new hubs must be implemented. Due to the changes around infrastructure and buildings, there is now space that could fulfil this task. Some of these circular hubs are private, like the processing and sorting of materials. Others, like a circular craft centre, can be public to inspire and make them more aware.

Additionally, the environmental conditions could be improved to make the industrial processes even less disruptive.

Because it is not sure how the future will look and what transitions will follow, the phasing is a bit vague towards 2050.

In that way, the future of the business park is flexible. It could reduce the pressure on the housing market or contribute to a circular economy by 2050.

Circular economy

- Living lab
- House walk-in days
- Attract investors
- Micro-zoning where needed
- Circular urban hub (processing and sorting of materials)
- Protect industrial processes, especially waterbound production sites
- Opening facades
- Improving the environmental conditions
- Circular craft centre (public)

Infrastructure

- Creating active streets
- Improving mobility hub Lan-singerland
- Connecting to regional walking and bike routes
- Exclude infrastructure for production
- Facilitating slow traffic
- Introducing time frames

Dwellings and amenities

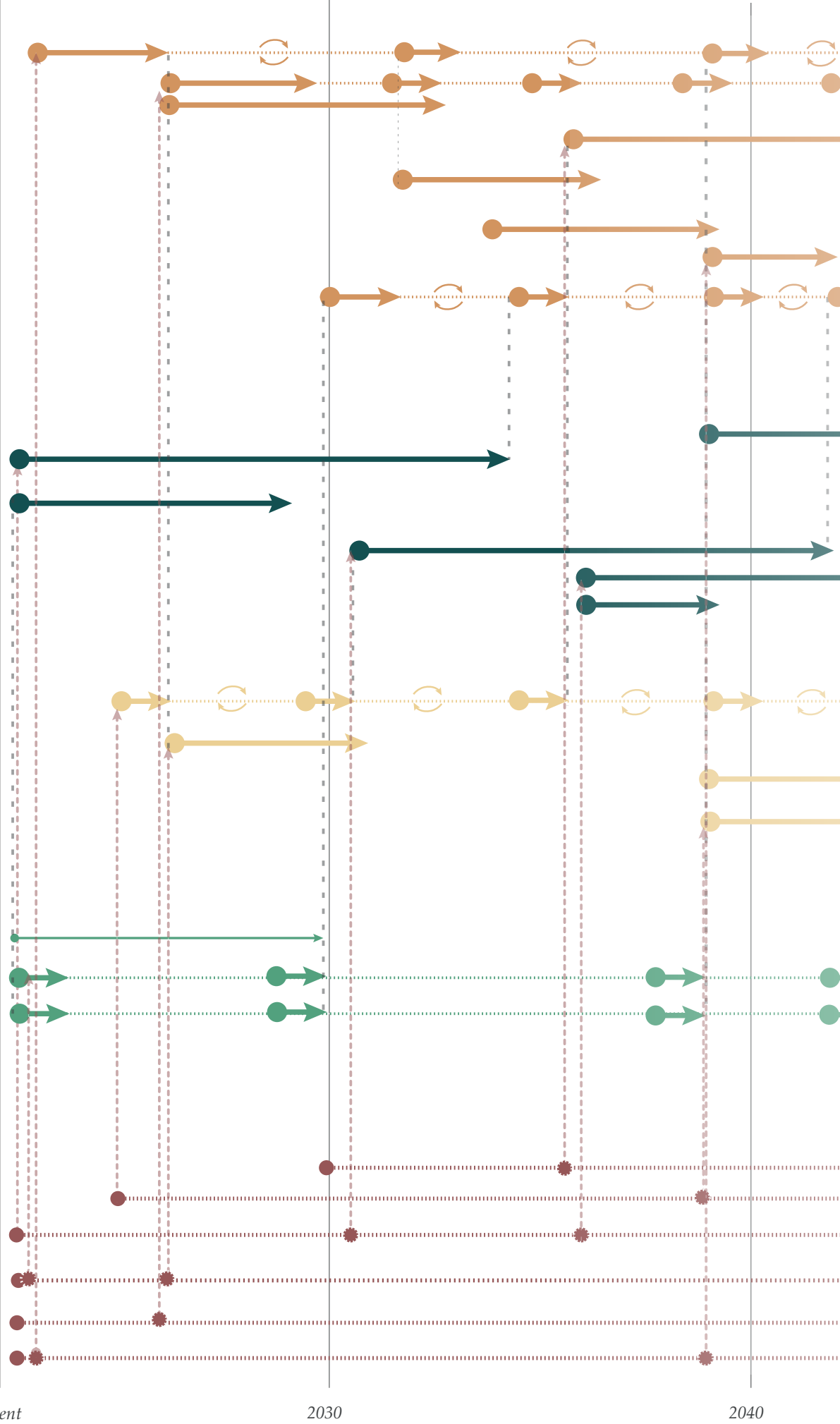
- Critically viewing the nuisances of production
- Realising shared working spaces and community hubs
- Shaping the plinth by adding amenities
- Vertical mixed-use strategies
- Horizontal mixed-use strategies

Green network

- Strengthening current green network
- Diversify vegetation
- Replacing paved areas for open soil
- Introducing green corridor
- Investing in more public space

Policies

- 1] Protect spaces for industry
- 2] Provide a spatial framework
- 3] Regulate access for different vehicles
- 4] Improve climate adaptivity, biodiversity, and public spaces
- 5] Funding to promote circularity
- 6] Facilitate events for knowledge exchange and education



present

2030

2040

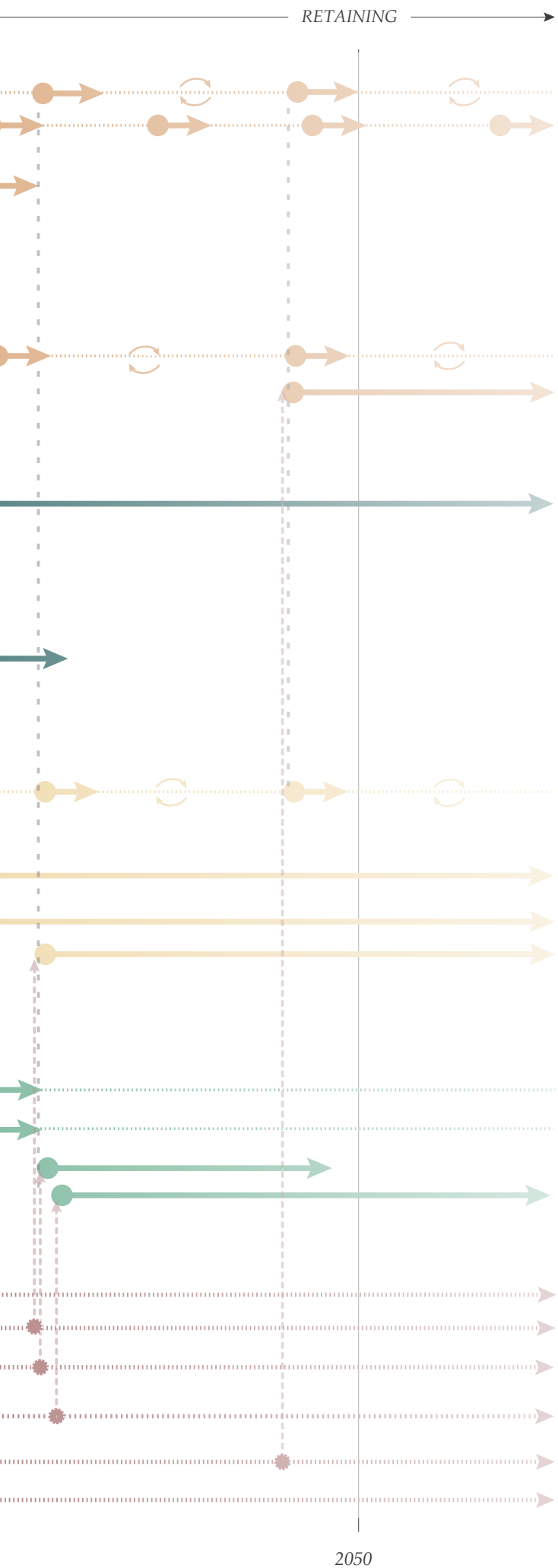


Figure 6.42: Phasing of different components in the example project Lansinghage

'With the strategic framework, example locations, and policy recommendation I want to bridge three knowledge gaps that were discovered during this thesis.'

This concluding chapter focuses on the main conclusions based on the key concepts that are used in this research. This is complemented by recommendations for further research and points of attention during this report in the discussion. It ends with the social and scientific relevance and a reflection on the process during this graduation year.

7.

CONCLUSION & DISCUSSION



(Sporzone, n.d.)

7.1 | What are the main takeaways of this research?

This research focuses on the spatial pressure between industrial and residential areas in the Province of South-Holland. From the origin, these functions were combined, but with the arrival of disruptive processes, this changed towards the separation of industry from the living environment.

However, current transitions, like the housing shortage and circular economy, ask for a new view on mixed-use concepts.

This immediately reflects in the conflicts between the spatial qualities and characteristics that both functions need.

Namely, not every industrial site can be mixed with dwellings. Most uncertainties are appearing at business parks. Therefore, this thesis targets the multifunctional use of space in the business ecosystem of business parks with a focus on construction materials. That is because this business ecosystem serves both drivers of change that need to be unriddled by 2050.

Therefore, the research question of this report is the following:

“How do spatial qualities and characteristics of business ecosystems with a focus on construction materials shape the future possibilities of mixed-use business parks in the Province of South-Holland by 2050?”

Through literature and policy review, interviews, observations at the example locations, constructing future scenarios, and research by design this research developed an answer.

To provide a mixed-use business park where liveability and circularity are facilitated several spatial qualities are important. Based on the key concepts these are discussed to formulate an answer to the research and sub questions.

Mixed-use

With the urgency of optimally using the space that is available in the Province of South-Holland the strategies of mixed-use can be applied.

Mixed-use provides a mix between working and living in a certain place. This can be done vertically, horizontally or over time. These different strategies must be blended over the entire business park.

Smart innovations in improving environmental conditions, like vertical zoning, micro-zoning, and critically viewing the nuisances, create opportunities to implement these strategies even more often. With these strategies, a smooth gradient between working and living can be ensured.

Liveability

The literature describes liveability based on four components. These differ a bit when they are projected on business parks, see chapter 3.

However, the main conclusion is that dwellings can only be added to places that are not needed for industries to develop. In that way, the environmental factor provides a buffer between the disruptive processes and the living environment. As explained above there are enough mixed-use strategies that deal with these environmental conditions.

In addition, green buffers like a row of trees could be implemented to protect against noise.

Furthermore, the densification of business parks could be improved. Nowadays, the space is not optimally used and does not always fit the surrounding neighbourhoods. Dwellings could be added at buildings with smaller spans and functions like offices or shops.

In addition, vacancy and wasteland could be reused to reduce the pressure on the housing market. This in combination with the arrival of amenities which can be used by employees, visitors and residents creates the starting point for a liveable environment.

These two points reflect in the infrastructure as well. Nowadays, business parks are mostly inaccessible to pedestrians and do not provide public spaces.

However, at a mixed-use business park, a strong division between routes serving industries and residents is needed. The theory this thesis used is the one of Rust, Ruis and Reuring where roads facilitate the residential area, industrial area, or both.

That results in roads that are assigned to heavy vehicles to transport goods. Simultaneously, this network must adjust to the needs of future residents. Places of 'reuring' and 'rust' balance the spaces for working and living while providing public spaces for people to meet.

Strengthening public transportation puts the location on the map and makes sure that the living and working environments become more accessible. Besides, slow traffic routes make the business park more attractive for inhabitants to visit.

Additionally, a change in public spaces is desired. The current situation has a lot of paved storage places for trucks and materials.

On the other hand, with the addition of dwellings, the business parks are lacking in public spaces, biodiversity, climate adaptivity and connection towards the surrounding neighbourhoods. A green structure, as suggested by the Lansinghage design, forms the opportunity to deal with these problems all at once.

When these are linked to the regional walking and bike routes, the location is not only improved on its own but also forms a stronger connection with its surroundings.

Circular economy

By 2050 the Dutch economy needs to be fully circular. This asks for space for companies to innovate and proximity to infrastructure and the urban fabric. The result is that local-orientated consumption creates closer loops. Furthermore, a balance between social and spatial aspects is wished. Building upon existing

structures and strengthening the site-specific elements are examples of spatial implementations. On the other hand, it is crucial to note that for the social layer, the business parks need to offer a wide range of labour while engaging stakeholders.

The R-ladder indicated a hierarchy of circular strategies that influence the circular economy (Potting et al., 2017), see chapter 3. This indicated several spaces to rethink, reduce, reuse, remanufacture, recycle and so forth.

Opening facades, creating walk-in days, testing prototypes, and creating active streets are instruments to rethink the circularity at business parks.

Another example is urban mining. Construction materials can be stored somewhere to be reused when needed. This could contribute to transformation and renovation projects. A circular urban hub helps to store, separate, sort and process materials and products close to the city.

Besides, a more public strategy is the circular craft centre. At these locations inhabitants can repair their own products, social workplaces are available and functions like thrift shops create more awareness of the behaviour.

Lastly, living labs are important to promote knowledge, develop innovative industries and provide space to experiment.

Next to these hubs, also extra places to store materials and products are crucial. As shown in the design, for example, location Lansinghage, see chapter 6, there is a lot of space available for storage if other facilities are reorganised. Streetscapes, wastelands, roofscapes, and use storage as buffers with vertical zoning can be used to fulfil this task.

Also on the regional scale, material hubs contribute to this structure by providing more space for storage.

How this works together is explained in the next key concept or in chapter 6.

The business ecosystem of construction materials

A business ecosystem is a wide range of different industries and stakeholders, like customers, government, suppliers, producers, and distributors, that work together in a network (Moore, 1993). This network causes collective innovation, supports the implementation of new processes, and coevolves. Nowadays, there are several conflicts among the stakeholders related to this business ecosystem, see chapter 4. Statements of the departments of the Province of South-Holland are not in line, municipalities are not considering spatial plans behind their addition of dwellings at business parks, and academics that research this topic are not heard. Engagement strategies where knowledge exchange is key are the most important to implement. That creates a better understanding of the different needs and wishes.

Next to this, the context of the links in the business ecosystem is important (Moore, 1996). On the regional scale, it is necessary to form a composition of centralised and decentralised industrial sites. That creates spaces for industries where they can stay disruptive and produce nuisances further away from the urban fabric. These are key to forming a circular economy. The central locations create smaller loops between the mining and processing and provide opportunities for mixed-use strategies. Due to these (de)centralised locations and the intensity of mixed-use, the business ecosystem of construction materials in the Province of South-Holland can be restructured into four groups.

First, the miners, these business parks are focused on manufacturing materials. The water-bound locations are important for the import and export of products and materials, while other locations are located next to farmland or greenhouses and therefore focus on biobased materials. Waterways and highways are the most important infrastructure. The dis-

ruptive companies and decentralised locations cause no space to add dwellings.

Another group that is not suitable to mix, is the one called distributors. They are close to the urban fabric while keeping a strong relationship with the decentralised areas. Their infrastructure is almost the same as the miners only N-roads are extra used.

Thirdly, the business parks which need proximity to the urban landscape, namely the mixed processing hubs. They form opportunities to mix with dwellings if space for industries is critically viewed and retained. Highways, public transportation and sometimes waterways are necessary. Additionally, they are connected to surrounding neighbourhoods and cities by slow traffic routes.

Innovative, high-tech business parks form the last group that the business ecosystem of construction materials needs. These places need to be highly accessible by several transportation routes and are therefore located in the centre of the Province of South-Holland. Addressing all this, the business ecosystem will benefit from new ideas, talents, and collaborations that address the drivers of change (Hayes, 2021).

Limitations to the mix

Next to the fact that mixed-use is possible, it is also important to note that the mix has several limitations caused by spatial qualities and characteristics.

For example, the industries that are water-bound have priority to keep their connection to the water. They are located there for a reason, and this is needed to optimise their production process. Nowadays, living next to the water is seen as a benefit, but this research in this thesis makes it clear that industries should come first. Otherwise, it is hard to achieve the goal of becoming 100% circular by 2050.

The second remark is that not every wasteland can be transformed by horizontal mixed-use strategies. Again, this has to do with the goal of a circular economy. The companies located at business parks need spaces to store their materials. In addition, they should get the space to experiment and improve their environmental conditions.

As the design experiment of this thesis shows, it is important to look at the infrastructure network. Transforming this network causes new spaces. These can be used to add a new function such as living or recreation. In that way, the spaces assigned for the companies stay the same. That means that they can develop their industrial processes.

The last limitation of mixed-use is based on the vertical mixed-use strategy. This strategy can be used for all industries with fewer nuisances and small spans. However, the maximum height differs a bit. When looking at Binckhorst in The Hague the vertical addition can be quite high. This is caused by the surrounding urban landscape, where the high rise is realised. On the contrary, Broekvelden is embraced by rowhouses and therefore the opportunity to add dwellings vertically has a limit. The recommendation is to analyse the urban fabric that is surrounding the business park to see what mixed-use strategy is wanted.

In short, the spatial qualities and characteristics of the business ecosystem with a focus on construction materials formed by different business parks and their stakeholders shape the future of mixed-use in the Province of South-Holland by reinforcing site-specific elements, spreading knowledge, separating spatial elements that serve a specific function and strengthening actors that are connected to the liveability and circular economy at business parks.

7.2 | What does this research contribute to?

The relevance of my graduation project is focused on what feasible options there are to implement mixed-use and circular economy strategies at the business park structure in the Province of South-Holland. With the strategic frameworks, examples locations, and policy recommendations I want to bridge three knowledge gaps that were discovered during this thesis.

First, the right balance between working and living is not yet discussed. There are a lot of different stakeholders who have different opinions on this, see chapter 4. Some are in favour of adding as many dwellings as possible, while others warn about the effects on the industrial processes. This causes the industry at business parks mostly just disappear when dwellings are added. With this thesis, I investigated the right balance and address another standing point, namely advocating for the importance of production in our cities.

This results in an addition to the current literature. For example, Louw and Bruinsma (2005) claim that mixed-use is possible for industries with an environmental factor 1 or 2. However, as this research shows, there are also options to add dwellings at business parks with environmental factors 3 or 4. To do so, the elements that structure the mixed-use possibilities addressed by Rowley (1996), grain, density and permeability, should be better implemented at business parks.

In addition, Mastura, Ab Ghafar, Ahmed, and Keumala (2017) describe elements to measure liveability. These are not projected at industrial sites so far. To make sure that a balance between working and living is achieved, this theory is adapted to business parks.

Besides, literature only describes design principles or pattern languages, but urban design and how it works on a specific location, are often missing. An example is the fact that in literature theories on infrastructure are named as important to structure the mixed-use opportunities. On the other hand, during the internship at the Province of South-Holland,

it became clear that they are not aware of this importance and therefore do not connect the Department of Mobility to this topic. With the research by design at example projects, I want to show how this can work.

Additionally, the strategies on the R-ladder (Potting et al., 2017) helping to achieve a circular economy are not that familiar to several stakeholders relating to this research. Therefore, they are named specifically for the design implementations to create awareness. On a larger scale, Van den Berghe and Verhagen (2021) state that business parks should work as a network to fulfil the task of becoming 100% circular. Therefore, the collaboration between different business parks is suggested in this thesis.

Regarding the circular economy, literature, as described by Hill et al. (2020), claims that it takes more space to store materials and keep them close to where they are used to create smaller loops.

However, nowhere is written about how large that amount of space is and how we should deal with it. Therefore, this research showed the opportunities at Lansinghage to indicate how this can be done. At this specific site transforming the road network and assigning space for industry creates space to add public facilities while providing storage and spaces to develop new industrial processes.

7.3 | Discussion

This discussion consists of two parts. The first one reflects on the limitations of the study and subsequent interpretations. Secondly, recommendations for further research are given.

Limitations of the research

The first limitation of this graduation thesis was the fact that not all stakeholders were interviewed. Some, like the future residents, are not there yet.

Additionally, some information on stakeholders is obtained indirectly. This is the case with the companies located at business parks and some departments of the Province of South-Holland. The ones that were interviewed are only presenting information from their perspective, which does provide a holistic insight into the needs of this governmental institution. This causes assumptions about their wishes and needs within a mixed-use business park.

The internship at the province helped me to speak to some departments and gain a lot of information. However, this also influenced the view on the topic. It creates tunnel vision into what the needs and wishes of the Province are, without taking a lot of other interests into account.

Besides, there are limitations in the information that could be found. This thesis deals with topical drivers of change that are not yet well described.

An example is the question about how much space is needed for storage when we change into a circular economy. Due to this lack of literature and knowledge, these questions are still partly unanswered.

Furthermore, this research focuses on business parks that serve the business ecosystem of construction materials. It claims that business parks have an environmental factor of 3 or 4.

However, other industrial processes have this factor which is not located at business parks. These could be in the rural or urban areas and profit from the same imple-

mentations.

In addition, the specific business ecosystem excludes other companies that have an environmental factor of 3 or 4. This causes a spatial framework where dwellings are added, even though these could be placed inside environmental buffers of other business ecosystems.

In addition, the data sources that are used were sometimes a bit old or did not provide complete information. These are critically viewed, but because of the regional scale and time limitations, it is impossible to be 100% sure about every detail of information.

Lastly, themes like liveability and the circular economy are very broad. It is impossible to gain all the knowledge that is there and project it in the right way onto the business ecosystem of construction materials.

Recommendations for further research

As becomes clear from the limitations, there are some recommendations when further researching this topic.

For example, it could be interesting to not choose a specific type of industry, like the business park, but do research into a business ecosystem. In that way, all the stages of the production process are considered and can be compared to spatial qualities. The relations between these locations could be investigated to see what the future needs are.

In addition, this thesis has the standing point of retaining as much space for companies as needed. A recommendation could be to change this perspective into creating as much space for dwellings as possible. Studies that explore different densities are an example of what could contribute to this topic.

Another future research could be on what the influence would be if we relocate all companies with an environmental factor lower than 3 from the business parks and house them inside cities. This creates new spaces at the business parks and asks for new strategies inside the urban fabric.

Furthermore, the engagement strategies between municipalities, companies, residents, and the province are now shortly described. To understand these relations better and form an approach that helps them achieve their goals, a study into their relations could be of value.

7.4 | Personal reflection on this graduation year

Starting this graduation year, I had two goals in mind to research during this period.

The first one was to write a thesis on how working and living in complex urban landscapes, like business parks, should be shaped in the Province of South-Holland. During the first couple of months, I tried to answer this big question by diving into the literature.

This approach seemed to be working for me. However, my mentors were worried that I would not be able to answer all the questions if I did not narrow down my topic. Therefore, I needed to retake during the P2 presentations.

This reflection and the feedback from my mentors helped me achieve a better structure in the report and a specific topic which addresses my interests even more. In the end, I am very happy that they hold up a mirror because I did not see the possible pitfalls. It changed my approach to combining different methods like observations on site, multi-scalar mapping, interviews, reference projects and stakeholder analysis, and ensured me that the key is to keep asking questions as long as it fits my topic.

Thus, after P2 I narrowed down my thesis topic to mixed-use possibilities at business parks, specifically focusing on shaping liveable environments which help facilitate a circular economy in business ecosystems related to construction materials in the Province of South-Holland. With the new methods, I learned to get a grip on the relations between stakeholders, landscapes, and material flows.

This helped me to form a strategic framework where I analysed three example projects and give a first draft for improvements to the policies regarding mixed-use opportunities at business parks. I feel like the approach of using different urban forms to map out the opportunities of mixed-use at business parks is a good move. Connecting these example projects to the whole province within the strategic framework is completes the circle.

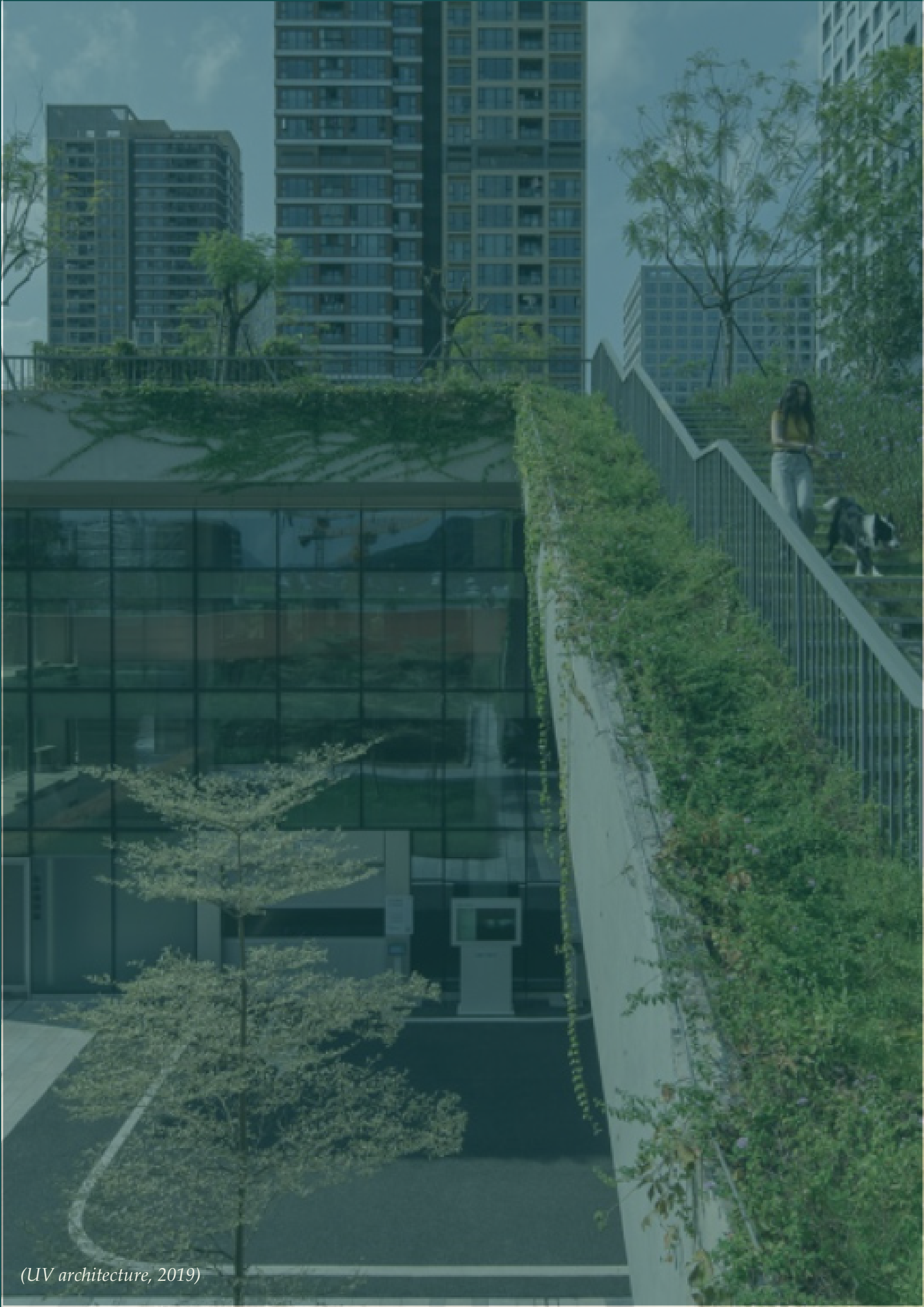
The second goal of my research is more personal. Next to the fact that my internship at the province causes a convenient connection towards several sources, I also planned to figure out if it suits me as a future employer. This approach is important for me because, during my bachelor's and master, there was not a lot of space to do internships.

Here I found out that my approach is working because I got a lot of insights into the challenges and opportunities the Province of South-Holland has to offer. However, the size of the province as an employer is too big for me. I like the dare to work on this scale, but it is hard to feel in place within the teams. However, my mentors were super helpful and always try to give me some feedback to get back on track. I loved their enthusiasm, creative ideas, and insights. Added to this is the fact that I moved back to Vianen, so working in The Hague is not so ideal.

In short, from both "studies", I learned a lot. The goal to research mixed-use opportunities is something I am already busy with. I feel like I know enough now to recommend strategies towards the Province of South-Holland.

8.

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- 9.1 | Appendix A: Playing a serious game
- 9.2 | Appendix B: Stakeholder framework
- 9.3 | Appendix C: Role of A12 in the Province of South-Holland
- 9.4 | Appendix D: Experiments on the road network
- 9.5 | Appendix E: Stakeholder activation over time
- 9.6 | Appendix F: Underlying maps for FSI, GSI, layers and OSR

9.

APPENDIX



(Cityzapper, n.d.)

Appendix A | Playing a serious game

One of the reports that was important during this thesis, was the “Toekomstonderzoek 50-50” written by the Province of South-Holland. During their research they look 50 years back in time, illustrate the current situation and develop some future scenarios.

To make sure that the conversation about the future of the Province will start, they created a serious game. During the internship the game was played twice. The first time with actors involved in business parks (21-11-2022) and secondly with fellow graduation students (12-12-2022). This appendix lights out what differences were between the two plays.



Figure A.1: Workshop circular business parks

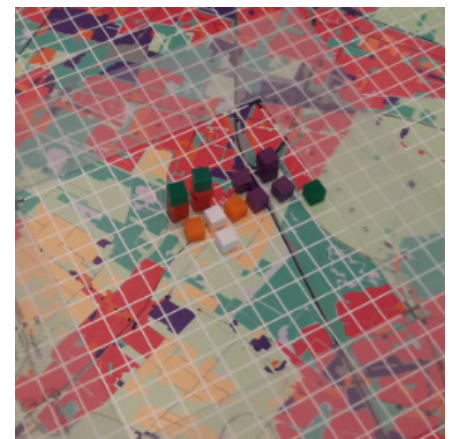
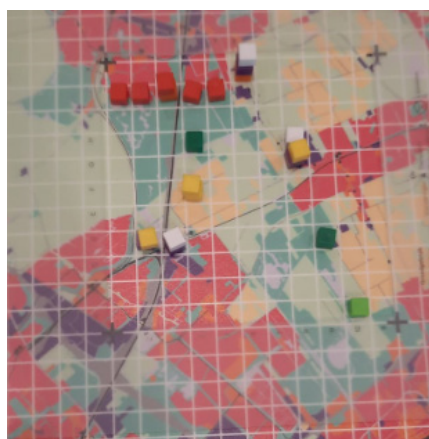


Figure A.2: Outcomes serious game while playing with actors of business parks

First of all, the stakeholders of business parks where not so familiar with the data they could use. They started placing their cubes without the surface or construction years taking into account. This causes a design based on own perceptions and meanings. The result was that there was a lot of friction during the discussion and even some kind of negative attitude against ideas of others.

In addition, the actors which participated tried to develop new structures by holding on to everything that was already there. They missed some kind of visionary view on possibilities. This could be explained by the fact that they are not used to design the urban fabric and are experts in their own working field.

The second game was played with students of TU Delft from the master Urbanism. They are used to take care of wicked problems while designing future scenarios. Therefore, you could see that they could handle more assignments at the same time, while considering what the influence of their actions would be.

Furthermore, this is one of the first batch of students which are used to design based on evidence and data. This makes sure that discussing the data was always part of the decision making.

To get a clear view on what possible future scenarios there are, multiple stakeholders need to play the game together. However, the

game is also developed to create more awareness at different actors and during the playing it became clear that this is successful.

The conversation started more quickly at the first game, than with the students. They are all from the same target group and try to come up with solutions, while the game is actually designed to start the conversation.



Figure A.3: Playing the serious game at the Technical University of Delft

Appendix B | Stakeholder framework

Tabel B.1.: Extracted information on standing points of different stakeholders (Workshop Master City Developer Binckhorst 06-12-2022, personal contact B. Jansen, M. Faver Linhares, E)

ACTOR	PROBLEM PERCEPTION	INTERESTS
Province of South-Holland Department of space, housing and soil	Regulations around industrial processes weight to heavy. Innovative solutions could be found to address this to deal with several concepts (liveability, circularity, densifications ect) at the same time.	<ul style="list-style-type: none"> Investigate what the future w what should be considered as for the province in order to ba working and living
Province of South-Holland Department of Mobility	Not really aware of the problem that occurs when adding dwellings to industrial sites. However, their implementations can be changing for the strategies proposed on the spatial framework.	<ul style="list-style-type: none"> <i>separate industrial transportation ones</i>
Province of South-Holland Department of Society and Economy	Circular economy will take way more space than the linear one. Therefore, the space need to be reserved for industrial functions. Vacant land / buildings are the only opportunities to add dwellings.	<ul style="list-style-type: none"> Realise and maintain a resilien for the whole Province of Sou Stand up for businesses
Municipality of The Hague	Have to deal with many wicked problems that therefore they think every solution or innovation is welcome. Most important is to keep the artisanal look of the Binckhorst.	<ul style="list-style-type: none"> Realising dwellings to reduce the housing market Keep space for industry in or strengthen the economy Create climate adaptive space Reinforce the accessibility of t
Municipality of Zoetermeer	<i>Lansinghage is relatively large and therefore important for the economy of Zoetermeer. There is a mix of different industry, but lacking in other facilities. There is also a need for more dwellings to fulfill the demand.</i>	<ul style="list-style-type: none"> <i>Realising dwellings to reduce pr housing market</i> <i>Keep space for industry to streng economy</i> <i>Create climate adaptive spaces</i>
Municipality of Bodegraven-Reeuwijk	<i>Not used to high buildings, therefore vertical mixed-use can form an challenge. In addition, this municipality is small and probably attract less new residents. Green, leisure, and working places have priority. Industry relatively old, so some buildings can be replaced.</i>	<ul style="list-style-type: none"> <i>Keep space for industry to retain</i> <i>Realising dwellings, provided th ons do not suffer</i> <i>Embracing the green structures Bodegraven</i>
Project developer	Need to combine as much functions as possible on a certain building block. This gives close proximity, equal opportunities and contributes to a lively environment. In that way a building can strengthen the rest of its surrounding.	<ul style="list-style-type: none"> Building as much dwellings a gain profit. Sustainable and flexible devel order to stay future proof

* Everything in italics is an informed guesse. This is based on fieldtrips and things that were writting in new articles. However, an interview

	SPATIAL INTERVENTIONS	SCALE	POWER
will bring and action points balance the	<ul style="list-style-type: none"> • Timeframes / rerouting logistics • Vertical buffers • Mix between horizontal and vertical mixed-use 	Regional	Production and blocking power
n from resi-	<ul style="list-style-type: none"> • Rerouting the mobility network inside the example locations, but also outside 	Regional	Production and blocking power
nt economy th-Holland.	<ul style="list-style-type: none"> • Reuse the existing buildings / vacant land to create new dwellings • Processing, storage and logistics will take more space, so this need to be reserved for industrial functions 	Regional	Production and blocking power
pressure on der to es the city	<ul style="list-style-type: none"> • Create identity by emphasizing traditional crafts • Mostly horizontal mixed-use, little vertical mixed-use, but with no structured plan • Reuse wastelands, parking lots and vacant buildings 	City Neighbourhood	Production and blocking power
pressure on the ghten the	<ul style="list-style-type: none"> • <i>Mix of horizontal and vertical mixed-use</i> • <i>Realising more facilities</i> 	City Neighbourhood	Production and blocking power
the economy at other functi- surrounding	<ul style="list-style-type: none"> • <i>Replace outdated buildings and replace them with industry that contribute to circular economy</i> • <i>Mostly horizontal mixed-use</i> • <i>Retain enough space for other facilities</i> 	City Neighbourhood	Production and blocking power
is possible to opment in	<ul style="list-style-type: none"> • Building upon existing structures/vacant buildings • Mostly vertically mixed-use 	Building block	Production power

ow needs to find place in order to confirm the statements.

ACTOR	PROBLEM PERCEPTION	INTERESTS
Academics (urbanism) TU Delft	Need of production inside of the city. Therefore businesses should be protected. Question arises if we have already reached a maximum of the mixed-use possibilities.	<ul style="list-style-type: none"> • Spreading knowledge • Gaining insight for knowledge g
Residents from surrounding neighbourhoods	<i>New housing types influence the demographic division within the city. This can cause tensions. However, this new neighbourhood also brings in new opportunities for example in employment or facilities</i>	<ul style="list-style-type: none"> • Employment opportunities • Access to educational, health ca and fresh food facilities
Future residents	Living next to industrial processes can be unhealthy and cause nuisance	<ul style="list-style-type: none"> • Finding a place to live • Diversify housing stock and eth a city • Employment opportunities • Access to educational, health ca and fresh food facilities
Companies located on business parks	Adding dwellings can expel companies from business parks, because of the increasing land prices and lacking regulations. Therefore, mixed-use is threatening the development opportunities from companies.	<ul style="list-style-type: none"> • Keeping space for future develop such as contributing to circular • Gain profit

* Everything in italics is an informed guesse. This is based on fieldtrips and things that were writting in new articles. However, an interview

	SPATIAL INTERVENTIONS	SCALE	POWER
gaps	<ul style="list-style-type: none"> Keep processing plants, recycling stations, logistics, food production etc on the business parks. Built upon these existing structures and look back into the history of a place Local economy can serve the community and circularity Create knowledge exchange and diversity in employment opportunities 	Regional City Neighbourhood	Fence sitters
re, leisure	<ul style="list-style-type: none"> <i>More transportation of goods and people from surrounding neighbourhoods towards this new mixed-use business park</i> 	Neighbourhood	Fence sitters
nicities of re, leisure	<ul style="list-style-type: none"> Adding as much dwellings as possible Mix between horizontal and vertical mixed-use 	Neighbourhood	Fence sitters
mpment economy	<ul style="list-style-type: none"> Environmental qualities forming a buffer Site specific elements such as water, train or highway 	Regional City Neighbourhood	Mostly fence sitters. However, when business park rules by organisation this can increase the power.

needs to find place in order to confirm the statements.

Analysing the intensity of highway A12 to see possibilities for circular economy and liveability

In figure the access to the Province of South-Holland via highways is mapped to see what the intensity of the A12 is in relation to others. The distinction between passenger and goods is made and workdays are separated from the weekends.

When looking into the details of the dataset the amount of cars is always higher than trucks and during the daytime, there is also more traffic on the road. However, that is not what this analysis focuses on. It is mapped to compare the highways at the same time of the day with each other. In that way, the conclusion says something about the A12 in relation to the other highways.

An informed guess is that the intensity of the highway also reflects on the business parks and their accessibility by car. This can add to the local production and regional processing which is the main core of this thesis and discusses the possibilities to form a circular economy. Besides, the accessibility reflects on the liveability as well, because the transport of persons is part of one of the four elements of literature on liveability.

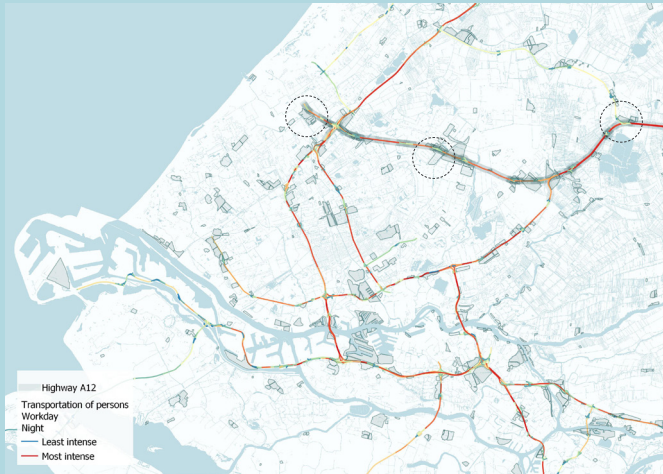
The conclusion from the analyses is that the A12 is less intensively used during workdays and weekends than the other highways in the Province of South-Holland.

This can be caused by the fact that vehicles travel more between The Hague and Rotterdam or that this is not the ideal route for transport (inter)nationally. However, the capacity of the A12 can maybe be stretched. That means that when the business parks all have their own role in the circular economy, see chapter 5 for the strategic framework, the A12 can form the connection between these different landscapes, and storage and processing hubs.

WORKDAY
TRANSPORT OF PERSONS

WORKDAY
TRANSPORT OF GOODS

NIGHT



DAY



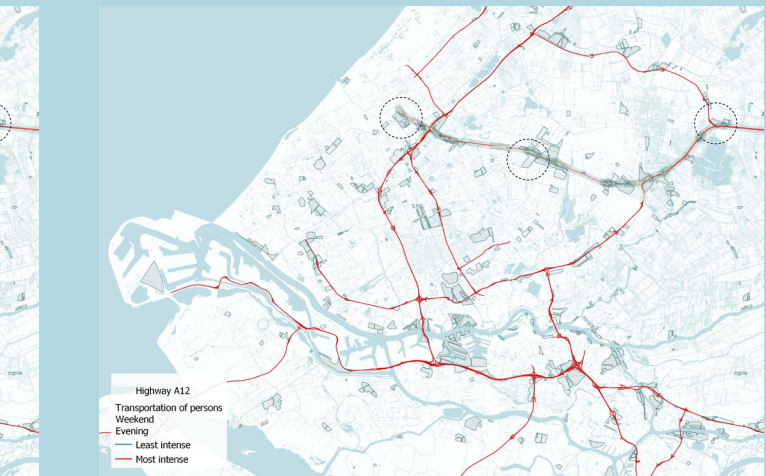
EVENING



Figure C.1: Highways in the Province of South-Holland with their intensity of use (scale 1.2000000, 25% reduced. Based upon INWEVA dataset)

WEEKEND TRANSPORT OF PERSONS

WEEKEND TRANSPORT OF GOODS



Appendix D | Experiments on road network

These experiments show different road networks crossing Lansinghage. The companies that are related to a circular economy and the business ecosystem of construction materials are mapped to see if with new implementations this network could still function.

The first experiment uses the Lansinghageweg to stretch its wings into the rest of the business park.

However, with this network the edges of the area are not really reached. This causes that some companies have a hard time to transport their goods and trucks have to make several loops to get somewhere.

Secondly, the two islands that work on their own. These are connected via the north and south side of the N470. This structure provides way more opportunities for companies to connect on the city and regional scale. Additionally, the Lansinghageweg is not necessary anymore so this could serve new functions.

Again there is a point of attention because the east side is not linked towards the agricultural area. This should be taken into account in the design.

Lastly, the experiment that looks into a ring road structure. Again this facilitates all companies related to this thesis topic. The west side of the business park becomes more quiet and separated from the industrial processes.

On the other hand, the trucks have to ride this ring every time they visit it. This is not a very flexible structure. Besides, the east side is not connected as well and the N470 causes nuisances which does cancel the benefit of a quiet area on the west side.

In addition, the experiment is done for Broekvelden and Binckhorst as well. However, they are not used in a design. See next page.

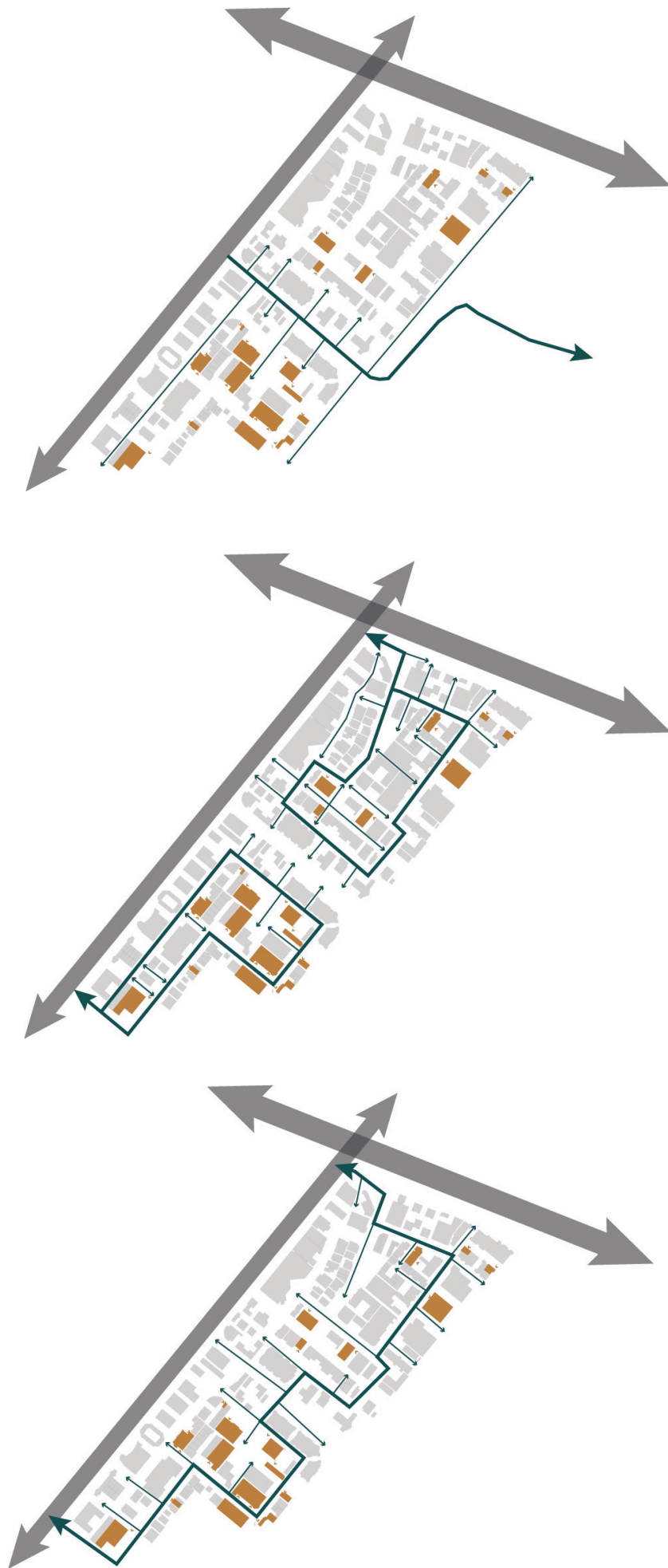


Figure D.1: Experiments on new road network Lansinghage

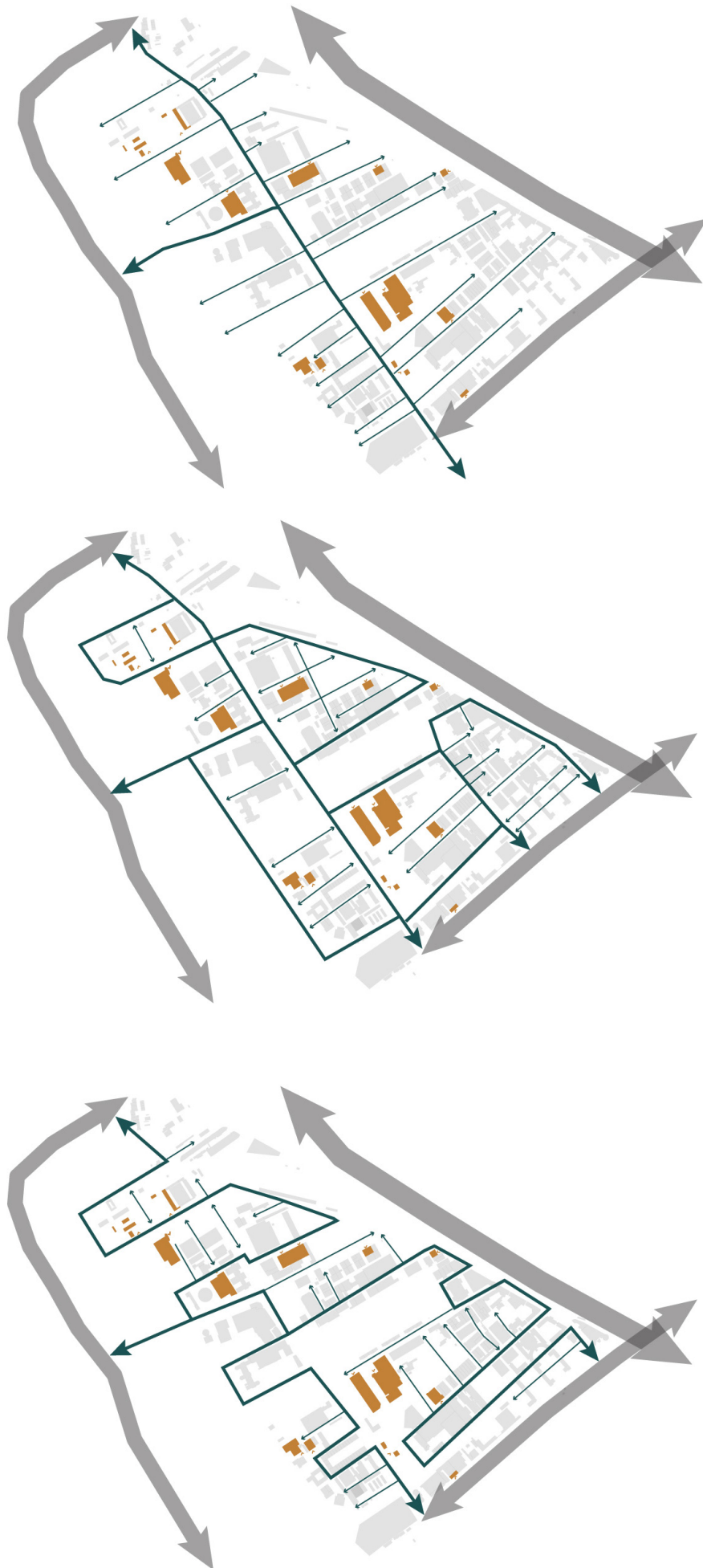


Figure D.2: Experiments on new road network Binckhorst

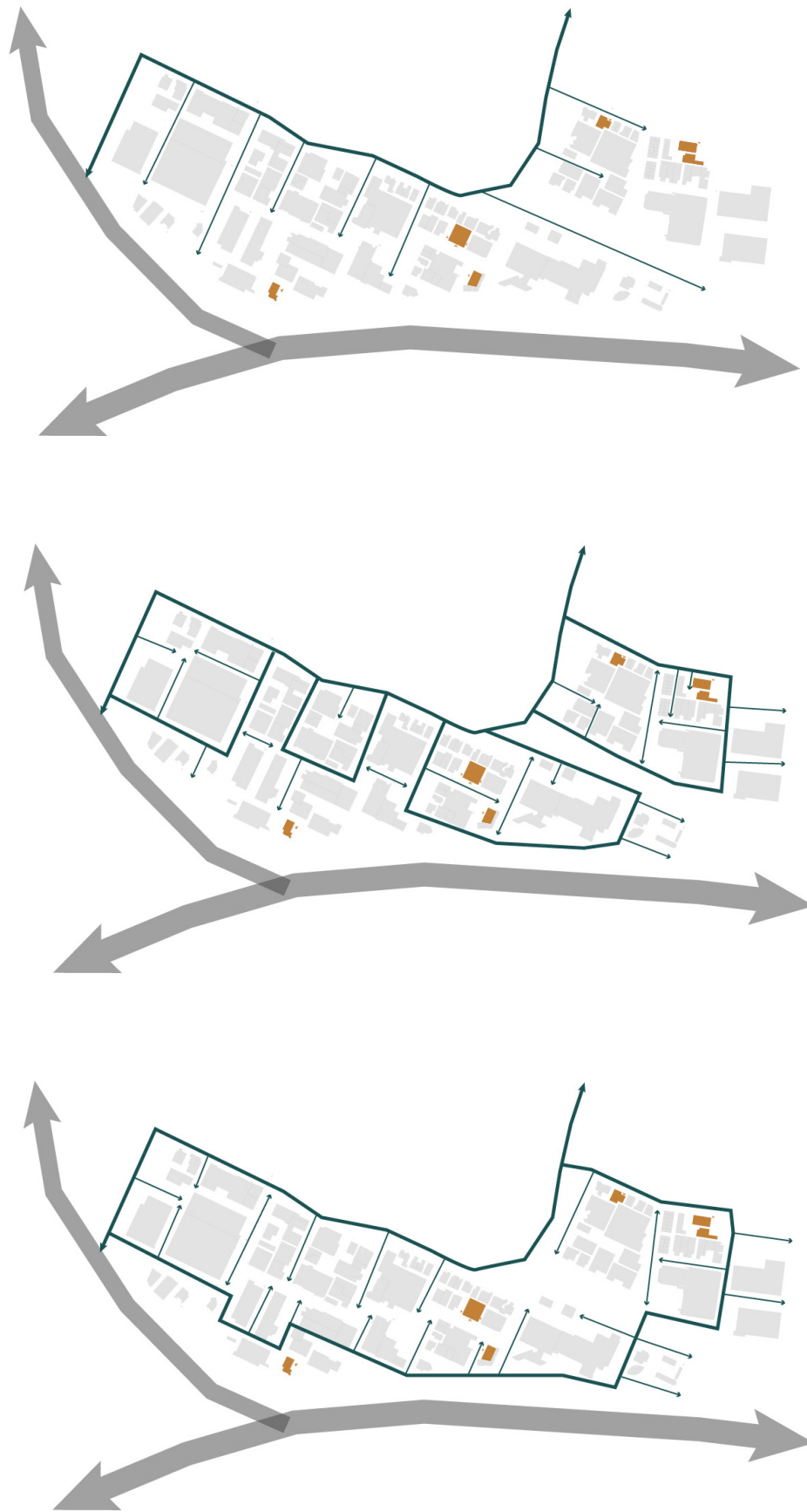


Figure D.3: Experiments on new road network Broekvelden

Appendix E | Stakeholder activation over time

Stakeholders related to the implementation of mixed-use strategies

When looking at the implementation of mixed-use strategies in different business parks in the Province of South-Holland it becomes clear that the province plays an important role.

Within the cities, the need for dwellings is high which reflects in the need for mixed-use strategies. The project developers are therefore also interested to develop these areas.

However, the village of Bodegraven does not need that many dwellings, as explained in the previous chapter. That is why the stakeholders at this location are having low interest and power.

Because at Binckhorst the property ownership is partly in the hands of the municipality, this stakeholder has more influence than for example in Lansinghage. That business park has a combination of future residents, entrepreneurial associations and the municipality that deals with mixed-use strategies. This reflects in the hierarchy of the stakeholders' power and interests.

Furthermore, the influence of the stakeholders differs over time. Around 2030 the deal to realise 200.000 dwellings in the Province of South-Holland needs to be reached. That means that the closer that date approaches, the more influence the stakeholders must exercise. The province should steer the municipalities because of their controlling role. That is why the increase followings a bit later on the municipal side.

After 2030 the prediction is that the population will continue to increase, so the wave of interest and power shall continue.

Lastly, the inhabitants and knowledge institutions always have the same kind of control. They are not directly linked to these developments but are partly connected because their

neighbourhood is adjacent to the mixed-use areas or because of the research they do on this topic.

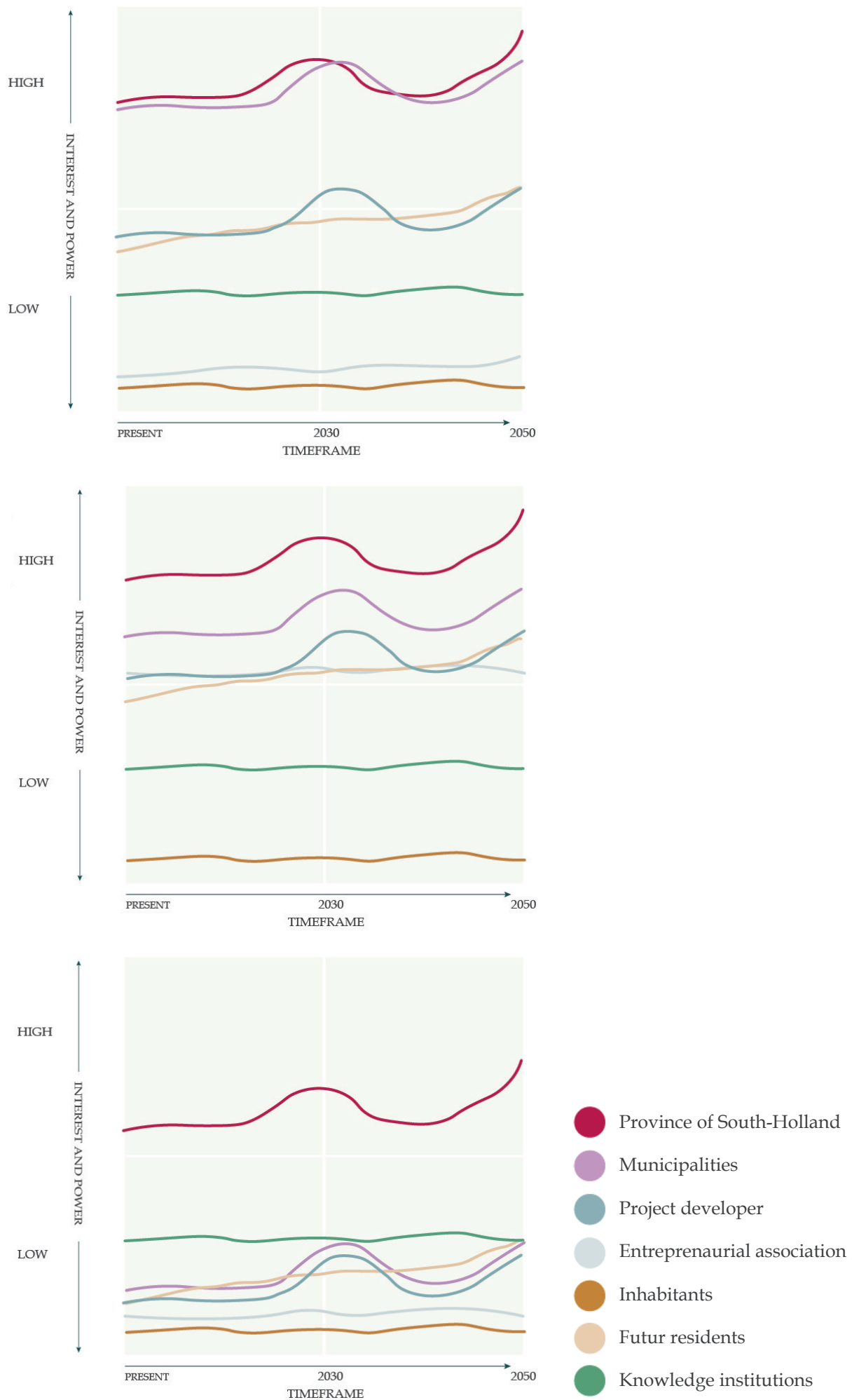


Figure E.1: Stakeholders need to act differently to create mixed-use areas at each example location (1; Binckhorst, 2; Lansinghage, 3; Broekvelden)

Circular economy

The other driver of change is the need for a circular economy. This causes different interests of stakeholders over time. Because this concerns all businesses spread over the province, the interests of this stakeholder stay the same for each location. As the goal of 2050 comes closer, the need will also grow.

However, the entrepreneurial association has other needs per example project. Because Broekvelden is not suitable for mixed-use and needs protection for industries to develop, this need is higher than at the other locations.

This immediately influences the (future) residents. They do not have a place in the village of Bodegraven and are therefore less interested.

The knowledge institutions and project developers stay the same at the three locations. They indirectly influence the circular economy.

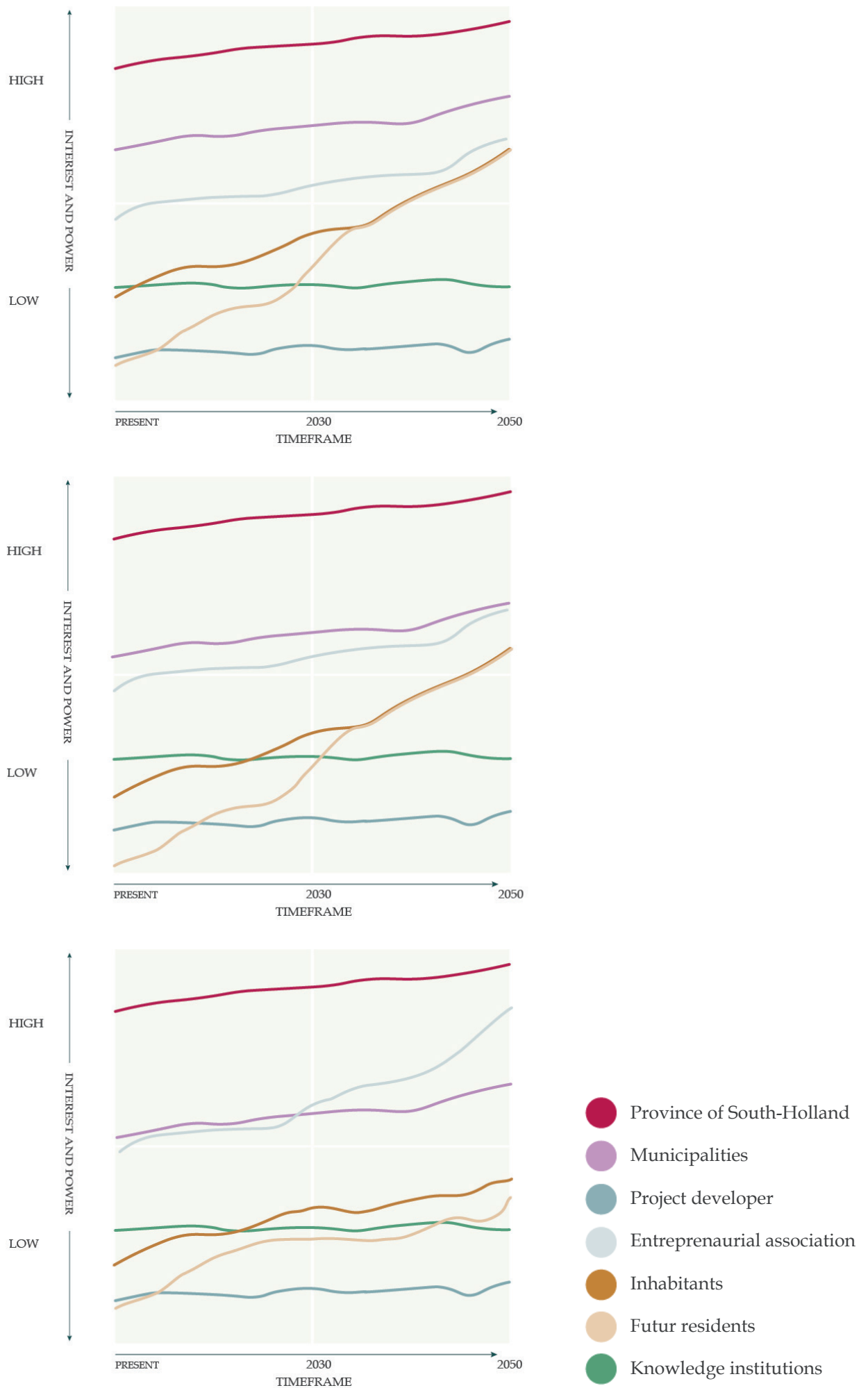


Figure E.2: Stakeholders need to act differently to facilitate a circular economy by 2050 (1; Binckhorst, 2; Lansinghage, 3; Broekvelden)

Appendix F | Underlying maps for FSI, GSI, layers and OSR

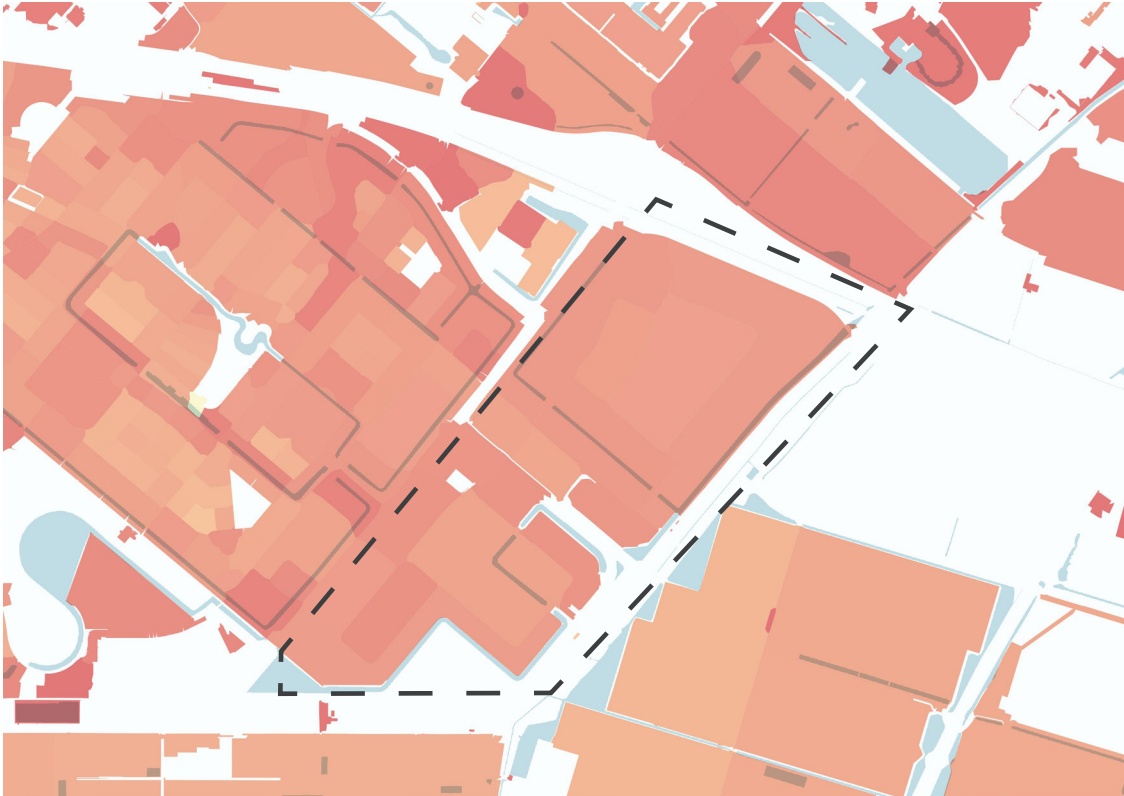


Figure F.1: FSI Lansinghage

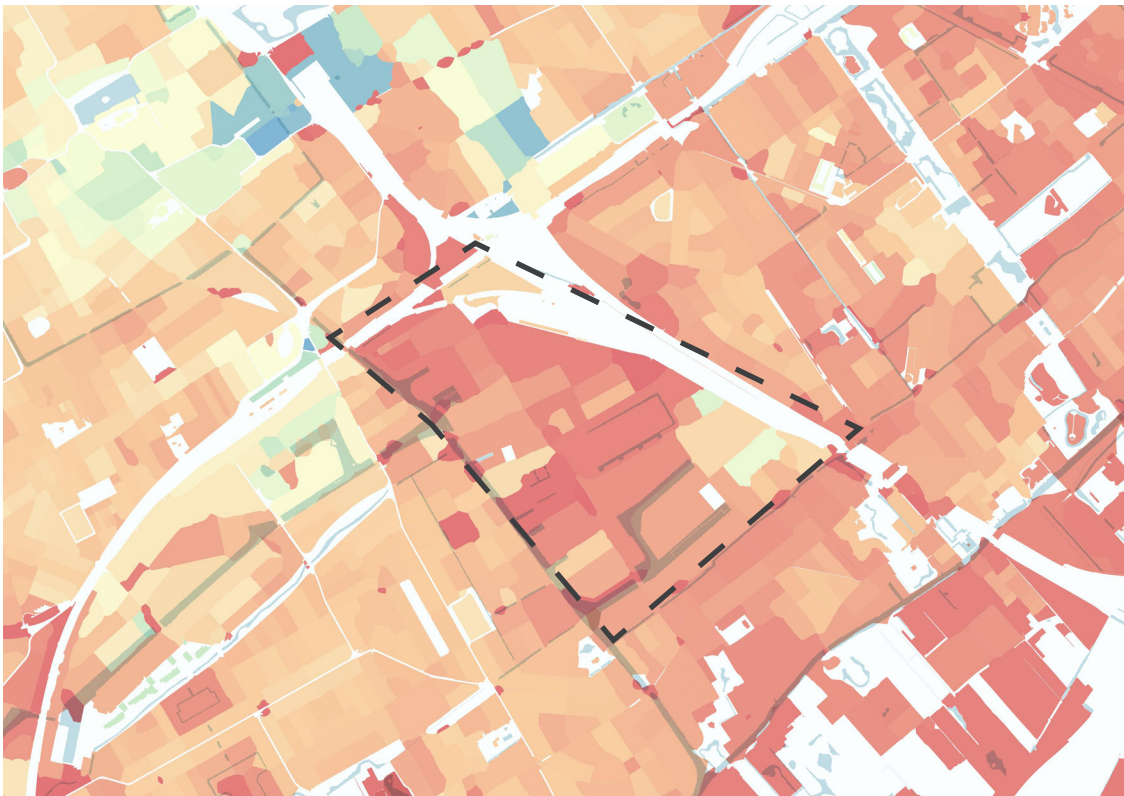


Figure F.2: FSI Binckhorst

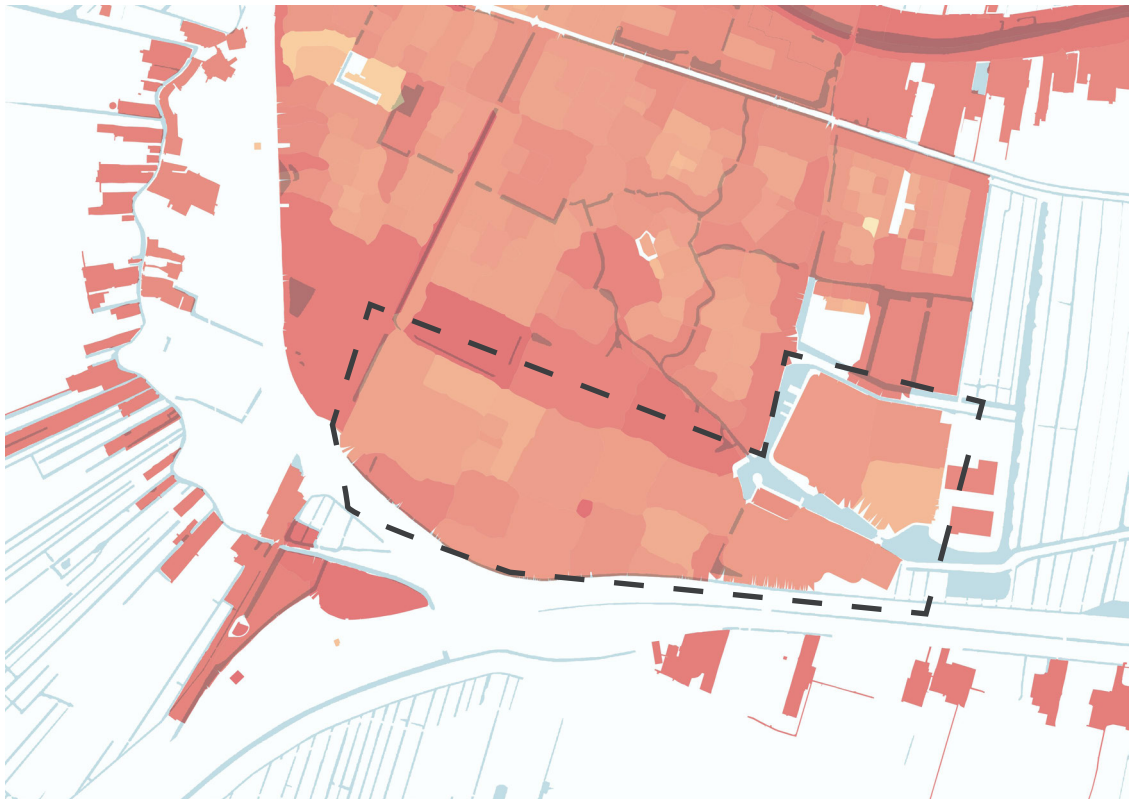
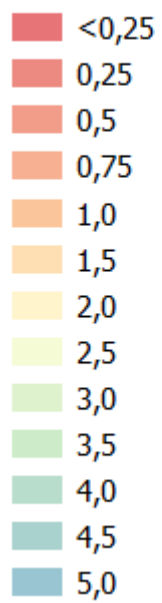


Figure F.3: FSI Broekvelden

Rudifun_Bouwblok_FSI



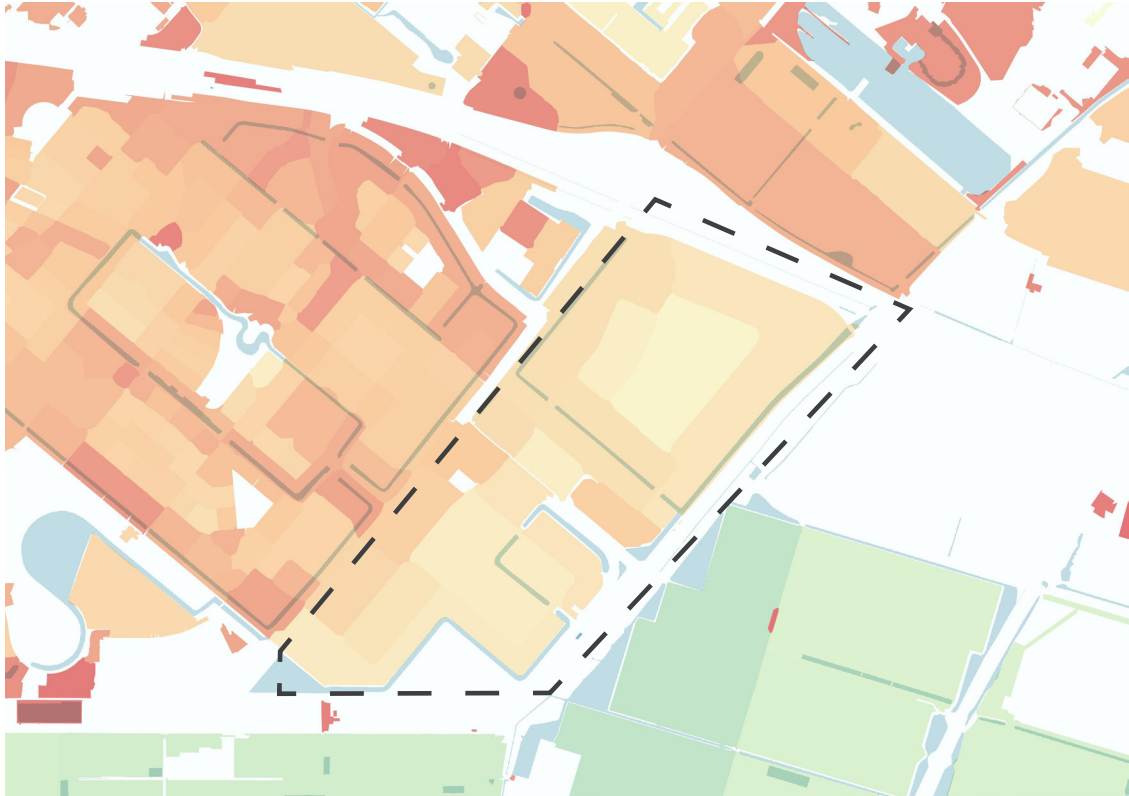


Figure F.4: GSI Lansinghage

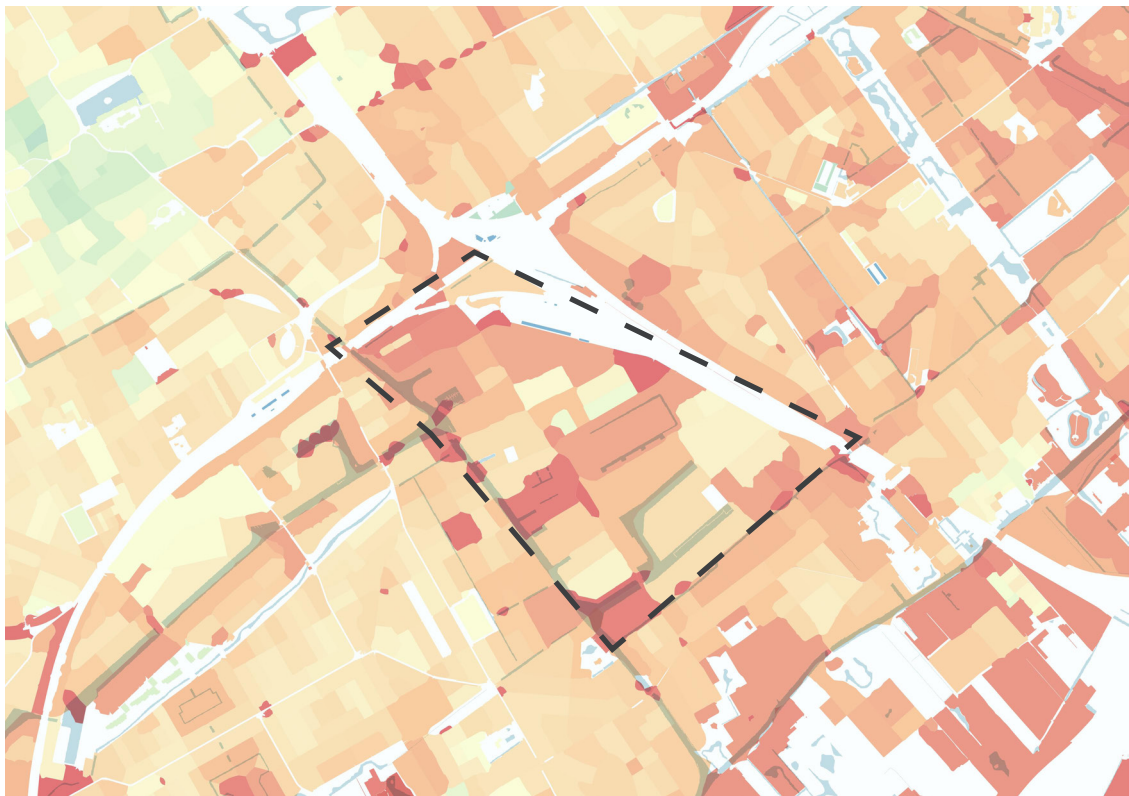


Figure F.5: GSI Binckhorst

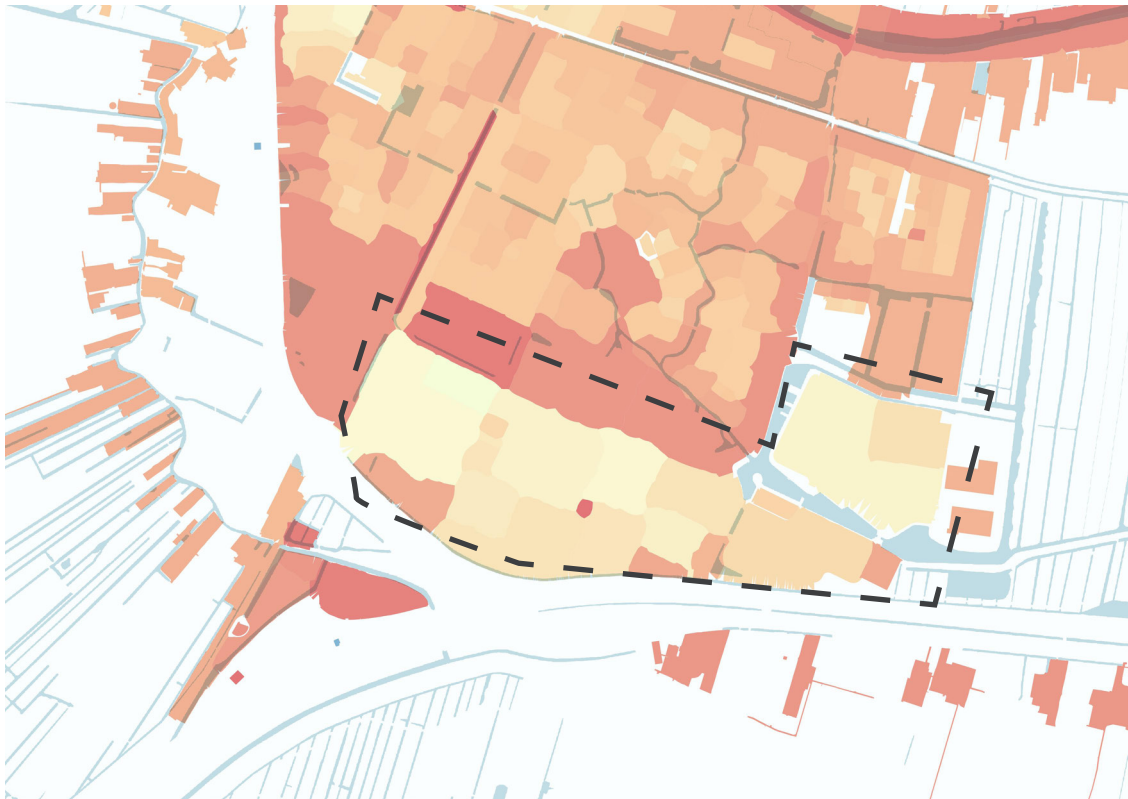
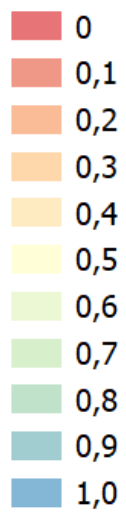


Figure F.6: GSI Broekvelden

Rudifun_Bouwblok_GSI



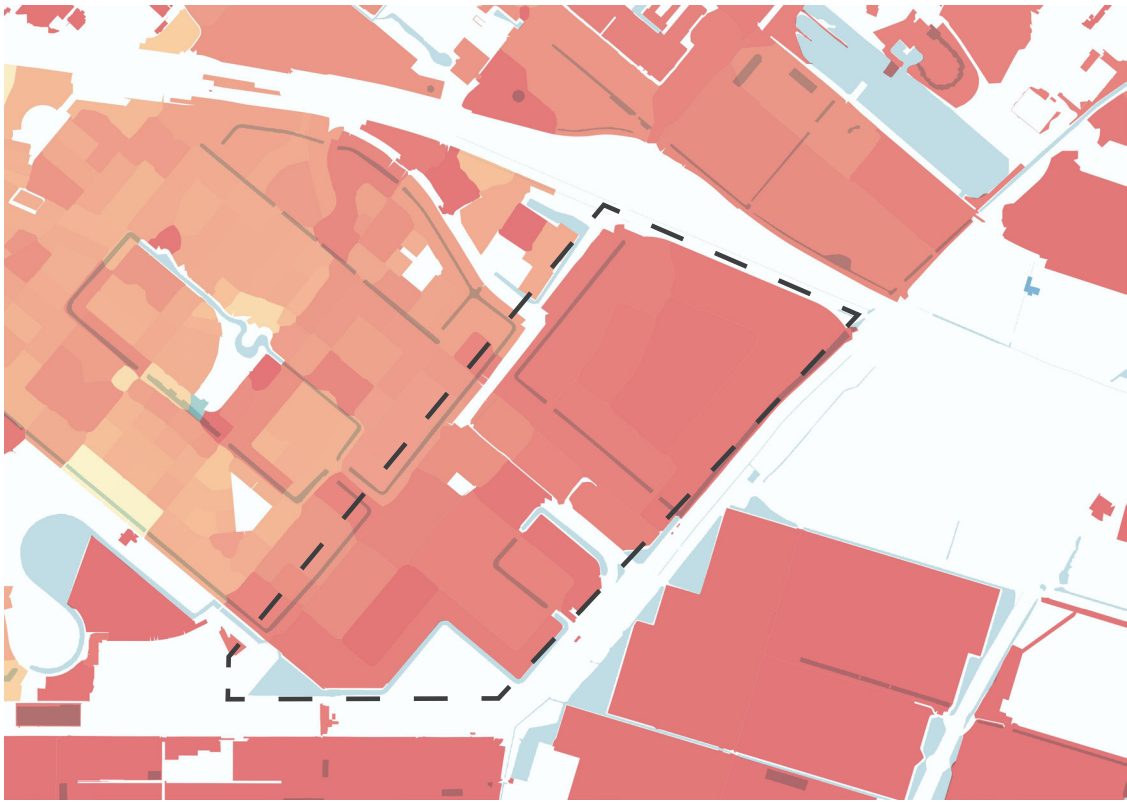


Figure F.7: Layers Lansinghage



Figure F.8: Layers Binckhorst

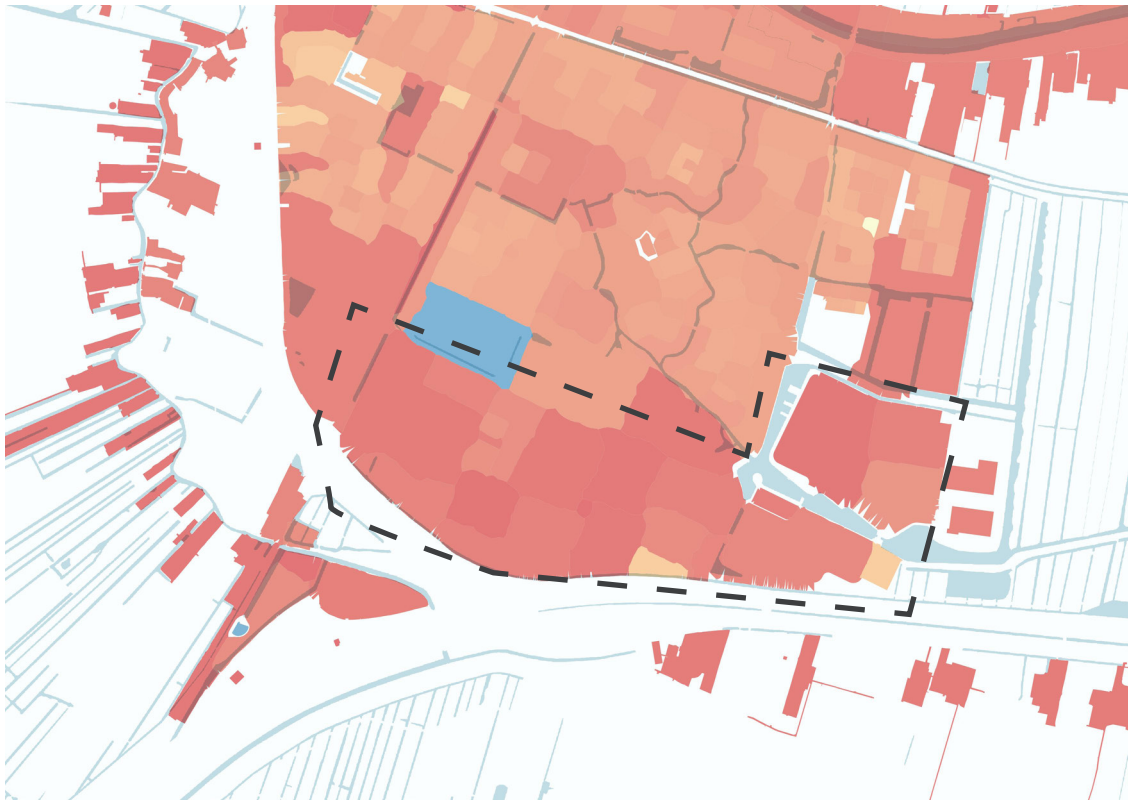
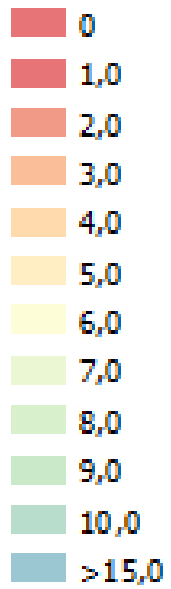


Figure F.9: Layers Broekvelden

Rudifun_Bouwblok_Layers



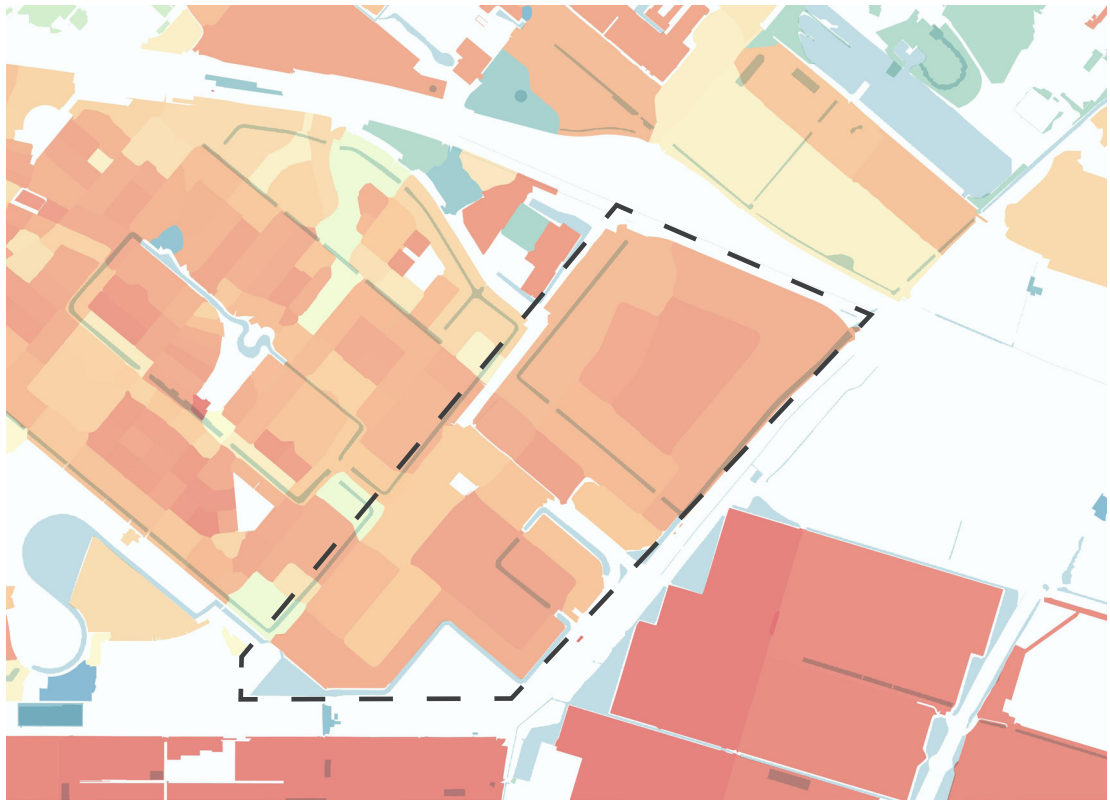


Figure F.10: OSR Lansinghage



Figure F.11: OSR Binckhorst

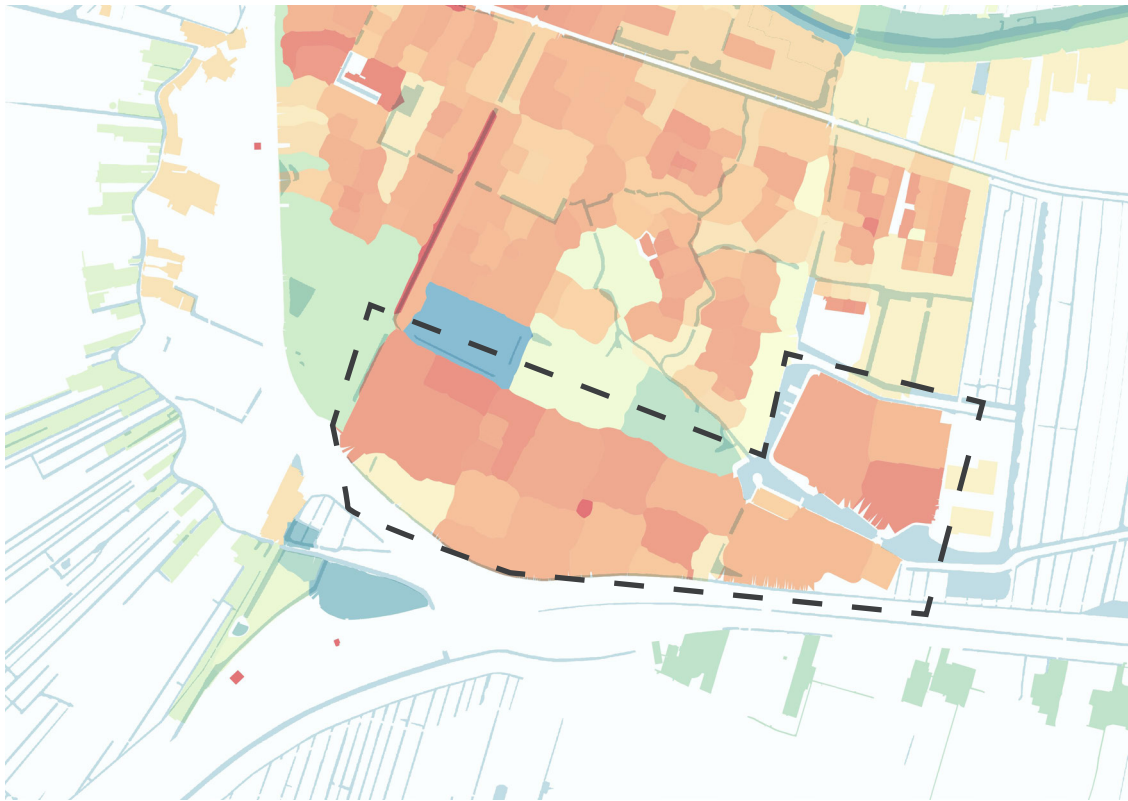


Figure F.12: OSR Broekvelden

Rudifun_Bouwblok_OS

