Water as a carrier for future values

a design for the longterm transition for the Benthuizer Noordpolder, the Netherlands

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Colofon

Water as a carrier for future values. A design for the long term transition of the Benthuizer Noordpolder, the Netherlands

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Abstract

Living in the deep polders in the deltaic landscape of the Netherlands poses large-scale challenges. Biodiversity decline, weather extremes, sea level rise, salination, the housing crisis, and subsidence affect large parts of the Netherlands. These challenges should be tackled together through the integral question of 'what does the area need?' instead of the more contemporary idea of adding one aspect and the rest will follow. This thesis argues that the territory-oriented approach in relation to current functions and natural and cultural value support urban development to create value in low-lying Dutch polders. In this project, a design for the Benthuizer Noordpolder is created with the use of the territory-oriented approach that regards several aspects of the project, such as urban development, water management, agriculture, and recreation. Through the investment in time, cultural and natural values, integral design, and adaption a design is created that takes a proactive stance toward the current climatic and societal challenges.

This is achieved by using water as a carrier. The hypothesis of a new waterway functions as the backbone of the transition of the area. This transition allows for the reconstruction of a landscape that is related to the natural cultural landscape. Through several steps towards 2100, the vision creates a new type of urban ecosystem that has a beneficial relationship with the landscape. Infrastructure, housing, and open spaces are reconfigured to enhance the system. Through the addition of floodable housing typologies and infrastructure, a new perspective is given on the relationship with the delta which argues for a shift from extreme water management to the creation of boundaries in which the water is allowed its natural rhythm. Through the territory-oriented approach and the use of the physical conditions of the site, the landscape is transformed from barren agricultural landscape to a multifunctional landscape in which there is space for agriculture, living, and recreation. With this design, the argument is made that it is possible to propose urban development in the low-lying polders.

The project's progression from today until 2100 is not without limitations. Questions have been put about the justness, the involvement of stakeholders, and water management specifications. This design for the area of the Benthuizer Noordpolder conveys that future value can be created by reimagining infrastructure, housing, and open spaces through long-term investment.

Key words: *natural cultural value, territory-oriented approach, sustainability, spatial qualities, barge canals, Benthuizer Noordpolder (the Netherlands)*

Aknowledgements

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to Marijn, through the good times and the bad, providing a safe space for all my troubles, discussions, and excitement. For your patience and encouragement.

From the bottom of my heart: thank you for all your support.

Content

Herinnering aan Holland

Denkend aan Holland
zie ik breede rivieren
traag door ***oneindig***
laagland *gaan,*
rijen ondenkbaar
ijle populieren
als hooge pluimen
aan den einder staan;
en in de ***geweldige***
ruimte *verzonken*
de boerderijen
verspreid door het land,
boomgroepen, dorpen,
geknotte torens,
kerken en olmen
in een ***grootsch verband.***
de lucht hangt er laag
en de zon wordt er langzaam
in grijze veelkleurige
dampen gesmoord,
en in alle gewesten
wordt de stem van het water
met zijn eeuwige rampen
gevreesd en gehoord.

H. Marsman
Verzamelde gedichten

Heritage Revealed

The basis of this project is a research question from the Province of Zuid-Holland to start a project to investigate the historic barge canals that have recently been granted heritage status. This question was elaborated with regards to how the connection between the landscapes and the physical elements that were of importance at that time could be connected and experienced again in the present situation. The historical barge canals and the urban centres that they evolved around can be found in image 01. The creation of the barge canals took place from the 15th until the 17th century, with its peak in the mid-16th century.

This thesis will investigate the challenge of creating a physical connection with connection to the historical aspect of the rise of the historic barge canals. To create a design, a smaller portion of the large-scale area was taken. The territorial area is based around Zoetermeer, from the north of the Rotte through the polder landscape and peat meadows to the Oude Rijn, zooming into the Benthuizer Noordpolder to hypothesize a design for a waterway to connect the waterbodies and consider the timeframe from today until 2100.

The motivation to take on this project comes from the interest to see how a new biophysical connection can consider cultural-historical values and current socio-ecological and climatic challenges and use these to create added value through spatial qualities and sustainable development.

This thesis will show that heritage is not limited to the tangible structures in the landscape that can be seen and experienced. Heritage is the landscape that we inhabited with all its traces that were left by natural processes and human interventions. It is the inheritance of the actions of people in the past and the knowledge that can be found in that history that can be applied to the knowledge that we have of the current situation. In this way, we can provide new meaning to the future and find ways to sustain those values of the landscape that are deemed important for future generations to know and live with.

01

Composition of the polders and cores of the barge canal network. (Author, 2022)

Bobbink, I. (2016). De Landschapsarchitectuur van het Polder-boezemsysteem.

Wellenberg, M., & van der Zee, A. (red,). (2021). Atlas van de trekvaarten in Zuid-Holland. Uitgeverij THOTH.

Part 1 | Methodology

Overflowing issues

1.1 Problem field

motivation and context
deltaic transformation
subsidence
weather extremes
sea level rise
salinization
ecological crisis
housing crisis
entangled

Motivation and context

The exciting subject from the project group heritage revealed was not the sole motivator to start a project researching the deep polders of the Netherlands. In research and increasingly also in the media, there is a lot of attention on the imminent threats that these deep polders have to deal with in an increasing frequency. Most of the media address a large water issue: the deep polders will overflow more often and what is now green might start to become blue. New houses will have to start dealing with the threat of water at the doorstep but will simultaneously have to consider subsidence and the threat of sea level rise in the long term. Planners, politicians, and inhabitants will have to adapt to the water in their current practices and habits. A chance was seen to combine these pressing issues with the heritage of the deep polders to see how we can learn from past practices and current issues as we strive towards an adaptive future.


Het Groene Hart wordt in de toekomst het Blauwe Hart

Algemeen Dagblad, December 18, 2021


Nieuwbouwhuis met kans op natte voeten

Algemeen Dagblad, December 8, 2021


‘Wij moeten ons aanpassen aan het water

Algemeen Dagblad, October 29, 2021

02

Snippets from news outlets (Author, 2021)

Deltaic transformation

Millenia ago, the deltaic landscape changed slowly because it was only impacted by natural processes. The landscape was boggy and wet. This peat landscape was difficult to navigate and, therefore, when humans started to inhabit the delta, the landscape underwent a tremendous change to facilitate human settlement (Deltares et al., 2021). The landscape has taken on the form as we know it because of the interplay between man and nature. The landscape changed with the development of safety through dikes and hand in hand with urban development and vice versa. The creation of safe places through a dike and polder system has led to the characteristics of the province of South Holland as we now know it (Meyer, 2001). However, these characteristics pose large-scale challenges. These pressing challenges are the result of years of transformation. Distinguished in this research are the following circumstances:

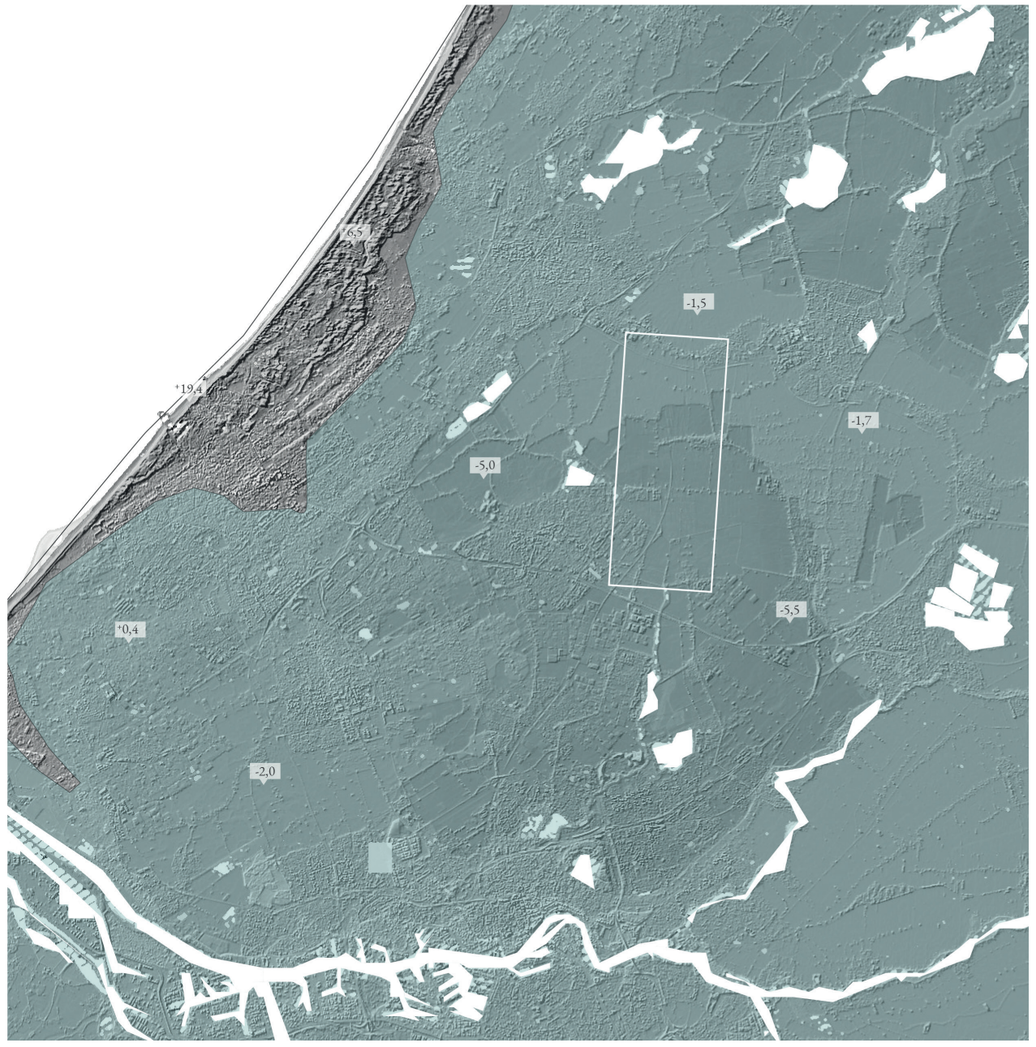
- Subsidence
- Climate extremes
- Sea Level Rise
- Salinization
- Ecological issues
- Housing Issues

03

timeline of soil transition
(Deltares, 2021)

Subsidence

The soil in the project area is sinking. This has always been the case, as this is what has made the area as people know it: the landscapes have retrieved their characteristics from the sinking soil. The two polder types in the area are not sinking equally fast. Because of the clay layer in the droogmakerijen, this area subsides less fast than the much wetter peat grounds (Provincie Zuid Holland, n.d.). Given this, subsidence in both these areas is the cause of large costs as houses and critical infrastructure need to be repaired in large parts of the project area. There is a higher chance of nuisance caused by high water or periods of long rain. Currently, costs to solve these incidental issues are lower than tackling subsidence as an integral problem. This is also caused by the division of tasks among the multiple bodies of government. In the contemporary state of the system, the Water Boards are usually responsible for bringing in solutions to the challenges that are paired with subsidence (PBL, 2015). They do this in dialogue with the farmers in the affected area. Nevertheless, solutions need to change to include more strategic, location-specific, and population-inclusive resolutions for a longer period. The way these strategies are shaped depends on the distance between the location and the city. Tackling subsidence more integrally can not only reduce costs but can also reduce CO2 which is released when oxidation of the peat landscape takes place. An integral way of dealing with subsidence is necessary, as the changing climate and increasing need for houses can cause subsidence to be augmented. Eventually, the current policy is not only the most expensive but also the option that will lose the characteristic landscape and its qualities (PBL, 2015).



04
Composition of the low-lying land (Author, 2022)

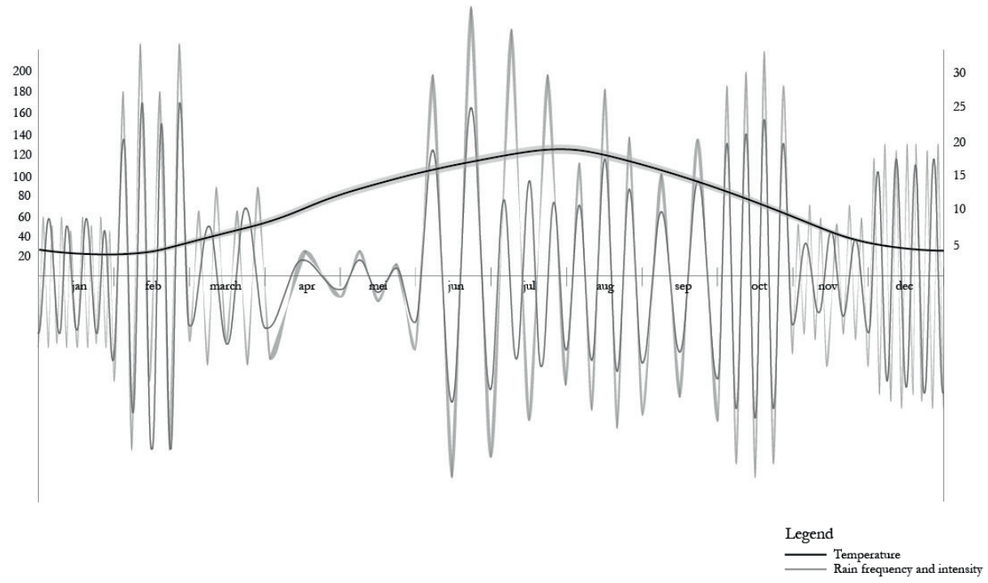
above NAP
below NAP (high to lower)
water
subsidence (little to a lot)
height above NAP

AHN (n.d.). Actueel Hoogtebestand Nederland. Retrieved on 18-11-2021. Retrieved from: https://www.ahn.nl/ahn-viewer

DINOloket (n.d.). DINOloket Ondergrond gegevens. Retrieved on 19-20-21. Retrieved from: dinoloket.nl/ondergrondgegevens

Weather extremes

Changes in climate extremes have been reported worldwide since 1950 (IPCC, 2021). In the project area, these changes are exhibited mostly in the periods of the year that have historically been the driest or wettest seasons of the year, thus creating more extreme situations (KNMI, 2021).
In the dry summer season, less water than normal is available. This causes freshwater scarcity and results in dry soils that retrieve water to a lesser extent than saturated soils. Droughts in the summer are caused by elevated temperatures during the summer month, but the problem sets in during spring as temperatures have been increasing and evaporation levels have been historically high over recent years (KNMI, 2021). In times of freshwater scarcity, subsidence increases. This has effects on agriculture and nature, but also on freshwater availability (PBL, 2015). Because of the expected increase in temperatures in the coming years, the chance of evaporation and thus drought stays high (KNMI, 2021). Whereas summers are dry, winters have become increasingly wet. Research shows that the number of days with rain has not changed, solely the intensity of the discharge has increased. The increase in rainfall causes a large potential for floods in the area (KNMI, 2021; PBL, 2015). This new shift in extremes asks for a new type of water management.



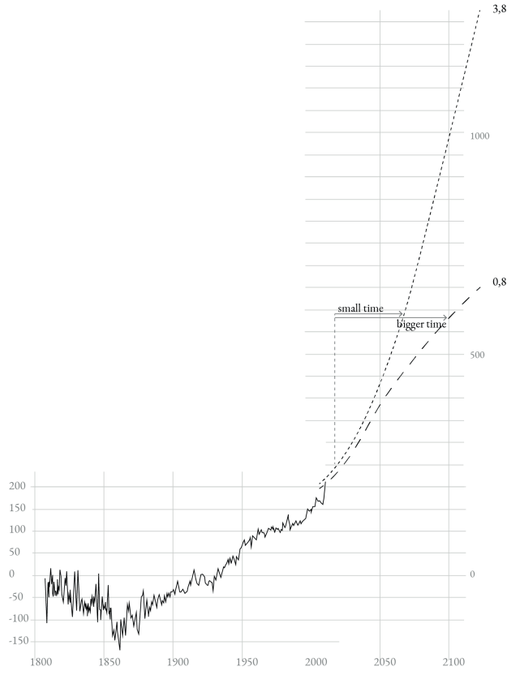
05

Projection of rain frequency and temperature change (Author, 2021)

KNMI. 2021. KNMI Klimaatsignaal '21: Hoe Het Klimaat in Nederland Snel Verandert. De Bilt.

Sea Level Rise

Sea Level Rise (SLR) is posing uncertain threats. The rise of sea level has rapidly been increasing over the last decades and is now set at 3,7 mm per year ((IPCC, 2021; KNMI, 2021). The speed with which the SLR is continuing relies on the decrease of emissions globally. Depending on that, the point at which the critical one one-meter is exceeded lies between 2150 and 2350 or much earlier between 2090 and 2040 (KNMI, 2021). Until 2050, prognoses about SLR are similar, but after this year the lines of the prognoses start to diverge. Because of the uncertainty after this year, it is becoming increasingly hard to predict an adequate way of intervening in the problem. This is because the lead time of interventions is steadily getting smaller. This means that the planning and implementation time of measures is just as long, or even shorter, than the time we need a measure to be read. It is thus to an increasing extent more important to implement adaptive measures (Haasnoot et al., 2020).



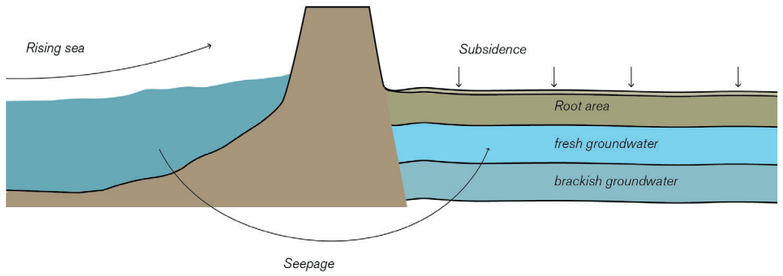
06

Projection of sea level rise and lead times (Author, 2022)

KNMI. 2021. KNMI Klimaatsignaal '21: Hoe Het Klimaat in Nederland Snel Verandert. De Bilt.

Salinization

Sea Level Rise does not only pose a threat to the area regarding flooding, the combination of the rising levels of the sea and the reduced discharge during the progressively dry summers cause the salinization of the groundwater and surface water (Kwadijk et al., 2010). This is the result of salt intrusion that is possible further inland because of the high sea levels. If this happens, salt water can reach the freshwater inlet at Gouda, which is then stopped as salt water hurts the current type of agriculture. In the occurrence of such an event, contemporary practice is that the climate-proof water supply (Dutch: Klimaatbestendige WaterAanvoer (KWA)) measure sets in. This means that the freshwater supply for the thesis territory will come from the Amsterdam Rijnkanaal via the Lek and the water system in the polder (Hoogheemraadschap De Stichtse Rijnlanden, 2017). If the sea level continues to rise, this measure will become the new standard and will have repercussions on the navigability of the Gouwe that leads ships to the Rotterdam harbour (Haasnoot et al., 2019). Continuation of the current use of the soil and the water in combination with the salinization of the rivers and groundwater due to SLR will mean that the challenge to supply fresh water to agriculture and consumers will be tough (Haasnoot et al., 2019).



07

Salinization (Author, 2022)

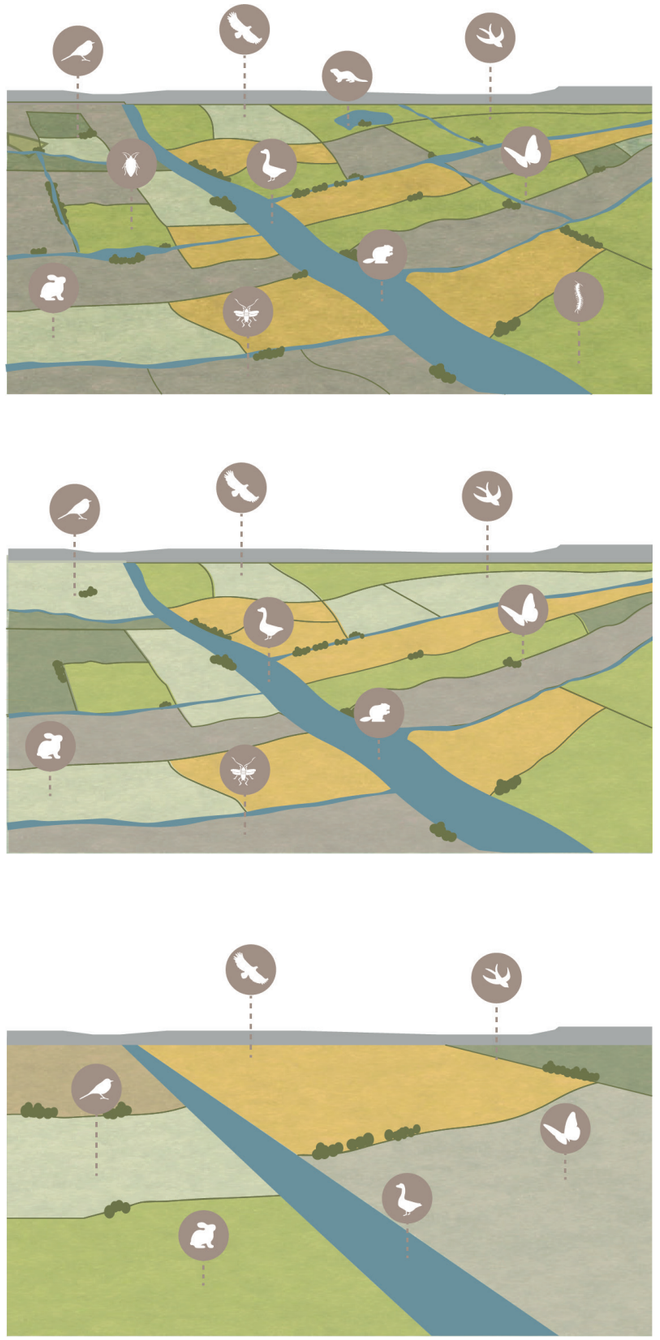
Ecological Crisis

A large demand for freshwater in the area is made by the large-scale agricultural plots that are present in the province. The increase in the scale of the landscape that was made in the 1950s puts pressure on the soil and water quality (PBL, 2019). Furthermore, due to the increase in scale the originality of the landscape has further diminished over the last century. This increase created a diminishing in the number of farms which has caused the biodiversity to decline immensely. Field boundaries such as hedgerows have made way for barbed wire and fences (PBL, 2019). This impoverishment affects social, economic, and cultural ecosystem services due to which the value of the landscape is lowered (van Tooren & de Graeff, 2013).

In this thesis, nature is regarded as part of the domain of the cultural landscape (Renes, 2007). In the case of the polders of the Netherlands, one can distinguish a natural cultural landscape, in which humans regularly interfere with the natural systems and thereby create variation in nature. The management of nature, in that case, goes hand in hand with the management of cultural-historical values (IPO & LNV, 2021).

Thus, truly natural landscapes do not exist in the Netherlands, as the landscapes are synthetic so the natural system cannot be perceived without the interference of humans. Throughout the country, there are increasing amounts of areas appointed as natural areas. These areas and their species are protected, and special rules apply to surrounding agricultural and urban areas. However, managing nature within solely these areas will not suffice anymore to guarantee the quality of nature in the whole country, as these strict divisions between the diverse types of landscape cause fissures between its users and profiters (van Tooren & de Graeff, 2013). This is also evident from the intricate nitrogen debate that has been swept up in the Netherlands, which takes Natura 2000 areas as a starting point for policy creation.

To create a better system that is not restricted to the protected areas, a basic quality for nature must arise. To facilitate this, a connection to agriculture can be made (IPO & LNV, 2021). The agricultural sector has a task to transition into more sustainable practices. Biodiversity, health, cultural-historical values, and the reduction of emissions are increasingly debated in the context of farming (PBL, 2019). Through an integral approach, including urban, peri-urban, rural, and protected natural areas, a systemic transition can be set in, through which the habitat of flora and fauna is secured with better qualities, agricultural practices become more sustainable, whereby social gain is assured (van Tooren & de Graeff, 2013).



08

transition of agriculture and decline of biodiversity (Author, 2022)

Housing crisis

A last core issue in the project area is the urgent need for new houses. There is a large pressure on the Dutch housing market, especially around the Randstad, as published by the Ministry of Dutch affairs (Staat van de Woningmarkt. Jaarrapportage 2021, 2021). The number of households will continue to rise until at least 2029 (BPD, 2021), and the national plan for one million homes tasks municipalities and government officials with the decision on where to build. Approximately 650.000 homes are planned to be built in or near the Randstad (Titawano, 2021) However, building new dwellings in the area is not without risks. Houses will be built in a low-lying part of the country and are therefore at risk of flooding. The area is deemed dangerous, as a potential flood can cause casualties or damage if there are people or capital (PBL, 2015). Because of this, over the last months, a discussion has again swelled up about the creation of dwellings in these low-lying areas. The development of the project must consider subsidence, sea level rise, and the risk of pluvial flood simultaneously. It is therefore argued that new types of dwellings are necessary to prolong safety when inhabiting low-lying polders.

Furthermore, it is necessary to consider the effects that planning all houses in low-lying polders will have, especially if these homes are planned outside current urban areas. To ensure this, it is necessary to consider the long-term effects of the proposed houses and to consider not only the benefits for its human inhabitants but the supporting systems such as water and nature as an integral part of the development (Hekman, 2021).

09

Pressure on the Green Heart (Author, 2022)

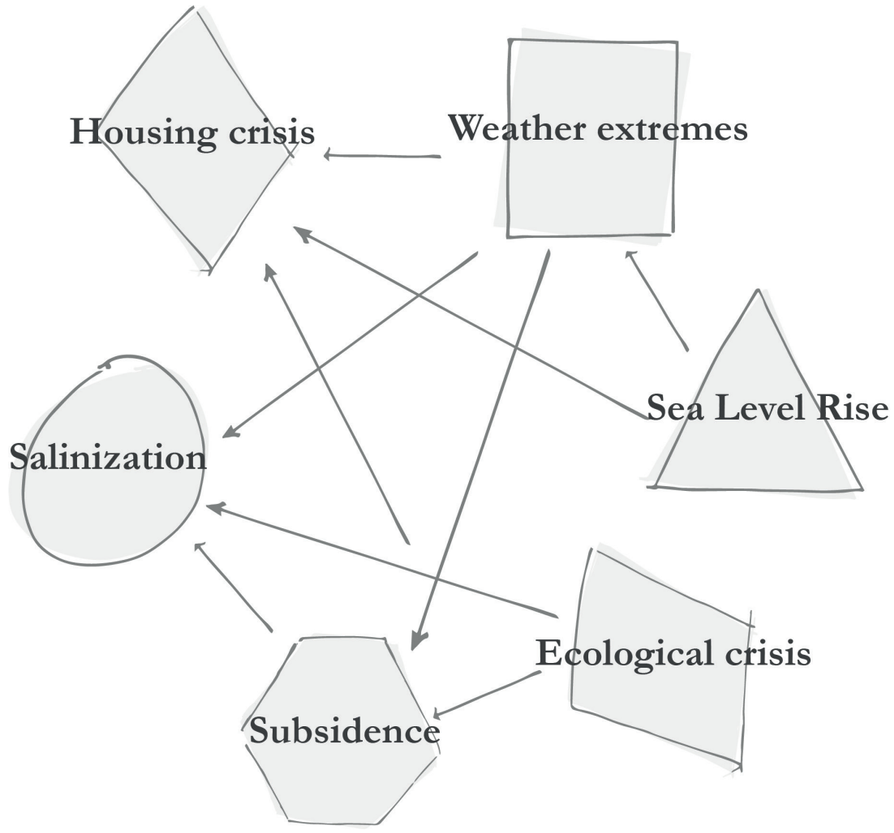
PBL. (2015). Het Groene Hart in beeld.

Entangled

The challenges mentioned in the context chapter of this report are all interconnected, as can be seen in Figure 10. Their interrelatedness, but also the unpredictable nature of these challenges makes spatial planning in the area increasingly difficult (Baptist et al., 2019).

According to Haasnoot and colleagues (2019), the emphasis of future measures which provide water safety lies in spatial planning. This includes the utilization of chances from other disciplines such as the energy transition, agriculture, and housing, as these opportunities can be valuable with regard to water management in the long term. However, during the contemporary process of planning large-scale infrastructures to help with water management in the Netherlands, that goal quickly deteriorates into the addition of small bits and pieces here and there. There is little to no regard for adding value with the implementation of large-scale infrastructures at the end of the planning process (Cheung, 2014).

Because of the uncertainties that are paired with the challenges, and the way new large-scale infrastructures are most often planned, a new manner of approaching the project and combining functions to tackle the challenges in which the future value of the location is put forward is needed. To ensure the extensibility of the design to different disciplines (water management, agriculture, energy transition, infrastructures, housing), adaptive designs should be developed that are focused on the regional context (Haasnoot et al., 2019).



10

Interrelations between the different challenges in the area (Author, 2022)

1.2 Problem operationalisation

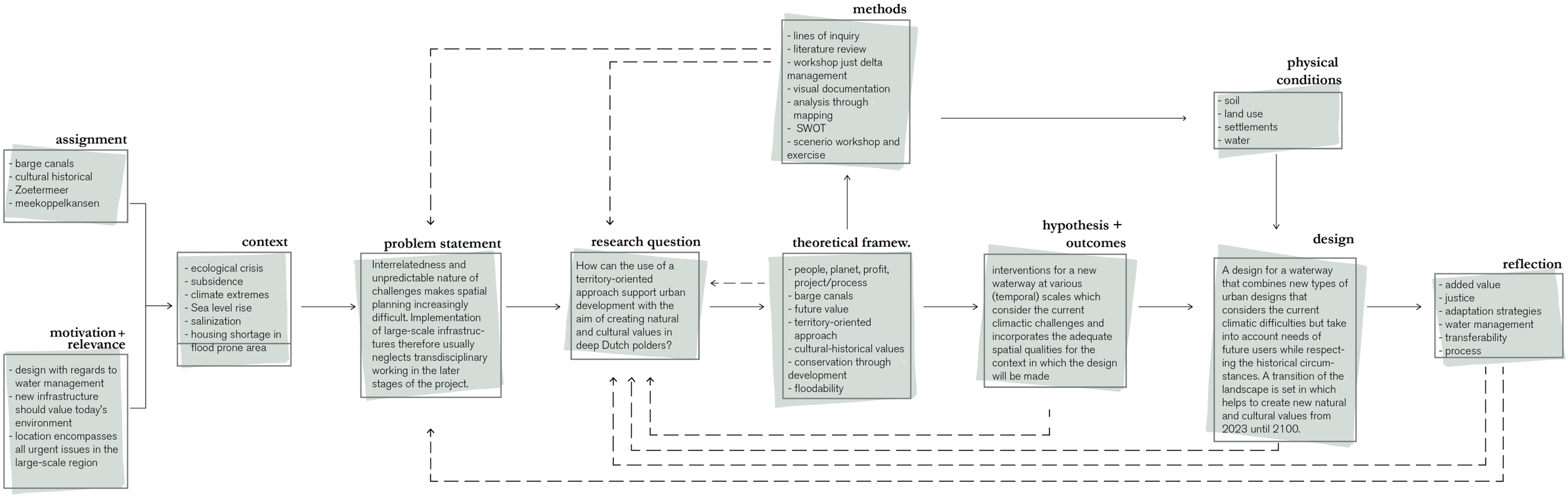
problem statement
methological framework
research question
frame of reference
theoretical framework
application of theory
hypothesis
aims and methods
scales

Problem statement

Deep polders in the Netherlands are dealing with increasing pressure from climatic issues as well as political ones. Their low-lying characteristics makes it prone to floods from rain on the short term and floods from the rising sea level on the long term. This makes the creation of new projects in these areas a difficult task. Large-scale infrastructural projects usually do not disentangle the intricacy of issues that affect the location that the project is set in. Due to this, these projects are not usually aimed at creating extensibility of a design into different disciplines and adaptive designs are usually not considered, whereby the creation of true long-term value is neglected even though with climate change this is more important than ever.

Methodological Framework

The methodological framework is an attempt to disentangle the complexities that have been stated in the problem statement coherently. The framework will function as a guide to structure the thesis in the process of research and design. It summarizes the various stages that the thesis encompasses and shows where feedback loops can be found.



11

Methodological framework (Author, 2022)

Research question

To make the challenges from the problem statement tangible, a research question has been drawn up. In this way, the project can be broken up into separate entities that can be researched apart from and concerning each other. The primary research question of the thesis is posed as the following:

> *How can the territory-oriented approach support urban development with the aim of creating natural and cultural values in deep Dutch polders?*

From the question, three key concepts can be deduced. These are territory-oriented approach, spatial quality, and the Dutch polder landscape. In the thesis these three concepts will be used according to the following definitions:

A] Territory-oriented approach (Dutch: gebiedsgerichte aanpak, GGA) – an integral area assignment on a local or regional scale that consists of spatial challenges that are consistent with each other and can be solved with added value.

B] Natural and cultural values – traces, objects and structures that are part of the environment and shape the image of historical development.

C] Deep Dutch polders – low-lying areas in the delta region of the Netherlands, formed over the years by human activity and posing an unique set of challenges as set out in the context of the thesis.

From these concepts, the secondary research questions are derived in the following way: [A]+[B], [B]+[C], [C]+[A]. This results in the following questions:

[A]+[B]: How can the territory-oriented approach consider values of spatial quality as nature and history?

[B]+[C]: How can natural and cultural values be translated to values in the low-lying polders?

[C]+[A]: What values in deep polders can be created by using the territory-oriented approach?

How can the **territory-oriented approach** *support urban development with the aim of creating* **natural and cultural values** *in* **deep Dutch polders***?*

Frame of reference

4P tetrahedron

General sustainability aspects in planning and spatial design consist of the 'triple bottom line.' This framework, as formulated by the UN consists of three Ps: people, planet, and prosperity (UN, 2002). Through spatial design, the three Ps are interpreted into territorial interventions. This can be added to the framework, as van Dorst & Duijvestein (2004) argue, by an additional fourth P. The additional P represents Project and Process. Project discusses the results of the integration of sustainability when creating a design. It considers spatial quality, relation across the scales, (bio)diversity, robustness, and aesthetics. The process considers the skills needed to realize a sustainable design project and refers to the interaction between stakeholders, the planning system, and the institutional (van Dorst & Duijvestein, 2004).

Spatial qualities

Spatial qualities can be conceptualised in three distinct types of values. These values are categorized as user value, experience value, and future value.

- User value – functionality, efficiency through use, through construction, and through management, etc.
- Experience value – identity, diversity, recognizability
- Future value – steering value, efficiency through time, expendability, adaptability

These values can also be explained through the link with economic, social, ecological, and cultural components (Hooimeijer et al., 2001).

The 4P tetrahedron of van Dorst and Duivesteijn can be connected to the values embedded in spatial quality that are described here. This has been done by Puylaert & Werksma (2011). They argue that these combined tetrahedrons can help to create a balanced result through spatial planning. This cannot be done without combining interest and creating identity and value for the future. They conclude that it is necessary to combine the two frameworks from the start to develop spatially in a sustainable manner.

Economical prosperity of the Barge Canals

JJan de Vries has researched the barge canals in his book Barges and Capitalism. Passenger Transportation in the Dutch Economy, 1632-1839 (de Vries, 1978). In this analysis of the barge canals, De Vries sets out to prove the use of the canals as a measure of prosperity in society. The effects of this prosperity, so he researched, could be felt in every segment of society.
Because of the elevated levels of prosperity, there was a lack of action when the broad network was established. Innovation of the network was not necessary as it was the fastest, most reliable mode of transportation that the area knew. This lack of a proactive stance is, in the end, why the barge canals gave way to the railways very quickly and easily. However, De Vries concludes that even though the prior use of the water network was diminished, the economic prosperity in that time has affected the (then future) value of the area as the development of the area into the Randstad can be dated back to the extensive transportation network that had been established between 1632 and 1700.

Nota Belvedere

The knowledge of social-cultural values from past uses of the landscape, such as the barge canals but also the creation of polders in the landscape, can then be translated to the future to add value. Nota Belvedere (Feddes, 1999) recognizes that the soil, the landscape, and the built environment are complex but full of indications of the previous uses of the elements. These elements of culture have been acknowledged to be of vital importance for the longue durée of an area and are seen to be the connection between the past and the future. Nota Belvedere provides valuable insights into how to deal with the cultural-historical values and interpret them in design, so the future use of the landscape is not compromised but compliments of the past, current, and future users through preservation through development (Dutch: Behoud door ontwikkeling). The relationship between the preservation of cultural-historical values and spatial planning is under constant pressure because of conflicting interests so a careful balance is needed to guarantee historical continuity. To do so, the formulation of spatial challenges must recognize this mutual connection. This recognition can have beneficial purposes: it can give inhabitants a feeling of belonging, it is a source of information and inspiration, it is of ecological significance, and it can add to the economical value.

Territory-oriented approach

To truly balance sustainability and cultural-historical values through spatial development, an integral approach is needed. The territory-oriented approach (TOA) (Dutch: Gebiedsgerichte Aanpak) can provide this. The approach is an integral area assignment on a local or regional scale that consists of spatial challenges that are consistent with each other and can be taken on to provide added value. By placing the location instead of institutional or administrative borders front and centre, actors are pushed to consider various angles of the project and, therefore, to work with an integral approach. The TOA considers the demographic, spatial and social-economical circumstances with the demarcation of the area and the content of the project. To attain this, the necessary characteristics of TOA are an integral approach, an increase in collaboration, being area-focused, and the creation of added value. This can be done through the application of one or more of the three types of approaches that have the following outcomes:

1. Content creating – an added value throughout content is pursued. Through collaboration, functions can be coordinated so quality can be improved.
2. Supporting – the goal is to create support for the project. Involving more actors can aid the reduction of friction.
3. Policy-promoting – the promotion of the project with the term territory-oriented approach.

Because of the integral approach, costs for various elements of the project can go down. Investments are therefore worth more compared to the traditional approach and, in combination with time and cultural-historical values, are needed to create future value.

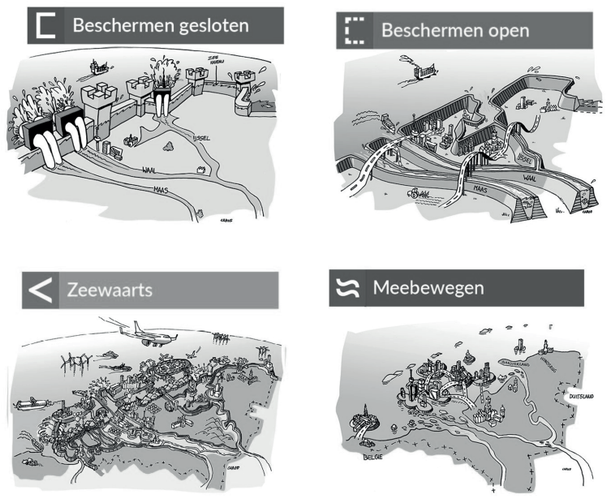
Adaptation strategies

To complement the approach, adaptation strategies as stated by (Haasnoot et al., 2019) can be used to present different conditions in which the project can take place. These adaptation strategies were made to see what options can be implemented in the short term to keep the long-term perspectives of the Netherlands open concerning the continuing threat of sea-level rise.

These adaptation strategies are the following:

- Protect – closed: protecting against floods and erosion with hard and soft measurements;
- Protect – open: the same as closed, but the rivers stay connected to the sea;
- Moving with the water: creating ways to live with the water in inland situations;
- Seaward: minimize the vulnerability to the results of floods and sea-level rise by a change in land use, heightening of the soil, spatial planning, etc.

The adaptation strategies show ways the delta and water management can look and how these options can be used in different mixes to go about different paths. An emphasis lies on the fact that the exact strategy is location-specific, and can be divided into low-regret, and high-regret measures. These first are necessary and do not cause any trouble when the sea level does rise, whereas the latter can cause trouble when floods occur. A suitable mix for a location can be taken after careful consideration of its current state and future needs.



12

Adaptation strategies (Haasnoot et al., 2019)

Floodability

The prevention of impact on a local level can be achieved by creating a floodable area. Floodability is the potential of the system to withstand floods that happen in the system while being able to conserve a level of operation that is adequate for its population. Different from resilience, floodability allows for a new equilibrium to set in, whereby the new system equilibrium is evolved to be more adapted to high water (la Loggia et al., 2020).

Practically, a floodable system is created out of two types of subsystems: floodable subsystems and resilient subsystems. A comprehensive combination of the two can be made to ensure the floodability of the system. By the creation of floodable land, new environmental, recreative and social functions can be introduced to the area. To do so, there is a need to reimagine infrastructure, housing, and open spaces (la Loggia et al., 2020). By making these distinct elements adaptive, the system can be enhanced.

To conclude, all notions that have been discussed in the theoretical framework can be converted into a future value. For this, an investment in these aspects – time, cultural history, integral design, and adaptation – is necessary.

Time + investment = future value

de Vries, J. (1978). Barges and Capitalism. Passenger Transportation in the Dutch Economy, 1632-1839.

Cultural history + investment = future value

Feddes, F. (Ed.). (1999). Nota Belvedere. Beleidsnota over de relatie cultuurhistorie en ruimtelijke inrichting.

Integral design + investment = future value

Jager, H. (2009). Toepassing van de gebiedsgerichte aanpak bij infrastructurele wegprojecten.

Adaptation + investment = future value

Haasnoot, M., Diermanse, F., Kwadijk, J., de Winter, R., & Winter, G. (2019). Strategieën voor adaptatie aan hoge en versnelde zeespiegelstijging. Een verkenning. Deltares rapport 11203724-004.

Theoretical framework

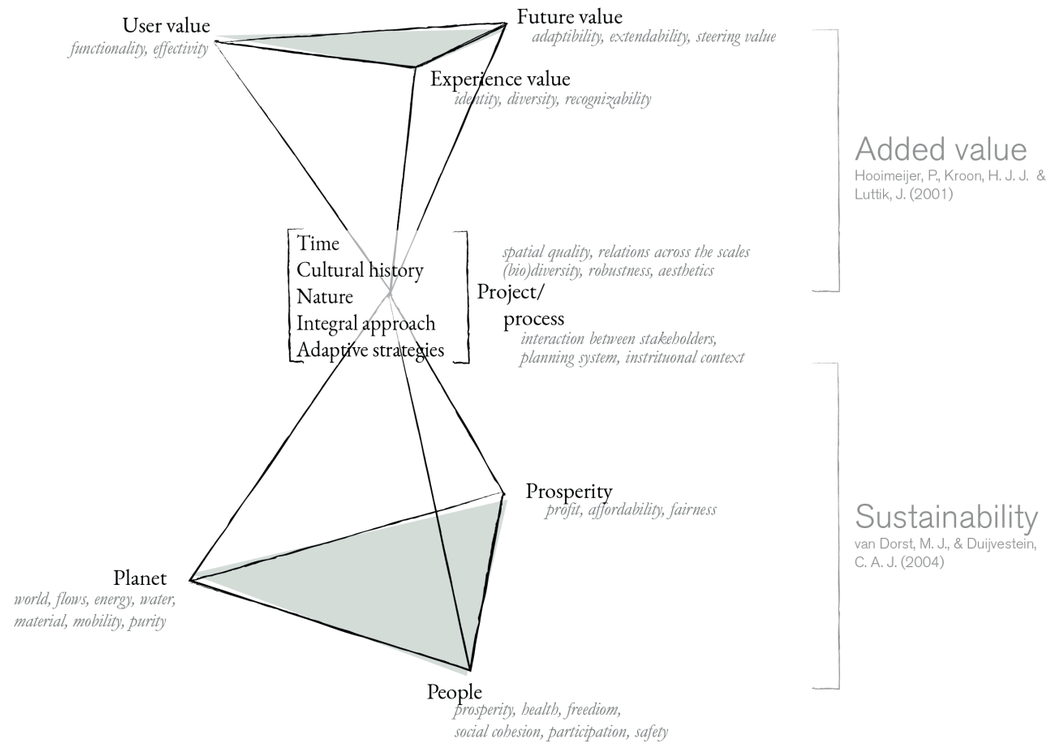
The theoretical framework aims to illustrate the relationship between the pieces of literature that are important in the process of taking on the challenges as stated in the problem statement.

The primary theory used is the 4P tetrahedron as presented by van Dorst and Duivesteijn (2004), which discusses the sustainability aspects of a project. This can be connected to the intended values of the project, as has been done in the report Duurzame gebiedsonwikkeing: doe de tienkamp! by Puylaert & Werksma (2011).

This project aims to connect the values to the 4P tetrahedron in a more practical way. It does so by relating prosperity and future value through time and investment (de Vries, 1978), cultural-historical value (Feddes, 1999), and integral approach (Cheung, 2014; Jager, 2009). Prosperity here means economic well-being and can be related to the making of investments.

The books and research used come from different periods and discuss different inputs on how to create future value through prosperity. Therefore, they complement each other well in terms of time scales and spatial scales. Together, they bring information to the table that is valuable for several stages of the theses. They discuss new developments in terms of time, cultural-historical value, and integral collaboration.

Placing the literature in this way creates the ability to visualise how the theories connect and what values they represent in the thesis. By bridging the gap between prosperity and future values, this thesis adds to the current discourse and gives a way to approach the problem field in a new way that realises the importance of the past functions and values in future integral development.



13

Theoretical framework (Author, 2022)

Cheung, J. T. O. (2014). Regional Approach to Infrastructure Provision.

van Dorst, M. J., & Duijvestein, C. A. J. (2004). Concepts of sustainable development. In s.n. (Ed.), The 2004 International Sustainable development Research Conference (pp. 176–183). University of Manchester.

Feddes, F. (Ed.). (1999). Nota Belvedere. Beleidsnota over de relatie cultuurhistorie en ruimtelijke inrichting. Jager, H. (2009). Toepassing van de gebiedsgerichte aanpak bij infrastructurele wegprojecten.

Puylaert, H., & Werksma, H. (H2Ruimte). (2011). Duurzame gebiedsontwikkeling: doe de tienkamp!

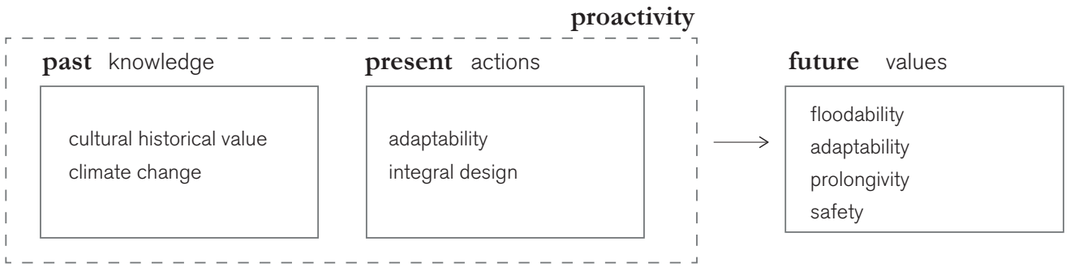
de Vries, J. (1978). Barges and Capitalism. Passenger Transportation in the Dutch Economy, 1632-1839.

Application of theory

Jan de Vries showed that a proactive stance to rescue the trekvaarten as the main transportation veins of the region would have been necessary. However, such a stance was never taken, but not for a lack of knowledge (de Vries, 1978).

In the current society, a proactive stance is needed to forego challenges posed by the issues as set out in the context and problem statement of this thesis. Therefore, in contemporary planning proactivity is needed as well. From the literature, it can be concluded that an integrated approach to the development of the area should be taken to act proactively on the challenges that face today's landscape and society to create future value in the area.

The territory-oriented approach (Jager, 2009) can provide the mode through which this can actively enter the paradigm of spatial planning. With the addition of the Nota Belvedere (Feddes, 1999), which states conservation through development, a clear connection can be made to the values of the past that can be incorporated into the functionality of the future, which includes the potentiality of the area to be floodable (la Loggia et al., 2020).



14
Application of theory (Author, 2022)

Hypothesis

Because of the uncertainties paired with the challenges as stated in the context and problem statement of this thesis and the way new large-scale infrastructures are most often planned, a new manner of approaching the project which tackles the challenges integrally and puts forward the future value of the location is needed. To ensure the extensibility of the design to different disciplines (water management, agriculture, energy transition, infrastructures, housing), adaptive designs should be developed that are focused on the regional context.

This unprecedented manner of approaching the challenges in the area will provide a design for a new way of living in which moving with the landscape is the basic. Through a design for a waterway through the area with the addition of new housing typologies, this novel way of thinking is within reach and can change the way the current population regards current issues in the area. The connection between the landscape and urban development is vital in dealing with the effects of climate change (Palmboom, 2010). The change in ways of living in the area that acknowledges future climatic challenges can also be an accelerator for an alteration in the relation with the context of the delta whereby the relationship between humans and the water is not based on a manner of complete control, but changes to a relationship in which the two can be present alongside each other. Furthermore, the creation of a design for the landscape through the addition of a waterway, and thereby setting in a transition, will show that this area has value beyond its current uses.

15
Hypothesis of a waterway (Author, 2022)

Aims and methods

To obtain the knowledge necessary to consider this hypothesis and achieve the preferred outcome of the project several methods will be used. These can be found in figure 16. The methods that are stated in the figure are not necessarily stated chronologically but can be used in different sequences and variations throughout the various stages of the thesis.

Following the research question, the projected outcome of the thesis will explain the importance of spatial quality through area development. The specific desired outcomes of the thesis are stated below. For completeness, they are paired with the related methods.

- Understand what impact the cultural and natural value of the landscape and its historic use can have on the spatial qualities of a developmental area and thereby expand on the knowledge of incorporating cultural-historical values in a design in a coherent way [1, 2, 4, 5, 9];
- Understand what is the process of incorporating spatial quality through a large-scale infrastructure project and thereby expand on the knowledge of adding spatial quality through the creation of large-scale infrastructure projects in the Netherlands [1, 3, 4, 5, 7, 9];
- Translate the water management aspects of the project area into spatial qualities [3, 6, 7, 8];
- Translate challenges as stated in the context into an integral design [2, 3, 5, 6, 7, 8, 9];
- With all these insights, design interventions for a new waterway at various scales which consider the current climatic challenges and incorporate the adequate spatial qualities for the context in which the design will be made [region of Zoetermeer, polder landscape, previous use of the surrounding landscape] [3, 4, 5, 6, 7, 8, 9].

	method	aim	limitation
1	Literature review	to understand and innovate	the literature must be applicable in the Dutch context
2	Monograph series		
a	Accumulation	understand the status quo and figure out the challenges	limitation to the amount of information that can be analysed
b	Clearance	quick exercise to understand potential and future measures in the area	limitation tothe analysis that can be donen into the viability of potential measures
3	TOHOKU method	come to shared values on the project within the disciplines of urban design and water management	the workshop outcomes are limited when carried out with solely two people
4	Visual documentation	analyse the current situation in regards of landscape and functionality	some locations in the project area are not accessible to the public
5	Mapping		
a	analytical	inform the project contextually	limited by the available information
b	projective	build on scenarios; see what can be	limited by the creativity only
6	Scenario building	look for scenarios that are diverge from realistic and wanted, to improbable and undesired.	limited by available information; not diverging too far from the project
7	SWOT-analysis	analyse the potential of the area and what to look out for; find potential synergies	limited by available information; not diverging too far from the project
8	Stakeholders	collect data about values of the end-users of the site	limited access to people and organisations within the project area
9	Case studies	analyse how various designs handle cultural-historical values through design of a infrastructure project.	limited by the existing frame of reference of the author

16

Methods used in the thesis (Author, 2022)

Scales

These outcomes will be taking on several scales.

Macroscale

The largest scale will be the outlet scale, in which the design relates abstractly to on the interrelations between the challenges. Furthermore, the functioning of the system in an abstract manner will be taken on. This will lead to a strategic plan. Water management can here be used as an addition to systemic mapping.

Meso scale

The embedding of the strategy that discusses the conditions in the landscape on the territorial scale will take place on this scale. The strategy will be adapted to the implementation of a new body of water and the transformation of the landscape. Here, the integration of the various disciplines will be worked out through maps, sections, visuals, and diagrams that will be focused on the waterbody and its surroundings. Here, the technical aspect of water management can be incorporated on a water body level.

Microscale

Here, the connection of the waterbody to the cultural-historical landscape and its uses will be worked. This scale will clearly show the implication of the interventions that take place to the users of the water and the surrounding landscape. The highlighting of zoomed-in elements of the design will be explained in a more detailed way.

Throughout all spatial scales, the temporal scale will have to be kept in mind. In this way, it can be ensured that the cultural and natural values will be used to create future value in the region.

Problem field analysis

Research by design

17

Scales used in the project (Author, 2022)

Part 2 | Analysis

Water under the bridge

Hypothesis of a waterway

The design of a waterway is the hypothesis to bring together the several large-scale challenges that the province faces and come to an integral design for an area which includes urban development, a possibility for the storage of water, and a transition in agriculture. With the creation of a waterway, the aim is to reconnect the Rotte and the Oude Rijn. The Province of Zuid-Holland is also keen to connect this waterway to the water network of Zoetermeer to stimulate recreational sailing and water use as well as create awareness of the water system of the city that lies directly in the polder.

To research the most optimal routing for the waterway, three options are designed.

The first option is to cross the landscape from south to north directly. Then, it is possible to create a connection to Zoetermeer via an existing waterbody that borders the two different landscapes that cover the area: peat meadows and large-scale agriculture plots. For this option, several height differences must be tackled. To connect the creation of a waterway to other new developments, housing can be created along the already existing waterway, connecting to older building structures.

The second design encompasses the same north-south connection but crosses the polder just north of Benthuizen to connect the water network of Zoetermeer to the larger scale water network. As a result of this design, it is possible to redesign the Benthuizer Noordpolder and extend the city of Zoetermeer to the polder while also creating a connection to the new water.

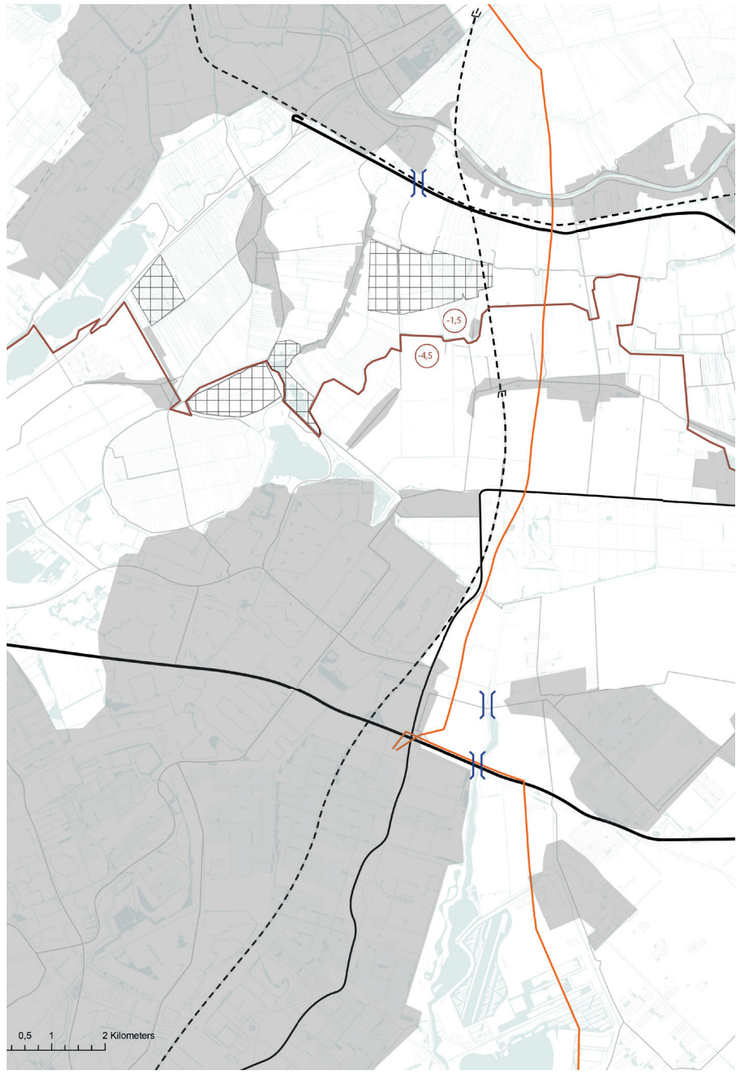
The last design uses existing waterways through the Bentwoud just north of the Rotte to connect to the water network of Zoetermeer before continuing to the Hoogeveense Vaart from where the Oude Rijn can be reached. This route considers the historic connection to the Hoogeveense Vaart which used to function as a connection to the Rijn. Because of this option, the Benthuizer Noordpolder can also be changed, and new developments can be built there to connect new structures to the water.

18 , 19, 20

Waterway hypothesis (Author, 2022)

Limitations

In the area, several set physical elements can aid to set boundaries to choose the waterway route. Through the mapping of the urban area, infrastructures such as train rails, roads, bridges, power lines, and natural areas an attempt is made to get a grip on the territory. This limitation map can prove a valuable tool to help structure the SWOT analysis.



21

Map of limitations of the area (Author, 2022)

- Urban area
- Train
- Roads
- Height difference
- Bridge
- Power lines
- Natural areas

SWOT

To come to the best possible route for the waterway, a SWOT Analysis has been drawn up of the location. Through this, it is possible to see which of the options is the most viable and in which most of the contextual challenges can be found. The maps of the SWOT analysis can be found in Appendix A.

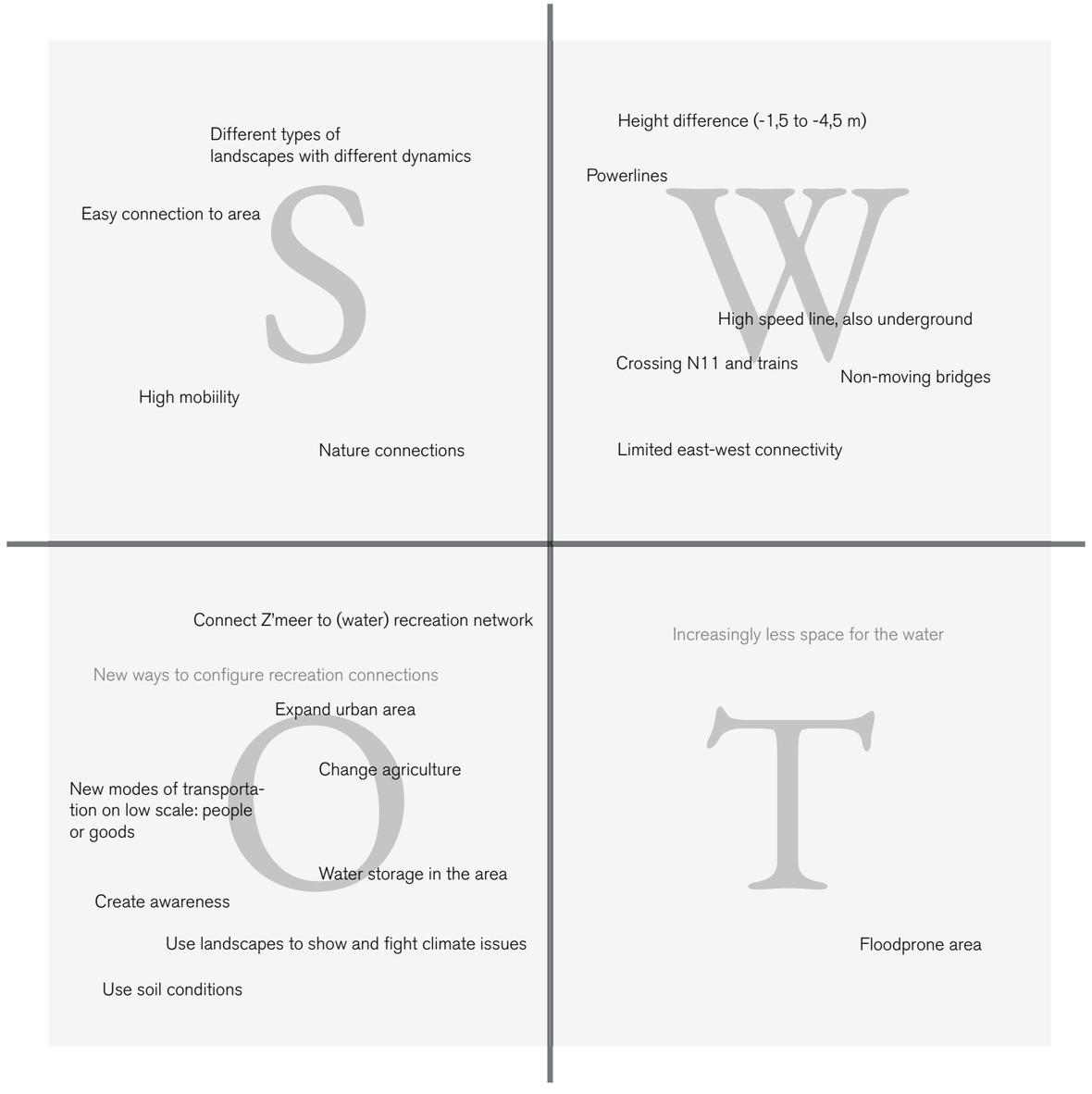
The strengths of the project have to do especially with the physical conditions of the area.

Weaknesses in the project can be summarised as the congestion of infrastructures and urban areas that lies between the Rotte and the project area. Therefore, in the design phase, it is important to consider what the value is of connecting the two waterways while also still considering the existing structures.

Opportunities are created through the meekoppelkansen that can be seen in the area. Throughout the project, several of these can be applied. These opportunities create the possibility of adding future value.

Threats in the area are to do with limited space for the water and the fact that the area is low-lying and therefore flood-prone

Through this analysis, a choice was made for the third option on the previous page. The waterway will therefore connect the city of Zoetermeer via the Bentwoud. This route considers the historical use of the Hoogeveense Vaart and provides context for new housing development in the area.



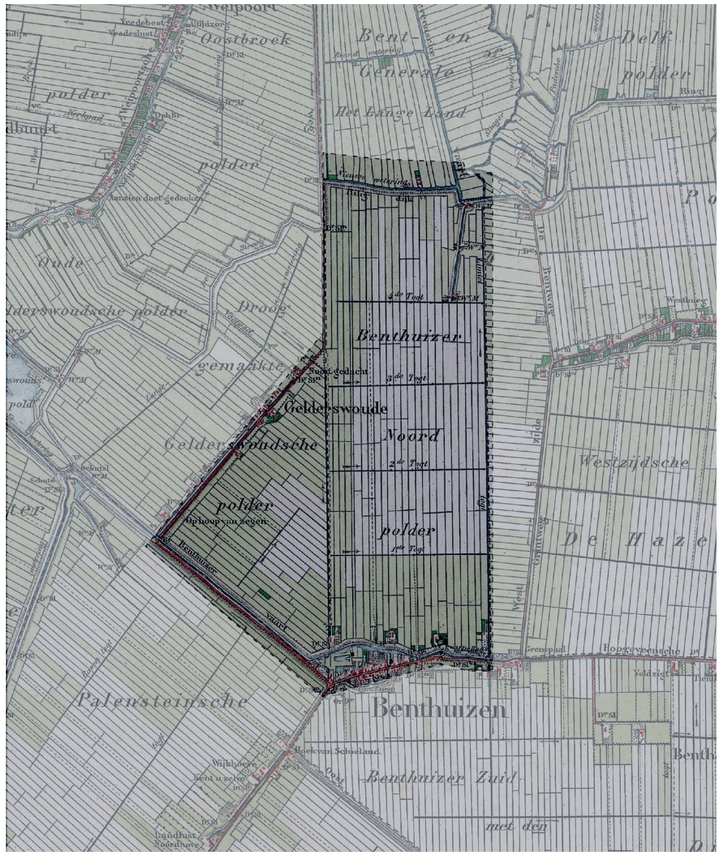
22
Results of the SWOT analysis (Author, 2022)

Thesis location

Through the conclusion of the analysis of the location for the waterway, the concrete location of the area distinguished for the development of an urban area is the Benthuizer Noordpolder, a polder located in-between the towns of Benthuizen and Gelderswoude, just north of the city of Zoetermeer. The northern boundary is the division between the peat landscape and the droogmakerijen – a height difference of three metres between the two. The location is a well-chosen study area because all the problems that are found on the larger scale – subsidence, salinization, water nuisance, and effects of the housing shortage – are present in the area. The findings can therefore potentially be extrapolated to a larger scale.

The area houses diverse types of landscapes. The establishment of settlements in the area dates to the 1500s, with the main structure of settlements of that time still present. The landscape, however, is a lot older than the current urban structure, as the main features of its structure can date back to the 1200s or earlier. This variation between the two main types has to do with the formation of the landscape throughout millennia.

The current function of the landscape is highly productive. Year-round, the specific area that this research targets is worked to facilitate the growth of brussels sprouts, corn, onions, wheat, sugar beetroots, and potatoes (PDOK, 2021). The grassland is productive as well, because of its function as graze for cattle.



23

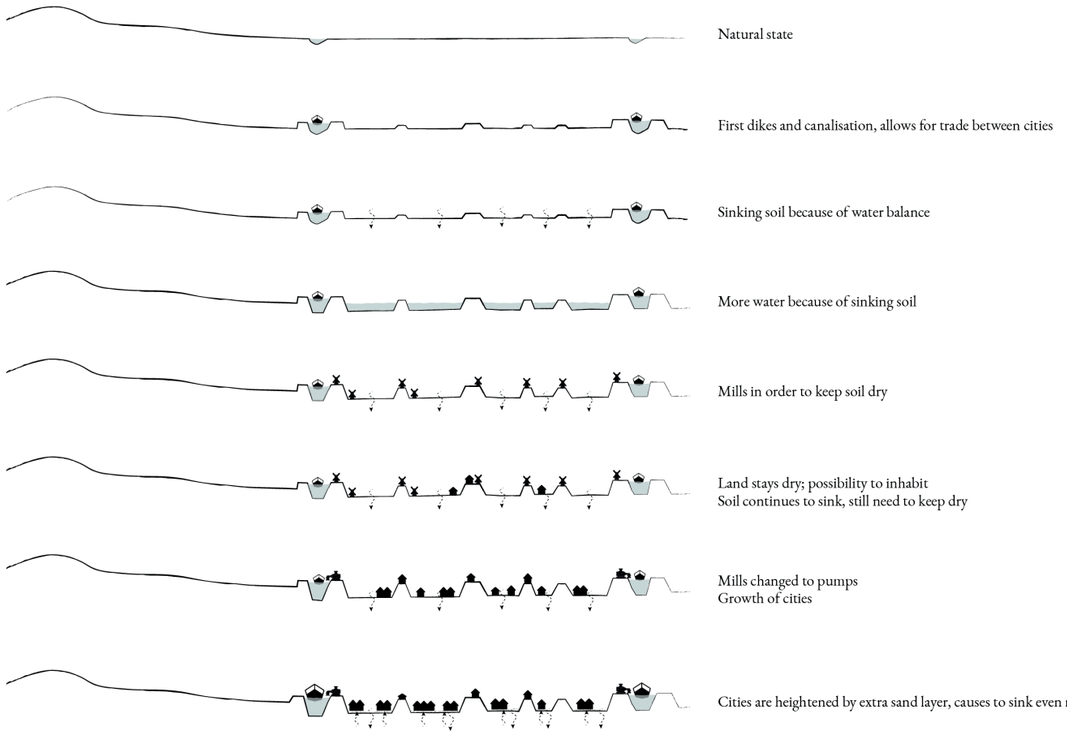
Map of the project location in 1925 and currently (Bonnekaart 1925, Kaartenkamer Tu Delft; Beeldmateriaal.nl)

Formation of the landscape - context

The landscape and its functions took years to get to their current state. When zooming out, it is possible to place into context the tremendous change that the landscape has undergone.
The deltaic processes caused the area to transform. This transformation was because of natural processes and was characterized by a low dynamic. However, when humans started to inhabit the land, the changing conditions proved unsuitable to live in safely. Therefore, from the year 1000 on, the structure of the delta started to transform on a large scale and very rapidly. This change is going on until the present day and will continue as humans are trying to continually control their environments (Meyer, 2001).

However, human settlements in the area meant that control had to be gained over the water, to prevent floods and to ensure the liveability of the area. Dikes were created to keep urban centres dry. Because control over the water was not covering the complete area yet, the areas in between the urban centres were still very wet. Transport was thus fastest and easiest over the water.
A network of waterways was set up over which people and goods could be transported on a strict schedule. The barge canals were the first public transportation system and were a reliable source of income and brought economic welfare through the possibility of intercity trade (de Vries, 1978).

In the wetter areas, people found out that it was possible to dig out the peat and use the dry substance as a form of heating. Farmers with land started to sell the dried peat to businesses and individuals in the city. Aided by the network of barge canals, this quickly became a lucrative business. This digging of the peat, however, left quite its mark on the landscape (Rijkdienst voor het Cultureel Erfgoed, 2018).



24

Stages of polder throughout the years (Author, 2021)

Meyer, H. (2001). Atlas van de Nederlandse Waterstad. SUN.

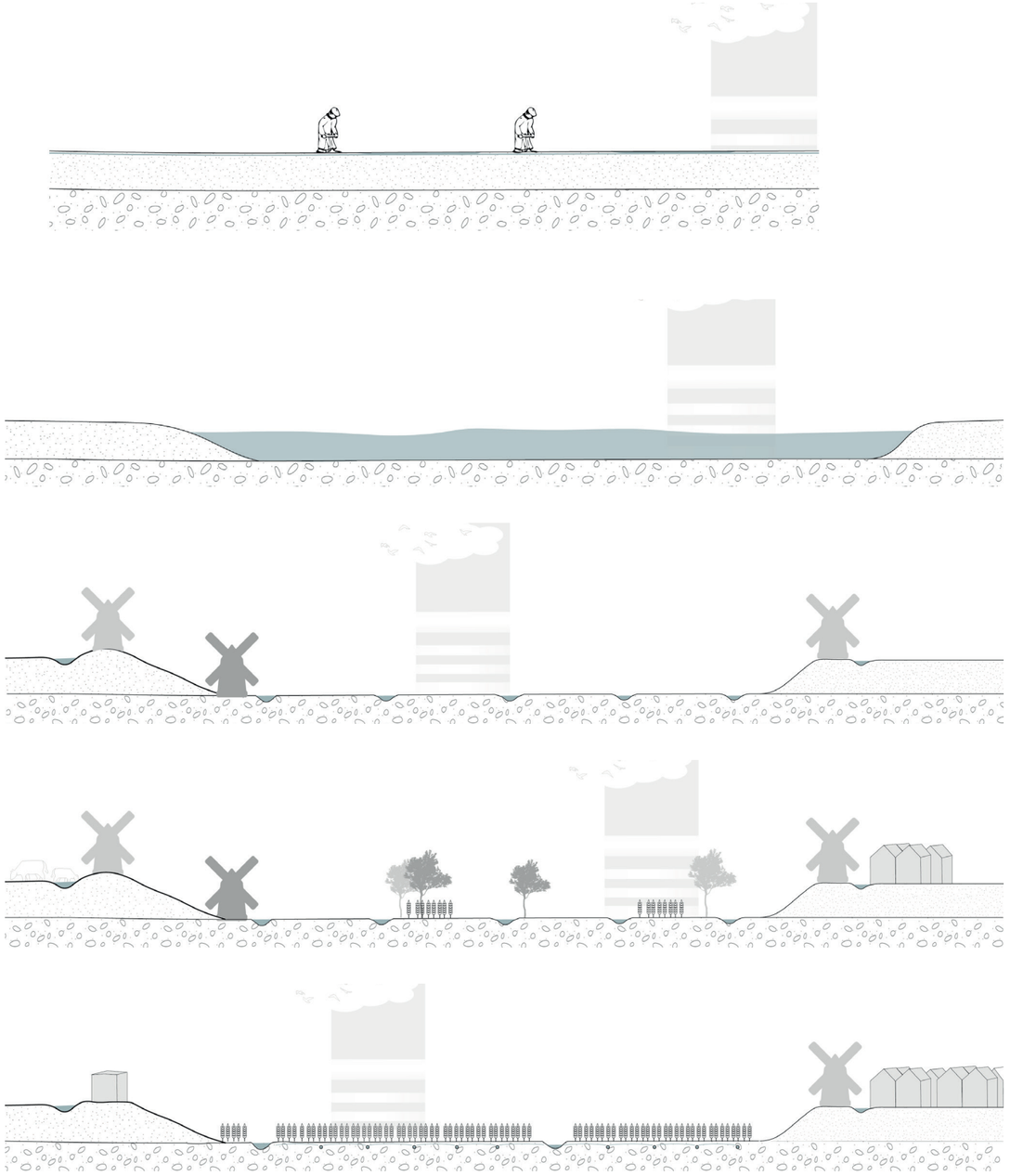
Formation of the landscape - Benthuizer Noordpolder

In the seventeenth and eighteenth century, the Benthuizer Noordpolder was used for peat excavations, resulting in a large lake – the Noordplas (Hoogheemraadschap van Delfland, n.d.).

In 1759, an accord was reached over the creation of a polder, which would be called the Noordplas polder and consisted of several smaller entities, one of which was the Benthuizer Noordpolder. Through the creation of a system of mills, the polder was artificially kept dry.

Because of the excavation of peat, the underlying clay soil was exposed which lent itself well for agricultural purposes. The area was, therefore, filled with farmers that would cultivate crops (Hoogheemraadschap van Delfland, n.d.)

After the extraction of peat was at its limit in the area around Benthuizen, the polders surrounding it were artificially kept dry with mills, and later pumping stations. This ensured that the land would continue to be suitable as arable land. After the second world war, the landscape was regarded as necessary to produce high-yield crops. Because of the increased knowledge on water management and the innovation of technologies, the scale of the landscape could be enlarged through the setting up of drains. With this application of modern technologies, the groundwater conditions are kept more stable. This change eliminated the land of its historic characteristics and flattened the landscape to a landscape used for monocultural production of crops to produce food or feed (Rijkdienst voor het Cultureel Erfgoed, 2011)



25

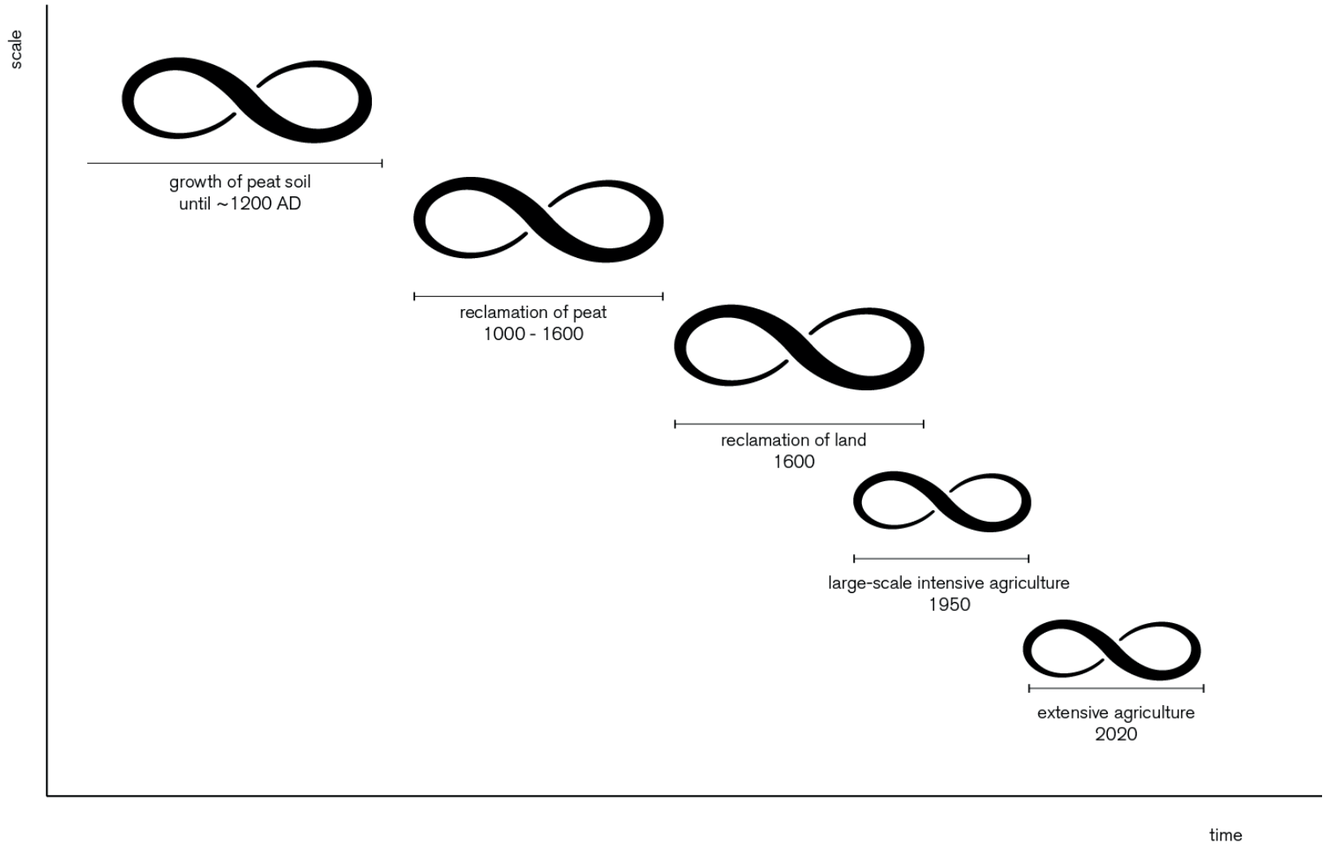
Timeline fo transition of the landscape (Author, 2022)

Landscape - adaptive cycles

The landscape has thus taken on the form as we know it because of the interplay between man and nature. The landscape changed as the development of safety through dikes goes hand in hand with urban development and vice versa (Meyer, 2001). In the location of the thesis, the Benthuizer Noordpolder, important alterations are visible when the landscape changed from peat landscape to droogmakerij, when the scale was modified to facilitate large-scale food production after the war, and when Zoetermeer started to grow in the 1970s and onwards (Hoogheemraadschap van Delfland, n.d.). These changes are part of adaptive cycles that correspond to distinct types of management of the polder throughout the years. When looking at the area of the thesis, Zoetermeer and the polder, the following adaptive cycles can be made out:

- Natural cycles
- Peat digging
- Droogmakerijen
- Scale enlarging
- Artificially heightening the soil
- Increasing water tables

As can be seen, the scale of the adaptive cycles continuously changes as the alterations that need to be made to the system become more specific each cycle.



26
Adaptive cycles (Author, 2022)

13
application of theory (Author, 2022)

Transition of the landscape

The resulting landscape has changed severely over the years but still has the same distinguishable characteristics that can be found in distinct landscapes. The combination of the peat landscapes, urban areas and droogmakerijen and scales that accompany these landscapes can be found in image 27.

In fear of not being able to feed the whole population anymore, agriculture was scaled up and the landscape changed from a peat landscape to a large-scale agricultural landscape after the war (Rijkdienst voor het Cultureel Erfgoed, 2018). Shortly after the intensification, the city of Zoetermeer was planned. It grew from a small urban core to an urban area in a few decades. The area in which agricultural practices had always been central, suddenly changed to be the urban fringe of the city of Zoetermeer. Because of the intensive agriculture and its large scale, the area is inaccessible and therefore does not function as a fringe that is supportive of the needs of the city. There is no relationship between Zoetermeer and the function of the Benthuizer Noordpolder (Pols et al., n.d.).

This landscape and the relation between its components and inhabitants is the basic condition that the thesis inherits, the result of over a thousand years of human management of the land and the water through cultural history. This regulation laid the foundation for a spatial structure that must be respected in the layers of the landscape that follow.

27

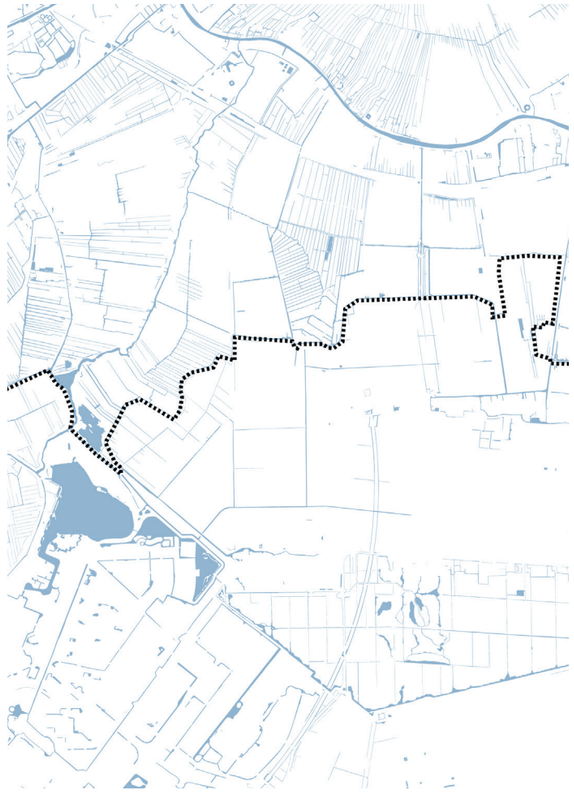
Timeline of the transition of the landscape
(Author, 2022)

Topotijdreis.nl

Landscape - current state

The intensification of agriculture and the elimination of most historical structures in the area leaves the resulting land empty and barren – stripped of the qualities that the area once had. It is therefore of importance that, through this project, these qualities that the surrounding area still has and the history that this part of the polder has, are strengthened, and highlighted.

The resulting landscapes could not differ more in sight and experience - to the north, luscious grasslands, filled with small bike paths and roads through which the area can be experienced, whereas in the south the landscape has been stripped of its qualities to facilitate crop production, resulting in a large, inaccessible field.



28 (left)

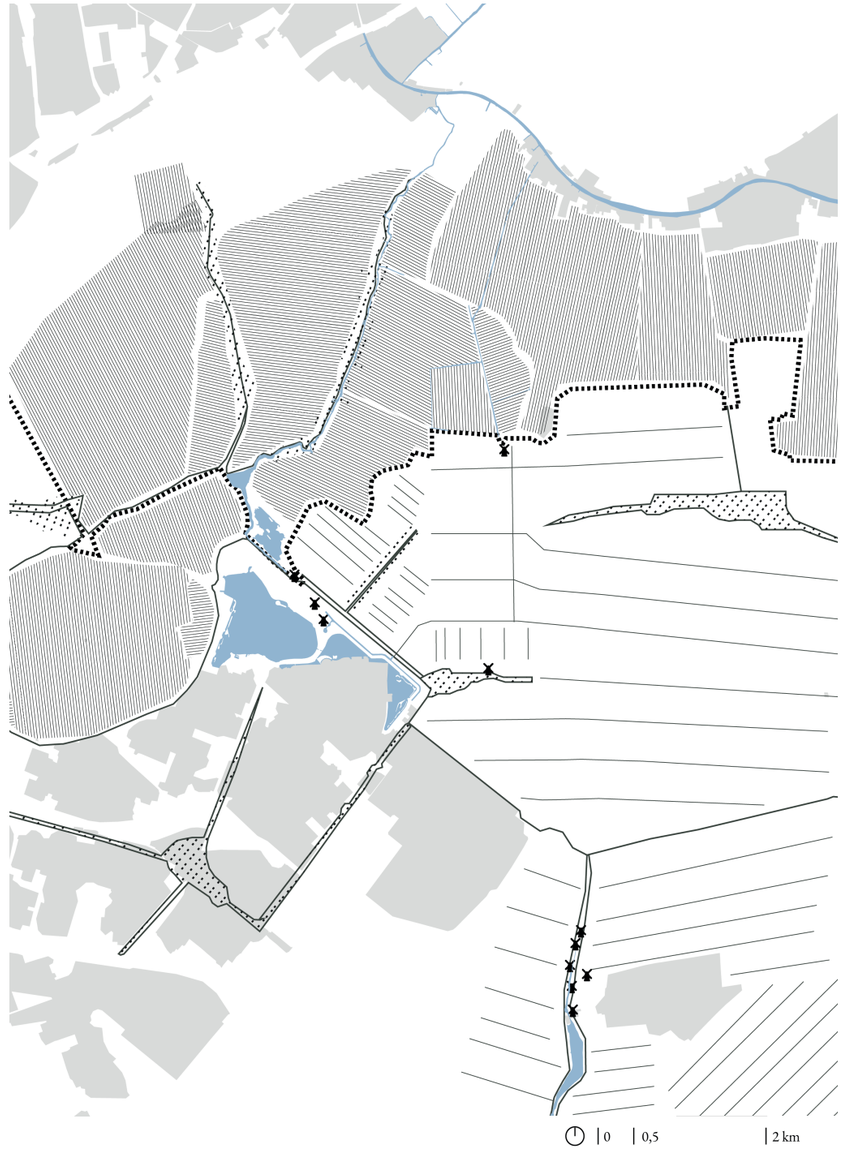
Map with the division of landscapes (Author, 2022)

29 (right)

Images of the landscapes (Author, 2022)

Cultural historical values

Even though the Benthuizer Noordpolder has completely been stripped of its recognizable elements when agricultural practices were intensified, the polder areas surrounding the Benthuizer Noordpolder are still home to these structures. Throughout the polders, there are old windmills, dike structures, large height differences because of peat extraction, and ribbon-like urban structures, build on dikes. These are elements throughout which the cultural and historical values of the area are stressed. Connecting these elements to the new design for the polder will create a sense of value to the polder, while also creating awareness of the history that this polder underwent and providing a basis for new developments that pursue creating future values in a historic landscape

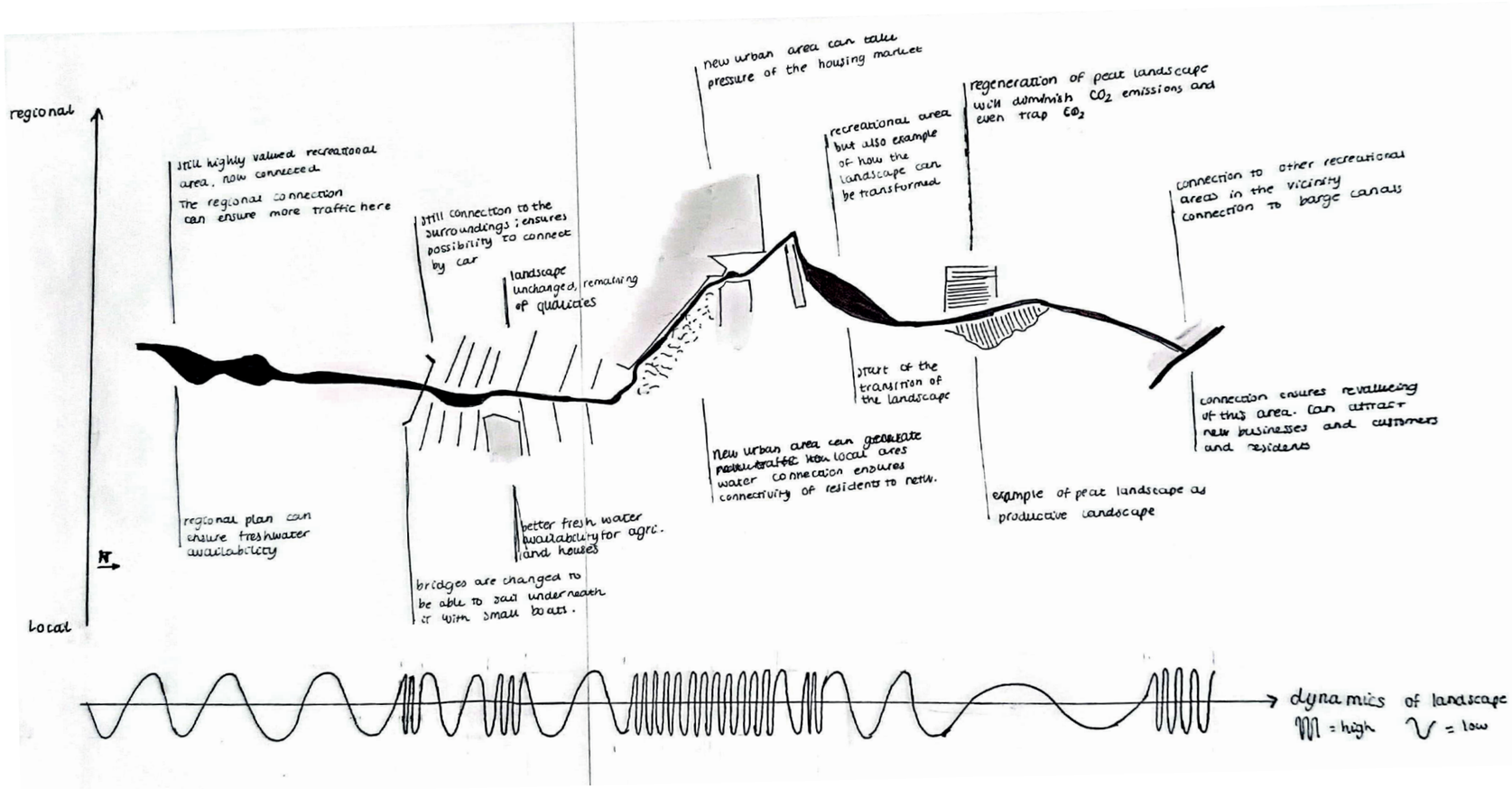


30

Map of cultural historical values (Author, 2022)

Dynamics

The resulting landscapes have distinct components with different dynamics. To see how the focus area of the design will change, it is important to know the relationship between the dynamics of these landscapes. The landscapes around the Rotte and the peat landscapes have a low dynamic, whereas the urban landscapes have a higher dynamic (Palmboom, 2010). In the location of the intervention, it is important to synchronize the high dynamic of the city and the low dynamic of the landscape to an urban ecosystem that follows the rhythm of the transition of the landscape.



31

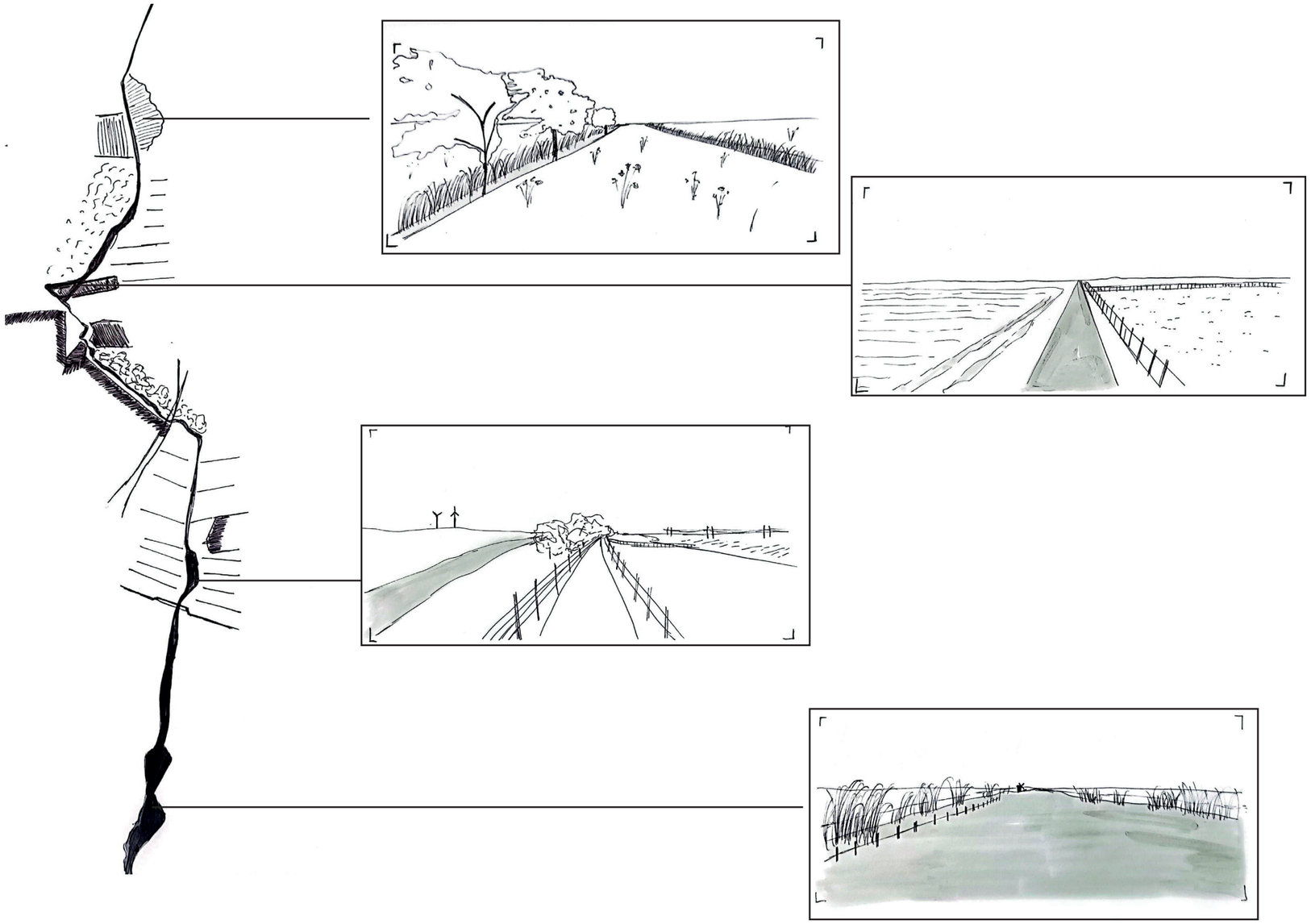
Dynamics of the area (Author, 2022)

Composition

Not only do the parts of the location have distinct dynamics, but the visual relationship between the water and the landscape also varies greatly. From south to north, the project visually connects the Rotte and the Rottemeren to the barging canal the Oude Rijn. The Rottemeren, with the possibility to connect further south, are wide and give an overview of the landscape. Continuing, the Rotte becomes smaller again and from the water, the whole landscape can be overseen.

The peat landscape north of the Noordpolder is an inspiration for the realisation of a smaller scale in the Noordpolder as well. Because of the small scale, the landscape can be experienced.

This aspect of the water is an important feature of the landscape that the design will bring to the Benthuizer Noordpolder. Through the addition of a higher-lying waterway, the landscape can be explored in ways that are now impossible. The waterway can create a catalyst to start to experience the landscape that is now vast and inaccessible and help to create a new step in the composition from the city to the landscape.



32

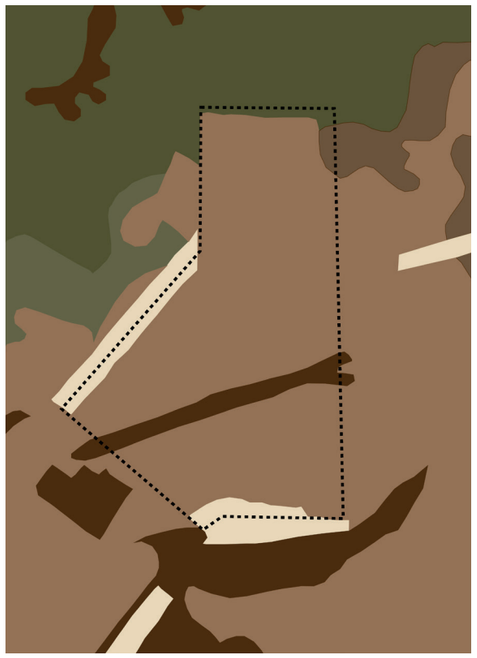
Composition of the waterway (Author, 2022)

Main characteristics of the site

The accumulation of transitions over the years is what gave the landscape its main characteristics. Firstly, in the area, there is a clear division in what land had to undergo the extraction of peat, and what areas were spared. The result is a height difference between the two distinct types of landscapes of more than three metres. This height difference is caused solely by the presence of a layer of unextracted peat soil in the higher-lying area. The lower-lying area consists of clay, also due to the more recent activity of intensive farming.

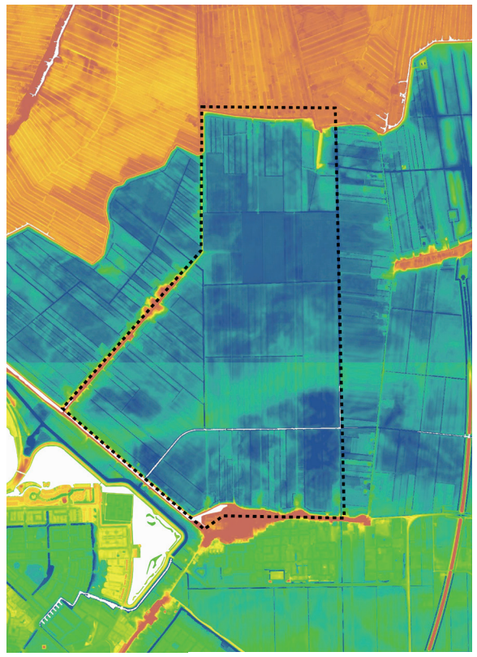
The height difference makes the low-lying are very flood prone as the area above Benthuizen is the deepest part of the polder, which causes water to flow there naturally.

Soil distribution



heavy silt
silt
clay
peat
swampy
above-ground

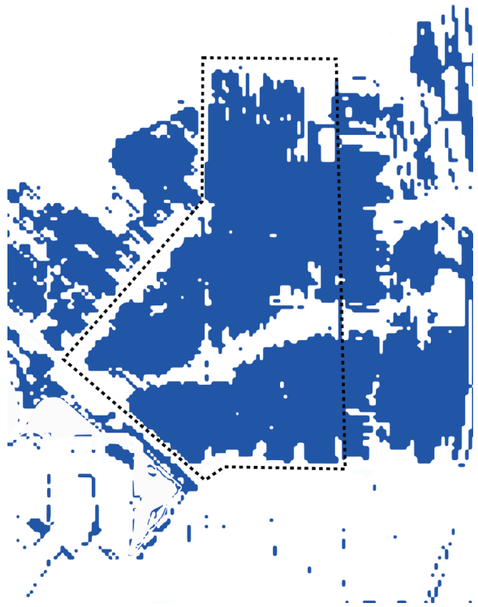
Height difference



low

high

Flood Prone



high flood risk

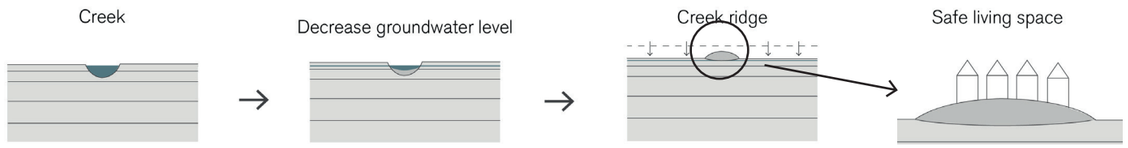
33, 34, 35

Current conditions of soil, height, and flood prone areas (Author, 2022)

pdok, AHN

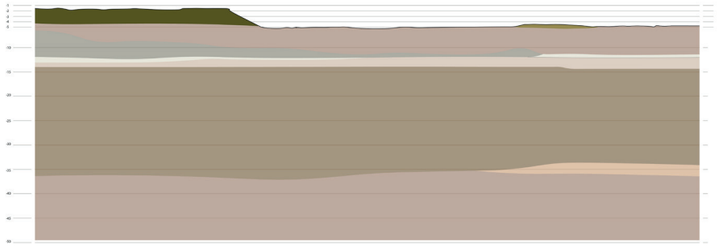
Soil

The soil in the area has transformed over the years. However, the current soil typologies are peat, in the northern part of the area, clay, in the area in which the project is created, and silty creek ridges. These creek ridges are the remains of the tidal processes in the area. Here, sandy soil was pushed in by the tides, creating an area in which more sand remained than the surrounding areas. Over time, because of the decrease in groundwater level, this soil became a little higher than the soil in the rest of the area. This sandy soil is more stable, thus in tradition, people built their houses there. In the area there is one remaining creek ridge that has not been utilized traditionally, leaving room for the project to grow in that area.



36 (above)

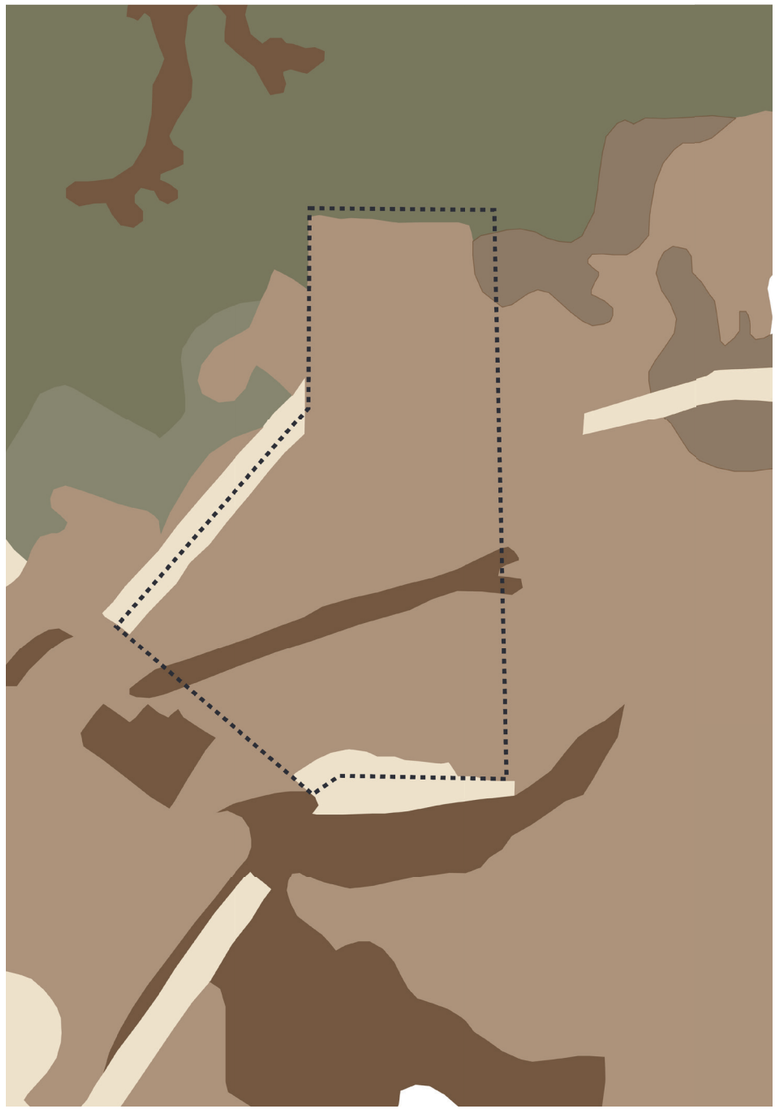
Creek ridge formation (Author, 2022)



37 (below)

Soil section (Author, 2022)
- Creek ridge
- Peat layer
- Clay layers

Dinoloket



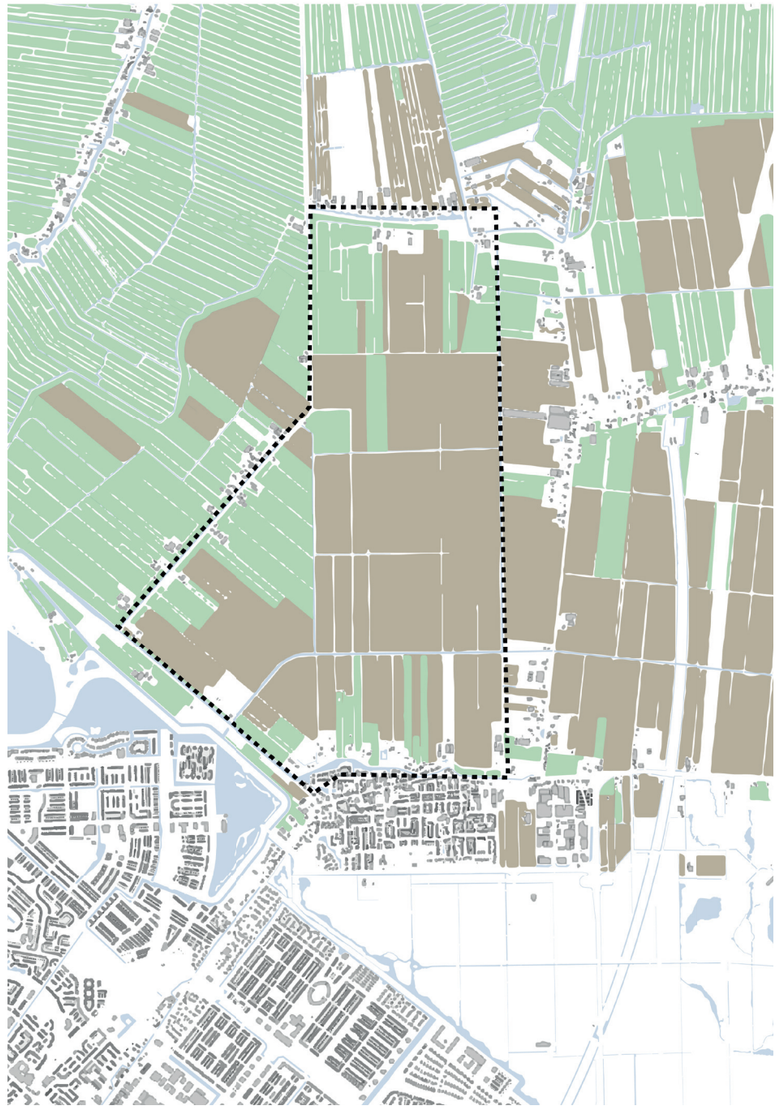
38 (right)

Soil distribution (Author, 2022)
- heavy silt
- clay
- peat
- swampy
- above ground

pdok

Uses

Because of the clay soil, the area is extremely fit for arable agriculture. The whole area is exclusively used to produce crops. Year-round, the land is used to produce wheat, corn, brussels sprouts, and potatoes. This makes the landscape empty and barren during winter. Furthermore, the production of these crops diminishes biodiversity as has been stated also in the context chapter of this thesis.



39 (above)

Images of arable land (Author, 2022)

40 (right)

Soil distribution (Author, 2022)

- arable land
- grasslad
- water

pdok

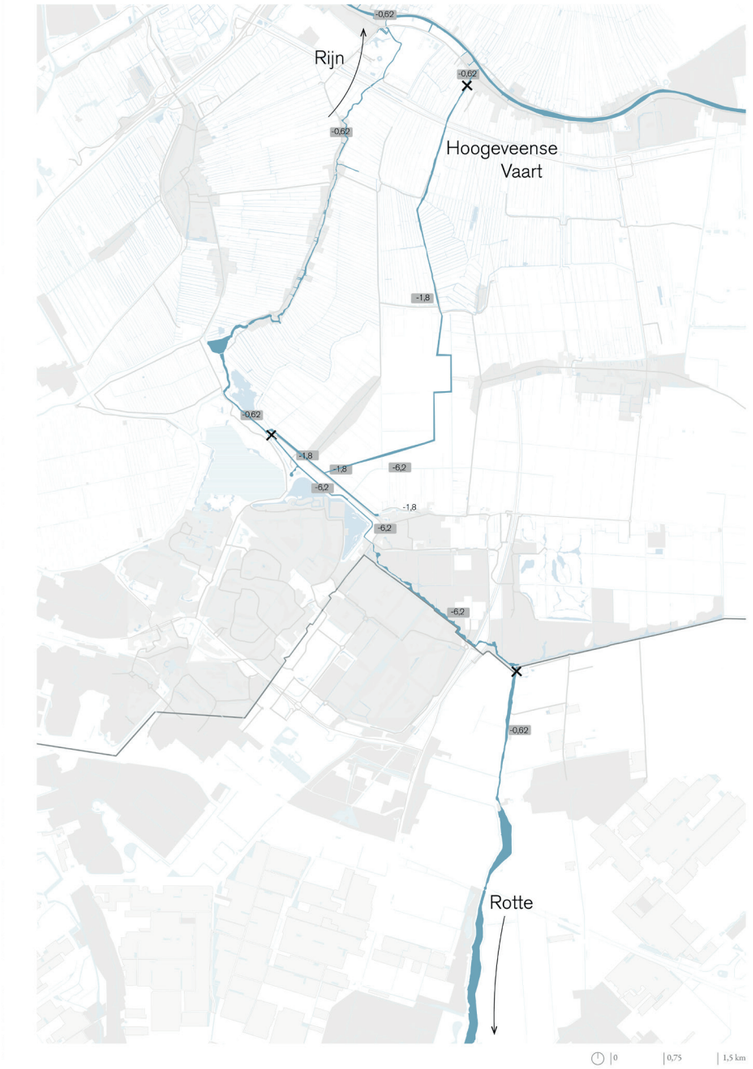
Water Management

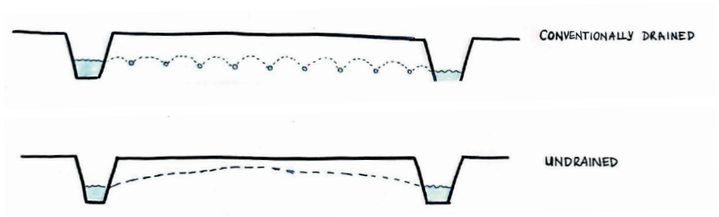
The effects of intensive agriculture are not solely experienced above-ground. This intensification is made possible by the drainage that has been placed under the surface to manage the groundwater levels more easily. The project considers taking out the drainage and creating a natural groundwater table, the effect of which is more fluctuating levels of groundwater.

As the design regards the connection to the large-scale water system, it is important to see how the Benthuizer Noordpolder is connected to the outlet water. The map in figure 42 shows that the outlet water does not reach to the polder. The pumping station Palenstein at the Elleboogse Wetering pumps the water in and out of the polder and helps to bridge a height difference of almost 5,5 metres as the boezem is set at a height of -0,62mNAP and the water level in the polder is set at -6,20 mNAP. Another water height can be found at the Benthuizer Vaart This water is -1,8mNAP and connects to the boezemwater via an inlet close to the pumping station. These heights can be seen on the map in figure 42.

The pumping station pumps from the Elleboogse Wetering into the Machinevaart, which in turn connects directly to the Dwarstocht of the Benthuizer Noordpolder via a culvert of 3,1 meters high and three meters wide. Figure 43 shows a simplified section of this system.

From these images, it is also evident that it is possible to connect the water in the southeast direction via Benthuizen and the Bentwoud to the Rotte and in the north direction via the Hoogeveense Vaart towards the Oude Rijn.





41 (above)

Transition groundwater levels (Author, 2022)

42 (right, above)

Map of water system (Author, 2022)

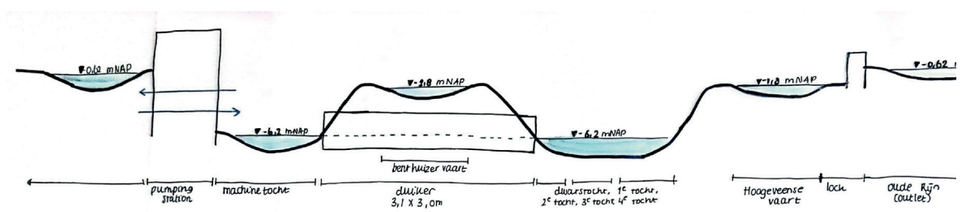
-1,8 Heights

Locks

Connected waterways

43 (right, below)

Section of water system (Author, 2022)



Clearance

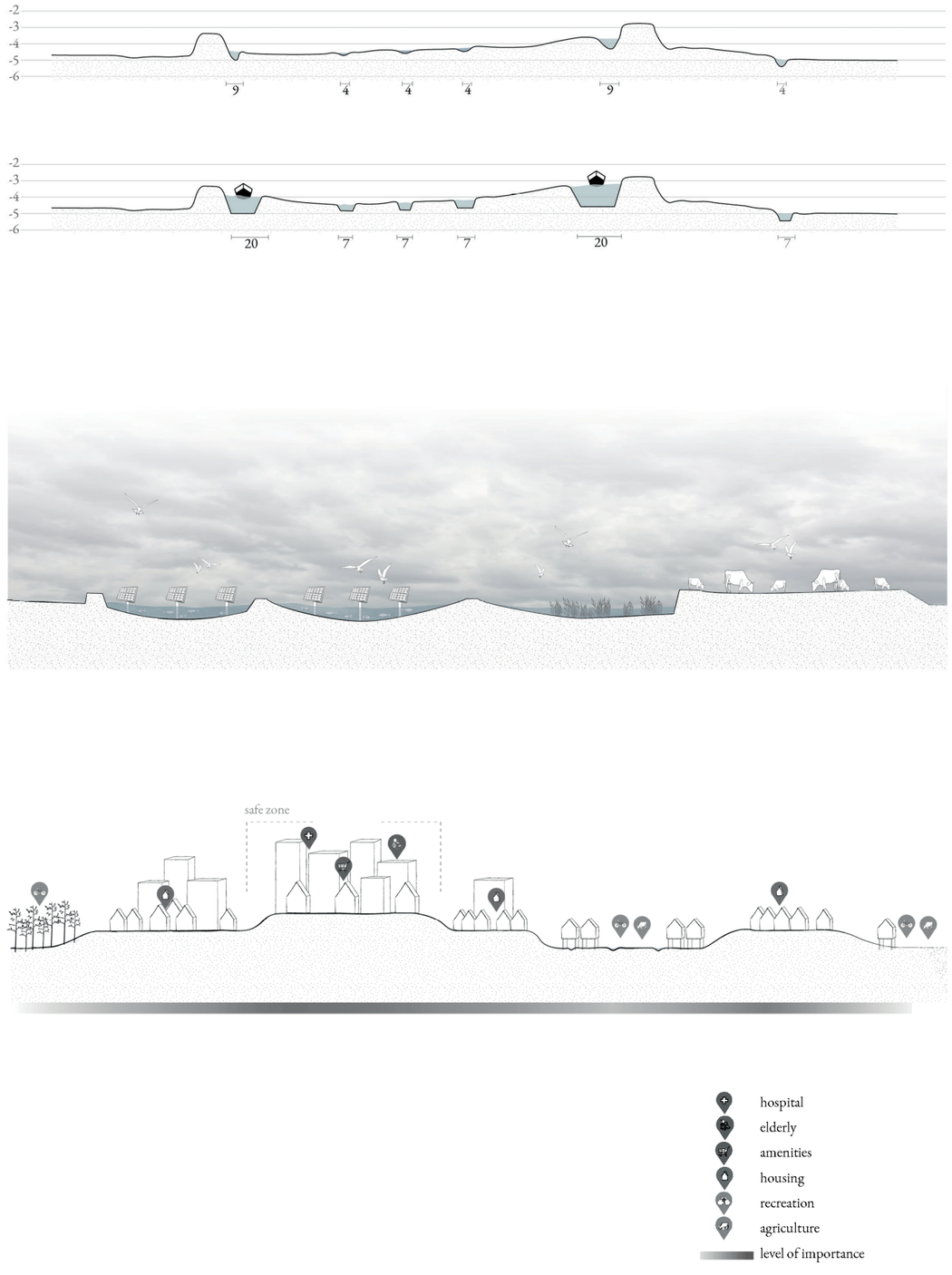
As a first step towards the design, the clearance series relates the thesis location to what can be. To tackle this concept, four what-if questions were posed. These questions, all relating to the lines of inquiry, give an insight into how the area could look in the future. These four insights pose a basis for the elaboration of the project.

Matter – what if we widen up the waterways?
The possibility of widening the waterways opens new possibilities for the functionality of the waterways. Because of the new width of the waterways, boats can navigate through the waters, creating a new mode of transportation in the area. This could eliminate the threat of losing critical infrastructures in times of high water, as the main mode of transportation could shift to transportation by boat, as a repetition of the historic use of the landscape. This can be local but also in a more regional manner. The literal clearance of soil can help to heighten other areas to maintain safety.

Topos – what if we fill the polders with water?
Filling the polders with water could be a solution at the time of high, to store the water until it is safe to let it out again, but the area could also benefit from a more permanent freshwater reserve. The water then also receives a seasonal aspect and can create awareness of the ongoing problematisation. This contained flooding can ensure the continuation of agriculture in the area, albeit in a different manner. This new way of using the land will make for a possibility of new functionalities in the polder.

Habitat – what if we create a hierarchy of functions?
The area would be reconstructed to house functions at different levels so that different parts of the area would be safe in case of flooding. The core would house the vital functions that the area needs. Smaller urban cores will be connected to larger cities via roads that are elevated enough to be used in case of high water.

Geopolitics - What if we were to build a new urban area in the polder landscape
Just as there would be a hierarchy in the distinct functions of the urban areas, it could be possible to create urban developments in which there was the possibility of floods without harm to the housing. For this, floodable housing has been applied to the location of the polder.



44, 45, 46

Results of clearance (matter, topos, habitat)
(Author, 2022)

Part 3 | Vision and strategy

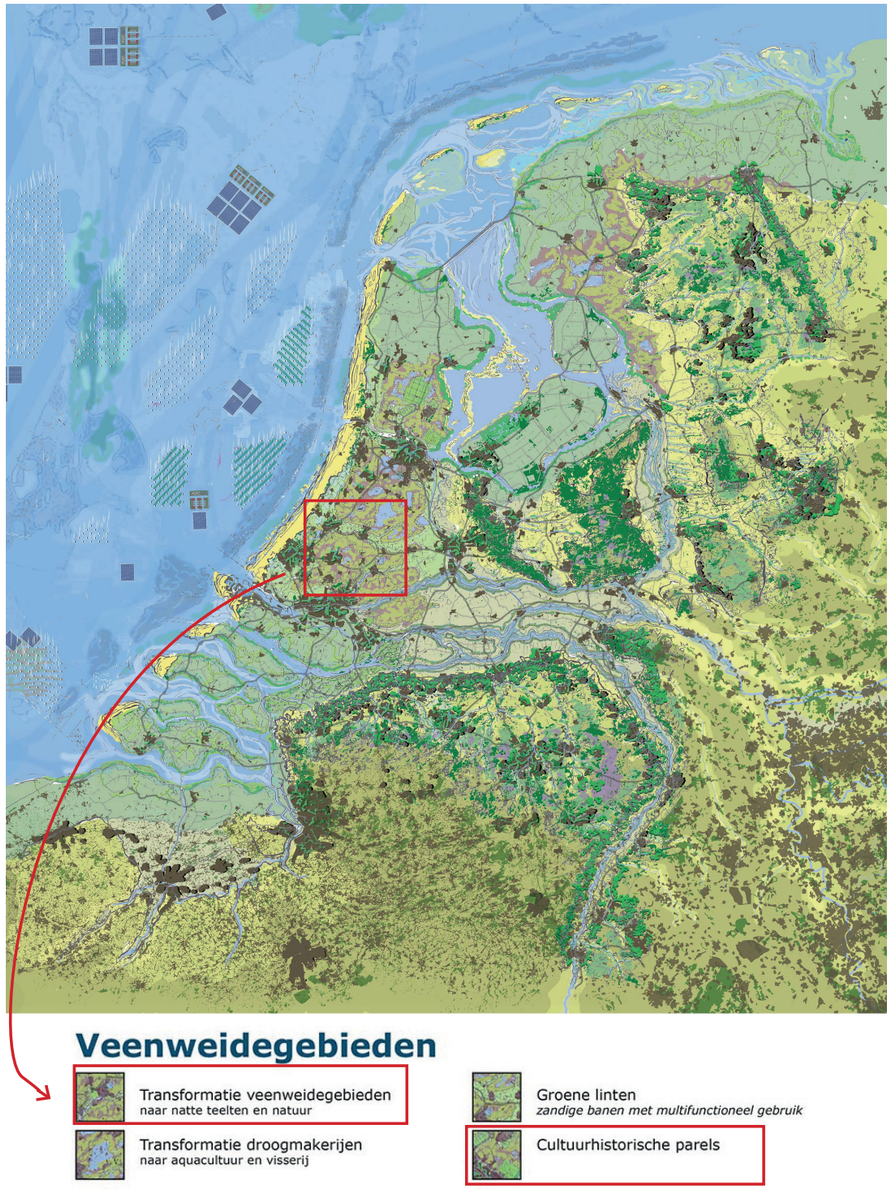
Uncharted waters

Scenario 2100

The timeframe that this thesis considers is long-term, from now until 2100. As a basis for this year, the thesis takes the image of Wageningen University and Research that proposes that the area is again transformed into a wet landscape in which peat is regrown. The project understands a landscape transformation is imminent as water in the deep polders of the Netherlands increasingly becomes within the bounds of probability.

At the same time, the project considers a new society, in which the increasingly older demographic (UN, 2020) lives more communal based in safer areas, while the landscape allows more extreme versions of housing. These houses that are in the landscape allow the landscape its natural processes, creating a new type of urban ecosystem.

The vision of the project is to consider a protocol of care for this period which means considering the long-term liveability of the area within planetary boundaries with a proactive attitude towards climate change. Through the investment in fundamental systemic changes, the prevention of impact can be ensured. Therefore, it is necessary to start the transition in the current paradigm of planning.



47

Proposal for the landscape in 2120
(Wageningen University and Research, 2019)

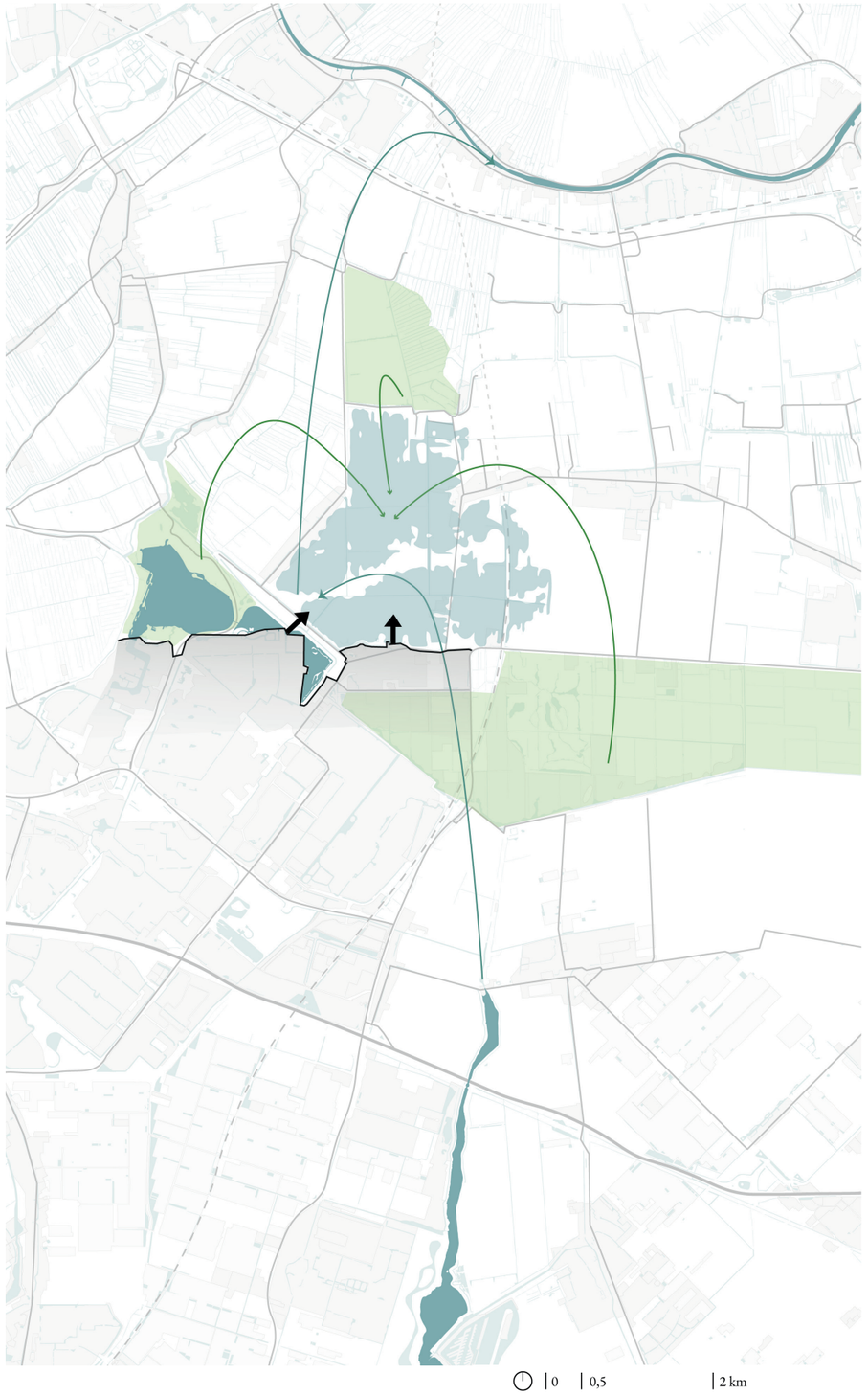
Territory-oriented approach

To realize what the area needs now and in the long term, the territory-oriented approach is applied. Through the combination of the problem statement and analysis, the scope has been set for the elements that are to be undertaken on a large scale and smaller scale. The area needs various aspects on these distinct scales, which need to be aligned. This can be done by implementing the territory-oriented approach that specifies what the location needs to flourish, without imposing on the current condition.

On the scale of the waterboard, the area can provide an example of how to deal with floodable conditions and provide a new waterway connection to the city of Zoetermeer, as well as further south.

On the scale of the relation between the polder and the city, there is a possibility to create housing, reconnect recreation and halt the negative externalities of the low-lying, sinking soil. Furthermore, there is a need for housing in the area, and there is the possibility to reconnect patches of recreational areas.

On the scale of the polder, a transformation of land use must be realized. The negative externalities that arise with the large-scale agriculture that is present in this specific part of the polder influence the climate and the prolonged activity of the area.



48

Potentials for the area (Author, 2022)

Vision

Water will be the carrier for the design. Through the creation of a new waterway, a backbone is created to enhance the area in the several aspects that through the territory-oriented approach have been deemed a necessary transformation for the longevity of the area, thereby investing in time, cultural and natural values, and adaptation to create added value. This waterbody, levelled with a dike, will be a connection to the cultural and natural values through the preservation of contemporary methods and landscapes and the implementation of physical structures such as buildings, sluices, locks, and mills. A visual connection is created as it is now possible to enter the landscape through a new mode of transportation that brings the human scale close to the landscape and natural scale.

Furthermore, to combat the enormousness of the area, the scale of the landscape is reduced by bringing back ditches that allow for a human scale in the area, thereby also recreating the contemporary structure of the landscape to create a recognizable element. These ditches can also help to transition the intensive agricultural area to a network of extensive farms.

These contemporary practices are accompanied by new structures that will ensure the connectivity and extent the usability of the area into the paradigm of living. These structures should be adaptive to be adjustable for future needs and uses. The embedding of a waterway as a connector into the surrounding landscape in a natural manner that values the past practices of the landscape without compromising its function in the future will be the main design challenge. The design will aim to bring together the water, its past, present, and future functions, and the people that use it.

This landscape will have the characteristic that it is floodable so a change in the mindset of current inhabitants is necessary, and infrastructure, housing and current functionalities will have to be rethought and therefore aims at a societal transition concerning housing, infrastructure, and agriculture in the context of cultural history while using the physical conditions of the territory as a basis.

49
vision image (Author, 2022)

Strategy - Physical conditions as a basis

The basis for the transition in the area are the physical conditions: landuse, soil, urban settlements, and water.

SETTLEMENTS
The design for a new waterway that will allow for the experience of the landscape, is based on the current lines that are present in the area. These allow for a connection to the current settlements in the area, whereas also creating a whole new line of settlements. Furthermore, these lines in the area help to create a new body of water that is within the structure of the contemporary landscape and therefore conforms to the cultural-historical values in the area.

SOIL
The area consists mainly of clay. However, there is a deviant soil type with sandier soil. This is limited to the creek ridge in the polder. By tradition in the area, these creek ridges were utilized as a stable ground to build houses. This creek ridge is not yet utilized in that way but will be used for that purpose in this plan.

Secondly, some areas are distinguishably lower than others. This height difference will be the basis for differentiation in heights in the plan. Digging out certain areas will ensure that the water will flow there, creating a more wet area.

The soil that is dug out will be the basis for the planning process, as the soil that becomes available in the area will be used to create the body of the dike.

WATER
The water level of the larger waterbody will be set at -1,8mNAP, whereby connecting the Hoogeveense Vaart to the north of the Benthuizer Noordpolder and the Benthuizervaart to the south. Water in the polder will remain at -6,2mNAP, whereby this lower-lying area can be used as a water storage polder via inlets from the higher-lying larger water body.

Furthermore, in the full area, the water table will be increased, aiding the battle against subsidence. This change in the groundwater level will have consequences for the current use of the landscape. Intensive agriculture is made possible by the consequent water level of 80 cm below the surface. By increasing the water level, incentives to apply new types of more sustainable agriculture are created.

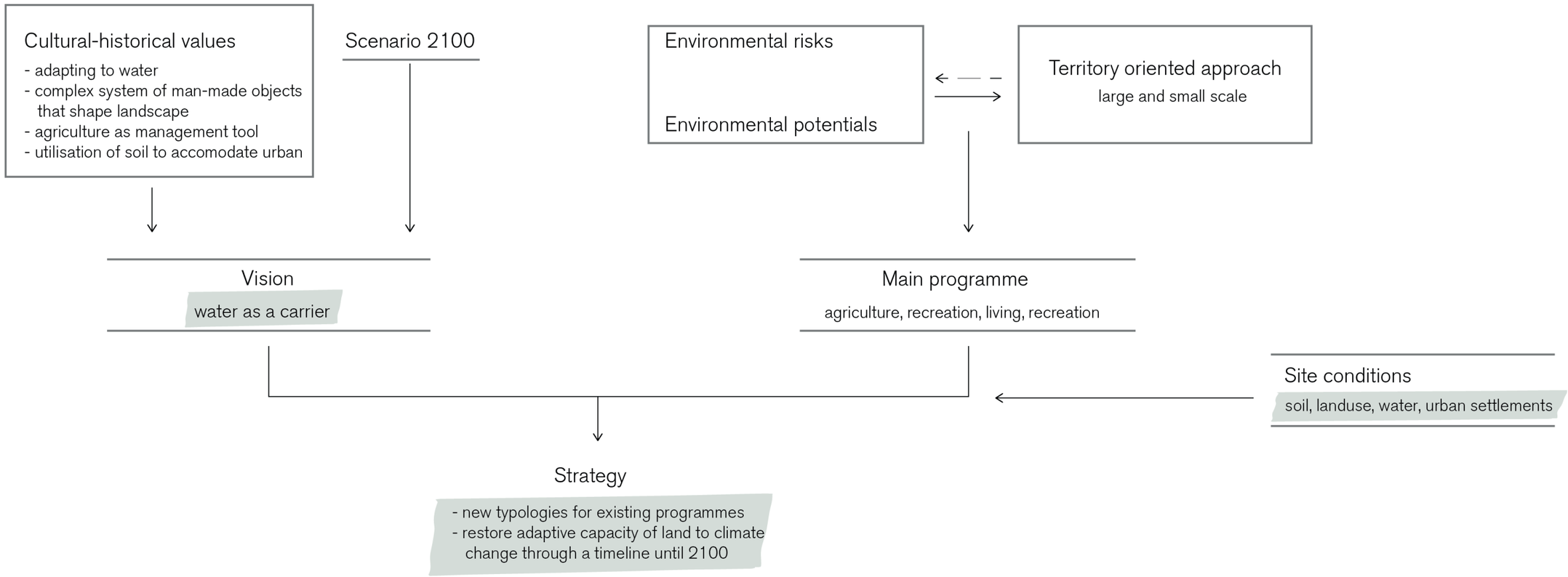
LANDUSE
Therefore, the current land use of the area is not to be eliminated, solely transformed. As the plan includes creating a wetter landscape, there is a need for a change of type of agriculture. This allows for a transition from intensive agriculture to extensive agriculture, a more multifunctional way of farming. Through the broader connection to the landscape as well as the society and the way that working the land with a higher water table can reduce or eliminate subsidence, this is thought to be a more sustainable way of farming (Brouwer et al., 2003).

Through these elements, the strategy considers the physical conditions as a basis. Water as a carrier for the design, soil as a material to facilitate the transition.

50
Basic conditions (Author, 2022)
Water
Settlement
Height difference
Creek ridge

Design framework

To summarise how the scenario, vision and strategy relate to the previous sections of the thesis, the design framework has been drawn up. From there, the thesis can work towards the implementation of the strategy.



51
Design framework (Author, 2022)

Design concepts

Concretely, the design will focus on five specific elements.

1 | Connection with large-scale water bodies
The design will seek to create a connection between the existing waterbodies the Oude Rijn and the Rotte. With this, a connection can be made to the large-scale water network and the design will function as a connector toward also the historic barge canals.

2 | Use the creek ridge as a basis for the developments
Historically, creek ridges in the area were used as a basis to build on. The sandy soil that creek ridges contain proves more stable than the clay soil that surrounds it. The creek ridge in the area was the only ridge unutilised and can connect the design both physically and historically to different settlements in the area.

3 | Reuse of soil
Whereas the creek ridge is the basis, this needs to be heightened to create safety in times of high water. This soil comes from the surrounding area which in its turn is dug out to create a smaller scale in the landscape and create an experienceable landscape.

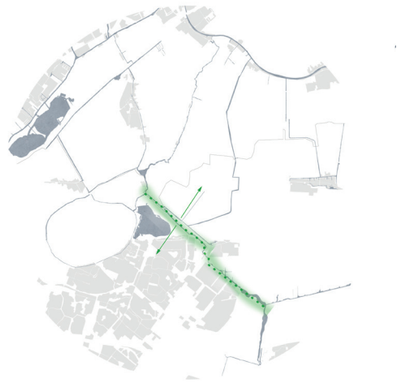
4 | Relationship between city and landscape
Through the design, an attempt is made to stimulate a new relationship between the city and the landscape. The landscape is made experienceable and provides a level of education on past and present water management practices and creates awareness of the effects that water

5 | Safe space in times of high water
Climate change affects this area greatly. The area is expected to have to deal with floods because of waterbombs and extreme dry circumstances in the short term. Therefore, the landscape will be able to store the excess water in the waterways. In the long term, the area will undergo the consequences of sea level rise. To overcome this, spaces have been designed to be safe when this happens.

1 | Connection waterways

2 | Creek ridge as basis

3 | Reuse of soil



4 | Connection city landscape

5 | Safe space

52
Design concepts (Author, 2022)

Part 4 | Design

Digging into the matter

4.1 Creating a waterway

Waterway design
Digging of soil
Resulting design

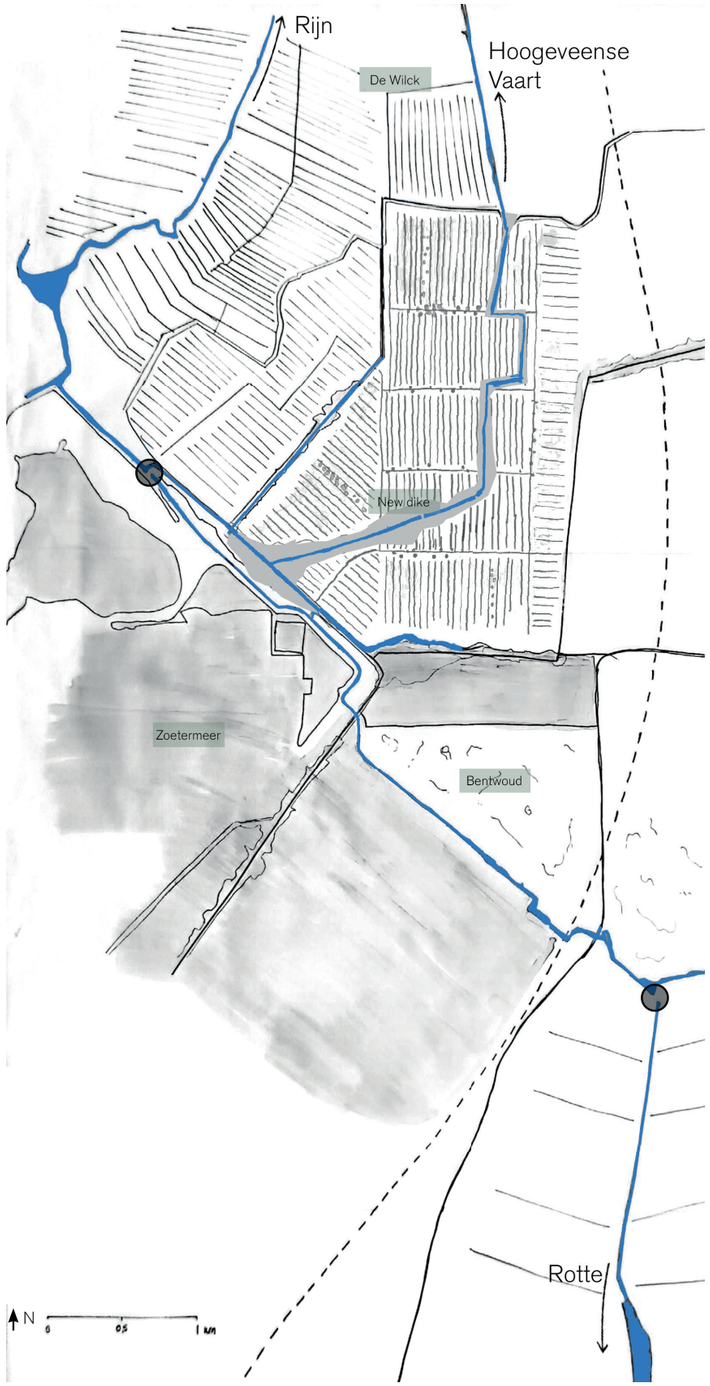
Waterway design - large scale

The design of the area starts with the creation of the dike body through the Benthuizer Noordpolder. This waterway provides a connection between the Hoogeveense Vaart to the north and the Benthuizer Vaart to the south. By the implementation of a lock at the west end of the Benthuizer Vaart it is also possible to access the outlet water and connect to the Weipoortse Vliet and continue to the Oude Rijn. Through this connection, it is also possible to connect recreational areas in this part of the polder by boat, facilitating a connection between the outlet water of the Rotte and the Oude Rijn while also connecting Zoetermeer to this network.

As a basis for the dike, the creek ridge in the area has been taken. This ridge will provide stabler soil than the surrounding clay and is therefore suitable for the creation of housing on the dike. This sets out the contours of that part of the dike. To create a connection to the Hoogeveense Vaart, a sharp turn towards the north is needed, creating a new view perpendicular to the landscape. Then, to allow for the deepest parts of the polder to be created into boggy areas, a turn is implemented in the dike. This creates a moment in which one can look out over part of Hazerswoude Rijndijk before turning towards the higher peat landscape in which the Hoogeveense Vaart is located.

From the Rotte, at outlet level of +0,6 mnAP, it is possible to go down to the Bentwoud with a lock crossing to -6,2 mNAP. From there, existing waterways are used to connect to the Palensteins pumping station where another lock will be implemented. Here, users can either continue on to the outlet of the Rijnland at +0,62 mNAP, crossing the Weipoortse Vliet before entering the Rhine, or users can continue at -1,6 mNAP, continuing over the Benthuizer Vaart to the Hoogeveense Vaart via the newly implemented waterway.

Through the creation of the locks that bridge large height differences, an awareness of the extremely low-lying situation that people live in. An insight is gained in how the watersystem works and how it keeps them safe, creating more sensitivity to floods.



53

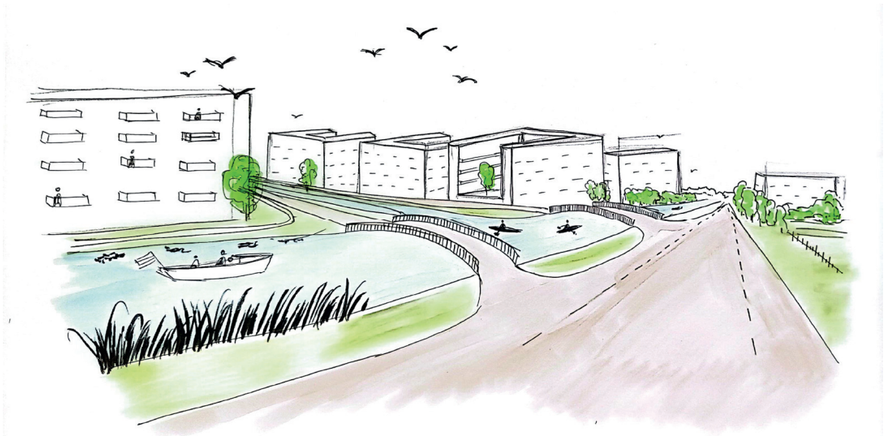
map of new waterway (Author, 2022)

- urban area > -1,5mNAP
- urban area < -1,5 mNAP
- road
- high speed rail
- ditches
- connected waterways
- large waterbody
- lock

The dike element has different slopes in different places. At the sites where the dike connects to the agricultural areas, a slope of 1:3 is realised to ensure that people cannot walk onto the agricultural land. At the locations of the boggy landscape, the slope is reduced to a natural slope so the landscape of the bogs continues on to the dike in a natural manner. Along the rest of the dike, the slope varies from 1:6 to 1:3, with platforms on which housing and recreational areas can be created.

The current waterway to which it connects, the Benthuizer Vaart, is 15 meters wide. This is why the waterbody in the new design also starts at this width. In several places the waterway gets wider, or narrower, to create different compositions in the landscape.

The current width of the Benthuizer Vaart is therefore also the limit to which the size of the boats is measured. Because of the narrow passage, solely small recreational boats can pass this part of the waterway. As a result, bridges do not have to be moveable as it is possible for these boats to just pass under them.



54

impression of connection existing and planned waterway (Author, 2022)

Digging of soil

To facilitate the heightening of the soil of the dike, an integral plan has been developed in which soil from the area can be used to create higher grounds. Through the implementation of both a smaller scale in the landscape and the boggy areas, the soil becomes available to use in the creation of the dike body. In the first phase, the scale of the landscape is altered. The creation of the ditches of an average of three meters wide provides 209000 m3 of soil. The widening of the existing ditches provides another 18000 m3 of soil. With this, the first part of the dike can be created, for which a total of 227000 m3 is necessary.

The rest of the dike body will be created in a later stage, and soil from the creation of the bogs will be used for this part of the plan. Through the creation of the bogs in the deepest part of the Benthuizer Noordpolder, it is possible to dig out 350000 m3 of soil. Through this, the bogs will be 0,5 meters deep on average. For the creation of the dike volume, only 325000 m3 is needed. Therefore, the bogs can be a little smaller and shallower than the space allows. The full transformation of the area will be discussed in the next chapter.

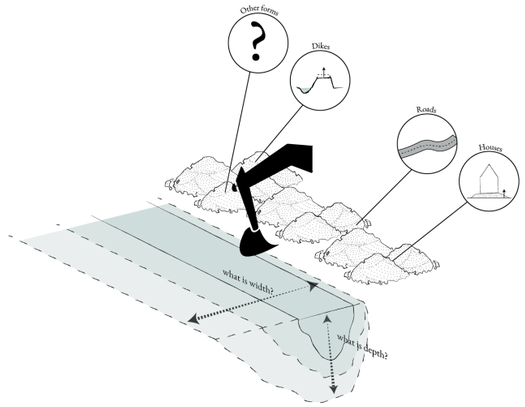
It is important to consider the depth of saline water under the surface when digging out the area. At the Noordpolder, these levels are 10-25 m below the surface (Climate Adaptation Services, n.d.), so the digging does not result directly in saline groundwater. However, in dry periods, there might be seepage of saline water.

Phase 1

For total area of kreekrug part 1	525.000 m3	
Current dike	-60.000 m3	
Parking structures	-237.000 m3	
		227.500 m3
Creation ditches	209.500 m3	
Deepening ditches	18.000 m3	
		227.500 m3

Phase 2

For total area of kreekrug part 2	525.000 m3	
Parking structures	-200.000 m3	
		325.000 m3
Bogs	325.500 m3	
		227.500 m3



55 (top)

Calculations of soil extraction (Author, 2022)

56 (left)

Use of soil after its extraction (Author, 2021)

Resulting design

The result of digging out the soil and the creation of the dike leads to a new landscape that is more dynamic and experienceable than the current situation. The altered landscape gives way to the transformation of agriculture from intensive farming to extensive farming. Through the creation of the dike, a new location is created to facilitate urban expansion.

This urban expansion can connect the transition of the landscape to the current urban structure, creating a beneficial relationship between Zoetermeer and the Benthuizer Noordpolder. The expansion will also allow for an answer to the demand for housing in the area. To do so, three types of dwelling are created. All with their relation to the natural cultural landscape, the water, and the city. All houses have the basic characteristics that they can be flooded and therefore provide safe places in times of high water.

The first structure is an urban block. Following the contours of the creek ridge provides wide and narrow spaces in which housing blocks and natural edges can alternate. On the widest part of the creek ridge, a small urban centre is created to provide the new residents with amenities and to create a point of interest in the landscape. Here, a visual connection between the water and the landscape is created. These houses are the most urban of the three types, connecting visually to the city as well as creating an urban core.

The dike follows along a less stable soil. Here, houses on poles will be implemented as they provide less weight for the soil of the dike. Furthermore, as the houses are high above the ground, processes of subsidence of the clay soil and the growth of plants and trees will not influence the houses. These houses have a moderate connection to the landscape and have a lesser connection to the urban cores.

In the landscape, the boggy areas will function as a place for residential housing in the form of floating homes. In more collective agglomerations, these houses connect living directly to the landscape through the experience of the water. There is little to no connection between these dwellings and the other urban areas.

The altered landscape gives way to the transformation of agriculture from intensive farming to extensive farming.

57

map of waterway (Author, 2022)
urban area > -1,5mNAP
urban area < -1,5 mNAP
road
high speed rail
ditches
connected waterways
large waterbody
lock

4.1 The landscape

Transition
Intensive agriculture
Transition agriculture
Extensive agriculture
Current landscape
Smaller scale landscape
Bogs
Nature reconnection

Landscape transition

The transition of the landscape looks like the images on the right. The proposed change in scale, from hundreds of meters wide plots to plots stretching only thirty meters, provides means to change the whole landscape. Through the creation of small ditches and bogs, the landscape can include more historic landscape elements such as trees and other green structures. The change in scale relates the Benthuizer Noordpolder again to the surrounding polders as there the scale is similar to the transitional area. This will create an ongoing landscape throughout the whole area.

58

Landscape before intervention (Author, 2022)

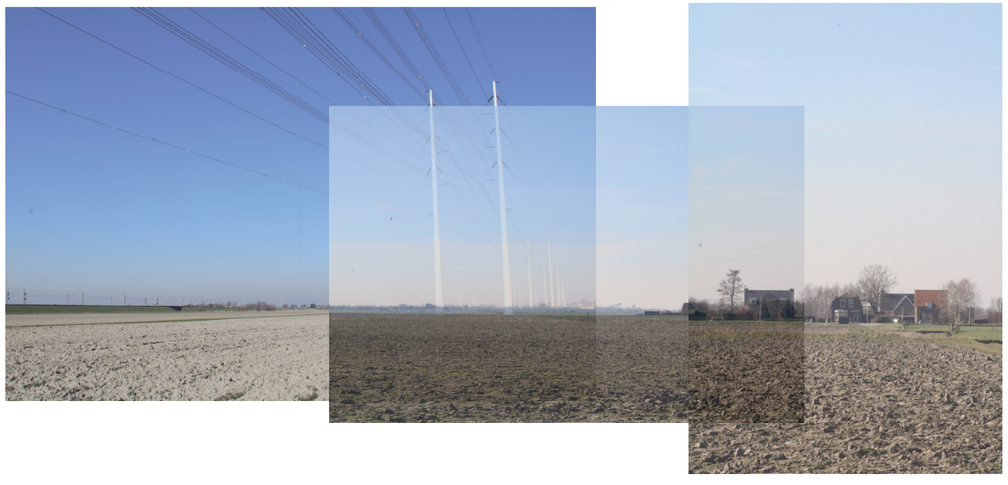
59

Landscape after intervention (Author, 2022)

Intensive agriculture

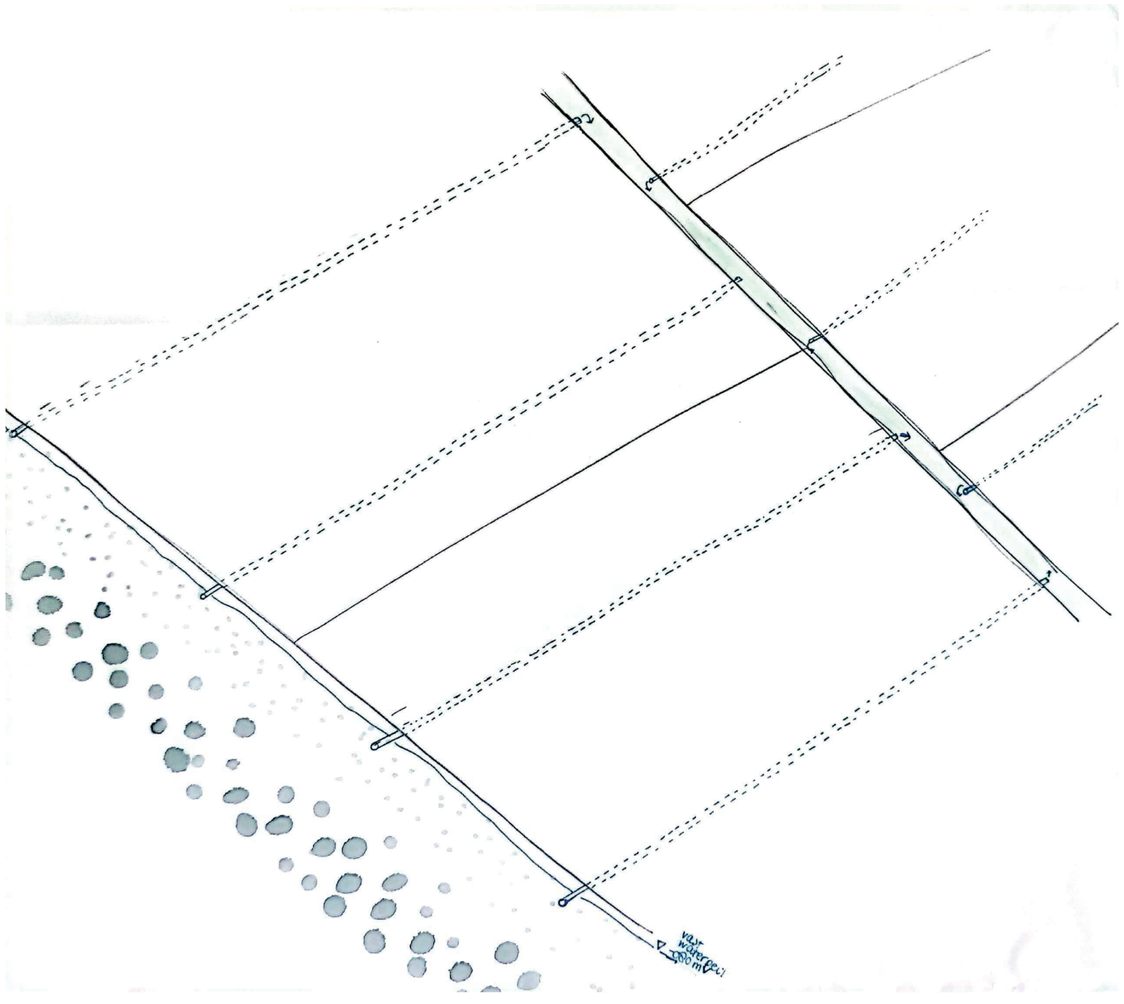
To optimally use the landscape and connect the development of nature to a change in agricultural practices, agricultural nature, and landscape management (Dutch: Agrarisch Natuur en Landbouwbeheer, ANLB) can be applied. This way of using the land is extensive instead of intensive and contributes to nature, climate, water, soil, and biodiversity, increasing the sustainability of the landscape (IPO & LNV, 2021)

The change in scale of the landscape and the increase in the water table ask for a transformation in the way farmers use their land. Through changing the large fields to smaller plots, the application of preservation through development can be shown: the combination of nature and landscape with other functions can lead to an added value for society and create more sustainable conservation (PBL, 2019).



60
Image of current agriculture (Author, 2022)

61
Principles of current agriculture (Author, 2022)

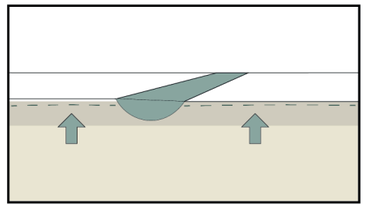


13
application of theory (Author, 2022)

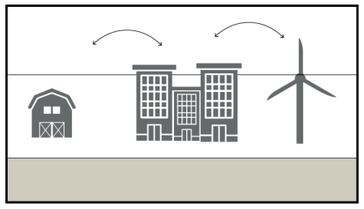
Transition of agriculture

With the implementation of this project, the agricultural plots change from large plots of land with monocultural features to a multifunctional landscape in which crops are produced and cattle are grazed simultaneously whereby the farming is assigned the role of nature maintainer as well as producer of food (PBL, 2019). By rotating the uses over the months, fields are maintained naturally while species are allowed to flourish at the same time. The multifunctionality of the landscape also provides multiple means of income for the farmer – the production of dairy, crops, and energy in combination with the recreational function of nature – and provides multiple pathways for the times to come (Brouwer et al., 2003).

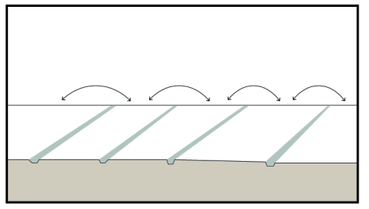
Through this, agricultural practices are combined with climate adaptation as by changing the area to this form of extensive agriculture, the area becomes floodable. It is no longer an issue if water overflows the plots, as the uses are accustomed to that. Therefore, this extensive manner of wetter agriculture, can also accommodate the water and thus the polder can also function as water storage with inlets from the waterway connecting to the polder (Possen et al., 2021).



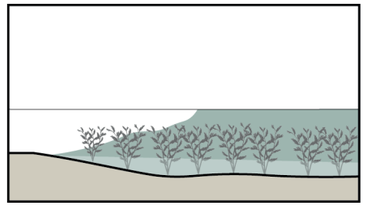
increase ground water table



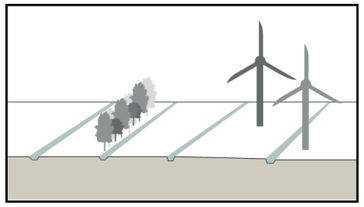
collaboration of parties



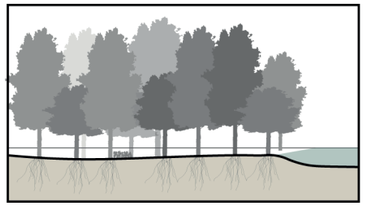
strip cultivation



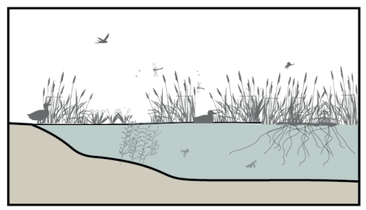
wet agriculture



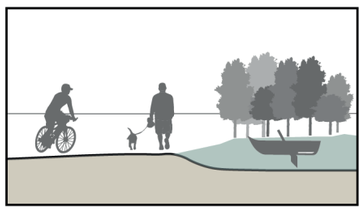
landcape elements



agroforestry



nature-friendly watersides



recreation

biodiverse grasslands

62

Transition to extensive agriculture (Author, 2022)

13

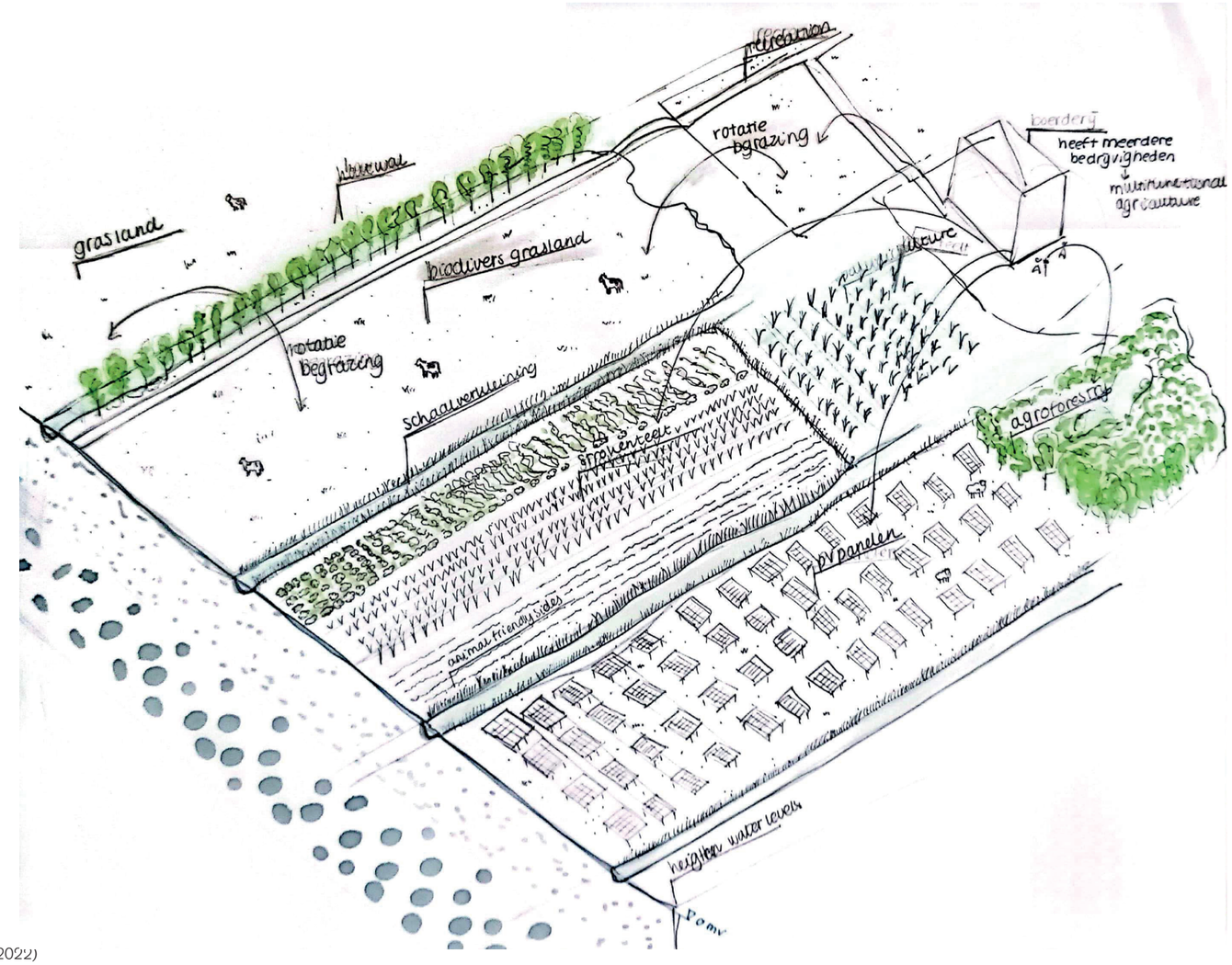
application of theory (Author, 2022)

Extensive agriculture

This way of farming can be combined with several divergent functions in the polder as the inclusion of urban development and recreation.

According to research, farmers are open to the transition to a nature-inclusive way of managing the land – in 2018, more than 50% of the farmers acknowledged the issue and proposed to focus on this transition instead of an intensive, export-based agricultural landscape (Bouma & Marijnissen, 2018).

This plan sets in motion the transition of agricultural practices to sustainable, nature inclusive and possibly circular. This will not only lead to a reduction of emissions and restoration of biodiversity but will also ensure a chance to add to the restoration of diversity and quality of the landscape in which urban expansion is possible and creates integral ways to deal with the effects of climate change.



63

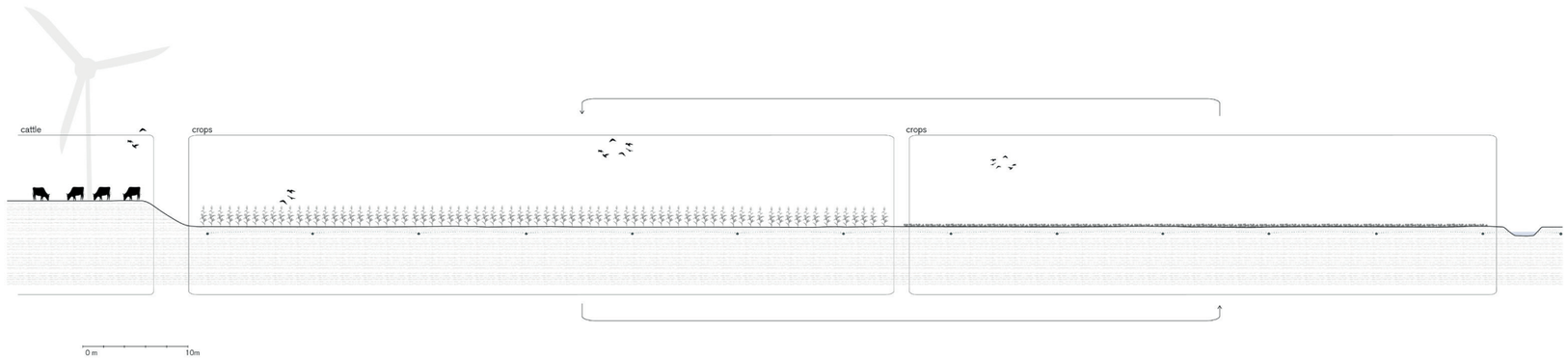
Image of extensive agriculture (Author, 2022)

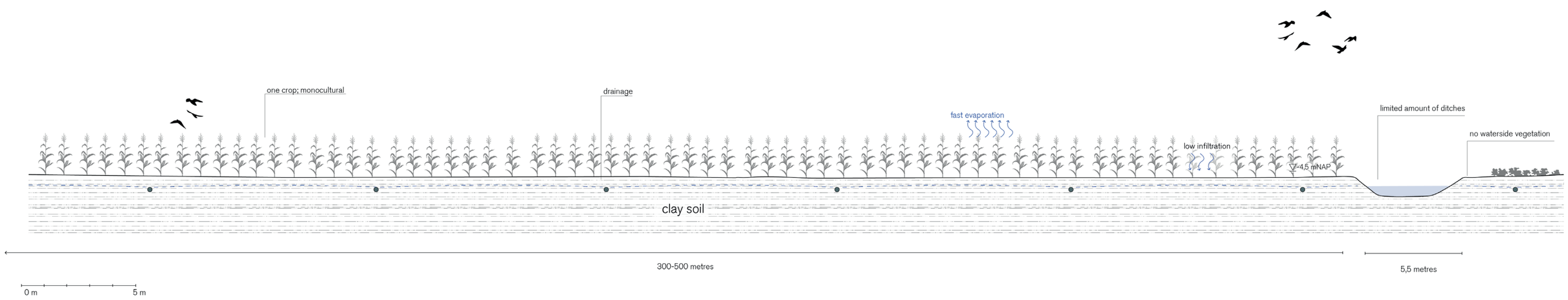
64

Principles of extensive agriculture (Author, 2022)

Current landscape

As stated before, the current landscape is a large-scale agricultural landscape. Fields are filled with crops that alternate throughout the year. These fields are three hundred meters long and are artificially drained. The lack of water in the area results in dry plots, especially in hot summers when there is an elevated level of evapotranspiration. There is no biodiversity as the crops do not provide adequate diversity for a multitude of species.





65, 66

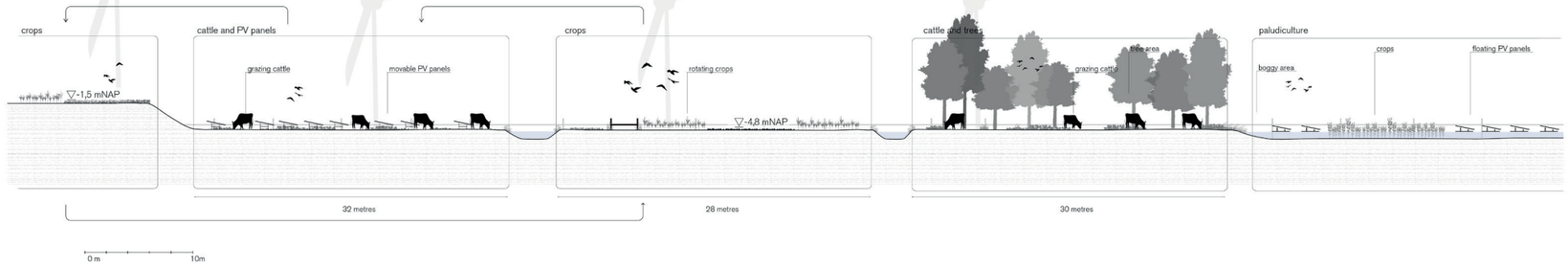
Section of current landscape (Author, 2022)

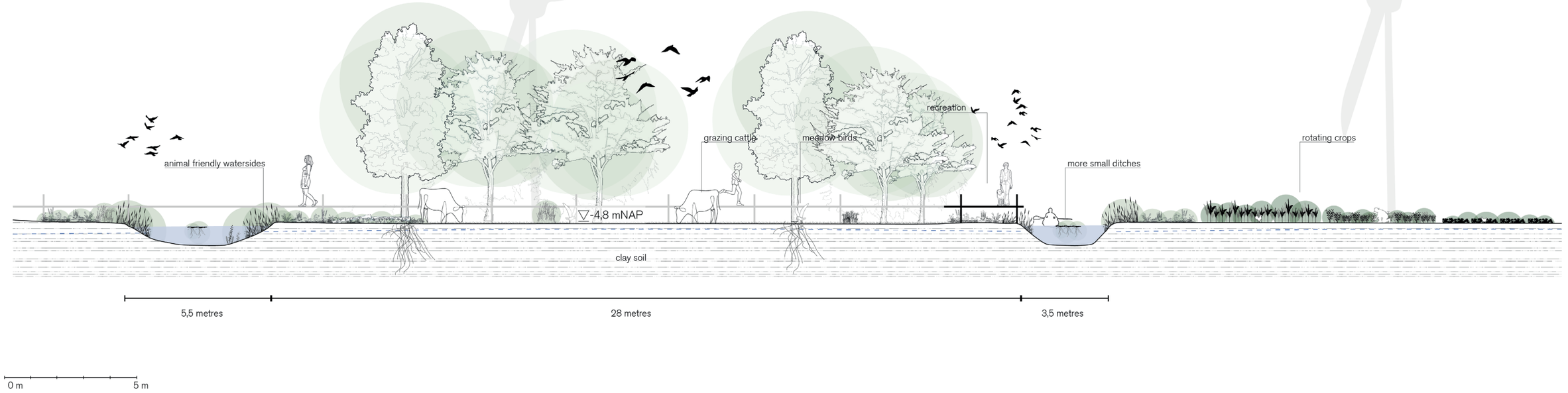
13

application of theory (Author, 2022)

Smaller scaled landscape

The design that is proposed here is a smaller scale landscape in which plots alternate more quickly and house several functions. Extensive farming is implemented whereby a farmer is then not only a farmer but is a protector of the land and all its inhabitants and users, providing an integrated approach to their farm. The area is no longer solely productive in terms of food, but also provides safety in times of high water, recreational value, and energy, while still producing food.

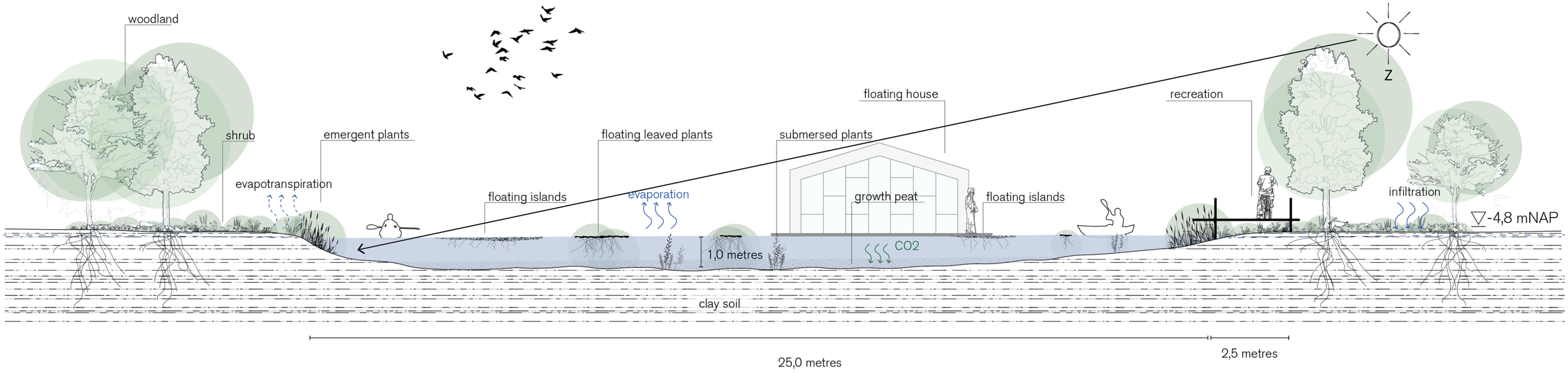




67, 68
Sections of extensive agriculture (Author, 2022)

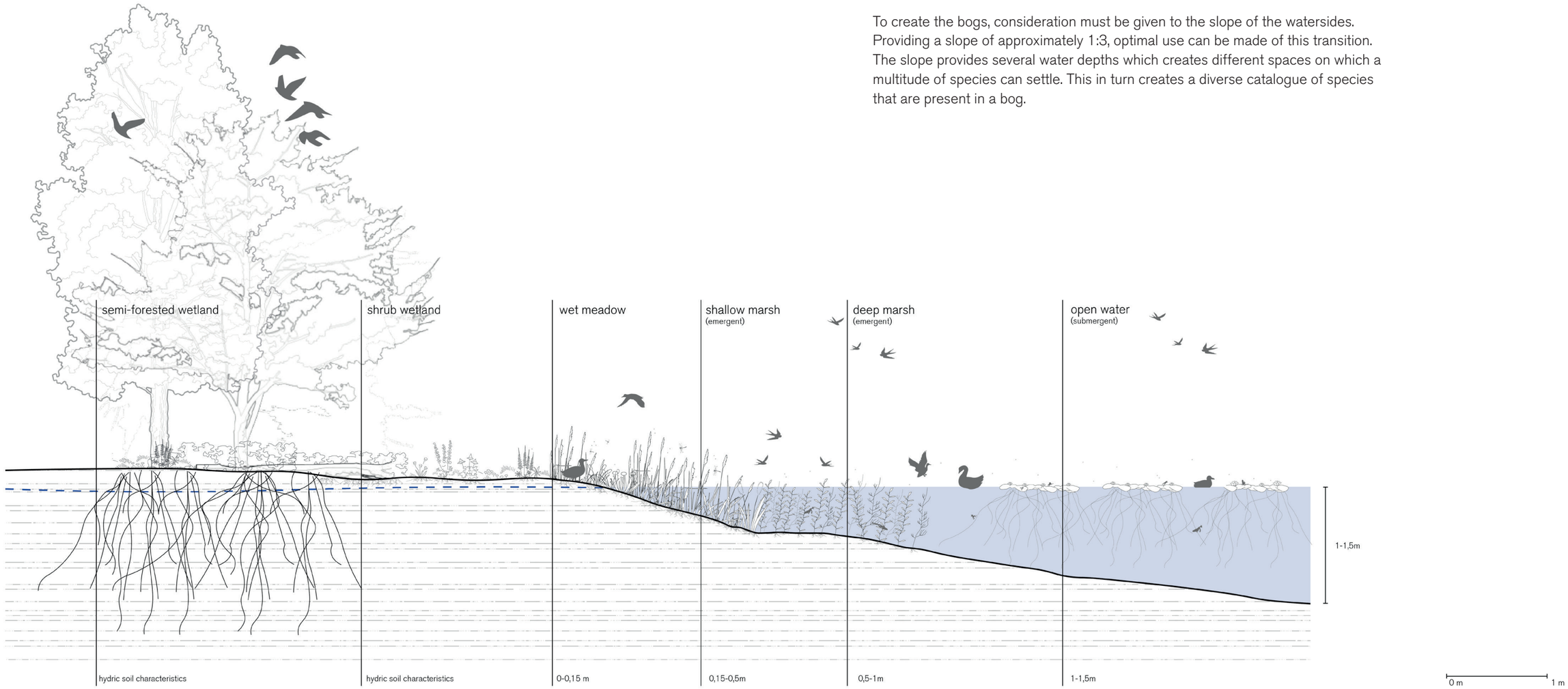
Bogs in the landscape

The smaller scale ditches are sometimes alternated with bogs. The bogs provide space for water flora and fauna that thrives in peatland landscapes. Here, nature is allowed to grow to make way for species that now live in the adjacent Natura 2000 areas. Created to provide soil for the urban expansion, the bogs will function as water storage during the wet season. Throughout the dry season, these areas hold less water and create a different sight. Over the years, more species will be found in the area as nature continues to grow. Making natural processes and the water cycle visible and experienceable, truly a new identity is added to the location.



70
Section of bog (Author, 2022)

To create the bogs, consideration must be given to the slope of the watersides. Providing a slope of approximately 1:3, optimal use can be made of this transition. The slope provides several water depths which creates different spaces on which a multitude of species can settle. This in turn creates a diverse catalogue of species that are present in a bog.



71

Section of waterside of a bog (Author, 2022)

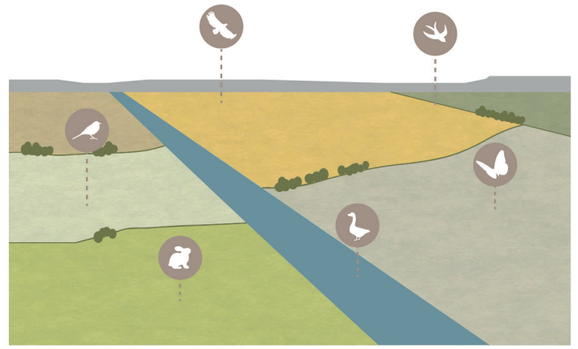
Nature reconnection

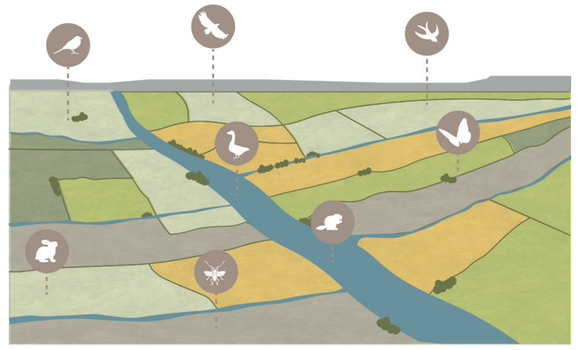
As stated before, the landscape has undergone a transition to a larger scale concerning its past uses. Through this design, the small landscape elements that were used in the past and are used in surrounding polder areas will be brought back into this landscape. These small elements such as hedgerows and ditches will create a variety in the landscape and will increase the sense of identity but will also add to the biodiversity. Returning the elements to the landscape creates more space for natural habitats through water banks and trees (IPO & LNV, 2021).

An investment in nature will not only add to the quality of life in the area, but the creation of natural areas can also bring future value in the battle for climate change and sustainability (PBL ding). The development of natural areas is connected to landscape goals such as biodiversity goals and nitrogen goals, by linking them to circular agriculture, climate adaptation, and urban development (PBL ding). Through an integral and extensive approach, the use of the landscape becomes multifunctional and agriculture, living, and recreation are combined to benefit the creation and preservation of natural areas. In this way, landscapes can be transitioning to more robust and resilient areas. To benefit from this optimally in the territorial area of this thesis, optimal water management must be realized (Possen et al., 2021). Currently, the land is kept artificially dry with water levels -0,90m under the surface. For the ecological value in the area to increase, the water table must be increased to -0,20m or even 0m under the surface level (PBL, 2019). Human water management will go then hand in hand with natural processes.

By creating a wetter landscape through the increase of the groundwater levels, adverse effects of too low groundwater levels can be mitigated. There is a more minor change of salinization during the dry season and because of the availability of water, subsidence will decrease. For both these effects, a sound natural system is vital as nutrients in the soil will increase the efficiency of the increased water table (Possen et al., 2021). Therefore, the effects will increase over the years as nature increases. If subsidence is halted, less CO2 is emitted. If natural processes set in and peat slowly starts growing because of the increased water levels, the reverse process can also be set in as CO2 will be captured (Field Manchester Metropolitan et al., n.d.).

Through the development of the addition of natural qualities, the landscape will thus be recognizable again. This recognizability will generate a new identity in the landscape which will result in an economic basis for the landscape (IPO & LNV, 2021). In this project, natural areas are realized through the creation of smaller landscape elements and the addition of bogs in the long-term vision. The smaller elements create new habitats that originated in the landscape. Building together with nature is not only better for the natural processes that service humans but will also create more safety through the creation of a floodable area (la Loggia et al., 2020). Recreational possibilities are also increased by making nature a part of the design of the landscape. All of this will provide more benefits to society.





72

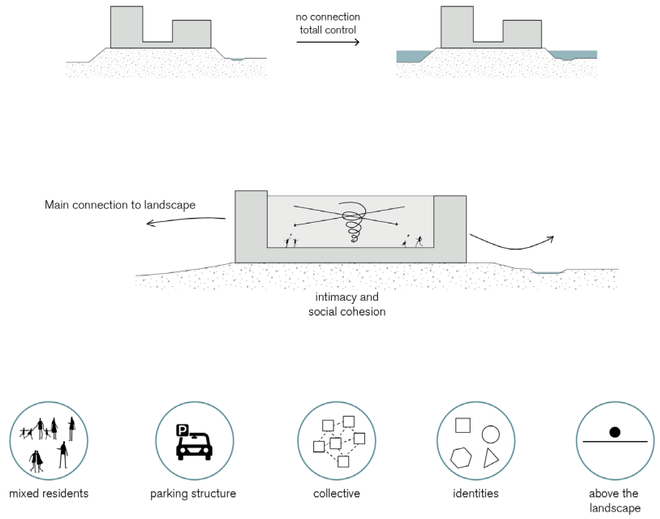
Reverse process of biodiversity loss (Author, 2022)

4.3 Urban expansion

Principles blocks
Identities
Public space
Relationship Zoetermeer
Houses on poles
Floating houses
Seasonal change
Urban fringe

Urban expansion

The new urban expansion falls into the new landscape following the principles of a megaform (Frampton, 2021). Through the implementation of a horizontal housing structure, the area can quickly be densified as there is a large demand for housing. The structure is inserted onto a podium which will provide long-term stability for the structures on top, as well as a safe place in times of high water. This megaform is then cut up into multiple smaller structures that bring back the human scale to the large structure. There is no physical connection to the water, but this ensures that the structures have complete control in the event of a flood. This structure helps to aid the transformation to a floodable area by providing a flood resilient measure, meaning that the structure of the megaform will not be altered in the event of a flood. To be flood resilient, the building facilitates multiple levels. Residential areas are higher than +2,5 meters NAP and the shared space in between is +4 meters NAP. This means that the structure is flood resilient for different predictions with regards to the unpredictability of sea level rise and can provide safe spaces to live and for social life.



73

principles of urban expansion (Author, 2022)

Principles block

In the polder landscape usually one can find small dwellings – single-family houses. As there is a large demand for housing in the area, it is necessary to consider a different way of configuring homes.
Due to this, a choice was made to create larger urban blocks. These blocks are opened in the middle to facilitate social spaces. Then, one of the sides is eliminated to connect the blocks to the landscape and give it an identity. The remaining facades are cut up into smaller pieces to bring back the human scale to the large blocks. To make the block safe in times of high water, its inside social space is elevated by 4 meters. These heightened areas are accessible with stairs. Parking is facilitated underneath the structure. This makes the area car-free and ensures that not as much soil is needed to heighten the creek ridge. To create a connection to neighbouring blocks, openings are made in the facades of the block. The roofs are used to produce energy for the residents of the building. The remaining space on the roof can be used for social activities.

There are three sizes for the urban block: 80 meters, 65 meters and 50 meters. In and around each block there are different activities and types of public spaces. The large and medium-sized blocks house more public functions in an urban setting, whereas the smaller blocks have a more private atmosphere.

Principles

	characteristics	related infrastructure	related public space	orientation
large buildings 80x80m	parking always harbour always public funtion inside the block	road accessible for cars water	park part of routing of trail multifunctional plazas (terraces, cafe, exhibition space, etc.)	water always
medium buildings 65x65m	parking sometimes functions on the block sometimes	road accessible for bikes, sometimes cars water	vegetable garden park playground part of routing of trail	water dike landscape
small buildings 50x50m	no parking private functions in the block	road accessible for bikes water	vegetable gardens park playgrounds	dike landscape

public

private

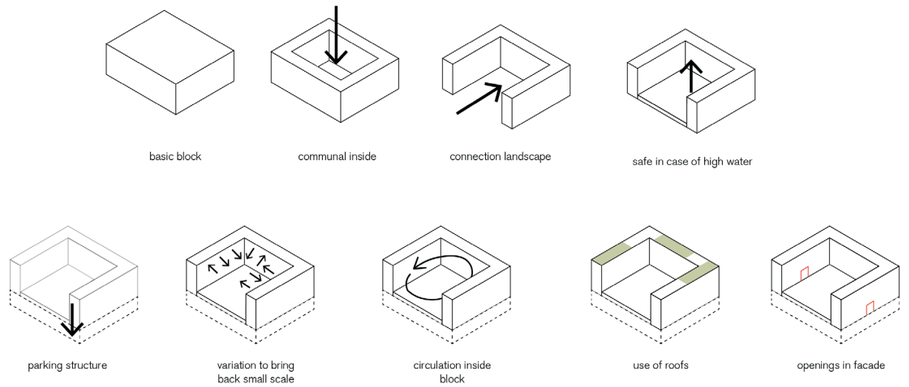
74

table of block types (Author, 2022)

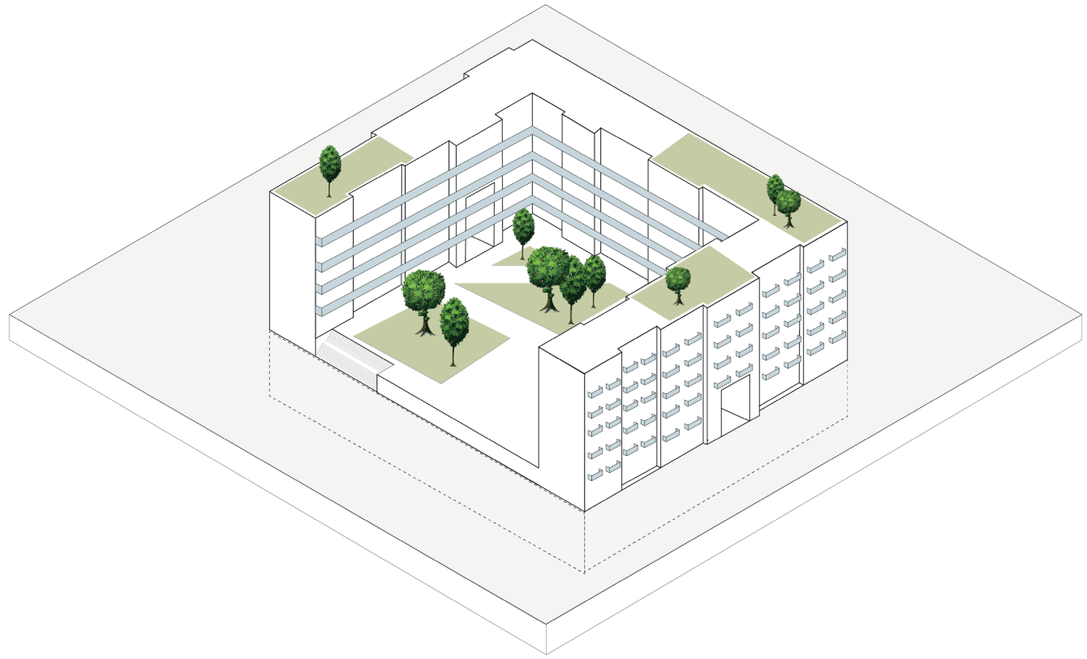
75

principel of block (Author, 2022)

Houses principle



Final block



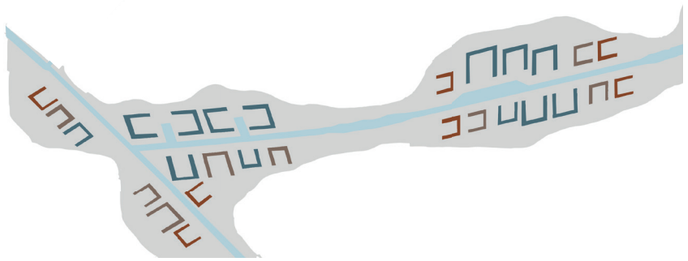
Identities

The residential dwellings have a visual connection to the landscape and the water. Through the careful placement of the opening of the blocks, several identities can be created.

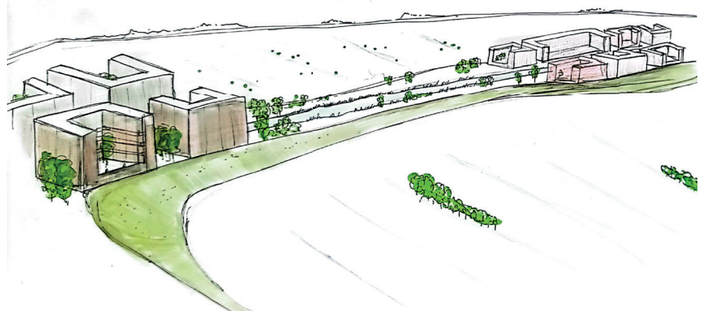
Some blocks look over the dike, connecting the inhabitants to the long-stretched element in the landscape that keeps them safe.

Other blocks look at the landscape, connecting the inhabitants to the new agricultural practices and giving way to the endless possibilities of recreation in the landscape.

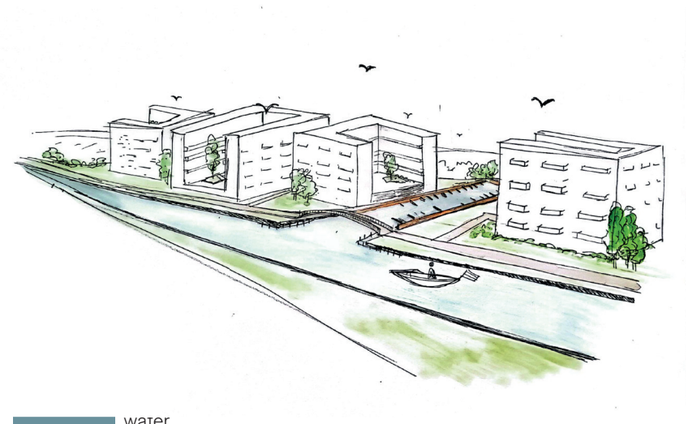
The third view is over the waterway and the small harbours that give the inhabitant the sense of being in a more urban structure and connecting them to recreants that make use of the waterway.



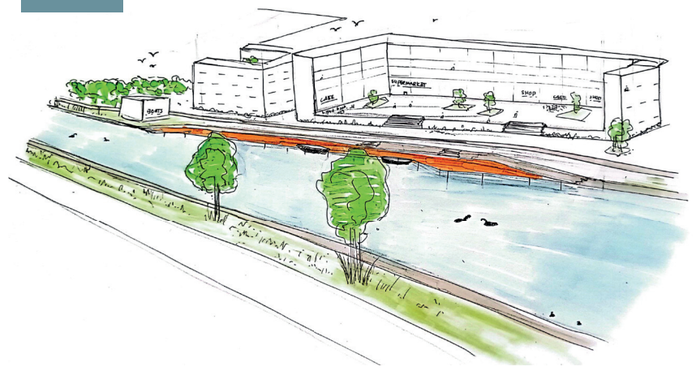
landscape



dike



water



water

76 (left)

Locations of dentities in urban structure (Author, 2022)

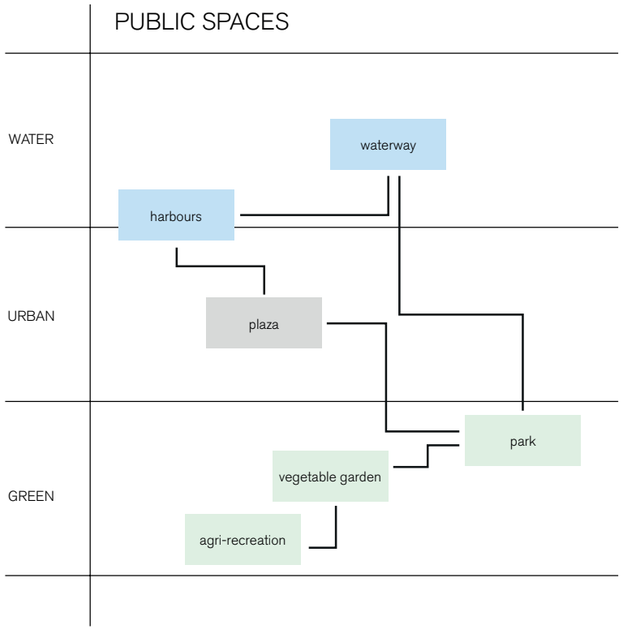
77, 78, 79, 80

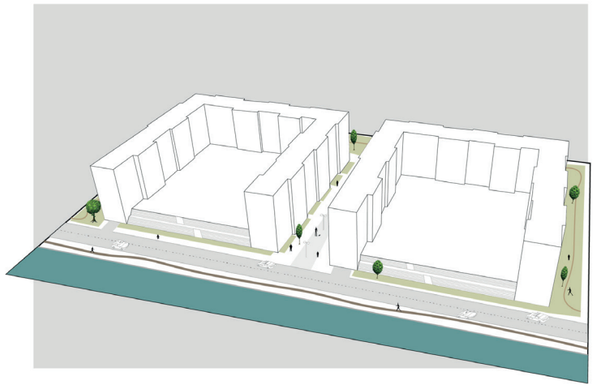
Identities in urban structure (Author, 2022)

Public space

There are several types of public space in the area and these forms are dictated by the configuration of the urban blocks. The way the blocks are oriented toward each other gives way to the activities that are planned between the blocks in the public space. The public spaces are related to water, green and urban spaces.

Water spaces relate to the waterway and to the harbours that are created. Through this configuration, there are places where people can experience the water while also being able to retreat a little from the main road.
Green spaces are recreational areas in which green structures are put central. These can be a vegetable garden, a park, and a playground for instance.
The urban spaces relate to the urban blocks and focus on the residents that live there. There are separate gardens, and the paved area makes it the perfect place to put up a small terrace. Furthermore, these streets can also be used by bikes. Larger urban spaces include the plaza.

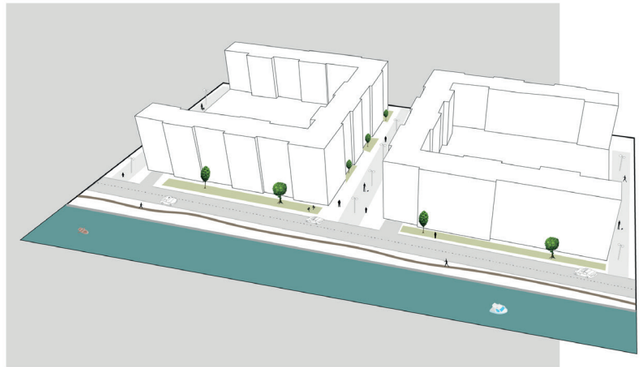




Urban

20 m

city street, adjacent gardens



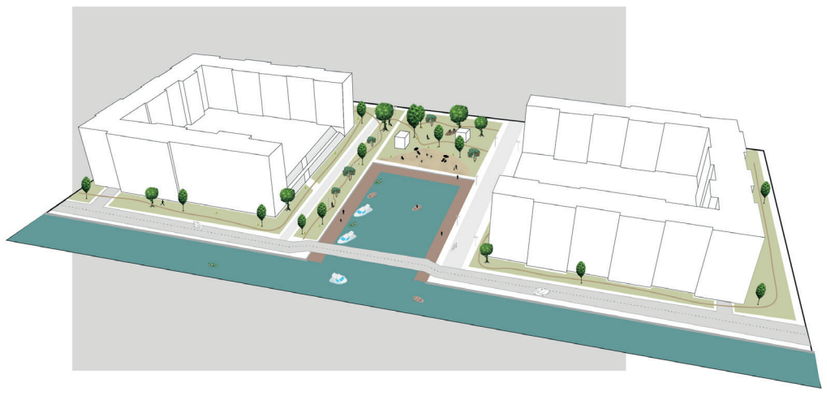
Urban

20 m

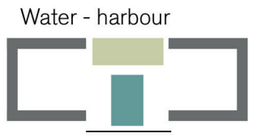
city street, adjacent gardens

81
Table of publix spaces (Author, 2022)

82, 83
Principles of urban blocks (Author, 2022)

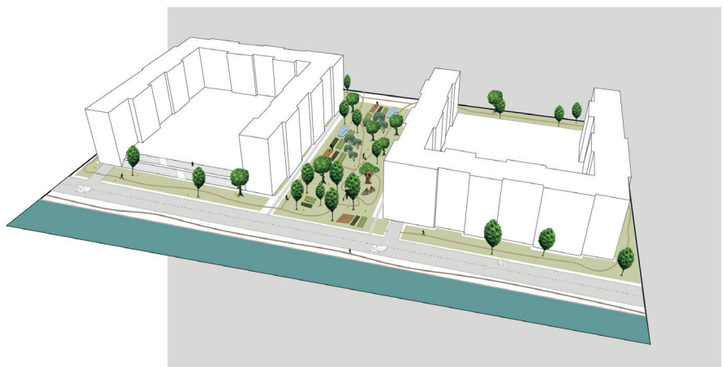


Water - harbour



50 m

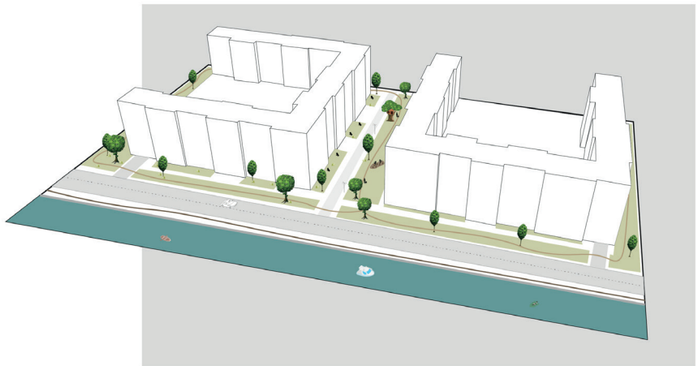
place for boats, place to swim, small park



Green - park

35 m

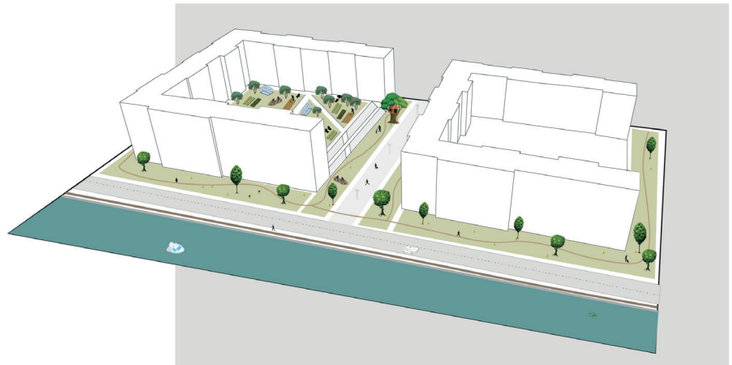
vegetable gardens, playground, pedestrian path



Green - street

25 m

communal gardens, pedestrian paths



Green - communal

20 m

communal gardens, pedestrian paths

84

Principles of water blocks (Author, 2022)

85, 86, 87

Principles of green blocks (Author, 2022)

Relationship Zoetermeer

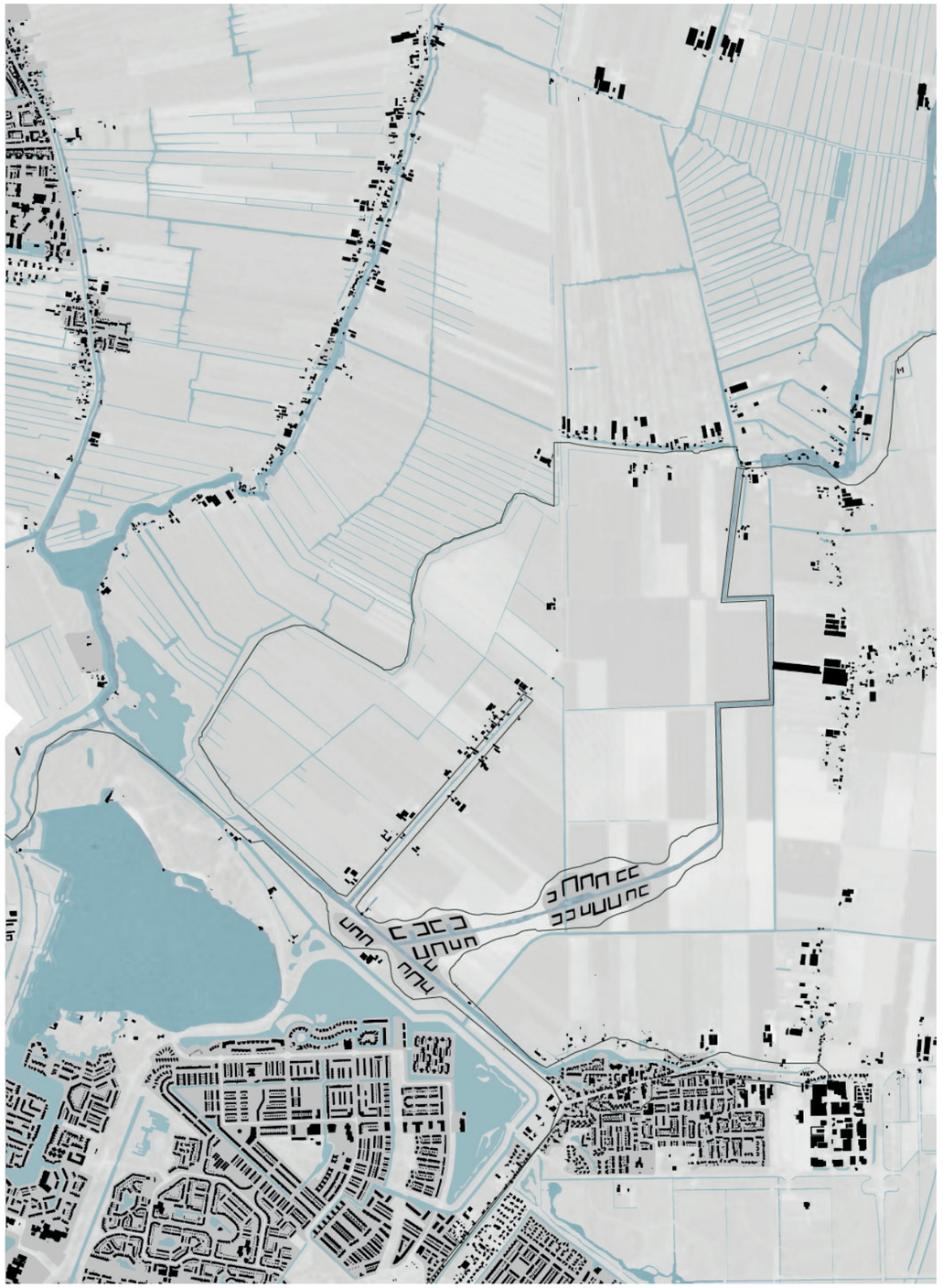
The urban expansion is connected to the dike at the Benthuizervaart which is the division between Zoetermeer and the landscape. As can be seen, the dike now follows a more organic path than it used to do. In this way, it is in stark contrast with the planning of the city of Zoetermeer which has strong orthogonal lines. The connection between the creek ridge and the city is purely visual as no additional routing to the city is created. Therefore, it is important to consider the structure's heights and appearance. At the beginning of the creek ridge, the blocks start with 3 to four layers. Then along the dike, they increase in height until they reach the middle of the second urban core. There, the blocks can be up to six stories high. Continuing along the dike, the blocks then decrease in height again.

88

Section of creekridge in relation to city (Author, 2022)

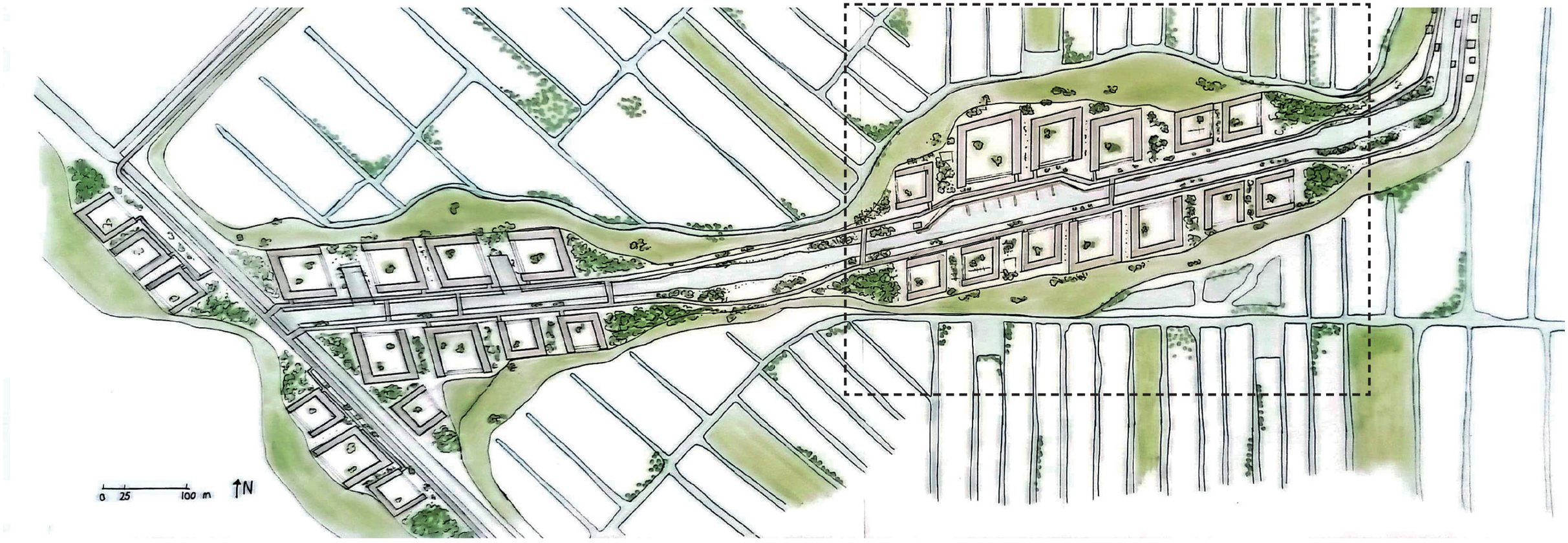
89

Map of creekridge in relation to city (Author, 2022)



Plan view

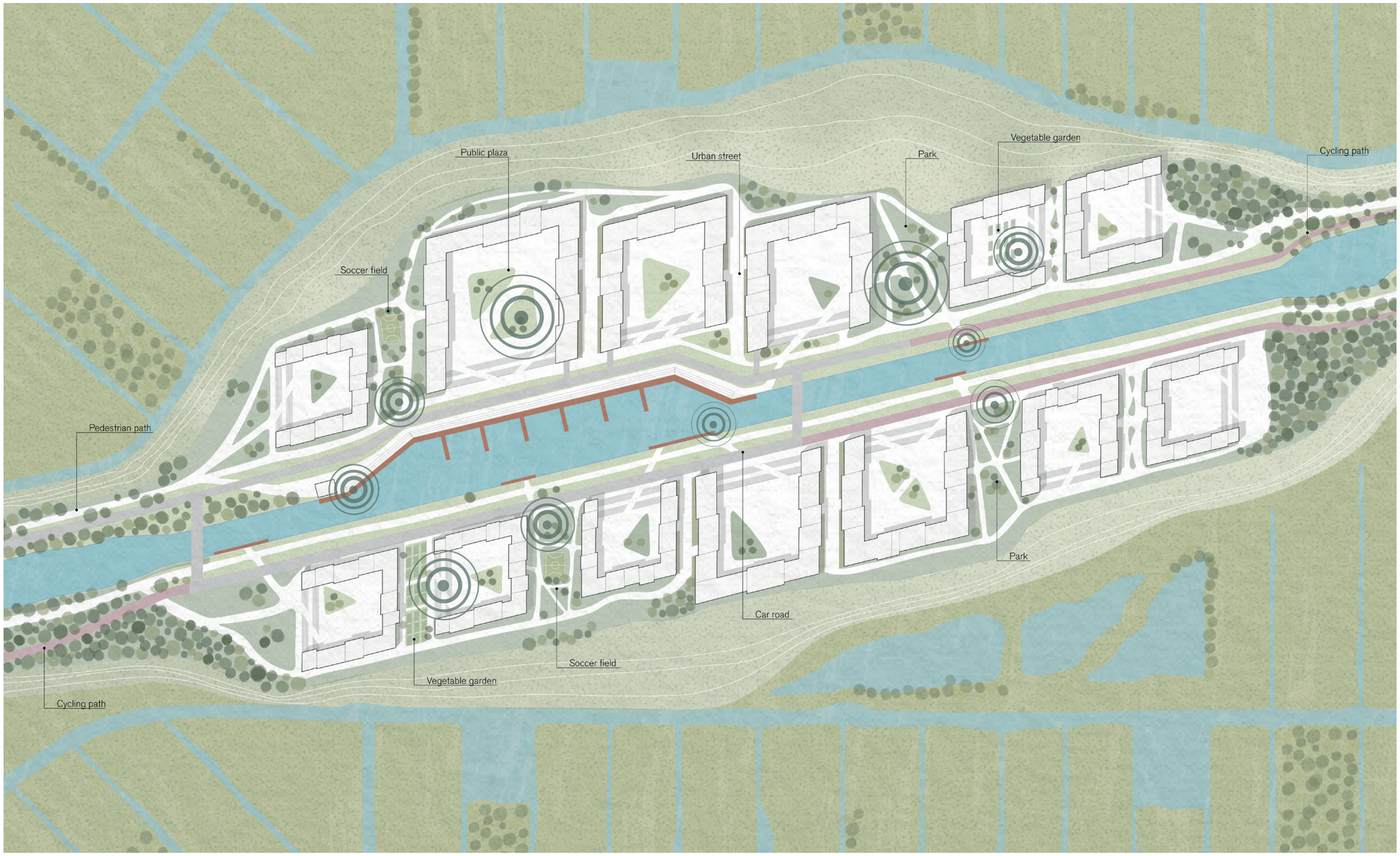
As the creek ridge is the basis of the urban expansion, the contours show an organic form. This is in contrast to the landscape and the urban blocks, that follow the straight lines of the landscape. The dike therefore has stark contrasts with the landscape but also within the dike there are contrasts to be found. In places where there are urban structures along the water, the watersides are straighter. Where there are no dwellings, the waterway continues along natural-looking watersides. This emphasizes the contrast between the places with and without urban cores along the dike.



90
map of complete urban expansion (Author, 2022)

Plan view

The map shows the result of the combination of the configurations as explained in the public space section. Between the blocks, activities are included. The roads on the map include car roads and car-free roads. On the latter, people can bike and walk. This ensures that some of the blocks have a private atmosphere as they are not along the main car road. These blocks in turn do not have a parking structure underneath. There are multiple places where people with boats can dock and where people can enjoy being on the waterside.

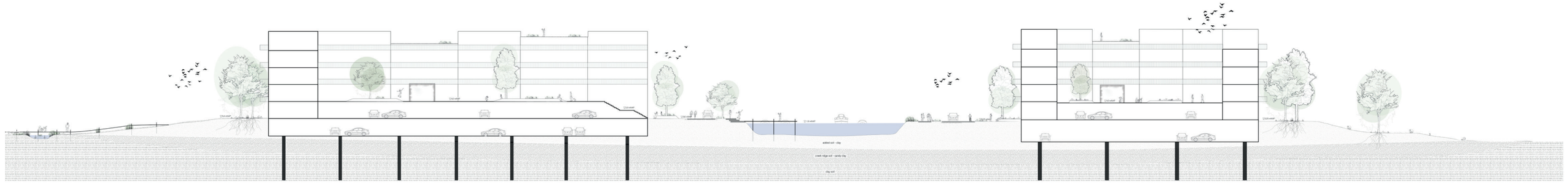


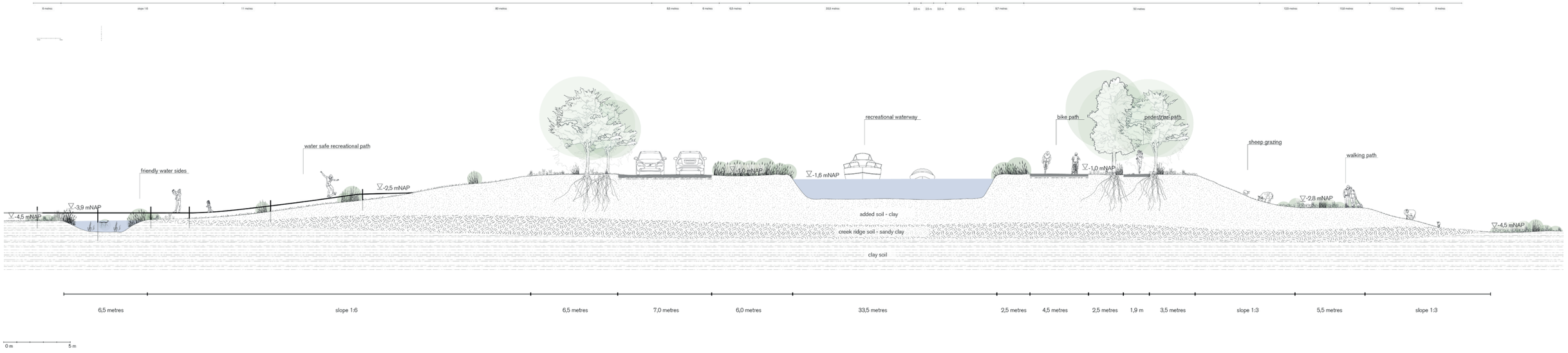
91

Map of centre of urban expansion (Author, 2022)

Sections

The sections clearly show the distinct types of relationships with water that can be found along the dike. There is a more natural waterside when there is no urban development. In these places, there is more space for green areas. The urban cores are oriented on the waterway as well. However, there is a starker contrast between the sides of the water and the dike body.



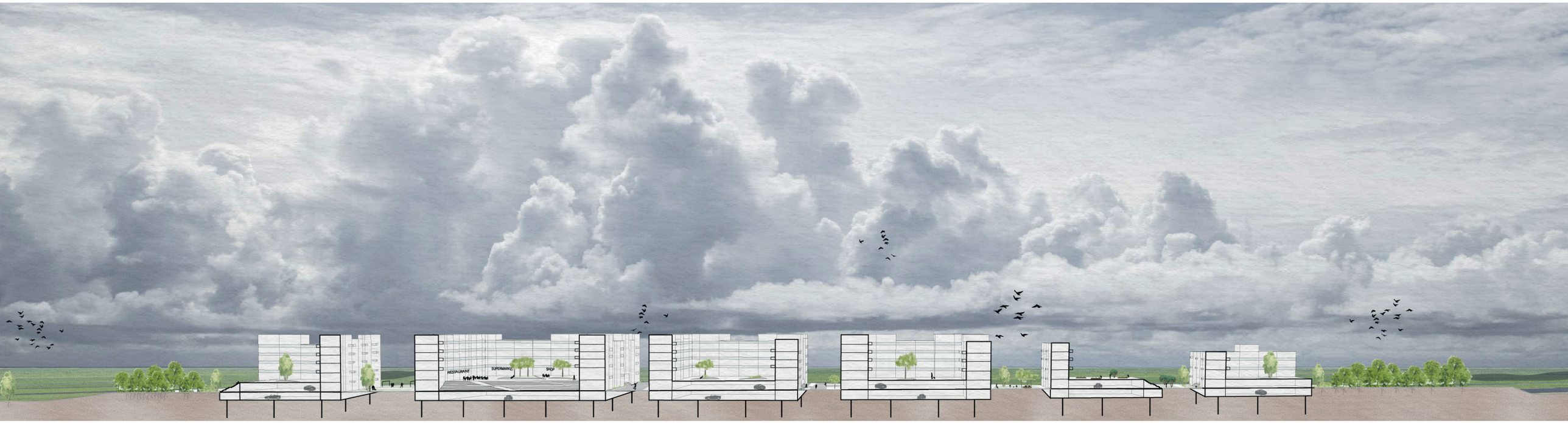


92

Section over urban structure waterway (Author, 2022)

93

Section over natural part of waterway (Author, 2022)



94

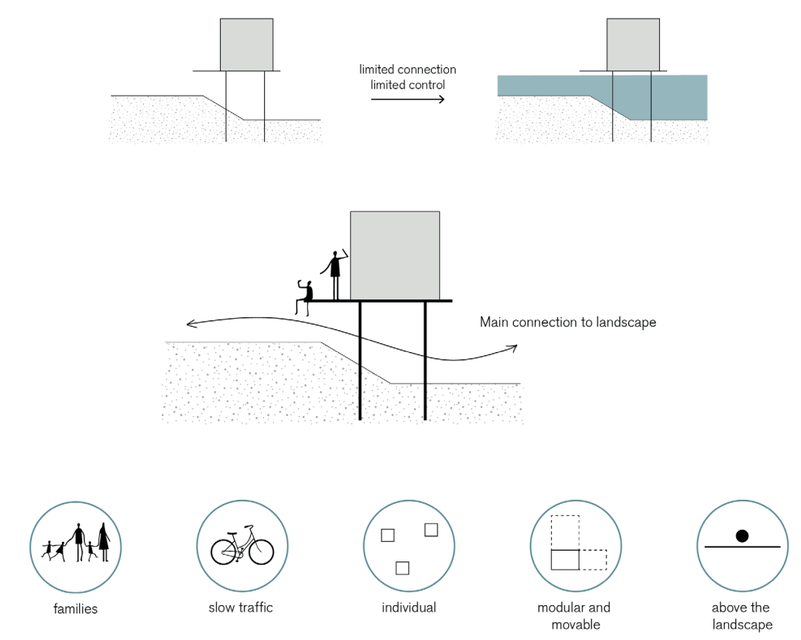
Persection over public blocks (Author, 2022)

95
Persection waterway (Author, 2022)

Houses on poles

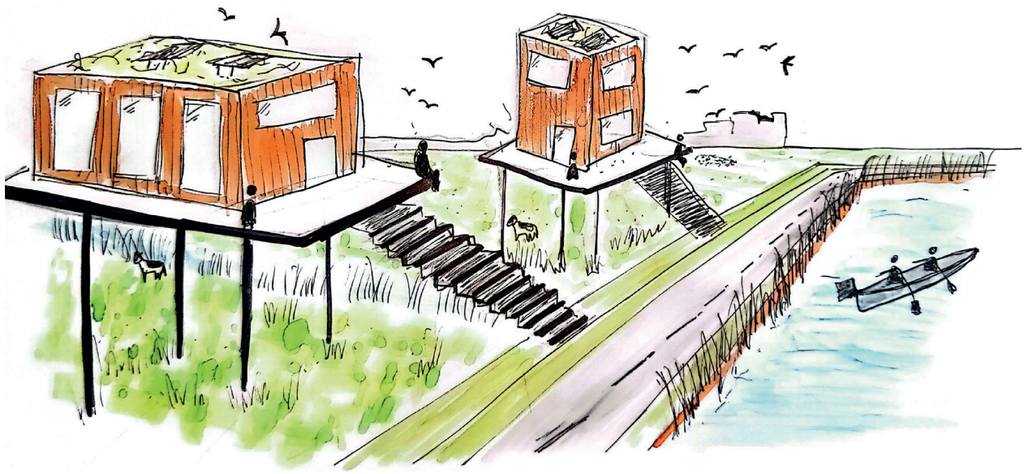
The houses on poles are options high above the landscape that provide safety in the case of flooding but are still safe in the event of a sea level rise of 4 metres. The homes are lightweight and this, and their height above the ground, limits the effect that the houses have on the landscape. Underneath the houses, the natural systems have free play through which the ultimate urban landscape can be created.

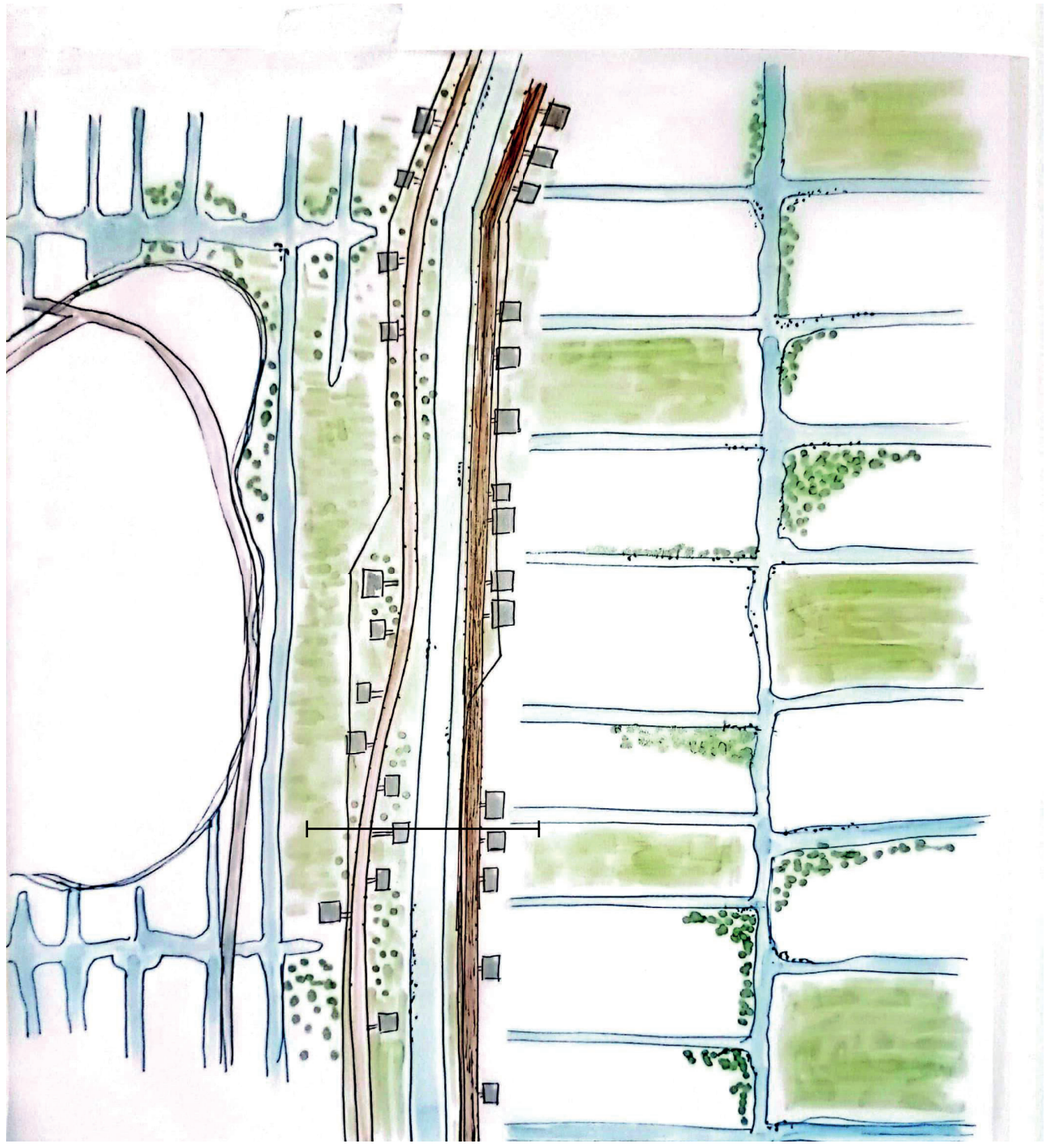
Houses can connect to the dike path when first constructed, and, when the infrastructure on poles is realised, the homes can connect to a new level of infrastructure. Because of their adaptable nature, the poles of the home can be lengthened whereby the houses can grow throughout time, as the threat of floods grows. This makes the houses strong flood resilient measures that can also be applied elsewhere if this area is no longer inhabitable.

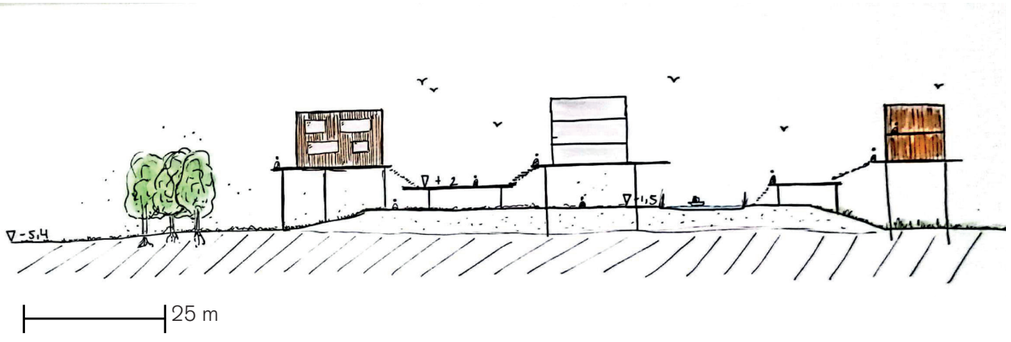


96

Principles of houses on poles (Author, 2022)







97 (above)

before and after image of impementation of houses on poles (Author, 2022)

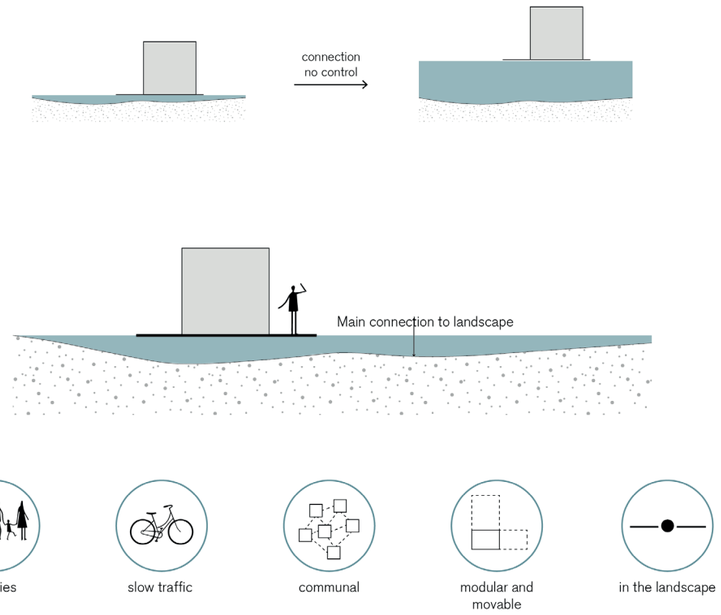
98 (right)

map and section of implementation of houses on poles (Author, 2022)

Floating houses

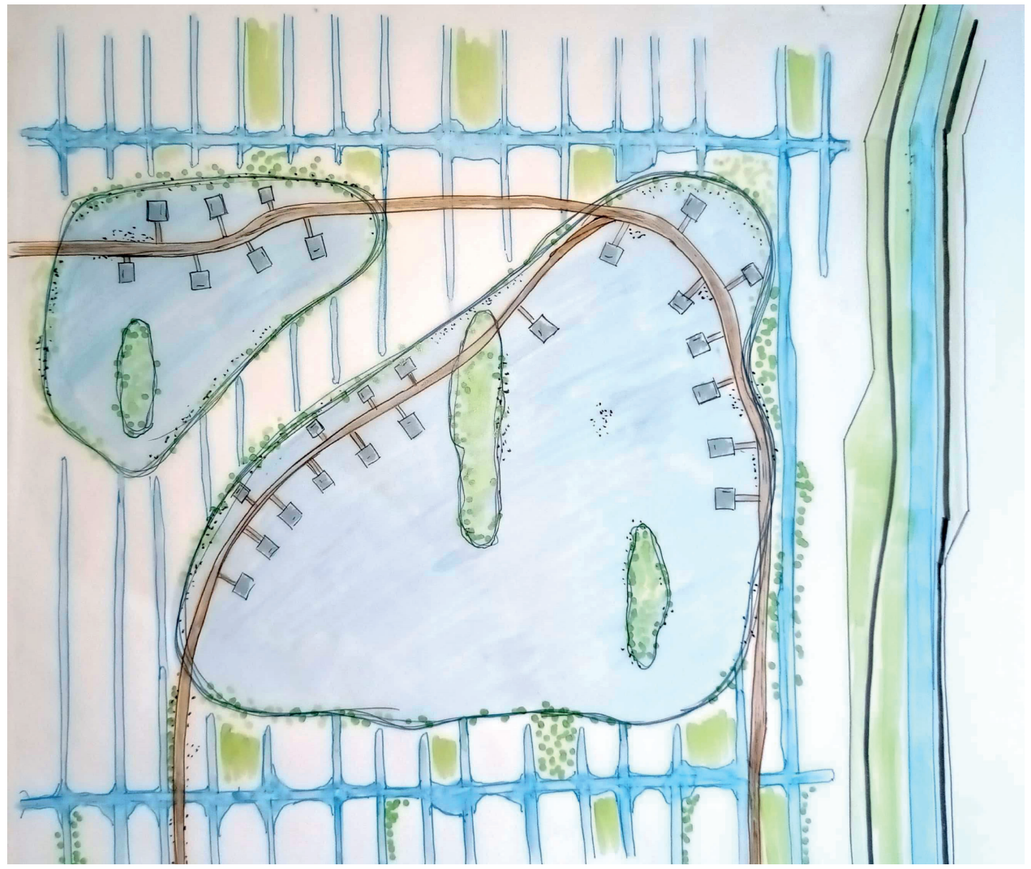
The boggy areas are perfectly suitable to create spaces for floating homes. Connected via floating infrastructures, that are also easily adaptable, they can roam around the area to find places that inhabitants see fit to live in. In the case of lower water in the summer, poles can ground the houses and provide a safe manner of inhabiting the area. This strong adaptable nature of the houses means that they can also be shipped to various locations if there is a need to do so. This measure means that these homes can also be applied elsewhere if this area is no longer inhabitable.

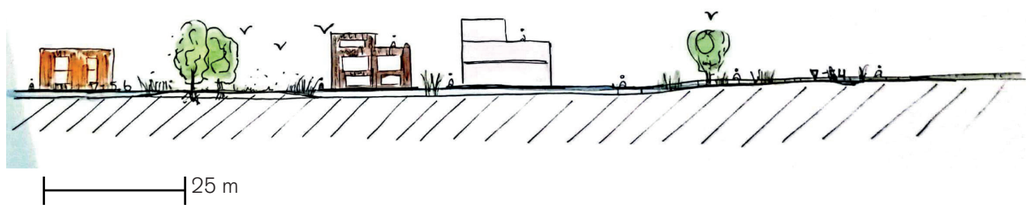
These homes have a strong connection with the water as the fluctuating water levels are constantly altering the height of the house. However, this leaves the houses exposed to the elements without any control over the water.



99

Principles of floating houses (Author, 2022)





100
Before and after image of impementation of floating houses (Author, 2022)

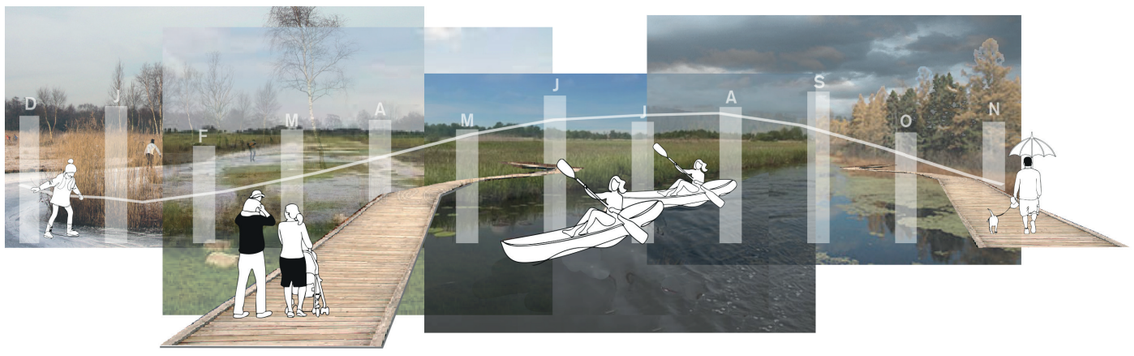
101
Map and section of implementation of floating houses (Author, 2022)

Seasonal change

The relationship between the dwellings, the landscape, and the water is an important factor in the creation of awareness of the changing landscape and the changing climate. The seasonal changes help with this. The amount of rain varies throughout the year. Summers and springs are drier than winters and autumns. Consequently, there are changing conditions in the landscape throughout the year. This results in different uses.

The current uses connected to the seasons are limited to crop rotations and the harvesting of the field. However, in the proposed design the seasons are actively seen through the activities that are undertaken in the area. In winter, it might be possible to skate on the frozen water. During the spring, there is the possibility to see the growing plants. In summer, there should still be enough water in the coming years to sail on the water. In the autumn, rain starts to increase, and the area becomes wetter again. Plants start to whither as winter is around the corner. The awareness of the seasons will increase as climate change will result in more extreme seasons (KNMI, 2021)

This change in uses can be seen in the season circles in the right images. In the current situation, there are limited uses. In the proposed situation, this changes and more season-bound uses arise.

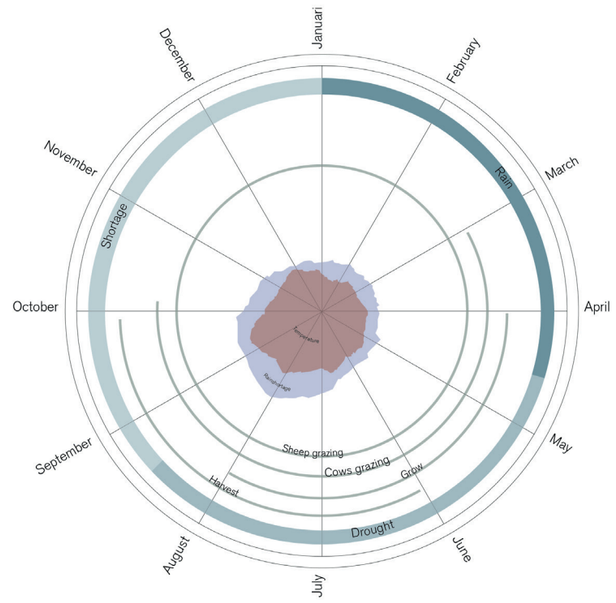


102 (left)

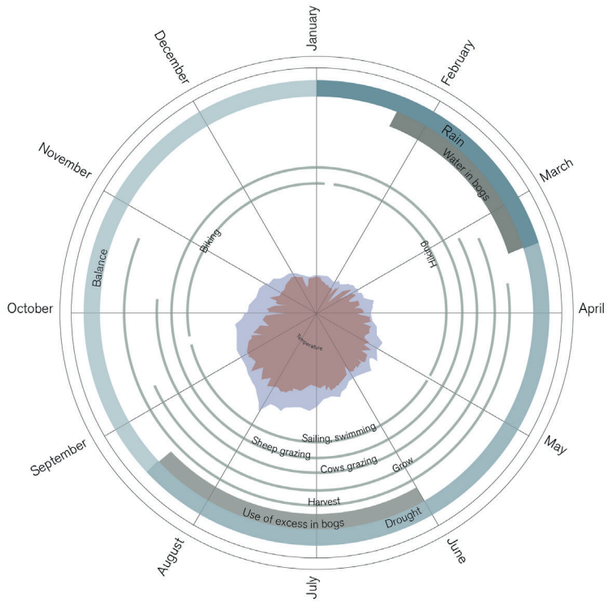
Seasonal activities (Author, 2022)

103, 104 (right)

Season circles in the current and proposed situations (Author, 2022)



Current situation

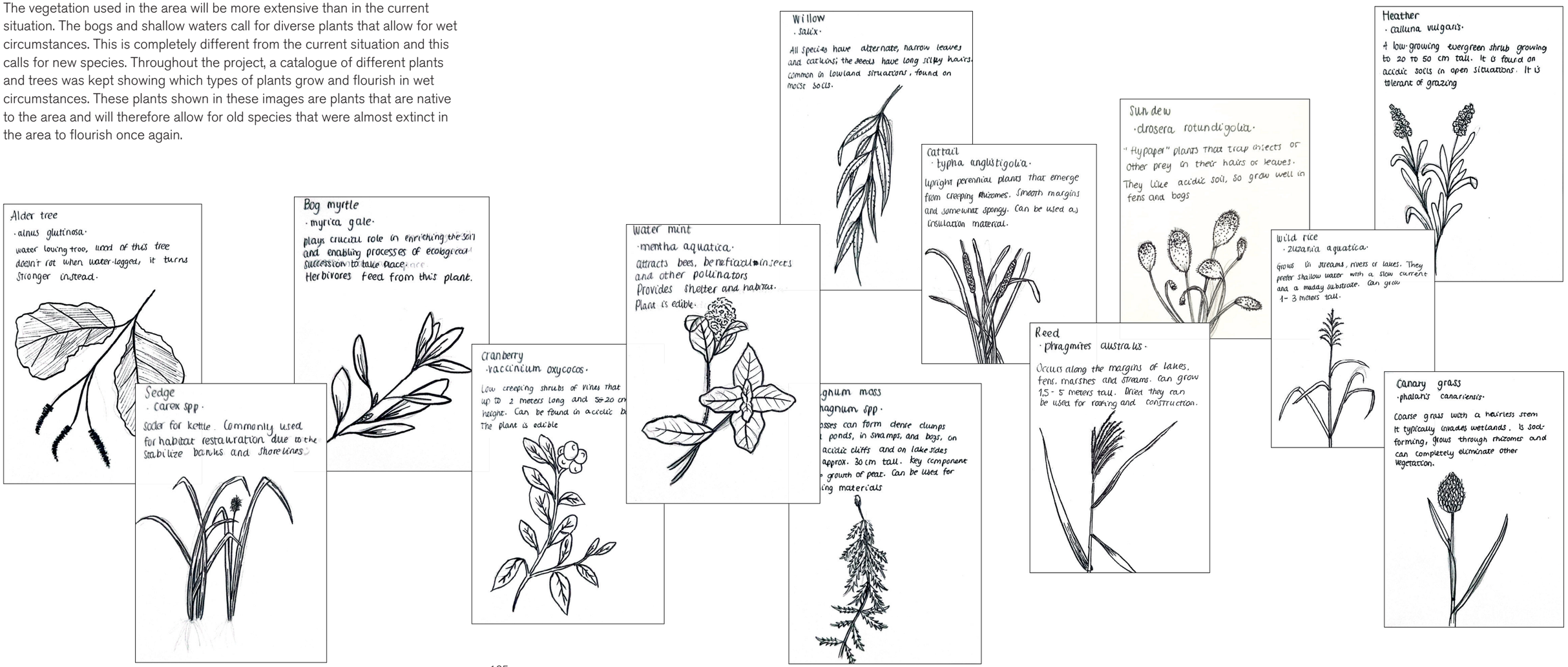


New situation

Vegetation

Not only the use of the area shows the seasonal changes, but also the change in vegetation throughout the year will show how the seasons alter throughout the year.

The vegetation used in the area will be more extensive than in the current situation. The bogs and shallow waters call for diverse plants that allow for wet circumstances. This is completely different from the current situation and this calls for new species. Throughout the project, a catalogue of different plants and trees was kept showing which types of plants grow and flourish in wet circumstances. These plants shown in these images are plants that are native to the area and will therefore allow for old species that were almost extinct in the area to flourish once again.

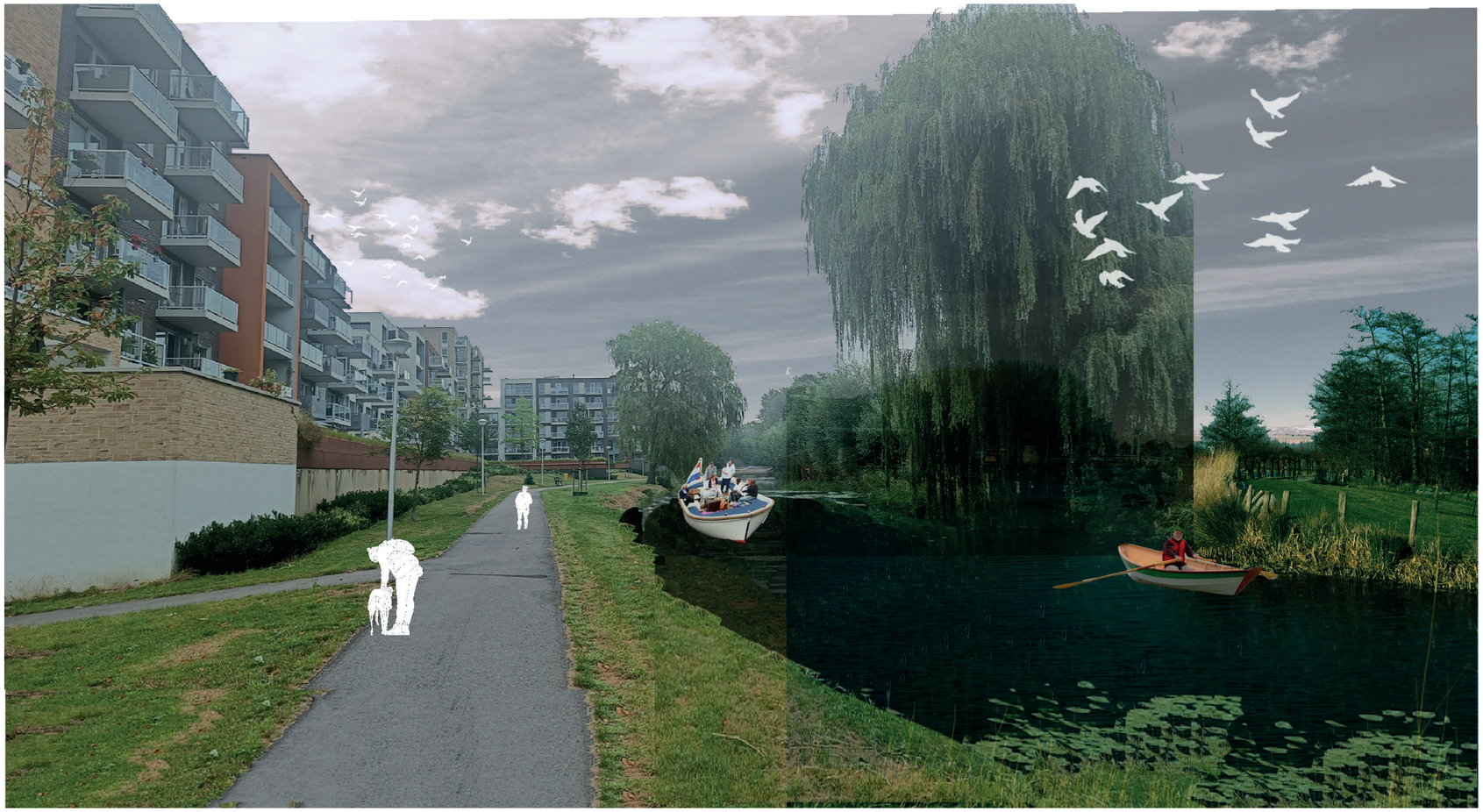


105

Drawings of plant catalogue (Author, 2022)

Urban Fringe

The transformation of the area from large-scale agriculture to the urban fringe of Zoetermeer creates a multi-beneficial relationship between this zone and the urban area of the city. The city provides the urban fringe with the possibility to evolve around the landscape and to show how revenue models can play out. This opens chances for the preservation of the landscape. Simultaneously, the landscape provides functions that keep the city safe such as the storage of water and other ecosystem services. The transformation of the area from agriculture to urban fringe places the area back in the local context instead of in the national or even global context of agriculture (Pols et al., n.d.).

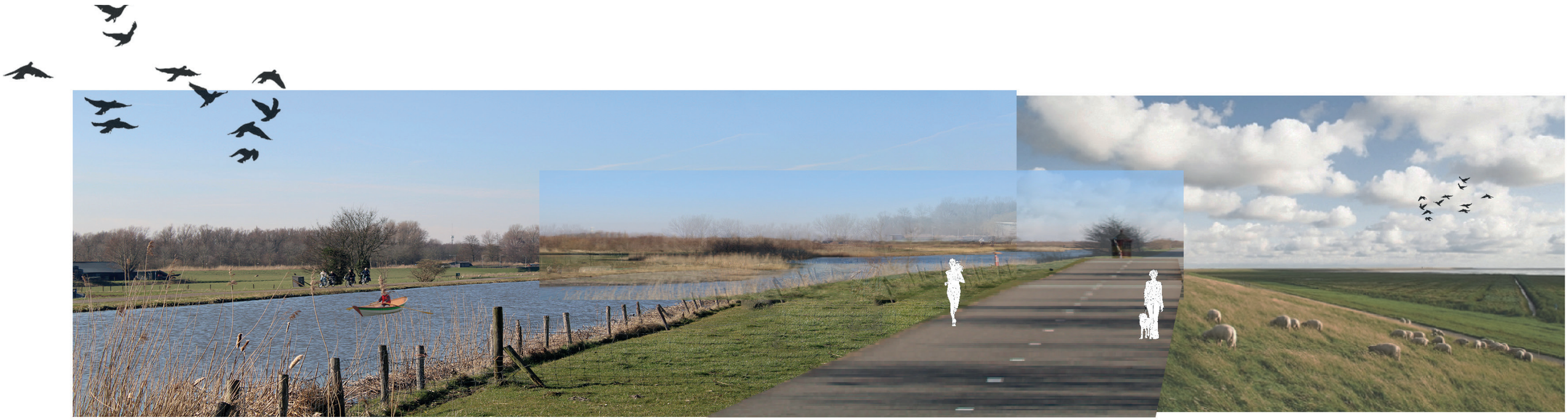


106

Impression of waterway (Author, 2022)

107

Impression of landscape (Author, 2022)



108

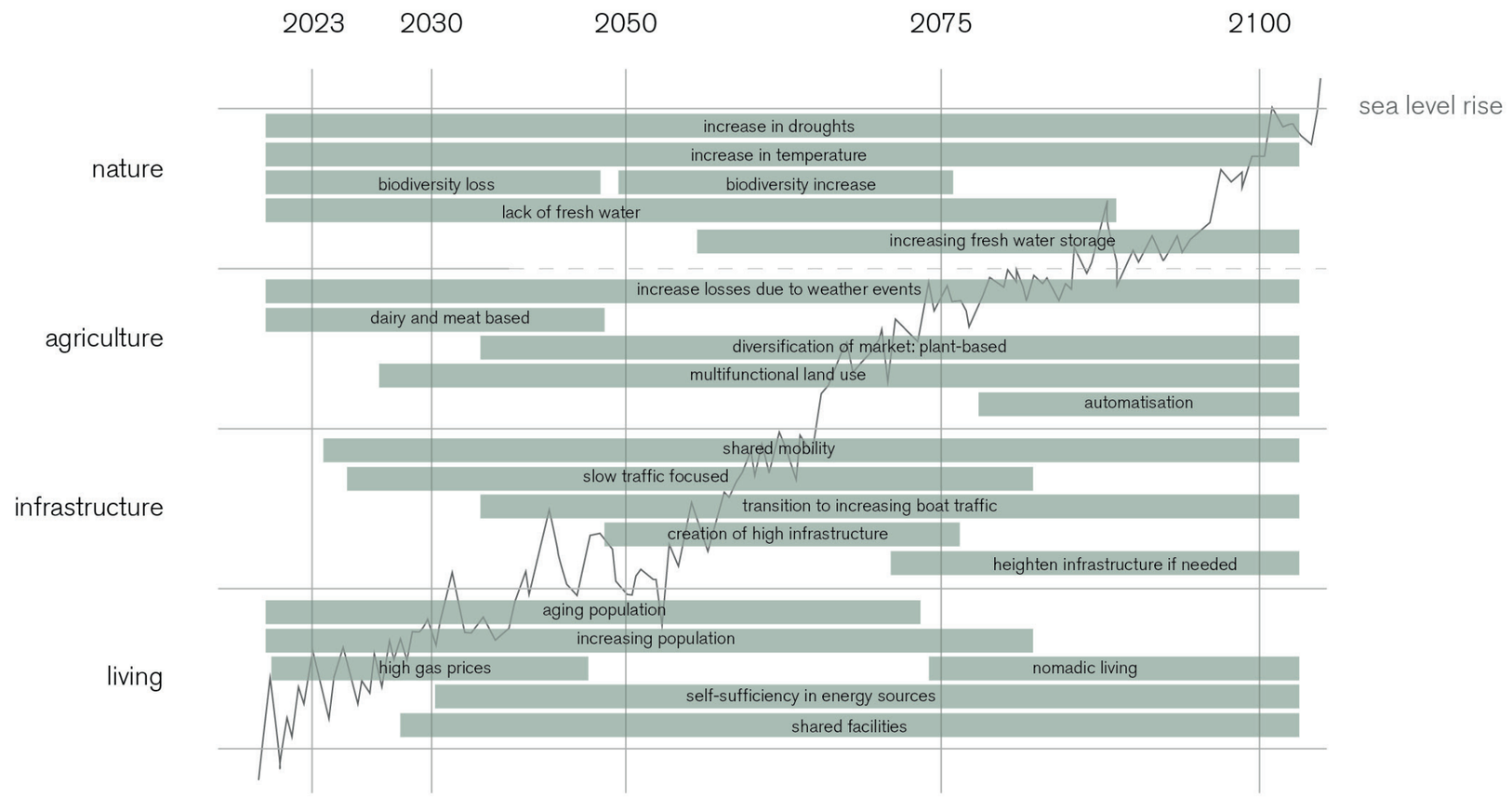
Impression of landscape (Author, 2022)

4.4 Design for a transition

Timeline
2022
2023
2030
2050
2075
2100
Connectivity

Timeline

To position the design in the context of change over the years, a timeline has been drawn up. This timeline considers the phasing over the years which considers trends with regards to agriculture, infrastructure, living, and nature. This is then also put into the perspective of sea level rise and other progressing challenges as they have been set out in the context part of the thesis.



109

Phasing timeline (Author, 2022)

Today

The landscape today is monotone and gains its characteristics from its main function as a productive landscape. The landscape is used to produce crops year-round, which creates alterations to the landscape. The seasons can be felt throughout the year as the crops grow or the land is prepared. However, to create the most productive landscape, drainage was put underneath the land. This eliminated the ditches and the classic characteristics such as the houtwallen and the old mills that the land had before – its scale is now unrecognizable without any point of recognition on the horizon.

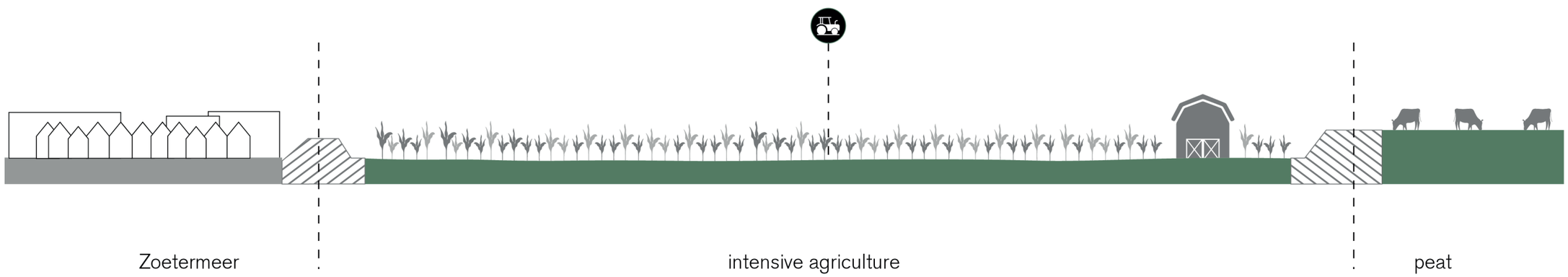
110

Plan view in 2022 (Author, 2022)

- urban area > -1,5mNAP
- urban area < -1,5 mNAP
- road
- high speed rail
- ditches
- connected waterways
- large waterbody
- lock

Life is hard. There is a lot to do and not much to gain. The way we work the land is not sustainable but we are stuck in a system that we do not know how to get out of. We want to change, truly we do, but there is no way to start if it is just us farmers. This change asks for a society-wide transition that focuses on the landscape and its surrounding functions simultaneously. If not, change will not happen.

landscape elements are seperate



111

Profile of a farmer (Author, 2022)

112

Section over current landscape (Author, 2022)

2023

In 2023, a year from now, the transition of the landscape is set in. The connecting waterway is started at the southwest end of the polder, on the more stable soil. This more stable soil is used as a basis for large and heavy buildings. This area is aimed to be a safe area, whereby creating a terp-like structure on which living is safe and can be elongated throughout the years.

This newly built area consists of high-density living, to facilitate older people in their living needs while also creating a safe space in case the area floods. Apartments, connected to communal facilities are configured in a way that the inhabitants can benefit from the safety, the landscape, and the company of others.

To recreate the recognition of the landscape again, a smaller scale network of ditches is recreated in the landscape. Rows of trees are planted along the water structures and bring back the connection to the surrounding plots of land as a recognizable similarity is created. This restores the human scale that can connect to the natural processes in the landscape again. Instead of being above the landscape or in its surroundings, humans can start to experience the landscape.

The creation of this new pattern is done simultaneously for the complete polder, as the soil that is gained with this, can be used as the basis for the planning process of the creek ridge that will be fully completed in a later stage.

Soil Balance

Needed

227.500 m^3

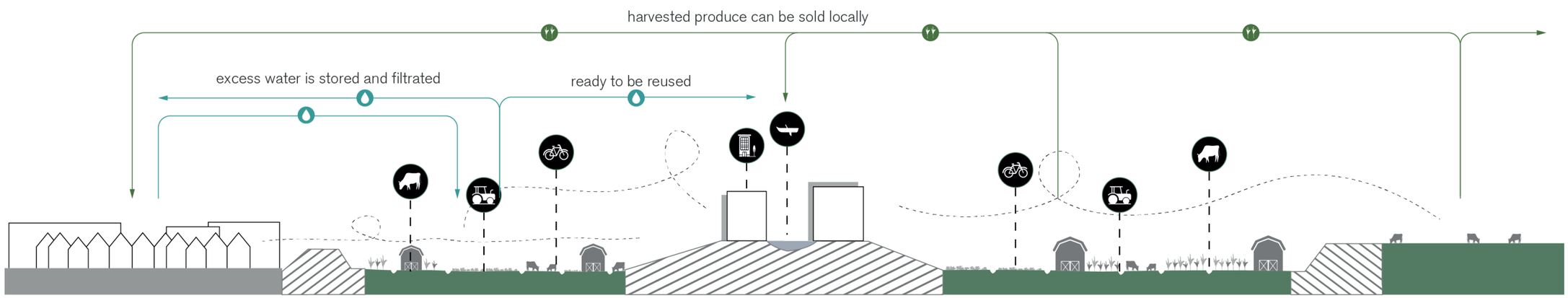
113

Plan view in 2023 (Author, 2022)

- urban area > -1,5mNAP
- urban area < -1,5 mNAP
- road
- high speed rail
- ditches
- connected waterways
- large waterbody
- lock

Landscape experience

We just moved to the area. My children are 3, 5 and 7 and can roam around the fields without a care in the world. The spacious recreational areas are closely within reach and they teach our kids so much about the values of the past and present and have a great educational value in terms of water manaagement inthe area.



Zoetermeer | extensive agriculture | dike body with residential area | extensive agriculture | peat

114

Profile of a father (Author, 2022)

115

Section over landscape 2023 (Author, 2022)

2030

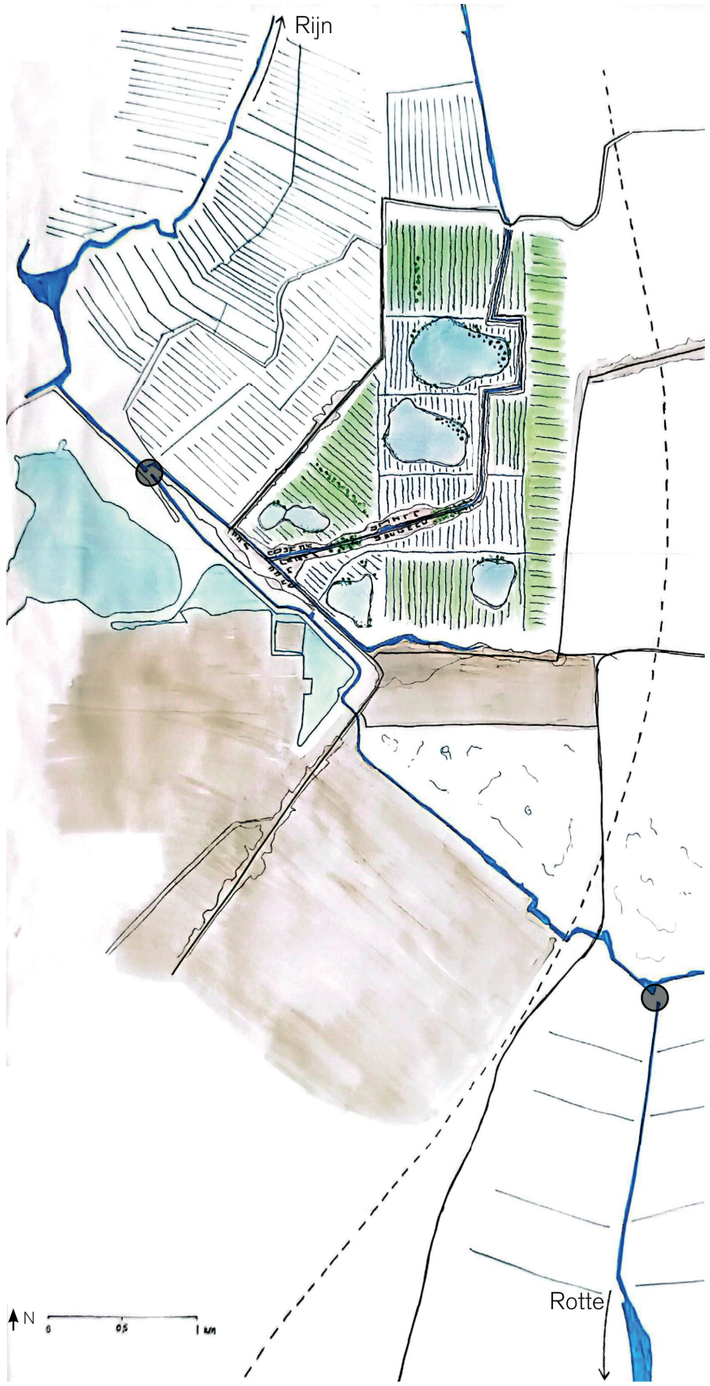
In 2030, the aim is to create the rest of the dike body to establish a connection between the Benthuizervaart and the Hoogeveense Vaart. Both water bodies lie at the same level, 1,80 metres below NAP, so a connection can be made at the same level. To realize a connection to the outlet water level, a lock is needed to bridge the height gap of 1,22 meters. From that point on, it is possible to connect to the Noord Aa and the Weipoortse Vliet, continuing to the Oude Rijn to experience the landscape and its cultural-historical values.

To facilitate the growth of this dike body, more soil is needed. The extraction of this comes from the polder, through the digging of small lakes in the deepest parts of the area. This allows for these areas to be transformed into natural habitats in which a new form of living can be initiated. The larger bodies of water allow for floating homes that can move along with the fluctuating levels of water. Houses will be able to land also on the soil, as there is the possibility that there is no significant amount of water in the lakes.

Soil Balance

Needed

325.000 m^3

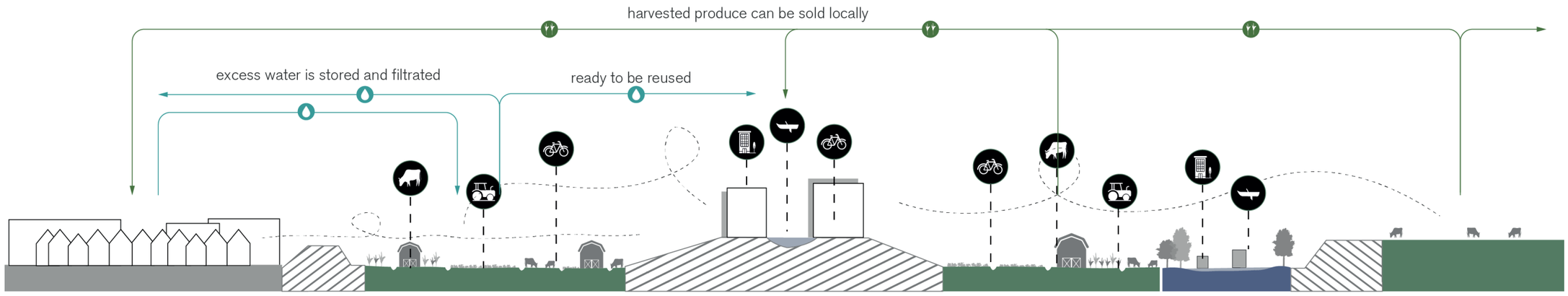


116

Plan view in 2030 (Author, 2022)

- urban area > -1,5mNAP
- urban area < -1,5 mNAP
- road
- high speed rail
- ditches
- connected waterways
- large waterbody
- lock

I grew up in this area before its transformation and was brought up on one of the farms in the neighbourhood. I am so glad our farm was able to transform into an extensive farm. Now it continues to provide supplies to the area but the fields also provide spaces to recreate and have a great educational value because of the increased biodiversity and water storage capacity.



117
Profile of a farmer (Author, 2022)

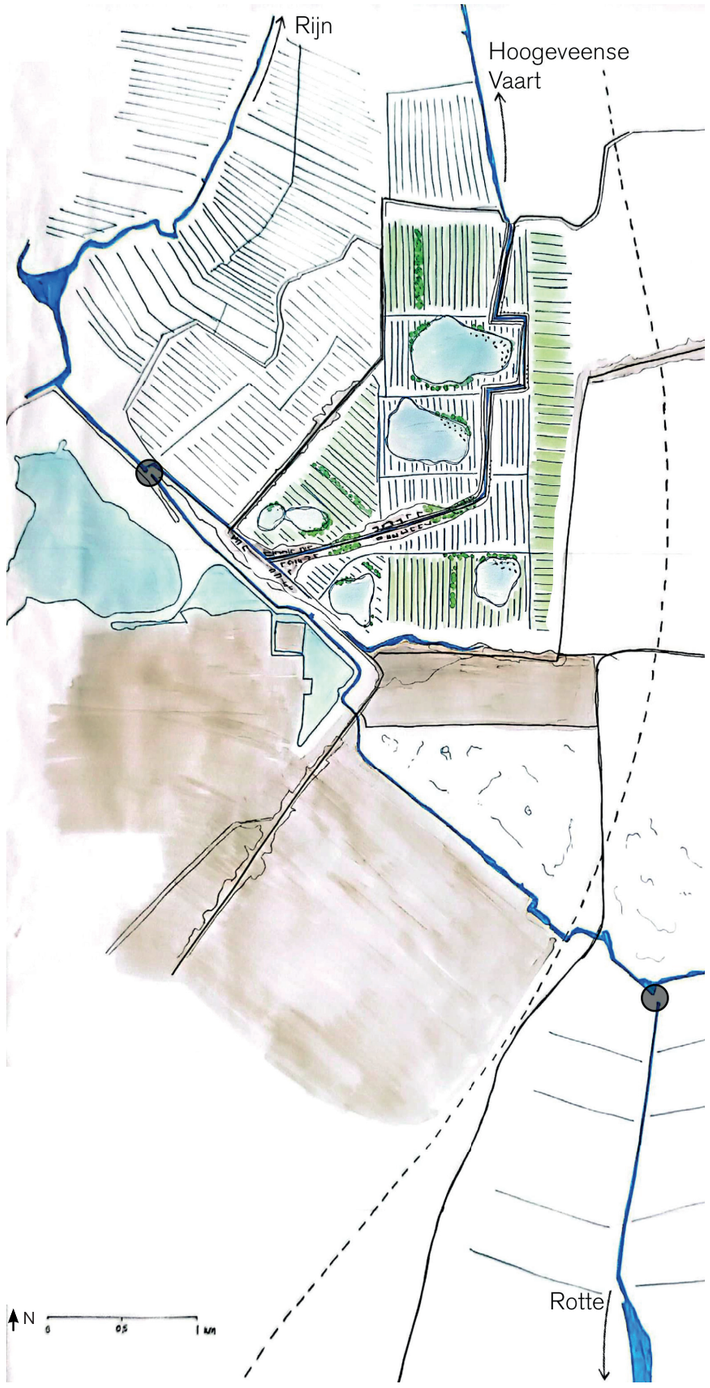
118
Section over landscape 2030 (Author, 2022)

2050

From 2050 on, water levels will continue to fluctuate more frequently and more significantly. Rainfall will be more intense in shorter periods, and longer periods of dry weather will be normal. Therefore, the landscape undergoes seasonal changes – wetter in the winter and dry in the summer, with the possibility of occasional high water in the event of peak rainfall.

In this period, a transformation in infrastructure is also foreseen. Elevated pathways will be established throughout the polder, following the structure of the dike. These pathways will be set at +0,5 meters NAP and can be connected to increasingly high houses on poles by stairs. These pathways will be publicly accessible for slow traffic but also serve as a direct connection to the houses, thus being a vital infrastructure in the area. Throughout the area, people can choose to attach their houses to this infrastructure as they see fit.

As the houses on poles are scattered through the area, so are the floating homes. Increasing numbers of houses are placed in the area, with connecting floating infrastructures for these houses as well, creating another flood-resilient infrastructure.

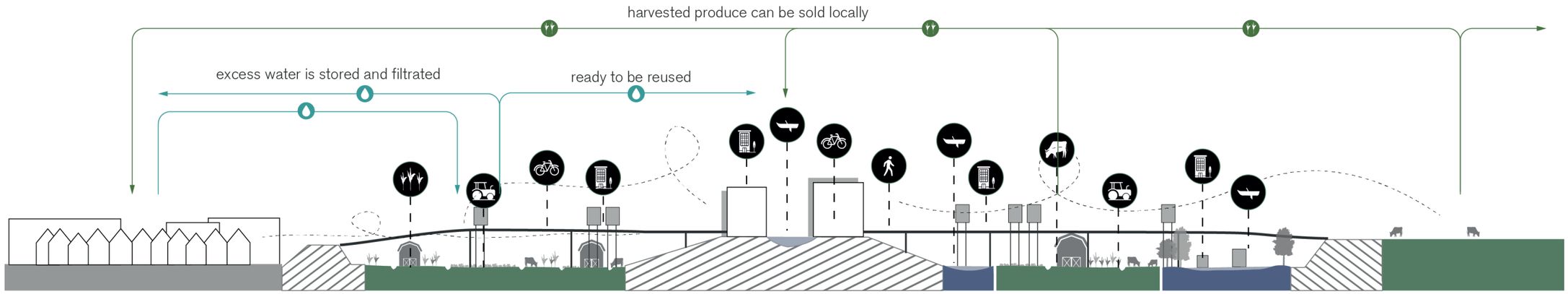


119

Plan view in 2050 (Author, 2022)

- urban area > -1,5mNAP
- urban area < -1,5 mNAP
- road
- high speed rail
- ditches
- connected waterways
- large waterbody
- lock

The water network is a great way of getting around. From my home I can easily access the city of Zoetermeer and go to the shops. I can also enter the landscape without an issue and continue my way along the farms to get my basic supplies of food. Transport over the water is quick and will be possible for a long time to come.



120

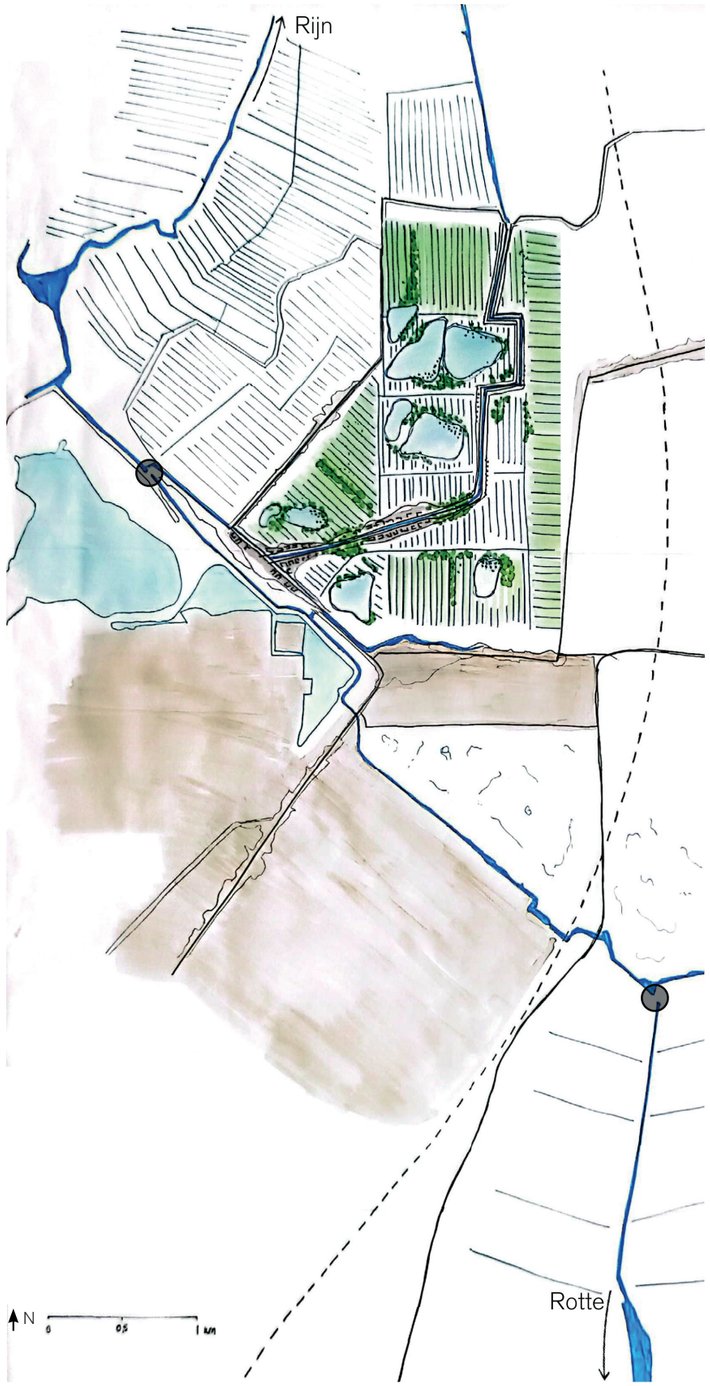
Profile of an inhabitant (Author, 2022)

121

Section over landscape 2050 (Author, 2022)

2075

In 2075, the full design is established, increasing the number of above-land infrastructures to accommodate the landscape and its natural flows. Societal changes are expected as well, as boats become a main mode of transport as floods become increasingly imminent.



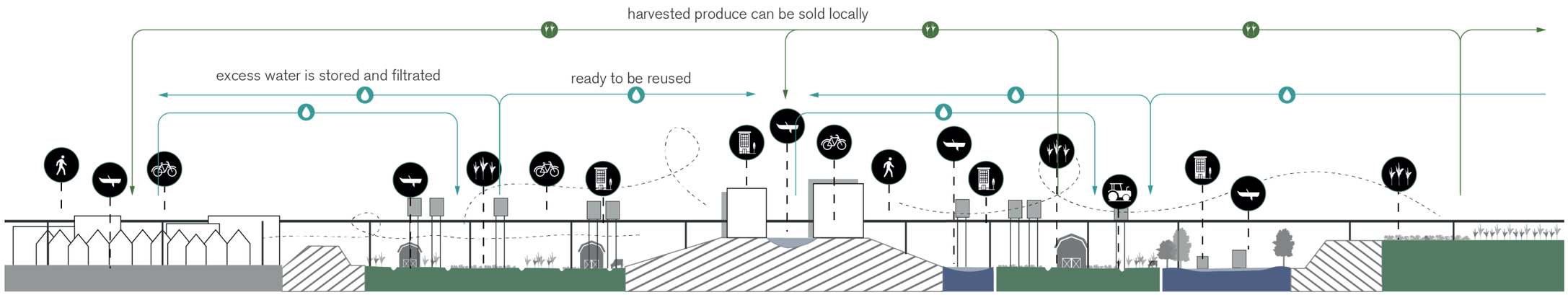
122

Plan view in 2075 (Author, 2022)

- urban area > -1,5mNAP
- urban area < -1,5 mNAP
- road
- high speed rail
- ditches
- connected waterways
- large waterbody
- lock

Landscape experience

The landscape continues to change and is never the same. The weather changes a lot at the moment. We have a lot of cloudbursts after periods of high temperatures. Luckily, the landscape is able to accomodate these unpredictable circumstances. I just like to come out here and see how the landcape looks after such an event.



123

Profile of an inhabitant (Author, 2022)

124

Section over landscape 2075 (Author, 2022)

2100

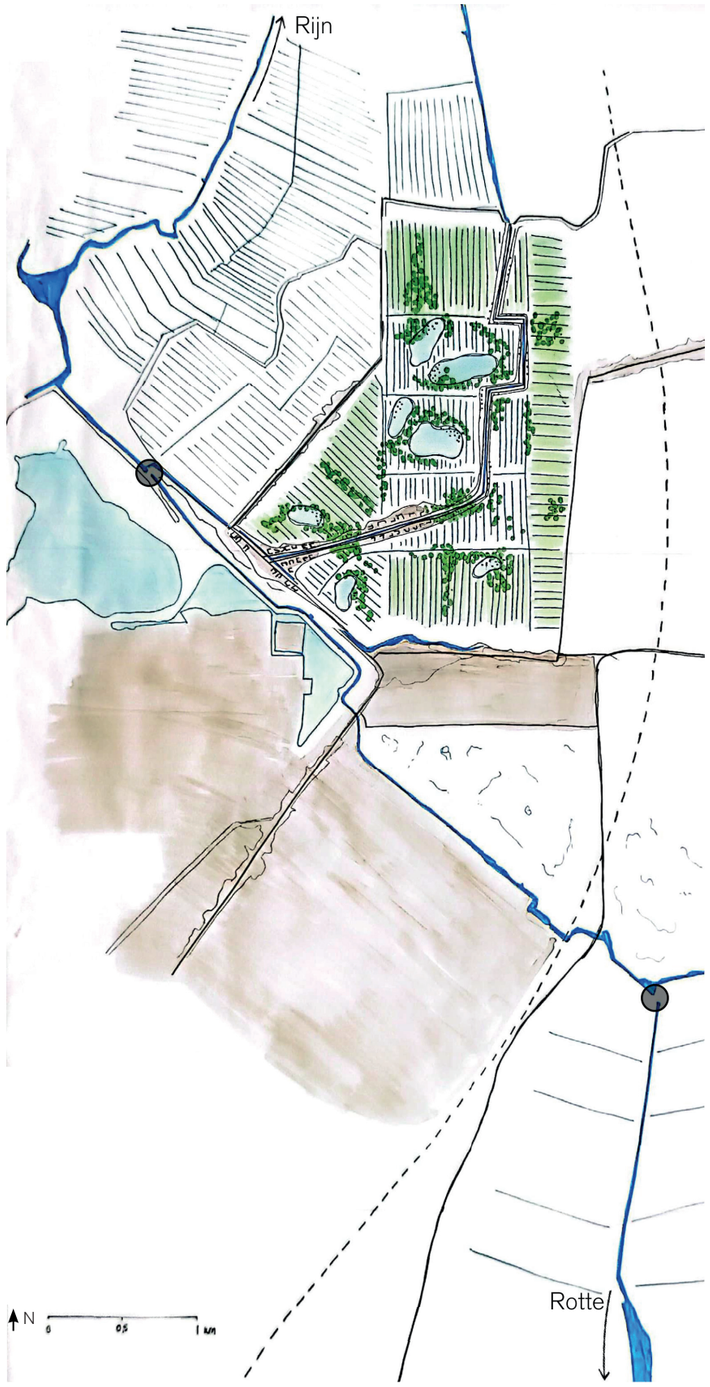
In the year 2100, there are no major transformations to the landscape anymore. However, floods are more imminent than ever. The phase for this year shows the extreme situation – the case of floods from the sea, with a sea-level rise of three metres. This influences land use. Agricultural practices on low-lying soil are no longer possible. However, living in the landscape that is now water is still a possibility through the flood-resilience of the several typologies.

The houses on the terp can still function as they did before the floods. Their function is not compromised, but the connectivity to other functionalities of the area is. The main mode of transport is changed from land-based to water-based, allowing for boats to connect to balconies and collective docks.

The floating homes allow for any fluctuations in the water level and are therefore not changed. The connecting floating infrastructures are not compromised and are still in full use. As for the people in the houses on terps, the main transportation has changed to boats to be able to reach other areas as well.

Lastly, the houses on poles can remain the way they are. The infrastructure has been heightened after the first stages of the design, so transportation on the above-land structure is still feasible. However, people use water transport as the main mode to be able to move around the area.

This extreme flood raises questions about the design. The year 2100 is characterized as the year in which large-scale changes are imminent to happen. With these potentialities of the extreme scenarios, the landscape could be completely underwater. However, there is no idea of how long this will be or how this will look. The housing typologies can accommodate this change in water level, but the functionality of the system with all its amenities will be compromised.

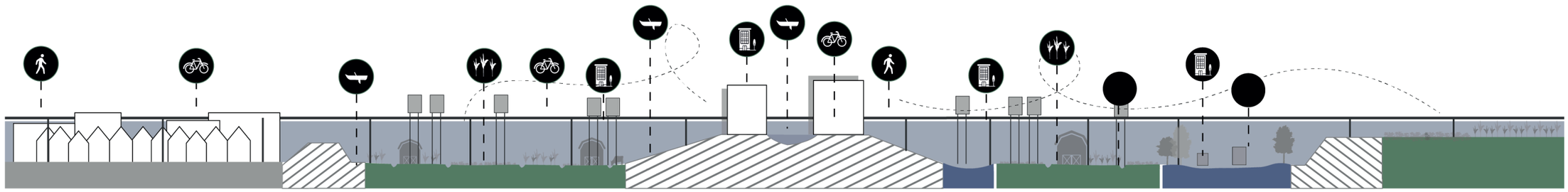


125

Plan view in 2100 (Author, 2022)

- urban area > -1,5mNAP
- urban area < -1,5 mNAP
- road
- high speed rail
- ditches
- connected waterways
- large waterbody
- lock

On this bench I can safely read my book. Because of the rain, there is a limited possibility to go outside as the landscape is flooded. Luckily, our homes provide public space high and dry above the landscape. We are good in terms of supplies as we can easily get around with boats and the infrastructure on poles. I am going to visit my daughter this afternoon.



126

Profile of an inhabitant (Author, 2022)

127

Section over landscape 2100 (Author, 2022)

Connectivity

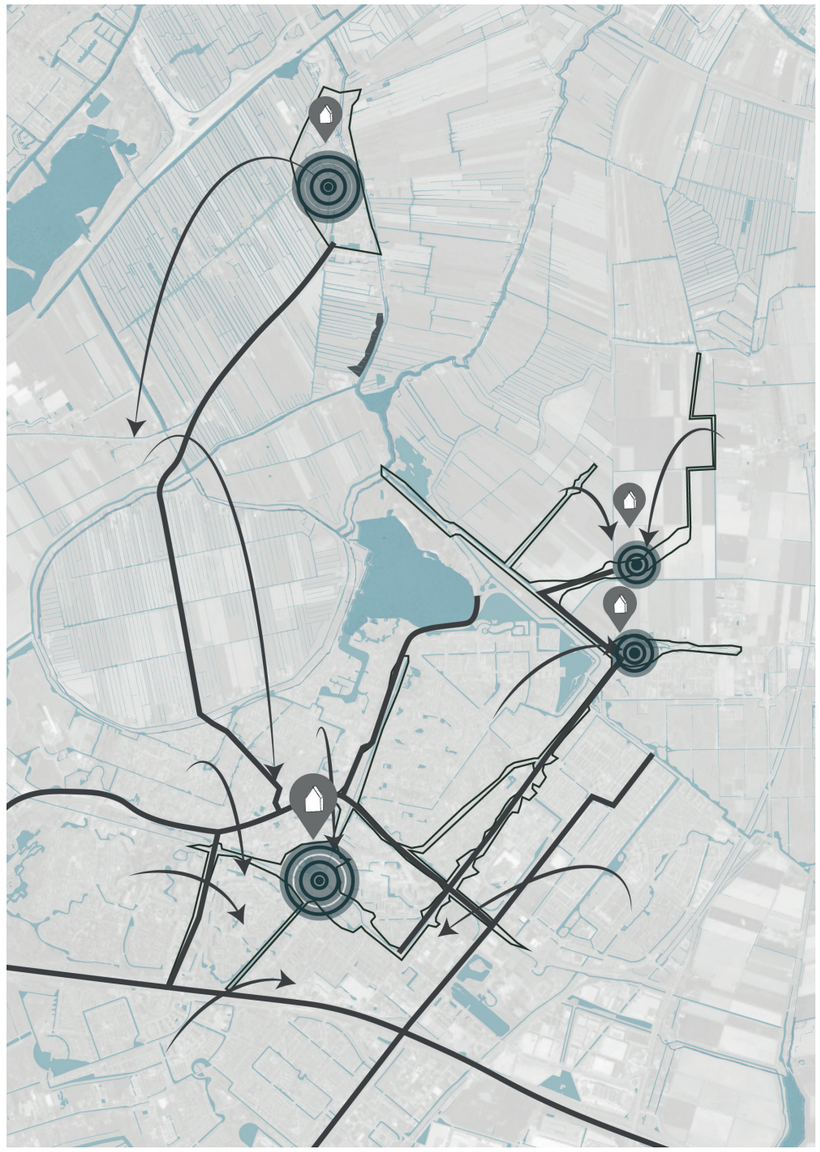
Connectivity in the area works on several levels, with different transportation modes at each level.

On the dike, there is the possibility to reach the destination by car. This is possible in the complete urban area. Because the area can function as a safe location in the area in case of high water, these roads must be connected to the network of other high structures in the area. Making use of dikes that are present in the city of Zoetermeer and the town of Benthuizen, this area can safely be reached by the inhabitants of lower-lying areas.

After the urban cores, the road changes to a road accessible by bicycles only. It is, however, wide enough to accommodate emergency vehicles so in case of trouble, the area can be reached.

Where the car road transitions into a bike lane, the first high infrastructure is connected to the dike as well. This ensures that the houses on poles next to the dike can be connected to the dike, but it is also a way to create awareness of the transition of roads on the dike to roads above the dike. This creates safe transportation in case of a flood that reaches several meters above sea level.

Water can function as a mode of transportation as well. Through the creation of several small harbours, inhabitants can store their boats near their houses. Inhabitants of the first urban area can take their boat to do their grocery shopping in the second urban area or take their children to school in Benthuizen. As the climate changes, the boat becomes a more prominent mode of transportation as roads are flooded more frequently.



128

Emergency routes (Author, 2022)

Part 5 | Discussion, cocnlusion, and reflection

Conclusion

Discussion

This thesis discusses a design for the Benthuizer Noordpolder. Through the implementation of the territory-oriented approach, large-scale challenges are tackled and turned around into a design that focuses on creating spatial qualities through the implementation of a safe living environment in a deep polder. The location is a well-chosen study area because all the problems that are found on the larger scale – subsidence, salinization, water nuisance, and effects of the housing shortage – are present in the area. The findings can therefore potentially be extrapolated to a larger scale and thus help to create answers for several deep polders in the west of the Netherlands that deal with the same complexity.

Added values

This project focuses on creating a design that takes a proactive position regarding the current climatic and societal challenges. Through the investment in time, cultural-historical values, integral design, and adaption a new type of urban ecosystem that follows the natural rhythm of the landscape is presented. This part of the discussion will go into how the investment in these aspects has created future value specifically.

Time

By allowing for long-term planning, it is still possible to create open pathways for the future. Thereby achieving a long-term liveability of the area while considering climate change. Through the investment in fundamental systemic changes over time, the prevention of impact can be ensured.

Adaptation

Adaptation measures in the project include a transition in housing typologies and infrastructure aimed at living with the rhythm of the landscape. The characteristic of these typologies is that they can be flooded and allow for an adaptation to the situation without compromising the functionality of the buildings or the infrastructure. They are low-regret implementations, which the next section will discuss more elaborately.
Through this adaptation, multi-level safety is created. This is done on three levels, the first being the prevention of floods as the area is a water storage area, and the second being sustainable spatial planning as houses are configured in such a way that they are floodable. Lastly, there is disaster management which is achieved through the evacuation routes with the infrastructure that is floating or on poles. Through multi-level safety, the investment in adaptation is turned into future value.

Cultural values

Cultural value aspects are regarded through the design of the landscape, creating a recognizable pattern by uncovering the old lots and using the tradition of building in the area while not disregarding the development of new structures that allow for the landscape to undergo its natural processes, thereby creating a potential new adaptive cycle of living with the landscape in a more symbiotic way.

Integral design

The integral design regards recreation, living, water, and agriculture as separate entities but evaluates how potential synergies can be created so design aspects can target multiple domains, thereby creating new value. The combination of functions will lead to a landscape with multiple uses. This will lead to a landscape that is experienced better by its users, thereby creating space value through user value (PBL, 2019)

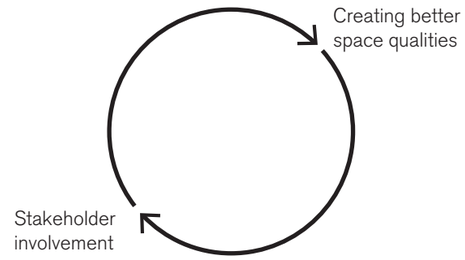
Because of the integral nature of the territory-oriented approach, costs for various elements of the project can go down. Investments are therefore worth more compared to the traditional approach and can be used more effectively to create future value.

Monetary investments for strong safety structures cannot eliminate all vulnerabilities that the area faces. Through the investment in these, however, a certain level of awareness can be created as well. With this, an increased level of insight into the system is achieved thereby also increasing the level of acceptance in the case of the occasional flood (la Loggia et al., 2020).

The economy is most usually the main driver of progress (la Loggia et al., 2020). However, the monetary aspect was disregarded in this thesis. It is therefore difficult to draw up the exact balance of the effects of this design. A recommendation can be made to calculate this. Research does suggest that creating better place quality will add economic value, social value, and environmental value not only in the short term but especially over long-term horizons (Carmona, 2019).

However, it might be more important to state that creating a better place value has a positive effect on the collaboration of stakeholders. Through the addition of spatial value, a shared perspective on the importance of the quality of space is created between the stakeholders (Carmona, 2019). This might be one of the most important and powerful gains of adding special quality as the improvement of the area will increase the interest of stakeholders, continuing in a loop as set out in figure 129.

Therefore, it can be said through the application of the territory-oriented approach and by the creation of a design for the long term, the value was added mostly through the connection of the components of the design. Using the landscape, water management challenges and urban development in an integrated manner to come to a shared vision for the three elements.



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Stakeholder loop (Author, 2022)

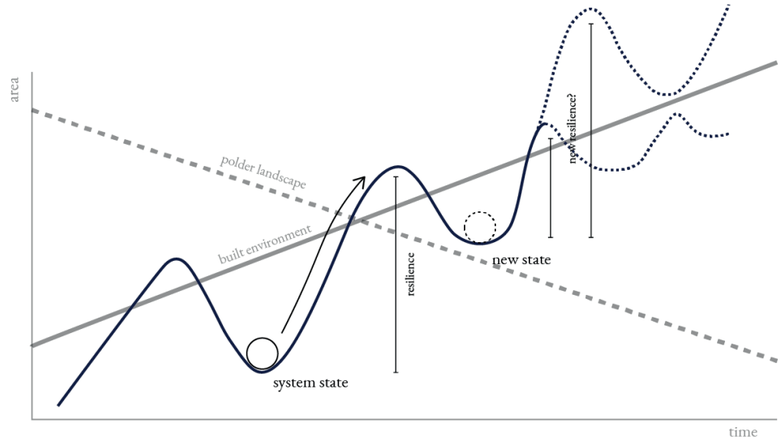
Resilience

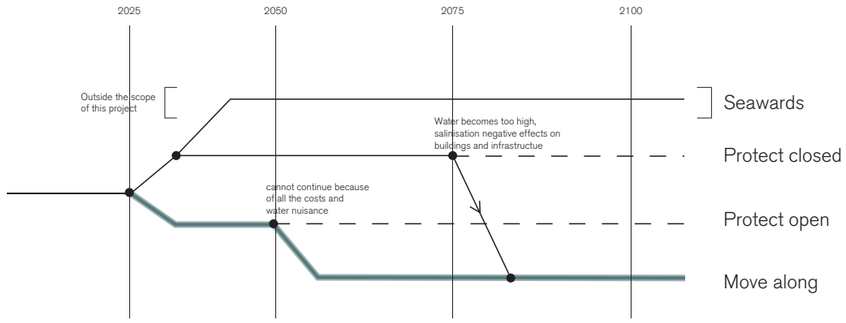
There is no knowing how all these additions to the system would affect the current system state. Currently, there is a certain ratio of the built environment and polder landscape. At this moment, this state is in relative balance and resilient to small events. Its system state will only change in the occurrence of a large event. When creating this landscape transition, a new state in the system is unfailingly created. It is uncertain what the new balance will be and what the effects will be on the local climatic conditions.

Adaptation strategies

In the theoretical framework of this thesis, the adaptation strategies of Deltares (Haasnoot et al., 2019) were proposed to detect in which different conditions the project can take place. The thesis undertakes a strategy to create new living conditions in inland situations. Therefore, the path that this project takes can be proposed as the path in figure 131. From the situation 'protect', the path can still easily be adapted to 'moving with the water'.

However, if on the large scale the strategy continues to take on protection, whether, in a closed or open situation, this project can still function as it is stated. It can then provide freshwater storage for occasions in which there is no freshwater availability because of a lack of rain (protect – closed) or in case of high water from the sea and therefore increasing saline levels (protect – open). In no circumstances does this project reject the strategy seawards. To conclude, even though the project is aligned with the strategy 'moving with the water', it does not limit other future scenarios from playing out – whatever that future will look like. Therefore, the project can be considered as a low regret intervention on the long term and large scale.





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New system state resilience (Author, 2022)

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Adaptation pathways (Author, 2022)

Social Justice

"Social justice is, and is normally understood to be, a question of equal opportunities"
In this regard, this is necessary for both this generation and with regards to future generations. This thesis proposes a design for the 'here and now' and the 'here and later'. Therefore, we can distinguish between intragenerational justice and intergenerational justice.

Intergenerational justice
In the 'here and now' there is a consideration of an older generation that requires a new type of housing that is simultaneously affordable and more communal than the larger family home they currently inhabit. Consequently, this movement will relieve some of the pressure on the housing market. These homes that are left by the elderly are in danger of being flooded in the incident of high water. However, houses are wanted and are quickly filled with new tenants or owners who must bear the cost of living in a potentially unsafe situation. Is it fair to continue the cycle like this, knowing that the new residents of the older structures will have to figure out issues with subsidence, flooding, and salinization whereas the residents of the new structures do not have to worry about this? Why not just enhance the current living conditions so everyone can live safely? And then who should be compensated in monetary values for instance: the people moving to a safe place for taking good measure investing in a safe solution? Or the people who live in the older structures so they can enhance their homes? There will always be differences in the answers depending on how you pose them and to who, but it is important to consider the design will promote injustice.

Intragenerational justice
According to Cooper & McKenna (2008) "Intergenerational justice – the concern about the well-being of future generations – must be given equal consideration to 'social justice', especially when regarding a future design scenario. Focussing only on the social justice of the current period, it "ignores the unsustainable situation that may be handed on to future generations." (Cooper & McKenna, 2008). Creating equal opportunities for the current generations and the generations to come is difficult as speculation about the future is paired with large uncertainties. To foresee their needs, strategies for the coming future will have to be made without knowing what we attempt to know is the most fitting or most wanted solution. Creating an adaptive situation for future generations is a learning-by-doing practice. The main thing that can be done is to create low-regret strategies, by which the creation of lock-ins is avoided. In this way, future generations can continue to make their own decisions with the additional knowledge gained over the years. This is what was attempted throughout the implementation of the strategy.

Distributive justice - Farming

Through the proposition for 'here and now' and 'here and later', the strategy that this thesis takes on neglects the situation of 'there'. Through the changing of conditions in this polder, externalities might shift to another location. This is especially true in the case of farming whereby it is still necessary to produce enough food to sustain a growing population. The question that can be connected to this, is the consideration of what the most sustainable way of farming is. Extensive farming is recognized as the way that farms in themselves can be the most sustainable. However, on the large scale, this demands a lot of space that could be used for other functions if intensive farming stays in place (Brouwer et al., 2003). This all depends on what scale you look at and what cycle of farming must be closed. This project looks solely at the situation of one polder in the Netherlands, but it would be interesting to envision a transition on the large scale and analyse in what way both extensive and intensive agriculture is sustainable.

Water management

Throughout the project, it became evident that too little emphasis had been put on the system of the outlet water and the polder water. On the map, visually, it appears to be possible to establish a connection between the two outlet water bodies of the Rijn and the Rotte. Maps and sections on a local scale were taken as the basis for the decision for a location, without the exact knowledge that was necessary to make that decision in mind. The location that was chosen, appeared to be able to connect to the existing waterways. However, throughout the design, more insight was gained into the specific heights of water bodies and the infrastructures and urban areas that it crosses, but also about the way the water system is supposed to work.

In the end, the waterways can be connected by the creation of two locks, giving the possibility of experiencing the true system of water management within the area.
From the Rotte, at an outlet level of +0,6 mnAP, it is possible to go down to the Bentwoud with a lock crossing to -6,2 mNAP. From there, existing waterways are used to connect to the Palensteins pumping station where another lock will be implemented. Here, users can either continue to the outlet of the Rijnland at +0,62 mNAP, crossing the Weipoortse Vliet before entering the Rhine, or users can continue at -1,6 mNAP, continuing over the Benthuizer Vaart to the Hoogeveense Vaart via the newly implemented waterway.

Through the creation of the locks that bridge large height differences, an awareness of the extremely low-lying situation that people live in. Insight is gained into how the water system works and how it keeps them safe, creating more sensitivity to floods.

Conclusion

Weather extremes, ecological crises, sea level rise, salination, the housing crisis, and subsidence affect large parts of the Netherlands. An area that is affected by all these challenges is the area around Zoetermeer, especially the Benthuizer Noordpolder. These challenges should be tackled together through the integral question of 'what does the area need?' instead of the more contemporary idea of adding one aspect and the rest will follow. Through answering the question How can the territory-oriented approach support urban development with the aim of creating natural and cultural values in deep Dutch polders? this thesis argues that a territory-oriented approach related to current functions and cultural and natural values can help to mitigate the challenges that the area faces and add future value.

In this project, a long-term vision until 2100 is realised through the application of the territory-oriented approach that regards several aspects of the project, such as urban development, water management, agriculture, and recreation. Through the investment in time, cultural and natural values, integral design, and adaption a design is created that takes a proactive stance toward the current climatic and societal challenges. Practically, this is achieved by aiming for a more sensitive position toward the landscape and its natural processes in relation to human activity in the area in a transition from 2022 until 2100.

[How can the territory-oriented approach consider values of spatial quality as nature and history?]

An analysis of the landscape, that takes the physical conditions as a basis, shows that there are areas that are more stable or deeper, so the stable soil can easily be built upon, and deeper areas can be dug out. This allows for the reconstruction of a landscape that is related to the cultural-historical landscape, and the addition of a waterway that connects to the outlet water via a lock on both the southwest and north side. This new landscape and waterway provide a means for the reconnection of the human scale and natural flows with the landscape in relation to its past functions. To do so, there is a need to reimagine infrastructure, housing, and open spaces configured in such a way that the system can be enhanced.

[How can natural and cultural values be translated to values in the low-lying polders?]

The transition towards 2100 creates a new type of urban ecosystem that follows the natural rhythm of the landscape. Through the addition of floodable housing typologies and infrastructure, a new perspective is given on the relationship with the delta which argues for a shift from extreme water management to the creation of boundaries in which the water is allowed its natural rhythm in a historical cultural landscape.

The project's progression from today until 2100 is not without limitations. Questions have been put about the justness of the project because of the large uncertainties that are paired with the development in sea level rise. Furthermore, several local stakeholders have been put forward in this project, but it was outside the scope to realize a larger-scale stakeholder analysis. This project has a high level of complex water management issues, knowledge of which has increased throughout the project. Especially connecting the site, the waterways became intensively difficult to figure out and proved hard to connect without generating convoluted solutions. Because of the intricate maze of waterways that exist at several height levels, locks must be created to connect the Rotte and the Rhine through this location. This detail adds a level of awareness of the water system in the deep polders, adding value to this location.

[What values in deep polders can be created by using the territory-oriented approach?]

Society-wide, questions have been raised about whether the aim to realize urban development in the deepest polders is perceptive and even possible. However, this design for the area of the Benthuizer Noordpolder conveys that these spaces have a quality and transforming them with the use of the integral methods of the territory-oriented approach can create added value to the location, for current and future uses, through spatial qualities and sustainable development.
The transformation of the area from large-scale agriculture to the urban fringe of Zoetermeer creates a multi-beneficial relationship between this zone and the urban area of the city. The city provides the urban fringe with the possibility to evolve around the landscape and to show how revenue models can play out. This opens chances for the preservation of the landscape. Simultaneously, the landscape provides functions that keep the city safe such as the storage of water and other ecosystem services.The design shows that the creation of necessary safe spaces in the deep polders can have a spatial quality. Furthermore, the design shows a new way of thinking about the climatic and social challenges and proclaims that this way of working is within closer reach than was previously thought possible.

Reflection

This chapter will reflect on the methods, relation to the master, relevance, and ethics of the project. It will conclude with a personal reflection on the process and project.

Research by design

The project recognizes research and design as convoluted activities that inform each other throughout the complete process of the project. Through the stages of the project, the design of the area was constantly questioned and reviewed considering previous design phases and external knowledge. Thereby, the method functioned as an iterative process that aided to make design decisions.

This iterative process creates the perception that the project seemingly has no end, as there are always elements of the design to improve upon with the knowledge gained from the previous step. For this, it is necessary to set a clear scope of the project. Given the complexity of the context, especially concerning the uncertainty of Sea Level Rise, this final scope was difficult. Continuously new questions arise about the future that the design is made for. This difficulty was overcome by setting a clear timeframe that the design was aimed at.

Furthermore, the process of research by design meant that some understandings of the greater picture, especially concerning water management, started to come after several phases. Due to this, there was an extended period of research into this subject which created uncertainties about the design. Therefore, the final decision was made later than would have been ideal.

Graduation topic, studio, master track, master programme

The focus of the thesis project is aligned with the Transitional Territories studio as the project discusses the relationship between water and water-related landscapes, in part of the delta region of the Netherlands. The brief of the studio specifically emphasises the 'traces that are drawn in the landscape forming a narrative of space occupancy over time' with regards to 'new cohesions, identity, and values' (Graduation Manual). This is where the theme of the thesis and the studio are truly aligned. In addition, the studio recognizes design as the carrier of the convolution of these complexities. Here, the connection to the larger-scale master's programme can be found. The aim of creating a design is to provide a vision of the spatial development of the area regarding the knowledge base of environmental, societal, and political circumstances while also keeping in mind the temporal-spatial component of the territory. This specific thesis argues the need for design to provide spatial quality in the matrix of values considering current climatic challenges. This connects the design back to societal practices and environmental circumstances. Through the role of a designer, a connection to the master's programme can be found. The role of the designer is to translate complex issues, in this project the convolution of contextual and climatic challenges and a complex temporal component, into an unobstructed vision that can be understood by a broader public.

Relation to the methods of the studio

The studio's lines of inquiry propose an approach through which the current elements of the site are redefined and revalued to understand these as the conditions from which we have to establish the foundation of the project.

The lines of inquiry were a good method to expeditiously push towards a critical analysis of the site in a well-structured way. Employing a structured method, working on accumulation was a way to quickly figure out the key elements of the site that were to be used during the design. The start proved difficult, as the site had not yet been completely established. But through this, the series of accumulation provided the project with a lens that has connected the zoomed-in site back to the challenges on a larger scale.

The general idea of clearance tended to be less well-worded than the lens of accumulation. This vagueness challenged to initiate the design phase and through this provided the first push to go beyond the limits that were established in the previous phase of accumulation and beyond the limits of current practice to see what the project could potentially be and how it could work towards a path of clearance. Even though this element of clearance was 'quick and dirty,' it was a key moment in the thesis as the design phase focused on the four 'what if' questions that I had posed for my project in the process of clearance.

The lines of inquiry as a method have proven to be a useful method to inform the progress of this project, from analysis through design.

Relation graduation project to the societal and scientific relevance

Societal

The societal aims of the thesis are the contribution to the awareness of the issues that are at hand in the area. The proactive stance toward the challenges that the area faces can decrease future risks and thereby prolong the liveability of the area. In addition, the thesis aims to contribute to the knowledge base about creating added value in an area in which building is necessary or wanted. The hypothesis of a territory-oriented approach proposes a top-down approach to provide leverage for the local population in the challenges that the location faces.

Scientific

The current practice of implementing infrastructure projects assumes the need for a large-scale infrastructure project and then starts to consider its surroundings to see where potential synergies lie. Even though the implementation of new infrastructure projects is proactive, as it anticipates the need of the future, contemporary practices are still reactive, because the consideration of the environment and its qualities is subordinate to the creation of infrastructure. It is important to consider the creation

of infrastructures through a territory-oriented approach – being an integral part of the development as an area, as it can help in the initiative-taking way of dealing with climate issues that give rise to complications in the project area in the short and long term. This thesis aims to add to the awareness and close the gap that exists between current research and practice. In this way, the thesis can also add to the task to close the gap in the socio-cultural dimension in the development of areas concerning infrastructures.

Furthermore, the thesis challenges the temporal aspect of designing in the long term. In current practice, there are few images of what the future can look like and how liveable environments can be created in the transition from now until 2100. The thesis provides a proactive proposal of how that future can look, but more importantly, asks questions about specific functions of the challenging circumstances if people were to keep living here.

Ethical dilemmas

Ethical dilemmas were experienced mainly in three phases of the project. Firstly, ethical issues were encountered while doing research concerning areas of expertise that are outside my specific knowledge. This information regards the fields of agriculture, soil balance, water management, and the specifics of ecology. These fields have all been considered in the project as elements of a system, rather than through in-depth specifics as the exact elements are outside the scope of my expertise.

Secondly, through the creation of the design, ethical choices had to be made. The program of the project includes an urban expansion into an area that is exclusively below sea level. This is done with the acknowledgement of sea-level rise, whereby taking the notion of the risk that is paired with this. The design has included measures to mitigate the externalities, but the risk can never be eliminated. In current societal debates, there is a lot of attention on this aspect: can we build houses here while their life span is longer than it might take the water levels to rise? Can we sell houses in this area without posing the risks that accompany that transaction?
This plan might be an answer to some of the questions but still has not found a way to eliminate the complete complexity of the risks that come with the area as it is completely based

The last stage ethical dilemmas will be encountered are in the potential application of the results in practices. Most of these are related to justice, part of which has been explained in the assessment of social justice. However, for the potential application of the design, it is necessary to regard the stakeholders a lot more than has been done in this project. In the end, an attempt was made to personalize the timeline through the profiles of the inhabitants. However, this consideration was after the fact and does not eliminate the need for a thorough stakeholder analysis of the area to consider the local inhabitants and farmers and figure out their specific needs and wishes, especially in a time in which there is a lot of ‘top-down’ decisions with regards to farmers.

All the measures that follow from this design ask for a change from inhabitants, politics, and industry users. There have been several adaptive cycles in the area over the last centuries, all with their own adaptation time. Measures like this can be fundamental changes to the status quo and can require lots of time for planning and implementation, especially when you consider that social processes can hamper the acceleration of adaptive measures (Haasnoot et al., 2020). Active participation of diverse urban actors is, therefore, necessary to realise a process of cocreation. All participants play a crucial role in the integration of systemic change. Including all stakeholders is the most promising adaptive strategy for resilience that includes multifunctionality in the design as it ‘improves the society’s ability to evolve.’ (la Loggia et al., 2020)

Transferability/applicability

The main idea of the project – creating a new landscape with water design as a carrier to transform the landscape into an urban ecosystem in which the landscape plays a vital role – can be easily applied to other locations in the western part of the Netherlands. The low-lying part of de delta is dealing with the same problematisation as this location is dealing with – subsidence, water nuisance, and effects of the housing shortage. It is, however, necessary to evaluate on several scales how the project can help the other affected areas, a zoom-out that this project lacks. This can be done by using the territory-oriented approach to create synergies between the several domains on multiple scales.

Personal reflection

When the project of the barging canals was proposed to me, my initial aims of the thesis were to create a design using water and to do that through an interdisciplinary approach. Even though the project did not go completely as planned and the interdisciplinary approach that was one of the main motivations for taking on the project could not be carried out in the end, the process of the thesis shaped my way of thinking about large-scale infrastructure projects and long-term planning.

Though there was no water management student helping me, there was a need for detailed knowledge about the water system. This knowledge grew over the project, but it took a little time to come to the correct conclusions. When this conclusion was reached, that the waterway connection was possible with the creation of two locks, the way the water system would now be visible fit also within the vision. Through this, a new important aspect could be added to the design. However, this struggle provided me with a more important lesson for the future: ask the important questions earlier in case you need it.

This struggle may have been a red line throughout the complete project for me as there was difficulty balancing the line between doing it all on my own and asking questions when I needed to. For a long time, I stuck to what I knew and could research to keep a grasp on the situation. However, this means that the step to the final design was not made for a long time. As a result, I feel that the design still

focuses on conventional methods of living whereas there first was a focus on extreme ways of using the landscape. Furthermore, the design is not as in-depth as I would have preferred it to be. Plenty of ideas about the way the public space should look in the design are in my head and never made it out to paper. This is the most disappointing result of the thesis year.

Related to this is that this is not the one correct answer – a design for an unpredictable future never is. There are more questions about the design that I have created for the area than there were before I started the design as the unfolding of a design-related research question into a design proposal is not the goal, but the process of concluding more questions.
That is the nature of the field of urbanism, problem-seeking instead of solution-driven. These questions, hopefully, give way to start a conversation about the challenges that are at hand and to look for proposals that can, eventually, provide the liveability of the landscapes of the past.

After this project, I have a clearer mind on what can be my task as an urbanist and what my position can be in the relation between the cultural and natural landscape and the new that will build on that. It is closely related to the Nota Belvedere, which states 'preservation through development.' I know now that there are so many opportunities for future practices to consider the old without disregarding the new.

The project and the workshops that I have followed through the process have stressed the importance of proactively designing for a better future as we will have less time to adapt in the years to come. The future can from time to time be daunting, but it is also exciting to see the creativity in plans and through people to show that it can be done if it is done together.

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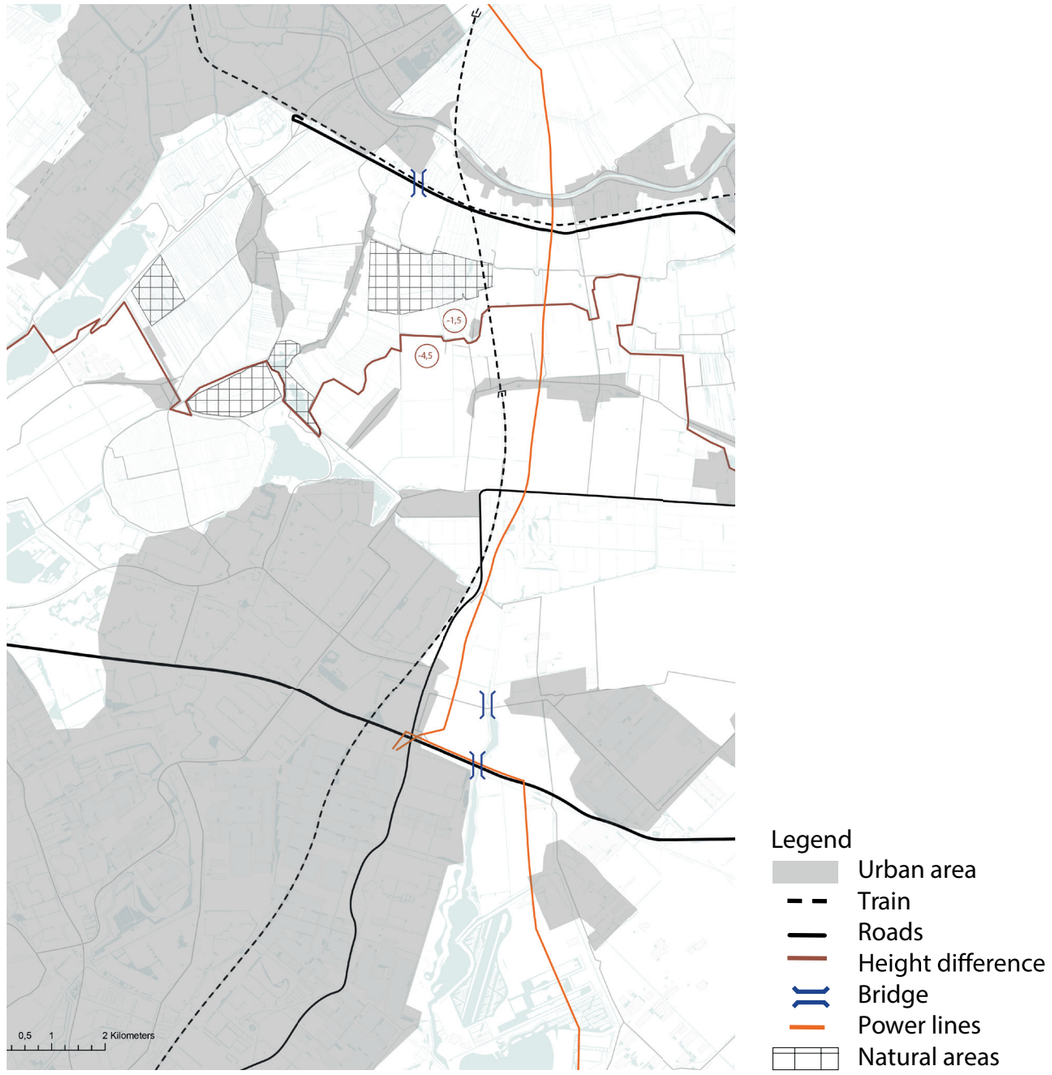
Part 6 | Appendices

Overflowing information

Appendix A - SWOT

Limitations



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application of theory (Author, 2022)

Strengths

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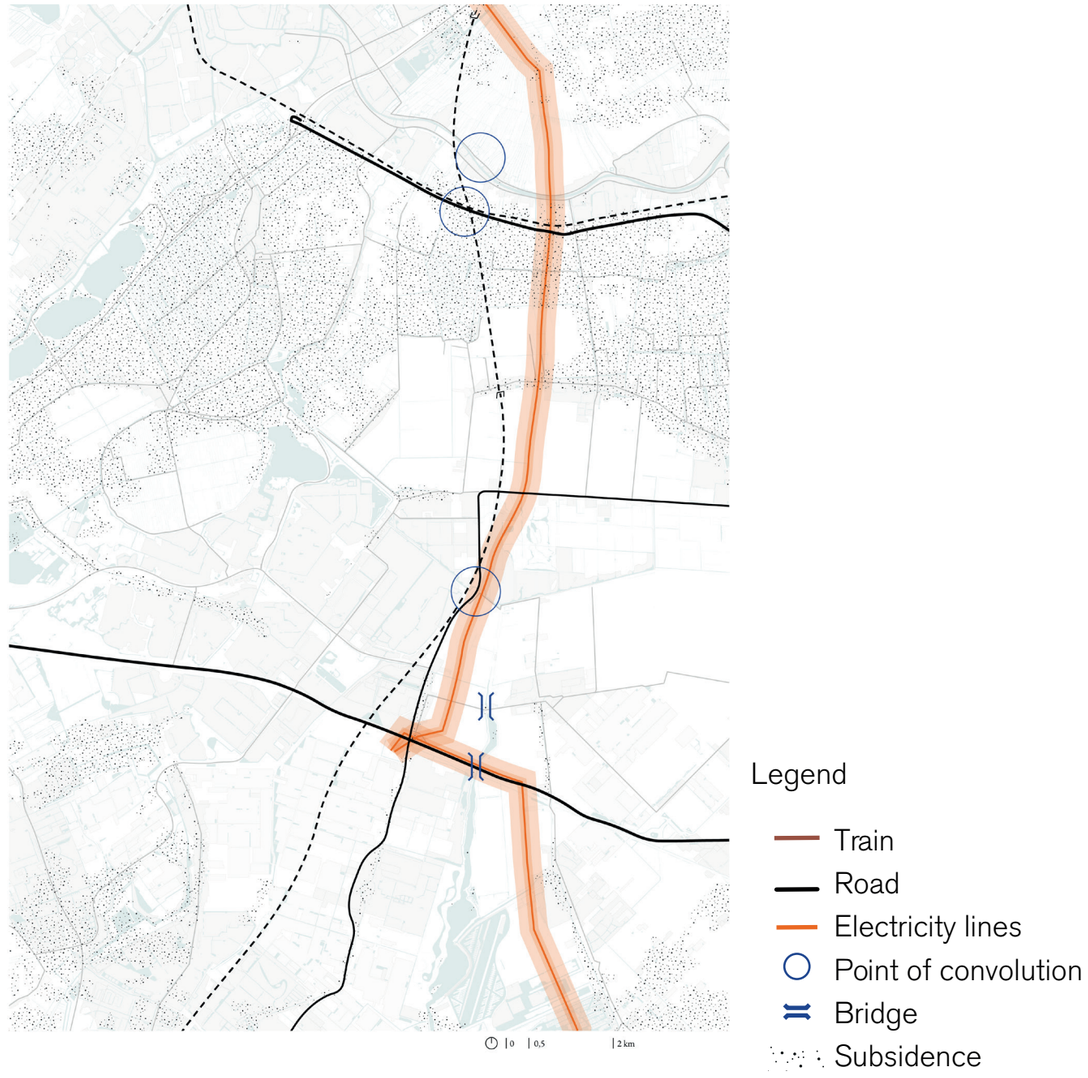
application of theory (Author, 2022)

Weaknesses



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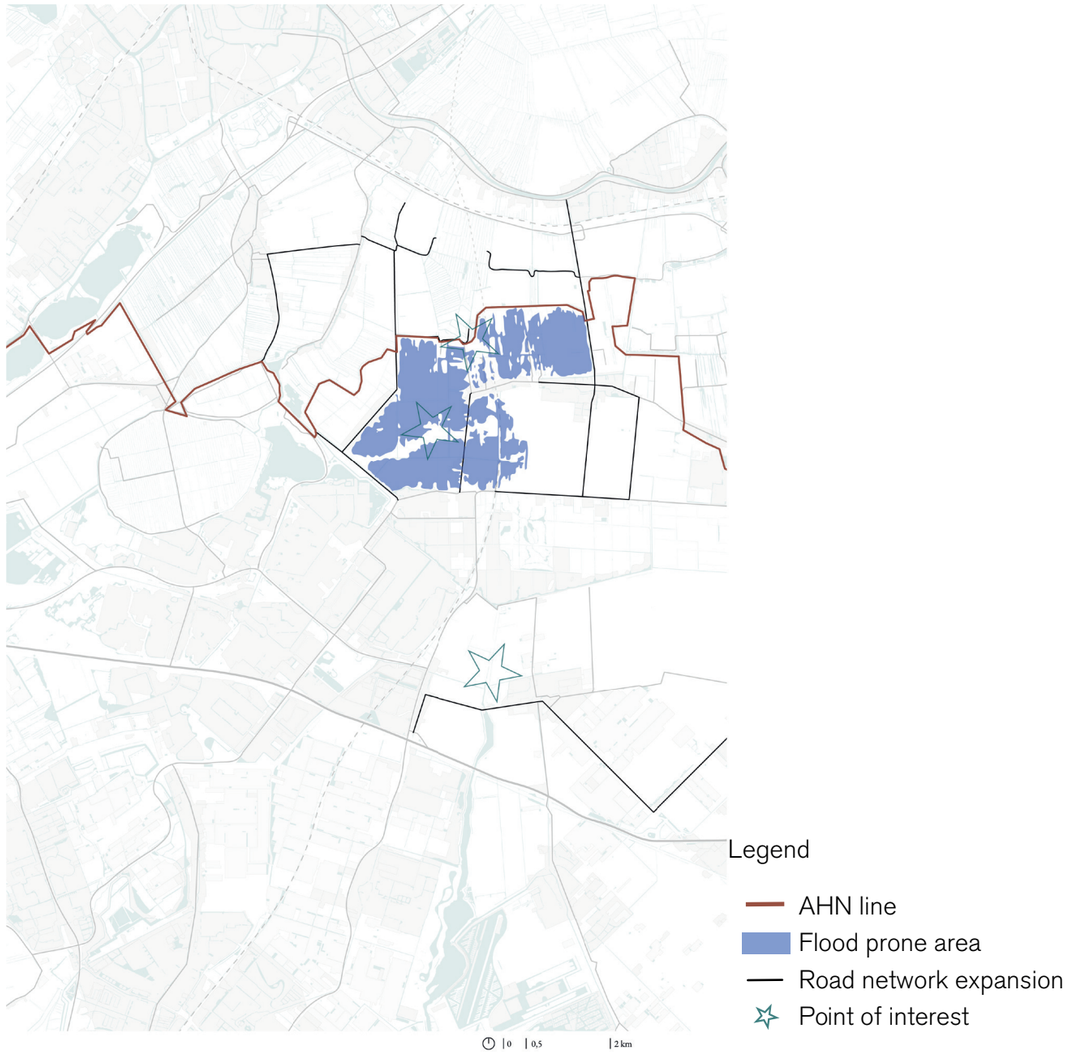
Opportunity



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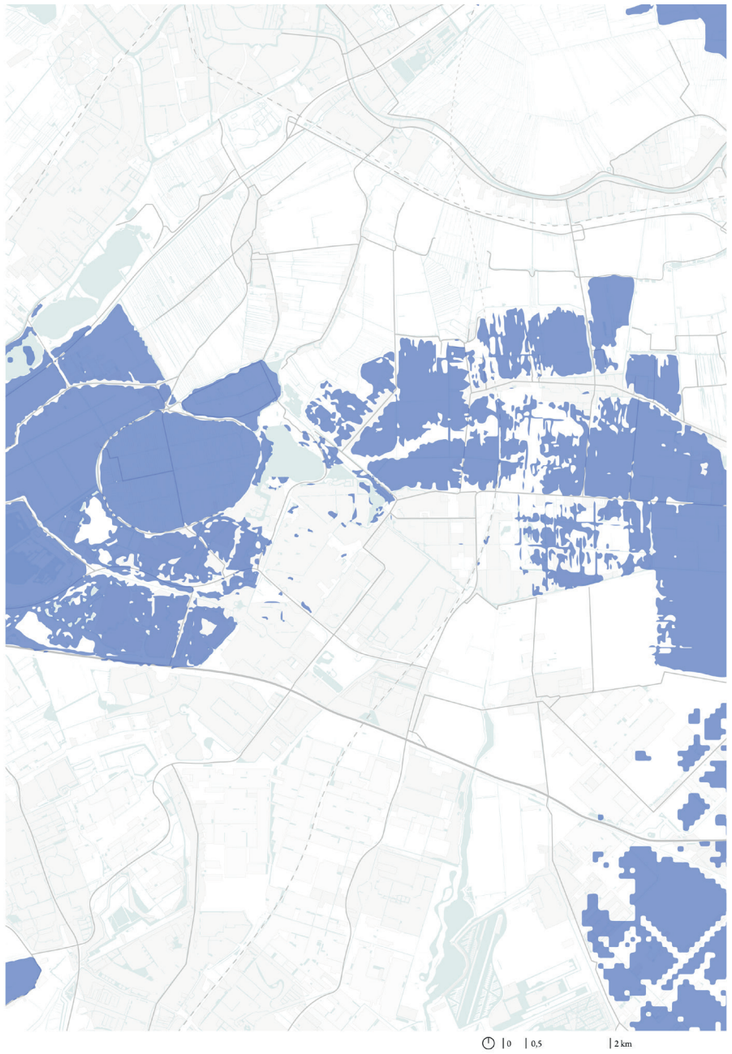
Threats



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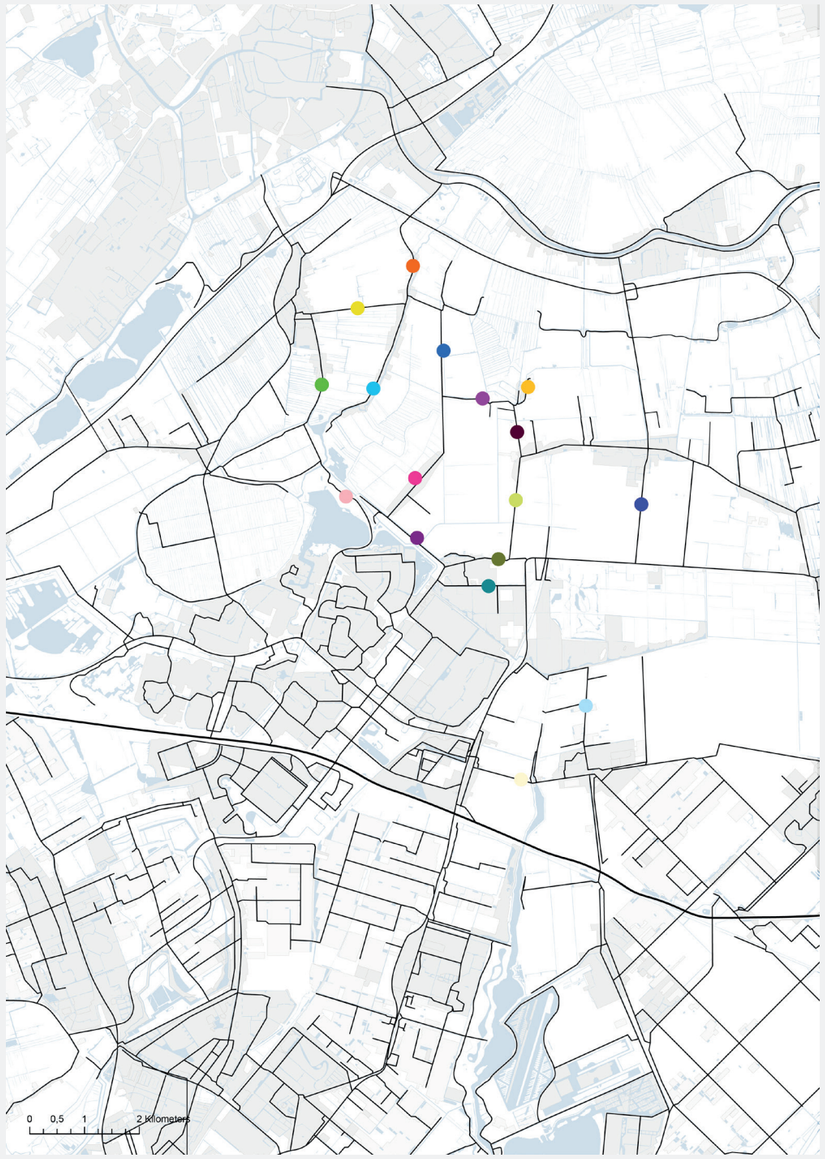
Appendix B - Mobility
Road network




Zuidbuurtseweg


Weipoortseweg


Weipoortseweg


Nieuwe weg


Nieuwe weg


Gelderswoudseweg


Langelandsepad


Noordweg


Bentweg


Westzijdeweg


N209


Heereweg

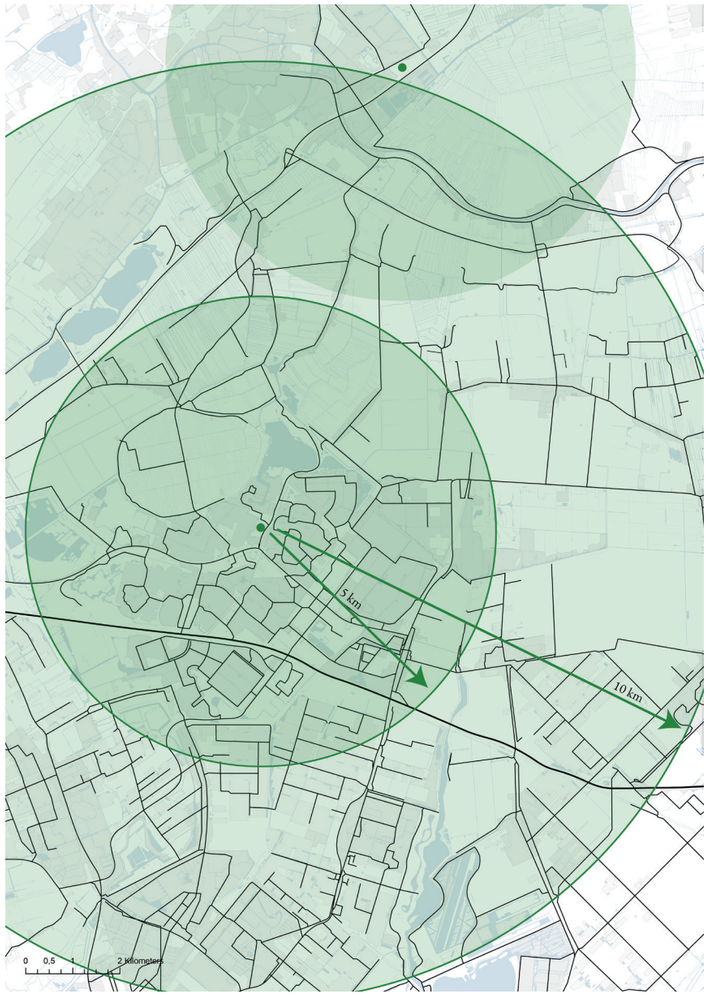

Slootweg


Azielaan


Bentwoudlaan

13
application of theory (Author, 2022)

Distance to hospitals



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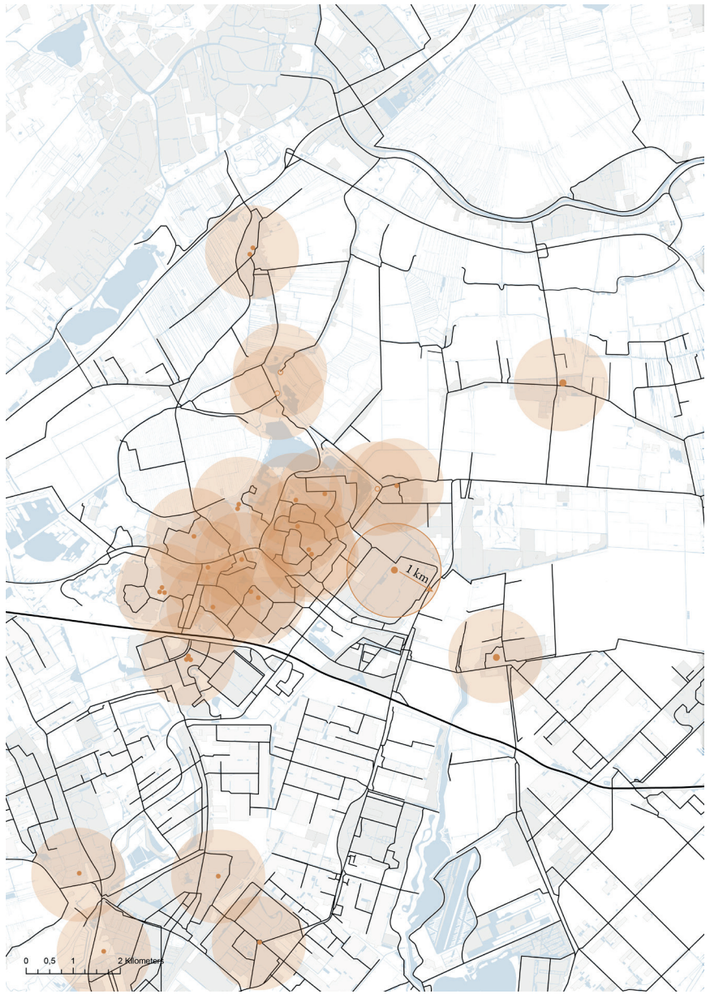
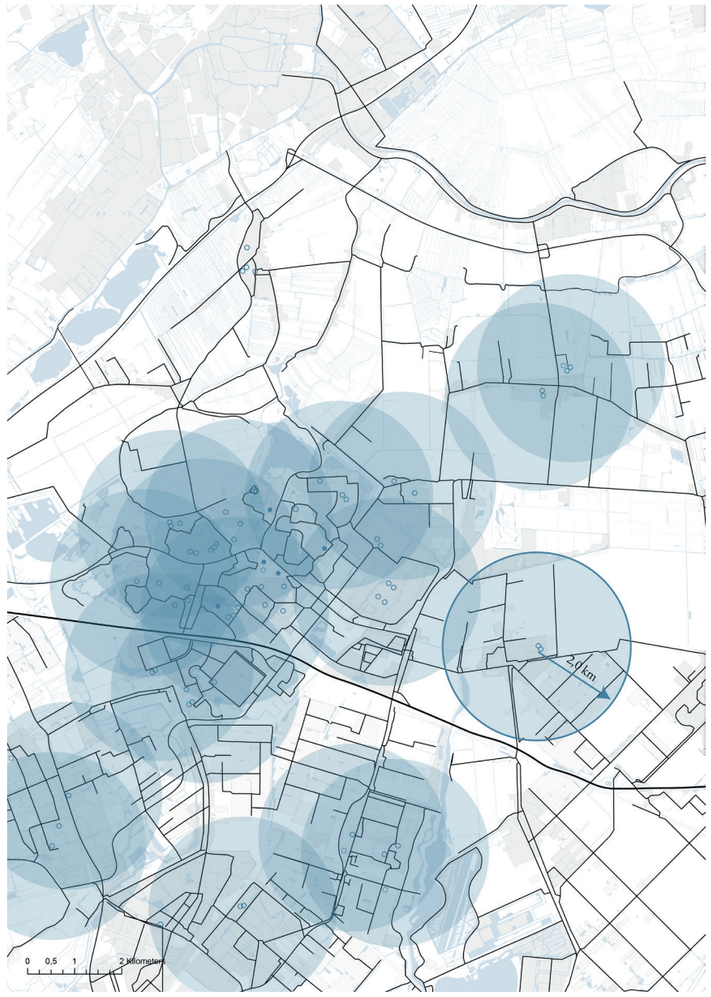
Distance to supermarkets



Distance to schools



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application of theory (Author, 2022)

Appendix C - digging of soil

Phase 1

Ophogen

	oppervlakte (m2)	hoogte (m)	volume (m3)	
Eerste stuk kreekrug	175000	3	525000	
Bestaande dijk	20000	3	-60000	
			totaal volume	*465000*

Bebouwing	breedte	lengte	diept	aantal blokken	volume (m3)	
Blok1	50	50	-5	19	-237500	
					Totaal volume	*-237500*
					Fase 1:	**227500**

Creatie sloten

	aantal slo	diepte	breedte	lengte	volume	
1	18	1	3,5	1700	107100	
2	12	1	3,5	137,5	5775	
3	16	1	3,5	150	8400	
4	18	1	3,5	400	25200	
5	13	1	3,5	500	22750	
6	26	1	3,6	425	39780	
					totaal	*209005*

Uitdiepen sloten

		diepte	breedte	lengte	volume	
A	1	1	3	750	2250	
B	1	1	3	950	2850	
C	1	1	3	400	1200	
D	1	1	3	900	2700	
E	1	1	3	1570	4710	
F	1	1	3	1500	4500	
					totaal	*18210*
					Fase 1:	**227215**

Phase 2

Ophogen

		oppervlakte (m2)	hoogte (m)		volume (m3)	
Tweede stuk kreekrug		175000	3		525000	
					Totaal volume	525000
Bebouwing	breedte	lengte	diept	aantal blol	volume (m3)	
Blok 1	50	50	-5	16	-200000	
Blok 2					0	
					0	
					Totaal volume	*-200000*
					Fase 2:	**325000**

Creatie bogs

Bogs	oppervlakt	diepte		volume		
a	219000	0,8		175200		
b	145000	0,5		72500		
c	105000	0,5		52500		
d	50000	0,5		25000		
e	75000	0,5		37500		
f	130000	0,5		65000		
					325200	
					Totaal	*325200*
					Fase 2:	325200

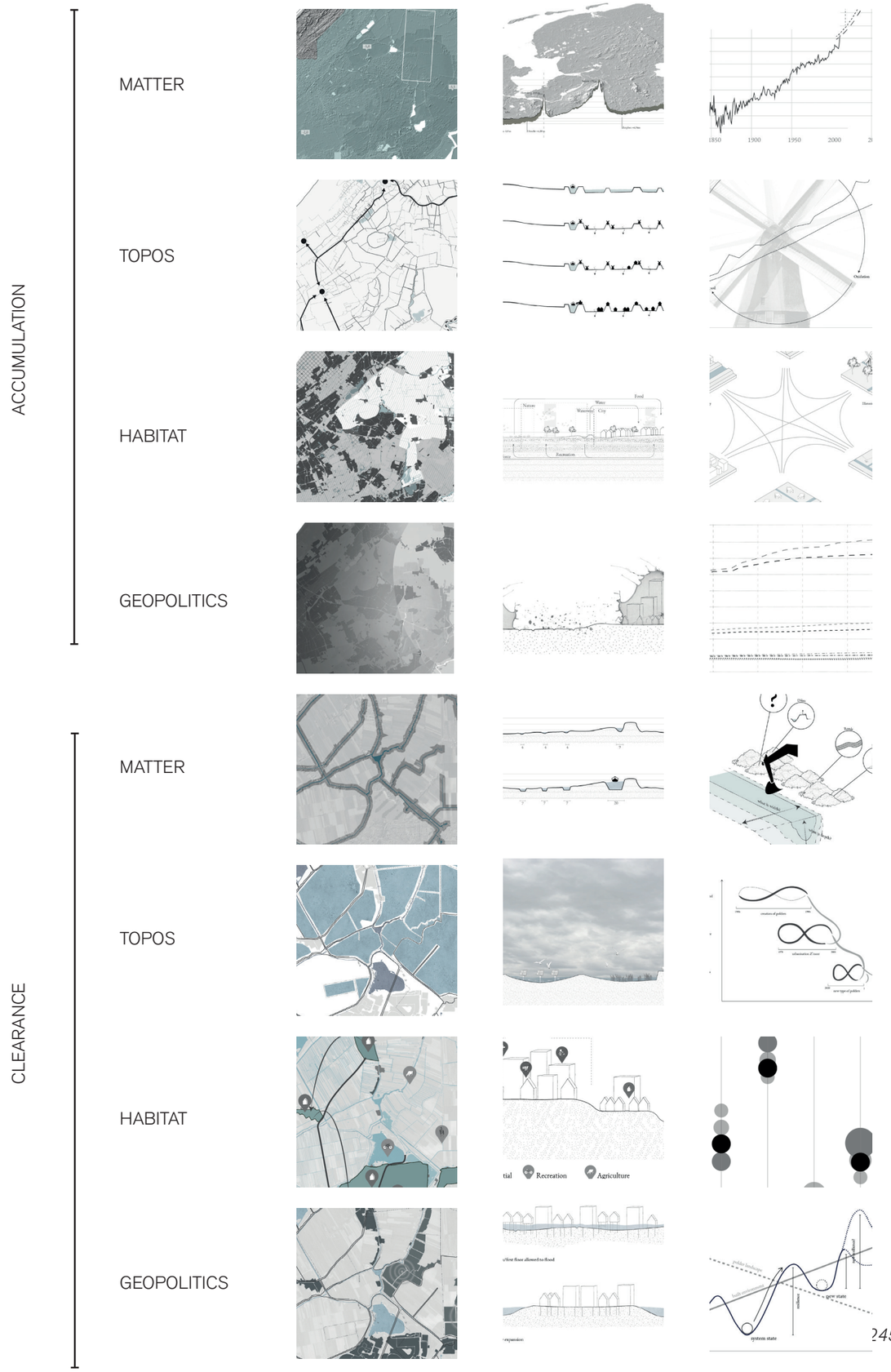
Appendix D - Lines of Inquiry

Monograph Series

The monograph series is a method into researching the chosen territories. The results are twofold – the accumulation series relates the thesis location to the problematisation of the area. What are issues that are current and that need to be taken into account when looking into the future? Some of these elements have been inherited from past practices and will have to be taken into account as well. The clearance series relates the thesis location to what can be. In order to tackle this concept, four what if questions were posed. These questions, all relating to the lines of inquiry, give an insight to how the area could look in the future. However, these elements have not yet been analysed on feasibility and need to be assessed in terms of practicality.
The process of mapping consists of choosing the right location, scale and temporal characteristics to visualise a storyline about the past, present and future problems and the possible solutions. The monograph series show a narrative about the territory from the point of the thesis project.

Accumulation
- -Matter: a land under water. The land and the sea level
- -Topos: creating liveable space. Polders and functional waterways
- -Habitat: inhabiting space. Land use
- -Geopolitics: competing over space. Increasing uses of land

Clearance
- -Matter: keeping the balance. Clearance of soil
- -Topos: changing the balance. Elimination of the existing polder structure
- -Habitat: shifting the balance. Shift functions within the existing boundaries
- -Geopolitics: creating a new balance. Create new boundaries



Matter

Composition

The project area lies exclusively below NAP. With a maximum depth of 5,5m below sea level, the area is one of the lowest-lying parts of the Netherlands. The depth of the area ranges between 1,5 and 5,5 metres, and a sharp cut in height between different parts can be deduced. This difference in depths is caused by the line on the difference in soil type. The lowest lying area is the peat soil, whereas the soil at 1,5 metres is characterised as azonal soil. Because of the low-lying characteristic, the thesis territory and its surroundings are prone to floods (Provincie Zuid Holland, n.d.). These threats are threefold as the flooding can be caused by a rise in the sea level, a period of intense rain and high water from upstream.

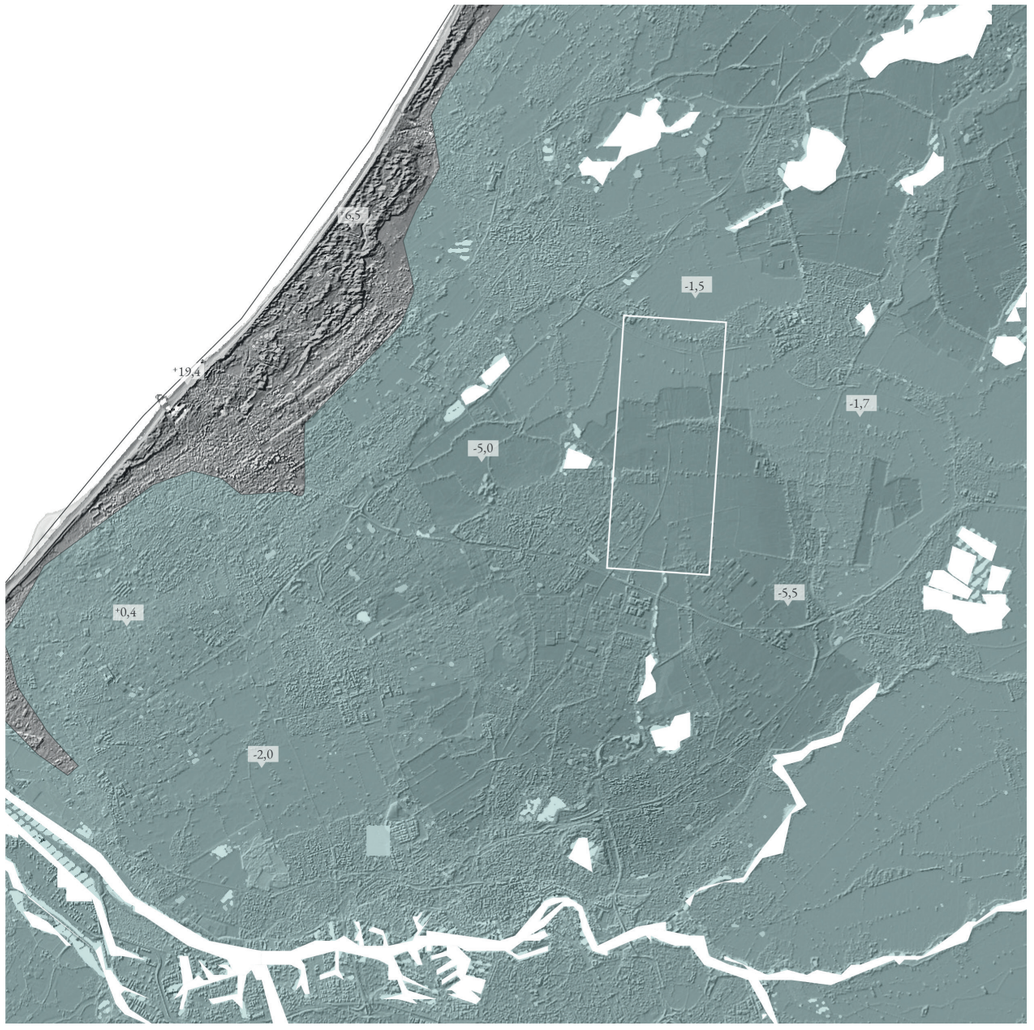


Figure A01 - Composition of the low-lying land

Figure by author, 2022

AHN (n.d.). Actueel Hoogtebestand Nederland. Retrieved on 18-11-2021. Retrieved from: https://www.ahn.nl/ahn-viewer

DINOloket (n.d.). DINOloket Ondergrond gegevens. Retrieved on 19-20-21. Retrieved from: dinoloket.nl/ondergrondgegevens

Matter

Alteration

Not only is the area below sea level, but the area is also sinking at a steady pace (PBL, 2015). This has multiple causes. The first cause is the local soil subsidence. With an amount of approximately 5 mm/year, the soil in the Province of Zuid-Holland is sinking faster than in other parts of the Netherlands (Provincie Zuid Holland, n.d.). In addition, tectonic movement causes the western part of the Netherlands to sink even faster than the estimated 5 mm/year. This phenomenon is called isostacy and is the result of the shift in tectonic plates because of weight placement. This causes an even faster sinking of the soil, with a large uncertainty about what the expected range will be over the next several decades (van Asselen et al., 2019).

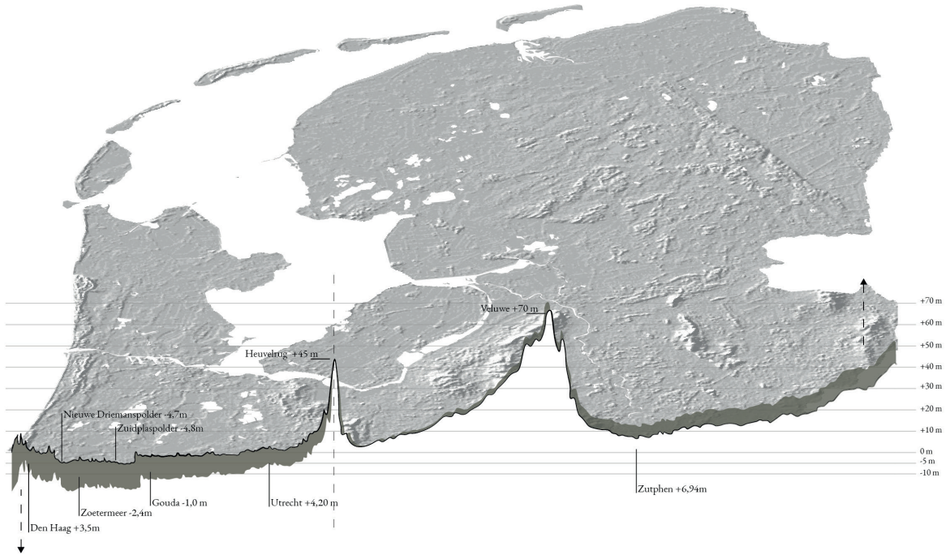


Figure A02 - Section of the Netherlands

Figure by author, 2022

AHN (n.d.). Actueel Hoogtebestand Nederland. Retrieved on 18-11-2021. Retrieved from: https://www.ahn.nl/ahn-viewer

Matter

Limitation

Not only is there uncertainty about the expected soil subsidence, the rate of sea-level rise is also unpredictable (KNMI, 2021). The feature that can be predicted with absolute certainty, is that the levels of the seawater will continue to rise. There are several prognoses that Haasnoot and colleagues (2020) describe. These prognoses are fairly similar to the scenarios based on the IPCC assessment (IPCC, 2021). However, the prognoses start to vary after the year 2050. The largest limitation of the area is dealing with the challenge of planning under uncertain circumstances (Haasnoot et al., 2020). The functional lifetime of planned adaptation reduces quickly, as the lead time is quickly deteriorating in just a small amount of time, compared to what lead times were twenty years ago. It is, therefore, necessary to act upon knowledge now, preferably with measures that allow for quick changes and bold decisions.

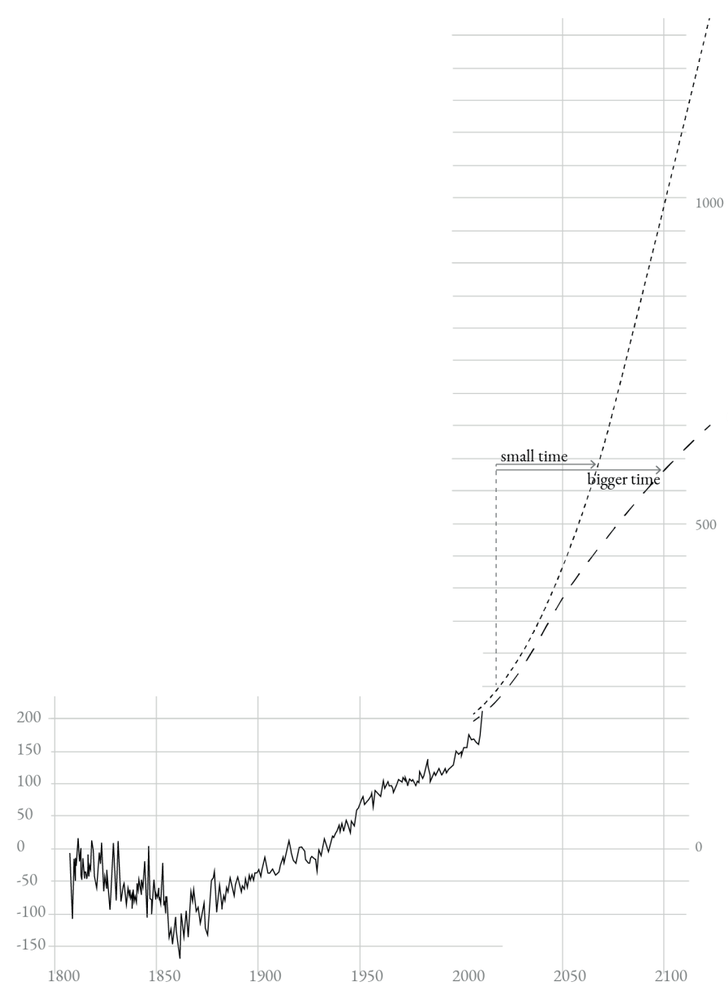


Figure A03 - Projection of Sealevel Rise and lead times

Figure by author, 2022

KNMI. 2021. KNMI Klimaatsignaal '21: Hoe Het Klimaat in Nederland Snel Verandert. De Bilt.

Topos

Composition

The landscape of the province of Zuid-Holland as it is now known has been shaped by the creation of polders. These polders, still almost exclusively the same as they were drawn up in the mid-1800s, vary in size and shape and have therefore very different feels, but share characteristic feats as the dike (Bobbink, 2016). These dikes ensured the security of dry land, as well as the possibility to create safe, navigable waters. These waters could then be used to transport people and goods throughout the province. For the main waterways in the province that was the principal use for two centuries after the creation of the network in the 1600s. The map shows the cores of the now historic centres of main cities in the areas that were connected to each other via waterways (Wellenberg & van der Zee, 2021).

Figure A04 - Composition of the polders and cores of the water network

Figure by author, 2021

Bobbink, I. (2016). De Landschapsarchitectuur van het Polder-boezemsysteem.

Wellenberg, M., & van der Zee, A. (red.). (2021). Atlas van de trekvaarten in Zuid-Holland. Uitgeverij THOTH.

Topos

Alteration

The creation of polders was a necessary course of action to use the area in a functional way. The polder system ensured security against the water and made it possible to live and navigate the low-lying land. However, after the digging of the first polders, the soil continued to sink which caused the area to resume to be flooded. Additional measures needed to be taken to see to it that the area remained liveable. Over the centuries, new technologies made certain that the land in the area stayed dry enough to build upon. This has increased the possibilities of being able to live in the area but has also increased the depth of the area and therefore the threats (Hooimeijer, 2011; Meyer, 2001).

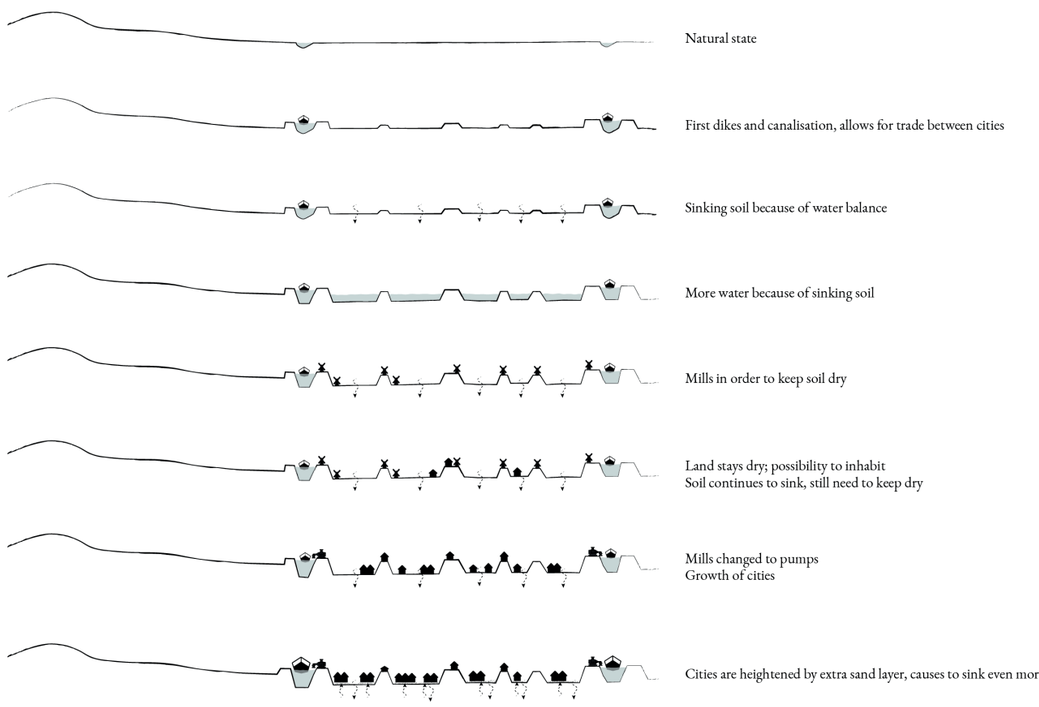


Figure A05 - Stages of polders throughout the years

Figure by author, 2021

Meyer, H. (2001). Atlas van de Nederlandse Waterstad. SUN.

Topos

Limitation

The constant alteration of the that has been illustrated in the previous section is a vicious circle. Because of the alteration, the soil sinks and is prone to be saturated with water again. Machines have to continue putting in the work to maintain the soil in a constant state of dryness. This vicious circle has negative repercussions, for the economy, the ecology, and the climate (Provincie Zuid Holland, n.d.). The result of the constantly sinking ground is that houses and vital infrastructure keep sinking too. This results in high repairing costs. Furthermore, the continuous lowering of the groundwater level makes the area prone to salt intrusion. Over time, this changes the ecology in the area. Furthermore, oxidation, which almost exclusively happens in the summer, is expected to increase because of drier periods of time. Oxidation releases CO2 and therefore contributes to climate change. In the total area of the Groene Hart, the emissions are 1.4 million tonnes of CO2. Preventing this from happening, can eliminate the emissions just as much as making all the houses in the Groene Hart CO2 neutral (PBL, 2015). How long can this vicious circle continue?

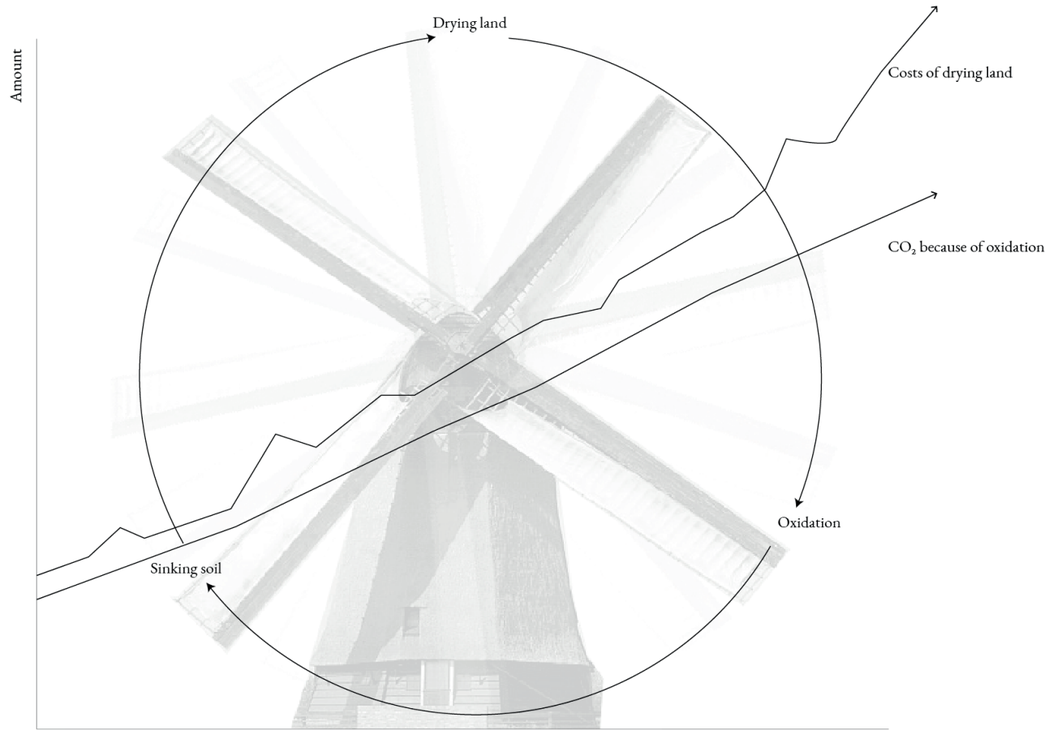


Figure A06 - Vicious circle of subsidence

Figure by author, 2021

Provincie Zuid Holland. (n.d.). Bodemdaling. Https://Www.Zuid-Holland.Nl/Onderwerpen/Ruimte/Bodem-Ondergrond/Bodemdaling

Habitat

Composition

The area is composed out of several types of land uses, the majority of which can be allotted to living areas and agriculture. The agricultural area lies enclosed in the urban area of four major urban agglomerations, which accounts for 7 million inhabitants.
With 110 thousand hectares, almost 60 per cent of this open area amid the Randstad consists of an agricultural landscape. Because of its position within the Randstad, and the connectivity that is ensured with the myriad of infrastructures, the Groene Hart and the urban functions of the Randstad are inseparable. The area is one of the least changed areas in function in the last two decades. The types of landscapes in the area, however, are in great contrast with each other as the different functions encompass very different interests (PBL, 2015). The task to see where synergies lie between the landscapes is something that has to be taken into account when designing.

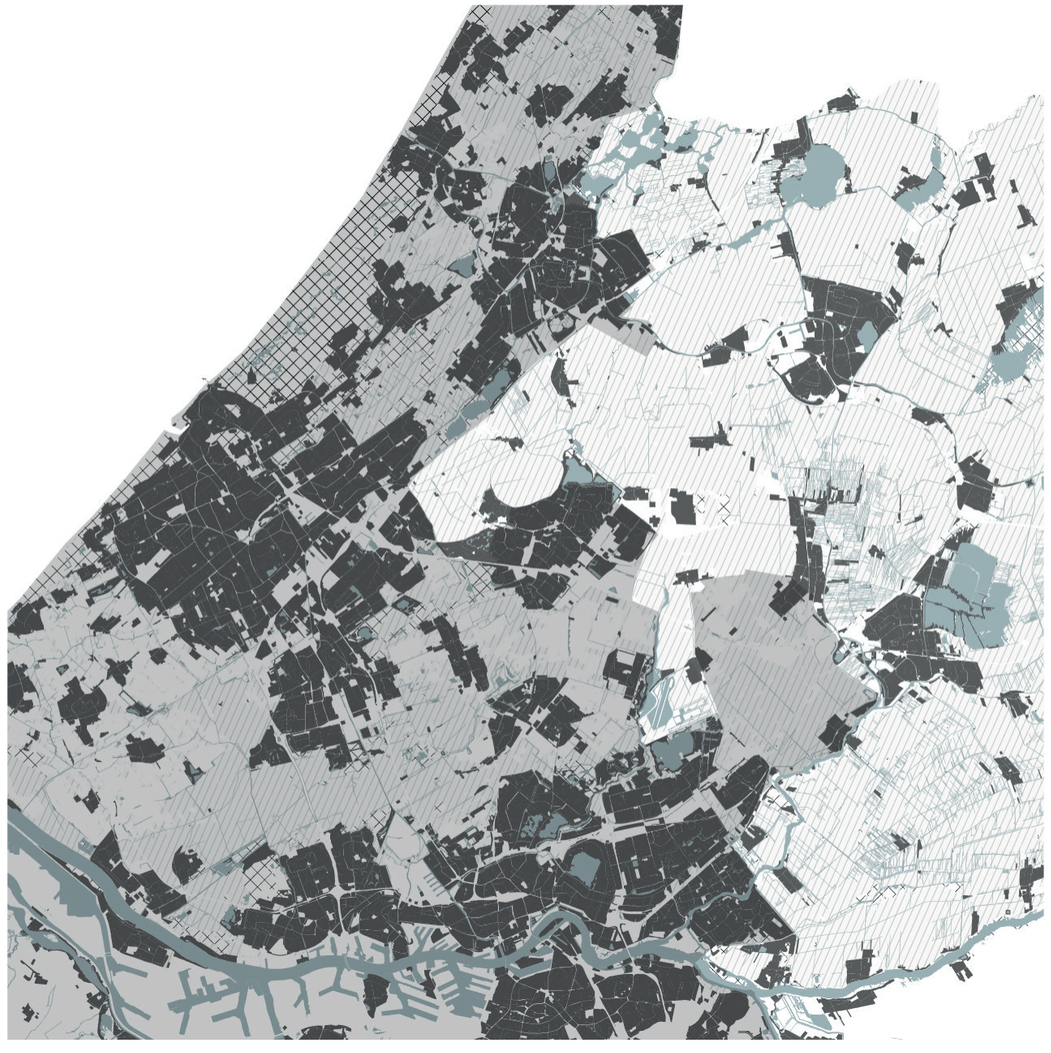


Figure A07 - Land uses in the province

Figure by author, 2021

PBL. (2015). Het Groene Hart in beeld.

Habitat

Alteration

However, current synergies between the landscapes must be considered too. Even though the urban landscape and the agricultural areas encompass a large scale, and the region is sometimes named metropolitan, the small-scale connections can be felt. The connections are maintained by the constant flows of people and goods between the landscapes. First, there are the goods produced by agricultural practices that find their way into the daily life of people in the city. These can be dairy products, meat and vegetable that are locally sourced. Furthermore, there is a large stream of commuters that live in the Groene Hart and work in the surrounding urban agglomerations, but this stream is also vice versa. In terms of landscape, the polder system Groene Hart provides safety to the cities with regard to water management. Furthermore, the landscape, with its various components, provides an area for a myriad of recreational purposes (PBL, 2015).

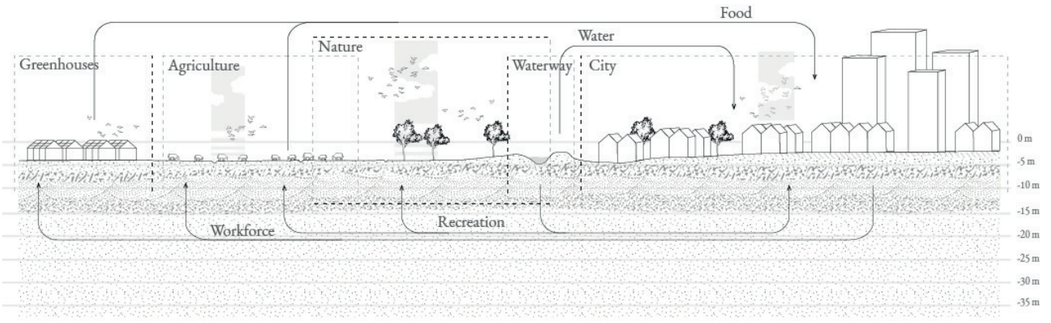


Figure A08 - Synergies between land uses

Figure by author, 2021

PBL. (2015). Het Groene Hart in beeld.

Habitat

Limitation

An alteration in one type of landscape can lead to a change in function in one of the other components. It is therefore important to think about the interrelations when designing within the area (PBL, 2015). One component cannot be seen as just that but must be related to a network of several other components and functionalities. It is vital to comprehend the externalities that can be caused by the alteration of one of the functions. Questions should thus be asked such as: what changes are necessary? What changes are preferred? How much can one element be altered before the limit is reached? What changes are necessary for the system and desirable? What changes are necessary but undesirable? By relating these elements to each other, insight can be gained about the effects of an alteration.

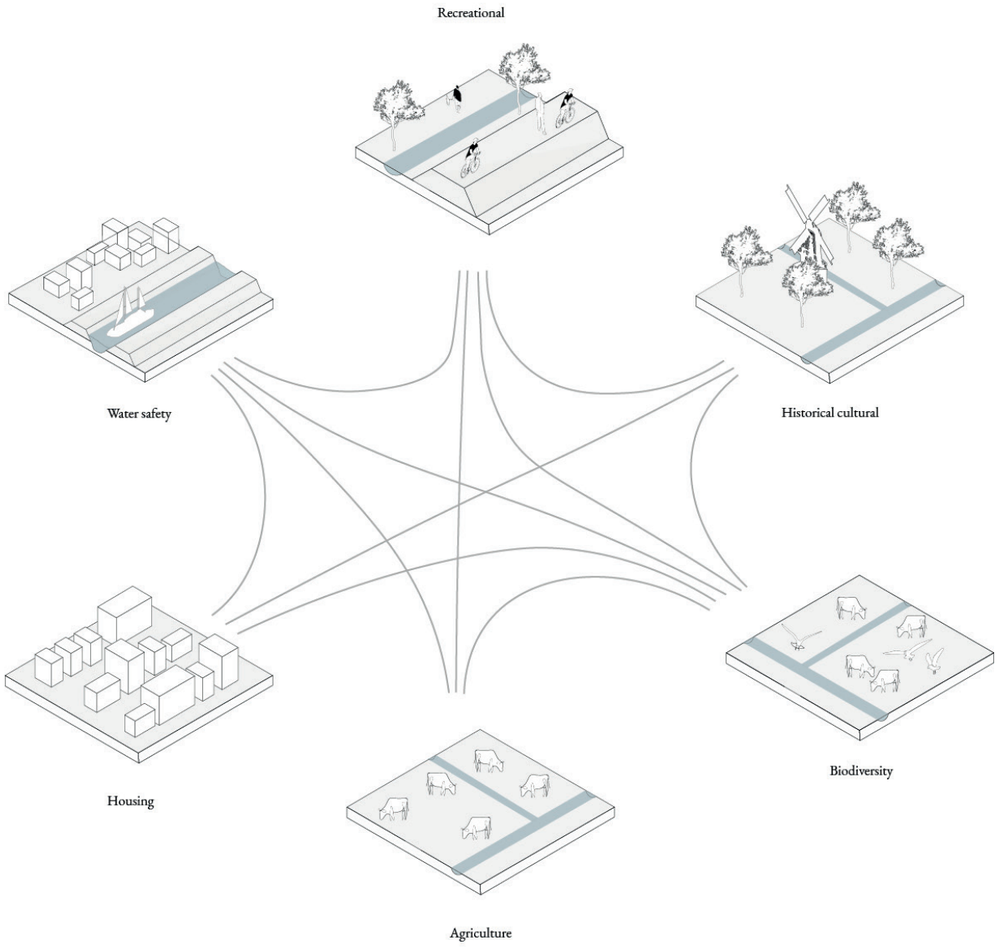


Figure A09 - Interrelations between the different landscapes

Figure by author, 2021

Geopolitics

Composition

The project location is right on the edge of the Groene Hart – the hard urban border of Zoetermeer marks the current border of the Randstad and the Groene Hart. The Groene Hart is a protected area with its own qualities and merits. Even though there are multiple governmental entities that have a voice within the area, there is a consensus about the level of protection of the green area in the middle of the urban Randstad. This is because the Groene Hart is of national, and international, importance with regards to the cultural-historical landscape. Three out of ten Dutch world heritage sites are located in the Groene Hart (PBL, 2015). However, the area is also a popular place to live, as there is good connectivity with the surrounding agglomeration of cities. People from outside of the area move here, but also two-thirds of the people that live in the area and move, look for a house in the Groene Hart (PBL, 2015). Therefore, there is a large shortage of houses in and around the project area (Staat van de Woningmarkt. Jaarrapportage 2021, 2021).

Figure A10 - Pressure of the housing market on the Groene Hart

Figure by author, 2021

BPD. (2021, March 15). BPD Hittekaart 2021: woningdruk traditioneel hoog in Randstad.

PBL. (2015). Het Groene Hart in beeld.

Geopolitics

Alteration

As mentioned before, there is a thin line between the Groene Hart and the Randstad and it is becoming increasingly vague. The alteration on the neighbouring page shows an abstraction of what will happen if that thin film bursts. If that happens, at one point at the Groene Hart, there is probably no stopping the expansion of the Randstad into the green protected area, as there are a multitude of municipalities that all benefit from being able to expand outside of the current urban borders. However, when that bubble will pop, or what exactly will happen cannot be said with certainty (Staat van de Woningmarkt. Jaarrapportage 2021, 2021).

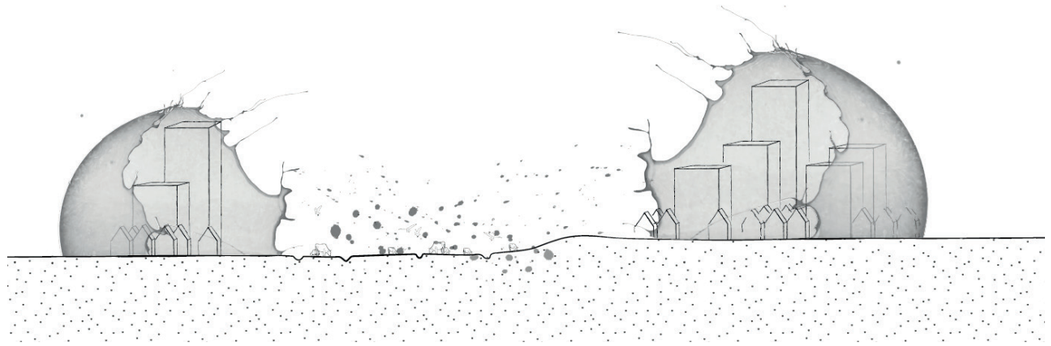


Figure A11 - The bubble of the housing market

Figure by author, 2021

Geopolitics

Limitation

Even though there is no certainty about when it will happen, it is becoming increasingly clear that bordering municipalities are out of capacity. The population density and housing density have been increasing over the past decades (CBS) and are not expected to stop. Zoetermeer already has a much higher than average housing density, but numbers continue to grow. However, the ultimate questions are: should it be possible for cities to expand into the Groene Hart? Should we want to build into the lowest-lying part of the country with the dangers of flooding that the area poses? How feasible is building in the area if the area will be flooded? Do we want to neglect the cultural-historical value that the landscape has?

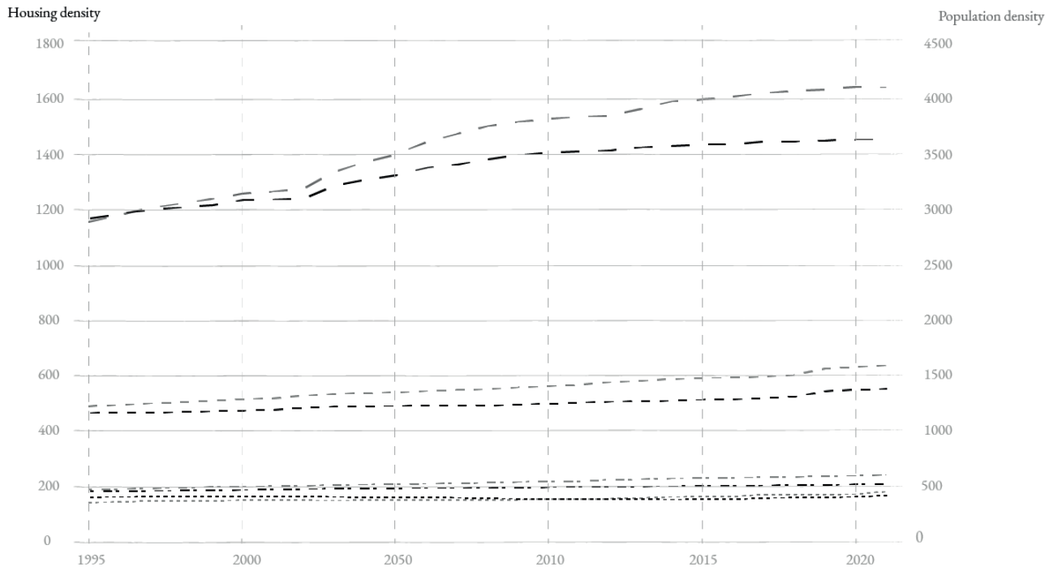


Figure A12 - Population and housing densities in the area

Figure by author, 2021

CBS Statline | Kerncijfers wijken en buurten 2020. (2021). CBS. Retrieved December 20, 2021, from https://opendata.cbs.nl/#/CBS/nl/dataset/84799NED/table

Matter

Composition

The literal clearance of matter is the soil in the waterways. This is already done to a certain extent in order to keep the waterways navigable and keep the water clean. However, what if we clear the waterways more than we are used to and therefore increase the amount of water that can be there?

Figure A13 - Possibilities of opening up existing waterways furhter

Figure by author, 2021

Matter

Alteration

The possibility of widening up the waterways opens up new possibilities of the functionality of the waterways. Because of the new width of the waterways, boats can navigate through the waters, creating a new mode of transportation in the area. This could eliminate the threat of losing critical infrastructures in times of high water, as the main mode of transportation could shift to transportation by boat.

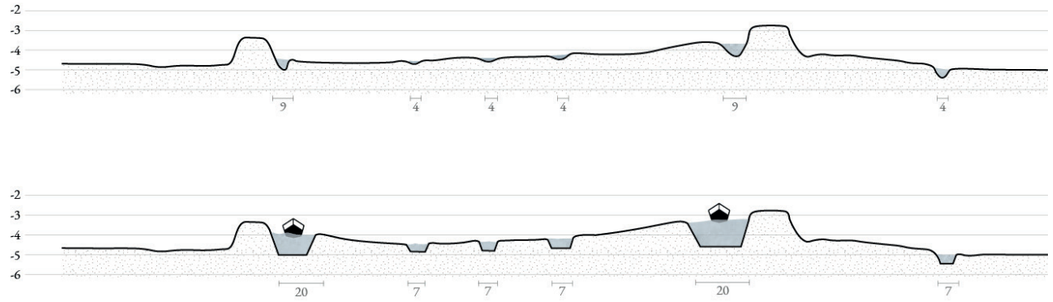


Figure A14 - Effect of widening the waterways

Figure by author, 2021

AHN (n.d.). Actueel Hoogtebestand Nederland. Retrieved on 18-11-2021. Retrieved from: https://www.ahn.nl/ahn-viewer

Matter

Limitation

The soil will have to be put to good use. Most probably, there is a need for the dug-out soil in various industries in the area. The soil can be used to heighten dikes, construct roads, or heighten the level underneath the built environment. However, what are high quality uses of the soil? In this way, the highly fertile soil will not go to waste but can be used in a place in which it comes into its own.
Furthermore, clear decisions need to be made about how wide and how deep the waterways will have to be. To do this, further investigation is needed into a lot more components. Questions that can be analysed, for instance, can be the following: What will the new functionality of the water be? How will the landscape look like?

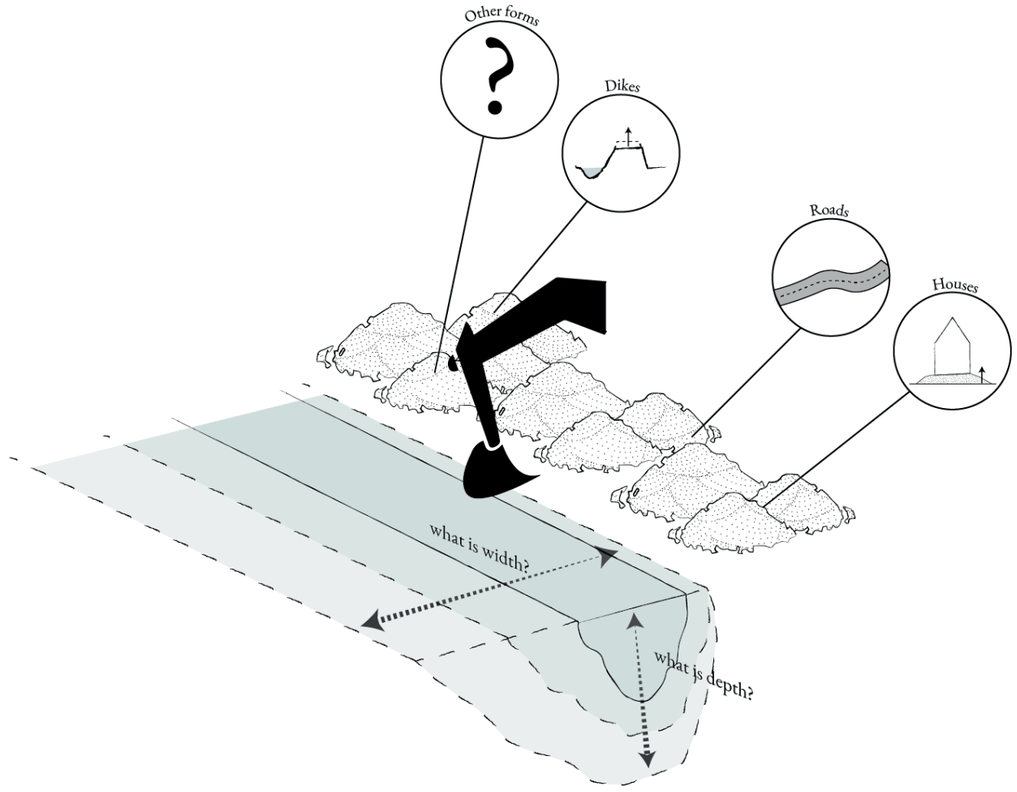


Figure A15 - Limitation of high quality soil use

Figure by author, 2021

Topos

Composition

The map shows the clearance of the current borders of the polders. What if, to alter the current situation, we fill the polders with water. This could first be in terms of high water, in order to store the water until it is safe to let it out again, but the area could also benefit from a freshwater reserve. This water can then be used in dry times when freshwater availability is low. This can ensure the continuation of agriculture in the area, on the fields in parts of the polder that are not underwater. The water then also receives a seasonal aspect and can ensure awareness of the ongoing problematisation.

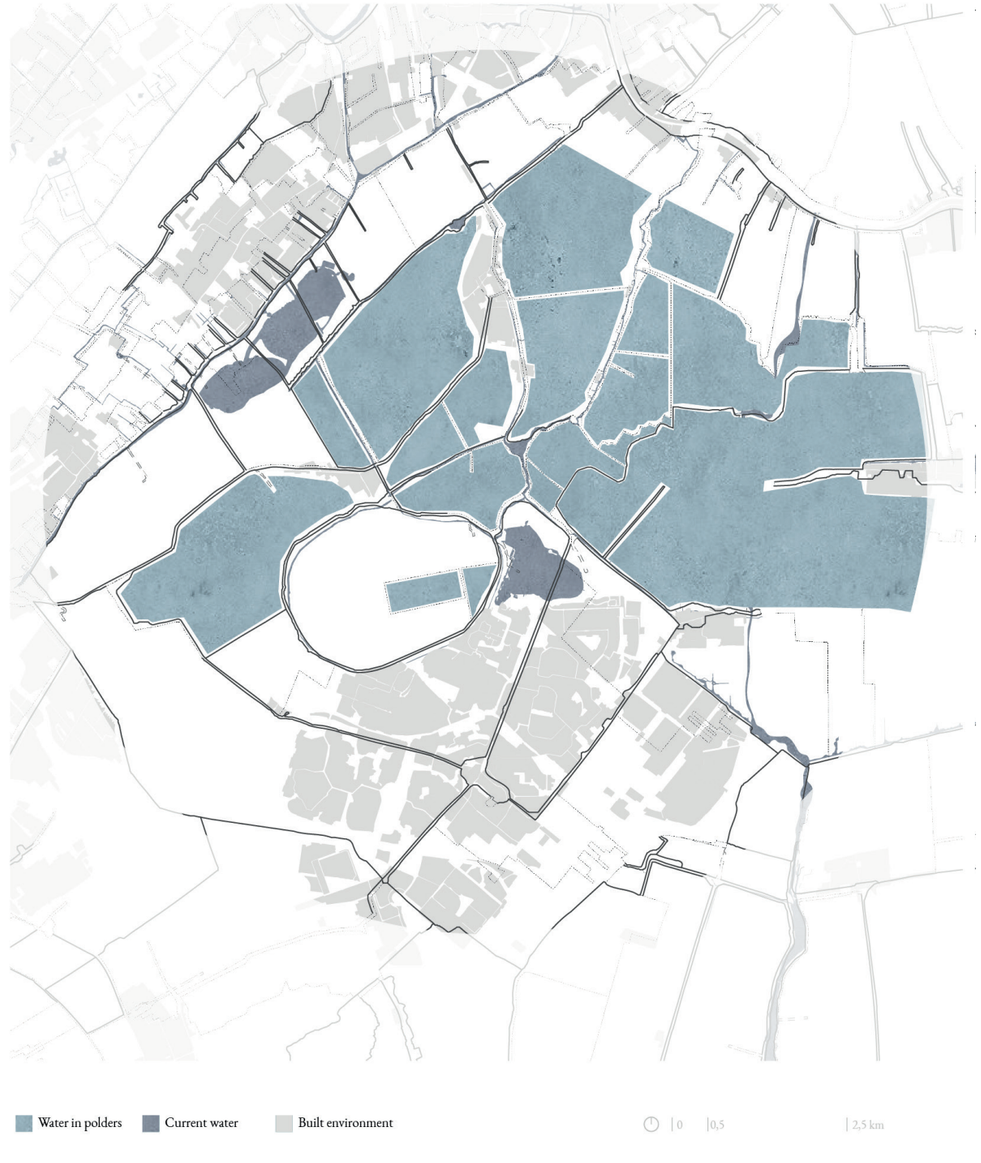


Figure A16 - Composition of polders underwater

Figure by author, 2021

Bobbink, I. (2016). De Landschapsarchitectuur van het Polder-boezemsysteem.

Topos

Alteration

The water on the land will make for a possibility of new functionalities in the polder. The land, when underwater, will not be able to be used in the conventional way as farmers now do. However, the land can still be productive. There is the possibility of growing new types of crops that have the ability to grow in wet soil. A new type of farm, such as fish farms can also arise because of the shallow waters on the land. Furthermore, as the water fluctuates throughout time and water levels cannot always be ensured, it could well be possible that the area is filled with solar panels. The landscape is then productive in ways it has never been before. Between the land that is underwater and the land that is higher and dry, a new dependent, hybrid system can be established, with functions that are existing or are yet to be determined.

Figure A17 - Potential functionality after polder put underwater

Figure by author, 2021

Limitation

This asks for a change of the inhabitants, politics and industry users. There have been several adaptive cycles in the area over the last centuries, all with their own adaptation time. The area used to be wetlands before the peat was dug out and the polders were dried. It stayed like that for a long period of time before the city of Zoetermeer was built up from the ground within 30 years. How long will it take before this extreme measure will be accepted? Measures like this can be fundamental changes to the status quo and can require lots of time for planning and implementation, especially when you consider that social processes can hamper the acceleration of adaptive measures (Haasnoot et al., 2020). It is therefore important to continuously think about the end-user and the process of implementing new ideas.

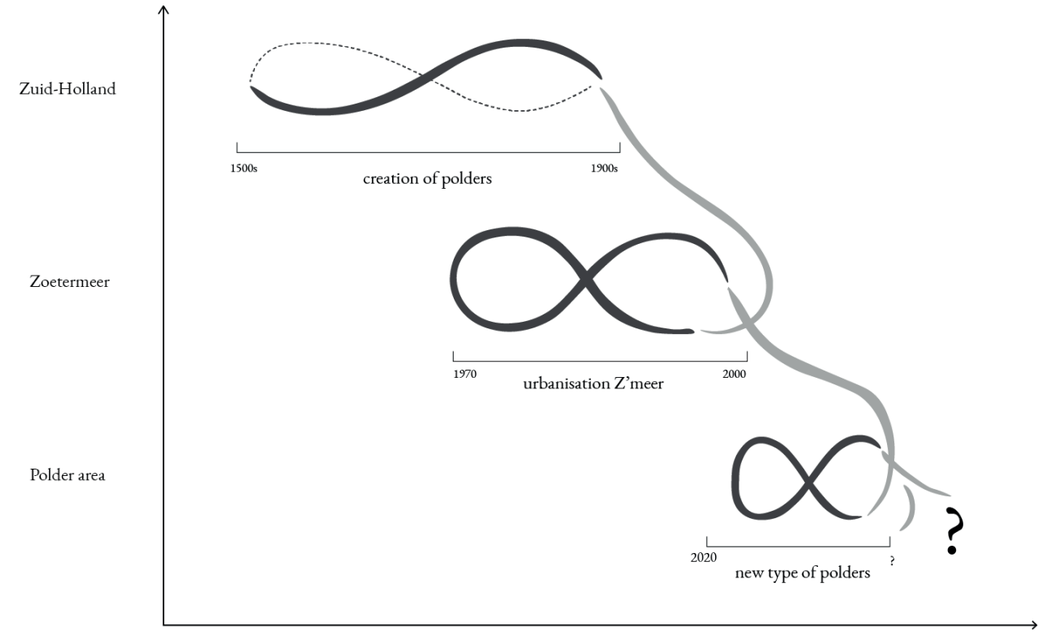


Figure A18 - Adaptive cycles of various landscape changes

Figure by author, 2021

Jiménez, M., Pérez-Belmont, P., Schewenius, M. et al. Assessing the historical adaptive cycles of an urban social-ecological system and its potential future resilience: the case of Xochimilco, Mexico City. Reg Environ Change 20, 7 (2020). https://doi-org.tudelft.idm.oclc.org/10.1007/s10113-020-01587-9

Habitat

Composition

The habitat line discusses the functions in the urban environment. What if these were shuffled in a way that parts of the urban area were allowed to flood? The area would be reconstructed to house functions at different levels so that different parts of the area would be safe in case of flooding. All current urban areas would be rebuilt to receive an elevated centre. This core would then house the vital functions that the area needs, such as a doctor or hospital and supermarket. Smaller urban cores will be connected to larger cities via roads that are elevated enough to be used in case of high water.

Figure A19 - Relocation of functions in the current urban environment

Figure by author, 2021

Habitat

Alteration

In section, there would be different plains at different heights for the various functions. Parks and sport's facilities would lie on the outskirts of the city, whereas the vital functions of the city would be kept high and dry in the core. Different levels in the housing areas can also be created, so that several areas would be safe. These areas would then not only house the current inhabitants but will have to be designed as such that evacuees would also be provided with a spot that is safe from the high water.

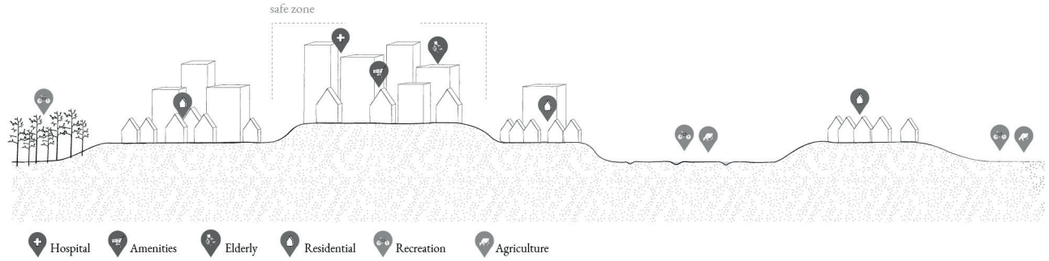


Figure A20 - The alteration of relocation of functions

Figure by author, 2021

Habitat

Limitation

The main question with this type of measure is: how to decide what functions are so vital that they are not allowed to be flooded? Ask different stakeholders and you will get various answers. Probably the easiest decision will be the question of hospitals and elderly homes. But then what follows? Vital amenities such as supermarkets will get their spot too, but after that, it may start to get increasingly blurry. Houses can be flooded and can be made to be allowed to flood, but who will cover the costs once such an event happens? Furthermore, food supplies come from farmers. But what if all farms in the area are flooded as they are located in the lowest-lying part of the area?

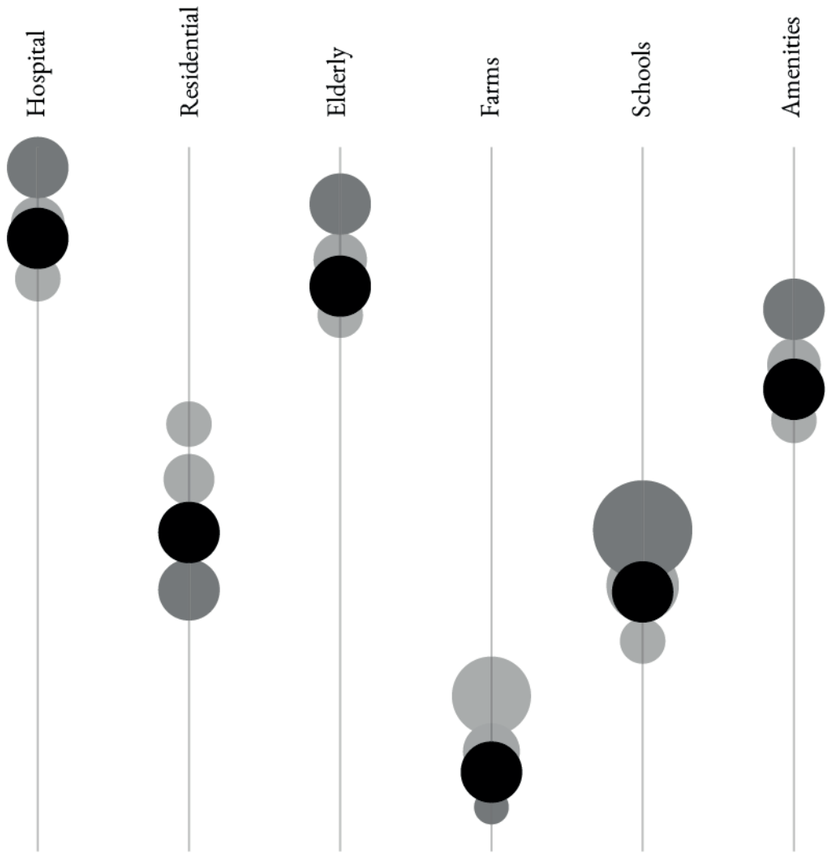


Figure A21 - Agreement of importance of various uses in the area

Figure by author 2021

Geopolitics

Composition

As mentioned prior, there is a large demand for housing in the area. What if we were to build a new urban area in the polder landscape of the current Groene Hart? To fulfil the need until 2029, an area a little smaller than Zoetermeer would be needed (BPD, 2021). However, the historic polder landscape will have to make way for a large-scale urban intervention.

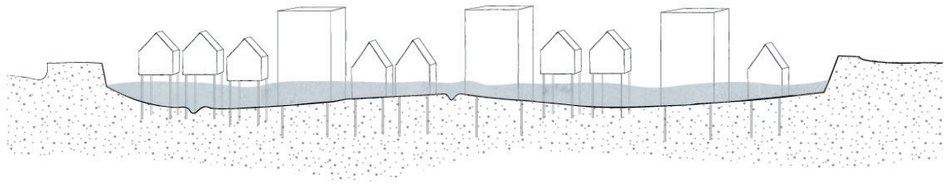
Figure A22 - Creating new urban environment in the current polder landscape

Figure by author, 2021

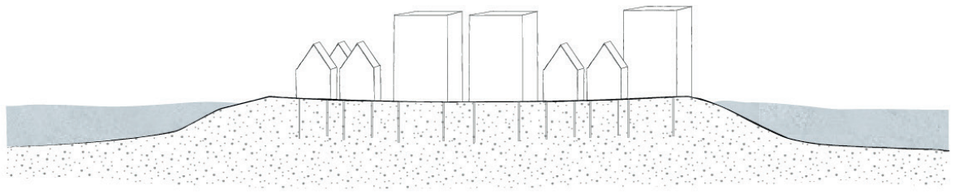
Geopolitics

Alteration

The area is prone to flood in the future. That is why, to make houses futureproof, their connection to the ground floor should be altered. To accommodate the water, the houses could for instance be on poles. In this way, water levels would be able to rise underneath the house, without its main function being lost. Another option would be to keep houses on the ground level but to make the first-floor flood-proof. This would need an alteration of the structure on that level, but also a change in the interior of the house. The last option would be to build houses on mounds, as historic Dutchmen did as well. In this way, the houses would not have to be changed in functionality. Furthermore, a connection to surrounding houses and vital functions can then be maintained through current modes of infrastructure in times of high water.



Houses on poles/first floor allowed to flood



Mounts for new expansion

Figure A23 - Potential necessary adaptations to houses

Figure by author, 2021

Geopolitics

Limitation

Currently, there is a certain ratio of the built environment and polder landscape. At this moment, this state is in balance and will only change in the occurrence of a large event. When creating a new border of the urban environment, a new state in the system is created. It is uncertain what the new balance will be and what the effects will be on the local climatic conditions. This depends on a myriad of factors, that will all need to be analysed. This could be the way the houses are built and relate to the landscape, the contribution that the newly built area will make to the Urban Heat Island effect, the way transportation is arranged, and so on.

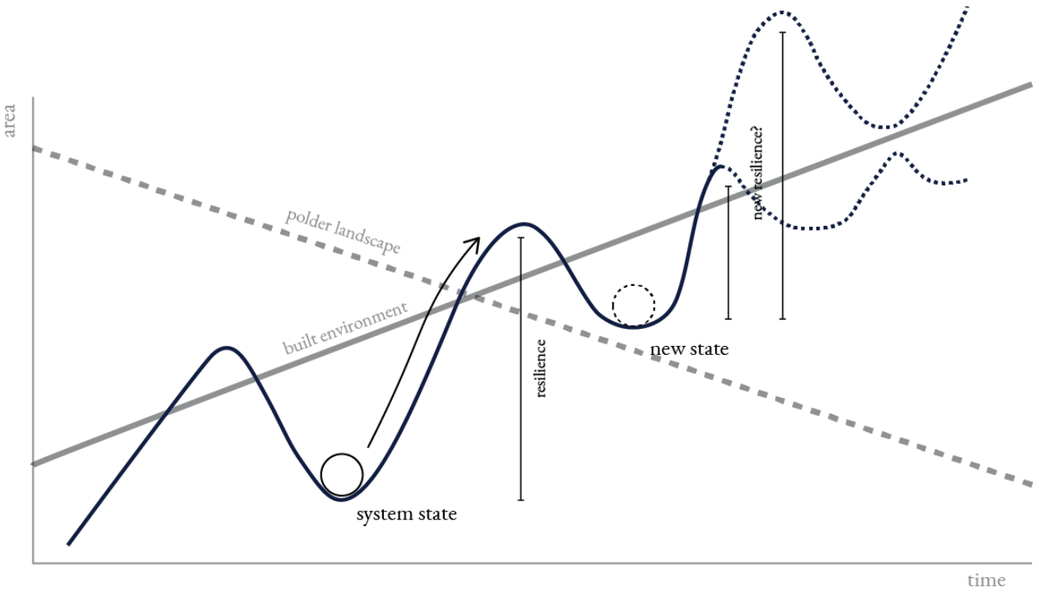


Figure A24 - The new system state after alteration of the ratio polder landscape:built environment

Figure by author, 2021

Appendix E - Workshop Just Delta Management

Delta Futures Lab

Addressing questions of justice in delta management with the Capability Approach

How to include ‘justice’ in delta management? Next to safety, efficiency, and sustainability, justice is an important dimension of good water governance. However, the concept of ‘justice’ is notoriously contested. People have different ideas about what ‘just’ water policy should look like. The Capability Approach is one flexible ethical framework that provides some normative foundations for thinking about questions of distributive and procedural justice in Delta Management. In this lecture, the Capability Approach as a policy evaluation method is explained and introduced as an alternative to the Cost-Benefit Analysis. The opportunities and limits of using the Capability Approach in research and policy are discussed, drawing upon empirical insights from the Dutch South-West Delta.

Facing the risk of accelerated sea level rise and soil subsidence, land use changes in the Dutch Delta seem inevitable. However, what kind of land use functions should we sustain? A topic of heated political debate is for example turning agricultural land into wetlands. Can we find a third way out, to balance different justice claims, or do we have to prepare for difficult trade-offs between coastal armoring and managed retreat?

Within a small group of students (7 – 10), you will explore multiple conceptions of ‘justice’ in Delta Management. The workshop is interactive and based upon a role play and discussion. The goal is to dissect different lines of argumentation and brainstorm about the multiple faces of justice in long-term delta management. Together, we may come up with new kind of problem definitions and solutions by looking at the dilemma through different scalar lenses.

Appendix F - Workshop Unravelling the Future

Vereniging Delta Metropool x Jong BNSP

“At the Deltametropool Association, we are increasingly taking the distant future into our work. We have a view on the challenges and uncertainties that we might have to deal with in the long term. Do you also want to become part of long-term thinking? Would you like to visit our office and experience how we work? Then sign up for the office visit + workshop!

As planners, we sometimes get lost in the present and forget about the long term. On a daily base, most of us are working in the here and now, often with time horizons of 20 to 30 years. Not to mention politics and society – which are most of the time where the issues of the day reign. However, we also know that a lot of what we build will be difficult to reverse and will therefore have an effect on our living environment and society for about, another 80 years. As planners, we need and must reflect better in the long term: What are the changes that might be coming and how can we best prepare for them? What are the consequences of what we are doing and are not doing yet? What are the possibilities that we leave for future generations to keep the Netherlands a safe and liveable country? It is more than time to take our long-term responsibility. This can start in the world of spatial planning.

Imagining, transforming, designing and reinforcing our “Deltametropolis” has been the mission of the Deltametropolis Association for more than 20 years now. We do by looking far ahead, with a view on the challenges and uncertainties that we will have to deal with in this long term. Through a number of ongoing projects, we try to bring long-term thinking to the attention of other parties and to stimulate it. By breaking out of the daily habits and institutional frameworks together with colleagues (civil servants, researchers, designers, etc.), we manage to get new insights into the consequences of our actions in the here and now.”

https://deltametropool.nl/activiteit/unraveling-the-future/