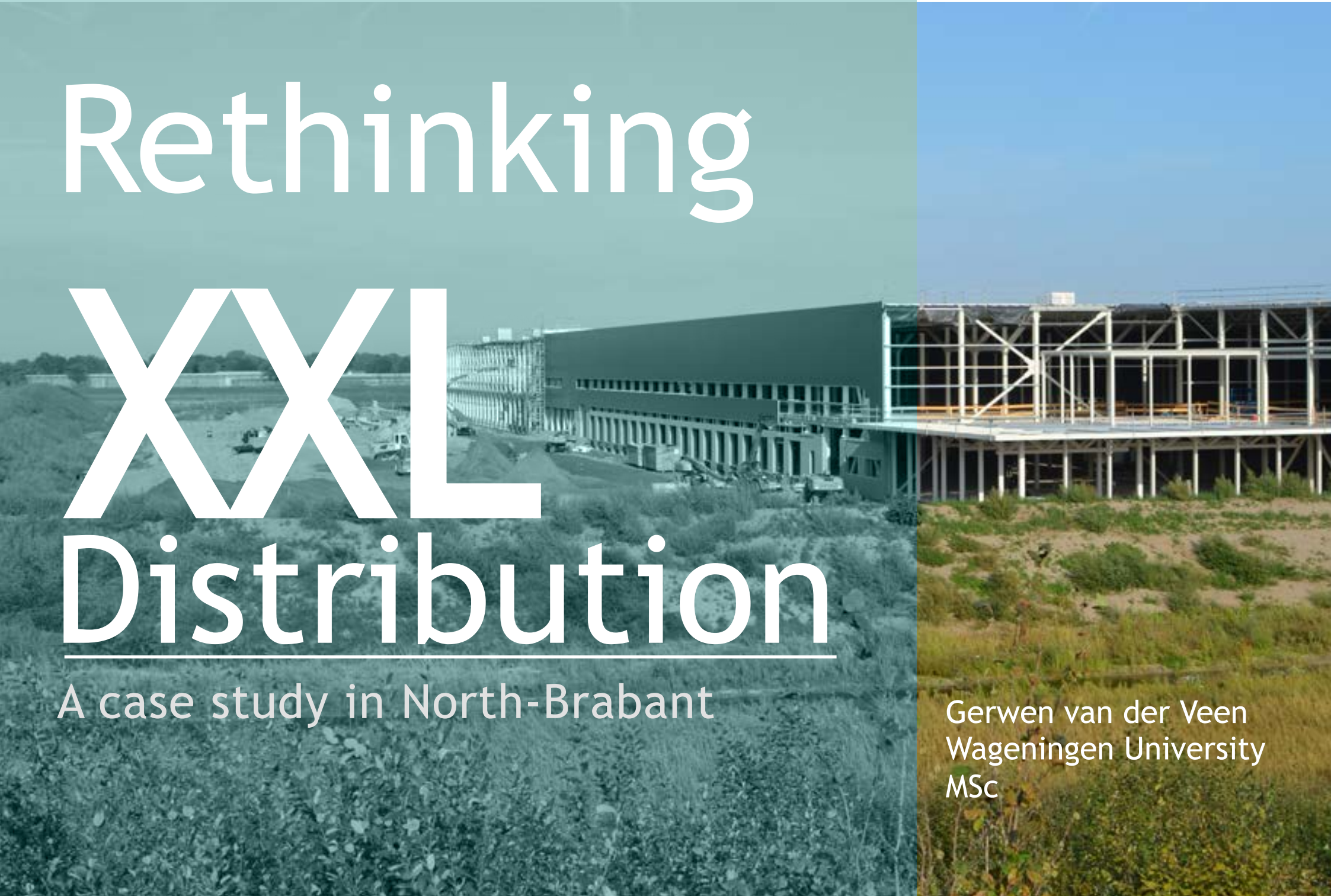
Rethinking XXL Distribution

A case study in North-Brabant



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MSc thesis Landscape Architecture
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Abstract

The rise of the online shopping markets and international trade, has shaped a new man-made object in the Dutch landscape. The appearance of the XXL-distribution centre is a building, which is larger, higher and above all covers a larger surface, in comparison with the regular distribution centre. Buildings are being placed around the cities, the highways and in the landscape. The lack of policies from the central government regarding the positioning of XXL-distribution, is worrying experts and residents. This thesis addresses the development from a landscape architecture perspective, with the following main design question: *What would be the most optimal integration for XXL-distribution in the Dutch cultural landscape between Rotterdam and Venlo?*

The main purpose of this thesis is to explore the combination of logistics positioning criteria and landscape integration concepts. To find a suitable landscape for the positioning of XXL-distribution on a regional scale, different models where tested, based on logistic criteria and the landscape integration concepts, regarding the openness and appreciation. The outcome of this study showed that sand- and peat landscapes are most suitable for the implementation for XXL-distribution, because of their existing vegetation in the shape of tree lines and forests. Open sea clay landscapes are more vulnerable for horizon pollution and are therefore less suitable, because of their openness. To reduce the footprint of XXL-distribution, a more efficient logistic model is developed based on the high bay warehouse. High bay warehouses have the ability to reduce the footprint of the regular distribution centres with 50 to 60 percent, but are exceeding a height of 45 meters. With a compact way of building, more space can be reserved for the integration of the buildings. In the final phase of the thesis a prototype is designed, for the sand landscape nearby Tilburg. By intertwining the landscape with the XXL-distribution a spectacular landscape is created with leisure, work and nature.

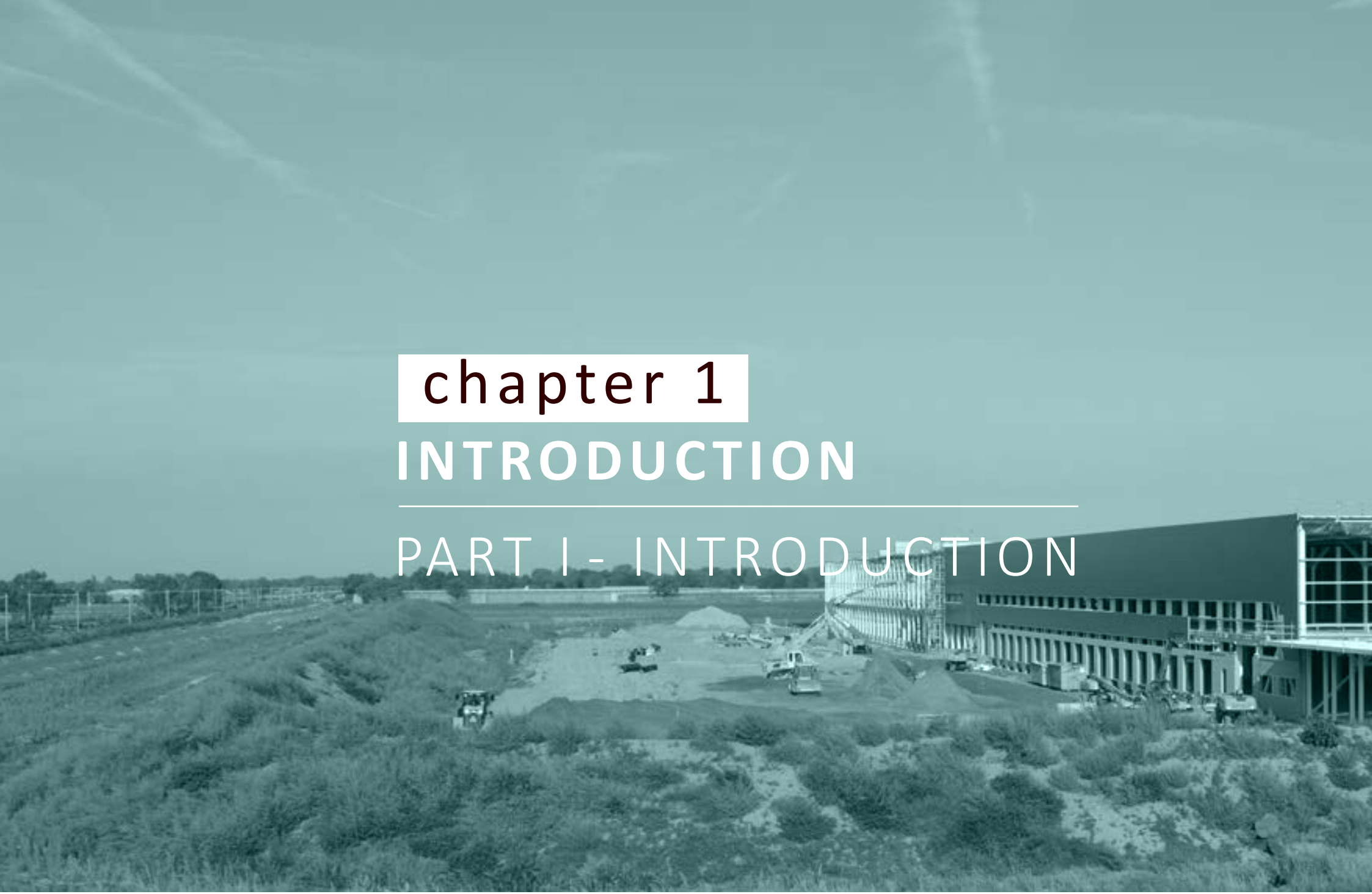
Preface

Before you lies the rapport "Rethinking XXL-distribution, a case study in North-Brabant". This master thesis has been written to fulfill the final phase of the master of landscape architecture.

My heartfelt thanks to my family and friends who supported me during this period. I also want to thank the people who reserved time for interviews, to give me an insight in the world of logistics.

Last but not least, I want to thank my supervisor, Adriaan Geuze. He guided me and inspired me to look for further solutions. Without him this end result would not have been possible.

CONTENT



chapter 1
INTRODUCTION

PART I - INTRODUCTION

1.1 Introduction

Grey massive buildings are popping up in the landscape of the Netherlands. The huge boxes are laying in the landscape along the fringes of the highways. Trucks are constantly moving in, delivering- and taking goods to further destinations. These warehouses are increasing in size and are now called fulfilment centres or XXL-distribution centres (Volkskrant, 2018).

The Netherlands is known as a country of import and export. For its small open economy, the Netherlands holds a high position on the international rankings. It is currently in the top-7 of the Global Goods trade. The land is traditionally international focused and trades mostly with abroad countries (CBS, 2018). Key factor is the Rotterdam harbour, which is the largest sea harbour of Europe. Also called the 'entry point of Europe'. This leading position is due to excellent accessibility via sea and inter modal connections (Port of Rotterdam, 2018). Roughly halve of the imported products which enter the Netherlands are distributed to other countries. Especially the hinterland of Europe is an important trade mark, which is part of the logistic corridor to the Ruhr area. Goods are transported to Germany, Italy, French, England and other surrounding countries.

The ongoing trend of E-commerce is one of the reasons distribution centres are expanding in size. Where in the past the distribution of pallets was the main business, now products are individually stored, packed and send directly to the customer (Buck, 2016). The functions of the physical shop in the shopping street moved to the distribution centre. Built XXL-distribution buildings measure an average footprint of 40.000 square meter. Excluding the necessary space for trucks to manoeuvre and park. In total this means parcels are easy double the size of the building surface. Resulting in a demand for

(Port of Rotterdam Authority, n.d.)

fig 1.1: Connectivity of the Netherlands

(Bol.com, n.d.)

fig 1.2: E-commerce centre Bol.com


(Green port Venlo, 2018)

fig 1.3: Tradepark North, XXL-distribution in Venlo

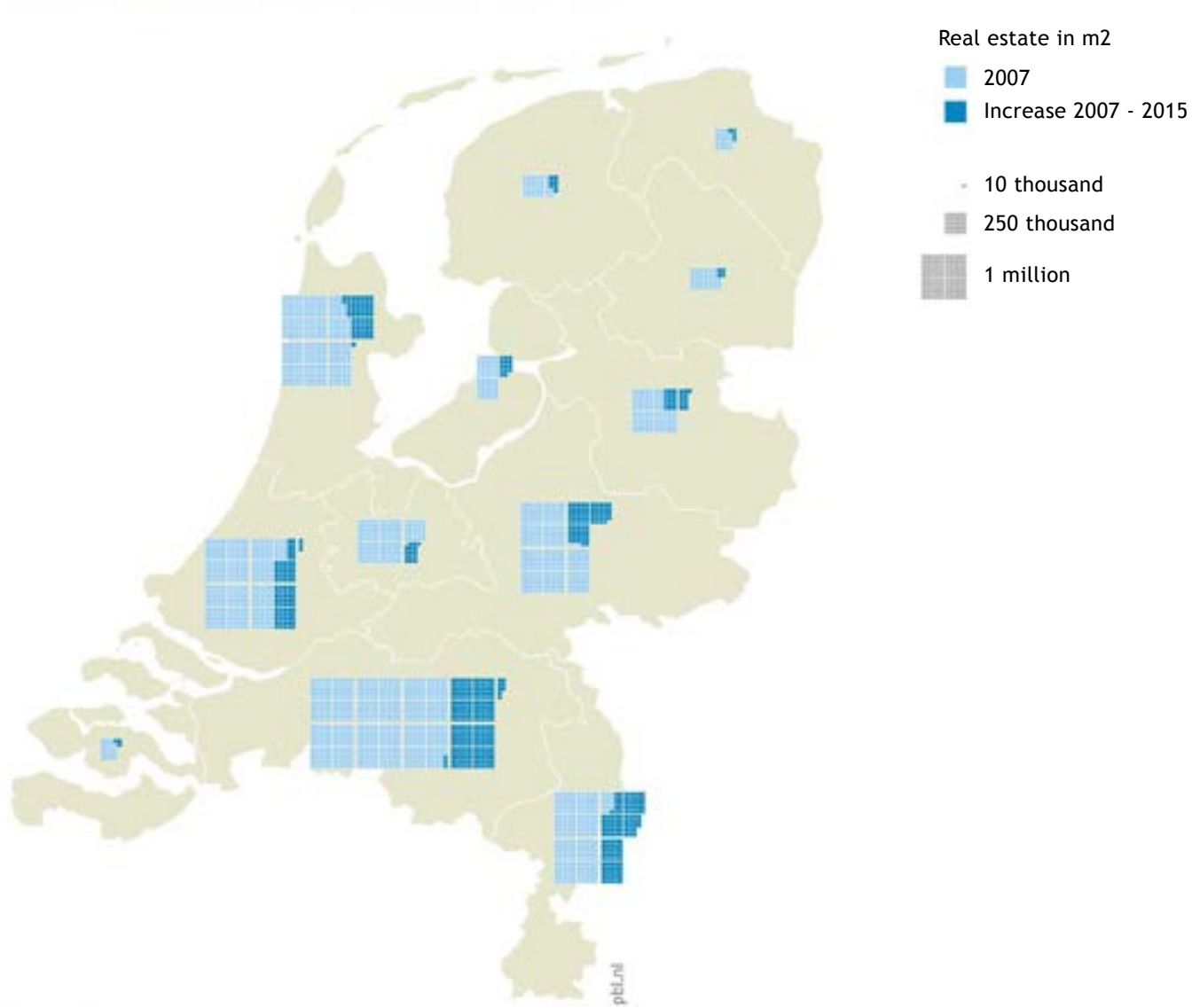


fig 1.4: Logistic real estate per province *(Bak, 2017)*

parcels of 6-8 hectares (Buck, 2018).
Due to the size and lack of large parcels within existing industry areas, new logistic warehouse are being built in the landscape. Transforming major landscapes into logistic hubs. Impacting the landscape experience and the flora and fauna.

1.1.1 Location

For this research the focus will be upon the province of North-Brabant. For a few years the province of North-Brabant distinguishes itself as the logistic hub of the Netherlands (Logistiek.nl, 2018). Brabant is one of the fastest growing provinces with XXL-distribution centres. Since 2013, there are 36 new large distribution centres located in the Netherlands. With a total of two million square meter, 46 percent of them are based in Brabant (Omroep Brabant, 2016). Brabant offers a great accessibility with its central location between Rotterdam, Antwerp and the Ruhr in Germany. Excellent connectivity by roads, trains and boats are attracting European online shops, chain stores, brands and logistic companies (BN de stem, 2018). For this research we will partly include the province of Limburg. Venlo plays a significant role in transport for the Ruhr and competes with cities as Tilburg or Eindhoven.

1.1.2 Problem statement
The ongoing building spree of XXL-distribution is raising the awareness among experts and the population. Because there is shortage of large scale parcels, new plans will be developed to satisfy the hunger of the XXL-distribution monster. By developing these plans there seems to be a absence of a strategic policy on how and where to establish large scale logistic parks from a landscape architecture perspective (Trouw, 2019). Policy makers are driven by the arguments provided by the logistic consultancy offices. These are mainly focussed on strategic locations with good infrastructure connections. Logistic warehouses are rapidly being built in various landscapes (CRa, 2019). Based around the exits of highways they form the new entrances of some of the major cities of Brabant or small villages. The once flat landscape is replaced by large boxes and sound barriers, which enhances the hard edge between the landscape and the city. This process happens on different scales at different municipalities. Some happen quite gradually, starting with the left-overs which are already strangled by infrastructures. Other plans are on a larger scale, for example in Moerdijk, where they are planning to transform the fertile sea clay into a giant distribution park
(Port of Moerdijk, 2018).

fig 1.5: The hunger for large parcels

Second problem are the outdated regulations which are mostly based on the old planning concepts, regarding building heights and cladding materials. The e-commerce sector is changing the logistic sector, driven by innovations in software and building techniques (Moonen, 2018). New buildings are being designed which are totally different in comparison with the buildings of 5 years ago. Third identified problem is the mono-functional use of XXL-distribution. Distribution is mainly focused on storage and cooling of products. At the same time these boxes are covering an enormous surface of the landscape. From a landscape system perspective XXL-distribution is a disadvantage by reducing the water infiltration, increasing the heat island effect and neglecting the energy case.

1.1.3 Knowledge gap
Uncluttered landscapes in the Netherlands are becoming increasingly rare due to implementation of man-made elements. The introduction of wind turbines, highways, industrial sites and business parks are increasing the negative impact on the scenic landscape (van der Wulp, 2009). Economic and political reasoning make it desirable to locate industrial functions in the landscape. Impact could perhaps be minimized by carefully choosing locations, designing the structures to meet certain criteria and taking mitigating measures (Bell, 1993). According to the concepts of Veeneklaas, Donders, and Salverda (2006) the effect of the man-made elements is affected by the landscape. An object in a well-organized and harmonious landscape can be perceived as a clutter free landscape. A more fragmented landscape will be perceived as a negative impact, lacking the coherence. This research is an attempt to bridge the knowledge gap of the implementation of large scale logistics on a regional scale, by combining logistic theory and landscape integration concepts.
1.2 Thesis statement

The thesis statement captures the essence of the intended project and puts boundaries around it. Doing literature research is not the primary goal of this thesis. The thesis focusses mainly on research through design and is therefore design oriented. The data that will be obtained and analysed will contribute to the design assignment. The data is critical to support the intended outcome of the thesis. In this paragraph we go into the objectives, the design question, the research questions and the relation between the research and the design.

1.2.1 Research objectives
The objective for this thesis is to generate a new view on the development of XXL-distribution on the regional scale of the province of North-Brabant. Different models will address perspectives or solutions for the integration of XXL-distribution. The aim for this thesis is to create a positive outcome for the landscape and the logistic market. Therefore, the thesis contributes to the ongoing debate between policymakers, architects, developers and landscape architects about the structuring of the landscape. At the moment the College van Rijksadviseurs (CRa) is concerned with the development and growth of XXL-distribution. Currently they are working on a exploratory research and a research through design study. The results will be published at the end of the summer of 2019 in the form of an advise for the government. This thesis will contribute to this dialogue.

For the thesis there are four specific objectives which will be answered throughout the thesis:

1. Calculation of the growth of the predicted XXL-distribution based on the active policy and reports.

2. Study to shape a more efficient distribution model based on ongoing innovations.

3. Different models formulated for the XXL-distribution impacted by several variables such as the logistics and the integration with the Dutch cultural landscape.

4. One model will be elaborated towards a more place specific and detailed plan.

1.2.2 Main design question:
What would be the most optimal integration for XXL-distribution in the Dutch cultural landscape between Rotterdam and Venlo?

Research questions:
1. What is the current role of the government in the positioning of XXL-distribution?

2. Which factors are contribution to the positioning of XXL-distribution and what can be expected in the future?

3. What knowledge and design tools can be derived from reference projects over the world?

4. How can XXL-distribution deliver collateral benefits to the landscape and/or society?

The first research question will go into the current day policies and regulations concerning XXL-distribution. The positioning of the XXL-distribution is based on the policy of the municipalities. Municipalities are mostly positive on the opportunities of employment and the economic benefits. It is important to get this perspective on the case to highlight the consequences for the landscape. Data will be collected with literature research and in-depth interviews with experts.

The second question is focused on the regional systems. Logistic landscapes have long connections to harbours, city centres and even abroad. To get a wide angle on the opportunities and challenges we are focusing on the route from Venlo to Rotterdam. In this way, the outcome of the thesis will formulate the optimal answer for a efficient implementation of XXL-distribution in the landscape. Data will be collected with literature research, interviews observations and a landscape analysis will contribute to the decision making of the models.

Research question three goes into the reference projects. Depending on different variables such as land availability, prices or policies there are different approaches for the design of distribution centres. In Singapore for example it is more common to build multi-level distribution centres due to high land prices.

Research question four addresses the XXL-distribution parks or buildings which could have a positive effect for the landscape or society. XXL-distribution is currently a mono-functional asset of the landscape, mainly focused on the storage of products. For this research the aim is to take a closer look at the possibilities to combine different functions such as water storage, ecology and energy. This research question will be answered in a later stage during the prototype phase.

1.3 Methodology

For the thesis two methods will be applied. The overall process will be guided by the Creative Process Solving (CPS) method. The CPS method is about expanding knowledge, connecting ideas and connecting ideas to problem statements, functionalities, values and consequences. It is about building a shared understanding (Tassoul & Buijs, 2007). This creative method is widely used within the research field of Industrial design in Delft. The method is structured in three 'diamonds' which describes the creative process (fig 1.6).

Diamond 1 – The first diamond is formulating different problem statements. Statements can be combined due to similarity and overlap. Defining the right problem statement opens the debate about the right direction. Analysis are necessary to get a more systematic view and understanding of the issues at hand (Tassoul & Buijs, 2007). After completing the first diamond the problem statement should be clear and the thesis proposal finished.

Diamond 2 – This phase is used for formulating ideas. By encouraging the weird and strange, a wide field of options or solutions to respond to the problem statement are created in phase one. After expanding and stretching the options, the options will be structured. This is called clustering and basically includes the structuring of the ideas with or without the involved stakeholders. Clustering can be done with groups or individual by selecting the overlapping ideas or ordering it in a group or theme, with the aim to define a pattern or guidelines for the design (Tassoul & Buijs, 2007).

Diamond 3 – The third diamond differs in process from the earlier two. This phase is more about the design and development. Still major details need to be thought trough, but this is not about generating options at random, it is more a design job. In this phase the design will be specified to one area. The models will be matched with the real world and will result in one prototype (Tassoul & Buijs, 2007).

Besides the CPS method there will be an overlap with the Research Through Design method (RTD). This method describes how designing can be deployed as a design instrument. RTD can be done using the four different knowledge claims of Creswell (2009). The 'Constructivist' claim is applicable in this research. The Constructivist view will be used in the second diamond and the third diamond (Lenzholzer, Duchhart & Koh 2013).

Additional methods are used to contribute to the CPS and RTD method to find the right information to answer the research questions. These are shortly explained bellow.

Landscape analysis
For this research a landscape analysis is made on different scale levels. First there will be a large analysis on the regional scale level between Rotterdam and Venlo focused upon the current infrastructures (rails, water and roads) and the geomorphology and soil types. This way of analysing is called the triplex model and explains the interaction between different landscape layers such as the division between the anthropogenic, biotic and abiotic layers. This information will be used for developing the models and finding the right locations for the positioning of XXL-distribution. In a later stage a more detailed analysis will be made for the elaboration of one model. Knowledge regarding the interviews with experts will be shared with Joran Lammers, who is working on the same thesis topic.

Observations
This thesis topic has a relation with the visual experience. Large boxes have an impact on the experience from a close and a long distance. Therefore, pictures and notes will be made during field trips, to document the landscape with its positive and negative sides.

Literature research
Basic preparation for this thesis is the literature research. Literature frames the research in a wide context and establishes the importance of the study. Past research experience helps to test a theory or hypothesis and therefore makes a growing accumulation of findings leading to new research direction (Creswell, 1994). The literature research will be necessary to familiarize with the current policy's regarding the topic of distribution areas. For example, the book Planning van Bedrijventerreinen provides a decent background perspective on the current day planning process. Literature research will also be used to construct the theoretical framework and methodology.

Interviews
Semi structured interviews and open interviews are held with experts and possible locals during field visits. Semi structured interviews with experts from fields such as mobility, logistics and planning make it possible to gain an in-depth grip of the current situation.

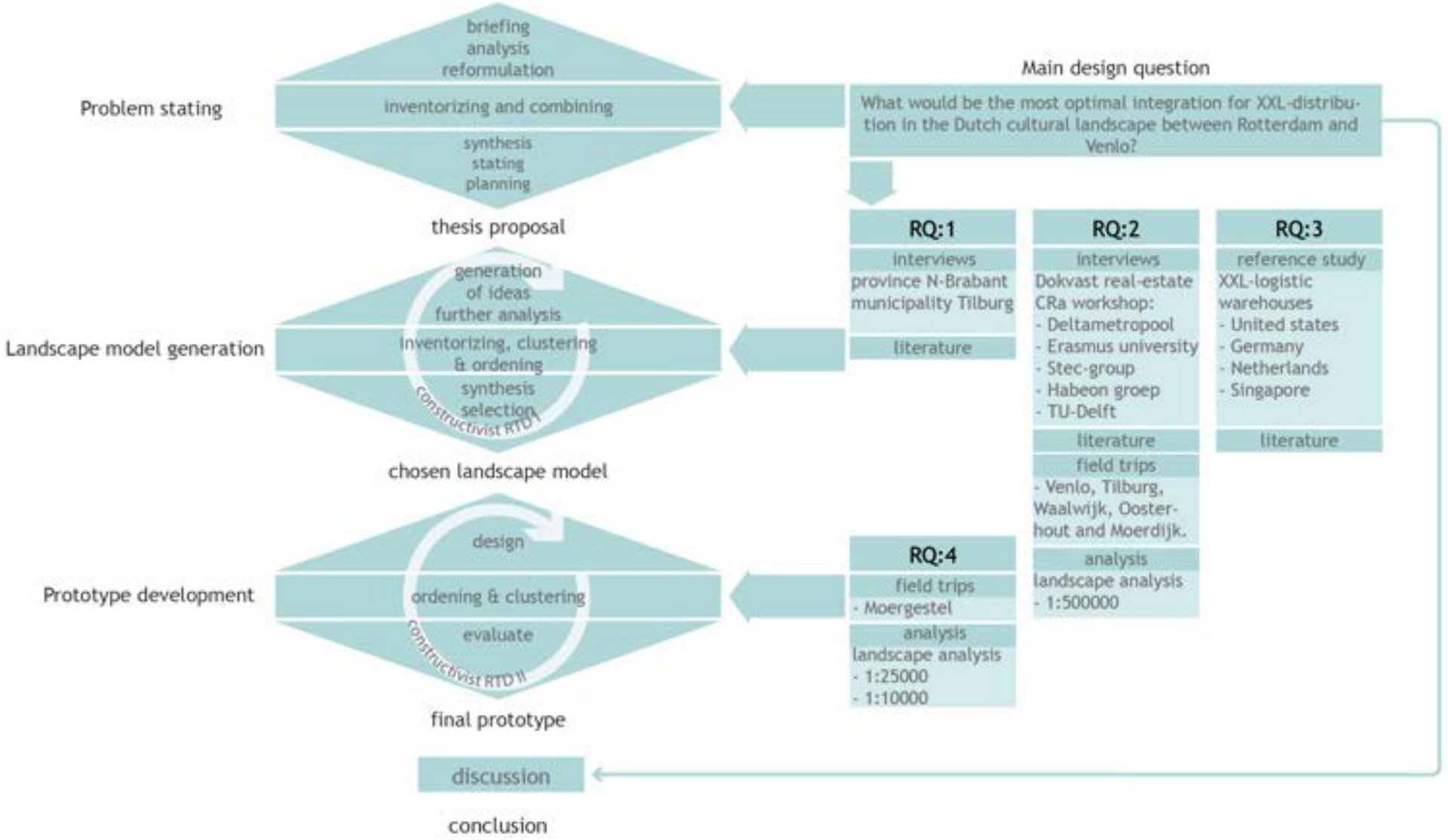


fig 1.6: Methodology model (Tassoul & Buijs, 2007)

1.4 Theoretical framework

The theoretical framework frames and provides the theoretical lenses for this research. The thesis combines the fields of landscape architecture and the logistic sector. From a landscape perspective the theoretical lens is shaped by the ongoing debates and processes regarding the cluttering and integration of objects in the landscape. The theoretical lens with the logistic point of view is described by the positioning criteria.

Landscape approach

The approach for this research for practicing landscape architecture can be defined as design as synthesis by Crewe and Forsysth, 2003. Crewe and Forsysth presented six typologies of landscape architecture approaches. Most applicable for this thesis is the design as synthesis, which is used for site planning. This is about integration problem solving by research and design, influenced by natural and social science (Crewe and Forsysth, 2003).

Integration

Landscape integration is commonly used for landscape design and can be defined as: "making someone or something become part of a whole". The subordination of one part to the whole entails understanding integration in the sense of adaptation. Landscape integration, so understood, constitutes an intervention strategy in the territory which aims at channelling the transformations of the landscape or correcting the ones which have been already carried out, into adapting them to the landscape used as a reference. More precisely, it would consist of adjusting an object or territorial action to the physiognomic characteristics of a given landscape, or some of its components (Rodríguez & Martín, 2011).

Landscape cluttering

The term 'boxing' (verdozing) of the landscape is a new term used in the field of planning and landscape architecture in an article of the Volkskrant from the 18th of May. The term 'boxing' which is defined by Taalbank as the "the tendency to centrally position large rectangle buildings along the road network for the storage and distributional of goods" is worrying experts and landscape architects like Adriaan Geuze (Volkskrant, 2018). This term is however not a new phenomenon and can be placed under the umbrella of landscape cluttering. Landscape cluttering seems to be close related to the Dutch landscape and received attention on a public and political level (Ministry of VROM, 2006). In 2000 even the Dutch government invigorated this by stating it as policy goal to achieve 'a beautiful country to live and work in' (LNV, 2000). The way a landscape is perceived as an unspoiled landscape is embedded in various literature studies. Landscapes with an agricultural function and a characteristic biodiversity can guarantee on a high appreciation by residents and visitors (Coeterier, 1996, Willis and Garrod, 1992). Agricultural functions are related to the historical landscape with their own characteristic landscape elements. (e.g. Coeterier, 1996, Gulinck and Wagendorp, 2002, Soane et al., 2012, Veen et al., 2009). The introduction of man-made elements such as wind turbines, large agricultural buildings and industrial and commercial areas are affecting the quality of the landscape. (Van der Wulp, 2009a). The impact of the man-made objects is however depending on the coherence within the landscape. Landscapes which are more organised and harmonious are more likely to be more appreciated, even with man-made elements. Landscapes which are fragmented are more likely to make no sense to the viewer (Veeneklaas, Donsers, and Salverda (2006). This aspect overlaps with the concept of disturbance by Tveit, Ode, and Fry's (2006). This are most often man-made object, which stands out because of a possible distinction from other elements in the landscape in terms of size pattern, shape style, texture or colour. Elements with a historic or regional value are often contributing towards the attractiveness of a landscapes so called landmarks. This is in most cases not counting for distribution parks.

The degree of cluttering can be reduced by taking mitigating measures like adding vegetation or selecting a specific type of landscape. The visibility of the object in the landscape is depending on existing vegetation and size of the object. Distance between the element and the observe influences the impact of the element. Also the distance impacts the extend to which an element is visible and dominates the view (Domingo-Santos, de Villarán, Rapp- Arrarás, & Corral-Pazos de Provens, 2011; Torres Sibille et al., 2009).

Photographic imagery research showed that a business park has a negative impact on the scenic beauty. Only when the distribution parks were placed far away and in combination with mitigating vegetation the negative impacts where limited (De Vries, De Groot, & Boers, 2012). Landscapes with an open character are more vulnerable for man-made elements (Meeuwsen & Jochem, 2011). Distribution parks are standing out more easily in an open landscape (RIVM, 2008). Therefore we are combining the landscape appreciation maps with the visibility maps. Taking into account that the landscape valuation gives an idea of the valuable landscapes and the elements affecting it (Crommentuijn, Farjon, Den Dekker, & Van der Wulp, 2007). By overlapping these maps, an attempt will be made for the positioning of XXL-distribution parks on a regional scale without cluttering the landscape.

Dutch cultural landscape

"Cultural landscapes reflect the interactions between people and their natural environment over space and time, A cultural landscape is a complex

phenomenon with a tangible and an intangible identity. The intangible component arises from ideas and interactions which have an impact on the perceptions and shaping of a landscape, such as sacred beliefs closely linked to the landscape and the way it has been perceived over time. Cultural landscapes mirror the cultures which created them" (Plachter & Rössler, 1995).

Positioning theory
This theory illustrates the criteria for the positioning of companies. This will be used as background information to understand the current existing situation.
The oldest ideas for location prediction for companies can be derived from the (neo) classical location theories. In this theory the company is the central focus point. The optimal location of the company can be calculated on the basic production costs and the transportation costs. The production cost will differ from location to location due to the differences in the main costs of the most important production factors, natural resources, labour, and capital. The neoclassical theory resulted in concepts as clustering, grow areas, multipliers and agglomeration-effects (Louw et al., 2009).
The behavioural location theory is the counter balance of the classical theory. The entrepreneur is the central focus point, he has his own ambitions and personal preferences for the position of his company. According to the behavioural location theory, the positioning of distribution parks in between the highway junctions can be explained from the perspective of reputation and status. Also, the layout and atmosphere of park management (quality of distribution parks) and concepts as city branding and city marketing play an indirect role in the emotional and personal driving forces for entrepreneurs (Louw et al., 2009).

The institutional location theory focusses upon the influence of multinationals, technical development and the national government on the regional development. The location of the company is according to this theory based on an investment strategy of large companies with several branches in a regional system. Within the company the internal processes play an important role together with the regional economical processes. The focus is upon the region scale topics like innovation and knowledge, research and development (Louw et al., 2009).

XXL-distribution
XXL-distribution can be defined as buildings with a surface of more than 40.000 square meter. The centres are dominated by retailers and on-lines shops like Primark, Action, Wehkamp, Lidl and bol.com. Also, brand owners like Tesla or Michael Kors and logistic companies like Rhenus and Schenker can be defined as XXL-distribution (Consultancy, 2016). Other terms which are used are: mega distribution, fullfilment centers, large scale logistics and XXL-warehouses.

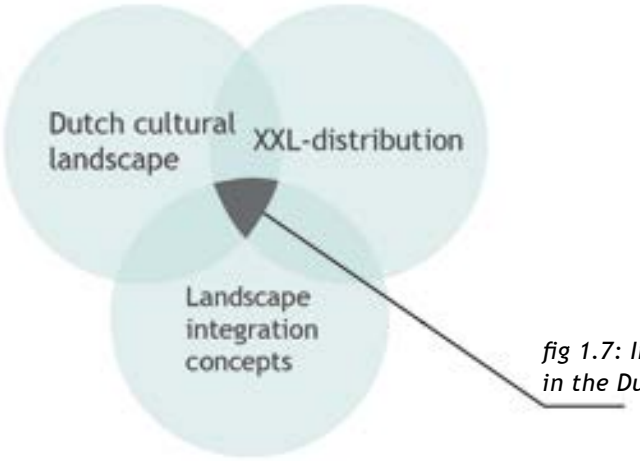


fig 1.7: Integration of XXL- distribution in the Dutch cultural landscape

chapter 2

LOGISTIC LANDSCAPE

PART II - RESEARCH AND RESULTS

2.1 Type of logisitics

Within the logistic sector three types of markets can be distinguished: retailers on a regional level, retailers on a national level and retailers and logistical suppliers on a international level (Logistiek.nl, 2008, Manyika et al, 2012).

Regional retailers

Retailers on a regional level are distributing goods from a central location. Most retailers are food suppliers like wholesale companies or the common grocery brands. Due to the vulnerability of goods it is necessary to have distribution centres spread out over the country, covering a number of stores. The distribution centres are storing goods under cool temperatures and are positioned in a close proximity of a highway junction. The rise of online grocery shopping is leading to a growth of distribution centres. Albert Heijn already has several smaller hubs located at the edge of the city. Trucks are unloading the goods from the distribution centre. Smaller electrical vehicles suitable for neighbourhoods are delivering it directly to the customer (Logistiek.nl, 2019a).

National retailers

Retailers such as Ikea, Action, and Bol.com are strategically placed in the centre of the Netherlands with one main distribution centre for the hole country. Those retailers develop their own buildings because they have specific preferences, which differ from the more standard logistic box, although this is mostly visible on the inside of the building. Products are defining the layout of processes to be stored in the most efficient way.

International companies

Companies which are operating on an international level are mostly brand owners such as Wehkamp and Michael Kors. As displayed by figure 2.2 a large portion of these companies is located in the south of the Netherlands. These companies are buildings logistic hubs to distribute their clothes for the (north-west) European market. Products are made in different parts of the world, for example China, and are therefore depending on transport by boat or plane to the Netherlands. A recent development of a new player entering the market is the clothing company Zara. They are opening a new distribution centre in Lelystad of 35 hectares. Clothes are transported from China by air freight to Schiphol airport and further distributed to the rest of Europe (Omroep Flevoland, 2017).

Mail order firms or logistic suppliers are specialising on the transport of the distribution process. Companies like DHL or Rhenus are large companies with an international logistical network with personal distribution centres. Ordered goods are moving 24/7 over the world by air freight, boats, rails and on the road.

fig 2.1: Regional distribution (Stec-group, 2018)

fig 2.2: National distribution (Stec-group, 2018)

fig 2.3: International distribution (Stec-group, 2018)

2.2 Positioning criteria

What makes the Netherlands so attractive for distribution? The following criteria were based on literature and interviews.

Location

First of all, it is important to state that the position of Brabant is unique within the Netherlands. Located between two deep sea harbours of Antwerp and Rotterdam there is an excellent linkage to the world trade market. Also the close proximity to the German Ruhr with a population of 5.1 million inhabitants makes it a strategic location in the logistic landscape (RVR, 2018). Cities as Tilburg and Venlo embraced there logistic role by branding themselves as a logistic hotspot. The municipalities are eager for new distribution.This proces has been going on for a couple of years, which is recognized on a global level (Bn, 2018).

Tax benefit

Countries are competing with each other to attract large companies. Quite recent the prime minster tried to convince online web shop Alibaba to position in the Netherlands for European distribution.
The Netherlands distinguishes itself from other countries with a tax systems which is interesting for companies who store a lot of goods. Taxes only have to be paid after delivering the goods to the buyer (Volkskrant, 2018).

Low interest

Distribution centres are an interesting real estate sector for investments. The low interest results in low development costs and is in combination with low ground prices a safe market with high profits. In 2017 a total of 1.8 billion Euro was invested in this type of real estate segment. This is an increase of 30 percent in comparison with 2016 (NVM, 2017).

Accessible infrastructure

For markets as logistics, wholesalers and factories an excellent accessibility via road and water is crucial for a fast and efficient transport on a regional and international scale. These sectors are depending on a lot of truck movements. Routes should be free from obstacles to maintain a constant traffic flow. Crossings or roundabouts will delay the supply-chain (Stec, 2015).

Sea harbour/airport connections

Sites close to a sea harbours or airports are popular places for companies who distribute goods. The availability of space in these areas is actually a problem. Ports and airports have become more and more surrounded by urbanisation. Schiphol is for instance interesting for air freight transport, but is based in a dense area with a lot of conflicting interests. Land prices are extremely high and space is scarce. Ports also have designated zoning plans

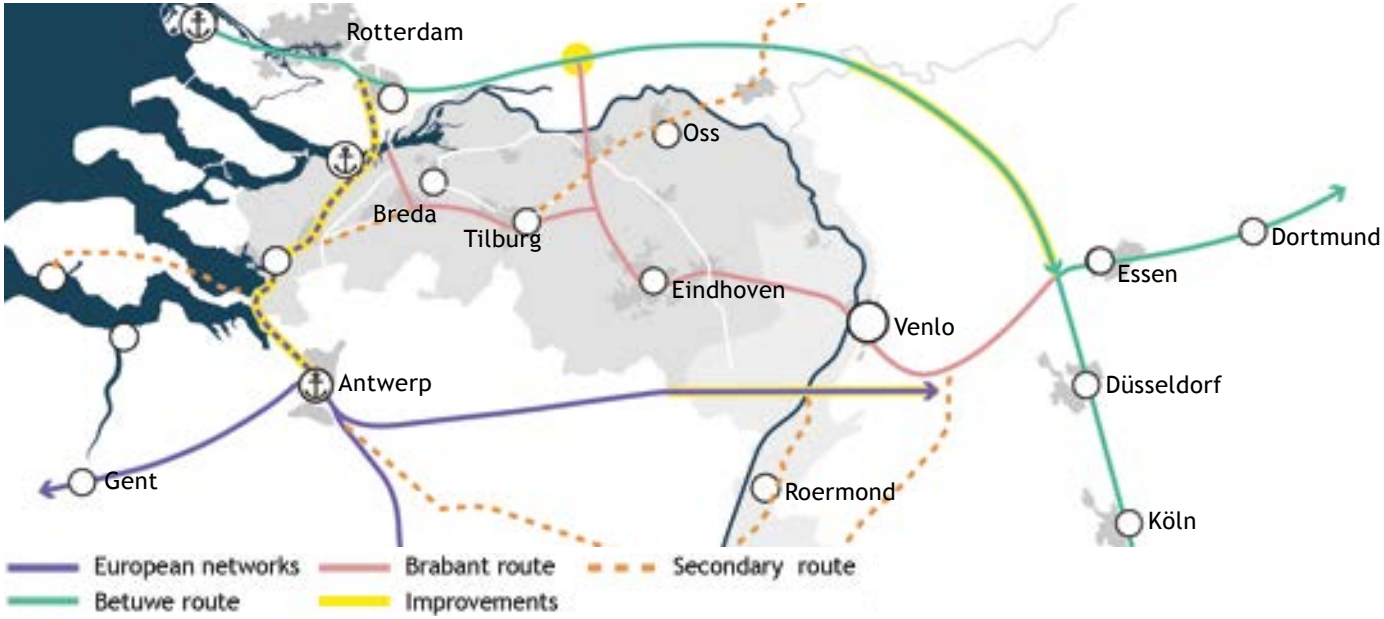


fig 2.4: Trade position of North-Brabant

(NOS, 2018)

fig 2.5: Prime minister in conversation with Alibaba

which only offer space for water related industries. On the Moerdijk port is for instance still space available but reserved for chemical industries. Unless the high ground prices often logistic suppliers like UPS and DHL are located along the airports (Sec-group, 2012).

Multi modal connections
Multi modal connections stands for more than two transport modalities, like train, road or boat. The province North-Brabant has a dense network of terminals, almost every terminal can be reached from an industrial park within 15-20 minutes. According to the prognosis of 2014 the transport via rail and water will be doubled in 2020. The development of bigger inland terminals illustrates the importance of the channels in Brabant. Multi modal connectivity is especially interesting for companies with large volumes, which includes XXL-distribution (GVT, 2017; Stec, 2015).

Labour market
Before XXL-distribution retailers are settling on a location, analysis will be made on the availability, size and quality of the labour in an area. Industrial sites located in areas with a low potential of labour have a negative effect on the positioning criteria. Companies which are already based in a region are inclined to relocate no more than 15 kilometres from their original location. The mobility of employees is limited especially when low educated, which is the case for most of the employees on an industrial site (Stec, 2015).

Market
As already mentioned in the previous paragraph each company focuses upon its own market. Companies based in Venlo are more oriented towards delivering goods to Europe. Companies based in Tilburg on the Netherlands, but could also deliver to Europe. Distances are short in the Netherlands and Brabant has a close proximity to France and Germany.

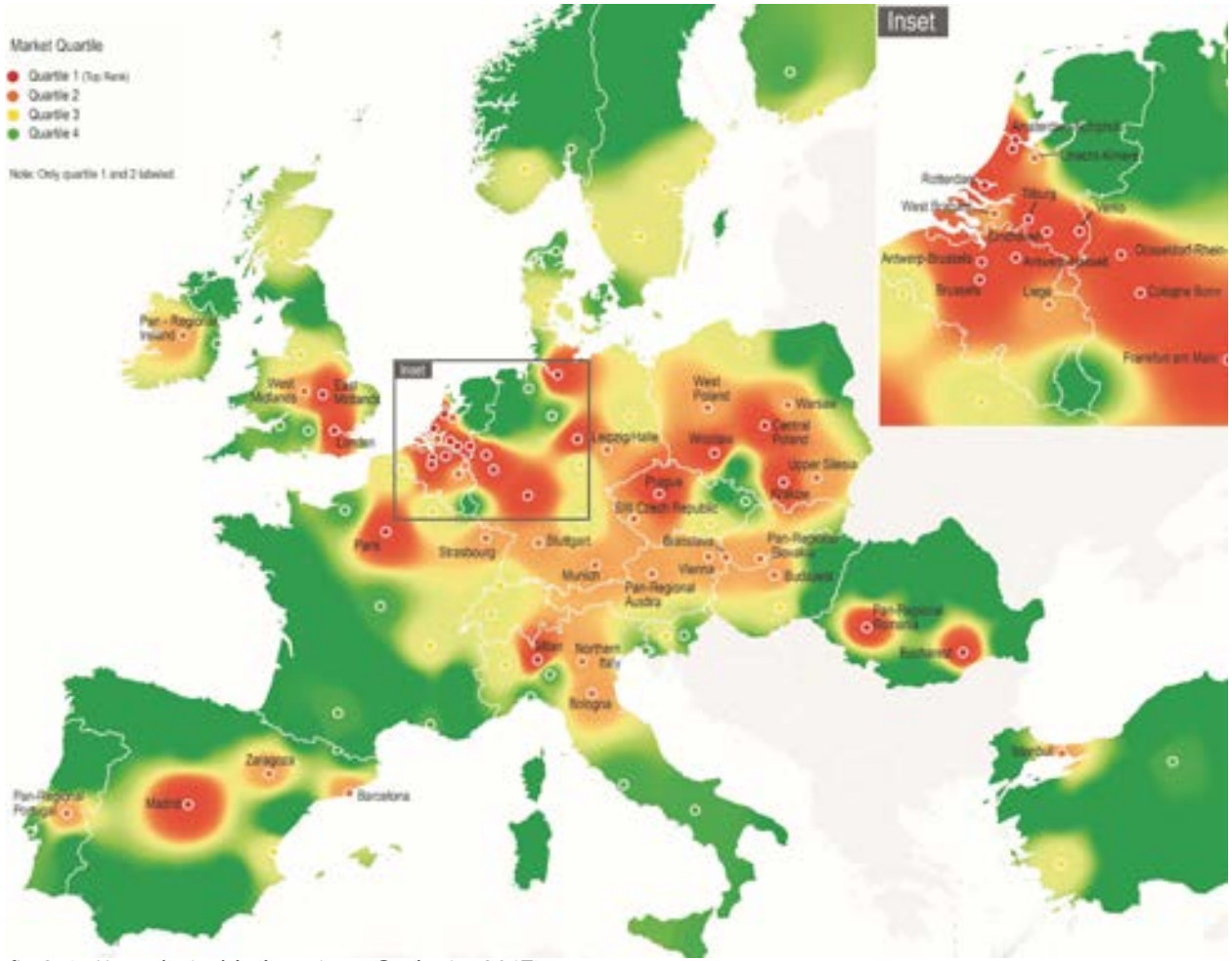


fig 2.6: Most desirable locations (Prologis, 2017)

Public transport
The connectivity for a company to a public transport network is an additional benefit. It is however not a crucial point for the positioning of XXL-distribution (Stec, 2015).

2.3 Role of the government

In the Netherlands the government can be divided into three structures: The central government is based in The Hague, the province North-Brabant in 's-Hertogenbosch and at last we have the municipalities. This paragraph describes the role of the government regarding XXL-distribution.

The central government

At the moment there are no policies on XXL-distribution by the central government. Infrastructure however is a valuable criteria and is indirectly connected to the positioning of XXL-distribution. The Ministry of Infrastructure and Water Management aims to guarantee upon the quality of accessibility, with a decent traffic flow in a clean and safe environment (Rijksoverheid, n.d.). One example of their projects is reducing the traffic bottlenecks on the A2 and the A58. These highways experience regular congestion of traffic what affects the national and local economies.

The A58 is an important logistic axis that connects the Rotterdam harbour with the harbour in Antwerp and the Ruhr area. One fifth of the total traffic consist of trucks moving goods. To maintain its logistic role in the future, the Ministry of Infrastructure and Water Management proposed together with the province to add a third lane to the road (Rijkswaterstaat, 2018). Innovative pilot projects are stimulated by the government like self-driving vehicles or platooning, which is currently tested on certain parts of the A58 (Omroepwest, 2018).

Province North-Brabant

The province has a facilitating and advisory role for the regions and the municipalities. The province is responsible for the planning, economy, environment, mobility and culture. Every couple of years the province publishes a document called the Structure vison. This document addresses the spatial and functional developments of the province. For example, new extensions for cities in the shape of industrial- or residential areas (Province North-Brabant, 2014). To be more specific, the province is divided into four regions: west, middle, north- and souteast (fig 2.7). Within these regions provinces, municipalities and water boards are making policies about the spatial development. Arrangements are made considering the development of housing, offices, retail, industrial parks and the landscape (Province North-Brabant, 2017).

Relevant for this research is the perspective from the province on industrial sites. This is a document alongside the Structure Vision, the province envisions the development of industrial parks for the coming years. Goal is to guarantee an overall quality, accessibility and good integration in the environment. Companies must profit from each other on a local and regional level. On a regional level the province has to make sure that there will be enough and diverse locations for companies to settle (Province North-Brabant, 2009). The following tasks are executed by the province to formulate a thought through policy for the short and long term regarding industrial parks:

Prognosis

With a prognosis the province calculates the growth for a period of 20-30 year for industrial parks of North-Brabant. Prognosis are executed every four years by an external company. The study is based on the expected economic growth, the employment in different economic sectors combined with the space companies need (Province North-Brabant, n.d.).

Monitoring data

Industrial parks are monitored on variable aspects: the development of sold parcels, the growth, the vacancy of buildings and deteriorating industry parks. If necessary the province could take action to restructure industry parks. Data is also used to inform companies, citizens and the government (Province North-Brabant, n.d.).

Collecting knowledge

The province needs to know the development of the industrial park for the future and wants to map these consequences for the provincial policy, for example for the structure vision. Research will be done on the trends regarding the industrial parks. The province also supports together with the government pilot project with subsidies to investigate new directions.

The municipality

For the role of the municipality we are focusing on the tasks which are regarding the industrial parks. The municipality consist out of the local council which represents the population within the border of the municipality. The local council is making sure that the interests of the residents and companies are served.

The municipality tasks consist of the creation of the zoning plans and defining which areas are suitable for nature, houses or industrial parks. By buying up farmers the countryside around cities can be development towards a new destination. Before selling the parcels, the area is developed with a road system, drainage lines and a ditch system. These developments can be risky if the demand for parcels stays behind. This happened for some municipalities during the crisis. Besides providing the areas, the accessibility towards a industrial park is an important task for the municipality. If necessary roads are developed between the highway junction and the industrial park (Rijksoverheid, n.d.).

2.4 Expected growth

The predicted growth of XXL-distribution is based on the prognosis of the province of North-Brabant. After four years the province publishes a document with the expected growth of the industrial locations. After one year new rearrangements are made for the regions to accommodate space for the industrial parks till 2040. This thesis is based on data from the 'Kwalitatief verdiepingsonderzoek bedrijventerreinen Noord-Brabant' by Stec-group (2015).

The growth of industrial parks is determined by the terrain quotient method. This method consist of three parameters: the development of employment per sector, the amount of jobs which settle on a industrial park and the space use per employee. These components are specified by region and industry sector. Developments regarding the parameters show that in the traditional sectors like industry, construction, trade and logistics continue to prefer a location on an industrial park. Large scale logistics is depending on a lot of truck movements, integration is therefore difficult within the inner city. Another development is the space use per employee, which continues to grow due the inventions of automation and robots. Less people are more productive.

To establish whether there is a need for new industrial parks, it is necessary to look at the current availability of parcels and their locations. Stec-group defined criteria specific for the industrial sectors and tested if the available parcels are suited for it specific function. For this report the illustrated data will be focussed upon the locations which are suitable for XXL-distribution. Some of these parameters are size, since parcels have to be bigger than 5 hectares and have a good connectivity. All the tested locations can be find in the report of Stec-group (2015).

fig 2.7: Regions of North-Brabant

Prognosis regions	west	middle	northeast	southeast
Expected growth industry parks till 2040 (ha)	340	195	110	160
Of which large-scale logistics and warehouses (ha)	250	130	95	120
Total growth large scale logistics for 2040 (ha)	**595**			

fig 2.8: Prognosis regions (Stec-group, 2015)

Available parcels per region (ha) (> 5 ha)	west	middle	northeast	southeast
Zeehaven Moerdijk	7			
Noordland (Bergen op Zoom)	14.5			
Vossenberg West II		41.49		
Vorstgravendonk			47.7	
De Rietvelden			21.5	
Doornhoek			18.34	
Kempisch Bedrijvenpark				40
Eindhoven Acht				53.6
total (ha)	244.13			

fig 2.9: Available parcels (Stec-group, 2015)

Shortage regions	west	middle	northeast	southeast
Growth large-scale logistics and warehouses 2040	250	130	95	120
Available parcels per region (ha) (> 5 ha)	21.5	41.49	87.54	93.6
Shortage (ha)	-228.5	-88.51	-7.46	-26.4

fig 2.10: Shortage regions (Stec-group, 2015)

Proposed areas for development per region (> 5 ha)	west	middle	northeast	southeast
De Ster (Bergen op Zoom)	15			
Voet Bavelse Berg (Breda)	10.86			
Logistiek park (Moerdijk)	142			
Auvergnepolder (Bergen op Zoom)	65			
Zwaluwenbunders (Tilburg)		23.2		
De Wildert (Dongen)		12		
Wijkevoort (Tilburg)		80		
Haven I - VI (Waalwijk)		27		
Haven VIII fase 1 (Waalwijk)		42		
Haven VIII fase 2 (Waalwijk)		56		
Foodpark de kempkens (Veghel)			23.3	
Heesch-West (den Bosch)			57.2	
Heesch-West (den Bosch)			47.8	
Foodpark de kempkens (Veghel)			42.4	
De Brand II (Den Bosch)			7	
GDC Eindhoven Acht				8.5
BZOB bos (Helmond)				13.67
Westfields (oirschot				10
Duurzaam industriepark Cranendonck				90
Rode ladder (Best)				20
total of regions	232.86	240.2	177.7	142.17
total	**792.93**			

fig 2.11: Proposed areas for development (Stec-group, 2015)

Prognosis

The prognosis shows a growth of 805 hectares of industrial parks till 2040. 595 Hectares (74%) consist of large scale logistics (5 ha or bigger).
The current availability of 244 hectares is not enough to accommodate the expected growth. The scarcity of parcels is a serious issue if the growth of XXL-distribution wants to proceed. Proposed areas to match the growth development show an oversupply of plans at various location spread out through North-Brabant (fig 2.11).

Region West-Brabant

The cities Bergen op Zoom, Roosendaal and Breda are situated in region west. The quantitative prognosis shows a need of 340 hectares of new industrial parks. Most part of the growth will occur in the first ten years. The growth will stabilise after 2030 with an exception for the sector logistics and warehouses. With a total of 250 hectares the large scale logistics is the biggest growth sector. The available parcels for large scale logistics are scarce with only two suitable locations, in Bergen op Zoom and the port of Moerdijk with a total of 21.5 hectares. The development of plans like Moerdijk Logistic Park with a size of 142 hectares, remains uncertain. Protest and obstructions with the council of state are bringing the planning to a hold (Stec-group, 2015).

Region Middle-Brabant

Region middle is the smallest region with cities as Tilburg, Oosterhout and Waalwijk. The prognosis shows a need of 195 hectares of new industrial parks. Of the total 195 hectares, 130 hectares are expected by large scale logistics. Similar to West Brabant there is a need for new industrial parks due to the scarcity of large parcels. Industrial park Vossenberg in Tilburg is the only location who offers the positioning of large scale logistics. Expansions of current industrial parks in Waalwijk and Tilburg have

the potential to locate large scale logistics in the future with a total of 240.2 hectares.

Region Northeast-Brabant
The region Northeast-Brabant consists of the cities 's-Hertogenbosch, Oss and Veghel. The quantitative prognosis shows a need of 110 hectares of new industrial parks. 95 Hectares are consisting of large scale logistics. Locations are necessary to facilitate large scale logistics. Three locations are suitable for implementation of large locations with a total of 87 hectares spread out across the earlier mentioned cities. This part of North-Brabant almost fulfils to the expected growth of large scale logistics.

Region Southeast-Brabant
The prognosis for Southeast-Brabant shows a need for 160 hectares of new industrial parks. Major part of this expansion consists of large scale logistics of 120 hectares. Available locations are around Bladel and Eindhoven with 93.6 hectares. Although Eindhoven has a strong identity on high-tech and education, apparently it also focuses on the large scale logistics. The Eindhoven 8 area is labelled as logistic location and really suitable for large scale logistics, according to Stec-group (2015).

Conclusion
The comparison of both the growth of industrial parks and the available locations shows a total need for 350 hectares of new XXl-distribution or large scale logistics. New proposed plans are totally adding up to almost 800 hectares of plans. This may look strange, but municipalities are reserving more spaces in order to still be able to facilitate a higher demand. Often municipalities are competing with each other to attract a large logistic player. It is difficult to estimate the growth of industry parks. For this study we are calculating with 550 hectares. The available parcels are not taken into account in this research because it remains unclear if these are already filled in or properly integrated in the landscape. It also gives us the freedom to make a visible difference on a regional scale and to propose options for the short and long term.

2.5 Trends

Developments in innovation and technology are changing the way we live. Digitization is making things easier, we can order things from the couch. The consequences for companies extends to the re-shaping of the storage space, internal processes and longer networks. To get a grip on the current developments we shortly highlight the most important developments.

Automation and robots are becoming a more common phenomena in large scale logistics. Repetitive tasks can easily be replaced by robots and are a benefit towards efficiency and a higher production on the same surface. With the economic growth the lack of labour also forces companies to switch to automation. However, logistics will still be depending on labour during peak hours. (Stec-group, 2018; Moonen, 2018; Consultancy.nl, 2017)

Distribution buildings are becoming higher. In the eighties and nineties the building heights were 8-10 meters. Nowadays buildings have a standard height of 14 meters. New modern E-commerce buildings are reaching up to 20 till 40 meters. New flexible robot systems allow higher storage units (Buck, 2018; Stec, 2015).

Higher buildings allow opportunities for multiple floors. Distribution buildings are no longer storing products but also processing and packaging it. These added functions take up a lot of space. Depending on the availability of the space of the parcel these functions are positioned on multiple floors (Buck, 2016b; Buck, 2018b; Stec-group, 2018).

E-commerce is one of the most important drivers for the growth of the logistic real estate market. Online shopping is not only interesting for web shops. Also established brands with a physical shop are switching to E-commerce. The combination of online shopping and shops in a shopping street are necessary to survive as a retailer (Emerce, 2019; Buck, 2016b).

Sustainability is important for the logistics because of its energy use. Industrial parks are responsible for 20% and 25% of the energy usage in the Netherlands. The first steps towards an energy transition are made. More and more companies are applying solar panels to their roof. It is still uncertain when the change to electric or hydrogen vehicles will happen (Stec-group, 2018; logistiek.nl, 2018b).

Clustering large scale logistics improves the flexibility and efficiency. Within the companies it is possible to exchange staff during peek hours or quiet times. Clustering is also helpful for the supply chain. Often E-commerce is clustered with a mail order company and transport companies. Larger industrial parks share facilities like tank- or service stations and restaurants (Stec, 2015).

2.6 Logistic dimensions

The type of logistic buildings can be differentiated in two categories: the more standardized buildings and the custom buildings. This is depending on the type of product or process.

The standardized building has a more conservative way of distribution. Products are delivered in pallets, stored and leaving the building on a pallet in a truck towards the shop. Trucks are parked at the docks waiting to be loaded and unloaded. Goods are checked and scanned and moved to the storage room. Buildings often reach a height of 13.7 meters. This height is limited by fire safety laws of the government. Buildings exceeding over 13.7 meters need a more advanced sprinkler system, which is integrated within the storage racks, which is more expensive.

Retailers are expanding their warehouses with the arrival of E-commerce. E-commerce delivers directly to the consumer, this results in a labour intensive process. Goods are moving in from the manufacturer by pallet. When an order is placed, the products need to be individual unpacked, stored and picked The software system knows exactly which products are in close proximity of each other and calculates the best routes. After picking the items, the products need to be sorted and transported to the package department. Transporting and packaging takes up a lot of space, due to different product sizes. The final step is to sort the products for the right truck based on the province. E-commerce has to incorporate extra space for returning products from the consumers. The process of unpacking, checking and sorting starts all over again. Although, both the standard and the custom buildings look like giant boxes, the difference is in size and at the inside.

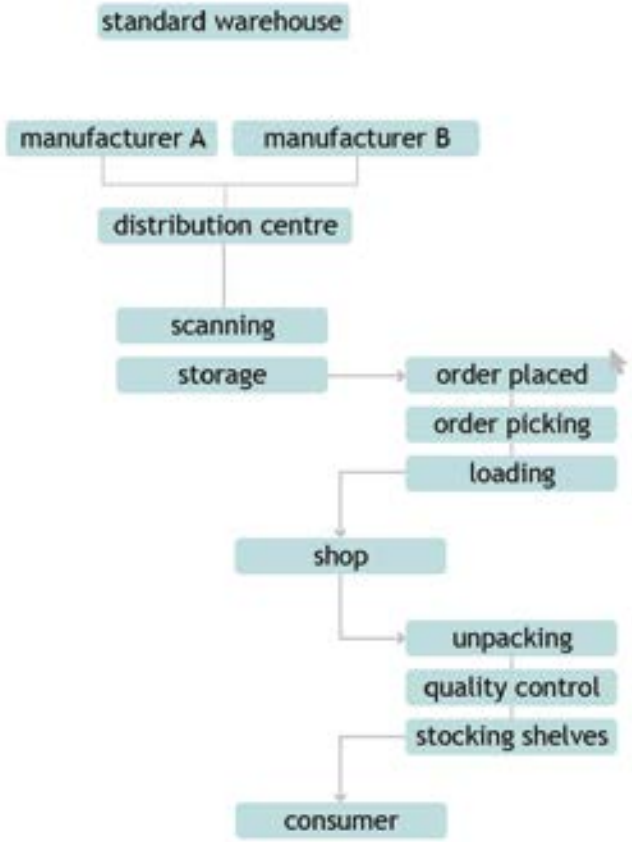


fig 2.12: Standardized processes

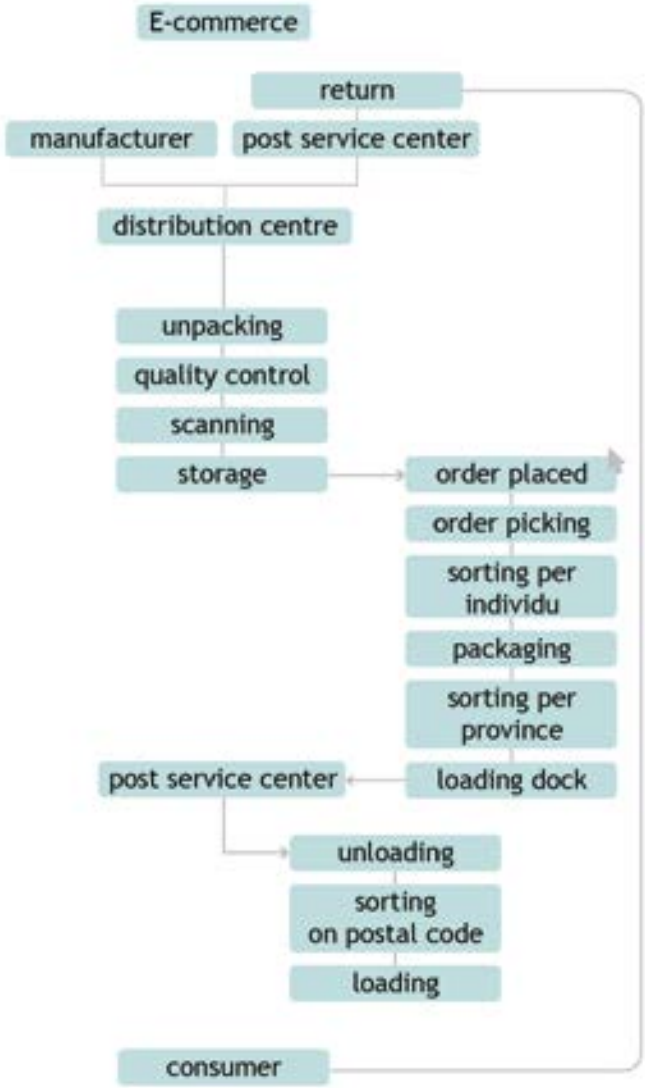


fig 2.13: Processes with E-commerce

Due to value added functions such as packaging the footprint of logistics is expanding enormously. This new type of large scale logistics results in a XXL-distribution park which is comparable in size with the Maasvlakte 2. The cheapest way to built a warehouse is spreading out everything on a equal floor level. In combination with low ground prices, logistic landscapes are occurring outside the city border. New logistic landscapes are created with a focus on trucks and efficiency. Roughly 40 percent of the parcel from XXL-logistics consists of manoeuvring space and parking places. In front of the docks there should be 38 meters of asphalt to park. Access roads are directly connecting to highways. The excessive public space is often used for water storage, which is necessary because of the large roof surfaces (Buck, 2018).

Companies often buy an extra piece of land to guarantee their expansion for the future in the coming 10 years. Flexibility to grow and adapt to the growth of the E-commerce market and future innovations in automation makes it necessary to reserve extra plots (Bol.com 2018; Wehkamp, 2017).

2.7 References

A reference study is applied to search for alternative ways to use the surface more efficiently to reduce the impact on the landscape. Although the XXL-distribution can be defined as a new type of landscape, it is important to consider alternative solutions in a small country as the Netherlands. Especially now the public opinion starts to resist against new developments and terms as boxing (verdozing) of the landscape. We will be testing on the following parameters: footprint, flexibility, roof height, and functional space. Shortly the parameters are explained:

Footprint: is the area which is occupied with the building and the necessary space for trucks.

fig 2.14: Tradepark North, Venlo

fig 2.15: Regular distribution park

fig 2.16: Maasvlakte 2

fig 2.17: Venlo city centre

Sometimes the truck space is included within the building itself. The parking spaces are not taken into account for this reference study.

Flexibility: standardized buildings have the opportunity to adapt to different storage layouts. Depending on the type of goods, companies use pallet system with wide or small corridors. Small corridors result in a higher storage capacity but are harder to reach for heavy forklifts. So companies with heavy products often use wider corridor paths. The flexibility is also depending on the owner of the building. Standardized warehouses are often built by investment companies. If a property is rented, this usually entails a period of then years. After then years a new layout can be installed or the building could be rebuilt, to adapt to a different pallet size and plan layout. (Kantoor en handel, 2008; logistiek.nl, 2012)

Roof height: the height of the buildings of single floor warehouses is often 14 meters. More advanced E-commerce buildings need to have the ability to incorporate multiple floor levels for value adding functions like packing and unpacking. The rise of automated system prefer a compact higher storage system instead of a spread out one on a single floor. A compact system limits the movements of robots and is therefore more efficient (Buck, 2018; Stec, 2015).

Functional space: functional space is the usable floor space within the building, for example a building with heavy constructions limits the usable storage space by its supporting construction. Light roof constructions are resulting in a lot of usable space in comparison with multiple floor levels. Supporting trucks to reach multiple levels of a building is a costly operation.

Single floor warehouse
Every model will be compared with the basic single floor warehouse. The single floor warehouses are the most common warehouse type of the Netherlands. Striking is that XXL-distribution is spread out across the landscape similar like greenhouses. Where greenhouses have an advantage of the elements like sunlight and temperature, this is not the case for distribution centres. Rainfall is more often a problem because of the lack of infiltration zones due to the large roof surfaces.

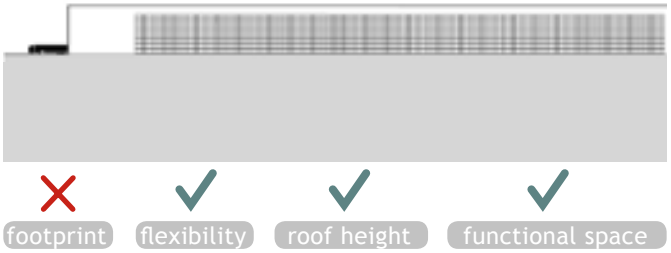


fig 2.18: Bol.com warehouse

Underground warehouse
Old mines can be suitable for warehouses. In Springfield Missouri, a old limestone mine is transformed into a logistic warehouse. The mining and warehouse construction continued for the next five and a half decades, removing over 31 million tons of limestone. Because it is located down below, there is a constant low temperature. The storage space is rented to different companies varying from E-commerce storage to standard pallets. This combination of a mine and logistic depends on the terrain and the availability of a mine. Mines are often located in remote areas. In the Netherlands we do not have the availability of a lot of mines, but it is an interesting solution (springfieldunderground, 2015).

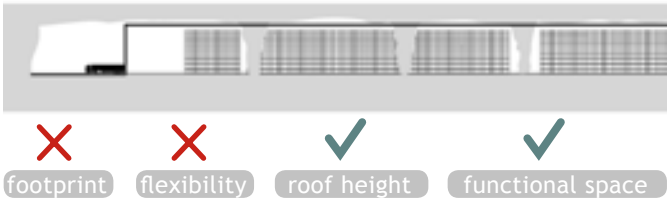


fig 2.19: Springfield warehouses

Double floor warehouse
The double floor warehouses efficiently uses the space by adding an extra layer on top of a single floor warehouse. These examples are rarely seen, in the Netherlands. In Woerden they built a double floor distribution centre for groceries. Trucks are driving up to the second layer by a 150 meter ramp. Extra space is needed for ramps and heavier constructions are required to carry the trucks. Also, the top floor loses storage space because of the necessary manoeuvring space for trucks.

✓ footprint ✓ flexibility ✗ roof height ✗ functional space

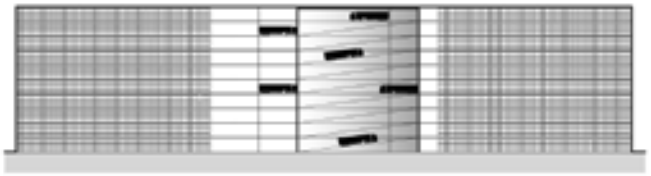
fig 2.20: Jumbo distribution centrum Woerden

High-bay warehouse
High-bay warehouse are automated warehouses which are used for the storage of packaged goods. The compact construction makes it possible to create a high density stacking in a relatively small space. High-bay warehouses can be built for different sizes and goods. These systems are built in areas with a shortage of space or to improve the efficiency. An advantage of the high-bay warehouses is the ability to expand the warehouse capacity on a short distance of the main company by simply building an extra block.

✓ footprint ~ flexibility ✓ roof height ✓ functional space

fig 2.21: High bay warehouse

Multi-floor warehouse
Multi-floor warehouses are often built in areas with extremely high ground prices, such as Singapore and Japan. Because multi-floor warehouses are vertically expanding the storage space, they have a positive influence on the footprint reduction.
Each floor can be reached by trucks with a circular truck ramp. Floor heights are limited by six meters due to the heavy storage construction, which limits the storage capacity. The heavy constructions are also limiting the ability to connect different floors with each other. This makes it difficult to incorporate new systems within the existing building.



✓ footprint ✓ flexibility ✗ roof height ✗ functional space

fig 2.22: Multi-floor warehouse

2.8 Preferred logistic model

Based on the reference study, the preferred model is the high bay warehouses. The high bay warehouse fulfils almost to all of the criteria.

The high bay warehouse is a new model which is shaped by the inventions of automation and robots. Although it is new, there are multiple examples of realised buildings with storage systems. Some buildings are close located to factories with similar boxes which is easy for the system. Other buildings are located in ports storing goods with different sizes. Comparing it to other references, it shows that it is possible to create a vertical storage space on a small space with light weight materials. While materials like concrete and steel are often used to support trucks and storage in multi-floor warehouses, the high bay warehouses uses materials similar to current single layer warehouses like the cladding and steel racks. The multi-floor warehouses used in Japan are extremely expensive to built and should probably consist of more heavy constructions in the Netherlands due to the longer and heavier trucks.

fig 2.23: Large high bay warehouse, Bremen

Flexibility

The flexibility from the high-bay warehouses has to been seen from different perspectives. From one point it is possible to built for large and small companies. The high-bay warehouses are adjustable and can be built specific for a certain product. Roof heights, lengths and widths can be adjusted to ensure a storage capacity for the long term. By simply building extra high-bay warehouses the capacity of the building could be enlarged. Belt systems are connecting the 'main building' with the added high-bay stores.

Down side of the system is that it asks for larger financial investments because of the automation. A simple racking system is faster to built because of the time it takes to program the system of robots and belts. The higher process speed and efficiency could be a valuable return on the investment, because fast delivery to the customer is one of the most important factors of E-commerce. Robots are also working 24/7 and are not depending on daylight or lunch breaks. Further development of automation and robots could make systems more accessible for smaller companies (logistiek.nl, 2019b).

fig 2.24: Small high bay warehouse Spar, Waalwijk

Robots and automation are reducing the low skilled labour positions in warehouses. It is difficult to indicate how much of the jobs would disappear due to automation, but jobs like truck drivers, forklift drivers and order pickers are vulnerable for automation. On the other hand it could be asked if is ethically justified to offer jobs with a repetitive pattern in buildings without any daylight. Employees have a limited time for every task and have keep up with the flow of orders (Consultancy, 2017).

Space reduction

Stacking storage till great heights reduces the footprint of the building. This is in favour for the landscape, since more space could remain as landscape and smaller quantities of roof surfaces are being realised. One of the reasons large scale logistics are being built in the landscape is the lack of availability of large parcels. Large warehouses are just to big to be implemented on existing industrial parks. The clustering of companies to one central location effects the market of the existing industrial parks. If buildings are left behind and empty for a longer period of time, they affect the quality of the industrial park. Currently 30% of the industrial parks of the Brabant is dealing with deterioration (Province North-Brabant, 2017). Logistics with a high bay warehousing could offer a solution to create a more sustainable industrial park. The reduced footprint offers opportunities to integrate vital companies on smaller parcels in deteriorating industrial parks. This will only be possible for smaller logistic companies. More in-depth research is however necessary to value if this an option to reduce the need for more industrial parks in the future.

To calculate the reduced footprint of the building, we compared a regular one layer warehouse with the high bay warehouse. The chosen one layer model has a standard layout with a loading zone and storage space with a height of 14 meters. In total this facility has a footprint of 65100m2 and has the ability to store 60000 pallets. A total of 40 docks on one side of the building are providing the logistic transport. Comparing it to a high bay warehouse with the same capacity and 40 docks, would result in a 60% percent smaller footprint. The footprint reduction is of course realised by the increased height but also with a compacter storage system. Regular warehouses are wasting lot of space due to the wide corridors. Every rack needs to be reached by a forklift which needs to be able to turn, to grab the pallet on the spikes.

Expanding vertical

Although the model looks promising for regular warehouses, but it is difficult to compare it with the E-commerce warehouses. There is a lack of information about how much space is needed for value adding functions like packaging and unpacking. This is also depending on the type of company. We do know that value added functions often are lighter elements. For these functions we propose different floor levels above the loading docks. These spaces are often not used, because the constructions are too light for storage purposes. With the belt systems as a transport medium it is possible to create a flexible system around the core of the high-bay warehouse. If more space is needed, the levels could be expanded up to 45 meters with the possibility to even overreach the docks shown in figure 2.26.

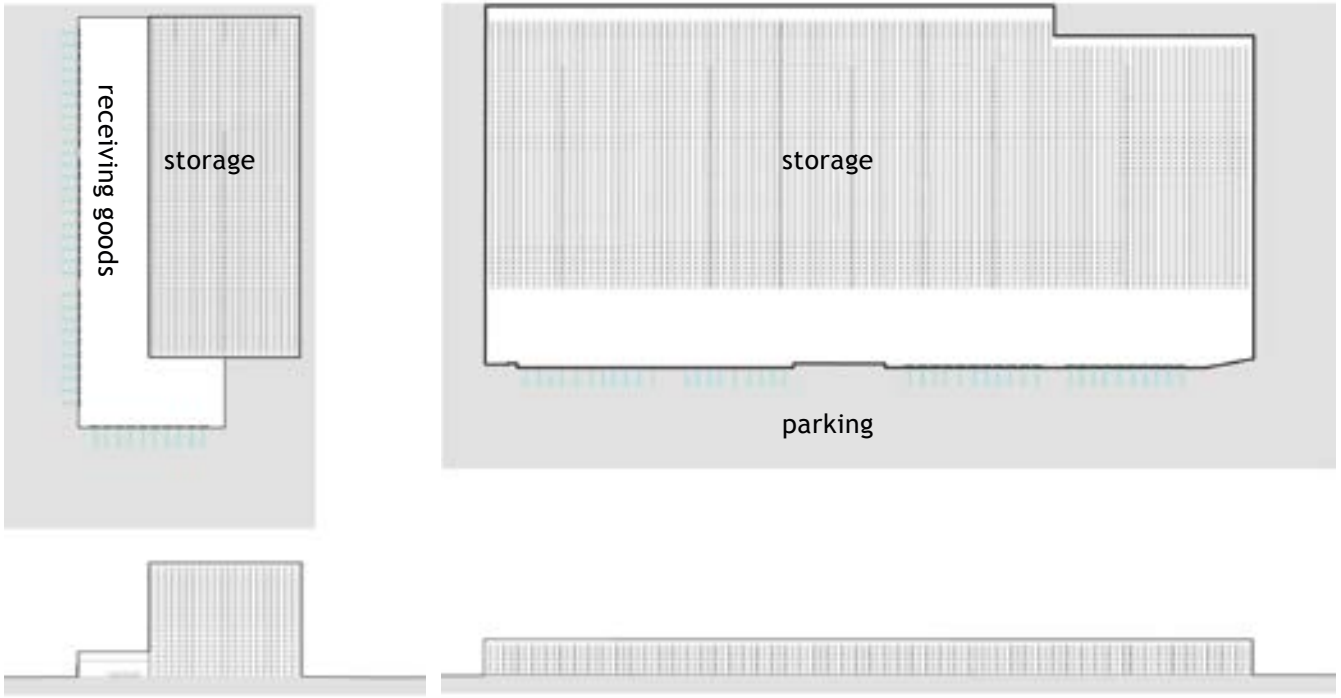
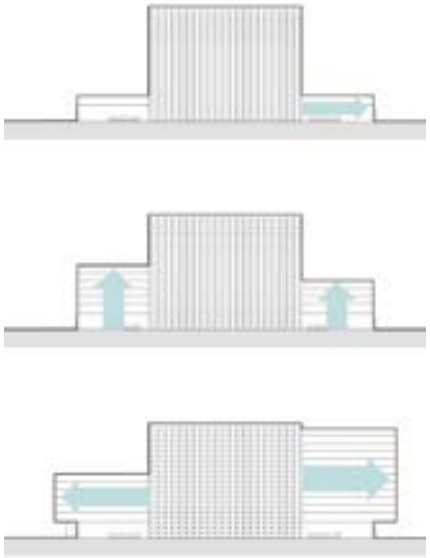


fig 2.25: Comparison between high bay and one level warehouse



Highbay warehouse	
Pallets:	60000
Docks:	40
Sqm:	26000
Height:	45m

60% footprint reduction

Regular storage	
Pallets:	60000
Docks:	40
Sqm:	65100
Height:	14m

fig 2.26: Expanding with flexible floors

Growth
The really big E-commerce players need to have the ability to expand their storage capacity.
By reserving extra space in advance around the building it is possible to expand to a total of 150 000 pallets and a total of 100 docks. This is visualized in the diagram below.

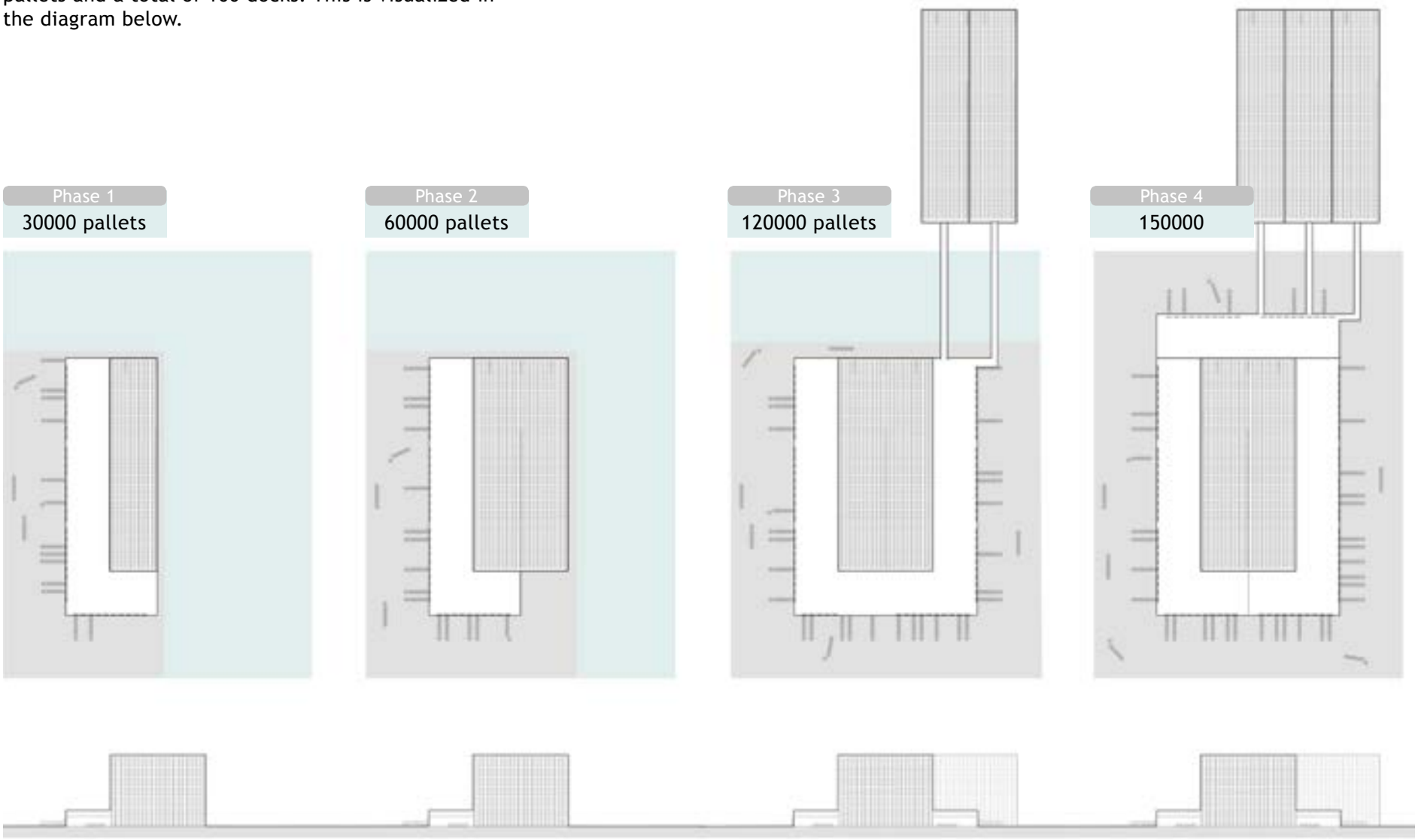


fig 2.27: Storage growth for high bay warehouses

2.9 Logistic analysis

In this analysis the emphasis lays on the infrastructural networks, which are in interest of XXL-distribution in the province of North-Brabant. The province North-Limburg is included to get a complete view of the continuous networks.

Scattered through the province of North-Brabant and North-Limburg, we find XXL-distribution at the cities like Tilburg, Eindhoven and Venlo. Smaller villages are not inferior to the larger cities. Villages like Oosterhout and Veghel are taking a prominent place in the logistic landscape, clustered around the highways. The development of XXL-distribution happens on different ways. Most common is the expansions on the edge of the city near existing industrial parks. Because there is a huge demand for large parcels, the logistic parks are expanding towards the landscape. This causes the border of the city to shift more and more towards the landscape. Another way to integrate XXL-distribution is to re-organise deteriorating industrial parks. By combining smaller parcels to one large parcel, it is possible to create a suitable plot for XXL-distribution. This does not happen very often, because these processes are slow and time consuming (Stec-group, 2015).

Large scale logistics could also be created independent from the city. The development of Tradepark-Noord nearby Venlo is a good example. By leaving space between the city and the distribution park, there remains a green recreational corridor. The connection between railways, highways and a position outside the city prevents unnecessary traffic congestion.

fig 2.28: XXL-distribution in North-Brabant

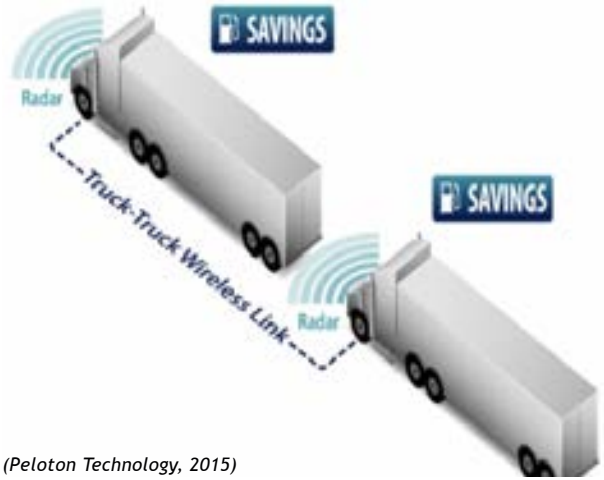
fig 2.29: Expansion at Roosendaal

fig 2.30: Tradepark North Venlo

fig 2.31: Road network

(De Kort, n.d.)

fig 2.32: Traffic congestion at the A58



(Peloton Technology, 2015)

fig 2.33: Platooning

2.9.1 Road network

The road network between Rotterdam and Antwerp is an important factor for the attraction of XXL-distribution. The short distances and a well connected road network is essential for a good accessibility. There are multiple routes to Rotterdam and Antwerp possible via the A4, A16 and A67. Large logistics companies like to spread the risk of transportation. For example the low water level in the Meuse last year resulted in an increase in traffic on the road (de Gelderlander, 2018).

The current pressure on the road network on the A58 between Eindhoven and Tilburg lead to plans for adding extra lanes. In the coming year the road will be widened to improve the traffic flow (Rijksoverheid, 2018). Besides the enlargement of the road there will be new innovative ways to make trucks more efficient. Concepts like platooning will make it possible for trucks to drive right behind each other while communicating. This will save fuel and improves the traffic flow. Other inventions could be a more global freight market. A lot of trucks are driving empty or half empty back after delivering. The energy transition towards electric or hydrogen fuelled trucks could also lead to new criteria regarding the positioning of XXL-distribution. For now it still remains unclear how these inventions are going to develop (Omroepwest, 2018).

2.9.2 Inland terminals

The inland terminals from North-Brabant are connecting the industrial parks of the hinterland towards the sea ports. The deep sea ports Rotterdam and Moerdijk are dividing the goods over the inland shipping. By doing this they unburden the pressure at on entry point. Inland ships are transporting the containers towards the different terminals where they are moved to the trucks for the last drive. Within Brabant we define three channels. One of them is the Mark, which is located in the southwest of Brabant and connects the cities of Breda and Roosendaal to the sea. The Wilhemina channel in the centre of Brabant, connects the cities of Oosterhout and Tilburg to the Bergsche Meuse. In the east we find the Zuid Willemsvaart connecting 's-Hertogenbosch, Veghel and Helmond which can be reached by IV class ships. The river Meuse is situated along the border of the province Limurg. This river is the only not man made connection for transport and has its terminals in Venlo, Wanssum, Cuijk and Oss (Nieuwsbladtransport, 2006).

Distribution prefers to be located within a radius of 20 kilometres. Especially in the north-west of Brabant there is a dense network of terminals. The province of North-Brabant is actively working on stimulating the transport via water. Large IV class ships are able to reach TIlburg since the widening of the Wilhelmina channel in 2017. Inland terminals are very valuable for XXL-distribution, because of their large product quantities, which are shipped from all over the world (Stec-group, 2015).

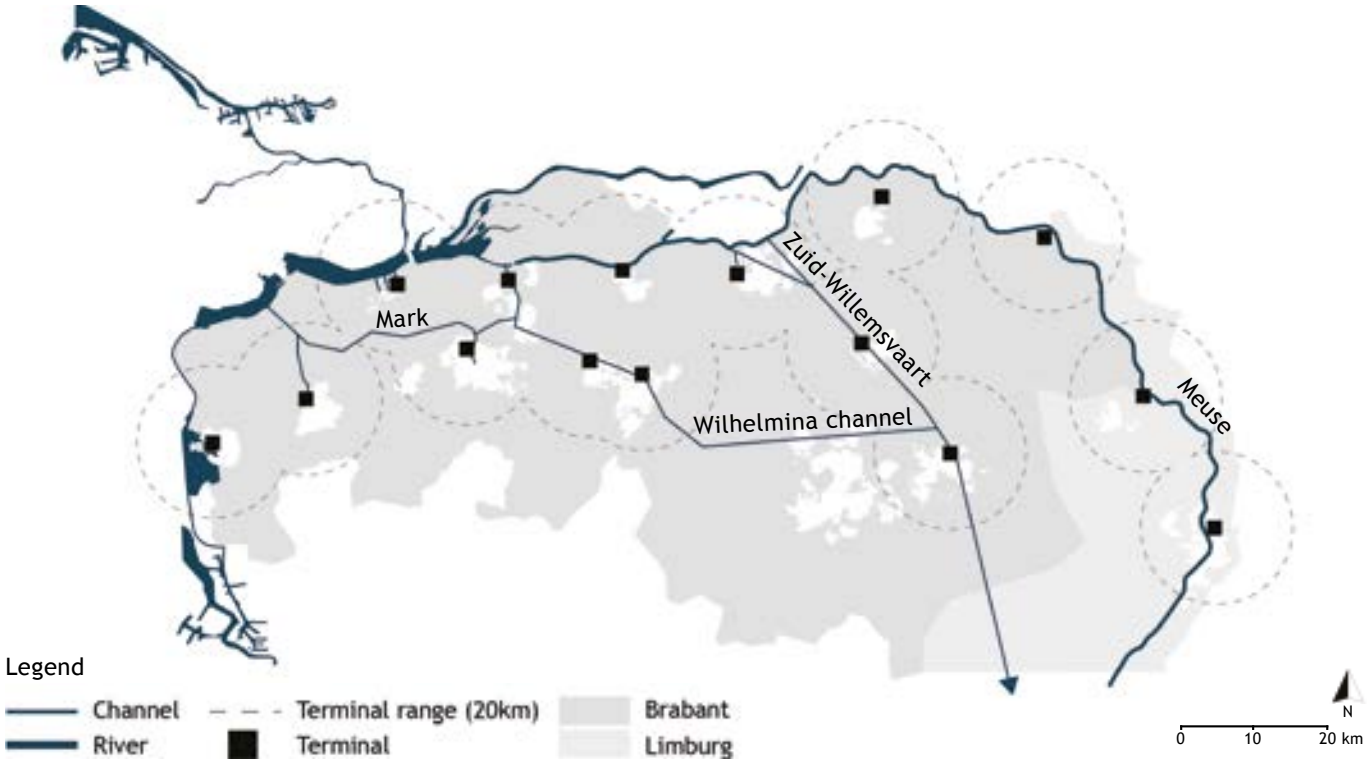


fig 2.34: Inland terminals

fig 2.35: Inland Terminal Tilburg

fig 2.36: Widening of the Wilhelmina channel

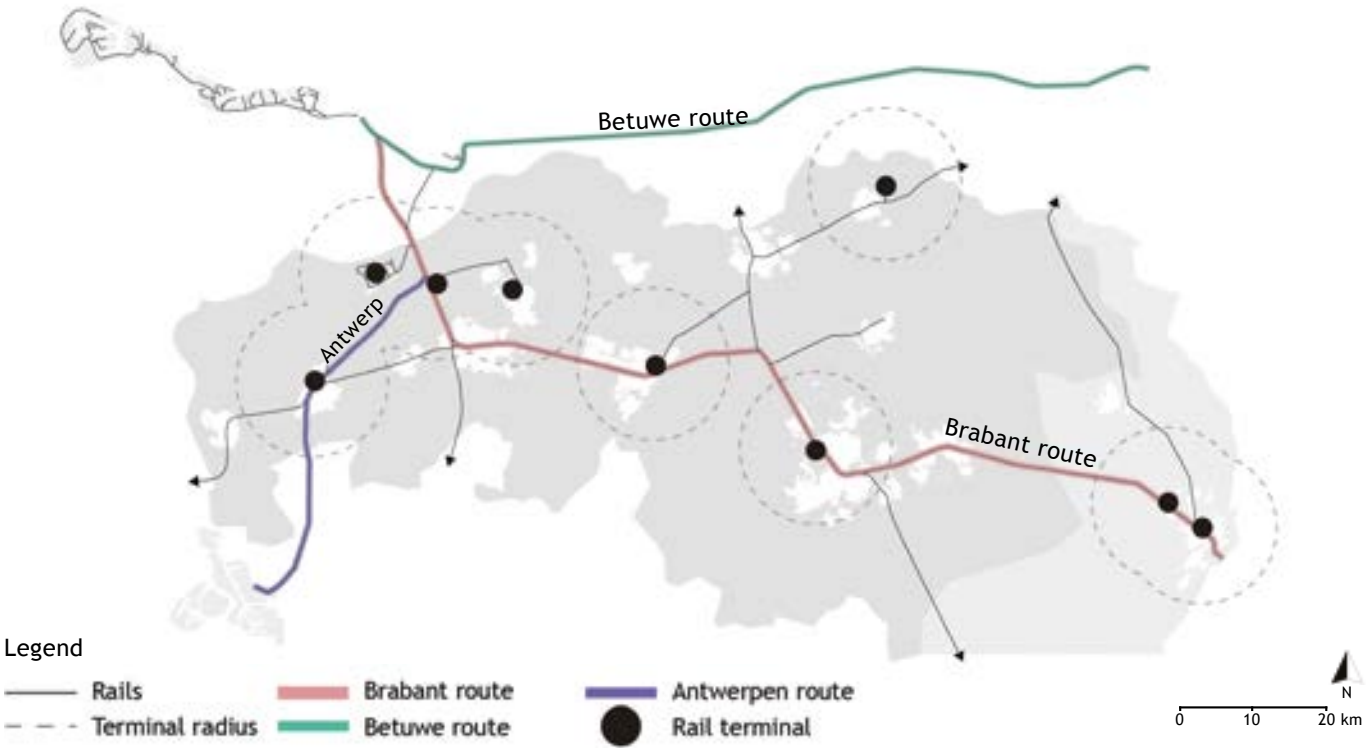


fig 2.37: Rail network

fig 2.38: Rail terminal Venlo

fig 2.39: Betuwe route

2.9.3 Rail terminals

Brabant and Limburg have nine rail terminals spread out over the provinces. From Rotterdam and Antwerp freight trains are supplying the hinterland of Brabant. However, not all trains take an intermediate stop, since the rail network is connected to the European network.
This makes it possible to transfer goods on large distances to middle, east or south of Europe.
The Betuwe route is the main-route for the transport of freight to Germany and further, especially for hazardous substances. The route ha a length of 173 kilometres and it is used each year by 22.000 freight trains. During constructions on the Betuwe route the traffic will be guided along the Brabant route. Currently constructions are going on in Germany to upgrade the two rails to a three rail system. Which leads to some frustrations under the population because of the nuisance and safety of hazardous substances through populated areas.

Besides the Betuwe route we find the Brabant route. This route is shared with public transport and crosses more cities and villages, this limits the transport possibilities. Each year there are 13.000 freight trains crossing the Brabant route. Terminals are based in Roosendaal, Moergestel, Oosterhout, Tilburg, Eindhoven, Oss, and Venlo. However, not all terminals are frequently used, since some of them are out of use or used as marshalling yard. That the terminals play a valuable role for XXL-distribution is illustrated by the opening of the second rail terminal of Venlo based in the XXL-distribution center Tradepark North (Prorail, 2017; Brabants Dagblad, 2015; Province North-Brabant, n.d.-a).

2.9.4 Electricity networks

The electricity network is of great importance of the development for cities and industrial areas. Power lines play an even bigger role as the connection to road and water ways. The power lines is built-upon the 380kV network. These lines are the supply between the power plants in the Netherlands and abroad. During a shortage, energy is transmitted between Norway, where energy is produced with hydroelectric power stations. During a high energy surplus on the Dutch network, energy will be send to the Norwegian network. This energy exchange also happens between Germany, but only with wind energy. In 2019 the Dutch network is connected with the Danish network. Power lines can be constructed above ground and underground, because of the risk of cable leads pose and losing electricity. Between the 380kV network are the transformer stations who convert the electricity to the lower 150KV network. 150kV Networks are connected with industrial areas and neighbourhoods. Cities have the availability of multiple 150kV connections, which makes them able to take over, during a power failure. More and more industrial areas are getting solar panel roofs. Sometimes companies use the electricity for their own buildings, but it also happens that the roof is rented to a third party who is specialised in solar energy (Hoogspanningsnet, 2019; Rhenus, 2017; Tennet, 2017; Wikipedia, 2019c).

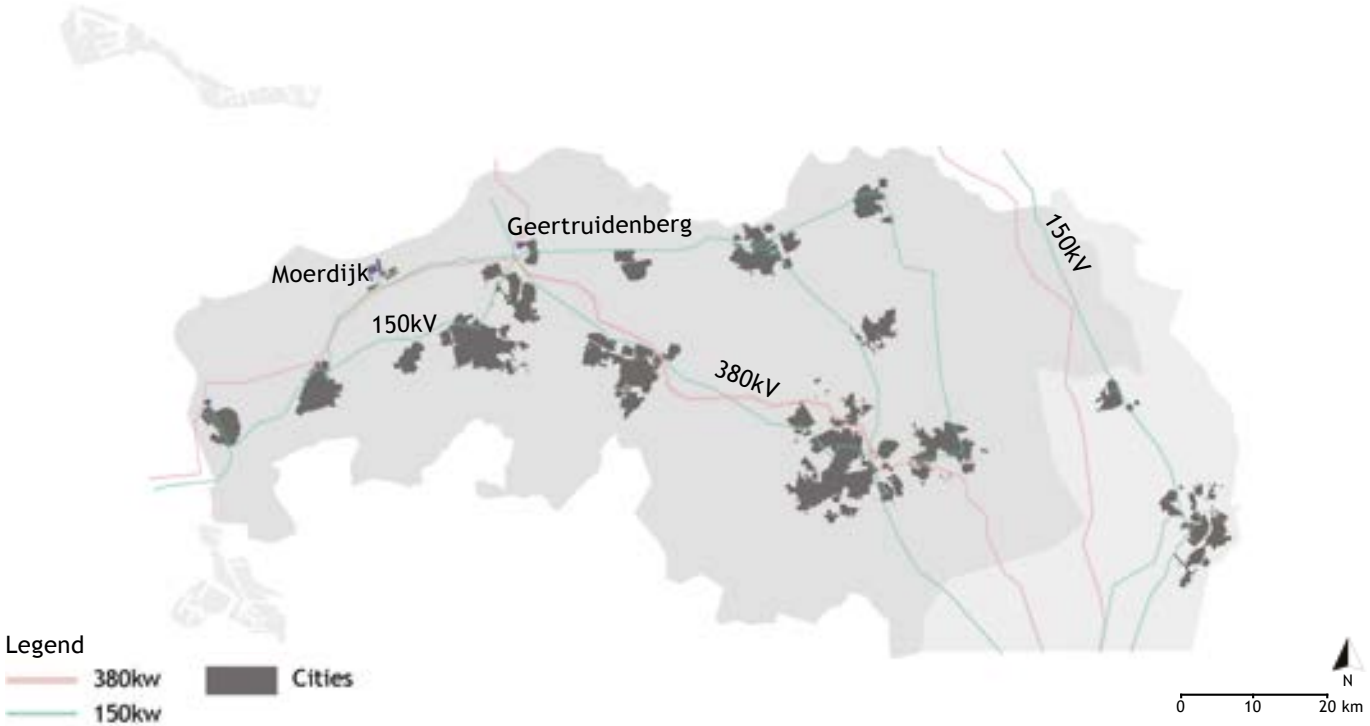


fig 2.40: Electricity network

fig 2.41: Smart grid network for 2050

fig 2.42: Solar panels on a distribution centre

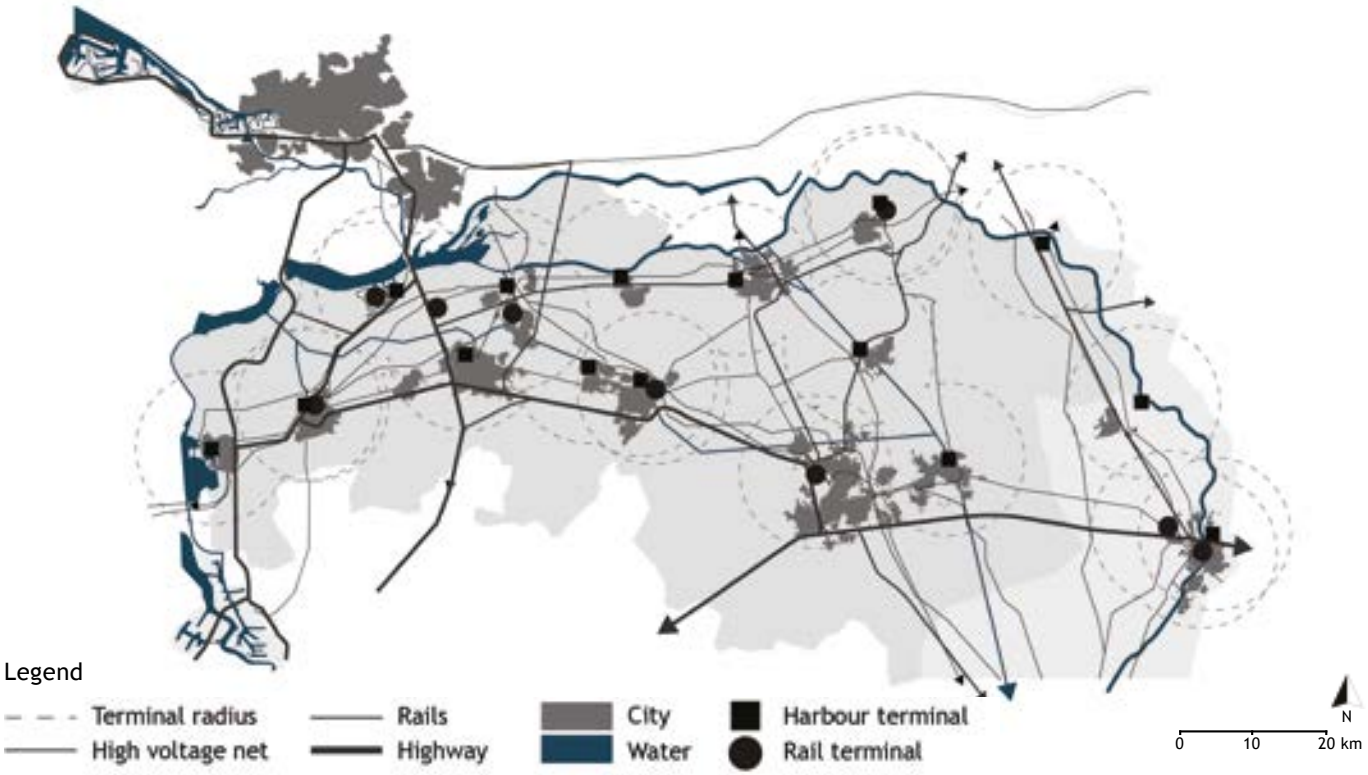


fig 2.43: Logistic landscape

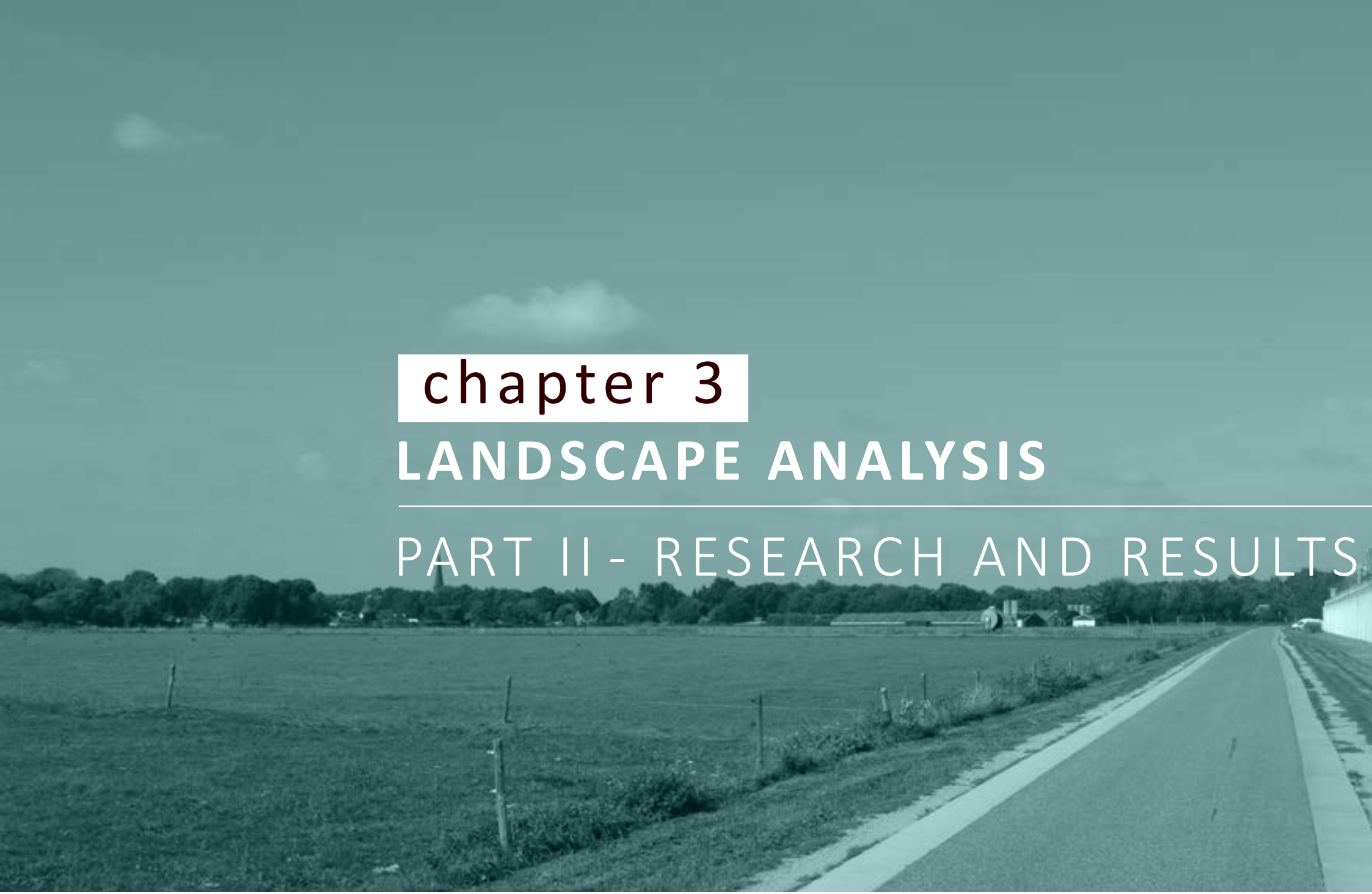
fig 2.44: Highbay warehouse

fig 2.45: Veghel industrial park

2.10 Conclusie

Within this chapter we described the different types of logistics, which can be divided on national, regional and international level. The role of the government, regarding the XXL-distribution,which is totally in the hands of the provinces and the municipalities. While we are talking about developments with the size of Maasvlakte 2. The trends are explaining current plans like large scale clustering and higher buildings. Inventions like automation and robots in combination with E-commerce which is shaping the XXL-distribution centers. The predicted prognosis for the growth of XXL-distribution continues in every region of Brabant. The scarcity of large scale parcels is especially in the regions West and Middle of North-Brabant. With the reference study we developed a flexible high bay warehouse, which reduces the footprint and follows the trends of automation and the striving for efficiency.

Brabant and Limburg are strongly rooted in the logistic network. The availability of rail and water terminals makes it possible to transport goods from all over the world to the distribution centres of Brabant. This connectivity is linked to the larger cities and smaller villages like Veghel and Tilburg. The terminals provide a dense network, which connect to every industrial park in the region, with a preference for a radius of 20 kilometres. Flip side of the success of the distribution parks is the burden on the roads and rails. Traffic congestion and endless rows of trucks are asking for widening of the A58 and A2. Rails going trough populated areas are causing nuisance and debates about safety.



chapter 3

LANDSCAPE ANALYSIS

PART II - RESEARCH AND RESULTS

3.1 Landscape of Brabant

This chapter serves the purpose to gain in depth knowledge of the different landscape types with each their own characteristics. Based on this data, a conclusion on suitable landscapes for the implementation of XXL-distribution can be drawn. The landscape of Brabant is diverse and can be roughly divided into four types: the sandy landscape, the sea clay landscape, the river landscape and the peat reclamation. In this paragraph we describe the geological processes that shaped the underground of Brabant.

This landscape has been formed in a series of geological processes. In the Early Pleistocene some 1.8 million years ago, the Netherlands was one big river delta. The land was crossed by weaving rivers that deposited packages of gravel, sand and clay. Sediment of sand and clay was deposited on the coastline. The landscape was bare, open and part of the tundra climate. The wind had free rein and covered large areas with the deposited sand from the rivers. Large plain sands landscape were created that now cover most of the Netherlands. The lower areas transformed into valleys and drained the water from the higher sandy areas. After the last ice age, a warmer period started with the rivers adopting a more regular meandering course. The open tundra landscape made way for a more enclosed landscape with forests. An increase in temperatures led to an elevated sea level of 60 to 75 cm per century. Peat areas where shaped by an rising groundwater level in combination with the poorly permeable soils. The effect was further enhanced in the lower lying areas, due to the supply of the seepage from the higher positioned sand areas (Vos, 2011).

Between 3500 and 1500 BC we see a new development of the coast expanding in a seaward direction. Large quantities of sediment were

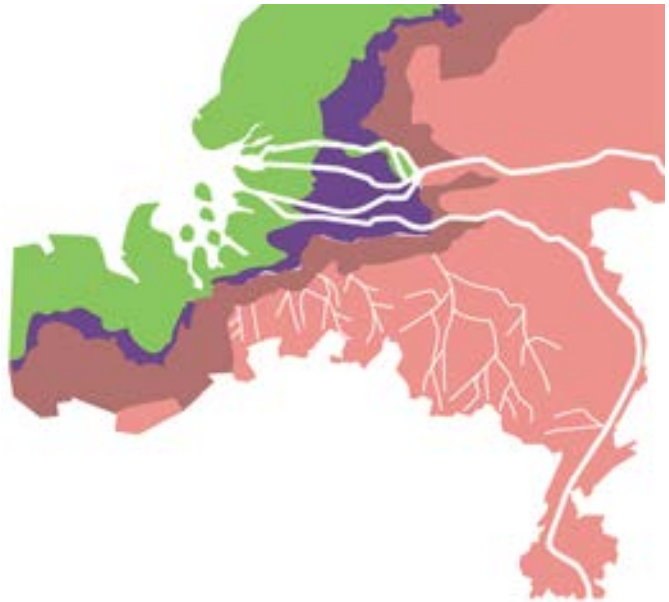


fig 3.1: 3580 BC

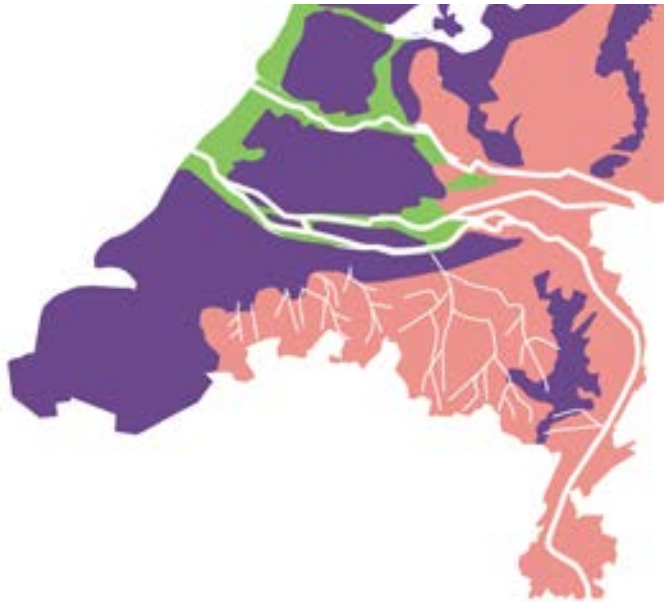


fig 3.2: 1500 BC

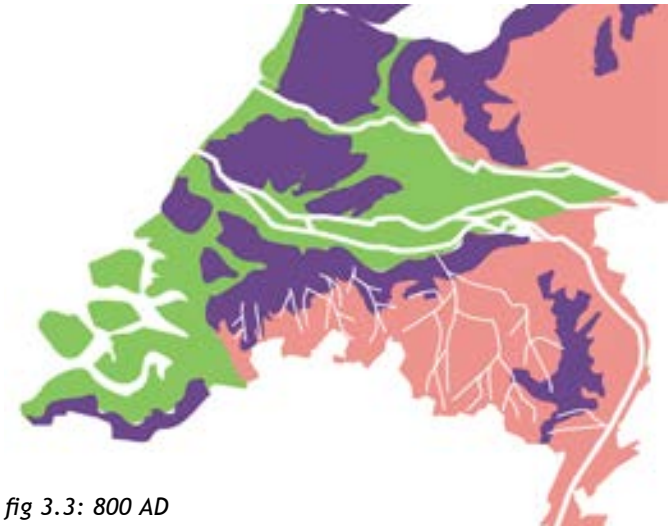


fig 3.3: 800 AD

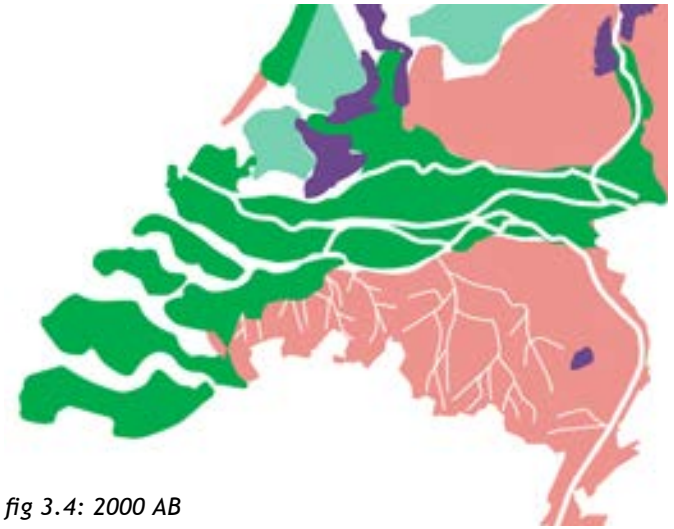
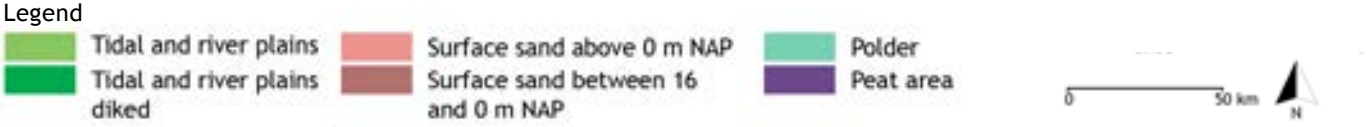


fig 3.4: 2000 AB



deposited in front of the sea cost in the shape of sand dunes and beach walls, which protected the hinterland from the influence of the sea and allowed the peat to grow on a massive scale (Vos, 2011).

Around 500 AD, the seas gets a grip on the peat areas. The sand dunes of Zeeland, which depend on the supply of Pleistocene sand plate in front of the Belgium coast, had run out of sand. However the process of coastal currents still removing sand from the Zeeland coast continued, causing coastal erosion and the weakening of the sand dunes. Gaps allowed the sea to enter behind the coast and small tidal areas emerged. The Roman influence was also presence in this era, which led to the development of roads, cities, trade fortifications and a rapidly growing populations. Rural settlements grew and began to systematically parcel the landscape into arable land to keep up with the population growth. Peat was mined for fuel and channels were dug to drain the land. The exploitation of the land by mining peat areas came with a price. The mining caused subsidence of the landscape and linked the peat areas to the dynamics of the sea. This allowed the sea to penetrate deep into the peat area. This impact is visible in the map of 800 AD. The sea has taken its hold on Zeeland and has made large holes in the landscape. Flooding caused an estuary area under the influence of the tidal. The area was no longer safe to live on, but also the clay layers were deposited. The end of the Roman empire caused a decline in development. The population numbers decreased drastically. Settlements and cities disappeared, the agricultural sector fell back to the time before the Roman influence.

Around 800 AD, people started to settle again in the estuary. The silting up of the salt marshes made it possible to slowly regain the landscape. It took however 200 years before the humans started to transform the landscape on a large scale again.

Residents of Zeeuws-Vlaanderen started to embank parts of the salt marshes with dykes. This took place in the estuary and along the rivers on a large scale systematic manner. Around 1300, almost the entire coastal and river floodplains were diked. Windmills and locks were invented to create and regulate the water systems of the polders.

The diking made it possible to live close to the sea and rivers. This meant the cultivation developed the landscape in large parcels of arable land. These parcels were a lot richer in comparison with the sandy soils in the east of the Netherlands. The embanking of the sea and the rivers also had negative consequence. During storms the sea water was pushed high up against the dikes. Polders, affected by settling became lower and lower. In contrast to the silting of the areas outside the dykes which became increasingly higher. This resulted in catastrophic consequences when a dyke breakthrough happened. The St. Elisabeth flood in 1421 caused 2000 deaths and made several villages disappear. The breaking sea and river dikes resulted in a freshwater tidal area. In 10 years the silting and river influences manifested itself in a dry area, what we now know of as the Biesbosch.
Overtime the cultivation of the landscape continues. An increase in population led to more and more demand for agricultural land. Large parts of forest were cut to provide timber for the iron mines. Meanwhile in the east and south of the Netherlanders, the countryside populated with pour farmers struggled with the sandy soils. The use of the 'podstal' principle made it possible to enrich the poor soils. Sheep manure was collected in a sunken stable, mixed with heater and spread out over the sandy soils. This resulted in 'enk' soils which created a micro relief in the landscape by the brought up manure.
This way of farming lead to an excessive exploitation of the heather landscape, what lead to a bare sand landscape. In 1850, entire villages in Brabant and Twente were in danger of disappearing due to drifting sand. Large pine forests were planted to reduce the sand movement and almost made drift sand disappear. The invention of artificial fertilizer ensured that farmers were no longer depending on the 'podstal' principle. Poor sandy soils could be transformed in podzolic soils suitable for farming (Vos, 2011).

fig 3.5: Sint-Elisabethsvloed 1421

fig 3.6: Farming on the pour sand soils

3.2 Landscape types

In 2011 the province of North-Brabant established a document what illustrates the different landscape types of Brabant. In total 12 different areas are described within their landscape type. This document will be used to frame the different landscape characteristics.

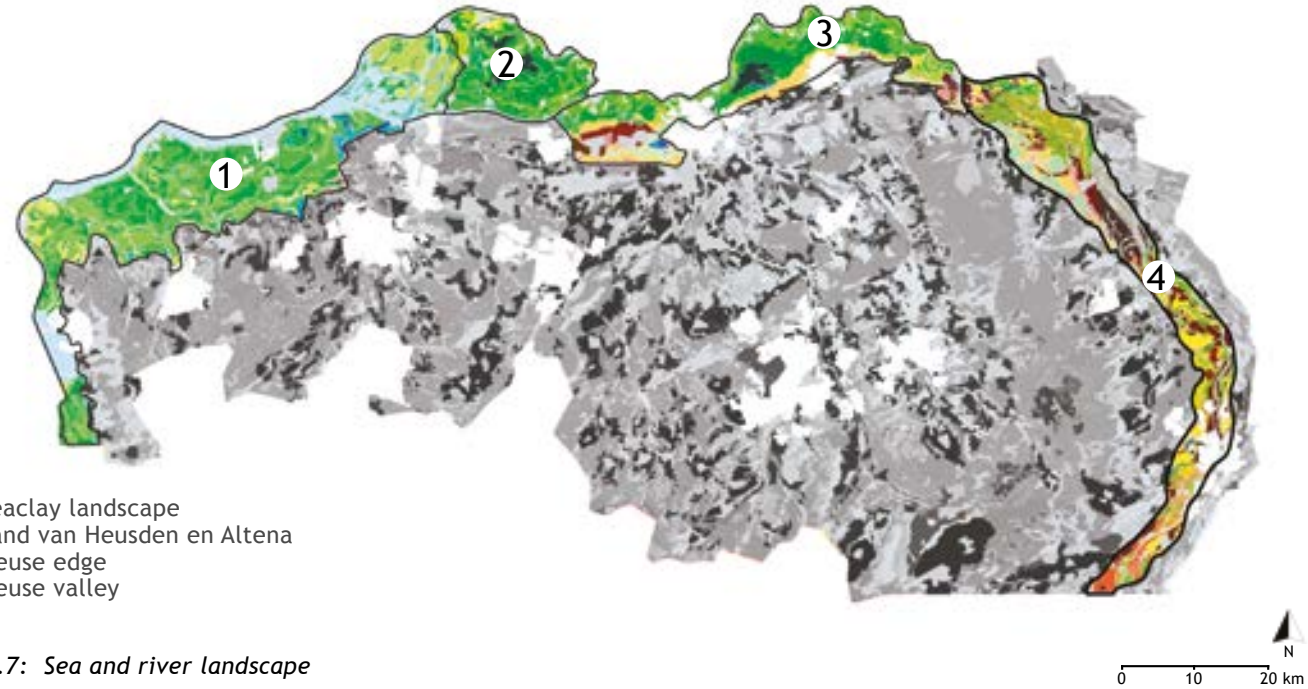
3.2.1 Seaclay landscape

The sea clay landscape is located on the transition from the plain sand plateau to the Rhine Scheldedelta. The area borders to the west to the province of Zeeland and to the north to the Meuse. The area consist of a few smaller cities like Stevenbergen, Zevenbergen and Willemstad. On the edge with the sand landscape we find larger cities as Breda, Roosendaal and Bergen op Zoom. As the name suggest the underground mostly consists of clay deposited by the sea.

The creation of this land has a rich history of gaining land from the sea. The royal family, who lived in Breda, commissioned engineers and landscape architects to develop the silt marshes in to an arable polder in 1605. Dykes were built, channels were dug and 2300 hectares of clay soil transformed into the Prinsenpolder. Agriculture is still the main land use today and the sea clay soil is considered as the best soil for arable farming in Brabant.

Characteristics

The landscape is characterized by its open and rational character. Long vista's are varied by dykes flanked by tree lines. Farming activities like ploughing, seeding and harvesting are determining the seasons. Visible relics of the past is the defence system of the Zuidwaterlinie with fortifications and line dikes. Willemstad and Klundert are good examples that preserved their defensive system (Province North-Brabant, 2011b).



1. Seaclay landscape
2. Land van Heusden en Altena
3. Meuse edge
4. Meuse valley

fig 3.7: Sea and river landscape

fig 3.8: Willemstad

fig 3.9: Sea clay landscape

fig 3.10: The Land from Heusden and Altena

fig 3.11: Meuse hedges

3.2.2 River landscape
The river Meuse shaped and carved the river landscape. The river enters the Netherlands in South-Limburg and flows into the North Sea. The river valley is a small stretch that meanders through the sand landscape and defines the border of the province of Brabant. The river landscape can be separated into: The Land from Heusden and Altena, the Maaskant and the Meuse valley.

Land from Heusden and Altena
This area borders with three sides to rivers, the Nieuwe Merwede, Begsche and Afgedamde Maas. West of the Land from Heusden and Altena lies the former tidal landscape of the Biesbosch. The village Werkendam is one the biggest villages with 27.000 inhabitants. Historic villages have a round or oval layout, new villages are more stretched out in a longer shape. The villages are connected by a single N-roads and local roads oriented in a east-west direction. The Land from Heusden and Altena is part of the young river clay landscape with higher, more sandy bank shores along the river and inland lower thick clay deposited by the river. The floodplain outside the dykes is regularly flooded.

Characteristics
The landscape is characterized by the large-scale parcelling and open river clay polders. Which are drained and transformed into arable land after the Second World War. River shores are elongated and more enclosed by vegetations. Vegetation in the agriculture areas is limited along the roads with single and double tree lines. There are a few forest clusters in the area. The river clay landscape has an important function for arable farming. The land use of the area consist out of soil bound crops. The parcels with the ticker clay soils are used as meadows for dairy farming (Province North-Brabant, 2011b).

Maaskant
The Land from Heusden and Altena continues to the east in the Maaskant. The Maaskant is also a young river landscape with a dominant land use of agriculture. The area is sparsely populated with small villages located along the river dyke. Villages like Megen and Maren-Kessel are over viewing the river. Extensions of new neighbourhoods are placed inland. Along the river we find various sand winning projects. Some of them are transformed into recreational water bodies. Others are still in use. The sand is used for the concrete and brick industry.

Characteristics
The landscape is in sharp contrast with the more enclosed bordering sand landscape in the south. The landscape is parcelled in large plots with a minimum of vegetation. The overwhelming openness is comparable with the scale of the Flevopolder. Vegetation is mainly based around the farms as a protection from the wind. Sometimes a single tree-line is cutting through the area. Farms are placed in the landscape in a gridlike way, along the north-south oriented roads and are systematically placed on the same distance from each other. The area mostly consist of small local roads connected to a single N-roads along the larger places (Province North-Brabant, 2011b).

Meuse valley
Along the eastern border of Brabant we find the meandering Meuse. Cities positioned in the Meuse valley are Venlo, Venray, Boxmeer and Cuijk. This small stretch of landscape is created by a river that cuts itself literately a way into the landscape, creating terraces and ridges. The terraces can be separated in the low, middle an high terraces. The low terraces consist of the current stream valley. The middle terraces are created in the late Weichselien by the weaving river. The high terrace is shaped by the erosion of the Meuse and can be

identified as a steep ridge bordering Germany. The river was an important catalyst in prehistoric times. The river made it possible to trade, and transport goods over longer distances. Farming happened on a small scale and worked together with the river. The river deposited after the floods a thin layer of alluvial mud. This enriched the soil and made the valleys of the Meuse excellent for hay fields. Higher terraces were used for the grazing of cows. Fields and properties were fenced of by hedges.

Characteristics
Currently Meuse hedges are still visible in valley of the river landscape and are protected under UNESCO world heritage. The valley along the Maas is not suitable for XXL-distribution because of its high historic and recreational value. Water safety would also prohibit developments in the river valley. Inland we find a dominant agriculture function. Intensive agriculture in the shape of horticulture, tree nurseries, greenhouses and dairy farming are characteristic for the area. Upscaling of the landscape partly resulted in a loss of its small scale character. Although landscape still can be classified as an enclosed landscape due to its mosaic parcelling and tree rows varied with forest clusters.

3.2.3 Sand landscape
The sandy landscape can be subdivided into the Brabantse wal, Baronie, Meijer, the Kempen and the Peelrand.

Brabantse wal
The Brabantse Wal is located between Bergen op Zoom and Putte. It is situated on the transition from the sea clay landscape to the sandy landscape. This transition is marked with a steep ridge. The Brabantse Wal was interesting area for recreations from an early age. In 1600, the elite decided to leave the chaotic cities in the weekends and find rest and peach in the countryside. Multiple rich

1. Brabantse Wal
2. Baronie
3. Meierij
4. Kempen
5. De Peelrand

fig 3.12: Sandy landscapes

fig 3.13: Brabantse Wal

fig 3.14: Estates and plantages in the Brabantse Wal

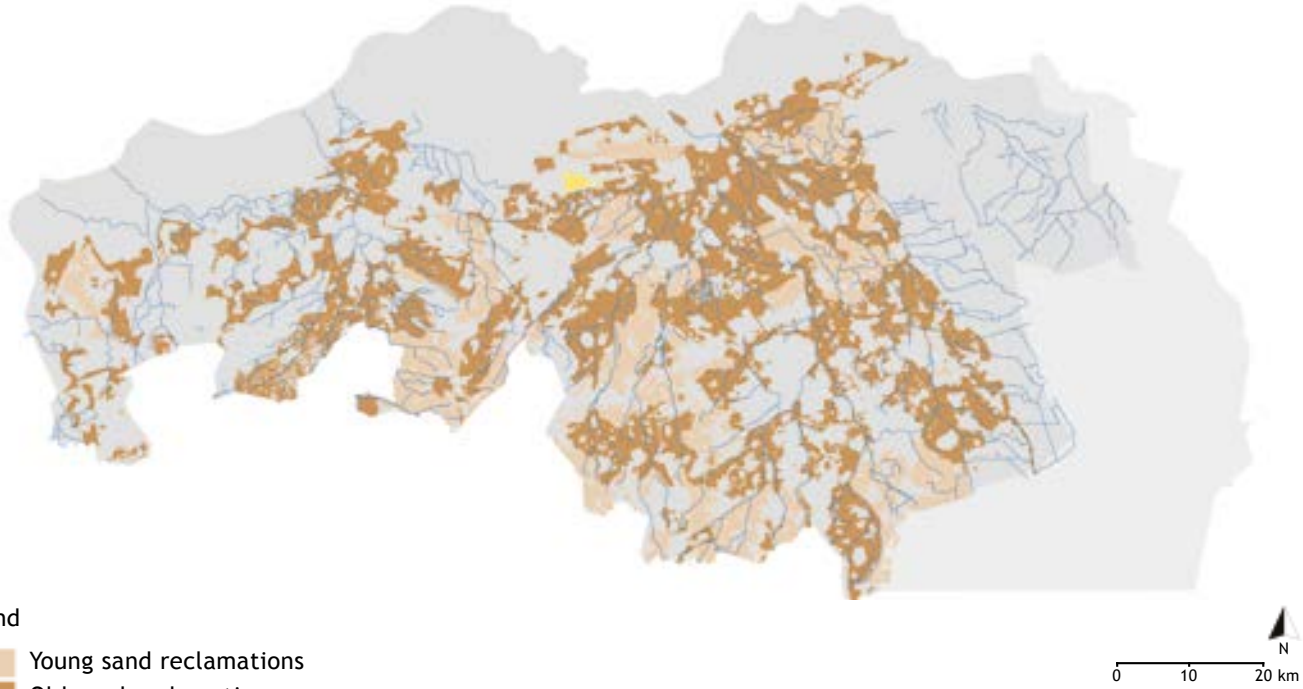


fig 3.15: Old and young sand reclamations

fig 3.16: Old reclaimations

fig 3.17: Young reclamations

citizens of Breda and Antwerp settled into estates around the Brabantse Wal. During the construction of the house, the heather fields and drifting sands were planted with forest and plantations. Parks, avenues and vistas were created around the estate in the landscape.

Characteristics

The Brabantse Wal is a noticeable high sand ridge, which used to be surrounded by peat bogs. The Brabantse Wal can be characterized as a small scale landscape of cities, villages, agriculture, estates, heather fields and drifting sands. Those function are encapsulated by a variety of forests of old park and coppice forests. Newer forests are the production pine forests. Because of this multitude of functions the area lacks a dominant agriculture function. The small landscape is an important carrier for the flora and fauna of the area. The landscape is protected as an Natura 2000 area (Province North-Brabant, 2011b).

Baronie

The Baronie is situated around the city Breda and Oosterhout and extends to the Belgian border. Similar to the Brabantse Wal estates were created for the rich. Old forests around Breda are planted as plantations for wood production, to built houses, castles and for hunting purposes. Currently the Baronie is the most important area for amphibians in Brabant. Many species prefer the small-scale cultural landscape and open agricultural landscape with meadows, wet grasslands, ponds and ditches.

Characteristics

The Baronie is made up of plain sand landscape with coarse-mesh mosaic of old and young sand reclamations, stream valleys and forests. The old sand reclamations can be identified by its small scale character and hedge row landscape of raised walls and micro relief and irregular parcelling.

Young sand reclamations have a more open linear character with avenue planting. The Baronie is intersected by various streams and watercourses, like the creek system of Aa of Weerijs and Markin the western part of the Baronie (Province North-Brabant, 2014b).

Meierij
The Meierij is located between the cities 's-Hertogenbosch, Tilburg and Eindhoven. Surrounded by these cities it fulfils an important functions as a recreational area. The Meierij is positioned on the transition between high and low. Nature reserves are positioned on the higher sandy soils and in the lower creek valleys.

Characteristics
The landscape shares the characteristics of the Baronie but has one special feature which turned it into a tourist hotspot. Forest areas on the sandy soils consist of impermeable layers of loam, which prevented the water to infiltrate. Fens appeared in the middle of forests, creating spectacular water bodies surrounded by trees. The vegetation of the landscape is a mix of forests, tree lines and open and enclosed creek systems. The invention of artificial fertilizer lead to the young sand reclamations which are more systemically parceled in comparison with old mosaic parcels of the old reclamations (Province North-Brabant, 2011b).

Kempen
The Kempen is located in the south of the Brabant on the higher sand areas around Eindhoven and extends towards the Belgium border. The plain sand ridges have coars-sand and poor soils with a strong infiltration capacity. After infiltration the water springs as seepage in the creek valleys.

The landscape of the Kempen is intersected by the steam systems of Grote and Kleine Dommel, Beerze

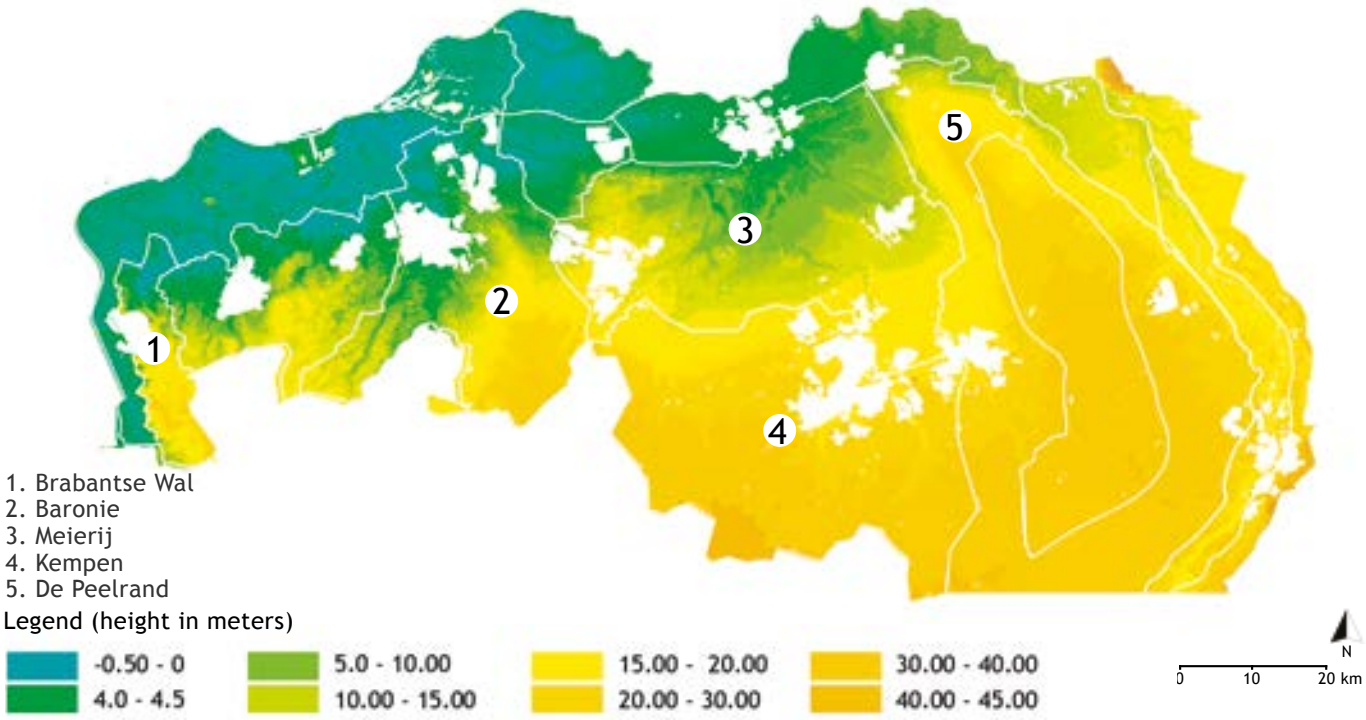


fig 3.18: Height map

fig 3.19: Meierij: Loonse and Drunense Duinen


fig 3.20: Meierij: visible plain surface sand

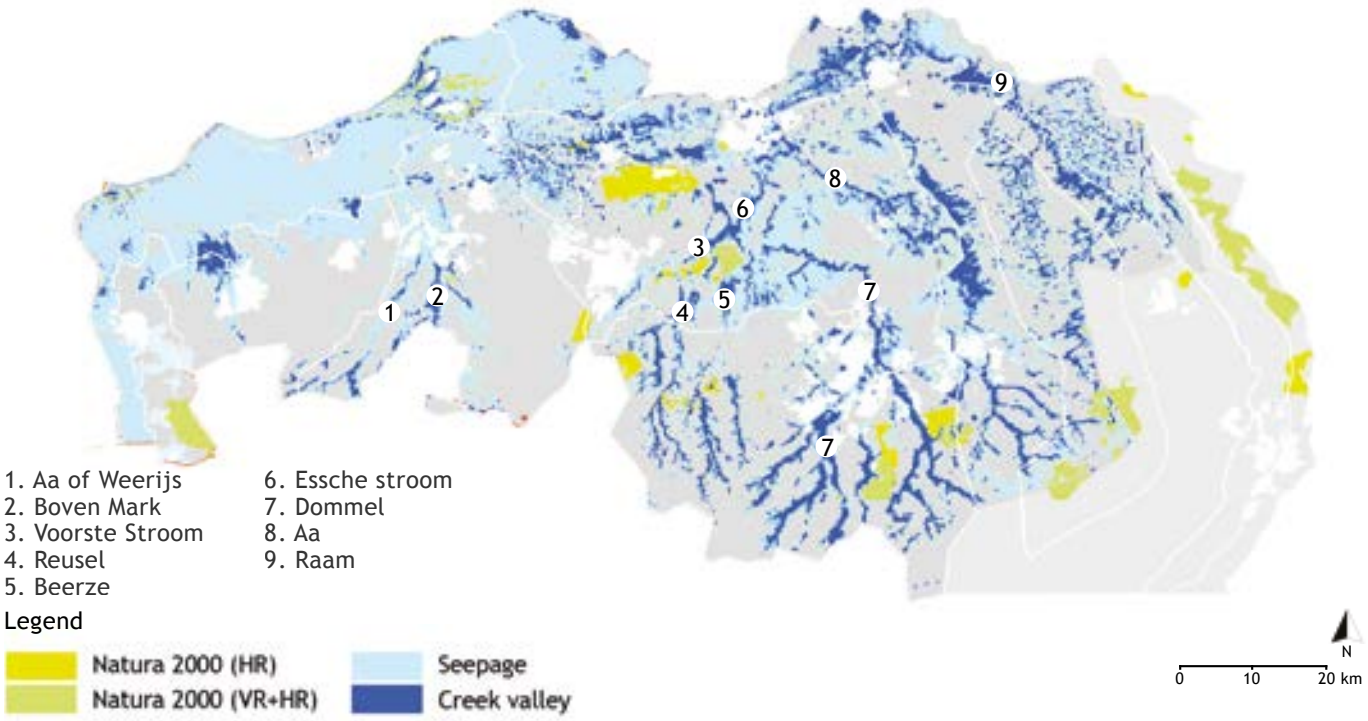


fig 3.21: Creek system and seepage

fig 3.22: Diverse land-use nearby Veghel

fig 3.23: Oxidating seepage water from the Peelrand crack

and Reusel. Parts of the Dommel and Beerze are culturally and historically pristine creek landscapes. The Kempen is a rural area with a mix of functions such as agriculture, nature living and recreation. (Province North-Brabant, 2014b)

Peelrand

The Peelrand is a small strip around the Peelkern and is part of the plain sand plateau deposited by the rivers. The western part of the Peelrand is more urbanised with larger places like Helmond, Deurne Uden, and Oss which are connected with highways. The eastern part is sparsely populated with smaller villages like Schaijk, Mill, Sint Anthonis and Overloon. Regional roads are connecting these places. Between the villages we find old ribbon developments. From these ribbon developments reclamations were started towards the Peelkern, the Meijerij and the Kempen.

The landscape can be defined as an old and varied sand landscape with a diverse mix of old and new agriculture settlements, arable land, meadows and forest. Historically characteristics are the old monasteries and hamlets which are scattered through the area. Farming up scaling farming is also in this landscape type a common phenomenon. Intensive dairy farming and greenhouses are dominant land users (Province North-Brabant, 2011b).

As shown by figure 3.21, there is some seepage in the area. This seepage is coming from the geological Peelrand crack. The crack in the earth crust is impermeable for water. This forces the water to spring to the surface which results in different water tables in front and behind the crack. (Janssen, 2009).

3.2.4 Peat landscape

The peat landscapes are located in the plain sand areas that, due to the lack of creeks, were unable to adequately drain the rainwater. The are actually situated on a sand layer because of the mining. Initially, they could be considered as a sand landscape, but since they differ spatially, we recognize them as a peat landscape

De West-Brabantse Venen

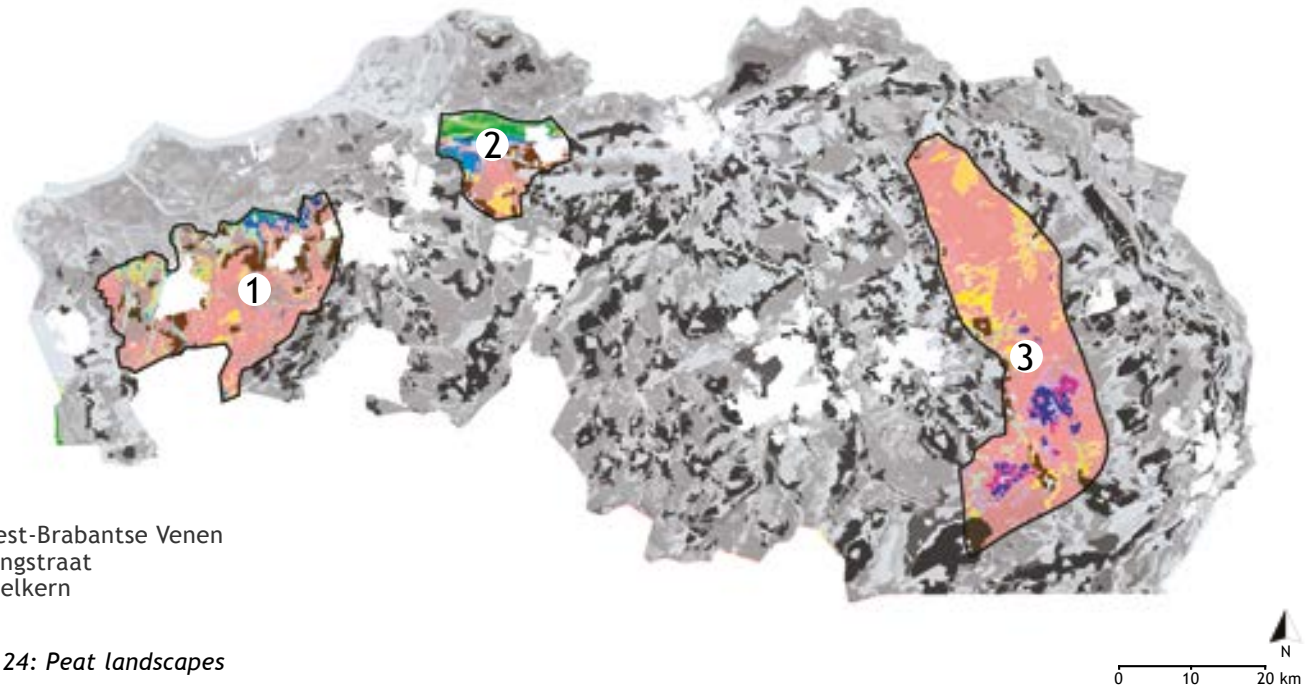
The West-Brabantse Venen are situated around Roosendaal and Etten-Leur. On the north it borders to the sea clay landscape. Due to a lack of streams around 1500 the landscape was completely covered by peat. Storm floods eventually swept away large parts. Residual peat reams who were excavated and minded by people. This peat mining was carried out by abbeys and monasteries. Characteristic of the landscape is the relative openesses and square parcelling, intersected by ribbon development and forest. These forest are planted to counteract drift sand, which occurred by the extensive sheep farming. (Province North-Brabant, 2011b)

Langstraat

The Langstraat is on the transition from sand to clay. It used to be part of a large peat cushion stretched between Dordrecht, Woudrichem and Heusden. Again large parts of the peat complex were swept away during the St. Elisabeth floodings of 1421. There is an enormous seepage pressure between the transition from sand to clay.

Characteristics

The landscape is layed out in a typical strip land parcelling with ditches, willow tree rows and dykes. Villages are developed in a ribbon along the small roads (Province North-Brabant, 2011b).



1. West-Brabantse Venen
2. Langstraat
3. Peelkern

fig 3.24: Peat landscapes

fig 3.25: Peat transport ditch

fig 3.26 Open Langstraat

fig 3.27: The Peelkern

fig 3.28: Peat mining

fig 3.29: Landscape nearby Elsendorp

Peelkern

The Peelkern used to be a former peat bog which worked like a giant sponge for the rainwater. The height of the peat reached up to a few meters and stood out in the landscape. Small pieces of peat were mined by villages but in 1850 and 1960, the landscape is systematically parcelled in large arable plots. A sand plateau remained with a strong infiltration capacity. The peat was sold in the city for fuel and as compost for the garden. In return, large quantities of manure were brought in to fertilize the soil, to make agricultural land use possible. Later also artificial fertilizers were used. The heather fields, which were too poor for farming were planted with pine trees for forest production. This explains the geometrical road structures. Some small pieces of heather and the nature reserve the Peel are still visible reminders of the old landscape (Province North-Brabant, 2011b). The Peel is a nature reserve which still has active growing peat layers. Some of the peat areas have been mined. This resulted in a diverse nature landscape of lakes, peat bogs and heather fields (wbdp, n.d.).

Characteristics

The Peelkern is a large scale agriculture landscape with a variety of arable lands and villages. The area has a rational parcelling structure, of large rectangular parcels which are bordered by channels and roads. Vegetation in the area consist of trees along the main roads and some forests.
Although the main function is agriculture, the poor sand soil is not the most suitable for arable crops. Therefore the landscape is defined by meadows and maize parcels. Along the roads we find large stables focussed on intensive farming of pigs, cows and chicken. The Peelkern is notorious for its farming reputation. The high density of intensive farming often raises discussions about the odour nuisance and animal welfare (Province North-Brabant, 2011b).

3.3 Landscape appreciation

This map shows an average appreciation of the landscape from the Dutch population, based on the physical landscape characteristic (fig 3.30). The selected characteristics consist out of two positive and two negative points. The two positive points are the availability of nature and historic characteristics. The two negative characteristics are urbanisation and horizon-pollution (Crommentuijn, Farjon, Den Dekker, & Van der Wulp, 2007).

The study stated by more small scale landscapes, like the sand areas in the south of Brabant are higher appreciated in comparison with the open landscapes. Sandy landscapes are more diverse and natural in comparison with the sea clay landscape which is more focused on agriculture, as already established in our landscape analysis. More interestingly for our research is the fact that open areas are more vulnerable for horizon pollution. Objects like highways are less appreciated in an open landscape in comparison with a more enclosed landscape (fig 3.31).
Within the sandy landscape there are differences, forest or nature reserves are highly appreciated. Areas affected by the upscalling of agriculture who lost their small scale character are negatively rated. For the model study the map will also be used to see which areas are highly appreciated on a more local scale. Areas which are highly rated in are giving an indication of the values of the landscape.

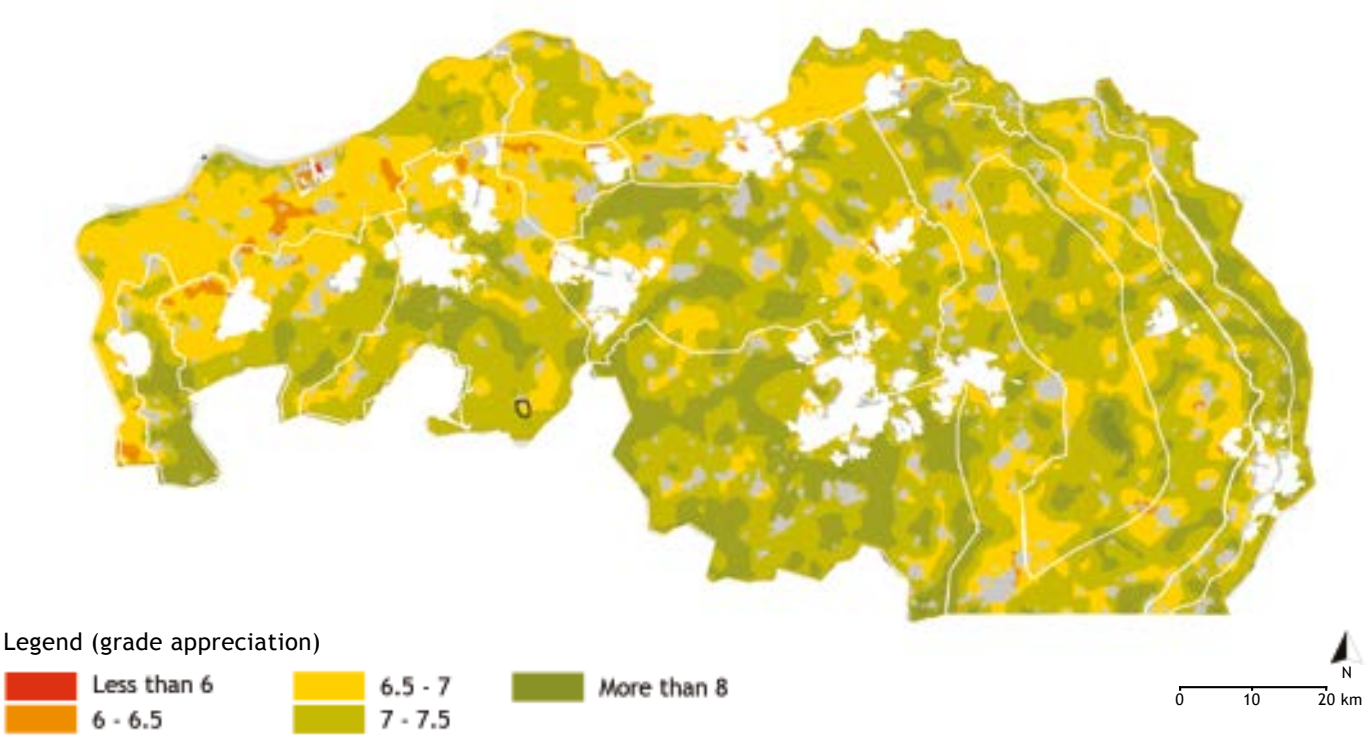


fig 3.30: Appreciation map

3.4 Landscape openness

This map visualizes the openness and scale of the landscape (fig 3.31). This map is defined by every object which is higher than the eye level. Elements like tree lines, forests, but also villages and cities are affecting the visibility (Meeuwsen & Jochem, 2011). For the integration of large object like XXL-distribution the openness of a landscape plays a role. The smaller the visibility of the object, the smaller the impact on the landscape (S. de Vries, M de Groot and J Boers).

Mitigation measures with vegetation only have an effect if the landscape is experienced as coherent or 'logic'. Planting a forest in a sea clay landscape to camouflage a distribution park will be perceived as a disturbing element, because of the open character of the landscape. Mitigation measures have therefore more effect if the object is located in a landscape with a variety of vegetation. This makes it easier for the object to blend in and become part of the landscape.

fig 3.31: Horizon pollution in the sea clay landscape

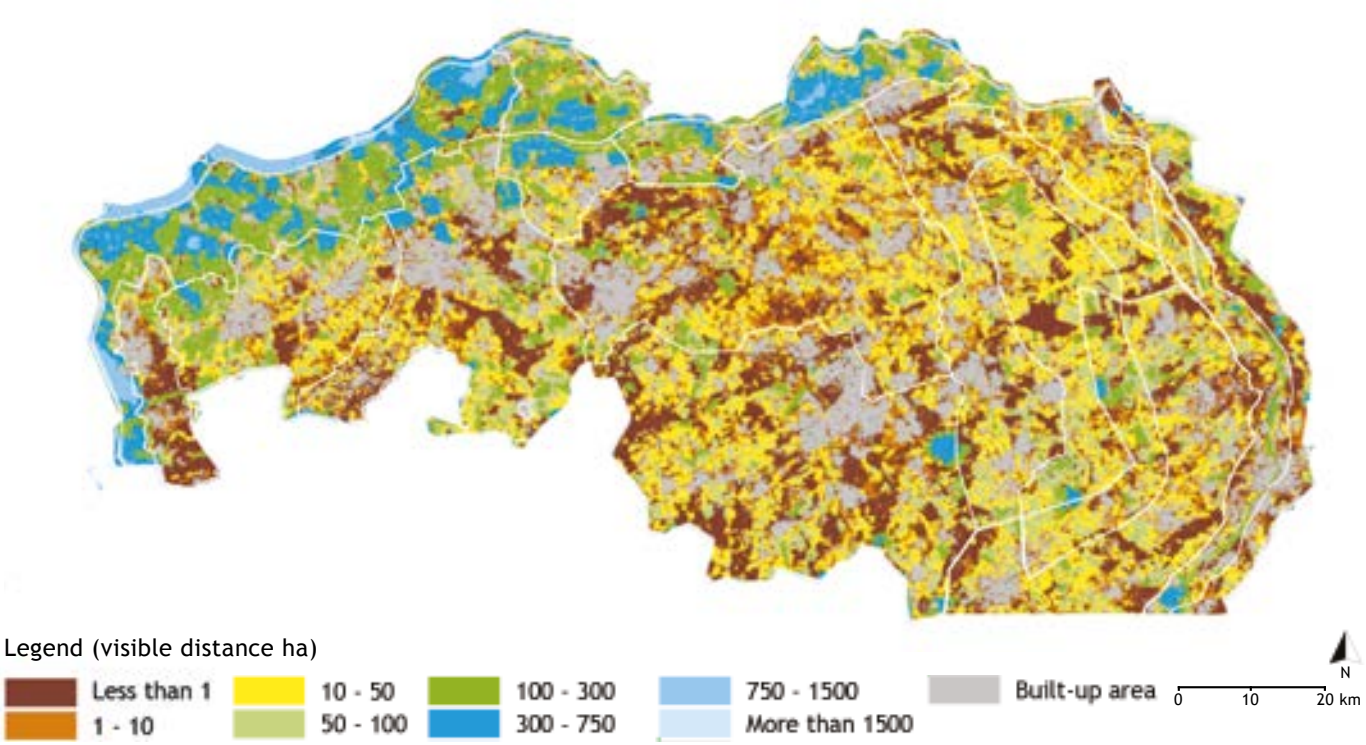


fig 3.32: Openness of the landscape

3.5 Conclusion

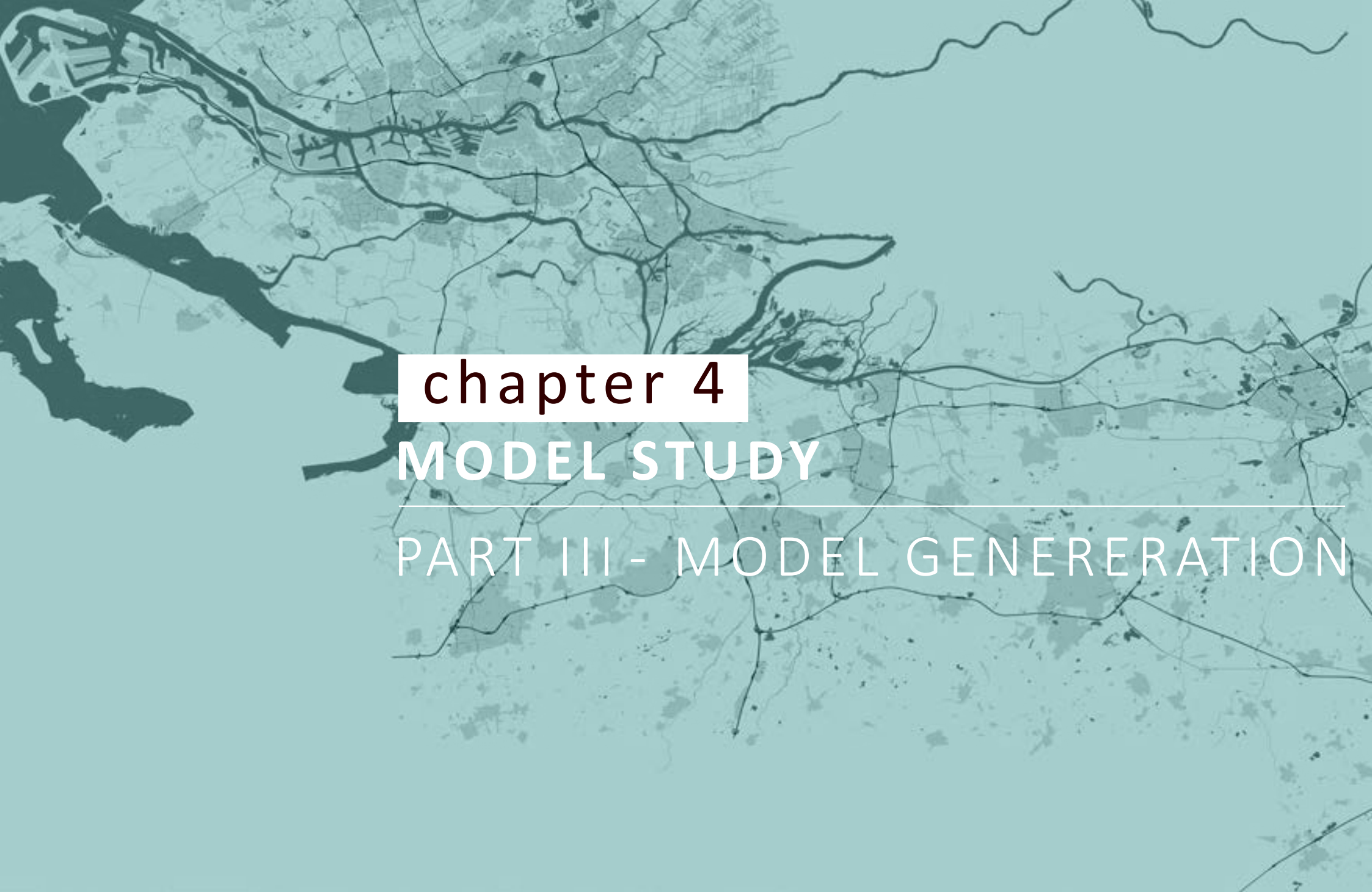
Based on the defined landscape characteristics, the landscape openness and landscape appreciation we are able to give a decision which landscape types are not suitable for XXL-distribution. The sea clay landscapes are open landscapes with none to little vegetation. Vegetation is mainly placed along the roads and especially for the sea clay landscape the openness is a precious element.
Removing this characteristic will lead to horizon pollution. This is similar for the river landscape of the Land from Heusden and Altena and the Maaskant. The Meusevalley on the other hand could be used for XXL-distribution, only behind the dikes.

This landscape is more enclosed by tree lines and forest clusters. Downside however is the small width of the area in combination with the existing functions as green houses, intensive dairy farming and tree nurseries. New elements such as XXL-distribution could lead to a cluttered landscape.

The sand landscapes are also suitable to integrate XXL-distribution because of its volume above eye level. The mixed use of functions framed by vegetation and mosaic parcelling limits the visibility. The reclamation of the pour sand soils resulted in forests, meadows and arable land. The landscape can be structured into three parts, the forest, the old and young sand reclamations and the creek valleys. Considering the nature values of the creek valleys and seepage we try to exclude these places as a potential position for XXL-distribution. Placing XXL-distribution in a creek valley would mean the area need to be raised to prevent problems with the water table. Old reclamations are also excluded because of its historical value and are high appreciated by the viewer. For the model study the young sand reclamations and forests nearby forests are the most suitable place for the positioning of XXL-distribution The forest has the density and size to compete with XXL-distribution and young sand reclamations are landscapes which are affected by upscalling and intensive dairy farming.

Peat landscapes are also suitable for XXL-distribution with a few exceptions. The West-Brabantse Venen consist of some open areas which are connecting to the open sea clay landscape. The Langstraat is a historical landscape with strip parcelling, which is extremely open. The Peelkern is however suitable for the implementation of large scale logistics. Although, there are some open areas the are also enough more enclosed parts. Mitigation measures of vegetation could easily be implemented and would be perceived as a part of the landscape.

For the model study there three landsapes out of four are suitable for XXL-distribution, the Meuse valley, the sand landscapes (Baronie, Meierij, the Kempen and the Peelrand)and the Peelkern



chapter 4
MODEL STUDY

PART III - MODEL GENERERATION

4.1 Modelling

This chapter visualizes the positioning of XXL-distribution on a regional scale with different options, illustrated by the models. To find the right positions, criteria from the logistic chapter are combined with the findings of the landscape analysis. The models will be rated after the modelling phase to get an overview of the preferred model. To receive more specific models, a few criteria are also used at the beginning of the modelling phase. This chapter will shortly describe both these criteria.

Growth

The growth of XXL-distribution is based on the prognosis of 550 hectares as established in chapter 2, which is predicted by the prognosis of Stec-group (2015). The aim to reduce the footprint of XXL-distribution, has resulted in the option of high bay warehouses, based on a reference study. Due to the stacking of floors the footprint of the expected buildings is reduced by 50 percent, in a more optimal integration even to 60 percent. This leads to a reduction of the expected growth of large scale logistics from 550 hectares to 275 hectares. The implementation will therefore consist of 275 hectares of XXL-distribution, positioned in North-Brabant.

Criteria during model phase

To define a specific model suitable for XXL-distribution, criteria are used in advance of the model making phase. Within each model the availability of these criteria are preferred:

- Small scale landscape
- Accessibility to a highway or provincial road
- Within the range of terminals (20km)
- Nearby power lines

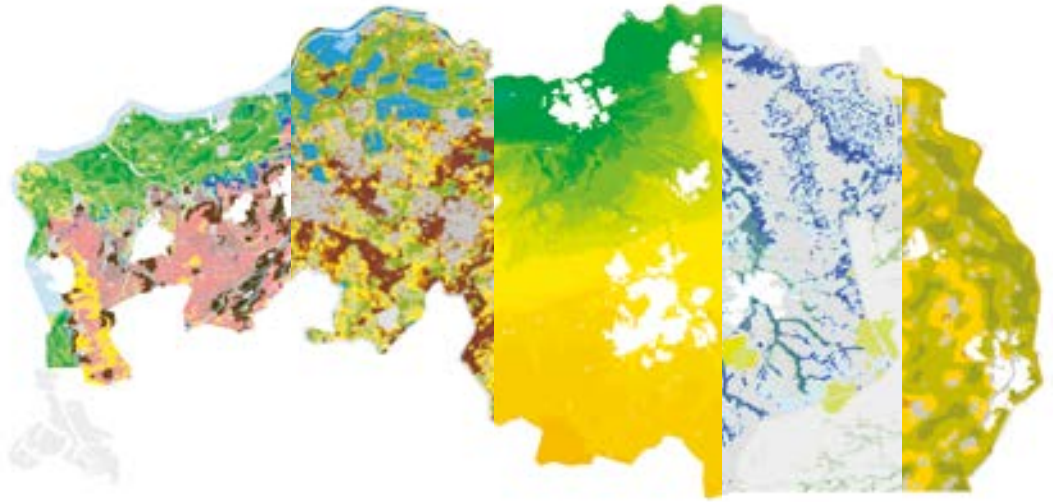


fig 4.1: Landscape analysis

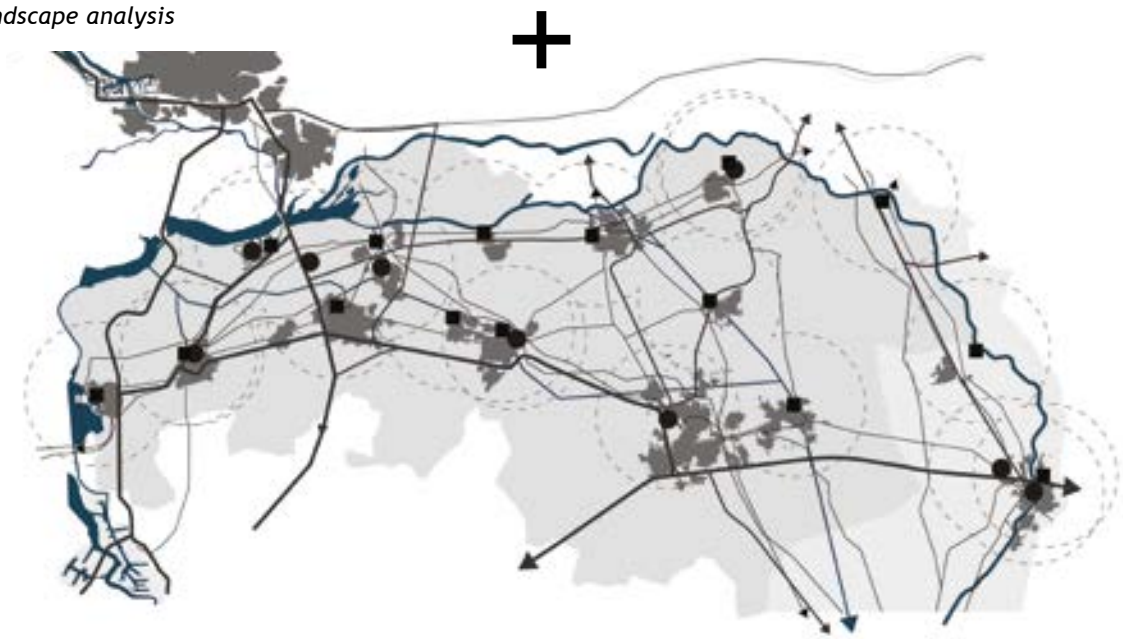


fig 4.2: Logistic landscape

Logistic- and landscape criteria
After defining the models, each model is tested on the following criteria:

1. Accessibility road: XXL-distribution prefers the option for a direct connection to a highway or four lane N-road. Other option is a direct connection towards a two lane N-road (Stec-group, 2012).

2. Accessibility terminal: XXL-distribution should be positioned within a range of 20 kilometres of a terminal (Stec-group, 2012).

3. Proximity to the market: a central position close to a densely populated market is in favour for XXL-distribution, because it limits unnecessary truck movements to the market. We have to keep in mind that the Netherlands is a small country and target markets may differ between companies (Stec-group, 2012).

4. Nearby logistic suppliers: logistic suppliers offer cluster benefits by sharing facilities like trucks service centres. Industrial parks within a range of a 20 minutes drive is considered as nearby (Stec-group, 2012; 2015).

5. Power line: power line connections are as important as a good road connections. Logistic industries are large energy users, especially with the growth of automation.

6. Land prices: land prices are included to give an indication. These are based on the ground prices from Boerderij (2019).

7. Working environment: based on a close proximity of a city. Places which are sparsely populated are for example not scoring high on this segment (Stec-group, 2012).

8. Nearby disturbing function: clustering disturbing factors like green houses or existing business parks give an idea of the value of the landscape. Pristine landscapes will be more vulnerable by XXL-distribution, in comparison with a landscape which is already fragmented.

9. Landscape type: based on a landscape analysis we prefer XXL-distribution in the sand and peat landscapes. Integration in landscapes with a lot of vegetation is more convenient in comparison with open sea clay landscapes.

10. Influence of water: we prefer infiltration zones for the positioning of XXL-distributions. The increase of heavy rainfall due climate change is a worrying element for areas with large roof- and asphalt surfaces.

11. Openness landscape: based on the landscape openness map, areas are selected with semi-open landscapes till enclosed landscapes. To reduce the impact of XXL-distribution in an open landscape. Open landscapes are defined by a visibility between 100-1500 hectares. Semi-open landscapes are defined by a visibility of 50-100 hectares and the enclosed landscapes have a visibility of less than 1 - 50 hectares.

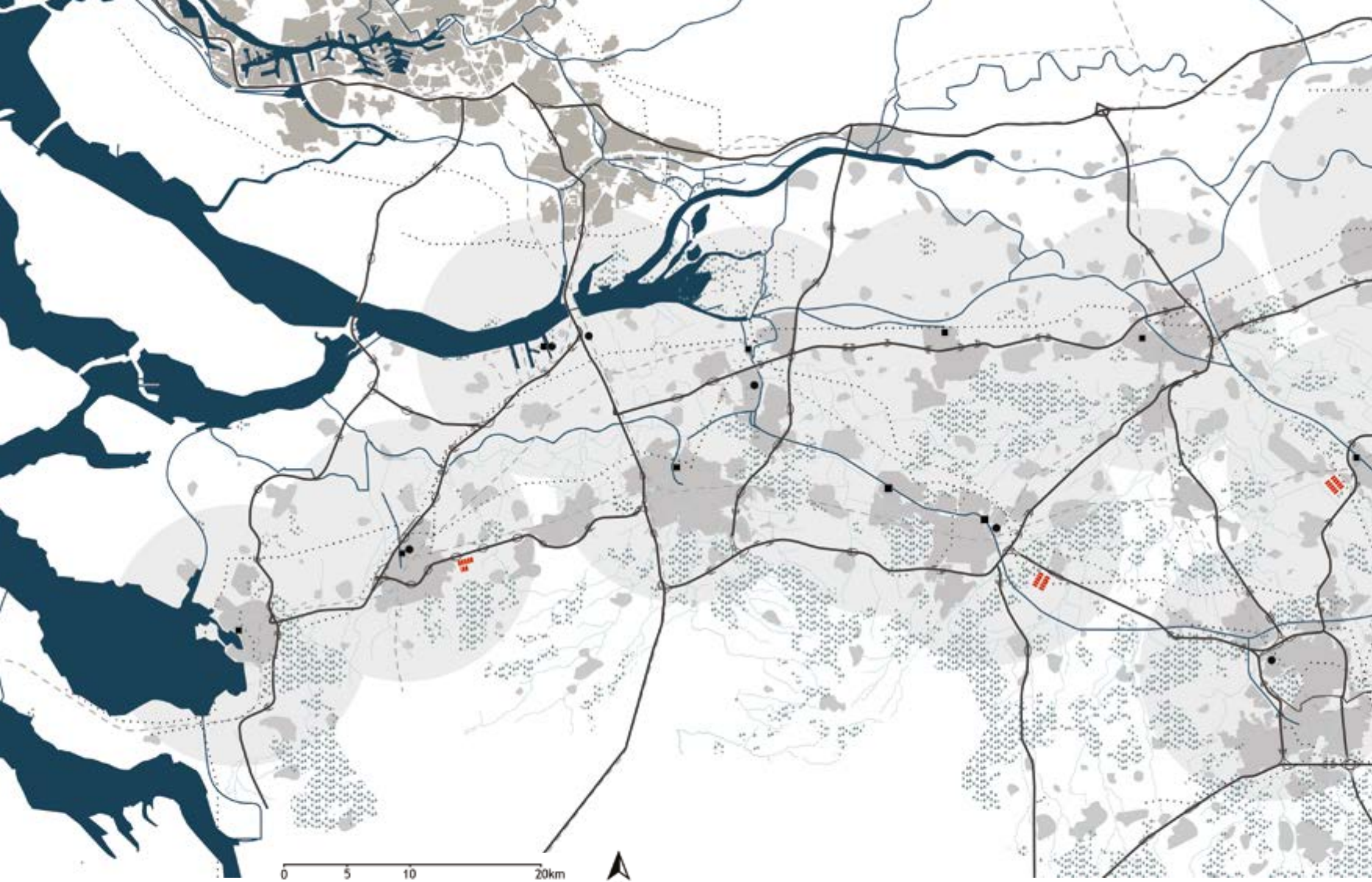
12. Position to existing functions: some nearby functions are preferred for existing functions like airfields or cities. For employees or business flights. Positioning nearby Natura 2000 areas need to be prevented.

13. Landscape appreciation: landscapes rated with a 7.5 or more are excluded as a possible location for XXL-distribution. These are often precious landscapes with a high historical- and natural value.

The model types
To explore the opportunities for XXL-distribution and in order to find multiple locations the models can be divided in clustering- and scattered options. Clustering options are dividing the 270 hectares in three or four sizable chunks in the landscape. Suitable locations needs to score high on criteria like accessibility or the position to labour. The impact on the landscape will be bigger because of the increased number of truck movements to one central point.

Scattered options consist of two logistic companies, with a total of 20 hectares placed in the landscape. Scattered options could be more flexible and easy to integrate in a small scale landscape. Spreading out the logistics could also lead to a negative impact due to the urbanisation rate of the landscape.

fig 4.3: Implementation compared with Tilburg` `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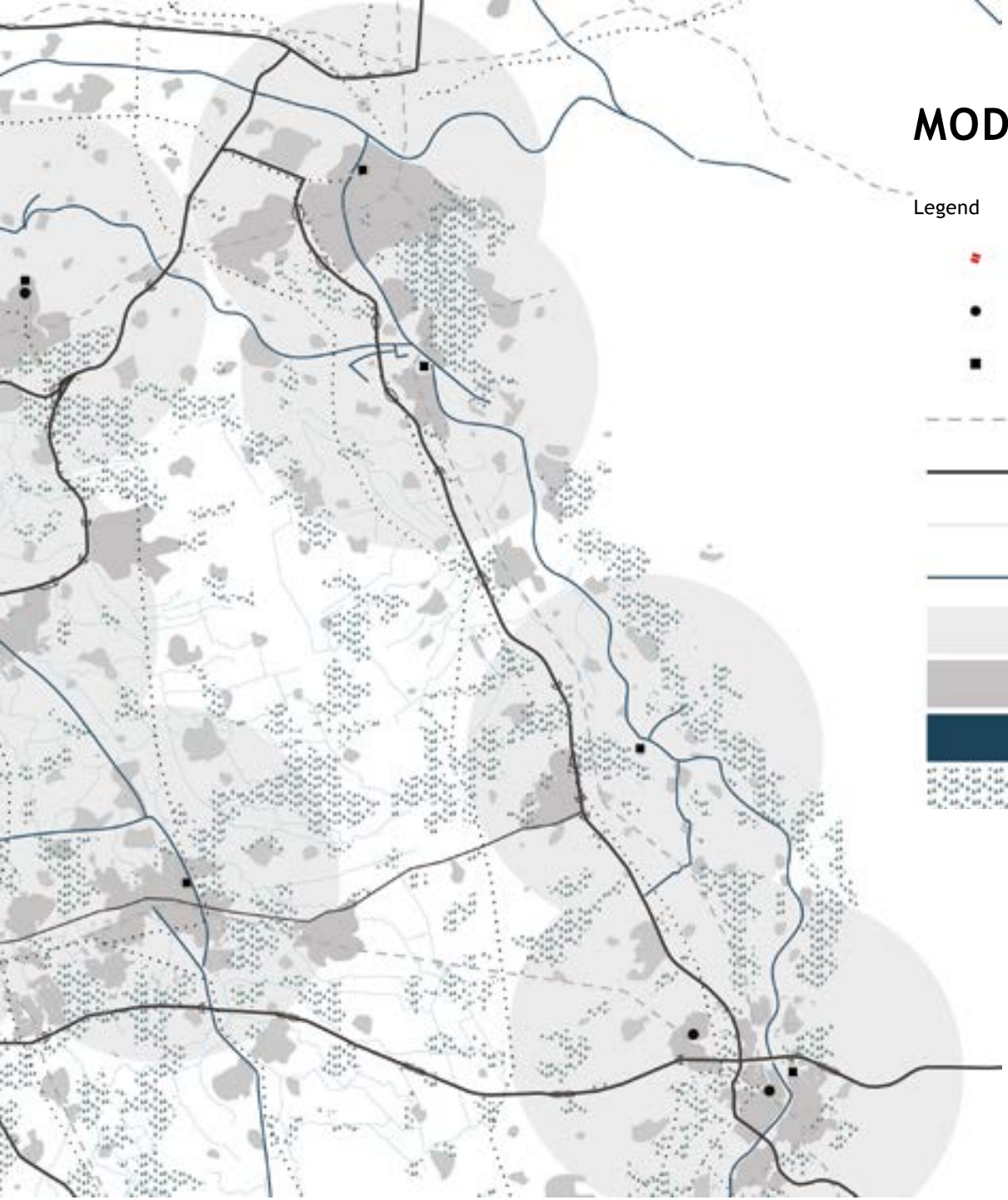
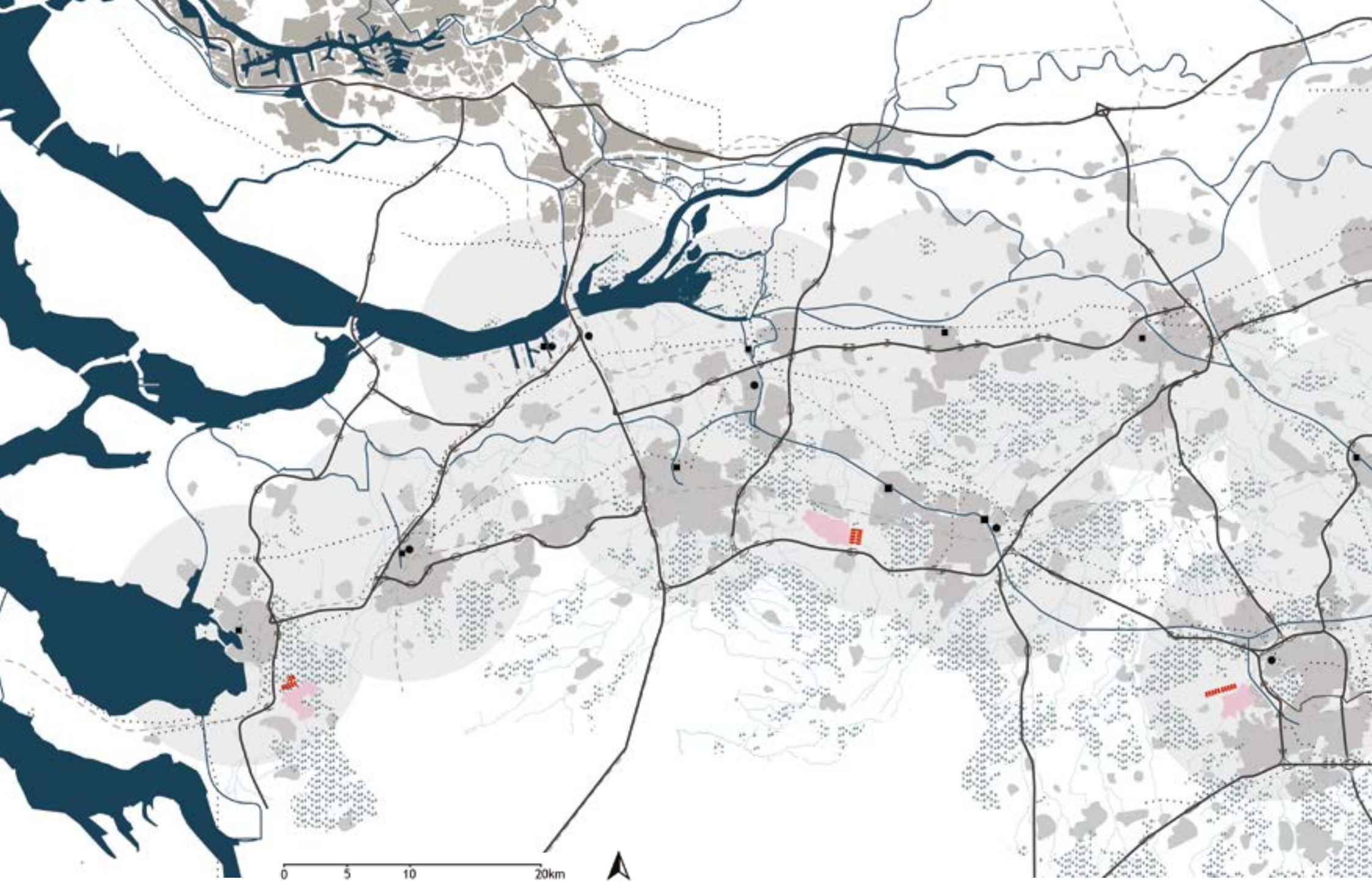


MODEL 1

Highway - clustering

The highway model is situated around the main highways the A58 and the A50. The logistic parks are positioned in three large clusters of 90 hectares in Veghel, Tilburg and Roosendaal. All these locations have a direct connection to the exit of the highway and are bordering to existing industrial parks and distribution parks. For the models we are taken into account the landscape characteristics of the lower creek valleys and the higher sand soils. Lower creek valleys have a strong ecological value and are depending on a ground water table. This is hard to match with the standards of the logistic parks. Most logistic parks in low areas are raised with a meter of sand to prevent flooding. Consciously choosing for a higher sandy soils prevents unnecessary adjustments of the landscape to implement new developments. An additional benefit from the highway model is that the highways are often clustered with the network of power lines.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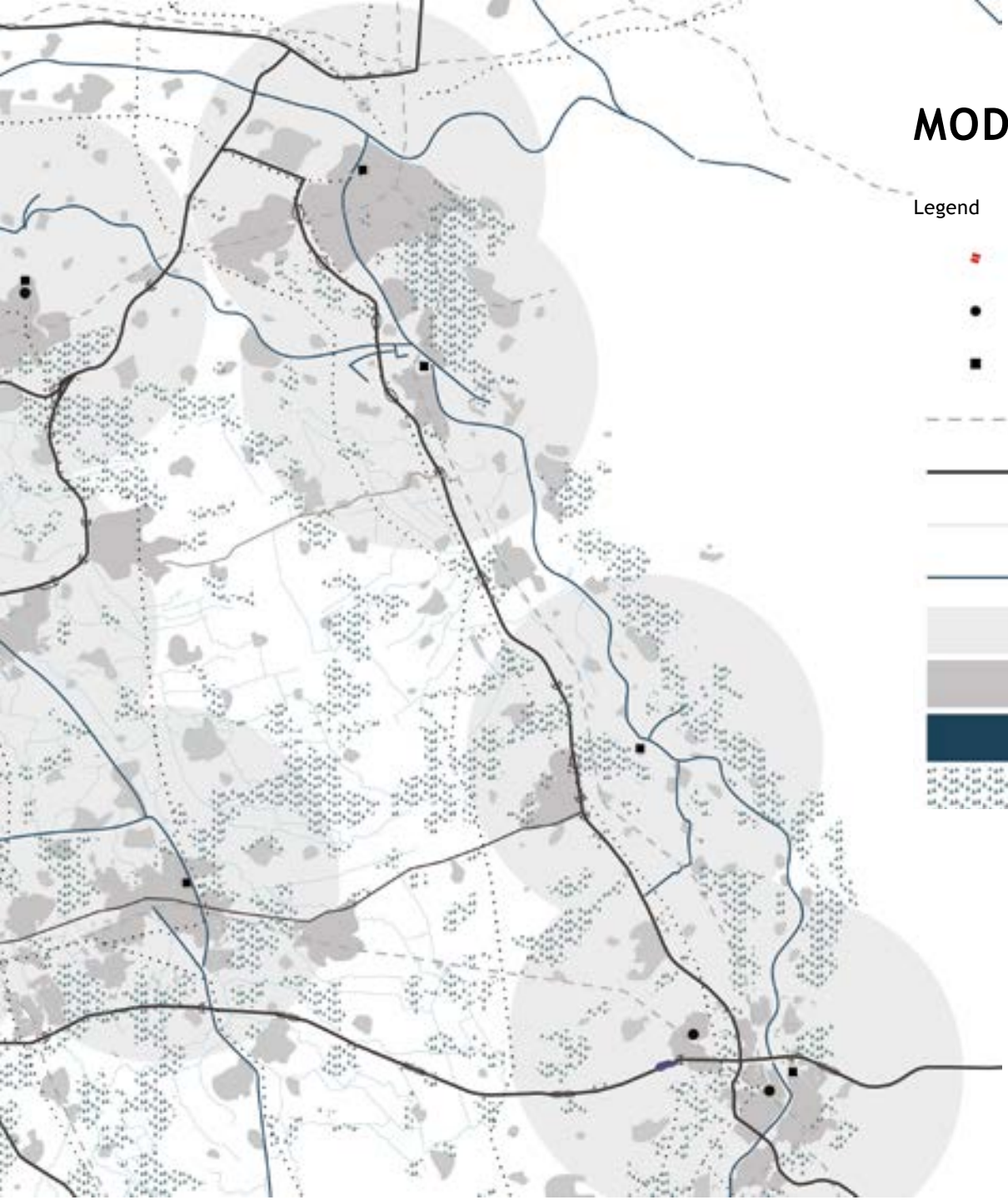
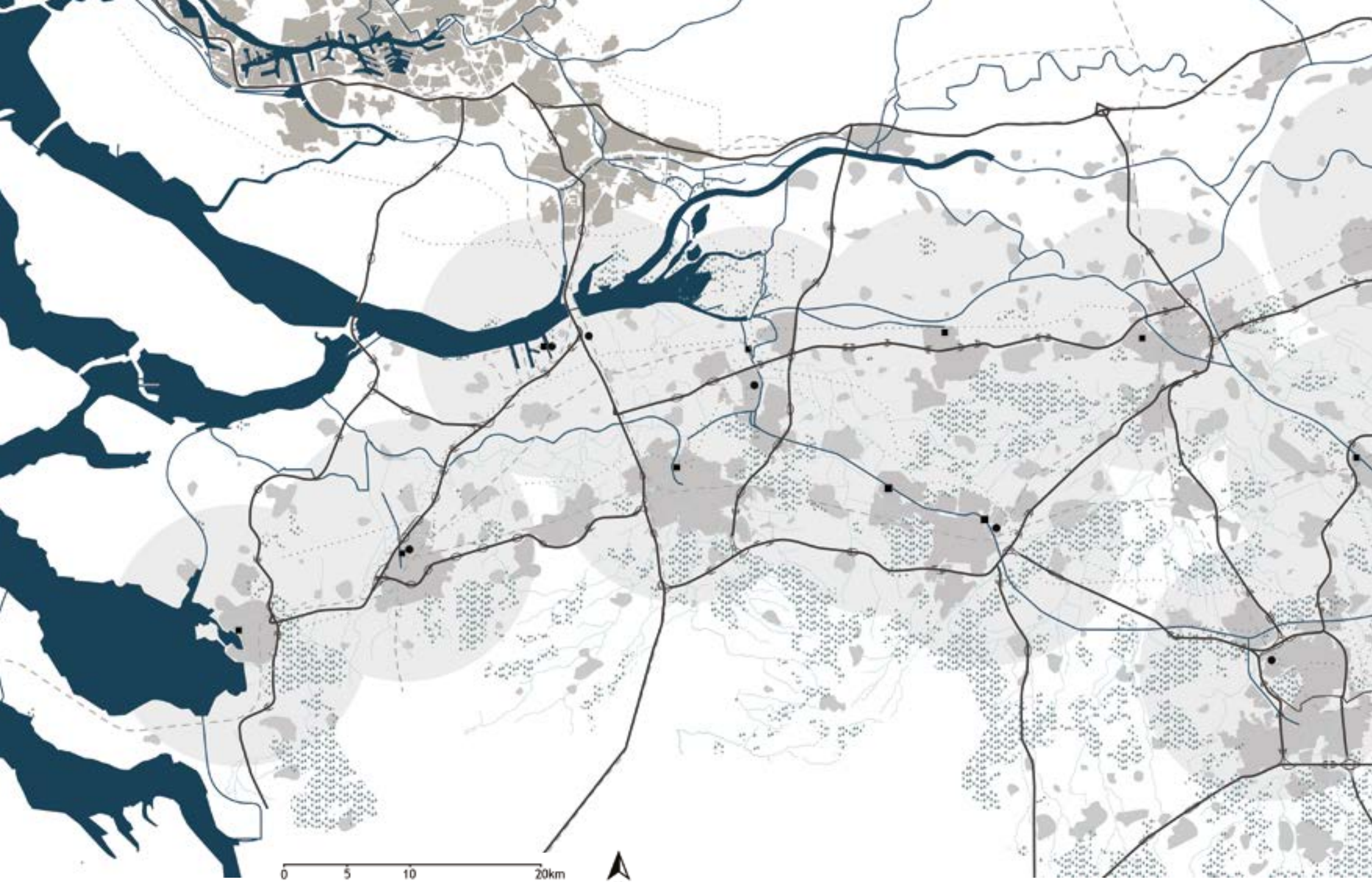


MODEL 2

Airport - clustering

The airport model focuses on the landscapes which are less desirable. One of them is the landscape surrounding airports, the noise of airplanes is combined with the nuisance of trucks. The chosen airports are Woensdrecht, Eindhoven and Gilzerijen. All these airports have a good highway connection and are closely positioned to the bigger cities. This is helpful to find the necessary labour. The airports of the Peel and Volkel are excluded because of the lack of a central position and connectivity. Some remarks are necessary for building around airports. Most of the times there are building limitations regarding the heights of the buildings. Also there are zones where it is not allowed to built because of the safety regulations. Areas around the start and the end of the runway are reserved, to make sure that if a crash happens there is enough runoff area.
The height limitations are causing a problem for the implementation of the XXL-distribution park. The high bay warehouses are exceeding up to 45 meters. Also some airports have a military function and this could conflicts with the function of logistics. Airport Woensdrecht also borders to the edge of a protected Nature 2000 reserve. This limits the options to expand.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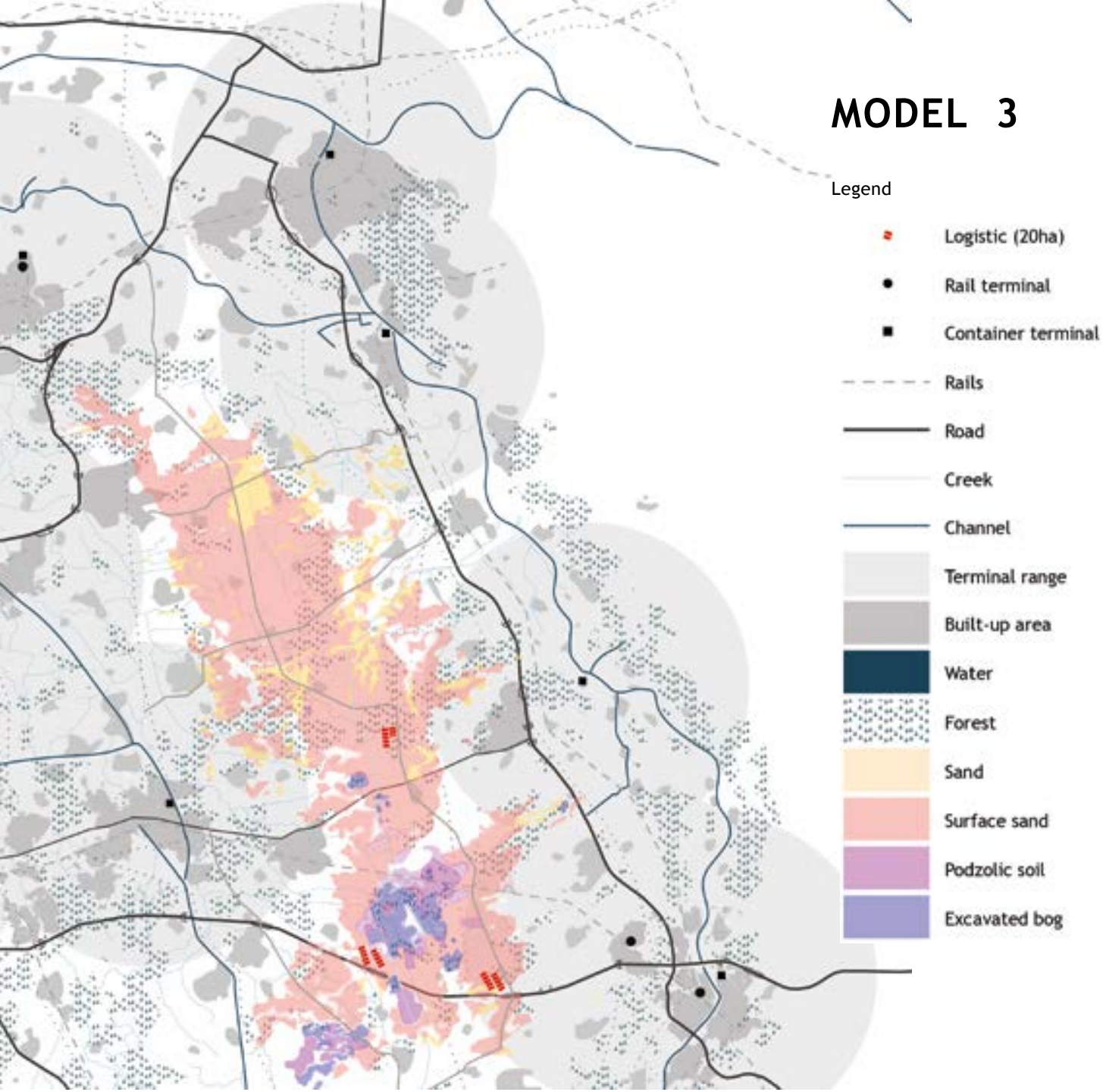
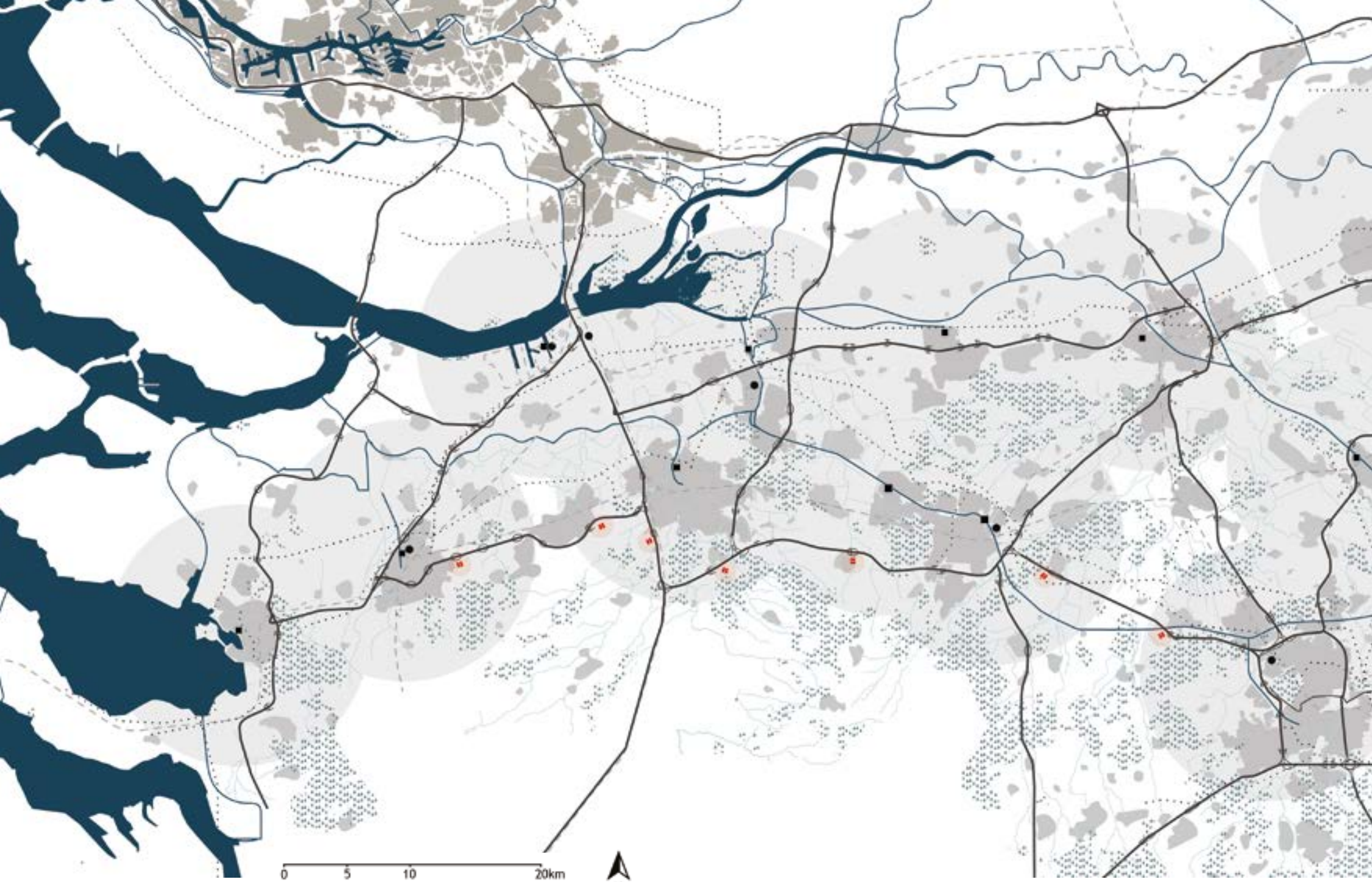


MODEL 3

Peel - clustering

The Peel area is located on the border of Brabant and Limburg. It current functions consists of a lot of intensive dairy and pig farming. Similar to the airport model this can be seen as an unwanted landscape or a production landscape. In the region there is a constant debate about this type of farming, resulting in conflicts between inhabitants and farmers. Also the nature areas are difficult to maintain due to the added nutrients and low ground water tables for agriculture. The XXL-distribution buildings are positioned in clustered into the area. This to guarantee a good accessibility close to the highways. Unfortunately the area the Peel lacks a good connectivity. Only the A58 highway crosses the area, this limits the amount of places for the positioning of large scale logistics. It should be noted that the Peel is a sparsely populated area what makes it difficult to find the necessary labour. One of the options is to create a public transport connection with Venlo or Eindhoven to supply work forces. With its close proximity to Venlo the area is competing with Trade park North. This competing position would possibly have negative consequences for both parks and the availability of labour.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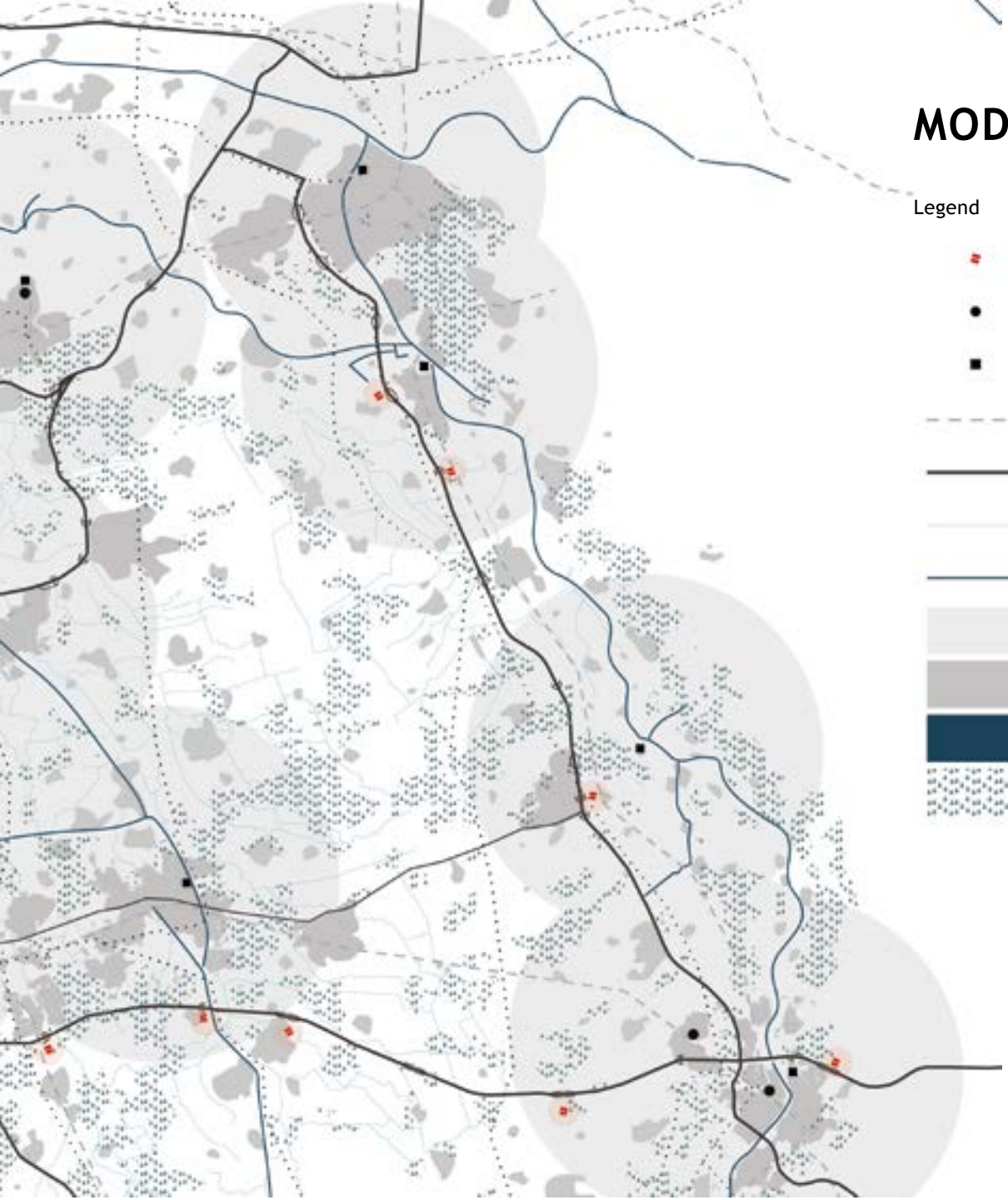
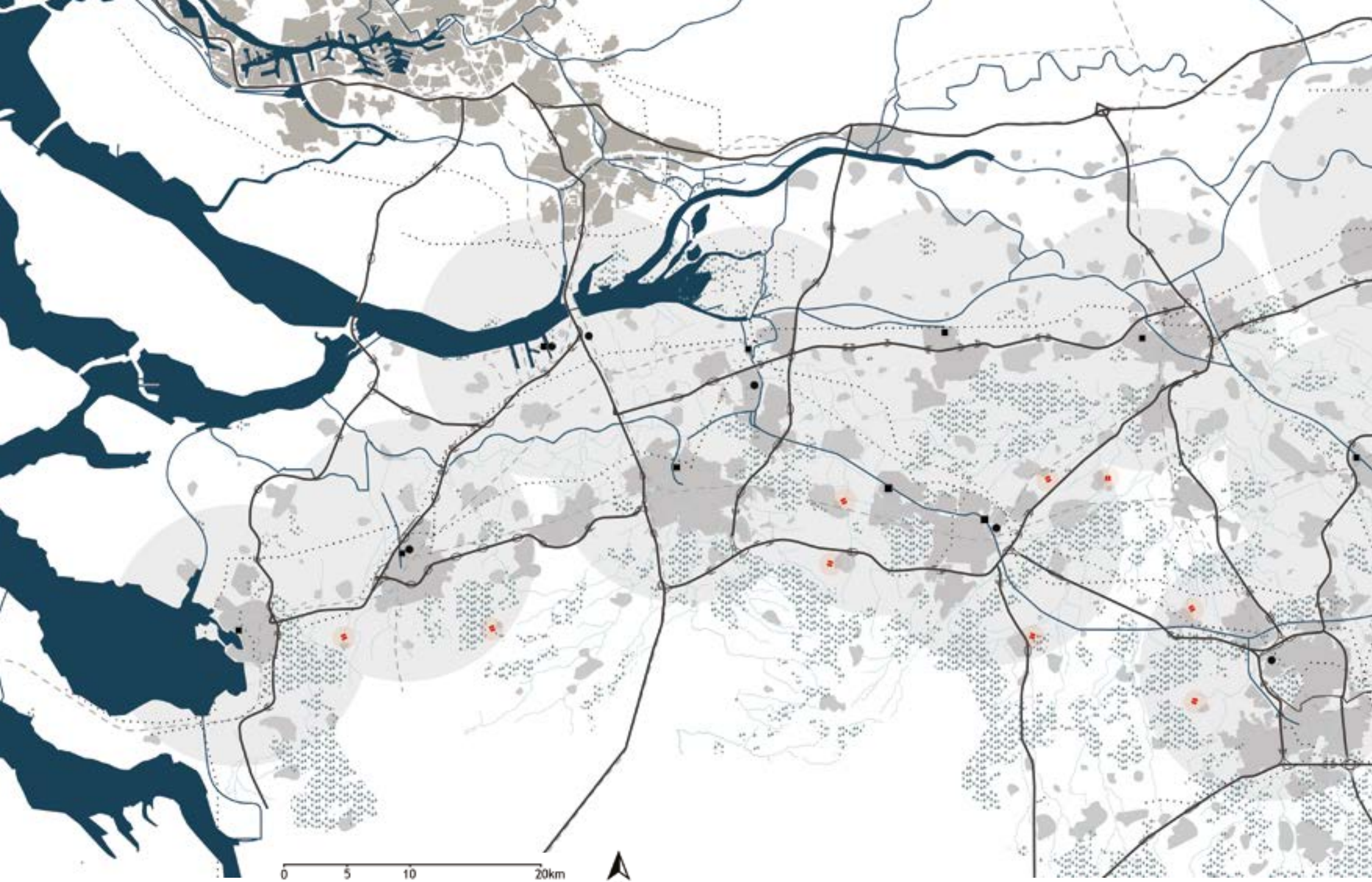


MODEL 4

Highway - scattered

The model Highway scattered shows the effect of spreading out the logistics along the highways. There are more possible locations suitable but we prioritized the main transport axis from Brabant and Limburg. Due to the dense network of terminals every location is within the 20 km range. With spreading out the locations over a larger area the total increase of logistic seams small. However, it is increasing the urbanisation rate of the country side. The danger could appear that in the coming years the locations are expanding due to the ongoing growth of the E-commerce market and demand for parcels. In the Netherlands it is policy wise easier to expand a industrial park if there is already one. Building new industrial parks will especially in the landscape cause a lot of resistance under inhabitants. Because the buildings are higher the XXL-distribution will be more visible from a larger distance and will appear more often into the landscape on multiple locations. To reduce the visibility the buildings are placed into the semi-open sand landscape.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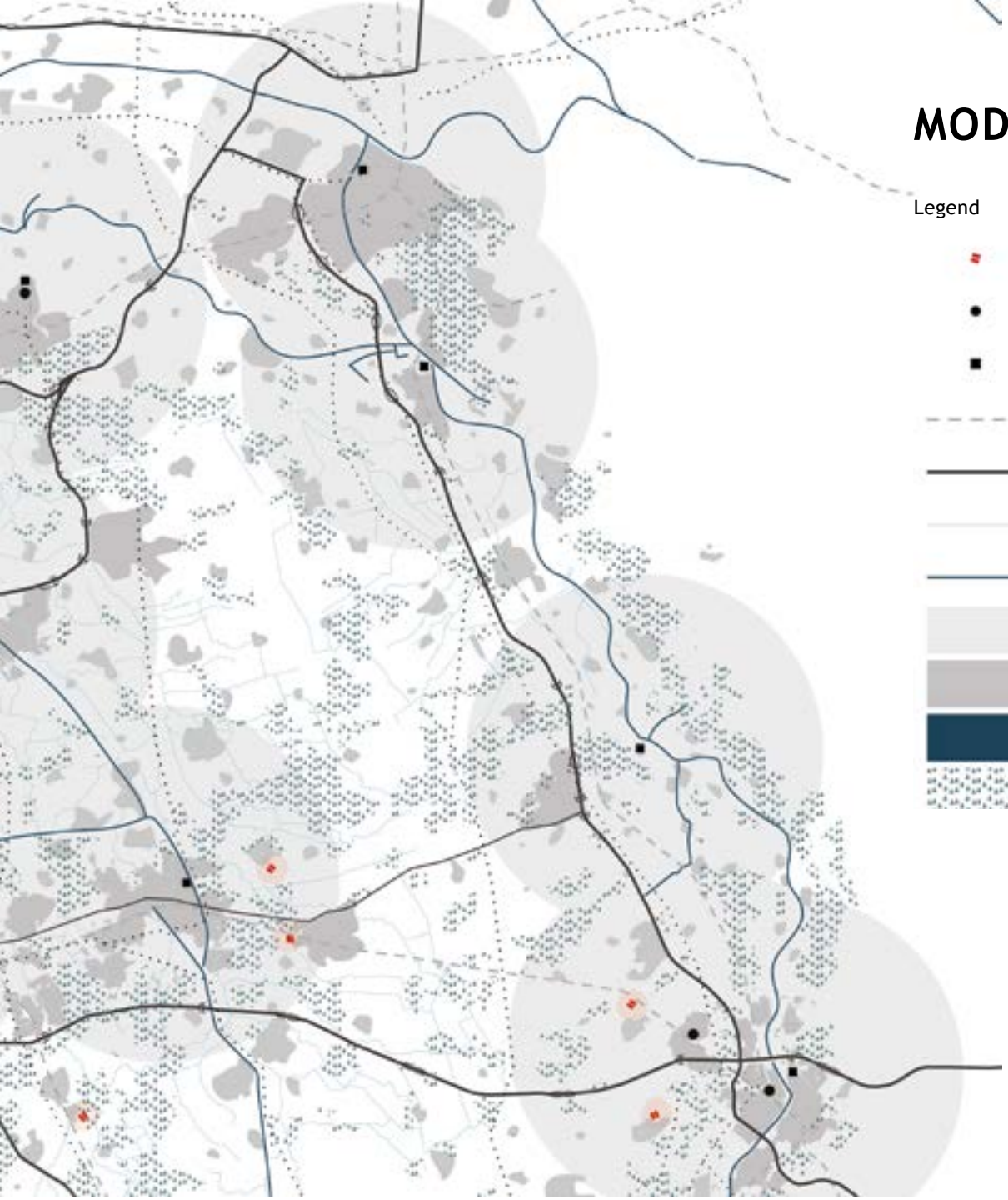


MODEL 5

Village - scattered

This model studies the opportunity to locate XXL-distribution on the outskirts of the villages.
The diverse landscape of Brabant is full of smaller villages besides the larger cities. Only the villages are selected with existing industrial and distribution areas. Spreading out the logistics over villages is an interesting concept. The expansion of large XXL-distribution parks will be prevented, invading the landscape. The logistic will be an extra facet of the landscape. Larger logistic parks tend to dominate the landscape into a boring and dull area. Each villages gets 20 hectares of XXL-distribution which needs to be implemented. The connectivity remains a difficult point for the logistics. Truck movements will increase on the local roads, which could cause traffic congestions or at least nuisance.

Implementing large scale logistics will also impact the identity of the villages. Most villages maintained over the years there small scale character. It should be considered that inhabitants have specificity chosen to live in a more quiet rural environment. The logistic park will probably change this identity and affect the liveability.

4.2 Conclusion

After defining the 5 models each model is tested based on formulated criteria on theory of logistics, landscape integration and the analysis of the landscape.

Model 1 - Highway, clustering

Model highway is a model what scores high in the table on the criteria from the logistics and that of the landscape. The locations are well connected and are located by the bigger cities in Brabant. The close distance to cities is a benefit for attracting labour. The chosen locations are close to cities who are already active in the XXL-distribution world. Together with nearby existing distribution parks this model is interesting for expanding companies who do not want to move their logistics out of the region. The locations are settled in the sand landscape and offer enough space to implement larger logistic clusters.

Model 2 - Airport, clustering

Model Airport scores like the model highway high on logistics and the implementation into the landscape. Difference with model 1 is the fact that most airports are surrounded by elements who have a negative impact experience on the landscape. Elements like fences and noise pollutions, it is interesting to cluster these elements. Disadvantage is the regulations regarding the building heights and the possible no-go zones by military airfields. Unfortunately this makes the airport not realistic to accomplish.

Model 3 - De Peel, clustering

The de-central location of the Peel is affecting the score on the peel model. The lack of highway connections and terminals makes it unattractive for XXL-distribution. Although, there is some intensive farming what creates odour pollution, the Peel is a relatively prestine landscape without a

			Highway C	Airport	De Peel	Highway S	Village S
Category	criteria	sub-criteria	model 1	model 2	model 3	model 4	model 5
1	accessibility road	highway (exit) or four lane N-road	✓	✓	x	✓	x
		N-road (two lanes, unhindered)			✓		x
		other roads					
2	accessibility terminal	presence terminal / quay in close proximity	✓	✓	x	✓	✓
3	close proximity to the market	central position	✓	✓	x	x	x
4	nearby logistical suppliers	cost reduction by logistic clustering	✓	✓	✓	x	x
5	powerline	380kw or 150kw net	✓	✓	✓	x	x
6	land prices (per ha)	81-90			x		
		71-80					
		61-70	✓	✓		✓	✓
		50-60	✓	✓		✓	✓
7	working environment	availability and offer	✓	✓	x	x	x
8	nearby disturbing functions	highway	✓	✓		✓	
		business park		✓		✓	
		fence		✓	✓		
		greenhouses					
		campsite					
		large new barn			✓		
		powerline	✓	✓	✓	✓	
9	landscape type	sea clay landscape					
		river landscape					
		peat landscape			✓	✓	✓
		sand landscape	✓	✓		✓	✓

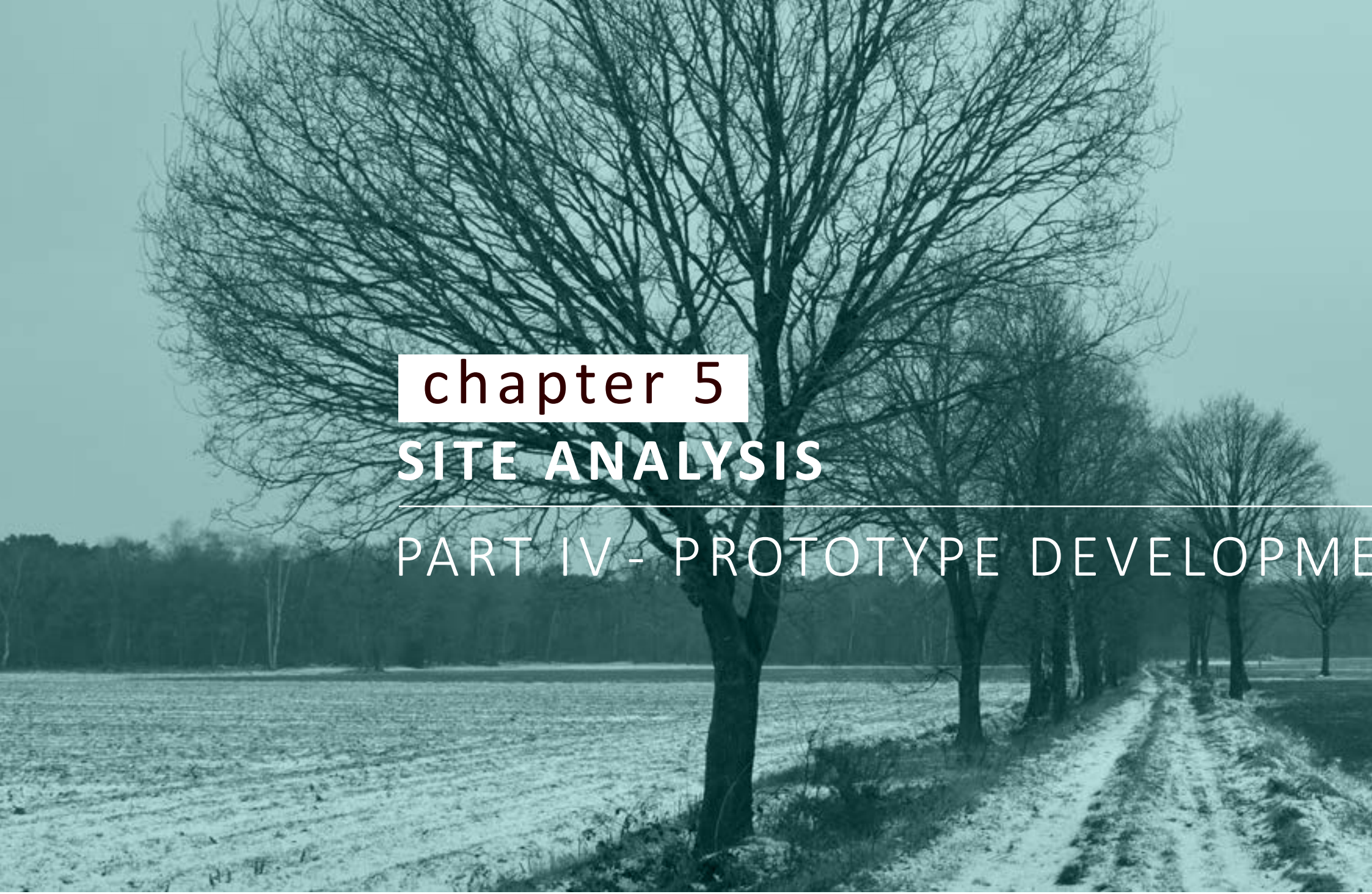
			Highway C	Airport	De Peel	Highway S	Village S
10	influence of water	seepage					
		creek valley		X		X	X
		infiltration zone	✓	✓	✓	✓	✓
11	openness landscape	open landscape					
		semi-open landscape	✓		✓	✓	✓
		enclosed landscape	✓			✓	✓
12	position to existing functions	business park	✓	✓		✓	✓
		city	✓	✓			
		airfield		✓			
		natura 2000		X	X		
13	landscape appreciation	less than six 6					
		6 - 6.5					
		6.5 - 7	✓			✓	✓
		7 - 7.5	✓	✓	✓	✓	✓
		7,5 - 8		X	X	X	X
		more than 8					
		score	18	15	3	9	3

lot of disturbance factors. Also the landscape can be defined as an semi-open landscape towards an open landscape. Therefore the score is both on the logistics and the landscape scale low.

Model 4 - Highway, scattered
Model highway scores relatively good for a scattered model. Because the buildings are placed on a close proximity to the highway there is a good connectivity. Due to the dense network of terminals it is still possible to stay within the range of the harbour and rail terminals. Disadvantage of scattering logistics on the large scale is the larger impact on the landscape. The high bay warehouses will be visible from multiple points into the landscape along the highway. Because there are more locations necessary it is more difficult to locate every logistic park on the preferred higher sand areas. Some locations will be located in the lower creek valleys.

Model 5 - Village, scattered
With the location of large logistics on the borders of villages we create an interesting model but not so positive for the landscape or logistics. The villages are selected based on existing business parks. Villages without any industrial or business park are excluded from the model. The effects on the landscape will be large on the landscape experience. Local roads have to deal with more heavy traffic and the landscape will be more urbanised. The lack of disturbing elements will result in an element what stands out in the landscape due to its scale.

After comparing and measuring all the five models it seems clear that model 1 (highway) and 2 (airport) have the most potential. Model 2 is however not suitable due to the building limits around airports. Model 1 will be further elaborated by choosing one specific site out of three.



chapter 5

SITE ANALYSIS

PART IV - PROTOTYPE DEVELOPME

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5.1 Location

In the previous chapter we defined the best model for positioning with logistic and landscape integration criteria. This model, The Highway clustering model, consists of three prime locations for the positioning of large scale logistics. In this chapter we choose one location which will be further elaborated with a specific analysis.

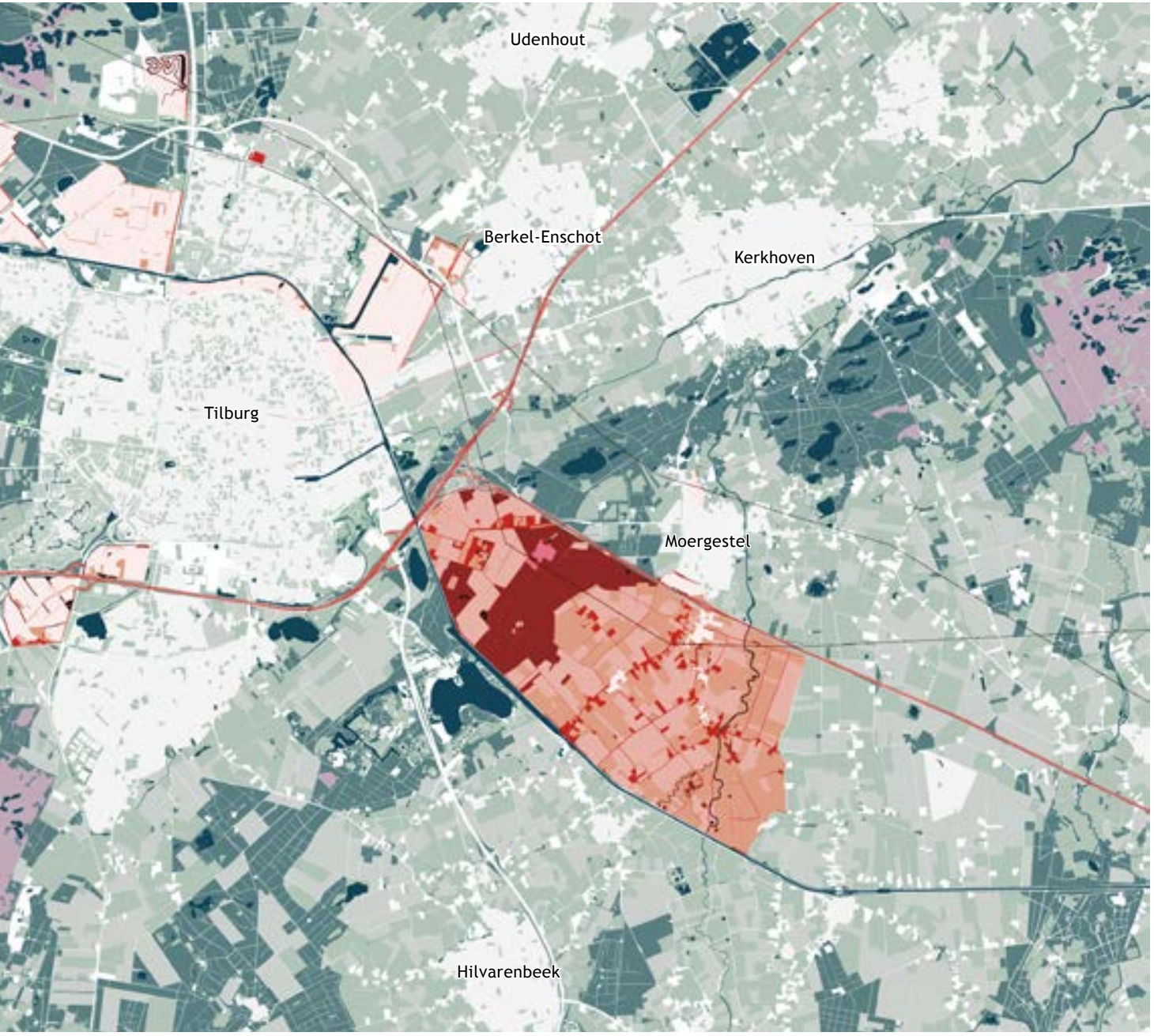
The site is located in the middle of North-Brabant. It is strategically placed between the highway A58 on the north and a water connecting in the southwest provided by the Wilhelmina channel. The area is part of the municipal territory of Tilburg and Oisterwijk. Important to mention is their different identities and approach to industrial areas. Tilburg is a major city with a population of 217.000 inhabitants (Allecijfers, 2018). The city is a mix of different architecture styles with classical and modern buildings alongside each other. Some of these buildings are especially tall for Dutch standards and are classified as skyscrapers. Often people describe Tilburg as the most "ugly city" of Brabant. Purely a subjective opinion of course (Wikipedia, 2019a).

Tilburg's current economic layout is relatable to historical periods. The city used to be an important player in the textile industry. Hundred thousands of sheep's provided the wool on the endless bare heather fields. However, due to the global market and large cotton cultivation in Europe the prices of products dropped. Low labour costs in Asia and North-Africa made it impossible to continue any longer do to the strong competition. Not only Tilburg, but also other cities in the Netherlands lost their main economic driver. After this economical disaster municipalities were forced to look at new economic activities. This was found in the service sector, education and industrial parks. Tilburg's industrial zones are located on the north of the city, with excellent connections to, road, train and boat and are a major part of the cities footprint. Industries vary from manufacturing, processing and transport. The city defines itself as logistic hotspot and embraced its industrial economy. To prevent stagnation and provide growing opportunities for existing companies the municipality is actively searching for ways to expand their current industrial parks (Wikipedia, 2019a; Logistiek.nl, 2019)

On the north side of the project area we find Moergestel. Located along the creek the Reusel, it is a small village with around 5000 inhabitants. Moergestel has a history of leather industry and shoemakers. Shoe factories used to be a strong economy for the village. Similar to the textile industry also the shoe industry disappeared overtime. The Van Bommel shoemakers are the only well known brand who survived. Current industrial zone's are located in the north and a more recent one is development in 2016 the south built along the A58. The industry parks consist of local, companies. Both industrial zones are relatively small in comparison with Tilburg's industrial footprint (Wikipedia, 2019b).

On the southwest side of the project area, on the other side of the channel there is a large water body owned by the Beekse Bergen Safari park. Originally this area used to be heather and forest landscape before 1950. To attract more tourists and provide recreation the province decided to develop it into a theme park. The lake is dug in 1950 to provide sand for the built of railways, neighbourhoods and industrial areas. In a period of twelve years the sand winning transformed the area in a recreational water body with a holiday park (Wikimiddenbrabant, 2017).

fig 5.1 Location project area



The project area

The project area is located at the east of Tilburg and on the south of Moergestel. The area is borderd by the A58 and the Wilhelminachannel. By bridges and tunnels it is possible to cross both obstacles. The area stretches out to the creek valley the Reusel in the east and is bordered by the A58 in the west. The area has mainly an agricultural function. Parcels are used for dairy and horse farming what results in grass and maize fields. In the centre of the area we find a forest, with a few heather patches.

Legend

5.2 Landscape history

The name Moergestel summarizes the landscape of the project area. 'Moer' stands for moore or peat and Gestel for higher spot in between two rivers. Moergestel is strategically placed at the edge of the creek valley Reusel. The creek supplied fresh water and the higher parts provided the necessary safety during floods. Farming happened around 1850 mainly along the creek on a small scale manor. Parcels were fenced off by hedgerows and tree lines. Expanding arable land was not an easy task. The sandy soil needed to be fertilized (Wikipedia, 2019b). This was done with the help of the heather landscape. The huge heather landscape between Tilburg and Moergestel was a bare open landscape with a few forest clumps (fig 5.1). To gain any profit from the land, sheep's were tend, which provided wool and the valuable manure. The manure was collected in the straw beds of the stables and mixed with heather. Distributing the manure over the land resulted in Brown "Enk" earth soils with a suitable layer for agriculture. The mining of the heather landscape was not only done by farmers but also monasteries. In 1880, French monks settled in a few farms and a sheep-pen and started cultivating the surrounding land. Due to the pour sandy soils and the growing monastery the need for an extra income was high. The monks found a solution in a small beer brewery to supplement their income. This new income generated the ability to expand the monastery by adding the characteristic towers in 1891 (fig 5.7). The beer is still their main income source (Koningshoeven, n.d.).

From the 18th century the landscape is changing on a radical scale. Tilburg and Moergestel are expanding. New connections are made by the Wilhelmina channel and the highway A58. The Wilhelmina channel finished in 1923 and built for the transport of coal and textile, almost lost its function due of the decline of the textile industry. However

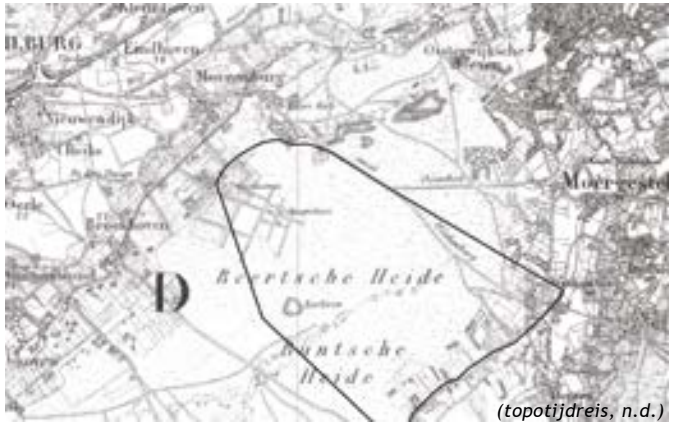


fig 5.2: Historical map of 1850

fig 5.3: Historical map of 1900

fig 5.4: Historical map of 1965

fig 5.5: Historical map of 2010

the upcoming inland shipping of sand, gravel and containers lifted the burden of the invested money. New inventions for agriculture such as artificial fertilizer, barb wire and planning approaches made it possible to expand the arable land. Farmers were no longer depending on sheep's or cows for their manure. Hereby the heather landscape started to disappear by the young reclamations. Also the decline of the textile market made sheep farming no longer profitable. Already from the beginning of the 18th century people had a great aversion towards under used areas such as the heather grounds. The municipalities tried to encourage the cultivation of the heather landscape by selling it to private parties. Large areas were sold with the claim to be made productive or planted with trees. This resulted into large landowners who experimented with the transformation of heather in farmlands, forests and estates. Forest production was a profitable business and the wood could be used for the mines in Limburg, and for telegraph poles. Hundreds of hectares of the fast growing foreign pine trees were planted to provide enough materials for the construction of the mines. The mines closure in

fig 5.6: Soil type map

1970 mend the production was no longer necessary. Estates could exceed over 400 hectares. Many of them were later sold to nature organisations. Some of them are still in private hands. What is left is a continuous nature corridor from Belgium to the Kampina national park on the most pour soils (Overland, 2015).

The inventions in agriculture made it possible to upscale the productivity of the agriculture production by the transformations of heather landscape to arable land. There was also a flip side to these developments. Not only the higher parts massively changed also the lower wetter parts. Creeks were straightened and ditches were dug for better drainage. Land consolidations made the scale of the landscape change to a more open landscape with a monoculture of grasses. These radical changes led to a loss of flora and fauna. Special species were seen in the wet creek valleys were never seen again. In the last 20th century many of these interventions were revered to restore the flora and fauna. This will be elaborately described in the coming paragraphs.

fig: 5.7: Trappist monastery

5.3 Green connections

On the west and the east of the project area we find two creeks, the Reusel and the Voortse Stroom. The Reusel used to be for 1930 an area with a high diversity of vegetations of swamps, peat and wet grasslands. This resulted in a wide variation of habitats for animals and plants. After 1930 the Reusel lost its valuable wetlands and was converted into a small channel useful for agriculture with a low water table. In 1990 the paradigm changed towards a more natural way of farming. By redesigning the agriculture landscape, nature habitats could be restored. And made it also possible to reserve more space for water retention. Changes continued after 1990 with a positive effect for the nature. The area measures now 700 hectares which is managed by nature organisations and farmers. The water table is raised to provide interesting habitats for birds. Wetlands are recreated by removing the topsoil, to create pour soil conditions for special plant species. Special birds and plants are re-occurring in the area such as Godwit, Redshank and the Snipe (Staatsbosbeheer, 2018; province north-brabant, 2019c).

The forests in the centre of the project area is part of the EHS corridor. Due to forest management the nature corridor can be differentiated in areas with its own characteristics. The nature reserve Kampina, located into the northwest reminds the most about the landscape dating back to 1800. It is a special area due to the low position in the creek system. Fens and creeks are running through the area and are creating dry and wet conditions for species. Although it seems a natural heather landscape, it is a human made landscape. In the 18th century it is extensively grazed by sheep. Trees are cut for firewood and small fens were dug to mine the peat layers. This led to a open landscape impacted by the human presence. In 1900 the landscape had time to recover from the exploitation and transformed

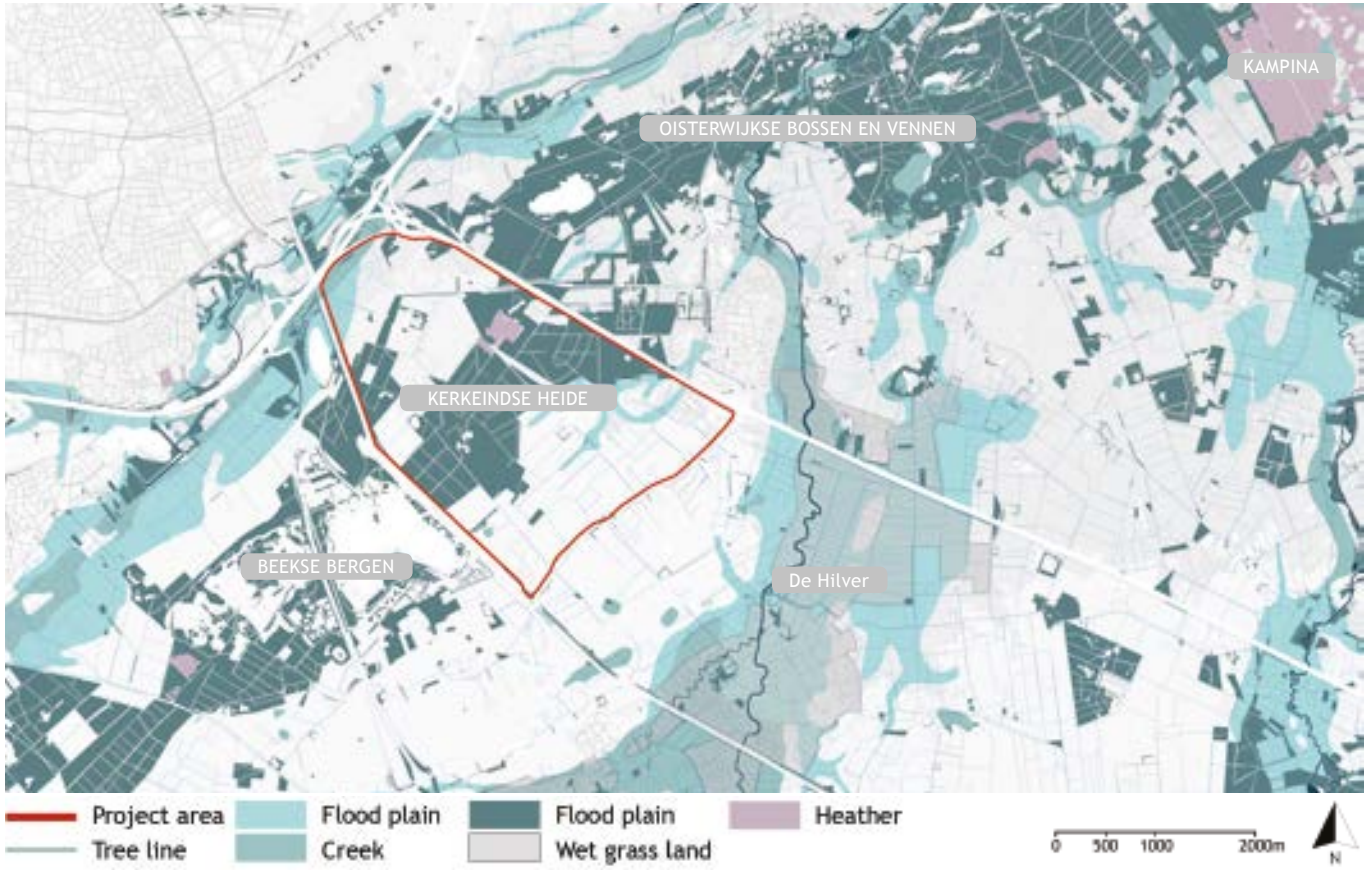


fig 5.8: Green

slowly towards a forest. This process is stopped by the nature organisations. Trees were cut again what resulted in one open heather landscape what we now know off. Currently it is an area with forest, wet heather fields and creek valleys. The wet heather fields are a specific vegetation type what is quite rare in the Netherlands (Overland, 2015).

On the west of Kampina we find the Oisterwijkse Bossen en Vennen. Like the Kampina this is a formerly heather landscape exploited by sheep farming. This area got the time from 1850 to gradually transform into a forest. Large groups of

fig: 5.9: Oirschotse Bossen en Vennen

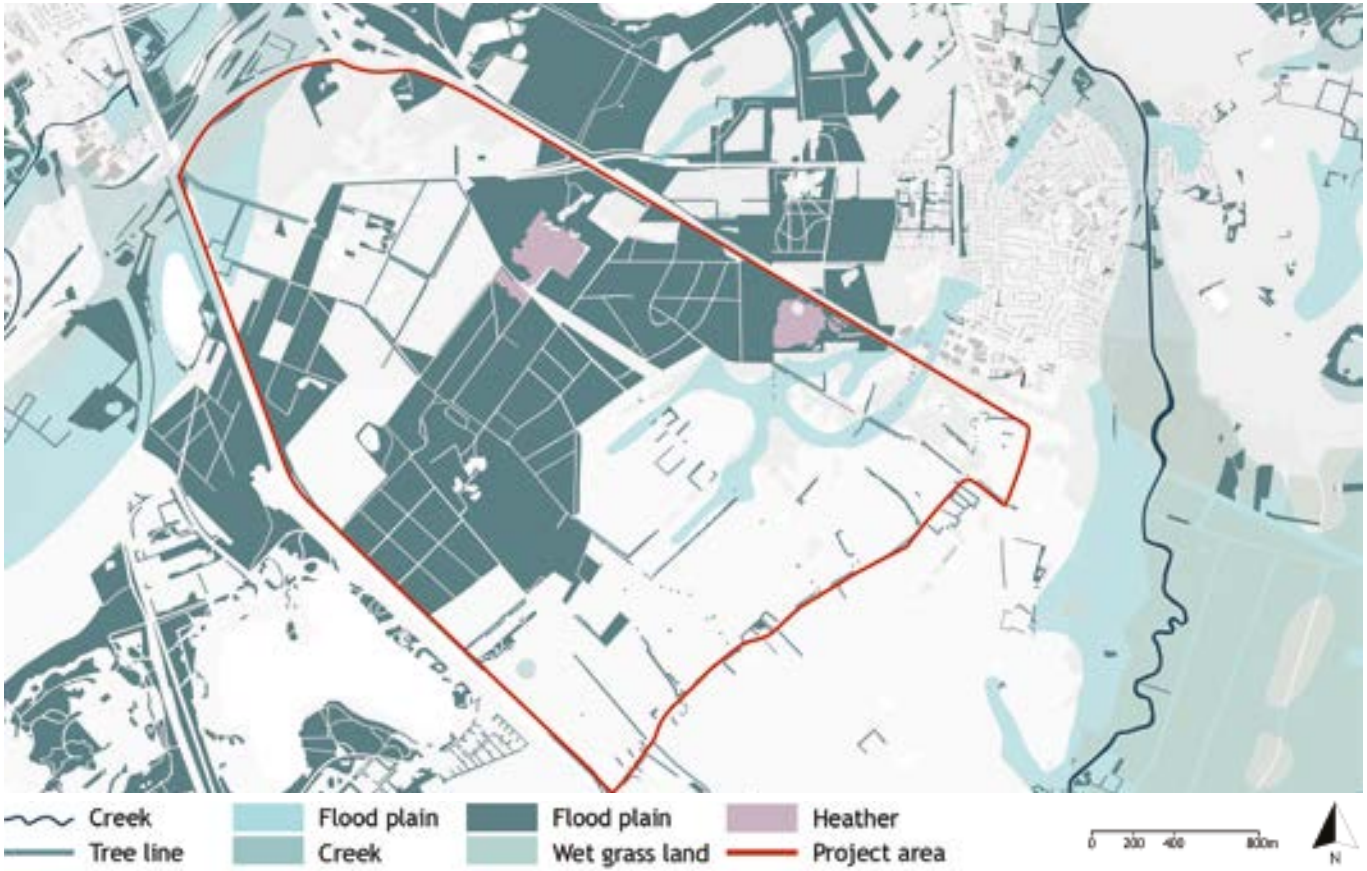


fig 5.10: Green project area

fig: 5.11: Godwit nature reserve the Hilver

fig: 5.12: Viviparous lizard

pine trees were planted to speed up this process. This in combination with the ferns resulted in an area which is unique for the Dutch landscape. The combination of a forest and endless reflecting fens results in a spectacle immersion of green. From an early stage tourist were attracted to the area. On the edges of the nature reserve we find a few estates. Some of them are still privately owned, but are working together with nature organisations to enhance the ecological network (Overland, 2015).

Project area

The Kerkeindse Heide is a small 220 hectares forest centrally placed in the project area. In-tangled between the highway, the monastery and the channel. The forest consist mostly out of pine trees. Which makes it a bit of a monotone experience. In the forest there are a few small fens and some patches of heather. Although small, they play an important role for the habitat of the Viviparous lizard. This animal species prefers the transition space between the forest and the heather.
The landscape is quite open on the east side of the forest with only a few tree-lines. The visibility to the area is limited by the houses along the roads and their large gardens. The gardens planted with great varieties of trees function as a thick tree line (Brabantslandschap, n.d.). The area is delimited in the southwest by the Wilhelmina channel. This is a strong landscape element, which cuts through the landscape as a knife. The channel is flanked on both sides by double oak tree lines.

Connected to the Wilhelmina channel is the Victoria lake. Although, it may look green Beekse Bergen is an exception within the ecological network. The theme park is full of exotic animals, like lions, rhino's and giraffes. Native animals need to move around the park from one area to another. Only the theme park is fenced off, the holiday park and the recreational lake is accessible for animals.

5.4 Water

The water map gives a indication of the height and infiltration capacity of the landscape. The creek valley is clearly visible following the lower areas around the higher sandy areas. The ditches in the project area are widely spread out due to the strong infiltration capacity of the sandy soil. Infiltrating water will be added to the ground water table and will emurse as seepage at the lower places in the creek valleys (Waterschap de Dommel, 2019).

In the area we find tree creek valleys. In the north, the Voortse Stroom which is almost totally swallowed by the city. The stream used to be a channel in 1965. The creek had for a long time a bad reputation due to the discharge of waste water from factories into the creek. Currently rainwater from Tilburg, which is discharged on to the creek. With the help of a constructed wetland, pollution is filtered out the water. Southwest of the project area we find the Reusel. This meandering creek is crossing the nature reserve the Hilver and flows through forests into the Kampina and ends in the north in the Dommel. The source of the Reusel lays southwest from the village Reusel in the higher lateral moraine. The catchment area of the creek crosses agriculture estates and nature reserves. The upper reaches of the stream are still channelled. The waterboard, united with nature organisations is working on plans to re-meander also this part to create a continuous sustainable landscape (Waterschap de Dommel, 2019).

Far east of the project area we find the Beerze. The creek springs in Belgium and has a length of 50 kilometres. This creek is mainly fed by rainwater from attaching ditches and seepage from higher areas. Unique for this area is the amount of fens. Scattered through the landscape we find a selection of different sized fens. Some fens are man-made for the mining of peat. The larger fens are created

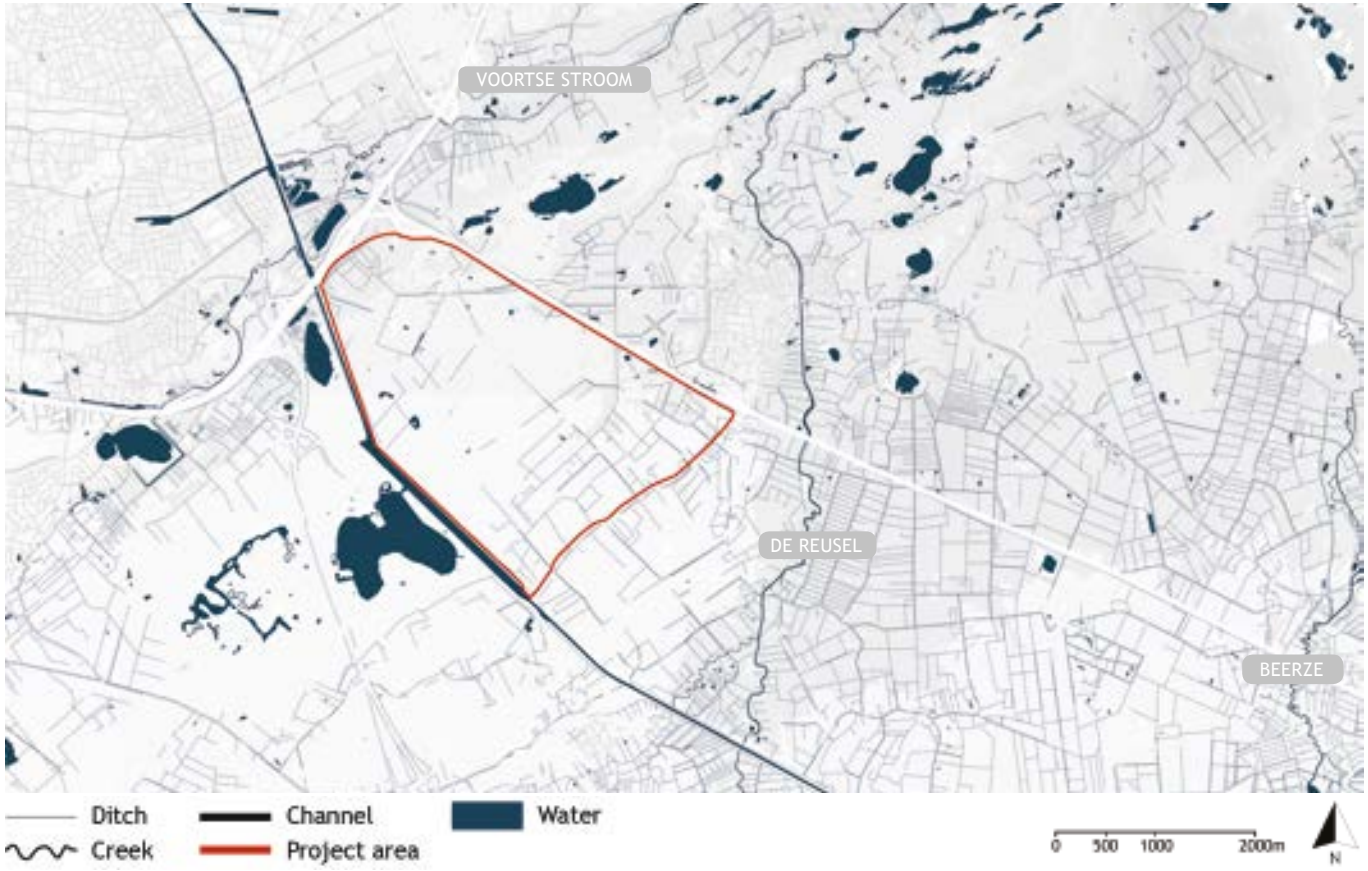


fig 5.13: Water map

fig 5.14: The Victoriameer from Beekse Bergen

fig 5.15: The Reusel

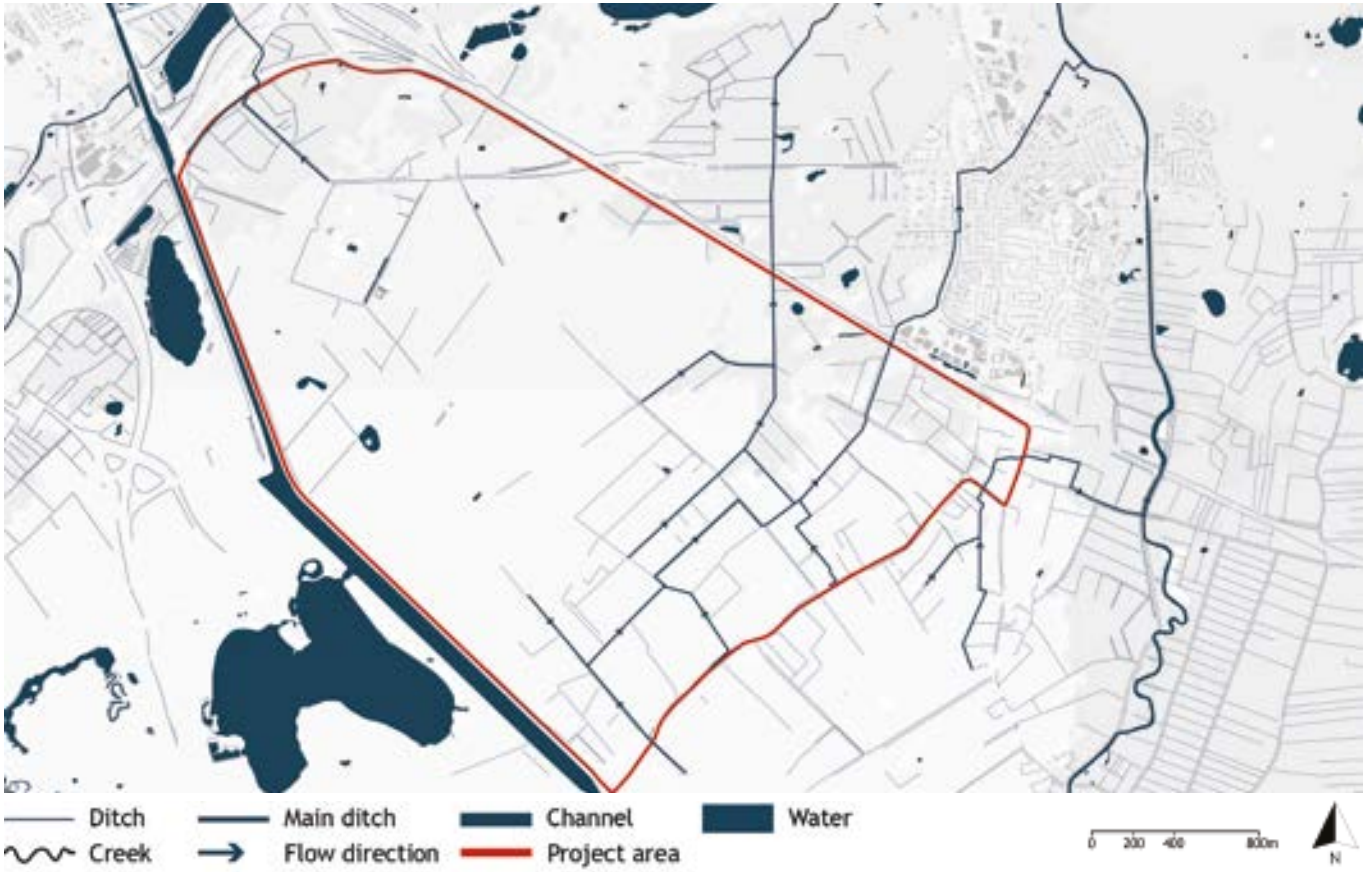


fig 5.16: Water project area

fig 5.17: Wilhelmina channel

fig 5.18: Ditches in the project area

by the elements in the last ice age. Plain sand deposited by the rivers is by wind erosion shaped in the circular fens (Waterschap de Dommel, 2006).

Project area

The area consists out of several ditches which are connecting to the bigger discharge channels. These are not directly going to the Reusel. The western ditch is flowing through an estate before it flows into the Reusel. The eastern ditch is running through Moergestel via a pipe into the Reusel. Due to the low water tables and strong infiltration capacity there is often no water in the ditches in the project area. In the northeastern corner in the project area we find the lowest point, with a height difference of halve a meter. Recently some heather areas with small fens are dug here.

There are some smaller water bodies into the area. Most significant is the Berkven, a fen which is already visible on the historic maps of 1850. This make it a historical relict. The Berkven is mostly hidden by forest and is used by boy scouts.
Water bodies in the north of the project area are part of the estates (Topotijdreis, n.d.).

5.5 Infrastructure

Multiple infrastructure connections are an indispensable factor for the positioning of XXL-distribution. In this paragraph we shortly describe the different infrastructure connections. The project area is connected via the highway A58. The A58 highway is currently a two lane highway to both directions. Frequent traffic congestions resulted in economic losses and made the province decide to take measures. In the future the road will be widened from two to three lanes to provide a better traffic flow between Tilburg and Eindhoven. One of the most economic region's of the Netherlands.

The water connection is provided by the Wilhelmina channel, which is already frequently used by inland shipping. In 2013 Rijkswaterstaat started a project to make it possible for even larger inland ships to enter. The widening and deepening of the channel improved the accessibility of the channel.
The channel is especially along the project area wider in comparison with other parts. This is a benefit for the location of an extra container terminal. This makes it easier for ships to turn for the position along the loading dock.

The availability of a nearby railway is missing for this project area. However, Tilburg has a rail terminal accessible by road and the Wilhelmina channel. By road it is a 10 minute drive. This rail terminal makes it possible to distribute and receive goods on an international network.

The project area is connected to the national bicycle network of the Netherlands. This makes the city accessible within a cycling distance of 15 minutes to the centre of Tilburg. In the creek valley there is a regional long distance walking route.

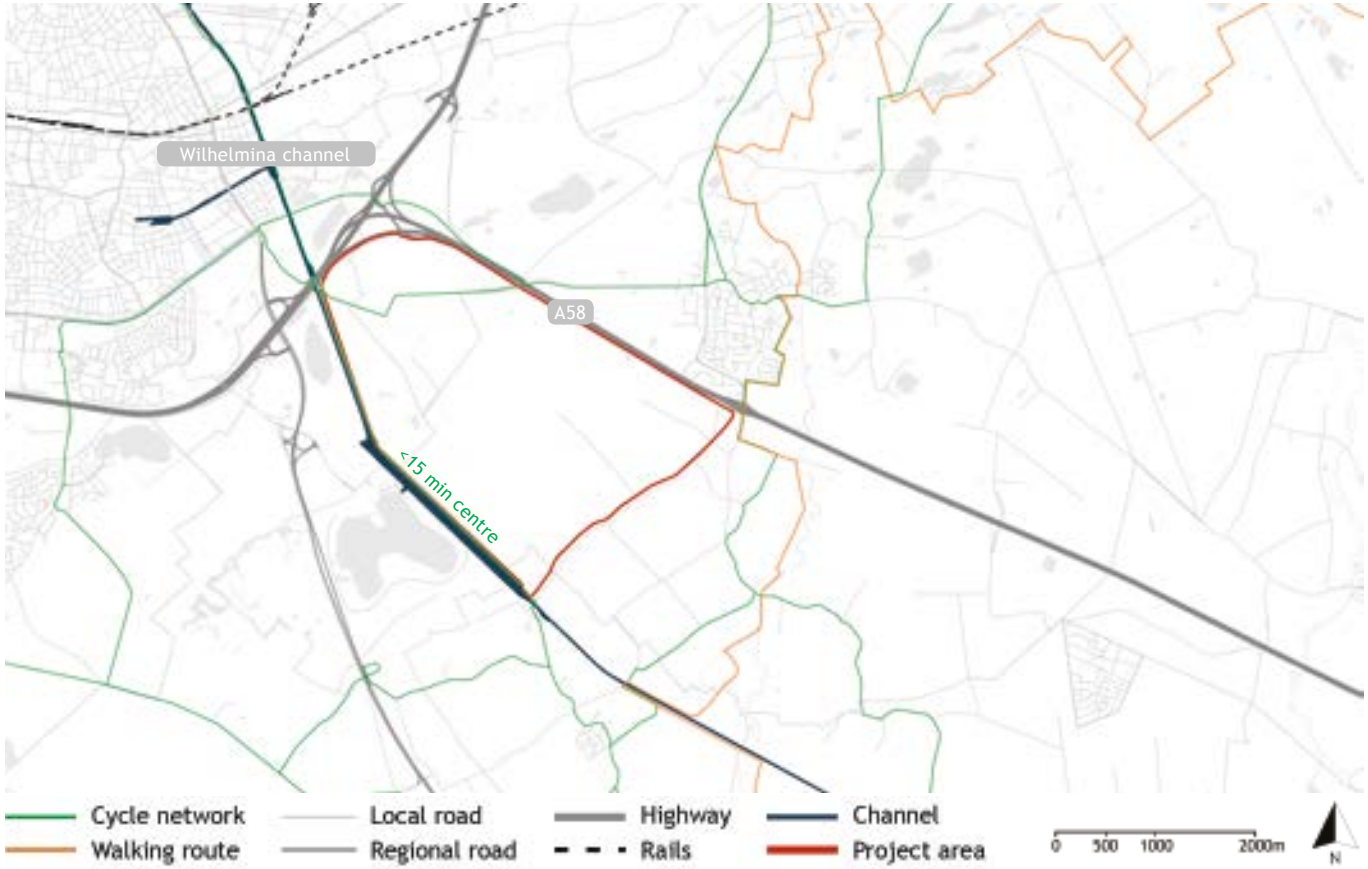


fig 5.19: Infrastructure networks

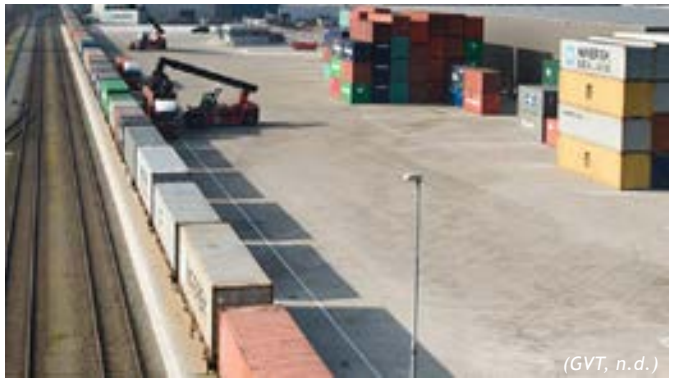


fig 5.20: Rail terminal Tilburg

fig 5.21: A58 highway at Moergestel junction

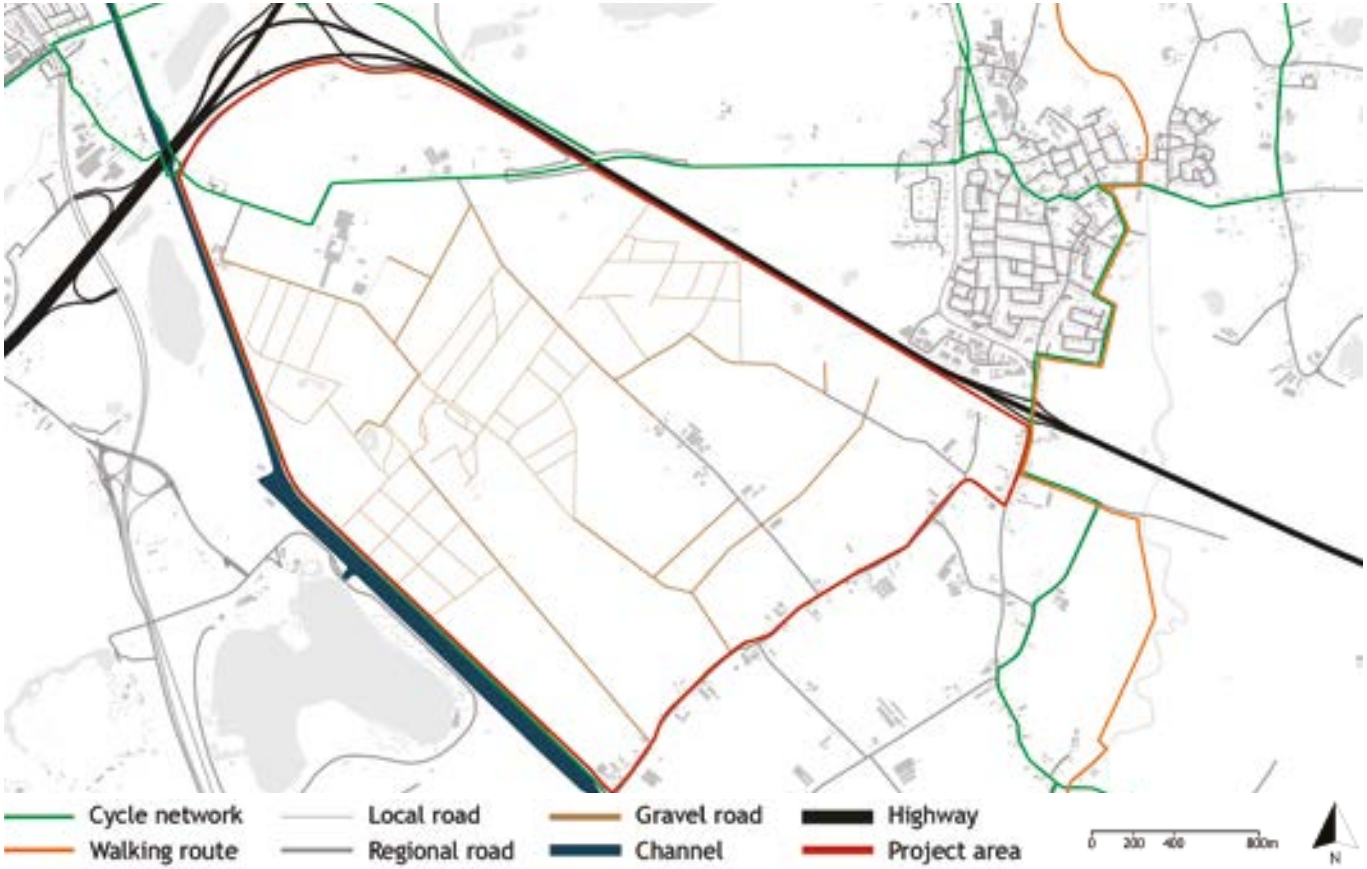


fig 5.22: Water project area

fig 5.23: One central road in the area

fig 5.24: Heatmap showes that the area is underused

Project area
The project area is closely located to the exit of the highway. However, we have to take into account the existing historical ribbon development along the street. If this road is used to reachthe XXL-distribution parkm the liveability for the residents will be affected.

Within the project area there is one central road towards a couple of farms. The road is part asphalt and part gravel. Most part of the roads into the project area consist of a gravel or sand layer. Into the forest we find a grid network of gravel paths probably for forestry.

Data from Strava maps showed that paths are not often used (fig 5.24).The recreational network lacks a coherent path systems, which attracts people to the area. The one central road is more used to cross the area and a small walk around the monastery seems to be popular. In comparison with the nearby nature reserves of the Oirschotse vennen the recreational use is much higher. The surrounding roads are on the other hand more often used by people for walking and cycling.

5.6 Buildings

For the buildings we can identify three categories: the cities, the villages and the scattered buildings. The city Tilburg is located in the northwest of the map on a short distance of the project area. What makes the area interesting for recreational purposes. The village Moergestel is one of the many villages of Brabant located close to a water source such as a creek. Moergestel has an identity of rural living. Most of the old buildings are clustered around the market square with the old church. Around the two main streets we find some neighbourhoods from the 80's and 90's (topotijdreis, n.d.).

In between the villages and the cities we find the farms, solitary houses and the Trappist monastery. The monastery is a popular location for inhabitants from Tilburg and Moergestel. Almost totally enclosed by forest it is only visible from certain angles. The two towers are a significant landmark of the landscape.

Throughout the region buildings are placed in lines along the roads. These ribbon development have grown due to the appearance of intensive farming in the region. In the past the only way farms could survive was by upscalling and undergo mechanisation. Now some farms are combined to mega stables. Older small farms lost their function but kept their residential function. The old farms area still a strong visible presence on the identity of the area.

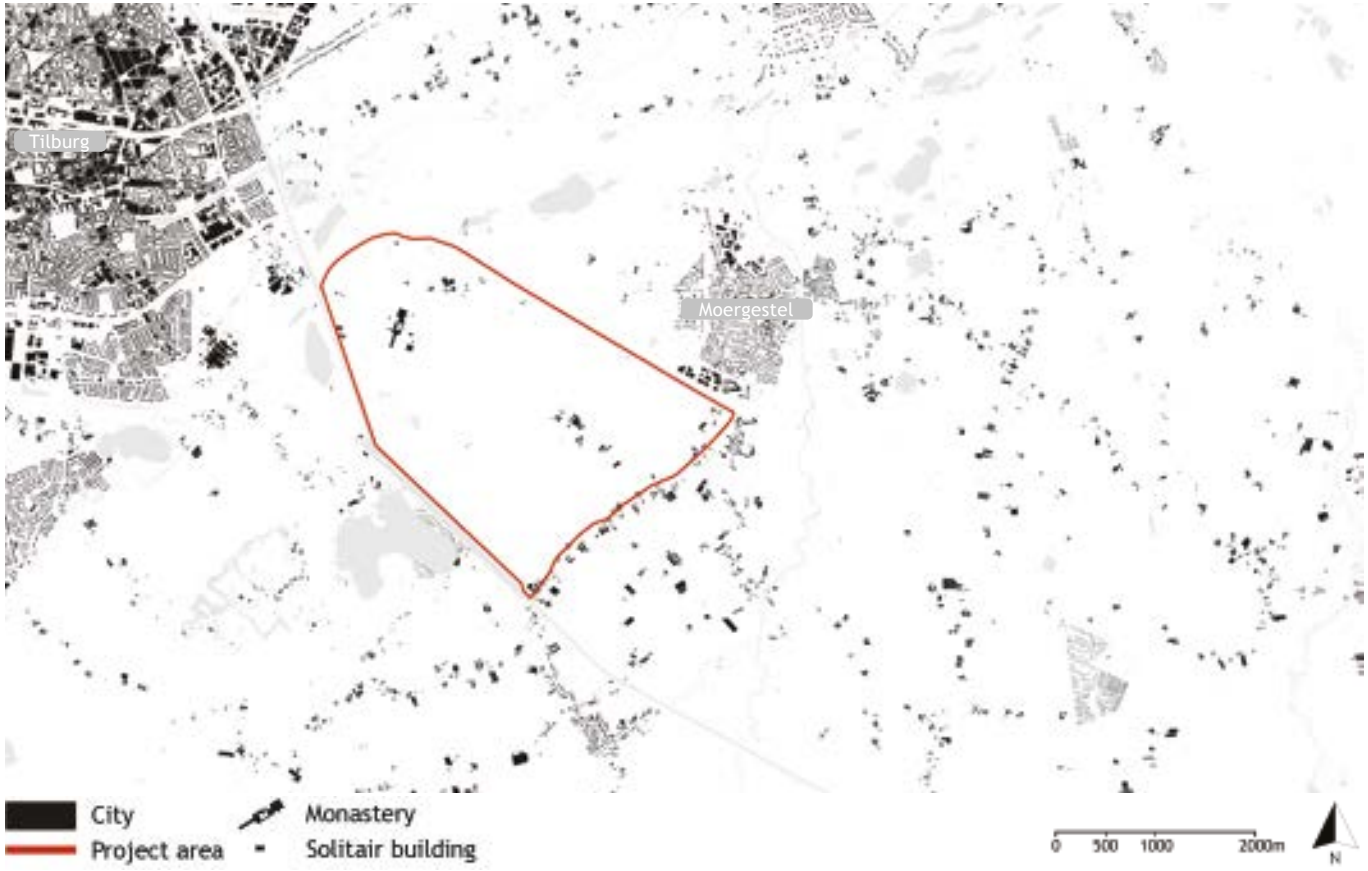


fig 5.25: Buildings

fig 5.26: Characteristic farms along the roads

fig 5.27: Intensive farming with large sheds

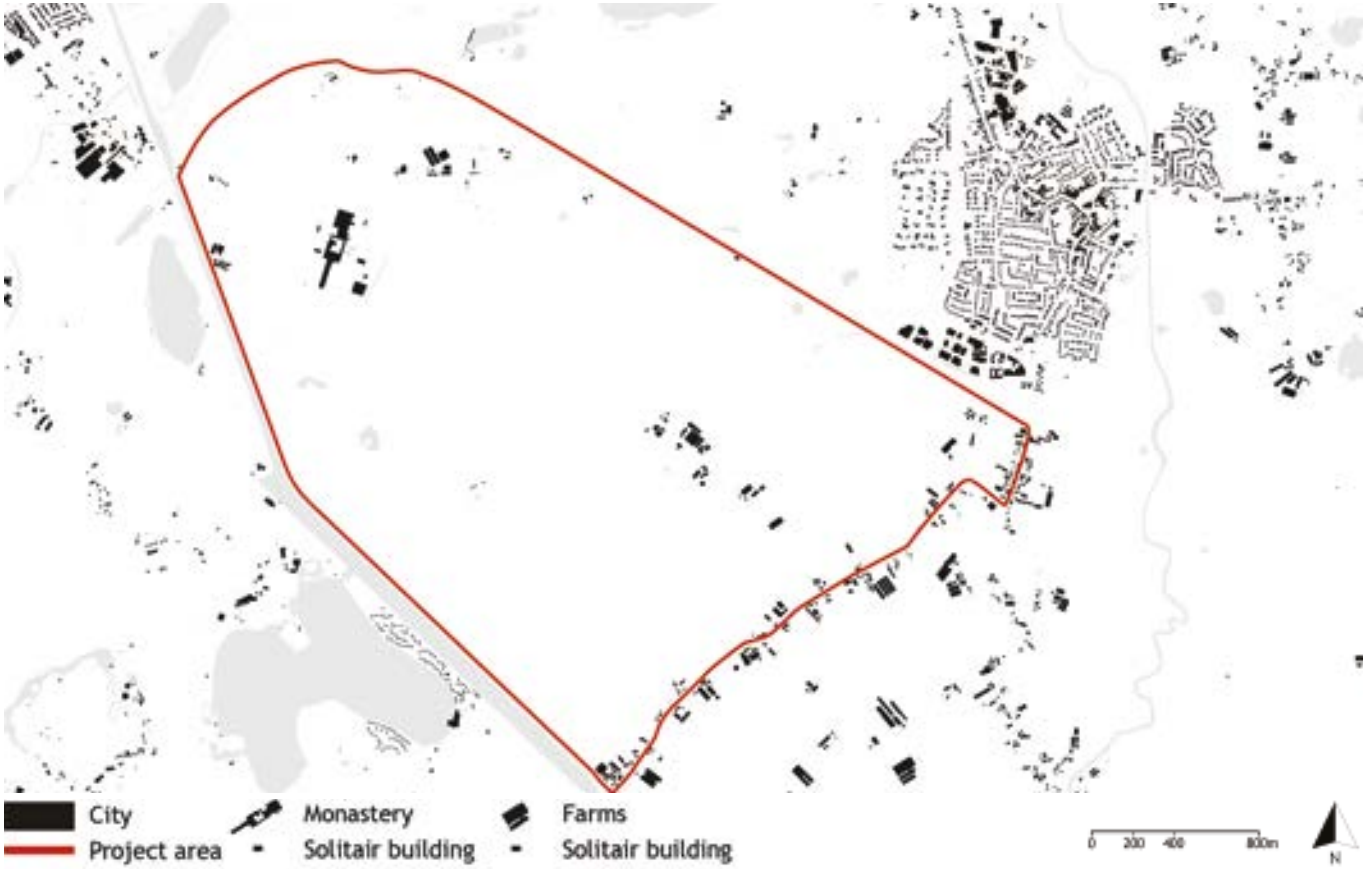


fig 5.28: Buildings project area

fig 5.29: City centre Moergestel

fig 5.30: Central square Moergestel

Project area
In 2008 Moergestel expanded along the highway with a small business park. The green meadows are replaced by a row of boxes as an advertisement to the highway. Central in the area of the project area are dairy farms and a horse farm.

Bordering to the south of the area is the holiday park from Beekse Bergen. The bungalows are placed along the tree-lines with a view over the lake and the agriculture area.

The historical farms are dating back to the 17th century. For farmers the need occurred to accommodate the animals, the living compartment, and the storage room in one building. These farms were called 'langgevelboerderij' (farms with a long facade). These farms can be found at the ribbon development in the east of the area and close to the junciton of the highway. Typical for these type of farms is the position of the long facade towards the street. This makes it possible for the grain cart to unload into the building (Wikipedia, 2016).

5.7 Vision and concept

This vision describes the transformation of the project area regarding the future. In this vision there are 3 main goals.

Large logistics, Large landscapes

The sand landscape provides a variation of design tools to face the implementation of the XXL-distribution park. The forest, heather, fens, terrain and water-system will be used to create a fascinating logistic park intertwined within the landscape of the high sands and lower creek valleys. Aim is to generate a robust landscape what proposes a new paradigm of logistic parks and has a collateral benefit for the surrounding landscape and its inhabitants.

Accessible landscape

Accessibility is a key stone of this work landscape. The project area has the potential to be much more than agriculture land use with a logistic park. The combination of a monastery, forest, safari park and a logistic park in close proximity of each other is rather strange, but unique. These functions are challenging each other to be exploited for recreation. Bike paths and bridges should encourage recreants to use the area. By design we are stimulating people explore the area and take the bike to work.

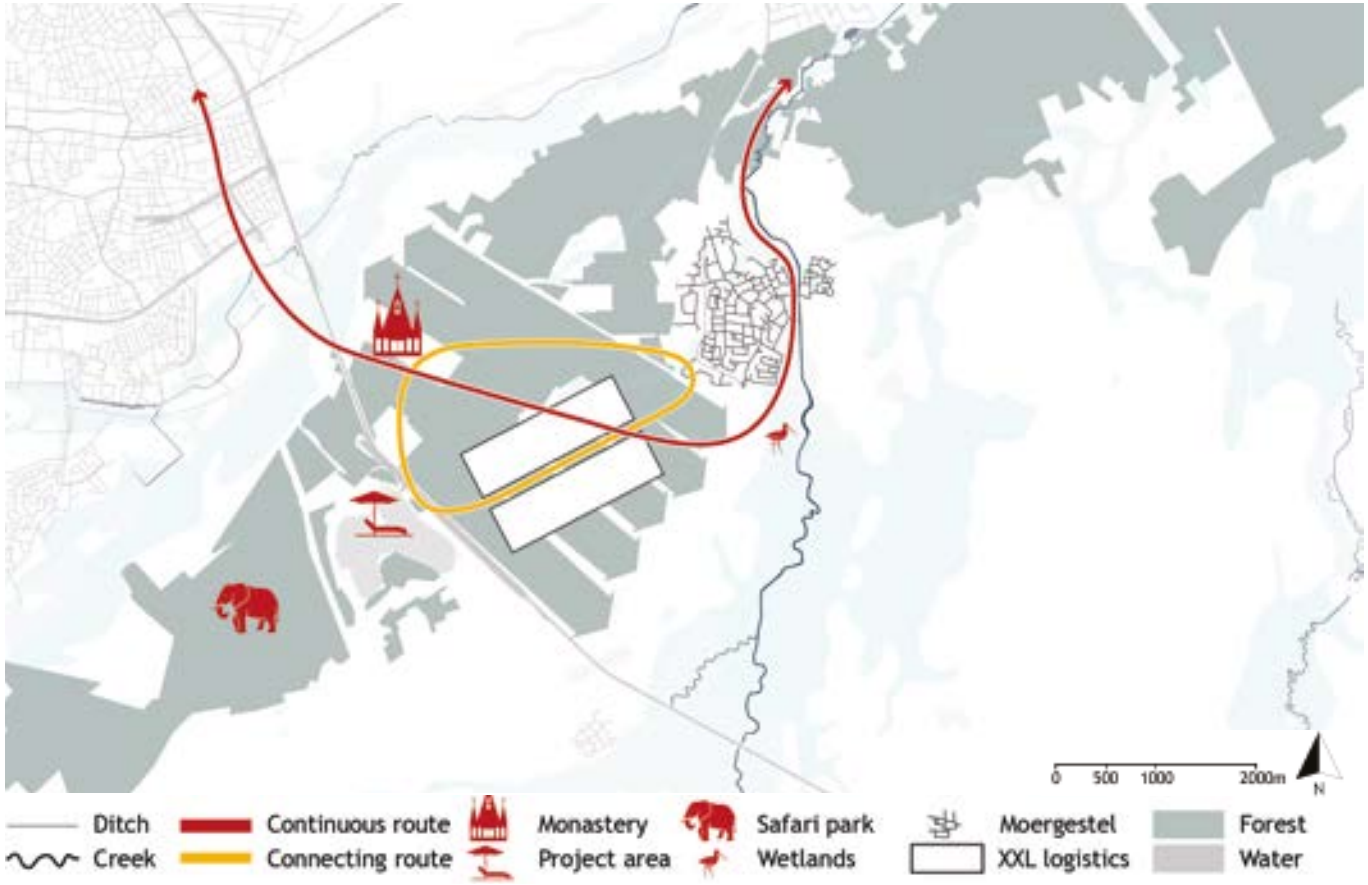


fig 5.31: Concept

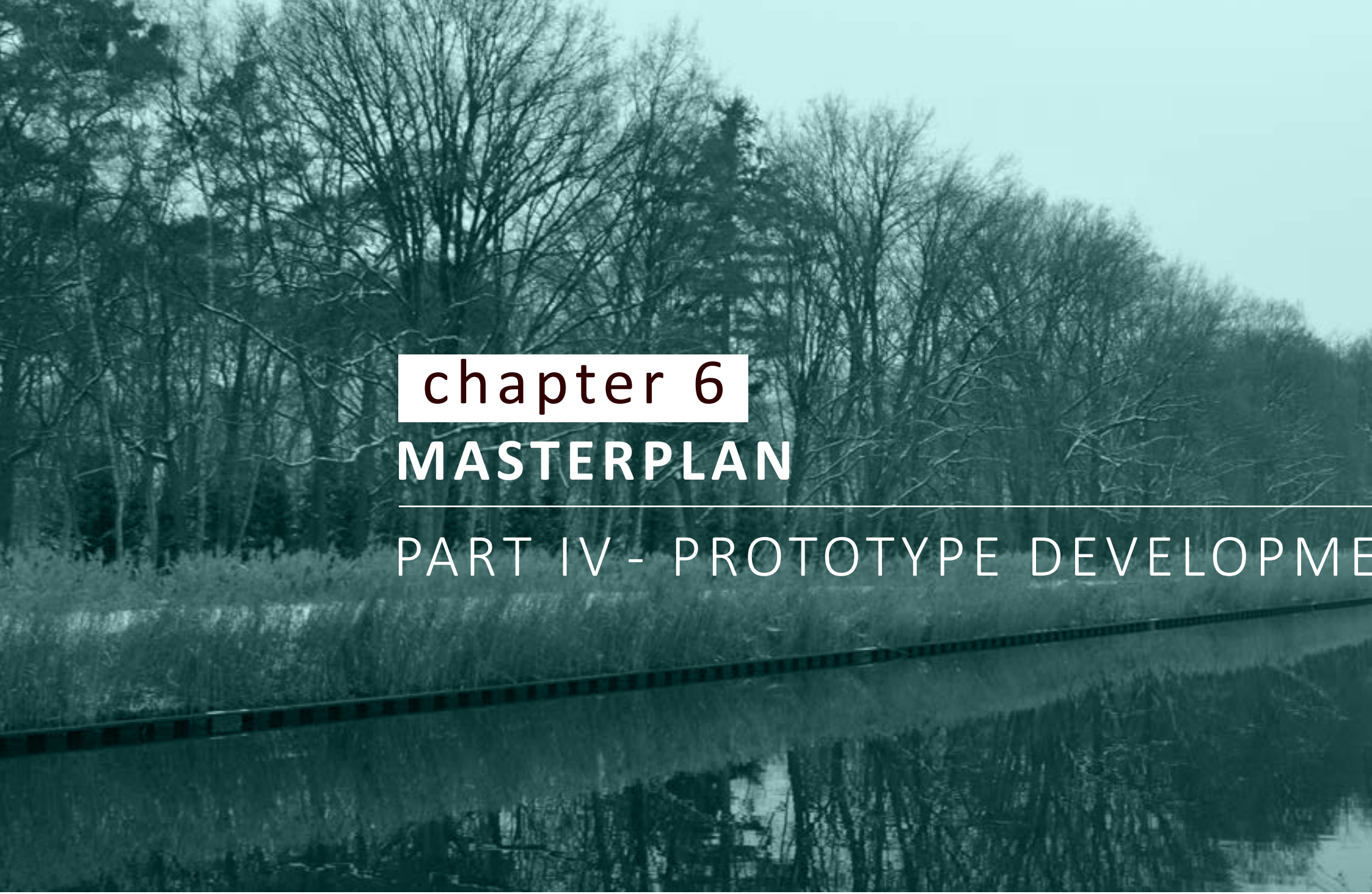
Nature network

For this project the logistic companies play a large role in the development of the landscape. Logistic companies are only welcome if they are realising nature in the project area. By buying parcels and transforming them into forest or heather fields In cooperation with nature organisations the nature corridor can be strengthen and new developments are realised. This is not only from an ecology perspective important. To reduce the impact C02, the paris agreements state that CO2 needs to be reduced. By planting extra forest it is possible to work on this goal and to expand at the same time the nature reserve. Currently the project area is quite monotonous. In the future the project area consist out of a diverse landscapes with different vegetations what will be enjoyed by multiple by users. Human and animals.

In diagram 5.32 and 5.33 the effect is shown of reducing the footprint of XXL-distribution. The regular warehouses with one single floor layer would totally fill the landscape with boring boxes. The high bay warehouses offers the same storage space on a much smaller footprint. Space is left to integrate and design around the XXL-distribution park. In the next chapter we will describe the masterplan and the development of the landscape to an exciting work, recreational and precious landscape.

fig 5.32: High bay warehouses footprint (90ha)

fig 5.33: Footprint with single floor warehouses (190ha)



chapter 6
MASTERPLAN

PART IV- PROTOTYPE DEVELOPME

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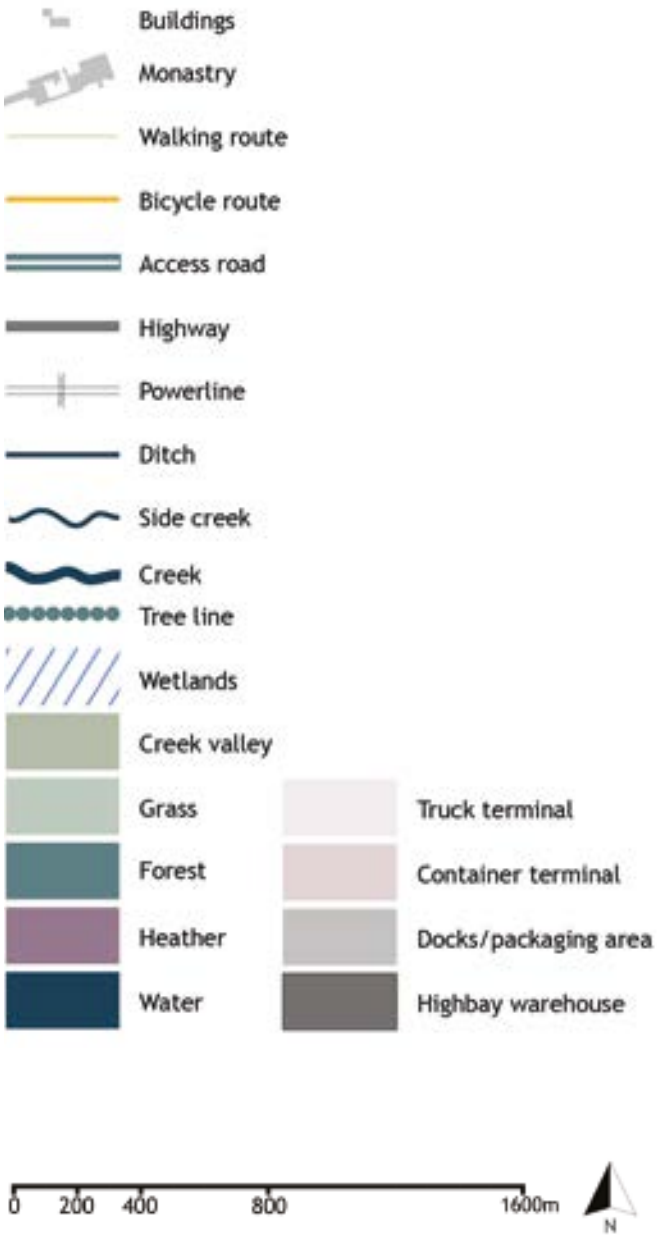
6.1 Masterplan 1:10000

The masterplan on the large scale proposes a sustainable combination of new developments and nature growth. Distribution parks are a profitable business,which have the capability to invest in real estate, but also should invest into the landscape where they settle. For this plan we are proposing an alternative approach were companies are developing nature within the same area. This provides collateral benefit for ecology and opens up new ways of experiencing a landscape. By combining the XXL-distribution with nature we have to take into account the strict order of dimensions from logistics. Roads dimensions are precise and need to have the right layout to process the large amount of trucks. The sand landscape of North-Brabant offers a wide range of landscape elements what could be used as design tools (fig 6.1). Although, the project area might be a small area, it is designed as a celebration of the Brabants landscape. With the implementation of heather, fens and forest, which continue into the valuable creek valley. The landscape between the forests and the creek valley, is now dominated by intensive dairy farming, but will be enriched by tree lines, hedgerows and smaller parcels. The public opinion is however changing towards a more sustainable way of farming. In this case we take the freedom to 'upgrade' the landscape to a type what suits a more ecological way of farming for the future

New routes and bridges are making the project area accessible for bikers, walkers and runners. The central loop connects the functions of the monastery, Beekse Bergen and the XXL-distribution within the project area. The high bay warehouses are popping out of the forest edge entering the heather landscape. The warehouses are embedded in the landscape and are therefore not constantly visible. With connecting the creek valley with the high sand landscape it will be possible to experience a pallet of flora and fauna from different landscape types. Longer continuous cycle paths are linking Tilburg and Moergestel towards the surrounding recreational zones.

fig 6.1: Landscape types: estate, heather, forest and creek valley



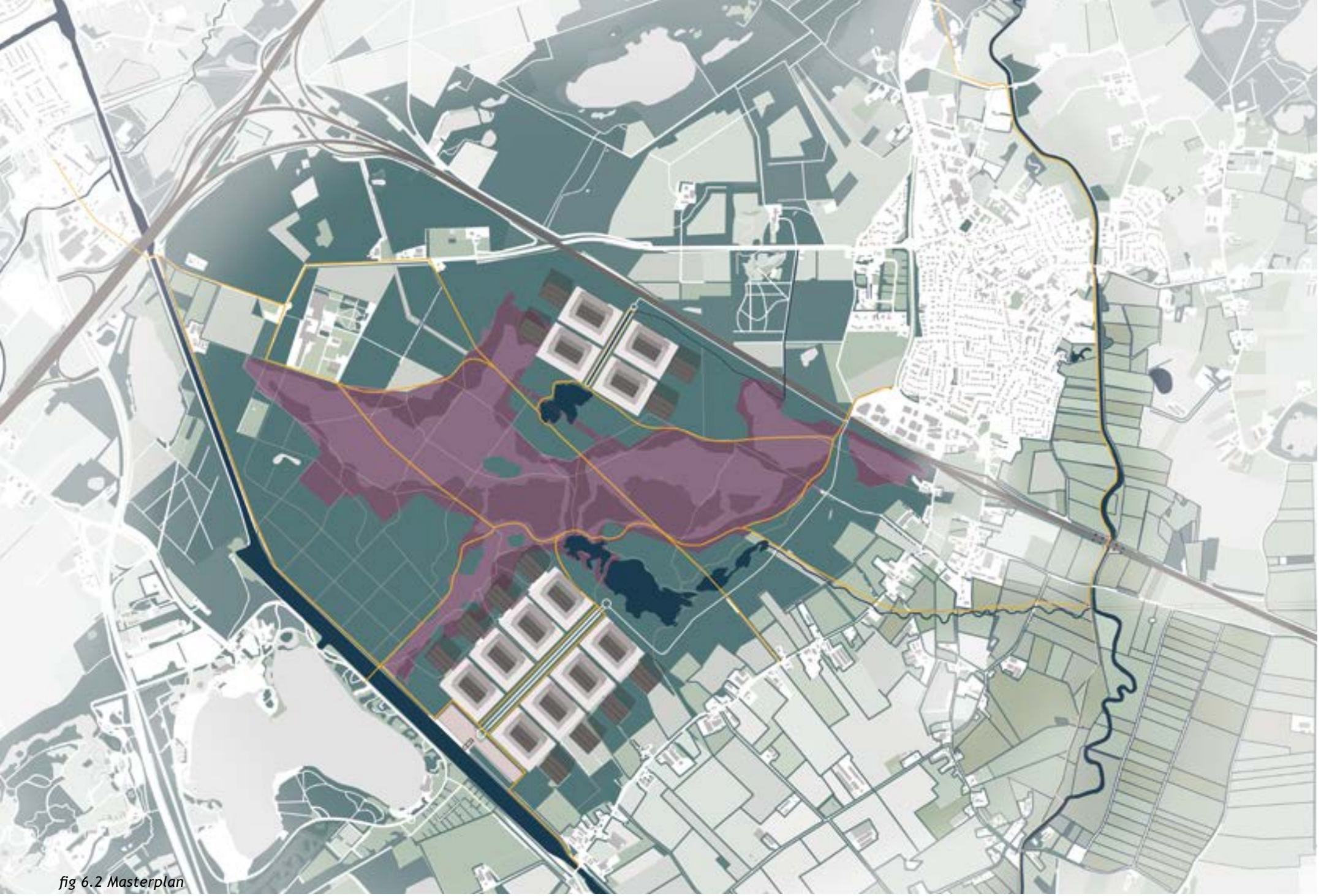


fig 6.2 Masterplan

6.2 Masterplan layers

The masterplan can be separated into the logistic park, the nature development, the recreational and logistic connections. In this chapter we will explain the design step by step.

With the highway clustering model, each project area has to integrate 90 hectares of logistic park. In total this is 270 spread out over three locations. The first step is to divide the 90 hectares into two blocks of 60 and 30 hectares. By dividing the logistic park it becomes less of a large object and is easier to implement, into the scale of the Brabants landscape (fig 6.4). The 30 hectare block is placed along the highway. In this location the traffic noise is constantly presence of the highway. Combining the logistic park with the highway prevents unnecessary disturbance of the area. The 60 hectare block is placed into the right low corner, close to the Wilhelmina channel (fig 6.5). This makes it possible to realise a water connection via a terminal. Making a container terminal is a sustainable way to move goods from the road to the water (fig 6.6).

By positioning both blocks at the outskirts of the area it is possible to create a central area as proposed in the concept. To facilitate the in- and outgoing products, a terminal and road connections are necessary. Access roads are realised within the project area. The access road in the north of the project area, is placed parallel of the highway. This is beneficial for the logistic as for the inhabitants. The trucks are granted with a fast connection from the highway, local roads will not be bothered by truck convoys. The road towards the second logistic park is following the existing road structure on the edge of the project area. With a sufficient distance towards the ribbon development to prevent any nuisance. The distribution centres consist out of two parts: the high bay warehouses and the logistic hubs. The high bay warehouses are not depending on a road connection, because they are supplied by the logistic hubs. This is why they are outwards placed into the landscape. The logistic hubs, which need to be accessible for trucks are centred in the middle of the plan. By placing the high bay warehouses outside in the landscape the logistic presence can be experienced without the nuisance of truck movements (fig 6.6).

After entering the project area the XXL-distribution is not directly visible. A layer of forest encapsulates the buildings. At certain places the forest opens up and shows a few high bay warehouses. This fits the scale of the Brabant's landscape and enhances the nature corridor. Most houses are surrounded by large gardens. The new forests consists out of a variety of tree species, such as birch, oak, beech and pine. Different tree species offer experiences of seasons throughout the year and have a bigger impact on C02 reduction (NOS, 2016).

The third layer connects Tilburg and Moergestel with a recreational landscape (fig 6.8 & 6.9). The heather is an semi open landscape what contributes to the extension of endangered species like the lizard and Silver-studded Blue butterfly. Recreational networks are made with cycling and walking routes linking to the Reusel and the monastery towards Tilburg. Walking over the heather offers the experience of the historical landscape from 1850 in combination with the contemporary high bay warehouses. A spectacular sight.

The last layer is the water system. An extensive area of arable land will be covered by buildings and asphalt. With the urgency of climate change resulting in longer droughts and wetter springs it is necessary to make a comprehensive water system. Rainwater is not directly discharged by ditches, but stored within the project area. During excessive rainfall the fern haves the ability to grow.

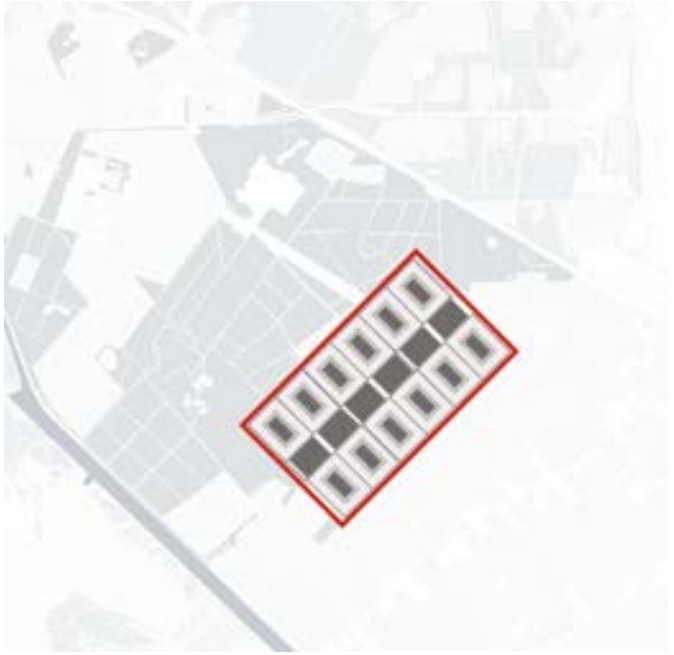


fig 6.3: 90 Hectares of XXL-distribuiton

fig 6.7: Forest layer

fig 6.4: Separation into two smaller blocks

fig 6.5: Positioning to create a central area

fig 6.6: Road connections

fig 6.8: Central heather landscape

fig 6.9: Routing

fig 6.10: Water system

fig 6.11: View on high bay warehouses

High bay warehouses
The high bay warehouses are entering the heather landscape. In this visual they are viewed from a distance of 600 meters. The visual empathizes the impact of the buildings. Unfortunately there is no theory available about colour or textures what helps to integrate the buildings. But by choosing a natural material as wood the aim is to integrate object as part of the landscape. Wood will be harvested from the area what will be used for the facade. Benefit of wood is that it is a sustainable material what can be re-used if the buildings are demolished. Wood also changes throughout the seasons by colour. During wet periods the wood will be darker and more grey. In dry periods the wood will be lighter as a colour. In appendix 2 a material study can be found with different materials tested in the landscape.

In the heather landscape solitary trees like oaks and pines get the freedom to grow to their natural size. The heather is maintained by sheep's who will eat the grass and the young trees. Especially at the start of the transformation from the meadows to the heather landscape this is important. It will take years to break down the rich nutrient layer.

fig 6.12: Location on map

Forest fen
The fens are natural elements in the landscape of the Meierij, sometimes shaped by man kind otherwise created by geological processes. This fen is fed by the rainwater from the distribution park. Excessive rainfall can easily be stored in the fens and has time to infiltrate in the soil and raise the water table. In dryer times the water can be used to keep the Reusel at a decent water level.

The fen is surrounded by forest what gives it an intimate atmosphere, although it is closely linked to the distribution park. This nature is on a short walking distance for the employees of the distribution park. The fen is also linked to the recreational routes to create an environment which is suitable for work and recreation. For the shape of the fen existing fens are studied around Oirschot. The fens which have an organic shape are the most aesthetically pleasing, and therefore most popular on Instagram. These fens have a close interaction between the trees and the water. The organic shapes allow trees to grow on close distance to the water creating strong contrasts.

fig 6.13: Location on map

fig 6.14: Visual forest fens

6.3 Landscape system

The marriage of the XXL-distribution park and the landscape is described in this paragraph. Most logistic parks are standing out in the landscape. This is concerning the buildings but also the public space or the surrounding terrain. Straight ditches and water bodies are dug to store rainwater for example. The aim for this project is to create a landscape system what is intertwined with the logistic park but can also be used for recreation.

Site preparations

The logistic retailers will buy two type of parcels: the parcels for nature development and those for the built of the logistic park. The nature parcels are developed in heather and forest areas. Ditches will be filled to increase the groundwater table. Developing nature will strengthen the nature corridor and the habitat of the protected species.

The development of the parcels for the XXL-distribution park are starting with the foundation. Logistic buildings need to have a level floor for an equal division of the storage weight. The foundation of the high bay warehouses will be 2 meters deep to generate enough soil to create a significant height difference. The loose soil will be placed on the edge of the logistic park to create a 10 meter high heather landscape. The heather hill will create a transition space between the high bay warehouses and the open heather landscape. Soil from the fens and the ditches for the water system will also be added on this hill.
Part of the preparation is some forestry, especially for the XXL-distribution cluster of 30 hectares, which is placed in the forest. The pine wood will be reused for the facade of the high bay warehouses.

Water

The second systematic layer is the water system. We strive for this project to create a sustainable water system. Because XXL-distribution is still an area taking up a considerable amount of space with asphalt and roofs, preventing the water to infiltrate. Precipitation is therefore collected in the larger fens on a close distance of the logistic park. The fens have the ability to store the water for a longer period. The average lowest ground water table is in the project area more than 120 cm below ground level. This means that in the summer the fens could be dry. This is the consequence of a high permeable sand layer. Also the fast infiltration could lead in the first years to a low water level of the fens. Partly filling the fens with a layer of loam is a way to reduce the infiltration effect. After the storage, the water flows with a meandering ditch to the lower Reusel valley. Here, extra wetlands can be created with the water. Water is again stored before it discharges into the Reusel and is at the same time strengthening the creek valleys ecological network. Putting the fens on the higher sandy soils acts in a way as a reservoir. Brabant is each year affected by droughts resulting in dry falling creeks. With these fens vulnerable areas can be filled in dry periods. In wet periods the fens have the ability to grow and store water before discharging.

The project area borders to a agricultural area which is linked to the current water system. Although we are proposing a more ecological way of farming this will not probably not be realised on the short term. Therefore it is important to filter the nutrients and nitrates out of the water before it is discharged in fragile ecosystems. This can be done with the help of constructed green filters. The grey water is also filtered inside the project area, the smaller particles are filtered in a septic tank and the larger particles can be filtered with a constructed green filter.

Energy

Logistic parks are a huge energy users. The close proximity to a power line gives the opportunity to use the network, but also give back when their is an overload of energy. The close proximity to Tilburg makes it possible to deliver energy to surrounding neighbourhoods without a huge electricity loss.

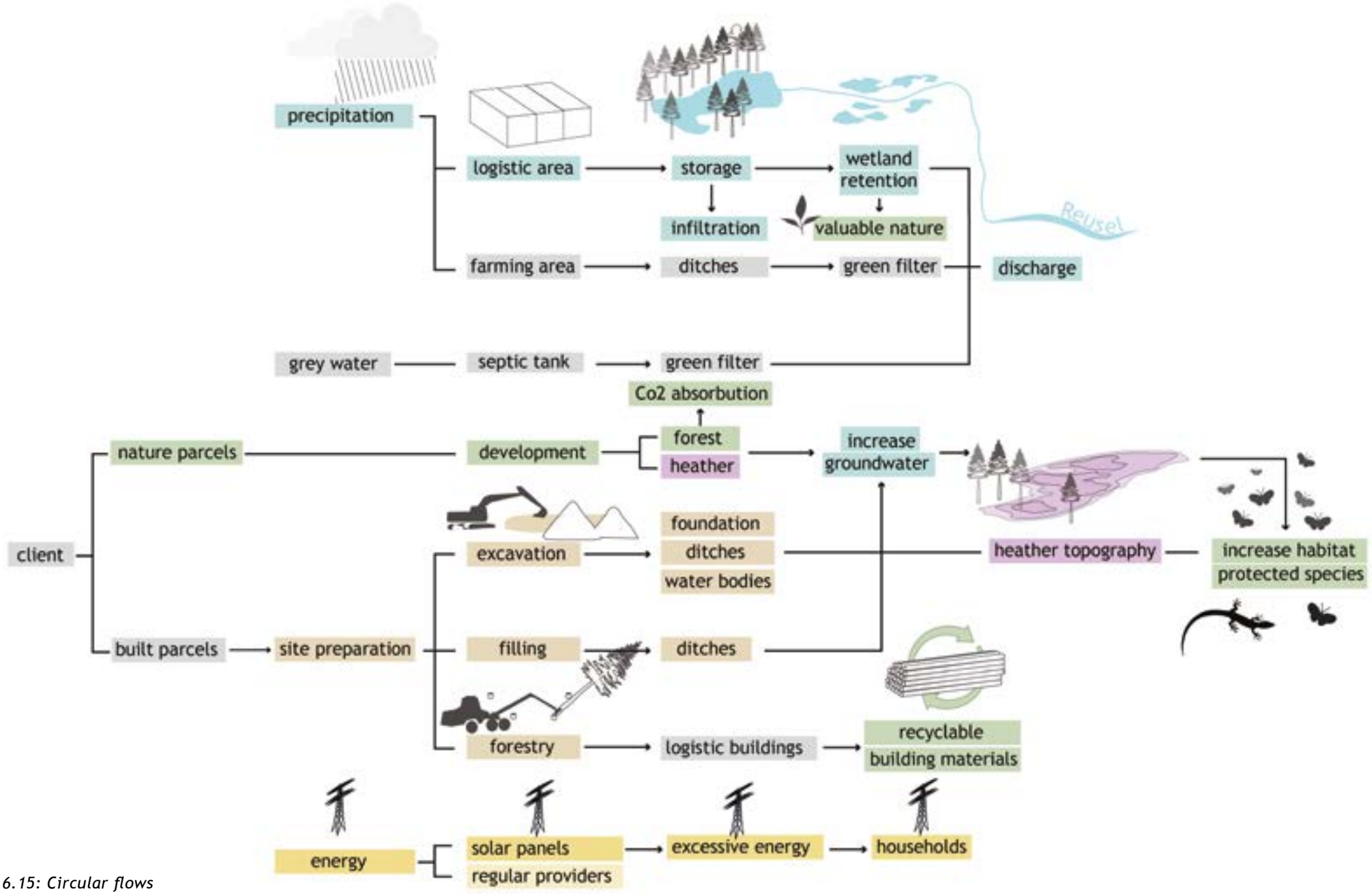


fig 6.15: Circular flows

Heather topography
The re-use of the soil within the project area is a fantastic asset to create a landscape with topography. By dumping the excessive soil at the edge of the distribution buildings we can create a hill of ten meters high, stretching out with a length of 750 meters and a with of 100 meters. The height difference will add different perceptions to the experience of the XXL-distribution. You can walk underneath the hill with a barrier of heather in between the distribution hubs and you. The more adventurous people can walk on top, and are presented with an overview of the area and the enormous distribution hubs. Tree clumps in between the buildings slightly cover the buildings what makes you wonder what the view will be after the next tree.

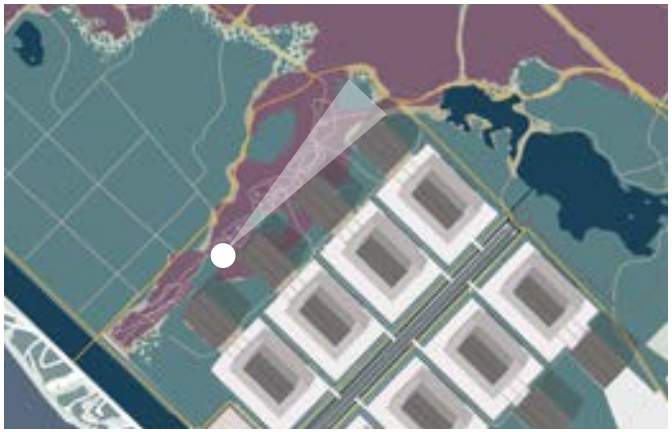


fig 6.16: Location on map

fig 6.17: Visual along high bay warehouses

6.4 Masterplan 1:5000

The masterplan shows a more detailed view of the heather landscape. The heater landscape is a more semi open landscape with some relicts of the old farmable land. The axis from the monastery is kept and some tree clumps are used to divide the area in multiple areas. Maintenance of the heather landscape will be done by the sheeps. Especially the first years of the heather landscapes this is necessary due to the nutrient in the top soil of the arable land. Overtime the topsoil will lose its nutrient layer. This process could also be accelerated by mowing and removing the heather landscape. The fens offer different experiences, one fen is more located into the open landscape other ones are totally enclosed into the forest. The area borders in the east to the ribbon development of Moergestel. This landscape is transformed from a semi-open landscape into a enclosed landscape. Small scale agriculture will define the characteristics of the area, which contributes to the characteristics farms.

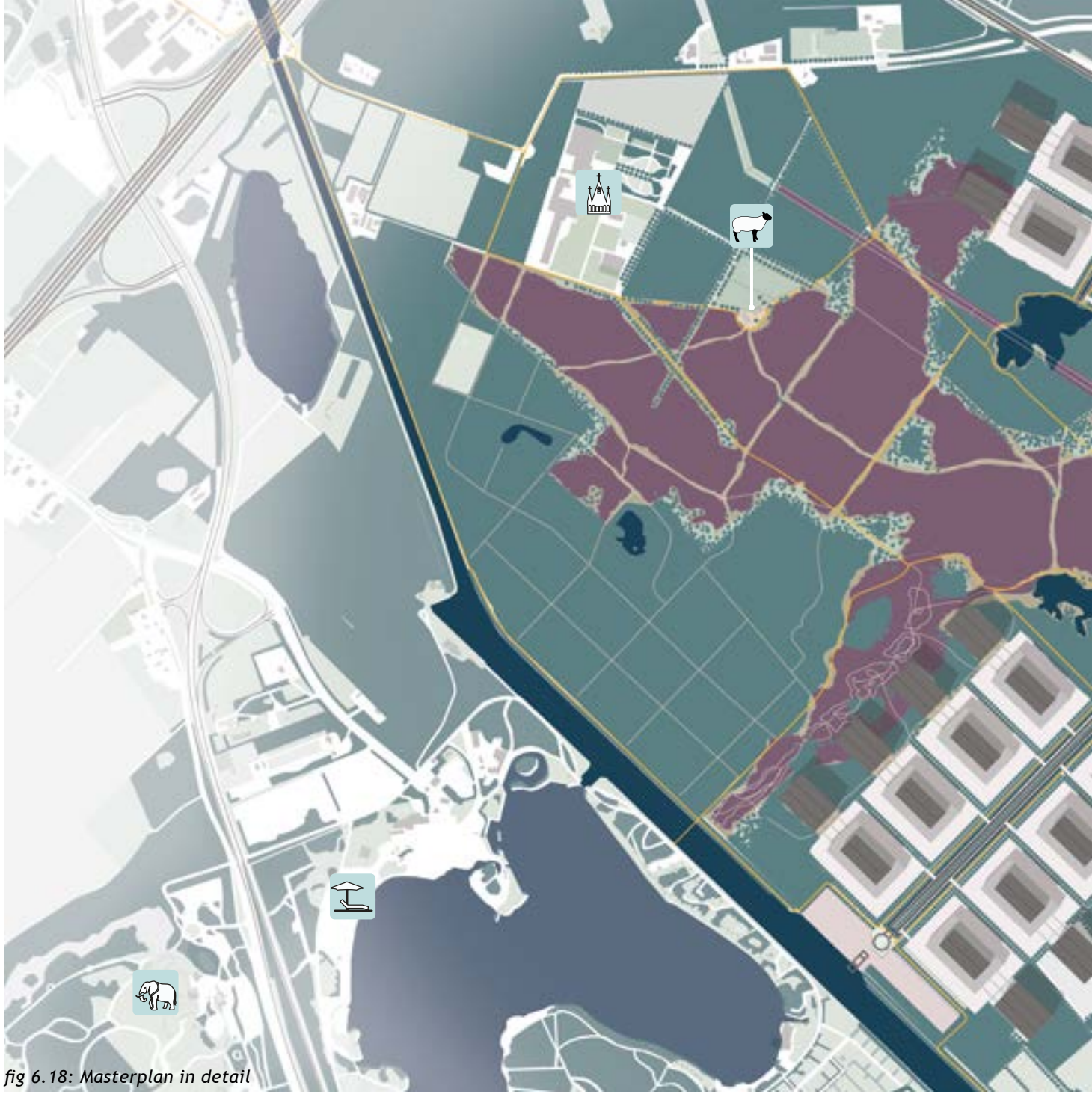
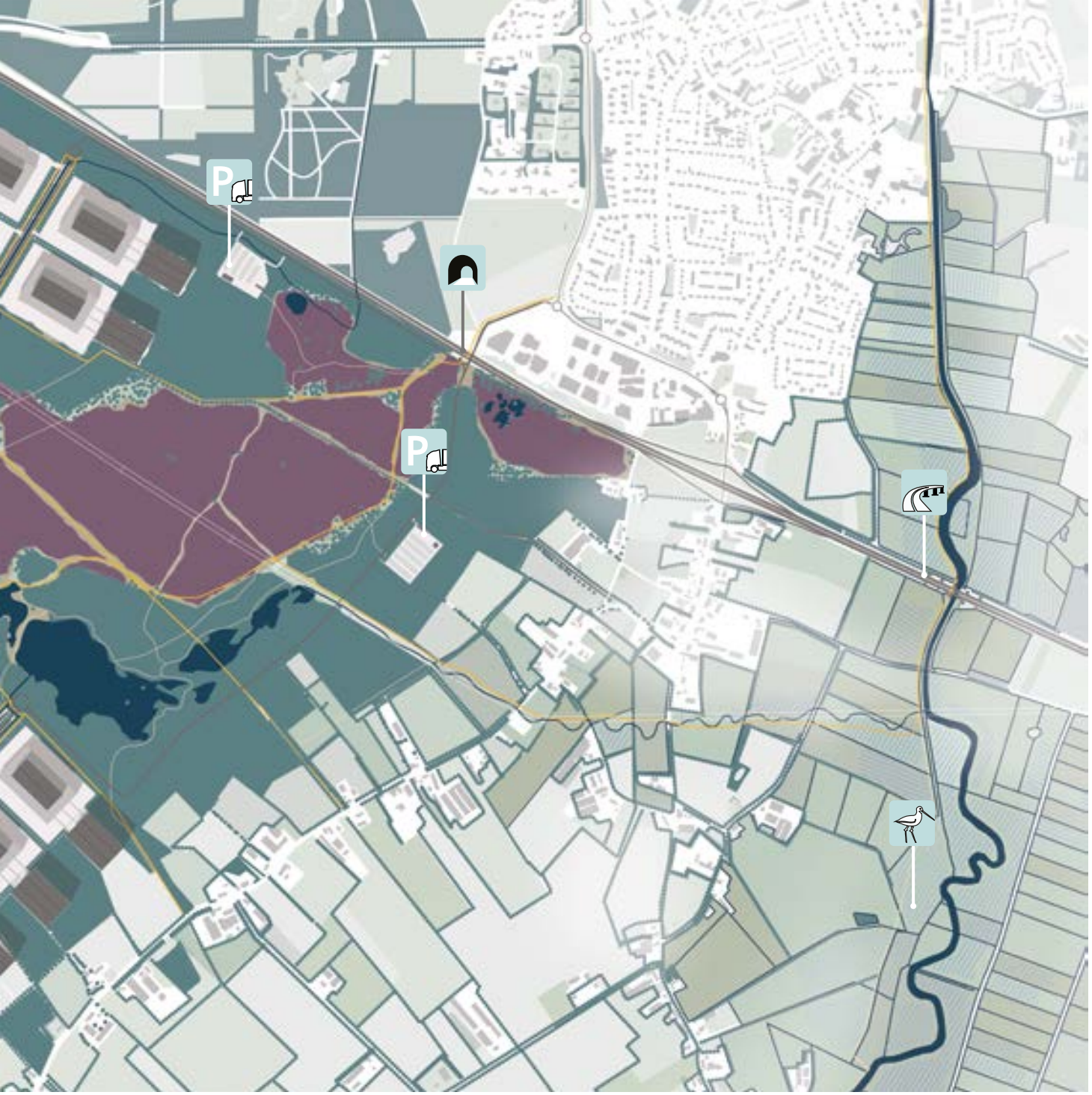


fig 6.18: Masterplan in detail



Legend

- Buildings
- Sheep pen
- Monastry
- Walking route
- Bicycle route
- Access road
- Highway
- Powerline
- Ditch
- Side creek
- Creek
- Solitary tree
- Tree line
- Wetlands
- Creek valley
- Weeds
- Grass
- Forest
- Heather
- Water
- Tunnel
- Raised highway
- Truck parking
- Recration lake
- Grutto habitat
- Sheep pen
- Beekse Bergen
- Truck terminal
- Container terminal
- Docks/packaging area
- Highbay warehouse

0 100 200 400 800m

N

Open fen
The masterplan celebrates the fact of water storage by implementing them as huge fens. The fens are relatively shallow, which means large quantities of water can be stored. These fens are placed in the open and enclosed landscape. The visualised fen is placed on the transition of the heather landscape, therefore offering different experiences and atmospheres. The fens grow and change throughout the season, indicating droughts or wet times. For the people who are working in the distribution centre it is possible to experience real nature on a close distance.

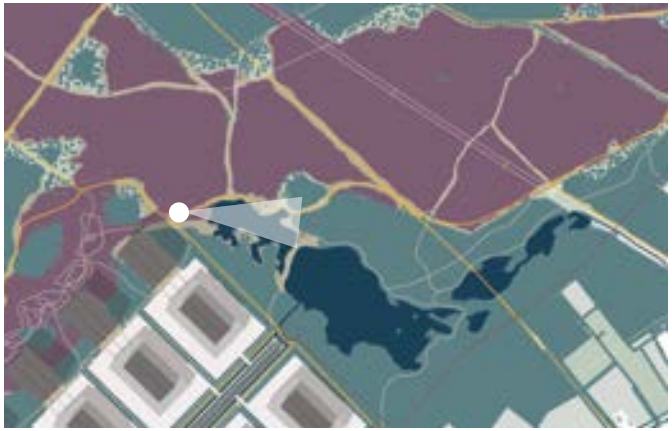


fig 6.19: Location on map

fig 6.20: Visual open fens

fig 6.21: Power line through the heather landscape

6.5 Power lines

The 380kV power network between Tilburg and Oirschot crosses the project area from west to south. The line provides an easy electric power network for XXL-distribution. Besides its electric advantage, the power line is a strong visible element in the open- and the enclosed landscape. The space underneath the power lines needs to remain free of any obstacles such as trees or bushes. This results in a long visible line, flanked by forest (fig 6.20). The vista even makes it possible to see the windmills along the A58. This open view will be maintained by sheep's. Because the power line connects the different landscapes it sort of functions as a highway for animals to move between different habitats and landscape features. In the northwest, the area mainly consist of forest. This will be ideal for animals who hide during the day like deers or boars. Because it is excluded from the recreational network, it will be a more quiet and peaceful area. The centre of the plan consist of the heather landscape with a variation between the large heather- and the smaller heather patches. The Viviparous lizard for instance, prefers the smaller areas with a transition between the forest and the heather. The large open areas are suitable for the Silver-studded Blue butterfly.

fig 6.22: Location on map

fig 6.23: Power line through the meadows

fig 6.24: Location on map

After the forest the power line continuous in the agriculture area. This semi-open meadow landscape is divided by tree lines and solitary trees. The meadow landscape contributes to the habitat of the deer. They are depending on meadow grasslands and come out in the night to graze. By combining the discharge of the XXL-distribution centre, the area underneath the power line is further enhanced as a ecological corridor. This meandering ditch flows in the open landscape of the creek valley of the Reusel. The creek valley is the last landscape type within the project area of the powerline. Here it leaves the area by crossing the A58 highway.

fig 6.25: High bay logistic hub

6.6 Logistics

The logistic hub surrounds the centrally placed high bay warehouses, like the principle of a top hat, the high part is the high bay warehouse and the brim are the logistic functions. The building on the visual shows the loading docks and the flexible layers, which can be used for value adding processes such as packaging and sorting. The building has a width of 116 meters and a length of 190 meters. To minimize the effects on the nature reserve, the logistic hubs are positioned on the inside of the distribution centre. Truck movements are partly hidden by the surrounding forest.

The facade of the buildings have a wooden cladding, similar as the high bay warehouses. The flexible floors have a more dark colour to reduce the size of the building. Glass is recommended if labour intensive process or an office are located on these floors. Enough daylight is a simple factor which contributes to better working conditions. The glass option is visualised in the sections on page 110. Certain areas on logistic warehouses are underused due to the turning circles of trucks. These areas will be planted with trees to continue the atmosphere of the forest.

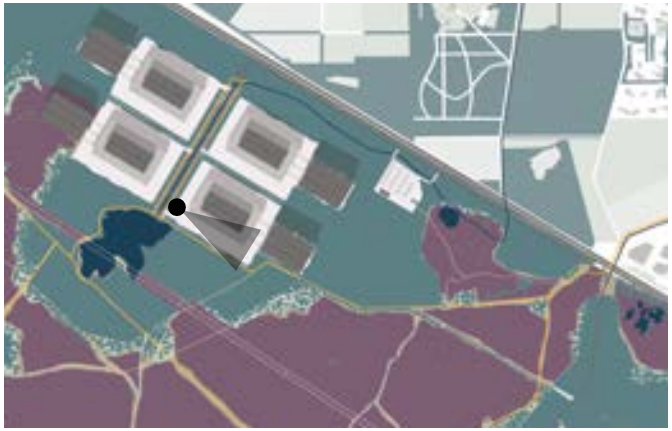


fig 6.26: Location on map

fig 6.27: Truck parking

fig 6.28: Location on map

Truck parking
The truck parking is located on two locations, at the side of the smaller XXL-distribution cluster of 30 hectares and in front of the larger cluster. Truckers are sometimes days on the road before they reach there final destination. The unloading zones of the logistic hubs are large, but can not be used for long time parking. Therefore, the parking space comes in handy. At the truck parking facilities like showers, restrooms and a tanks stations are available. The parkings are positioned in the forest, to reduce the impact on the landscape. Walking paths are connecting them to the nearby forest. In the future electric or hydrogen load stations could be integrated to use the area as a charging point. Electricity will be provided by the generation of solar panels on top of the logistic buildings.
The safety of the trucker and the load should be granted by camera surveillance, a fence and sufficient light poles. These measures are necessary because of the valuable loads and to ensure the area is safe for recreational use.
The truck parkings offer a combined total of 200 truck parking places. 85 of them are based in the north and 115 in the southeast for the larger XXL-distribution centre.

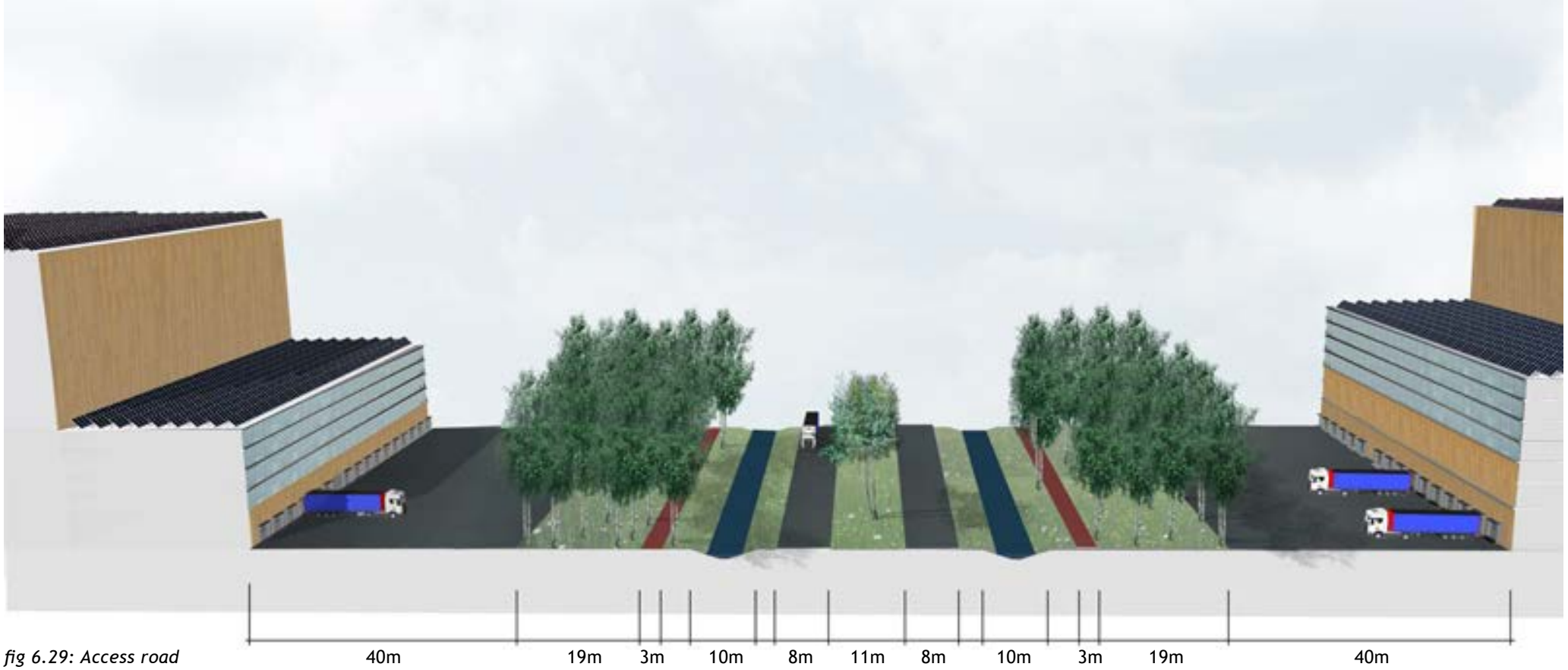


fig 6.29: Access road

Access road
This section shows the access roads towards the logistic hubs. The aim of this road is to continue the green character of the overall plan through the XXL-distribution park. The access roads are flanked on both sides by birches. The birches are planted in high concentrations, which will create an interesting colour combination with the black and white tree trunks. The road consist of two lanes in both directions, to provides a clear overview for the trucker. The roads are separated by a central reservation space of grass and solitary birches. The logistic building are accessible by bike due to the bike paths crossing the birch forest. The bike paths are connect towards the central bike routes of the masterplan. The centre of Tilburg can therefore be reached in 15 minutes. This makes it for employees attractive to take the bike instead of the car. On the side of the cycle path we find the ditches which are transporting the water to the larger fens. The ditches are dividing the road from the cycle path, to create a more pleasant cycling experience. The ditches consist of flaunt slopes which improves the ecology.

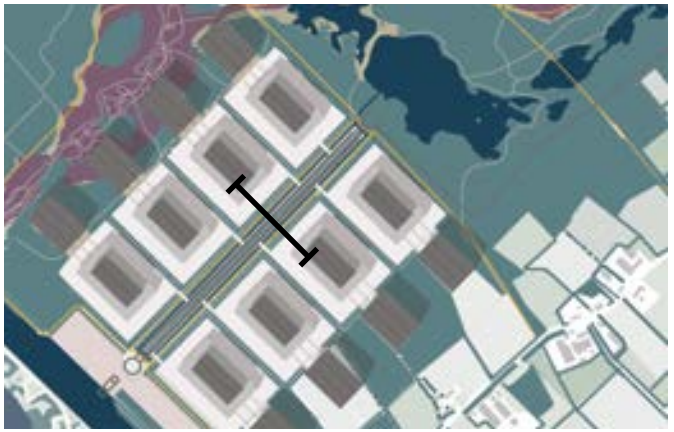


fig 6.30: Location on map

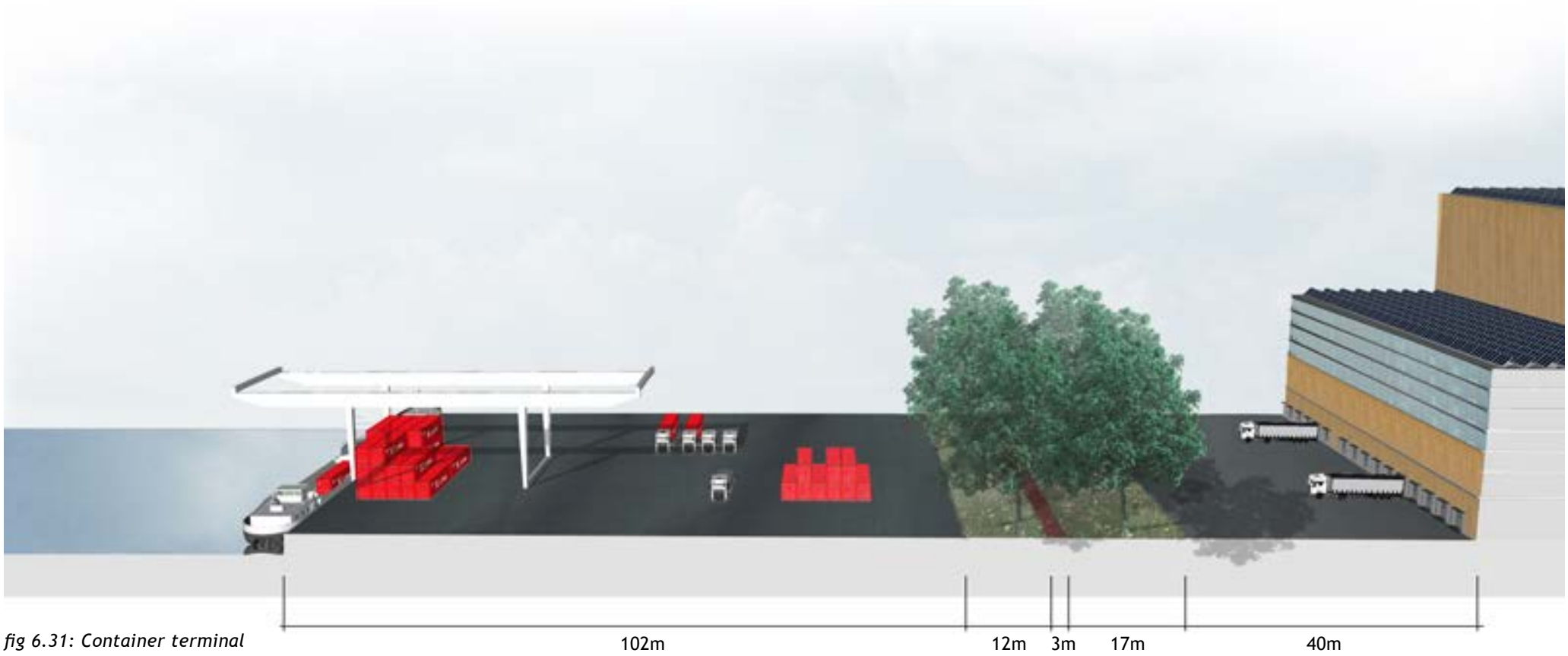


fig 6.31: Container terminal

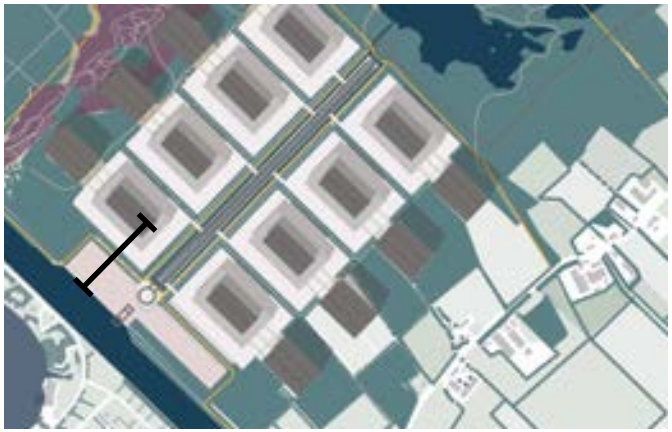


fig 6.32: Location on map

Container terminal
The container terminal is placed at the end of the 60ha logistic cluster. This limits the drive distance between the distribution centre. The container terminal dimensions are based on the terminal in Tilburg built in 2017. The terminal consist of a large container crane, for the unloading of the boats, some space to stack the containers and parking places for trucks and container chassis. To reduce the CO_2 emissions the transport in between the logistic hubs and the terminal is done with electric vehicles. In the near future also electric inland ships will sail on the Wilhelmina channel, which makes it an even more sustainable solution.

Between the terminal and the distribution centres there is a space for a tree line and a cycling route. This route is part of the national cycling network. By incorporating the route it is possible for people to cross the logistic hub and experience the activities. The route is flanked by large oak trees which are part of the linear element of the channel.

Halve of the terminal is embedded in the forest to minimize the visual impact on the linear character of the channel and the nearby holiday park.

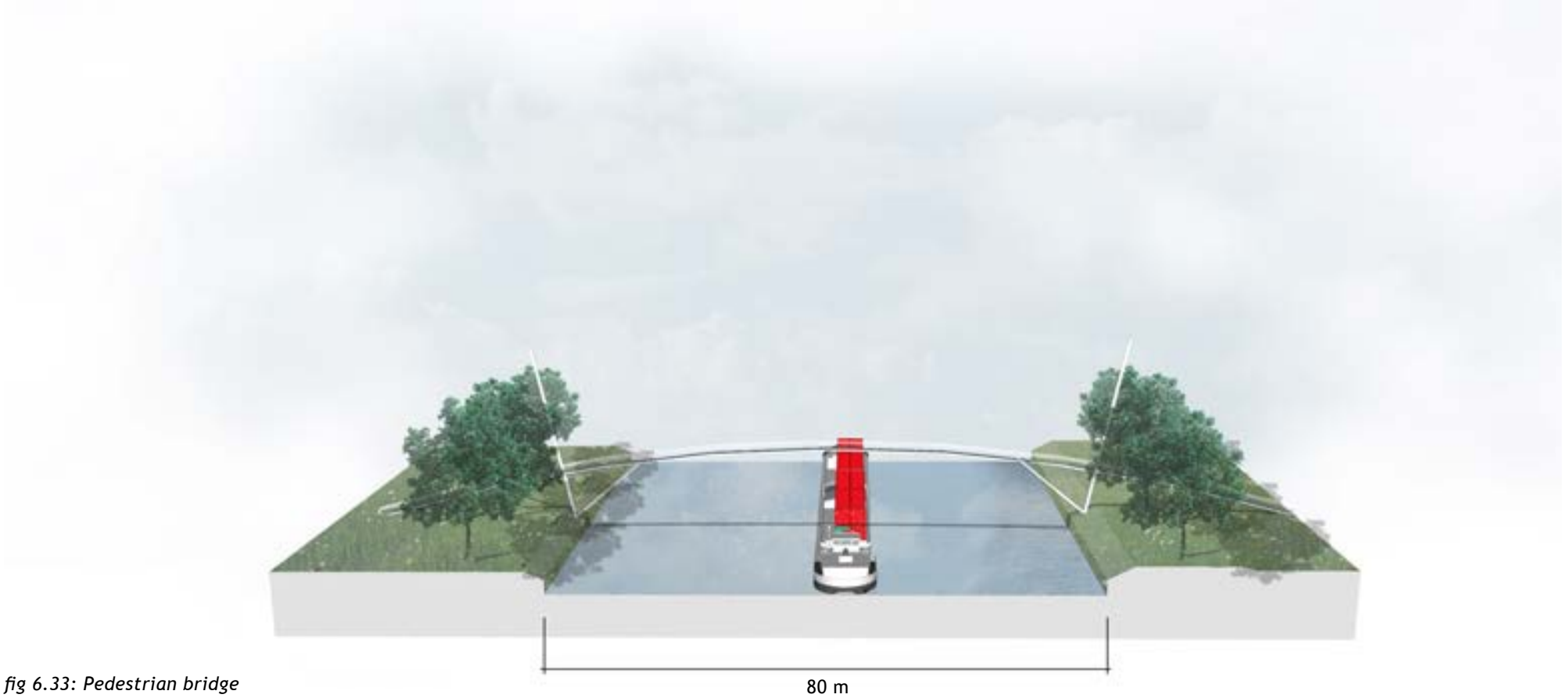


fig 6.33: Pedestrian bridge

Pedestrian bridge
The holiday park from Beekse Bergen is connected to the project area with a subtle walking bridge over the Wilhelmina channel. The recreational potential of both the areas can now be fully utilized. Visitors will be able to explore the heather landscape and its surrounding forest, in a close proximity of the holiday park. On both sides of the channels tree lines are placed, to maintain the continuity of the linear element of the landscape.

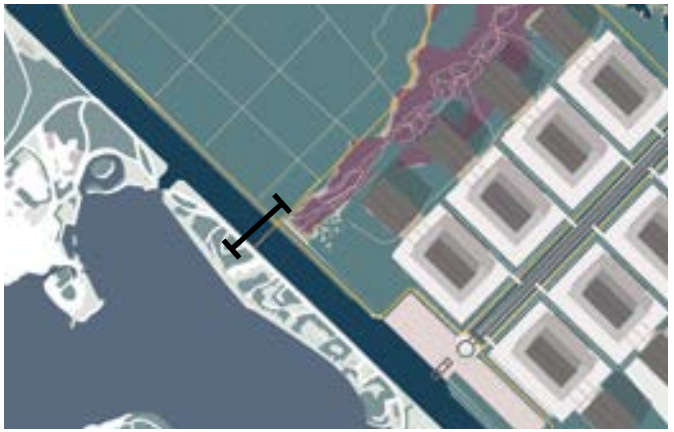


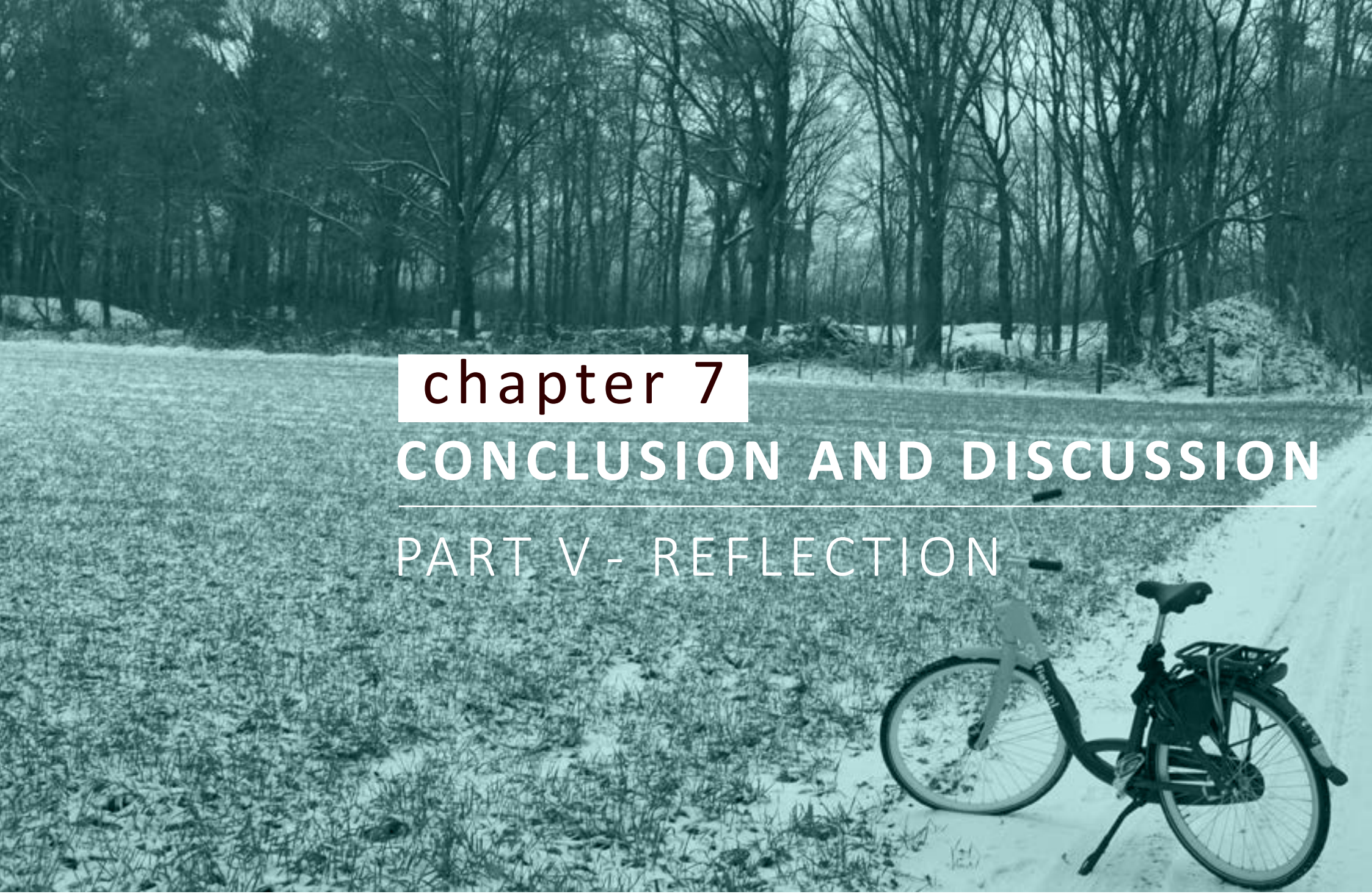
fig 6.34: Location on map

6.7 Conclusion

With this project we aim to develop XXL-distribution with high bay warehouses, a nature- and recreational area. The approach of this landscape design, is to work together with the landscape and the XXL-distribution. By making fens and heather topography the landscape profits from the left overs of XXL-distribution, which normally opposes problems or nuisance. With the integration of both worlds, a spectacular landscape occurs of large high bay warehouses, placed in an open heather landscape surrounded by forest. Truly a distribution park, which is exciting to go to for the employers and the residents of Moergestel and Tilburg.

This approach of developing a landscape together with distribution parks is quite unique and should be applied in more sand landscapes. Sand landscapes shares the same characteristics such as creek valleys and higher sand soils. The concept however, should not be simple copied to other areas. Each area is still defined by their own characteristics. The combination of for instance the many bridges and recreation is not applicable for every location, but is based on the limitations and characteristics of the project area.

To realise this plan, policy regulations should be more flexible. XXL-distribution with high bay warehouses can only be accommodated if buildings limits are higher. Which look cool, but their main functions is to create distribution parks with a smaller footprint and the same storage capacity. Policies regarding the development of placing XXL-distribution in sand landscapes or sea landscape should be regulated from a governmental level. In combination with the duty to develop nature as a company. Otherwise an unlevel playing field is created what makes it impossible to compete with other cities or provinces industrial parks.



chapter 7

CONCLUSION AND DISCUSSION

PART V - REFLECTION

Conclusion & Discussion

In this chapter the main design question and the research questions will be answered with a conclusion. In the discussion the research will be evaluated on the results and the limitations.

What would be the most optimal integration for XXL-distribution in the Dutch cultural landscape between Rotterdam and Venlo?

The most optimal integration is possible if both, the logistic preferences and the landscape are in balance. The logistic preferences are defined by the logistic criteria, such as accessibility, intermodal connections and labour. Integration on a landscape level, regards a landscape which is not affected by cluttering or the new term 'boxing' (verdozing). The impact of an object on the landscape is depending on the visibility. By reducing the visibility of an object, the smaller the impact on a landscape (Domingo-Santos, de Villarán, Rapp- Arrarás, & Corral-Pazos de Provens, 2011; Torres Sibille et al., 2009). This thesis recommends to integrate XXL-distribution in landscapes with an abundance of vegetations such as tree lines or forest clusters. Mitigation measures with vegetation to integrate the building, seems more logic, considering the characteristics of the landscape. If for instance, XXL-distribution would be positioned in a sea clay landscape, its landscape origin is shifting from an open landscape towards a 'volume' landscape. Camouflaging the object with mitigation measures as vegetation would not be effective, because the basic landscape characteristic, namely the openness is compromised.

With data maps regarding the openness of the landscape and the landscape appreciation, the possible locations are studied (Crommentuijn, Farjon, Den Dekker, & Van der Wulp, 2007 ; Meeuwsen & Jochem, 2011).

Large part of the base of North-Brabant consist of the sandy and peat landscape, what results in a wide range of available locations. Within the sand landscape, XXL-distribution is preferred on the higher sandy soils against a forest background. The lower creek valleys are more vulnerable for implementations, because of the open character. In combination with the natural and ecological value, these areas are avoided during the modelling phase. Implementing XXL-distribution in creek valleys would also demand raising of the land because of the increased water table. The outcome of the modelling phase, showed that placing the objects scattered in the landscape contributes to landscape cluttering and the urbanisation of the landscape. The size of the integrated objects would stand out from the smaller villages as a disturbing factor. Clustering XXL-distribution in the landscape is preferred by the logistic criteria and the landscape integration criteria. Only a limited amount of locations are affected by the impact by the new XXL-distribution centres. The most potential locations for XXL-distribution are positioned along the main highways, cities and within the range of the terminals. After deciding the location on a regional scale, an in-depth analysis is still necessary to position the buildings on a local scale. With a design study we shaped a design which is place specific and reacting to existing function. In the design the XXL-distribution becomes part of the existing landscape , by using landscape elements such as forests, tree lines, fens and heater topography.

1. What is the current role of the government in the positioning of XXL-distribution?

At the moment there are no policies regarding XXL-distribution by the central government. Infrastructure however is a valuable criteria and is indirectly connected to the positioning of XXL-distribution. The Ministry of Infrastructure and Water Management aims to guarantee upon the quality of accessibility, with a decent traffic flow in a clean and safe environment (Rijksoverheid, n.d.). The province has a facilitating and advisory role for the regional regions and the municipalities. The province is responsible for the planning, economy, environment, mobility and culture. Every couple of years a document is published called the Structure Vison. This document addresses the spatial and functional developments of the province. The province of North-Brabant is divided in four regions. The regions are working together on topics as the positioning of large scale developments like XXL-distribution. For instance, the middle region consist of the cities Tilburg and Waalwijk, both are important players regarding XXL-distribution.

The municipalities are obligated with the task to determine the zoning plans and define which areas are suitable for nature, houses or industrial parks. Before industrial parcels are sold to companies the road , drainage and ditch system is created. Sometimes the areas are not developed before they are sold, because the parcels size is may vary, depending on the type of company.
The lack of a leading role from the government is worrying, considering the size of XXL-distribution. Provinces are competing with each other, to attract large players. When a province decides to build a sustainable distribution park and another province does not, an unlevel playing field is created. Themes as climate change and the energy transition should be regulated from a governmental level, because of their increasing role. This can be simple arrangements, like the obligation to implement solar panels on every large roof surface, or more complicated, like the development of XXL-distribution together with nature development.

2. Which factors are contribution to the positioning of XXL-distribution and what can be expected in the future?

The factors for the attraction of XXL-distribution are playing a role on a nation scale and a more regional scale of North-Brabant. The business climate of the Netherlands, offers a tax benefit and has an open altitude towards investments and employment. The municipalities are eager to attract large players, cause of their employment and investments. The other national factor what contributes to the positioning of XXL-distribution is the investment opportunity from the real estate market. The low interest, results in low development costs and in combination with low ground prices is a safe market with high profits. The province of North-Brabant is positioned in the trade rectangle between Antwerp and Rotterdam. These two deep sea harbours provide the linkage to the trade world. With the hinterland of the Ruhr and the rest of Europe, this position is highly interesting for XXL-distribution. In combination with excellent intermodal connections of water, road and rails, the suitable locations for XXL-distribution stretches out to a large part of North-Brabant. The dense network of terminals, makes it for every industrial site possible to reach a terminal within 15-20 minutes.
Trends which are occurring are becoming more and more part of the ordinary live.
Developments in innovation and technology are changing the way we live. Digitization is making things easier, we can order things from the couch. The growth of E-commerce is one of the main drivers for the expansion of the buildings. They are re-shaping the storage system, internal processes and are part of longer networks, delivering directly to the client. Repetitive tasks are more and replaced by automation and robots, to speed up the efficiency and to reduce the delivery time to the customer.

3. What knowledge and design tools can be derived from reference projects over the world?

The aim of the reference study is to reduce the footprint of the distribution centres and to find an alternative, which meets the standards of the existing one layer warehouse. Therefore, every model is compared with the basic single floor warehouse, with an height of 14 meter and a rectangular shape. These buildings are the most common warehouse type of the Netherlands. Each reference is tested on the following parameters: footprint, flexibility, roof height, and functional space.
In total four different types of warehouses are tested. Warehouses can be placed underground in old mines or have multiple layers because of the high soil prices. In Springfield in the USA, an old limestone mine used for the storage of products. Because it is located down below, there is a constant low temperature. However, the lack of mines in the Netherlands makes it not the most realistic option. Multi-floor warehouses, are often built in areas with extremely high ground prices, such as Singapore and Japan. Because multi-floor warehouses are vertically expanding the storage space, they have a positive influence on the footprint reduction. Down side are the heavy constructions, which are needed to support the trucks and the multiple floors. The best solution is the high-bay warehouses. The highway warehouse fulfils almost all the criteria and uses lightweight materials similar to the existing one layer model. The high bay warehouse is a new model, which is shaped by the inventions of automation and robots. The compact construction makes it possible to
create a high density stacking in a relatively small space. High-bay warehouses can be built for different sizes and goods and are easily expandable. With this model the footprint will be reduced by 50 to 60 percent in comparison with the regular warehouses. The buildings will be smaller in size but the height will increase. High bay warehouses can reach an height up to 45 meters and are therefore more visible in the landscape.

4. How can XXL-distribution deliver collateral benefits to the landscape and/or society?

The prototype aims to develop a masterplan with XXL-distribution what is intertwined with the landscape. Distribution parks are a profitable business who have the capability to invest in real estate, but also should invest into the landscape where they settle. For this plan we are proposing an alternative approach were companies are developing nature within the same area. This provides collateral benefit for ecology and opens up new ways of experiencing a landscape. The position of the prototype is located in the sand landscape between Tilburg, Moergestel and the Beekse Bergen. By combining the distribution centre with nature development, an area is created what makes it even interesting for recreation. The masterplan is a celebration of the Brabant's landscape by implementing heather topography, fens and forests, which continue towards the nearby creek valley. Forest is used for the integration of the XXL-distribution. The fens function as a storage and buffer for excessive rainfall, which allows the water to infiltrate. The heather topography is created by the excavations for the foundations of the XXL-distribution. The landscape profits from the left overs of XXL-distribution, which normally opposes problems or nuisance. With the integration of both worlds, a spectacular landscape occurs, of large high bay warehouses, placed in an open heather landscape surrounded by forest. Truly a distribution park which is exciting to go to for the employees, the residents and tourists of Tilburg and Moergestel.

Discussion

The design proposes a combination of intertwining the XXL-distribution with the landscape. The sand landscape is, because of its diversity, excellent for the integration of XXL-distribution. The landscape has the ability to store, infiltrate and discharge the water. Forests can be planted to integrate the high bay warehouses. However, designing a masterplan is still a creative process and therefore highly subjective. Perceptions may differ from designer to designer. In the masterplan chapter decisions are explained as much as possible to give an insight in the whole process.

This design approach, of using the landscape as a system contributes towards the integration of XXL-distribution in the sand landscape. Every designer, planner or policy maker should consider the landscape characteristics and identity of an area. Fens are for example not common in every type of sand landscape and recreational networks are not everywhere necessary. Furthermore, it should be stated that this masterplan is not the cheapest option out there. Developing a high bay warehouse and nature at the same time, is a costly operation. However, keeping the developments out of the open landscapes, to maintain the openness of the landscape and moving them to the more enclosed sand landscapes, to limit the visibility. This is already a way cheaper option due to the different soil prices.

The growth of XXL-distribution is based on data from the prognosis of 2015 by Stec-Group. Currently, more recent data is available about the growth prognosis of XXL-distribution, published in December 2018, also by Stec-Group. At the time this research was conducted, this information was not yet available. The predicted growth of based on the research of 2015 was already been processed in the modelling phase. Updating this data would have been difficult because both researches are difficult to compare. The prognosis from 2015 differentiates the data by sector, in this case large scale logistics. While in the 2018 prognosis the large scale logistics is placed under the umbrella of logistics and warehousing. What indicates the growth of all the logistics and warehouses including small scale developments, what is not interesting for this thesis. Nonetheless the prognosis still shows a growth of 530-750 hectares in the logistic and warehouse segment (Stec-group, 2018). Establishing the continuous trend for XXL-distribution.

The reference study showed the outcome of high bay warehouse as the best way to reduce the footprint of the buildings. The used measurements such as docks and storing space is based on one example of a regular warehouse building. The availability of data is often limited, regarding the amount of storage and docks of a buildings. Shaping a general high bay warehouse is difficult, because E-commerce has their own process flows and products, what makes every building unique. More in-depth research is therefore necessary from the logistic branches and experts to verify if high bay warehouses really could be used, in the way they are proposed in the masterplan.

During the model phase of the thesis suitable locations are defined with the input of the landscape criteria based on: the appreciation of the landscape, the landscape type, existing disturbing factors and the openness of the landscape. Some comments need to made about these criteria.

The openness of the landscape is a criteria, which addressed the impact on the landscape and made us choose locations with an abundance of vegetation. The theory stated that the distance between the element and the observer influences the impact of the element. Also the distance impacts the extent to which an element is visible and dominates the view (Domingo-Santos, de Villarán, Rapp- Arrarás, & Corral-Pazos de Provens, 2011; Torres Sibille et al., 2009). By placing objects in a landscape with a dense vegetation, such as a forest. This would suggest by the theory that the visibility is limited and the object is well integrated. However, if the forest is placed along an open creek valley, the buildings will still have an impact on the landscape because of the height of 45 meters. Therefore, locations should be tested on the small and large scale. With the positioning of the XXL-distribution we excluded the areas affected by a seepage pressure. This seriously limits the available locations to the higher sandy areas. In North-Brabant, which mostly consist out of the sand landscape there are still enough available locations . For other provinces this might be a problem.

The appreciation of the landscape is a criteria, which defined if landscapes are less- and highly valued. In a way this gives an indication about the opinion of the people about the areas. However, the valuation of a type of landscape is not the same as a valuation about XXL-distribution. If the people are asked if they would like to a distribution park or a less valued agriculture landscape they would probably prefer the agriculture area. The social layer of implementing XXL-distribution and its additional activities under local residents is missing in this research. This should be further elaborated with interviews to determine if a location is really suitable for XXL-distribution. From a planning perspective the developing of XXL-distribution in a sand landscapes will have more implications in comparison with the sea clay landscape. Sea clay landscape are sparsely populated and are mainly focussed on agriculture. The assumption is, that the residents living in the sand landscapes are more involved in the landscape. The sand landscape houses more mixed functions such as theme parks, camp sites, bungalow parks and natural reserves.

It should be stated that the regional modelling study does not take into account the municipalities borders. Municipalities tasks are limited within their borders. Although, municipalities are working together in regions, the freedom of the thesis would be limited by its current borders. The idea of the regional study is to provide locations from a landscape and a logistic perspective and not from the existing regulations. The thesis proposes, that the government should take a leading role in the positioning of XXL-distribution, municipal borders should therefore not oppose a problem.

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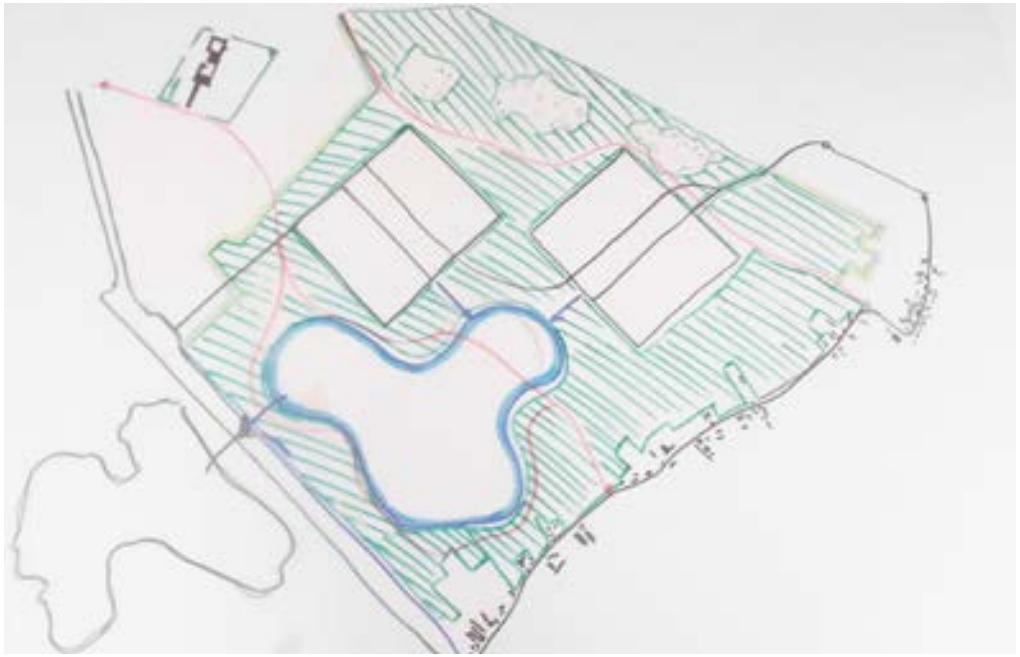
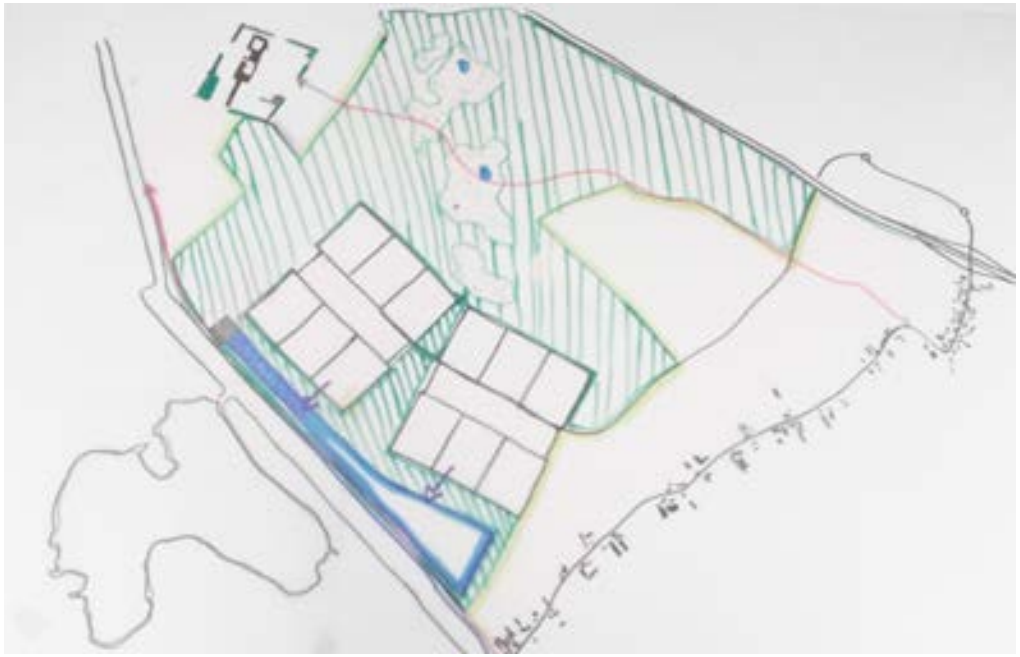
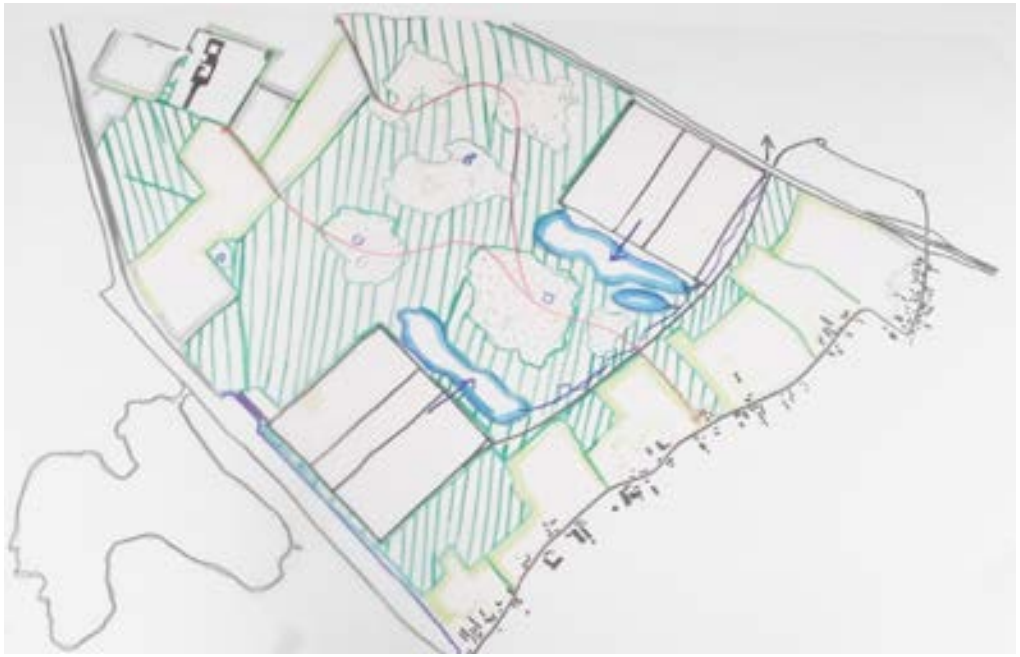
appendix

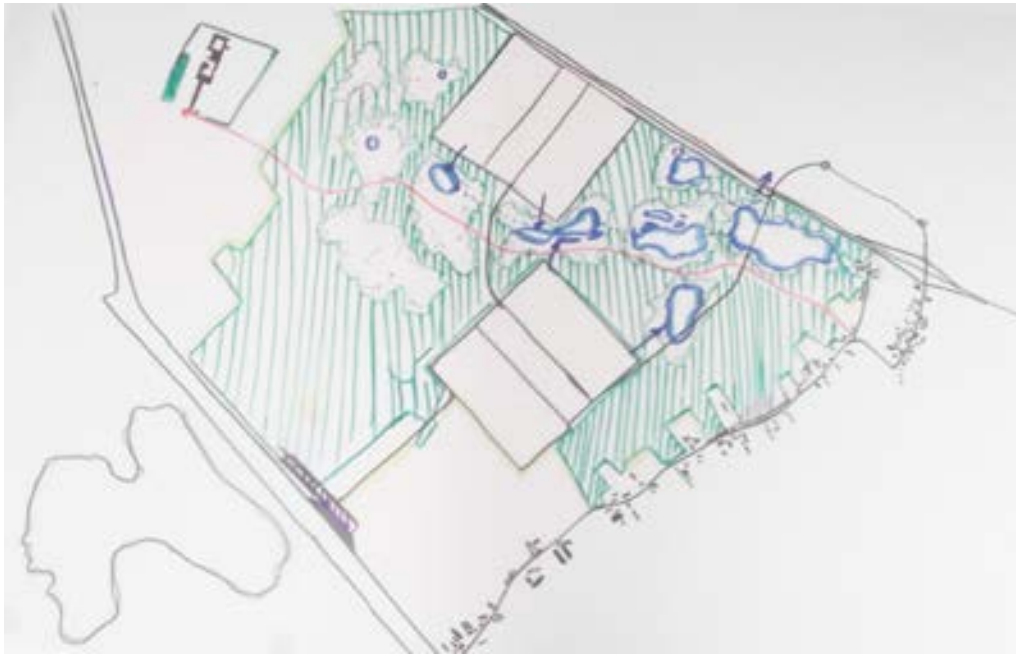
A & B

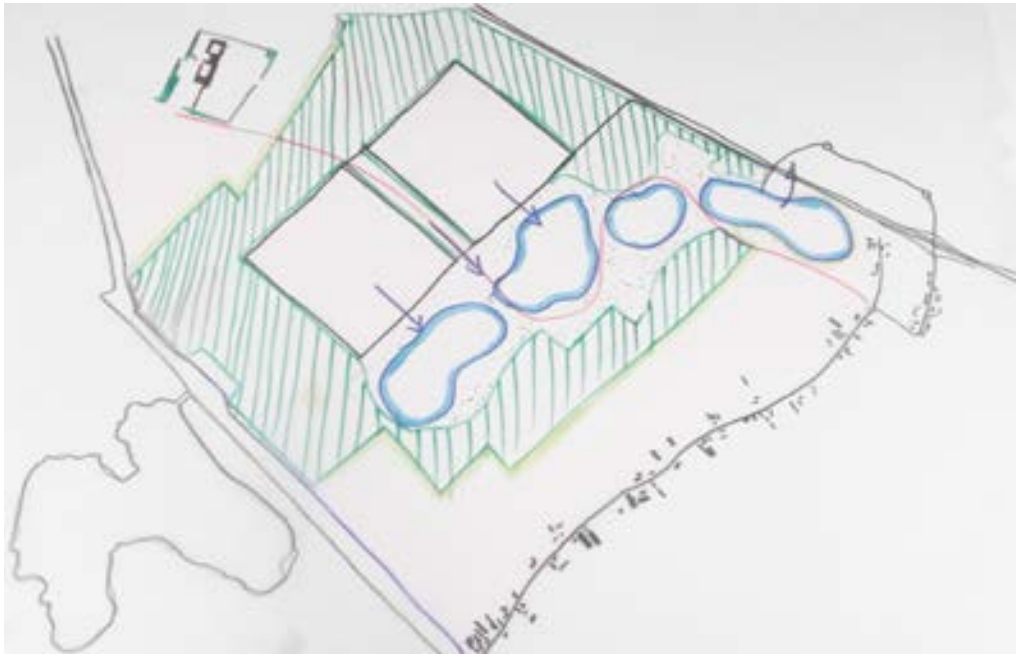
APPENDIX A

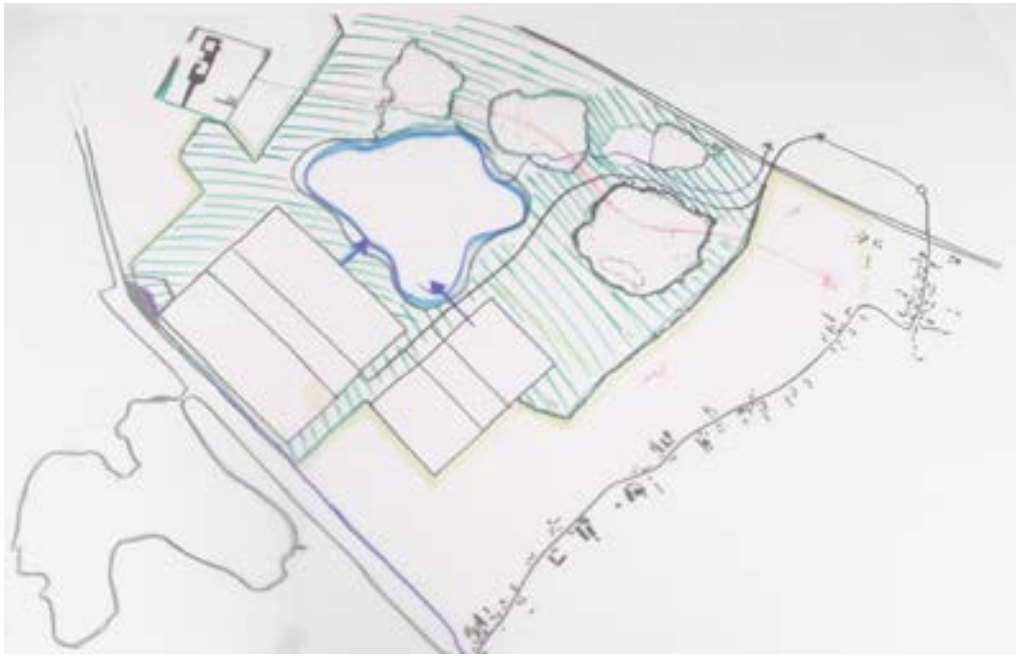


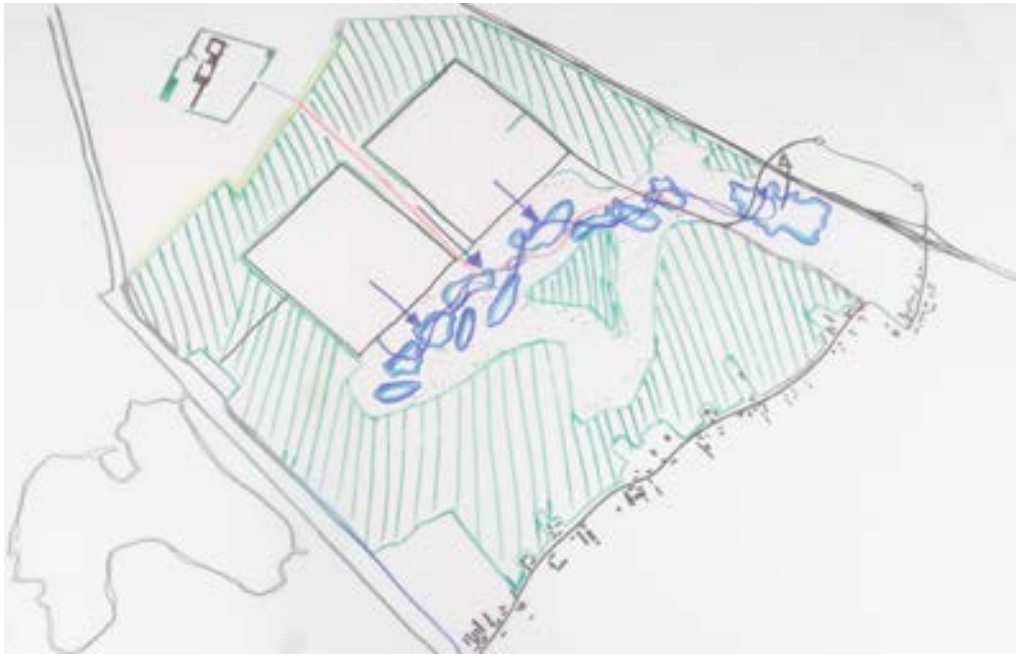


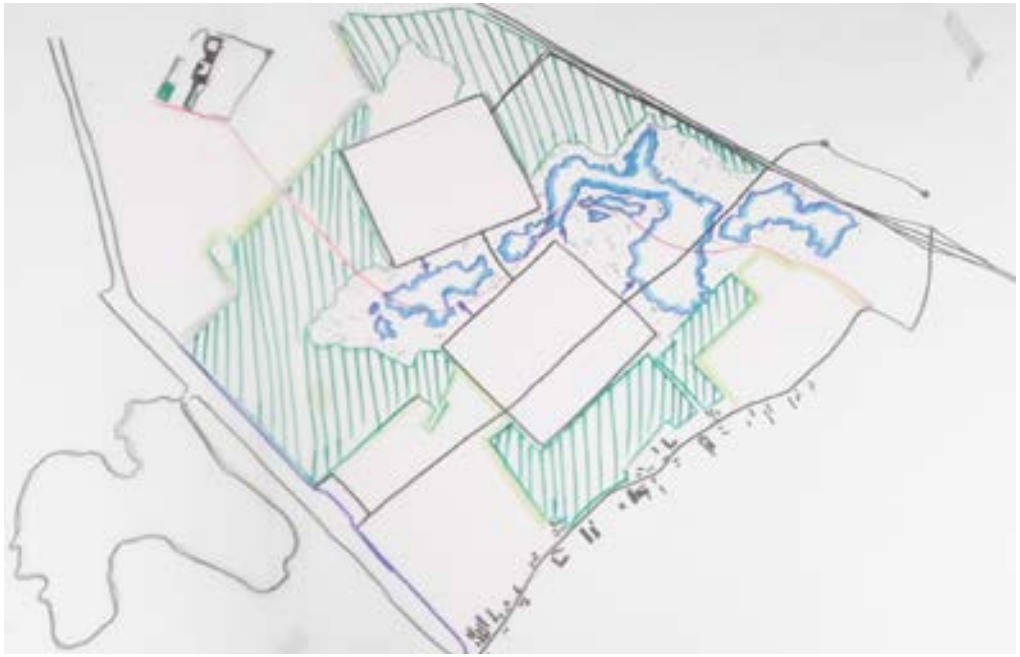












APPENDIX B