A People's Water Landscape

A community based regional landscape design approach for a changing water system

Master Thesis Landscape Architecture
Wageningen University and Research Centre

Frank-Juriën Dam, BSc

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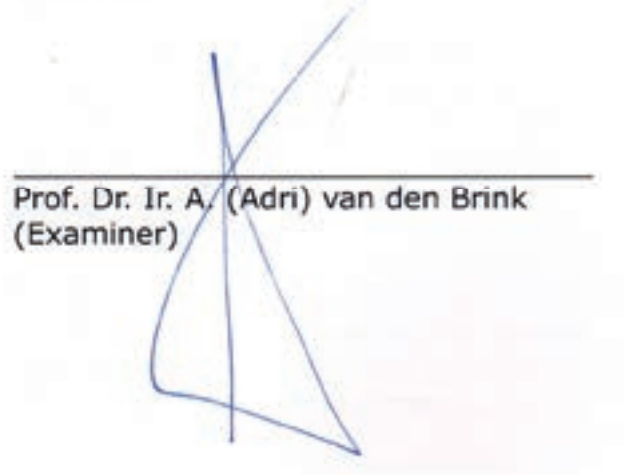


Prof. Dr. Ir. A. (Adri) van den Brink
(Examiner)

During one of my sailing trips I entered Hasselt over the Zwarte Water river, on a Skûtsje, a former freight ship, pulled by a small tugboat.

Preface

Water and the Dutch are inseparable. For me, that is even more true because of my background as sailor and because of my roots in the water landscape of north west of Overijssel. During my thesis I became aware that major things are going to happen in the Dutch water landscapes. I focused on the IJssel lake area, where in 2008 the Delta committee suggested a water level rise of 1,5 meter. This would mean a major impact on the landscape around the lake, like the historical harbours. I also knew that in the region where I grew up, the Zwarte Water river is in direct contact with the IJssel lake: major changes in the water level of the IJssel lake meant major changes in the Zwarte Water region. In this thesis I have developed a method to prepare the landscape for changes in the water system, which reconnects people with the water landscape. The several cycling and hiking trips through the study area during this thesis process gave me inspiration and new insights in the area which I already know for such a long time.

I would first all like to thank Marlies Brinkhuijsen and Annet Kempenaar, who guided me trough the thesis process with helpful information and inspiration. Furthermore, Adri van den Brink and Maarten van der Vlist have to be mentioned for their valuable support as well.

Finally, I want to thank my fellow students, friends and family for their mental support, inspiration and criticism during this thesis process.

Summary

This thesis started with the problem that due to climate change, economic and social growth, and new insights in protection by dikes, the water system has to be updated significantely. However, the solution to heighten the dikes even more decreases the link with the water system: people asume they are safe, while higher dikes result in bigger catastrophes in case these dikes breach. Together with this fact, people are less connected with the water system making them less prepared for flood disasters, and people are less aware of changes within the dynamic water system. The alternatives to update the water system, especially within the 'Space for the River'-program, for example the river bypass in Kampen, avoid the heightening of dikes but create other problems: the major transformation of the land results in a landscape which people do not have a connection with and which have vanished their traces.

This challenge could be tackled by a landscape architectural approach which is integrative, process based, switches between scale levels, and which takes its inhabitants as integral part of the landscape. The region on which the approach will be tested is the Zwarte Water region. This former estuary is the place where the IJssel lake and the Vecht river come together. This means that changes in the water system come from both sides: both up- and downstream.

The problem and approach to solve this come together in the following subquestion:

"How could a water system be adapted on the basis of a landscape architectural design strategy, with the focus on the local community?"

First, the values of the community within the landscape have been analysed. It turned out that people have an inherent connection with their landscape, which could be seen as their home. Landscape influences their inhabitants, and inhabitants inlfuence the landscape. Pedroli et al. (2011) gives 4 interpretations of this phenomenon of landscape identity, that together represent the values of people in the landscape. The following values can be distinguished:

- Continuity
- Legibility of landsape characteristics
- Legibility of stories and traditions
- Legibility of interventions and processes
- A healthy economy, community and ecology
- Distinctiveness
- Diversity, complexity and mystery
- Adaptivity and supporting a dynamic landscape
- Accessibility and facilities

Next, the Zwarte Water region has been analysed on basis of these values. It turned out that the region is highly connected with the water system: The Zwarte Water river is the axis of the region along which the cities have developed, and on which the present economy is based with for example the carpet industry, shipping and recreation. Besides that, furhter away from the Zwarte Water the water has played an important role in forming the landscape: the landscape of the Mastenbroek and other places in the Zwarte Water region are full of mounds. However, the link with the water has been decreased and is less clear nowadays, the water system is not very accessible and experiencable, and the landscape is being used as if flooding is not a possibility anymore.

These characteristics of the several aspects of the Zwarte Water region landscape have been used to determine which water strategies could be implemented at which locations. First of all, 4 water management strategies have been developed based on lists of interventions and strategies as found in literature. These are:

- Resistance, about dikes and pumping stations to control the water system.
- Buffering, which includes retaining, storage and drainage, to reduce peaks within the water levels.
- System resilience, a natural approach to the water system, about sedimentation and abandoning.
- Disaster resilience, about preparation for critical water levels, to reduce damage and losses of lives in case of a flooding disaster.

Each of these strategies represent a small list of interventions. The impact on the landscape of each list of relevant interventions for each sub landscape in the Zwarte Water region are then compared with the landscape identity values. It turned out that in some strategies mostly have positive effects on the values, while other strategies have a negative effect, but in most cases more than 1 strategy is possible for each sub landscape. The determination of one or more strategies per sub landscape then had been translated into a map where all interventions have been visualized.

However, this approach only shows which interventions are the best for each sub landscape, not how they should be implemented based on the landscape identity values. Therefore the process approach has been introduced. This consists out of two design principles:

- Legibility of the existing
- Legibility of the new

The first is about conserving the existing landscape as much as possible, and avoiding ruptures. This keeps stories and traces of people within the landscape tangible. Therefore a subtle transformation of the landscape is required. The second is about creating awareness for interventions. Both awareness for the changes of the dynamic water system as well as the awareness for future interventions help to create an understanding of what is happening within the landscape. To create awareness the landscape has to be made experiencable, for example by making new paths along the water system.

These principles are then translated into a time line. The first step is to increase the awareness of the water system and to make the water system more clear and experiencable. The second step is to make use of zoning and policies to influence longterm processes, such as the obligation to built on mounds in some areas and the prohibition to built in bypass reservations. The third step is to actually implement the interventions as determined in chapter 4 at the moment they will be required.

The approach was then tested on 2 locations within the Zwarte Water region. In Wolfshagen in the Mastenbroek polder the approach leads to an interesting landscape where the restored creek network contrasts with the robust compartment dikes and new mounds that strengthen the rectangular polder structures. The design for the bypass in Zwolle (the second location) shows the elaboration of the longterm approach where the implementation of the bypass is postponed, in order to create awareness, for example by iconic paths represen-

ting the border of the bypass, and to give the sports facilities the time to be replaced.

These detailed designs show that the time line has to be slightly adjusted (fig. I): Smaller and less controversial interventions, like the broadening of waterways, could be combined with awareness interventions. Bigger and more controversial interventions like dike heigtening and bypasses are postponed until later.

To conclude, a landscape architecture design strategy to adapt regional water systems should take the local community as its basis, represented by the values that connect people and their landscape, as determined in chapter 2, to determine which water management strategies fit the best in each sub landscape, and to determine how these water management strategies should be embedded in the landscape using a process approach.

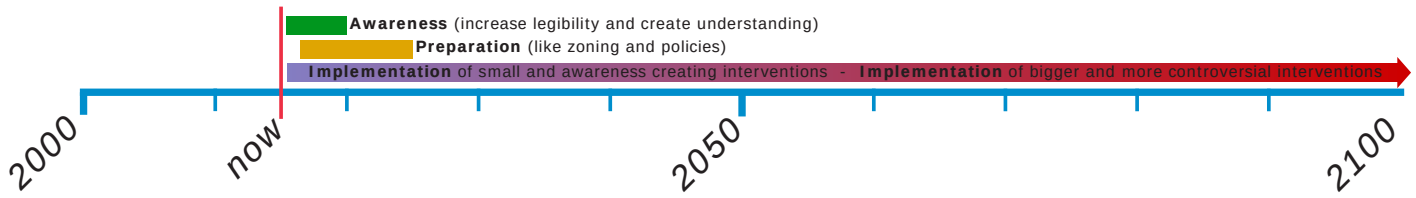


Figure I | *The process approach timeline.*

Samenvatting

Deze thesis begint met de probleemstelling dat door klimaat verandering, sociaal-economische groei en nieuwe inzichten in dijkenbouw, het water systeem aanzienlijk geactualiseerd moet worden. De oplossing om dijken steeds weer opnieuw te verhogen voldoet niet, dit vermindert namelijk de verbinding met het water systeem: bewoners denken dat ze veilig zijn terwijl hogere dijken juist resulteren in grotere rampen mochten er dijken doorbreken. Tegelijkertijd zijn door de verminderde verbinding met het water veel mensen niet bewust van het feit dat ze zich zouden moeten voorbereiden op mogelijke overstromingen, en zijn veel mensen zich ook niet bewust van de veranderingen in het dynamische water systeem. De alternatieven om het water systeem veiliger te maken waarbij het verhogen van dijken wordt vermeden zien we vooral terug in het 'Ruimte voor de rivier'- programma, waar bijvoorbeeld de IJssel bypass bij Kampen voor nieuwe problemen zorgt: de grote veranderingen in het landschap die de ingrepen teweeg brengen resulteren in een landschap waar mensen geen verbinding meer mee hebben, en waarin hun herinneringen en sporen zijn verdwenen.

Een landschapsarchitecturele benadering kan deze uitdaging aan gaan: deze benadering verbindt de lagen in het landschap, is gebaseerd op processen, het schakelt tussen verschillende schaal niveaus, en ziet bewoners als een integraal onderdeel van het landschap. Deze benadering wordt getest op de Zwarte Water regio. Dit voormalige estuarium gebied is de plek waar de rivieren de Vecht en de IJssel samen komen in een vallei die uitmonden in respectievelijk het Zwarte Meer en het Ketelmeer, en vervolgens samen in het IJsselmeer. Dit betekent dat veranderingen in het water systeem van twee kanten komen: zowel bovenstrooms als benedenstrooms.

De probleemstelling en de benadering komen samen in de volgende onderzoeksvraag:

"Hoe kan een water systeem aangepast worden op basis van een landschapsarchitecturele ontwerp strategie, met de focus op de lokale gemeenschap?"

Als eerste zijn de waarden bepaald, die het landschap en de lokale bevolking met elkaar verbinden. Het blijkt dat mensen inherent met het landschap zijn verbonden en dat het landschap gezien kan worden als een thuis. Het landschap beïnvloed haar bewoners, en bewoners beïnvloeden het landschap waarin ze wonen, wat samen gaat over landschapsidentiteit. Pedroli et al. (2011) geeft 4 interpretaties van landschapsidentiteit, waaruit meerdere waarden die de mens en het landschap met elkaar verbinden gedestilleerd kunnen worden. De volgende waarden kunnen worden onderscheiden:

- Continuïteit van het landschap
- Leesbaarheid van landschapskarakteristieken
- Leesbaarheid van verhalen en tradities in het landschap
- Leesbaarheid van ingrepen en processen in het landschap
- Een gezonde economie, gemeenschap en ecologie
- Onderscheidend vermogen
- Diversiteit, complexiteit en mysterie in het landschap
- Een dynamisch landschap en het vermogen van het landschap zich aan te passen
- Bereikbaarheid en voorzieningen

Vervolgens is de Zwarte Water regio geanalyseerd op basis van deze waarden. Hieruit blijkt dat de regio een grote verbintenis heeft het met water systeem: de rivier het Zwarte Water is de as van de regio waarlangs de steden zich ontwikkeld hebben en van waaruit de hedendaagse economie zich heeft ontwikkeld met bijvoorbeeld de tapijt industrie, scheepsbouw en recreatie. Ook buiten de grenzen van de rivierloop heeft het water een belangrijke rol gespeeld: de polder Mastenbroek en andere gebieden langs het Zwarte Water liggen vol met boerderijterpen. Echter, de connectie met het water is steeds minder geworden; het water systeem is minder duidelijk, het water systeem is niet heel toegankelijk en beleefbaar, en het landschap wordt ingericht alsof overstromingen niet meer mogelijk worden geacht.

Deze eigenschappen van de landschappen in de Zwarte Water regio zijn vervolgens gebruikt om te bepalen welke water management strategieën op welke plek het meest geschikt zouden zijn. Als eerst zijn 4 water management strategieën ontwikkeld, gebaseerd op lijsten van mogelijke interventies en strategieën zoals deze in de literatuur gevonden kunnen worden. Dit zijn:

- Weerstand, wat gaat over dijkverhoging en gemalen om het water systeem te controleren.
- Buffering, wat gaat over het vasthouden, bergen en afvoeren van het water om zo pieken in de waterhoogtes te verlagen.
- Systeem veerkracht, een benadering over het terugbrengen van natuurlijke processen in het landschap, zoals sedimentatie en het verlaten van gebieden.
- Rampen veerkracht, wat gaat over het voorbereiden op waterhoogtes waar de hedendaagse dijken niet tegen bestand zijn, om de schade van een overstroming te beperken, zoals overstroombare dijken, compartimentering en vluchtroutes.

Elk van deze 4 strategieën vertegenwoordigd een lijstje aan ingrepen. De gevolgen die de ingrepen van elke strategie op de individuele landschappen hebben, zijn vervolgens vergeleken met de waarden die mens en landschap verbinden. Een aantal strategieën blijkt vooral positief te zijn voor deze landschappen, anderen blijken negatieve effecten te hebben op het landschap, maar in de meeste gevallen blijkt dat meer dan één strategie mogelijk is die voornamelijk positieve effecten heeft op het lokale landschap. Deze uitkomsten zijn vervolgens vertaald naar een conceptuele kaart waar de ingrepen benoemd worden.

De benadering hierboven laat echter alleen zien welke ingrepen waar zouden moeten plaatsvinden, maar het zegt niets over hoe ze uitgevoerd moeten worden. Daarom wordt hier de proces benadering geïntroduceerd, welke bestaat uit twee ontwerp principes, en samen de kern vormen van de landschapsidentiteit waarden:

- Leesbaarheid van het bestaande landschap
- Leesbaarheid van het nieuwe landschap

De eerste gaat over het zoveel mogelijk behouden van het bestaande landschap en het vermijden van grote veranderingen, om zo verhalen en sporen van mensen in het landschap tastbaar te houden. Dit vergt een subtiele transformatie van het landschap. Het tweede principe gaat over het vergroten van besef voor een veranderend water landschap. Dit gaat zowel over het vergroten van het besef dat het

water systeem dynamisch en veranderend is, als het duidelijk maken hoe individuele ingrepen een landschap laten veranderen. Om het besef dat we in een veranderend landschap wonen te vergroten, zou het landschap meer beleefbaar gemaakt moeten worden, bijvoorbeeld door het aanleggen van paden langs het water.

Deze principes zijn vervolgens vertaald naar een stappenplan. De eerste stap is het vergroten van het besef dat het landschap aangepast moet worden, wat gedaan moet worden door het meer beleefbaar en leesbaar te maken. De tweede stap is het reserveren van land en het invoeren van beleid om lange termijn processen te sturen, zoals in dit geval het verplicht stellen dat in sommige gebieden nieuwbouw verplicht op terpen moet plaats vinden, maar ook het verbieden van nieuwbouw in bypass reserveringen valt hieronder. De derde stap is het inpassen van de ingrepen in het landschap, op het moment dat ze nodig worden geacht.

Deze methode is vervolgens getest op twee locaties in de Zwarte Water regio. In Wolfshagen in de Mastenbroeker polder leidt deze methode naar een landschap waarbij de herstelde kreken contrasteren met het robuuste, vlakke en rechthoekige landschap van de polder met zijn nieuwe compartimentering dijken en nieuwe terpen. Het ontwerp voor de bypass in Zwolle laat een uitwerking zien van het lange termijn proces waarin de daadwerkelijke aanleg van de bypass wordt uitgesteld naar een later moment. In tussentijd wordt een voorbereidend en tijdelijk landschap aangelegd, waarin bijvoorbeeld iconische paden de randen van de toekomstige bypass laten zien en waarin men de tijd krijgt de sportvelden opnieuw over het terrein te verdelen.

De toepassing van het stappenplan in de detail ontwerpen laat zien dat het stappenplan nog iets aangepast moet worden (fig. II): kleinere en minder controversiële ingrepen, zoals het herstellen van kreken, kunnen gecombineerd worden met ingrepen die het landschap en de dynamiek verduidelijken. Grotere en meer controversiële ingrepen zoals dijkverhoging kunnen uitgesteld worden tot later.

Uit het bovenstaande kunnen we concluderen dat een landschapsarchitecturele strategie om een regionaal water systeem aan te passen, de lokale gemeenschap centraal moet stellen, waarbij de waarden die de mensen en het landschap met elkaar verbinden, zoals in hoofdstuk 2 opgesomd, ten eerste de best passende water management strategieën bepalen voor elk individueel landschap, en ten tweede bepalen deze waarden hoe deze water management strategieën in het landschap ingepast dienen te worden op basis van een procesbenadering.

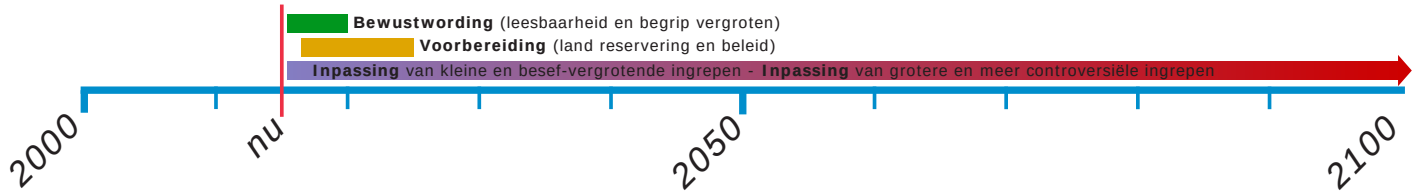


Figure II | *Het stappenplan.*

Index

Introduction

1.1 Problem introduction

‘Are you Dutch? That’s great! We need you guys!’
(Intermediair 2008, about Dutch water engineers in New Orleans)

Our immemorial battle with the water has resulted in an internationally recognized knowledge about water management. The Dutch have been fighting against the water for centuries, and even in the 20th century we had to cope with extreme floods and land that was taken by the sea, like in 1953. But the water also brought economic prosperity and wealth, for example by shipping, resulting in famous cities like Amsterdam.

However, nowadays the link with the water has decreased. For transport we mainly use roads, and we made our dikes high enough to safeguard the inhabitants, eventhough many of us live below sea level.

But due to climate change, we have to question our water safety once again. According to the IPCC in their report of 2013, ‘warming of the climate system is unequivocal’: the climate is changing, especially due to anthropogenic influence. On the one hand, we as landscape architects should work on mitigation, like emission reduction and ‘energy landscapes’. However, due to the fact that higher sea water levels and more extreme water conditions seem inevitable, we as landscape architects should especially work on the adaptation to climate change. We have to be aware that the sea water level could have rise to over 1 meter in 2100, as stated in the scenarios model used by the Delta Committee 2008 (fig. 1.1.1).

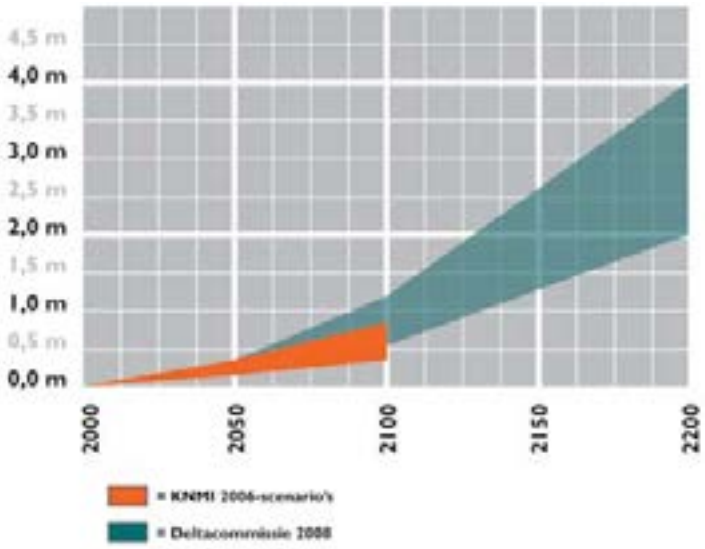


Figure 1.1.1 **|** *This graph shows the ‘Delta Scenarios’ for sea water level rise. The red bandwidth represents the expected possible water level rise, the grey bandwidth a water level rise possibility we cannot ignore. (Delta committee 2008)*

Not only climate change demands to rethink our water safety, our dike norms should be reconsiderd as well. The low zone of the Netherlands and the river areas are divided into dike rings. Every dike ring has its own assigned dike norm, the risk that a flood can occur due to failure of the dike which is mostly based on the size of the dike ring, the economical values, the amount of people living there, and the depth of a dike ring. This results in dike rings along the Meusse river with an exceedance probability of once per 100 years, and the Randstad dike ring, ring 14, with an exceedance probability of once per 10000 years.

Important is the fact that the dike norms are too low. Eigenraam (2006) states that both because of the growth of the economy, the number of people, and a wrong calculation, dike norms

- originating from the sixties with the first Delta plan - should be much higher. Furthermore, new insights in for example 'piping' show dikes are not up to date (fig. 1.1.2) With the 'expected yearly loss', Eijgenraam (2006) gives a calculation that could deal with changing water levels and the development of the economic and social values within the dike rings.

Figure 1.1.2 **|** *The red dike segments are not up to date. (Inspectie V&W 2011)*

Dikes have to be made even higher if we want to keep the same level of safety. The second Delta commission proposes to make all dikes 10 times saver, and even proposes to think about an unbreakable dike, making the dikes even 100 times saver (Kennis voor Klimaat 2013). But we are also aware that dikes cannot be made higher to infinity; the higher a dike, the bigger the disaster in case of failure. And the higher a dike, the lower the awareness of the flooding risk. Recently, approaches like the Dutch 'meerlaagsveiligheid' ('multi level water safety') have been introduced to decrease the consequences of flooding within dike rings (Nationaal Waterplan 2009).

With climate change and too low dike norms the Netherlands faces new challenges in their water management. The Delta plan by the Delta commission from 2008 was the beginning of a new process to increase the water safety in the Netherlands (fig. 1.1.3), not only by increasing the height of dikes, but to seek for smart solutions within our water landscapes as well.

Figure 1.1.3 **|** *The Delta plan: many different sub regions that all need specific interventions (Delta commission, 2008)*

1.2 Society context

In the previous chapter we saw the need to adapt our water systems, due to for example climate change and other insights relating to the water system. The classical way to adapt water systems to higher water levels is to raise the dikes. However, raising the dikes does not always have positive effects on the landscape: for example a historical city centre that looses its characteristic water front (as can be seen in Verbeek (2011) (fig. 1.2.1)), or dike houses that disappear behind high dikes.

Figure 1.2.1 **|** *Dike raising could lead to the loss of characteristic waterfronts in historical city centres, as this visualisation for the waterfront of Enkhuizen shows: here a dike is placed in front of the characteristic dike with wall. (Verbeek 2011)*

High dikes also decrease the link between the local community and the water system. Roth et al (2006) state that higher dikes will decrease the chance that a disaster will happen, but increase the damage of the disaster. This means that people presume to be safe because of the low chance of a flood, eventhough they actually need to prepare for serious flooding. In general they are not prepared. In many cases, they are not even aware of the consequences of a possible flooding disaster (Wanders 2010, Metz 2012). In general, people rely on their government for their safety. Furthermore, Rijkswaterstaat states that the campaign 'Nederland leeft met Water' increases the awareness of the Dutch, while contrasting to this, Roth et al (2006) and Metz (2012) state that the government is lacking their responsibility for this safety, for example by lacking the maintanance of the dike system.

The near-floods of 1993 and 1995 in the river area, as well as the climate change and the outdated dike system were major challenges which changed the Dutch approach to the water system. To tackle these challenges alternatives were introduced, especially the 'Space for the River'- program, which mostly includes new gullies and dike displacements. (Roth et al 2006)

However, this approach did not make local inhabitants satisfied. Agricultural landscapes, which mostly include natural areas as well as some homes, are transformed into floodplains. The 'Space for the River' program resulted into projects near Lent and the Noordwaard which are known for their protests. Especially the IJssel Bypass near Kampen is a controversial project (Box 1). Major spatial planning projects like the Hedwige polder in Zeeland (fig. 1.2.2) and the Wieringermeer border lake in Noord Holland show that the local community does not accept the top down approach in which land is being traded and planned without them. We saw that this resulted in delayed or cancelled projects. After all, these projects affect the landscape in which those people life and earn their money, and which is cultivated by their ancestors.

Figure 1.2.2 **|** *Major landscape planning projects leads to protest, like in the Hedwige polder.*

Nevertheless, the challenges in the water system we face today demands the landscape to adapt and to change. The choices that are being made and the alternatives that will be implemented have to be explained to the local community as good as possible. When we, as landscape architects, focus on the community, those water landscapes could evolve to be more interesting, appreciated and understood, which would be easier to realize as well.

Box 1: IJssel Bypass Kampen

The 1993 and 1995 flood risk was the reason to start with the 'Space for the River' (Ruimte voor de Rivier) programm, to make the Dutch river landscape more flood resistant with interventions such as deepening of winter and summer bed, dike replacement and bypasses. The IJssel Bypass (fig 1.2.1) is a good example of this last intervention. This is a river bypass south of Kampen to reduce the water level of the IJssel river, a Rhine water discharging river.

According to local political parties (Gemeentebelangen Kampen, 2014), the project is not yet required as it was planned as a reservation for the moment when climate change results in much higher river discharges, 18.000 m3/s through the Rhine river to be precise, while today the Rhine could handle up to 15.000 m3/s. However, the province of Overijssel (2014) states that the first phase of the bypass is already required for a 16.000 m3/s discharge of the Rhine, a discharge the river landscape already has to be prepared for now.

The combination of the construction of the new Hanzelijn railroad between Zwolle and Lelystad, housing and water safety are a good example of an integral areal development, where both short (housing and railroad) and long term (climate change adaptation) requirements are combined.

However, the province and municipality promote participation and they claim the project includes 'spatial quality'; the bypass is a typical example of a traditional top-down project. Perhaps this is the reason why many local citizens are not content with the project, or maybe it is because of the large scale of the project, laid out in a delicate landscape.

It seems unlikely that the project will be cancelled.

(Provincie Overijssel 2014, Gemeente Belangen Kampen, 2014)

Figure 1.2.3 *| The IJssel Bypass, with the IJssel on the East side, the city of Kampen on the North side and one of the border lakes and the Flevo polder on the West side. (TV Oost, 2014)*

1.3 Landscape architectural context

1.3.1 Introduction

In the previous chapters we saw that the water system should be updated due to climate change and other insights in the water system, while together with this the link between the local community and water system has decreased significantely, due to low awareness of flooding consequences and the large scale and top down approach of adaptation projects.

Landscape architecture is known for its holistic approach, and with landscape architecture it should be possible to propose landscape interventions that help to adapt the landscape to adjusted norms within the water system, and simultaneously restore the link between the society and the water system. By exploring the interpretations of landscape architecture and the relation between people and the landscape an approach will be determined how landscape architecture could contribute to the challenge to combine the community with landscape adaptations. Together with this the task within this thesis is also to see how such a challenge could contribute to the subject of landscape architecture.

1.3.2 What is landscape architecture

Landscape architects have the landscape as work field, as domain, here they can make a difference, a design. Within the following paragraph the interpretations of these terms are scrutinized.

Landscape

Vroom (2010) gives several interpretations for the word 'landscape' that can be found throughout the literature. For example the visible unity of our surroundings, or the territory we live in. But landscape as painting as well, think about the famous Dutch painters from the seventeenth century. Landscape could also be an office landscape, with elements as desks, chairs, plants and walls. Some see landscape as counterpart of the city, where the landscape refers to the rural idyll. Others see cities as part of the landscape, urban landscapes. The meaning of landscape is dependent on knowledge, values and interests in the landscape. Jackson (1984) maybe gives one of the better definitions of landscape: "Maybe it is not only a scene or an ecological unity, but also a poetic or cultural unity which changes during history", which is still a complex way of understanding the landscape.

According to Motloch (2001) Landscapes are "point-in-time expressions of ecological, technological, and cultural influences." Meinig (1979) states that "any landscape is composed not only of what lies before our eyes, but also what lies within our heads", and exposes ten different ways of seeing the landscape. Related to this, Koh (2008) states that 'nature is a cultural construct', with the argument that the European Landscape Convention states that landscape is formed out of ecology and environment. Whether or not this reasoning is correct, it shows the importance of seeing a concept like the Ecological Main Structure (EHS) not as an ecological restoration. However, as an expression of culture it could neglect local culture. Similar to this, Meeus and Vroom (1986) sug-

gest that “landscapes are wholes that exist and can be defined only on the basis of interpretations. The process of interpretation should be based on both scientific knowledge as well as culturally determined values.”

The many interpretations of the term landscape exist because “the landscape is an integrative, dynamic and evolutionary concept” (Koh 2008). This integrative approach sounds logical, but Papenborg and Togt (2012) state that nature and culture are often being seperated, for example in projects like the EHS, while according to them the best alternative is to combine nature and culture. After all, when nature is a cultural construct nature becomes part of culture with for example the ‘landscape machine’ for the Ems delta by Papenborg and Togt (2012) (fig. 1.3.1).

The idea that the concept of landscape can be seen in different ways because of its dynamic and evolutionary character results in the fact that the definition could be used for men’s own interests (Vroom 2010). Nature organisations take the landscape as something where nature is an important part of. However politicians, planners and designers see the landscape as made by men, which gives them the argument to modify the landscape once again.

Fig. 1.3.1 | Landscape as nature, vs, landscape as culture, with the Ems Delta design by Papenborg and Van der Togt (2012)

Designing the landscape

Modifying our landscapes is our profession. We do this with design; landscape design. Which brings us to the question of what ‘design’ is. Verweij (2014) states that the term ‘design’ has spread in all kind of directions. Design changed from a discipline into a lifestyle, and the term ‘design’ is not only used for creating forms out of all kind of materials, but also out of ideas. New education programs like ‘Business Design’ and ‘Design Thinking’ underline this.

When we look to design within the landscaping practice we can determine a more relevant meaning of ‘design’. For example, Meeus and Vroom (1986) state that “designing implies putting forward proposals for future developments of the landscape”. And Bijhouwer (1954) and Motloch (2001) in Vroom (2010) state that “designing is a creative process, which reacts on the conditions and which includes emotions and meaning.” In addition to this, Motloch (2001) states that “landscape design is the creation of responsive, evocative, meaningful, sustainable, and regenerative landscapes.” Bernard and Loidl (2003) have a more narrow explanation of the term: “Design is coherence”. Ekkers (1990) in Vroom (2010) determines 4 elements of designing: arranging, functionality, referring and aesthetics, elements that relate to Vitruvius’ elements of architecture firmitas, utilitas and venustas.

Crewe (2003) in Vroom (2010) defines several design approaches, in which actual approaches could be mixes of these approaches:

- Designing with a synthetic approach (for example with scenario research);
- Designing with an artistic approach (low scale artistic expression);
- Designing with an analysis approach (determining natural and historical developments);
- Designing with a participatory approach (democratization of design);
- Designing with an ecological approach (design based on natural processes);
- Designing with a symbolic approach (like land art and cemeteries).

Next, design is not only a sheet of paper with lines, it represents the identity of a place and it is a critique and a desire for a place. (De Jong 2008 in Vroom 2010)

Landscape architecture

Landscape architecture can be seen as a combination between science and art, whereby the science part includes 'the required knowledge and understanding of the natural environment, like soil, geology, hydrology, vegetation and climate, but also technical knowledge of building structures like roads and bridges' (Waterman 2009). The art part consists of 'giving shape and evoking an emotional response' (Makhzoumi and Pungetti 1999). This balancing between art and science can be seen in landscape architecture education. While for example the Academy of architecture in Amsterdam focusses on the artistic site of the discipline, Wageningen University focusses on the ecological and scientific approach.

Duchhart (2007) states that spatial form and ecological processes are two major ingredients of landscape architecture. According to Vroom (1983) in Duchhart (2007) this spatial form is about 'sensory delights and meaning', with for example 'visual memories and recognition, regularity, polarity, directions, landscape patterns, rhythm, mass and openness interrelationships' to achieve this. Duchhart states that this rationality in landscape design and analysis is not the right way. Instead, intuition and community should have a major role, whereby the community could be seen as part of the ecosystem. This integrative idea relates to the 'layer cake model', known as the triplex landscape (fig. 1.3.2), by Kerkstra and Vrijlandt (1988) in Duchhart (2007), with an anthropogenic, biotic and abiotic layer. Those three layers are constantly changing with the abiotic layer changing less fast than the anthropogenic. This diversity in dynamics later resulted into a 'philosophical' approach by Kerkstra and Vrijlandt whereby different land uses could be separated from each other with a 'framework', with high dynamic land use like large scale agriculture, which is separated from low dynamic land use like recreation and nature, resulting in Plan Ooievaar (fig. 1.3.3) (Duchhart 2007) and eventually in projects like the EHS.

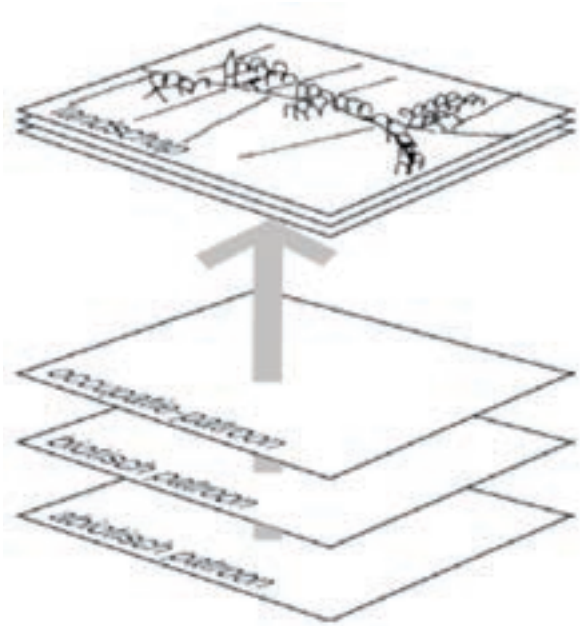


Fig. 1.3.2 | *The Triplex landscape model by Kerkstra and Vrijlandt in Duchhart (2007). This shows the community as part of the ecological system the landscape is.*

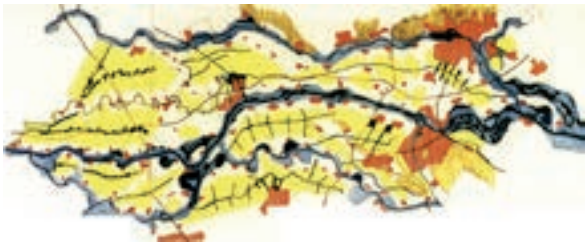


Fig. 1.3.3 | *Plan Ooievaar as prototype of the framework approach, were different functions are separeted from each other.*

According to Vroom (2010), landscape architecture is similar to garden architecture. Garden architecture however is about the combination between art, nature and functionality in one composition, and for a longer time. On the other hand landscape architecture is more about processes and structures on a larger scale, for example the regional scale, which can be steered, and are not fixed in time. The similarity between garden architecture and landscape architecture is nature. Hunt (2000) in Vroom (2010) gives an explanation. Nature can be seen as 3 levels. The first is about wilderness, the untouched nature. The 'religious' status of wilderness of today leads to new wilderness, which is however based on ideals, images, and trends. The second is about the rural landscape, the productive landscape, although the contemporary urban citizen sees this second nature sometimes as first nature. The third nature contains symbolic places and gardens, places in which humans have great influence. There are also transitions and relations between those natures, for example in estates. This explanation of nature shows that nature is a social-cultural construct, men defines and makes the nature, a role for the landscape architect. This also leads to the idea that principles from garden architecture are being implemented in landscape architecture. We see this in the fact that the Dutch terms of garden architecture and landscape architecture in the English world is simply called 'landscape architecture', as can be seen by several examples in collection books of international landscape architecture like 'In Touch' (2012) by the Landscape Architecture Europe Foundation and '1000 tips by 100 landscape architects' by Santos Quartino (2013).

Fig. 1.3.4 | *Traditional landscape architecture: park design. Romantic nature as ideal.*

Fig. 1.3.5 | *Modern landscape architecture: applied engineering. Functional use of space.*

Fig. 1.3.6 | *Post-modern landscape architecture: participatory, idealistic and low scale.*

Meeus & Vroom (1986) determined three stages of landscape architecture during the past centuries. The first one can be called 'traditional landscape architecture' (fig 1.3.4), typically for the ninetheenth century, and is about knowledge of land forming techniques and horticulture. Garden and park design are good examples of this approach, which 'reflect a more sculptural than a programmatic approach' (Meeus & Vroom, 1986), and where the artistic approach is dominant.

The second stage is the 'modern landscape architecture' (fig 1.3.5), a design profession where science is used to tackle complex and expensive design issues, especially on the regional scale, like the mid 20th century Dutch IJsselmeer polder designs. This project also showed the lack of professional trained landscape architects, who could come up with a vision to design those new landscapes. However, this modern landscape architecture approach 'becomes a form of applied engineering' (Meeus & Vroom, 1986).

The third stage is the 'postmodern landscape architecture' (fig 1.3.6), and is especially typical by its participatory and idealistic approach, with for example the inclusion of nature. Eventhough this thesis is written almost 30 years later than the paper of Meeus and Vroom, the participatory approach is still important in landscape architecture, with examples like informal community gardens on wastelands. (Meeus & Vroom 1986)

1.3.3 The role of landscape architecture

Vroom (2010) states that landscape architects have to know the landscape as good as they can on the one hand, and on the other hand they have to use the landscape 'as a mirror of our aspirations and desires'. Furthermore, "the primary societal role of the profession of landscape architecture can be conceived as 'the synergism of art and science for the management, planning, and design of the entire physical and cultural landscape, including its vestal wilderness and its growing urbanness" (Motloch in Makhzoumi and Pungetti, 1999).

However, landscape architects are more than garden architects. Global issues like the climate crisis, food crisis, energy crisis, landscape identity crisis and so on are major issues we as landscape architects have to work on, because landscape architecture is the profession that combines landscape values with innovation. According to Motloch (2001), landscape architects have the ethical obligation to create landscapes that are regenerative, benefit to the quality of life, reduce the ecological foodprint, and conserve the resources of the earth, not only for now, but also for future generations. Motloch (2001) and also in the book 'Ecology and Design' (Hill 2002) the need for a landscape design incorporating ecology regeneration is mentioned. As stated before, also Koh (2010) advocates an ecological approach. The idea that "more uniformity needs more variety" (Bernard & Loidl 2003) is not only a design task, it is also about the cultural diversity in the world that is highly related to the ecological diversity because it leads to a more flexible and healthier system.

1.3.4 The landscape approach

The approach that fits the role of the landscape architect is the 'landscape approach', as explained by Koh (2010), which is an ecological approach not only for landscape architecture, but it also fits disciplines like architecture and urban design. However, the ideas of the landscape approach are emerging and are not yet fully adapted by landscape professionals.

Koh (2010) states that the traditional modern approach to landscape architecture comes from the architectural approach, which has its base in the artistic approach. The modern approach includes 'form seeking, compositional, goal directed, colonial and imperial' and is based on form and engineering, whereby architecture 'privileged city over country, and architecture over landscape'. The landscape and ecological approach contradict with this modern approach in the way that it is adaptive, poetic, context based, participatory, integrative and process based (Koh, 2010). He also states that the landscape approach is about the 'ordinary', and that architecture, which is artistic based and usually 'showing off', is only part of landscape and community. According to Koh (2013), the rules of architecture, with examples like the golden section, don't count in the landscape approach.

Zooming in and zooming out is an important component of the landscape approach (Koh 2013); low scale, representing design (for example gardens), is different from the middle scale, representing planning (for example regions) and is different from the high scale, representing management (for example continents, with the Convention of Malta and Natura2000

as examples) (fig. 1.3.7). Koh states that the architectural approach works with the Euclidian geometry, which does not allow this zooming.

The landscape approach could be summerized as “Landscape is what, landscape is how” (Koh 2013). Here the landscape is object of study, but also the approach of dealing with the landscape is based on the landscape itself, an adaptive approach.

1.3.5 People and their landscape

Previously we saw the lost link between people and the water system, due to a low awareness of the flooding risk and the protests towards mainly large scale projects. There are many reasons to increase the link between people and their landscape.

To start with Hendriks et al. In Knaap et al. (2004), according to the European Council (2000) people have the right to feel at home in their landscape. People and their landscape are united by their landscape identity while it distinguishes them from other people and landscapes, according to Haartsen et al. (2000) and Kruit et al. (2004). And with globalisation, for example the increasing influence of the European Union in the European countries, the need for regionalism increases, partly as a response to growing uniformity (Pedroli et al. 2011). According to Koh (2010), identity even reduces competition.

The link between self-identity and the landscape is inherent, which for example causes protest among the community in case of drastic changes in the landscape, because peoples own historical traces are vanished. This is

Fig. 1.3.7 | *Interpretation of the 3 scale levels by Koh (2010). These scales are interconnected: large scale interventions like policy affects the small scale, small scale design affects the large scale.*

in contrast with visitors, who could appreciate the new landscape (Pedroli et al. 2011). However, still a danger exists in the fact that these new landscapes could lead to placelessness, especially in case of large scale interventions, which we see in the booming cities of China for example (Koh 2010). So, it is worthy to protect our own environment, or as Saito (2007, p. 247) states: “People’s attachment to, affection for, and pride in their native landscape and its vegetation and non-human inhabitants are inseparable from their aesthetic appeal, and such an attitude provides a powerful motivation for protecting them (…).”

People can also learn from the landscape, because it posseses a lot of knowledge. We can analyse how landscapes are adapted to specific and local conditions, and we can also see the

mistakes made in the past. Cultural or landscape diversity can be seen as biodiversity; more diversity leads to more adaptive possibilities. (Based on Koh 2010 and Antrop 2005)

According to Pedroli et al. (2011) positive aspects of landscape identity are highlighted which makes it useful as a unique selling point, for example in city branding and tourism. Landscapes could contribute to give context to its artefacts (Antrop 2005 and Koh 2010). Additionally, Hull (1994) and others in Radstaak (2012) state that identity of places contributes to self-identity, health, sense of community, sense of place and spatial differences to use as selling points.

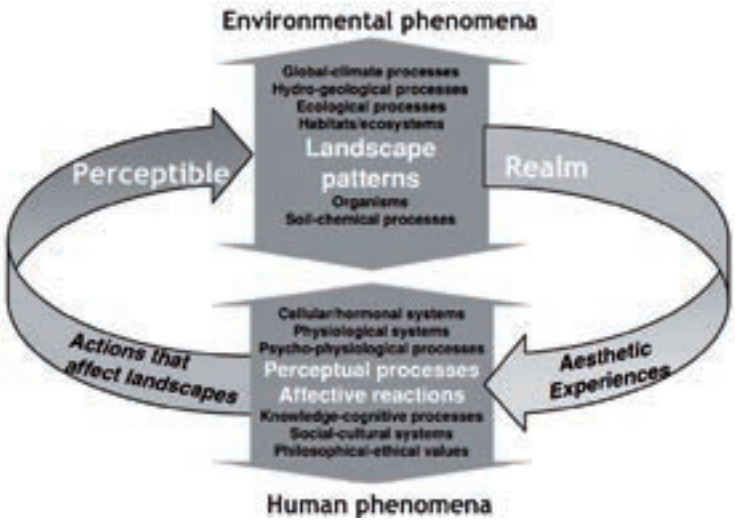


Fig. 1.3.8 | *Landscape affects people, people affect the landscape. (Gobster et al. 2007)*

People and their landscape also affect each other, according to Giddens (1984) in Brandenburg et al. (1995) “Places are both enabling and embedding, in that physical locations affect people and people affect and construct social meanings of those physical locations.” And according to Gobster et al. (2007), aesthetic experiences of the landscapes leads to action within these landscapes (fig. 1.3.8). It would be interesting to create these experiences by landscape architectural design in order to reconnect people and their landscape.

1.3.6 Conclusion

Landscape is an integrative and dynamic concept and is highly related to ecology, which makes the community part of the ecological system. Design within these landscapes can be seen as the creation of place. Landscape architecture is designing places based on science, in order to create healthy landscapes. The landscape approach is an ecological approach, which is adaptive, poetic, context based, participatory, integrative, process based and ordinary, and is contrasting to modern architecture, for example by its intensive relation between the low and high scale levels within the landscape. The landscape is shaped by the people who live in it, but it is also a home for these people, where the landscape shapes their identity. Therefore people protect their landscape, but the landscape also leads to action.

With the landscape approach, landscape architecture could be the key to adapt landscapes for challenges within the water system, in order to increase the link between people and their landscape.

1.4 Zwarte Water region as test case

1.4.1 Regional context

An area vulnerable for climate change is the IJssel lake in the middle of the Netherlands, and especially its surroundings, which harbours renowned identies, think for example about the several fishery villages. The Delta Committee is managing this area for some years now and came with several plans. The exploring view in the beginning (Delta committee 2008) resulted in a plan for a 1,5m rise of the water level as a fresh water buffer, which would result in dike heightening (Verbeek 2010), city harbours that have to be changed and nature areas that could be vanished. Nowadays the committee is studying on a more flexible water level, combined with increased sluicing and pumping capacities, and the strategy to keep bigger interventions open for the future (Strootman 2013, Delta Committe 2012). More about this later.

The area that will probably has the most effects of water level changes in the IJssel lake area is the region around the Zwarte Water river, east of the IJssel lake, a region where several rivers, especially the Vecht river, streams and canals come together in a low former estuary region and flow into the IJssel lake. The funnel shape of the east part of the IJssel lake results in high water levels in this region due to storm water during north western storms.

Together with the increased level of the Ijssel lake in the west, the discharges of these rivers and streams from the east, with a river basin that exceeds the Dutch boundaries and that are increasing due to more and extreme weather conditions due to climate change, make the Zwarte Water region a hotspot for water level changes.

Figure 1.4.1 | *The Zwarte Water region is located in north west europe.*

North Sea

Figure 1.4.2 | *The Zwarte Water region is both influenced by the IJssel lake in the west as well as the Vecht river basin in the east.*

Figure 1.4.3 | *The IJssel lake in the west, an enormous water surface. Water level changes here have direct consequences for the water levels in the Zwarte Water river because of their connection.*

Figure 1.4.4 | *The Vecht is the biggest river in the basin that floats towards the Zwarte Water region. Increases in discharges and discharge peaks will have consequences for the water levels in the Zwarte Water river.*

1.4.2 Introduction to the region

The Zwarte Water region is a former estuary, a river mouth, and this fact makes the region attractive for people, who have settled there for a long time already, resulting in old cities and old farmlands, and with a characteristic identity.

The Zwarte Water region is a diverse region: both urban as well as rural environments can be found here. Furthermore, many differences in the rural landscape can be found: both small scale and ecological rich areas, as well as large scale agriculture.

All of this makes this area an interesting case study area to research and test measures to adapt for water level changes that possibly could apply to other delta areas as well. The region could be compared with the Netherlands in general, which also deals with rising water levels in the west, increased river discharges and a major urban presence in the delta.

Noordoost Polder

Ketelmeer

Kamper Eiland

Kampen

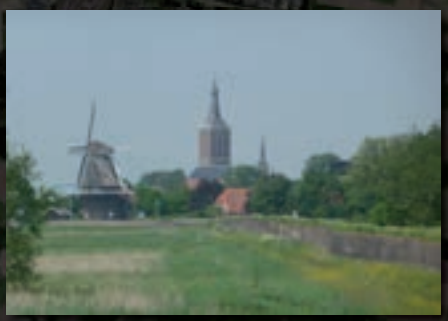


Figure 1.4.5 | *Ecological and historical values near Hasselt.*

Figure 1.4.6 | *The wide and open agricultural landscape of Mastenbroek.*

Figure 1.4.7 | *Urbanisation near Zwolle.*

Figure 1.4.8 | *The Zwarte Water region.*

1.4.3 Bottlenecks within the Zwarte Water water system

To know what the challenges are to make the Zwarte Water region safer for flooding, the different directions of where the water might come from are studied in this chapter. In figure 1.4.18 the water system is visualized.

IJssel lake

The water of the Zwarte Water river is in direct connection with the IJssel lake. When the IJssel lake rises, the Zwarte Water will also rise. The level in the Zwarte Water mouth near Genemuiden is more or less the same as at the IJssel lake, more upstream the influence decreases. When the IJssel lake water level rises its influence on the water level upstream increases relatively.

The IJssel lake is highly dependent on the sea water level because it sluices its surplus of water, mainly coming from rivers like the IJssel river, into the IJssel lake. The level of the IJssel lake is also depending on other issues like the proposal for a fresh water buffer of 1,5m by the Delta Commission 2008, a plan that has been retreated currently.

How much the sea water level will rise cannot be predicted, but there are some scenarios and estimations. The IPCC for example developed a range of models of pathways of the development of climate change in relation with sea water level rise. The KNMI then developed 4 scenarios out of these models, based on the minimum and maximum expectations of temperature rise and change in atmospheric circulations. Together, these 4 scenarios show a sea water level rise of 35cm till 85cm in 2100. (KNMI 2006)

These are average data, but the Delta Commission asked the KNMI to develop data which represent the 'highest realistic scenario'. The KNMI then stated that this scenario includes a 1,3m sea water level rise in 2100. (KNMI 2013)

The IJssel lake water level rise could be adapted with 4 options. On the following figures this will be explained with the sea water level left, the lake water level right and the Afsluitdijk in the middle.

Figure 1.4.9 **|** *Rising together with the sea water level. Therefore dikes, water fronts, floodplains and other areas have to be adjusted.*

Figure 1.4.10 **|** *Pumping. With a small sea water level rise pumping is only needed incidentally, with a major rise of the sea water level, pumping will be needed permanently.*

Figure 1.4.11 **|** *Increasing the sluicing capacity, which could cope with around 25cm (Deltacommissaris 2012) sea water level rise.*

Figure 1.4.12 **|** *A flexible water level. Before expected high water levels during storms for example, extra water could be sluiced, resulting in a reduced peak of the water level in the IJssel lake.*

At this moment, the Delta Commission proposes a combination of these four adaptation strategies. On the short term the sluicing capacity will be increased, pumps will be installed, and there will be a more flexible water level. This could prevent a water level rise of the IJssel lake in the coming decades, but for the long term, up to 2100 and beyond, and in case the sea water level rises more then expected, a water level rise of the IJssel lake together with the sea water level is probable but at this moment of later concern.

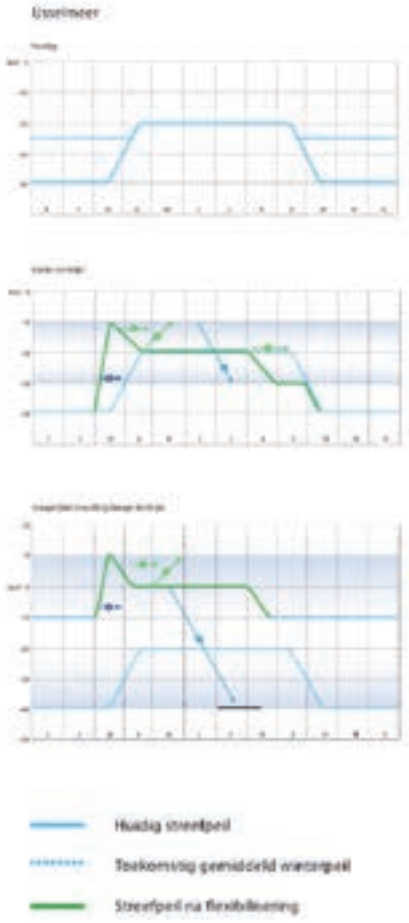


Figure 1.4.13 | *The possible development of the water level in the IJssel lake, whereby 'short term' represents 2050. (Strootman Landschapsarchitecten 2013)*

Dike norms

The low zone of the Netherlands and the river areas are divided into dike rings. Every dike ring has its own assigned dike norm; the risk that a flood can occur due to failure of the dike which is mostly based on the size of the dike ring, the economical values, the amount of people living there, and the depth of a dike ring. This results in dike rings along the Meusse river with an exceedance probability of once per 100 years, and the Randstad dike ring, ring 14, with an exceedance probability of once per 10000 years. The exceedance probabilities of the dike rings in the study area can be seen in figure 1.4.18. The dike rings are bordered by primary dikes, which means small dikes along minor streams like the Meppelerdiep and Sallandse Weteringen. These are located within the dike rings, and have their own flooding risk.

However, these dike norms are not always reached, for example due to a lack of maintanance or new regulations, which applies to the Zwarte Water region as well (figure 1.4.14).

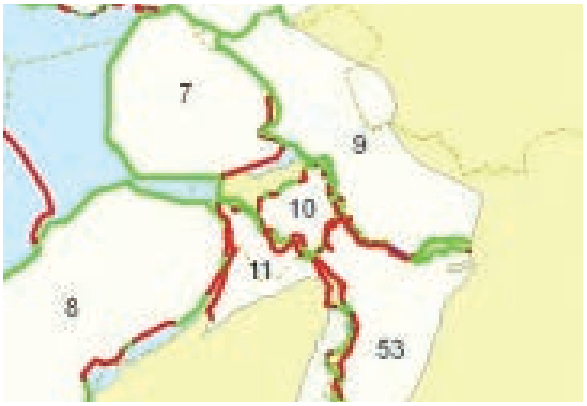


Figure 1.4.14 | *The red dike segments are not up to date. (Inspectie V&W 2011)*

Perhaps more important is the fact that the dike norms are too low. For example Eigenraam (2006) states that both because of the growth of the economy and amount of people, and a wrong calculation, dike norms - originating from the sixties with the first Delta plan - should be much higher. Furthermore, new insights in for example 'piping' show dikes are not up to date. With the 'expected yearly loss', Eijgenraam (2006) gives a calculation that can deal with changing water levels and development of the economic and social values within the dike rings. The second Delta commission even proposes to make all dikes 10 times saver, and comes with the idea with an unbreakable dike, making the dikes even 100 times saver (Kennis voor Klimaat 2013).

Due to our high safety level, the preparation for a flood has decreased significantly in the past century, while the damage in case of a flood increases. For example the 'multi level water safety' concept (Nationaal Waterplan 2009) is highly adopted in the past years to prepare the dike rings for floods, despite of the high safety levels of the dike rings.

River discharges

The Zwarte Water river water level is affected by both water level changes on the IJssel lake, as well as by changes of the river discharges. These river discharges are dependent of rainfall, which will change due to climate change. The climate scenarios developed by the KNMI (2006) state the rainfall will increase with 4-12% in winter, resulting in higher water levels in the rivers, but could decrease up till 19% in summer, resulting in low water levels in the rivers. Furthermore, rainfall peaks will occur more often, resulting in more extreme river discharges in short time. Furthermore, according to the Dutch ministry of V&W (2007a) we could expect a rise of 11% to 31% discharge increase of the Vecht in 2100 due to increased rainfall.

Sallandse Weteringen

Parallel to the IJssel river, the Sallandse Weteringen drain the low lands along the IJssel. These drainage canals run to Zwolle, after which they become wider, and become the Zwarte Water river. A risk here is the idea that water coming from these Sallandse Weteringen could only flow through the narrow canals of the inner city of Zwolle. In case of rainfall peaks, this water could threaten Zwolle, like in 1998 when the rainfall peak was combined with high water levels on the Zwarte Water. To protect Zwolle several areas upstream were slightly flooded, resulting in major agricultural damage. (Van Goor 2010).

Recently another risk has been exposed. In case of a dike breach upstream along the IJssel, especially up to the German border along the Rhine, this water will flow parallel downwards along the IJssel river, towards Zwolle, after which a catastrophe will follow. Therefore dike norms upstream will be increased. (Waterschap Rijn en IJssel 2014) (figure 1.4.15)

Figure 1.4.15 | *Water in the low zone parallel to the IJssel river has to go through the city of Zwolle. In case of heavy rainfall this could be problematic, in case of an upstream dike breach it could be catastrophic.*

Other minor streams

Minor streams in the region, with especially the Meppelerdiep, do threaten their surroundings. They are located within the dike rings, which means during high water levels on the IJssel lake and Zwarte Water river, water from these minor streams have to be pumped out. In 'regular' situations this is no problem, but the low quays and other low water fronts will result in flooding of urban areas, nature areas and agricultural areas in case of extreme discharges, which will occur more and more due to climate change. (Waterakkoord Meppelerdiep / Over-IJsselse Vecht 2011)

Ramspoldam

The Ramspoldam (figure 1.4.16) closes in case storm water flows into the Zwarte Water region from the IJssel lake. Without this dam, the water level in the Zwarte Water river can increase up to several meters within hours. The inflatable dam closes when the IJssel lake is 50 cm higher. However, just like the Kadoelen sluice (fig. 1.4.17) near Vollenhove, this dam cannot be closed for storm water from the IJssel lake when the upstream discharges are too high. (Min V&W 2007b)

Figure 1.4.16 | *The Ramspol dam.*

Figure 1.4.17 | *The Kadoelen sluice.*

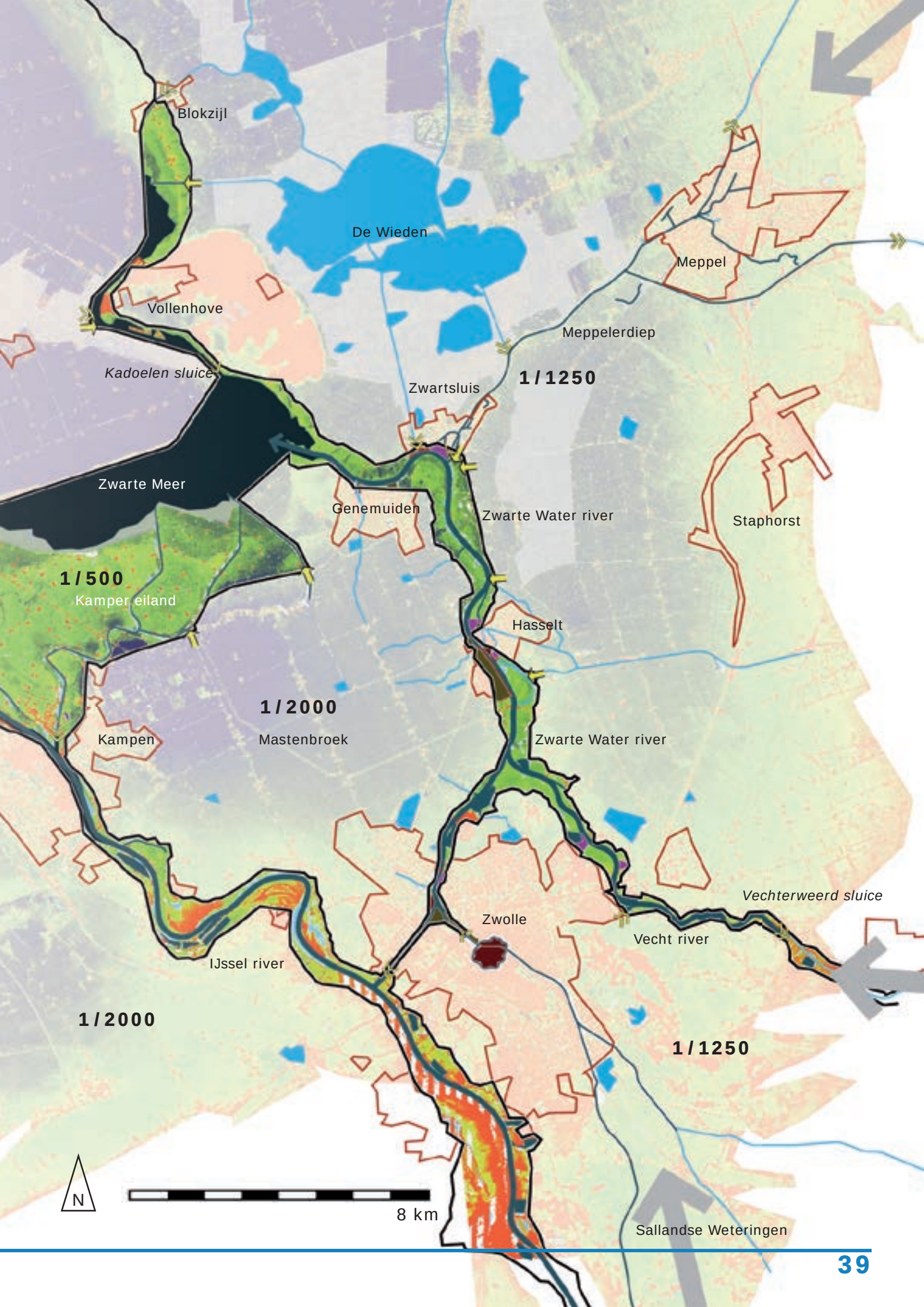
Figure 1.4.18 | *The Water system of the Zwarte Water region.*

The IJssel lake has a direct connection with the region and brings in water in case of a north western storm. This water is stopped by the Ramspol dam. However, the dam cannot be functional in case of a major discharge from upstream, like the Vecht and the many other streams, as shown in the map.

The height map is integrated in the water system map, showing the low parts around the Zwarte Water river. The IJssel river however appears to be relatively high.

The exedence chances of the dike rings are made bold (PBL 2014). It shows deeper areas have a lower exedence chance.

Furthermore, the floodplains of the Zwarte Water contain not only grasslands but urban functions as well, such as recreation and shipping related businesses. These are the first to deal with changing water levels.


Blokzijl
De Wieden
Meppel
Vollenhove
Meppelerdiep
Kadoelen sluice
Zwartsluis
1/1250
Zwarte Meer
Genemuiden
Zwarte Water river
Staphorst
1/500
Kamper eiland
Hasselt
1/2000
Kampen
Mastenbroek
Zwarte Water river
Vechterweerd sluice
Zwolle
Vecht river
IJssel river
1/2000
1/1250
N
8 km
Sallandse Weteringen

1.4.4 Conclusion

The Zwarte Water region shows a diversity of landscapes. Both urban and rural areas, ecological and agricultural and semi closed sandy heights and open peat landscapes can be found within this region. The former estuary river is the axis for the region, with several villages around, of which Zwolle is the biggest. The river was a transport hub bringing wealth to the region in the past, but it also brought flooding disasters, resulting in many dike ponds today. The postwar economic growth resulted in a well controlled and safe water system and a society that could live independently from the water system. However, this has also decreased the link with the water.

With climate change and an outdated dike system, the water safety and the water levels of the Zwarte Water region will be changing. First of all, the water level will be more flexible in the coming decades, due to a flexible water level on the IJssel lake. After that, it will probably rise but it is not yet clear by how much (Strootman 2013).

The areas especially have to adapt for upstream water, with increased peak discharges. For example the Vecht discharge could increase with up to 31% in 2100 due to increased rainfall (Min V&W 2007). Next to the Vecht, other streams flow to the region as well. However, these streams are mostly flowing through urban areas, like the Meppelerdiep and especially the Sallandse Weteringen. Furthermore, in case the IJssel dike breaches it will cause a lot of damage in Zwolle. These urban areas seem to be the real bottlenecks in the system. Next to that, besides the fact that the dike norms are not based on current economic and social values, most dikes do not meet the required norms. Therefore the general safety as it is today is not high enough.

This all makes the Zwarte Water region an interesting case study area for a research on water level change adapta-tion with a landscape architecture approach.

1.5 Research Statement

Problem statement

The Dutch have a long history with the water, but due to several threats this relation with the water has to be questioned again. First of all, climate change will increase the sea water level and the river discharge peaks. Second, due to new insights in the water system safety, safety should be increased. For example, due to urban growth our water system should be made saver. But interventions are also needed because of the fact that many dikes are not up to date.
The challenge to update the delta because of several threats, of which climate change and urban growth are the basis, can be found throughout the world. Especially the Dutch are the ones that are known for their skills to adapt these water system, and to stay this way, we as Dutch have to experiment and innovate constantly.
However, just raising the dikes once again is not the solution. They are like walls, which not only damage the views in the landscapes, for example by hiding historical city centres and dike houses from the water system. They also make the community blind for the danger of the water system as higher dikes increase the damage in case of a dike breach. This blindness not only results in the fact that people are not prepared for floods, the people also protest when new water system adaptations are made that influence their landscape.
Furthermore, the alternatives for dike raising are not perfect: with projects like 'Space for the river' agricultural businesses and houses have to be removed to make space for floodplains, for example a project like the IJssel Bypass Kampen. Other major landscape transformation projects like the Hedwige polder and the Wieringermeer randmeer show the community does not accept the top down approach which vanishes the land they live, work and grewed up in.

Purpose statement

Landscape architecture is an holistic discipline and could therefore combine both the water adaptation challenge with the needs of local communities. The purpose of this thesis is then to come with solutions that contribute to the discussion how water landscapes should be adapted for the future.

Landscape architecture already has a long tradition in the field of water landscapes. However, using the principles of the landscape approach could result in new inisights, insights that are contrasting the reality of contemporary water landscapes. The basis for this is the local community. They can be seen as integral part of the ecological system, and interventions in the water system should be in symbiosis with the existing landscape and so on as well as with its residents. The ecological landscape, however, is dynamic and with the right conditions it could adapt itself. Tools the landscape approach offers are the connections between low and high scale levels, the poetic, and the ordinary. Using experimental design this thesis could generate new ideas, both for the local site and water landcapes in general, as well as for the discipline of landscape architecture.

To test these principles a test area is needed which represents a diverse water landscape. The Zwarte Water region is such an area. The water levels in this former estuary river are both influenced by the IJssel lake in

the west, and the river basin in the east, in which the Vecht is the biggest river. The Zwarte Water region offers a diverse range of landscapes, including dense urban areas, with streams flowing through, rural polders, sandy landscapes and floodplains. The area is characterized by a rich history related to the water system, and many nature values.

Research Questions

Main question:

How could a water system be adapted on the basis of a landscape architecture design strategy, with the focus on the local community?

Subquestions:

In what ways does landscape supports the local community?

What are the characteristics of the Zwarte Water region landscape?

How should the water system be adapted, taking the identity of the Zwarte Water region into account?

What spatial effects has a process approach on the local landscape?

Methods

1 Introduction

This chapter showed which challenges we have and how this could be solved with a landscape architectural approach. This chapter is mainly based on literature study, in which technical theory related to the water system is based on reports in Dutch language, and landscape architecture theory is mostly based on international literature. For the Zwarte Water case study introduction, reports in Dutch language, mapping and the personal knowledge of the author are the basis.

2 People and their landscape

The subquestion that will be answered in this chapter is:

In what ways does landscape supports the local community?

Using literature study this chapter will reveal the theory of characteristics of landscapes which influence the needs of the community. This theory will be both the basis on which landscape characteristics are analysed in the third chapter, to determine the choice of water management strategies in chapter 4, and as a theory that is used to create a process to implement the strategies in chapter 5.

3 Landscape analysis

The subquestion that will be answered in this chapter is:

What are the characteristics of the Zwarte Water region landscape?

The theoretical landscape characteristics as determined in the previous chapter are transformed into theme maps for the Zwarte Water region. The values that are represented by these maps are the basis to determine interventions in the Zwarte Water region. Every theme is analysed using mainly

site visits, mapping, literature and personal knowledge.

4 Water management strategies

The subquestion that will be answered in this chapter is:

How should the water system be adapted, taken the identity of the Zwarte Water region in account?

This chapter leads to a map for the Zwarte Water region in which every sub landscape has its most fitting water strategy based on the community needs.

First of all the different water interventions that increase the water safety are collected in literature. These interventions are transformed into a handfull strategies, and act as possible future directions, or scenarios. Next, these strategies are being tested in the Zwarte Water region, by determining which water strategy fits the best in each sub landscape, which is based on the findings from the landscape analysis and on the water challenges that are present in each area of the Zwarte Water that are presentated in chapter 1.4.3. This map with in every sublandscape the best strategy or mix of strategies is the basis for the design of the adaptation of the Zwarte Water region.

5 A process towards adaptation

The subquestion that will be answered in this chapter is:

What spatial effects has a process approach on the local landscape?

As landscape architecture is generally not about the implementation of an end result in the landscape, but about the process of landscape dynamics, a process is designed that helps to implement the water strategies in the coming decades. This process is supported both by the needs of the community as well as the evolving challenges in the water system.

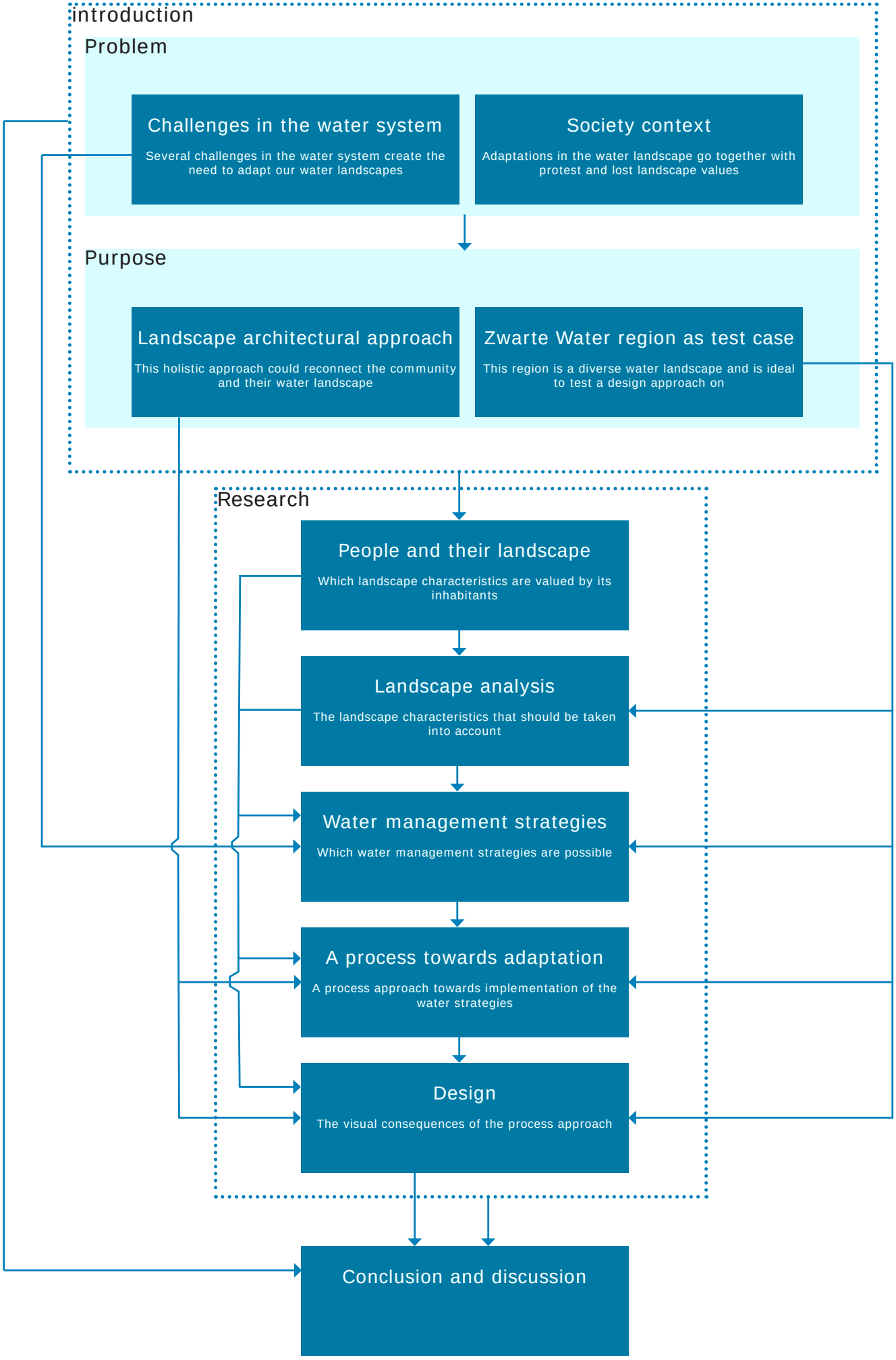
In this chapter this process concept will be translated into small scale designs to test the visual consequences of the process of the implementation of the interventions as determined in chapter 4. At the end, the regional design approach will show what effect this process thinking has on the several landscapes in the Zwarte Water region that will be adapted in the coming decades.

6 Conclusion

Within this chapter the main question will be answered:

How could a water system be adapted on the basis of a landscape architecture design strategy, with the focus on the local community?

The community based approach to adapt to the challenges in the water system leads to a process in which the water landscape of the Zwarte Water will evolve. The visual consequences of the process towards the implementation of the water strategies are being evaluated in order to determine whether this landscape architectural strategy is fruitful, both for the Zwarte Water region and delta regions in general, as well as for the discipline of landscape architecture.


introduction
Problem
Challenges in the water system
Several challenges in the water system create the need to adapt our water landscapes
Society context
Adaptations in the water landscape go together with protest and lost landscape values
Purpose
Landscape architectural approach
This holistic approach could reconnect the community and their water landscape
Zwarte Water region as test case
This region is a diverse water landscape and is ideal to test a design approach on
Research
People and their landscape
Which landscape characteristics are valued by its inhabitants
Landscape analysis
The landscape characteristics that should be taken into account
Water management strategies
Which water management strategies are possible
A process towards adaptation
A process approach towards implementation of the water strategies
Design
The visual consequences of the process approach
Conclusion and discussion

People and their landscape

2.1 Introduction

In chapter 1 you have read that landscape interventions lack the integration of landscape values of the local people. Within this chapter the exact values are being determined, which people need in the landscape, by answering the folowing subquestion:

In what ways does landscape supports the local community?

The answer will be a list of key values that will form the basis for this thesis.

2.2 Connecting people and landscape

People do not just live in the landscape, in which landscape is a seperate unity. No, people are interconnected with the landscape. People are shaped by the landscape, for example people learn in the landscape, because landscape shows how nature works (based on Koh 2010 and Antrop 2005). The landscape is shaped by the people, to make it suitable for their daily practices. Landscape possesses peoples' meomories. We could state that landscape is like a home. People even have the right to feel home in their landscape, according to the European Council (Hendriks et al. 2000 in Knaap et al. 2004).

People and their landscape are united by their landscape identity, while it distinguishes them from other people and landscapes, according to Haartsen et al. (2000) and Kruit et al. (2004). Furthermore, with globalisation, for example the increasing influence of the European Union in the European countries, the need for regionalism increases, partly as a response to growing uniformity (Pedroli et al. 2011). According to Koh (2010) identity even reduces competition.

According to Pedroli et al. (2011), landscape identity has several scales, like local, regional, and national. Regions, maybe the most important scale, mostly have vague borders and are determined by a dominant natural characteristic, for example soil type (Vroom 2010). Within this thesis the term 'landscape identity' will be used when discussing the identity in relation with the landscape. Pedroli et al. (2011) takes the definition of 'landscape' from the European Landscape Convention, which is described as '(…) an area as percieved by people, the character of which is the result of the action and interaction of natural and/or human factors'. According to Vroom (2010), identity of objects and environments is being determined by 'specific characteristics, contrasts and meanings'. Identity is about recognition, identity is also about 'home': genius loci, or spirit of the place. Lynch (1960) defines 'place identity' as "that which provides individuality or distinction from other places". Pedroli et al. (2011) defines the difference between place identity and regional identity, as where place identity is about a specific spot, while regional identity is about the common unity of an area.

Although 'landscape identity' can be described as 'the perceived uniqueness of a place', Pedroli et al. (2011) concludes that landscape identity should be described as 'landscape identity is the unique psycho-sociological perception of a place defined in a spatial-cultural space.' This somewhat vague description is elaborated hereafter, because this description shows four different interpretations of landscape identity to make the term more clear.

2.3 Landscape identity: 4 types

Pedroli et al. 2011 shows four different interpretations of landscape identity (Box 2). Landscape identity could be based on the personal identity or cultural identity on the one hand. On the other hand it could be based on spatial identity or existential identity. This results in four different directions of landscape identity (Fig 2.1).

Spatial identity could be described as making an image of the landscape from outside, about 'where am I?' and is about the physical layout of an area, the landscape characteristics, and includes components like orientation, distances, ordination, forms, patterns, elements, colours, processes, sounds and smells (Pedroli et al. 2011).

Existential identity, also known as place identity, could be experienced when we live within the landscape and become part of it, and is about 'Who am I?', which is about objects in and features of the physical environment, associations, memories and symbolic meanings linked to the landscape, which makes existential identity an inherent quality of the landscape, as people perceive this. The scale of existential identity is mostly about home, town, and region (Pedroli et al. 2011).

According to several authors in Pedroli et al. (2011) a distinction could also be made between personal and cultural identity. Personal, as in experiences of individuals, and cultural as in general stories of certain places.

When we combine those two 'axes', four landscape identity types can be distinguished: spatial-personal, spatial-cultural, existential-personal and existential-cultural identity. (Fig. 2.2)

Figure 2.1 | *Four types of landscape identity, by Pedroli et al. (2011), showing the 4 different interpretations of landscape identity.*

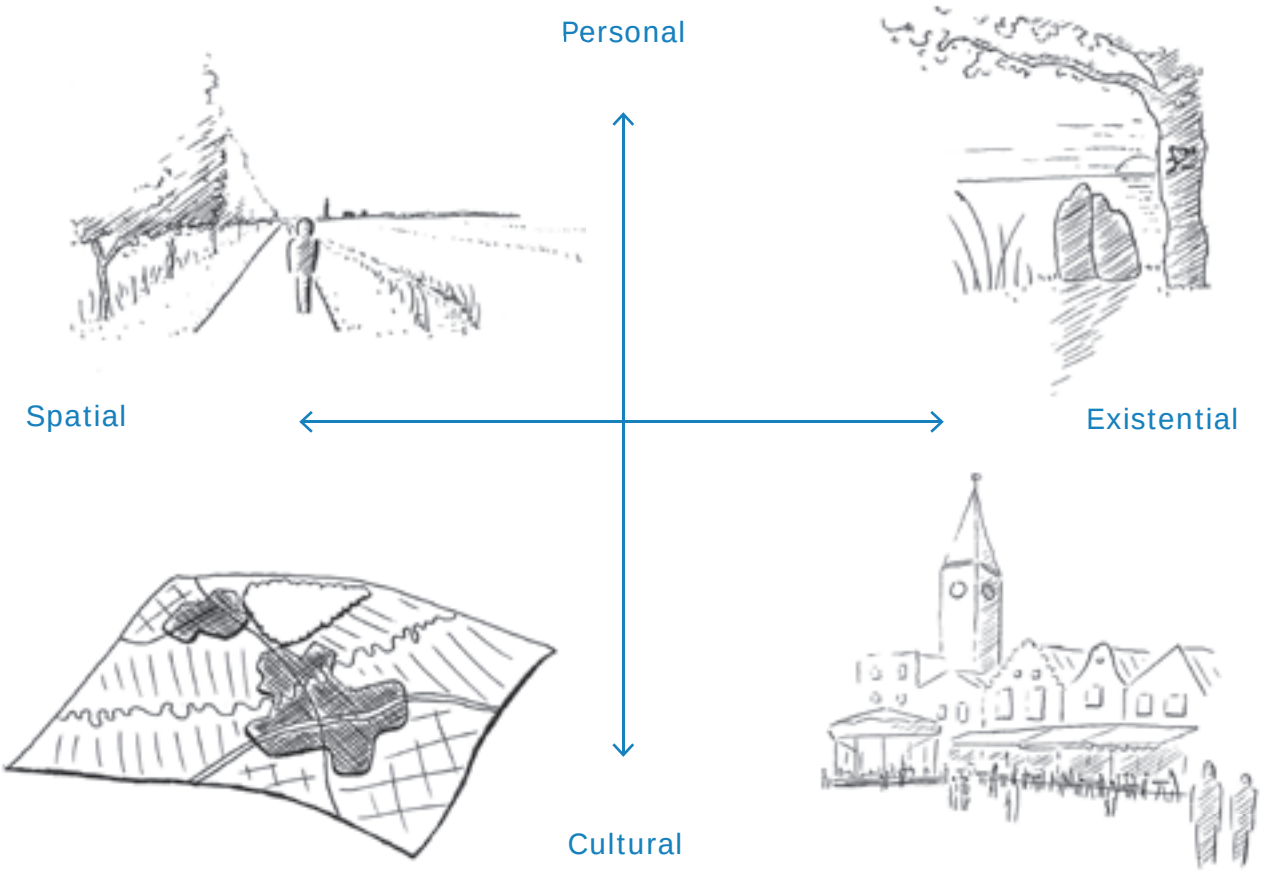
Box 2: The 4 types of landscape identity

Spatial personal identity
The five elements of Kevin Lynch (paths, boundaries, districts, nodes and landmarks) contribute to the orientation of individuals in the landscape, and can be made visible by letting these people making 'mental maps'. These mental maps (spatial-personal) emphasize other landscape elements than expert maps (spatial-cultural), and according to for example the European Landscape Convention, this should be taken in account. (Pedroli et al. 2011)

Spatial cultural identity
As a way to increase 'landscape quality', the 1992 Nota Landscape and the 2002 Nota Green Space in the Netherlands use the term 'landscape identity' mostly as the spatial-cultural component of landscape identity, because it is referring to ecological and historical features that characterise places. (Pedroli et al. 2011)

Landscape characteristics like routes and landmarks creating a personal perception of a landscape.

Memories connected with the landscape, the 'I-feeling'.



Landscape characteristics, distinguishing one place from another.

Social cultural features and events linked to places within the landscape, the 'we-feeling'.

***Figure 2.2** | The four types of landscape identity, based on Pedroli et al. (2011), translated into pictures.*

Existential personal identity
According to Pedroli et al. (2011), personal existentialism is about self-identity, and includes:
- distinctiveness: diversity between regions;
- continuity: tracing personal history;
- self-esteem: pride to come from a certain region;
- self-efficacy: support of the area for a certain lifestyle.

Twigger-Ross & Uzzell (1996) state that those four principles could help to determine threats to identity.

Existential cultural identity
Cultural existential identity is formed by a sense of coherence among people, including a history of cooperation and sharing of their space (Pedroli et al. 2011). Or as the European Landscape Convention describe it: "The landscape contributes to the formation of local cultures... [it] is a basic component of the European natural and cultural heritage, contributing to human well-being and consolidation of the European identity" (Pedroli et al. 2011).

These 4 main types of landscape identity show that landscape identity has multiple interpretations. This is because identity is being determined by culture, and therefore it is not rational (Vroom 2010). Identity is a social construct, just like spatial quality. We can define it, and we can agree about whether a landscape possesses quality, but quality itself is not normative. Men tried, especially in government institutes, to quantify landscape quality. A landscape should have esthetical values, a good ecological system, and a good economic-functional basis, according to the Nota Ruimte (Van Zoest 1994) in Vroom (2010), not saying what this exactly contains. Or what about the idea that a farm has to use a certain percentage of ground for landscape elements like trees (Stortelder 2010 in Vroom 2010). Within spatial quality three ways of quality are determined: the objective quality (for example maps and scientific data), the normative quality (for example how much an emission should be) and the subjective quality (about feelings and opinions). Between these quality definitions there are some struggles, according to a certain quality the EHS is a good plan because it increases ecology, according to another it decreases economical values (Vroom 2010). However, the definition by Vitruvius, about functionality, aesthetics and reliability, (Vroom 2010), is still being used, 'spatial quality' is too complex and subjective to determine and to use. Also Darby (2000), Frouws (1998) and Saugeres (2002) in Pedroli et al. (2011) state that 'the' landscape is always contested.

Duineveld (2014) states that values of landscapes are subjective, and are a social construct. However, he states that those values are used as objective many times, for example in policy reports. Duineveld states three explanations. The first is that some people believe the material world has its own values. The second is that people do not want to take the illusions of values for granted. The third reason he states, is the idea that people rhetorically give values to certain things and ideas that have to be taken for granted. This last reason leads to, for example, elite landscapes. Ideas like 'landscape qualities' are highly subjectively but could be determined by a small group, making this a political statement of what the landscape should be.

So, when looking at the 4 interpretations of landscape identity, we see that the Nota Ruimte 2006 (Min VROM et al. 2006) is especially focussing on the spatial cultural interpretation of landscape identity, and ignoring the existential side of landscape identity, which could result in landscapes that do not reflect the needs and values of the community. An example is the fact that positive aspects of landscape identity are highlighted, which makes it useful as a unique selling point for example in city branding and tourism (Pedroli et al. (2011)). Landscapes could contribute herein to give context to its artefacts (Antrop 2005 and Koh 2010). This example shows that strengthening the spatial-cultural focus on landscape identity could improve a region.

Furtermore, the personal-spatial focus on landscape identity, about experiences, could be important to a region as experiences could lead to action. This way of changing the region gains a lot more support from the community.

2.4 Key values within the landscape

The integrative approach is found back in many projects of today, because many challenges could be combined in less solutions. Strengthening landscape identity could also be a challenge combined with another challenge, for example in this thesis, where strengthening landscape identity is combined with water system adaptation. Landscape identity then is threatened by this change, and although landscape identity could be lowered, strengthening landscape identity is still the goal. Previously we have seen change is part of identity.

Previously we have seen that Pedroli et al. (2011) distinguished four types of landscape identity: Spatial personal identity, spatial cultural identity, existential personal identity and existential cultural identity. Now, for every of these landscape identity types it is determined how this can be strengthened, keeping the change of landscape in mind.

First of all, Pedroli et al. (2011) and Hendriks et al. In Knaap et al. (2004) link identity with legibility. This relation not only shows that identity is about legibility, but maybe even that identity is legibility. However, for every of the four landscape identity types legibility has another function, this will be elaborated below.

Spatial personal identity
Spatial personal identity is about orientation and experience. According to Pedroli et al. (2011), landscape architecture is one of the disciplines that mainly focus on the spatial personal idenitity when they deal with identity tasks.

Kaplan and Kaplan (1989) state that a legible and coherent landscape can be explored without getting lost. Pedroli et al. (2011) taking in account Blajenkova et al. (2005), state that people use both landmarks (place identity) and landscape structures (regional identity) to orientate within the landscape. For example, towers could be kept in sight.

Experience of the landscape plays a role within identity forming and orientation. For example, the landscape is differently interpreted with different ways of transport, as Verbeek (2011) shows, pedestrians see details in the landscape and could also smell it, car drivers only notice the major landscape elements. These scale differences can also be used for orientation. According to Granpré Molière (1955) in Meeus & Vroom (1986), the human body itself is the basic dimension in nature and landscape. Walking through a landscape shows us landscape elements which we can estimate in size. Bigger landscape elements such as parcels could be estimated with the help of these smaller landscape elements. (Fig. 2.3)

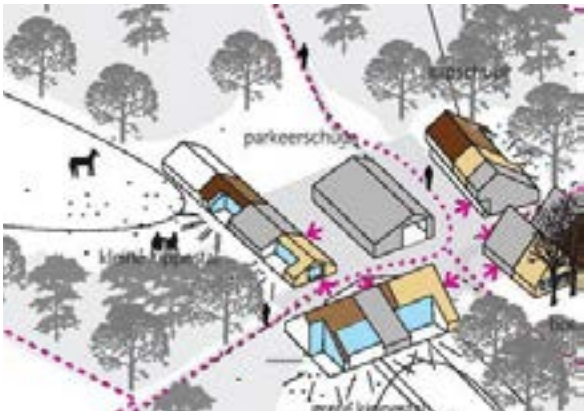


Figure 2.3. | *Example: The Hub Farm concept, by Paridon x De Groot, transforms former farms into small residential spots that form a node within a local walking network, with new paths like along edges of fields. This setting exists next to the new larger farms and existing car routes, resulting in different scales of farms and routes.*

On the other hand, this does not mean that everything should be clear in the landscape. Apart from coherence and legibility, people also prefer complexity and mystery in the landscape (Kaplan and Kaplan 1989). (Fig. 2.4)

Figure 2.4 | *Example: Classical park design, in this case Stourhead, England, were sudden vistas are part of a narrative route throughout the park.*

In addition to this, there are many other minor parameters that relate to landscape experience. Thwaites et al. (2009) gives 9 key concepts to assess environments on how they are experienced. These are stewardship, coherence, disturbance, historicity, visual scale, imagibility, complexity, naturalness and ephemera. Two parameters are added in Chen et al. (2010) for the urban landscape, which are 'signs of life' and 'signs of welcome'.

Spatial cultural identity

Spatial cultural identity is about landscape characteristics, and about the relation between the several layers within the landscape. According to Antrop (2005) coherence increases the legibility of a landscape. Coherence within the landscape has several interpretations. Vertical coherence is about the natural appearance of the landscape and its use, in relation with other places. Horizontal coherence is about the relation between the different layers of the landscape. There is also seasonal coherence, about the use and appearance of the landscape fitting to a certain moment in the year, and historical coherence, about the landscape appearance of one moment in history. (Hendriks et al. 2003) (Fig. 2.5)

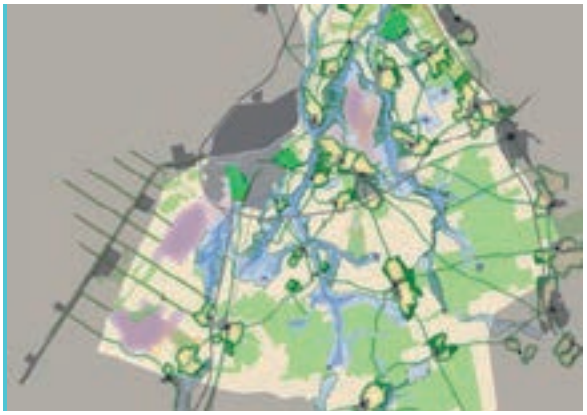


Figure 2.5 | *Example: The land use within the Drentse Aa landscape has still a warm relation with the soil and water characteristics, the design plan by Strootman Landscape Architects strengthens and visualizes this coherence even more.*

Existential personal identity
Existential personal identity is about the meaning of an individual for the landscape. Previously distinctiveness, continuity, self-esteem and self-efficacy have been discussed as terms that form the existential personal identity. Continuity is about maintaining the physical landscape as much as possible to protect traces of history as legibility of someones own history. Changing the landscape then should be done by 'acupuncture', small interventions on the low scale with a regional impact, a catalyst, with the biggest effect on for example hotspots on recreational routes. Continuity could also be protected with a more long term process. (Fig. 2.6)

Figure 2.6 | *Example: Small designed attractive hotspots along the main routes within the Lofoten landscape in Norway lower the presence of tourists, and this way their negative effects on the surrounding natural landscapes.*

Self-esteem would be translated into a healthy landscape, a landscape which for example is economical, social, cultural and ecological healthy. This is, however, mostly subjective, new factory could both be seen as pogression and as a problem, and thus this is a landscape value where different views should be taken in account. (Fig 2.7)

Figure 2.7 | *Example: Urban Farming projects can be seen to have it all, they support a healthy landscape and society.*

Self-efficacy would be translated into the idea that the landscape should be both functional and accessible to fulfill the demands of an individual and shoud for example provide a well built infrastructure. (Fig. 2.8)

Figure 2.8 | *Example: The new Hanzelijn railroad between Lelystad and Zwolle made the region more accessible.*

Distinctiveness could be translated into the idea to strengthen existing unique elements, for example a church tower that can be accentuated by sight lines, and furthermore other unique characteristics should be secured, and should even be made more accessible and legible. (Fig. 2.9)

Figure 2.9 | *Example: The Erasmus bridge in Rotterdam has become one of the main icons of the city.*

Existential cultural identity

Existential cultural identity is about the culture and community of a place. According to Antrop (2005) 'the ability to tell the (his)story of a place strongly enhances the identity and the overall value.' This means continuity is also important for existential cultural identity. Legibility is about telling the common stories of a place, we need to search for local qualities. (Fig. 2.10)

Figure 2.10 | *Example: Temporary rebuilt of the Donjon in Nijmegen. Bringing back a tower that we only know from stories and vague paintings gives us a much brighter view of what this place has looked like in the past.*

According to Pedroli et al. (2011) the spatial-layout, the architecture, and the green structure are important for the interaction between community and their surrounding landscape, and thus they are the basis for strengthening existential cultural identity.

2.5 Continuity and change

One of the most remarkable values within the landscape and related to the needs of the community is continuity. This, however, does not mean a standstill of the landscape; landscape identity supports change. This is in contrast with 'authencity', which is about characteristic elements that have survived time (Buchecker et al. in Knaap et al. 2004). According to Meeus et al. (1989), landscape consists out of both previous land use, and the conditions for new land use. According to Antrop (2005) 'landscapes change because they are the expression of the dynamic interaction between natural and cultural forces in the environment.' And Pedroli et al. (2011) state that landscape identity changes during time due to the changing context of players and functions. With this, we can state that a static identity is not healthy for a region. Several studies support this with the idea that next to continuity, a dynamic landscape is needed to contribute to well-being (Antrop 2006, Van den Berg 1999, Coeterier 2000, Lorzing 2001, Motloch 2001, Room 2006; in Knaap et al. 2004).

An example of where identity and change support each other is the Dutch Belvedere program, 'conservation through development'. This example also shows that there are different ways to deal with change. According to Meeus et al. (1989) there are four options to deal with problems in the landscape: introduce ruptures, maintaining continuity, wait and see, and flexible development. It is obvious that, depending on scale, these options have different relations with landscape identity.

Keeping existential identity in mind, changing the landscape should be supported by its residents. Participation, however, does not support change very well and is about the tendency to look back and to protect what already exists, according to Meeus et al. (1986), and can be related with the NIMBY phenomenon. On the other hand Meeus et al. (1986) also state that involvement of those concerned with its use leads to a sense of ownership and belonging. Therefore we can say it is obligatory to create an understanding for changes among local people, for example to make the changes within the water system visible, and the alternatives and arguments for adaptive interventions. We already saw that experiences could lead to action, and together with the idea to make changes visible we can state that a dynamic landscape should be an experiencable landscape. An example is the creation of a viewpoint on a dike near Hamburg to be able to experience the tidal Elbe river system, on figure 2.11.

Figure 2.11 | *A viewpoint on a dike in the tidal Elbe river system near Hamburg, Germany. This example shows the reconnection between the community and the dynamic water system.*

2.6 Conclusion

Within this chapter we have searched for the values of the landscape that support the local community. To begin with, landscape is like a home, a home were people live and learn, and which is also shaped by people. People and their landscape are united by landscape identity. In general, landscape identity is about the perceived uniqueness of a place as result of a dynamic, adaptive and constantly changing interaction between people and nature. Pedroli et al. (2011) stated 4 interpretations of landscape identity could be determined: spatial cultural (geographical), spatial personal (orientation and experience), existential cultural (common history and tradition) and existential personal (individual memories) landscape identity.

When these interpretations are used seperately it is possible that several values in the landscape are ignored, for example when authorities claim to integrate landscape identity while they only use a spatial-cultural focus and ignore the existential interpretation of landscape identity.

However, if all interpretations together are kept in mind during a design process they could have a positive effect on the local community and their landscape. Therefore, these 4 interpretations are translated into key values in the landscape that support community by taking a closer look to each interpretation. For each interpretation, a number of values could be determined. Some of these values are overlapping on multiple interpretations, and some could have a bigger impact on the landscape identity than others, but for this thesis this is irrelevant: all values have to be taken into account. The following key values can be determined:

- **Continuity**
Which is about protecting the landscape the way it is, and about longterm and subtile development, for example by acupuncture, to keep stories and memories physical.

- **Legibility of landscape characteristics**
Coherence within the landscape. Which is about patterns in similar landscapes, for example with the same water level (horizontal coherence), but also about the relation between the use and the soil type within the landscape (vertical coherence). One of the advantages is the increased orientation within a region.

- **Legibility of stories and traditions**
The long history of places can be amazing. Bringing these stories and traditions back to life can make citizens proud and more involved in the regional history.

- **Legibility of interventions and processes**
To connect people with their landscape, natural processes and interventions in this landscape should be made understood, especially in changing landscapes like climate change affected regions.

- **A healthy economy, community and ecology**
The functions and events within the landscape should be supported, in order to increase the self-esteem of individuals.

- **Distinctiveness**
Iconic elements could be made more accessible and visible in order to give them an even more iconic status for the region.

- **Diversity, complexity and mystery**
Not everything has to be clear in the landscape. Diversity, complexity and mystery add experiences to the landscape, and diversity in scale of objects and structures leads to landscape understanding.

- **Adaptivity and supporting a dynamic landscape**
Landscapes should be adaptable for future needs of society and nature, to stay functional, instead of making the landscape into a museum. Furthermore, landscape dynamics make landscape more lively.

- **Accessibility and facilities**
For self-efficacy, accessibility and a diversity of nearby facilities are important to do the things we want to do.

3

Landscape analysis

3.1 Introduction

Within the introduction chapter we have read that the Zwarte Water region is a diverse region consisting of both urban and rural areas, on several soil types, and with water bodies and streams running through the landscape. In this chapter the landscape characteristics of the Zwarte Water region will be revealed based on the values from the previous chapter. Taking these values as basis will reveal the relation between the Zwarte Water landscape and its community; it shows where possible interventions could increase the relation between the community and the water system, but it also shows which landscapes should be threated more carefully.

The values as described in the previous chapter are being analysed for the Zwarte Water region:

Continuity: Rupture and continious landscapes
Old landscapes represent the unique identity of the Zwarte Water region. In this analysis they will be revealed.

Legibility of landscape characteristics: Landscape types
The landscape of the Zwarte Water region is highly diverse. Several sublandscapes can be determined that all have their unique landscape characteristics.

Legibility of stories and traditions: The history of the Zwarte Water region
The Zwarte Water region has a rich history, especially in relation with the water system, which has formed the region as the way it is today.

Legibility of interventions and processes: Water experiences
The relation between the water system and the community is formed by the places where the water system could be experienced. Whether they could be experienced, and how they are experienced will be discussed.

A healthy economy, community, culture and ecology
The landscape supports the self-esteem of individuals. A healthy local economy, community and ecology could play an important role within this self-esteem and are therefore determined whether or not they could have a possitive influence on this self-esteem.

Distinctiveness: Landmarks
Unique landmarks help to make the local region recognizable and seperate them from other regions.

Diversity, complexity and mystery: Landscape density
Diversity, complexity and mystery in the landscape are highly related to the density of landscapes, due to for example the presence or lack of overview.

Adaptivity and supporting a dynamic landscape: Dynamic landscapes
Some landscapes are likely to change in the short term future, to adapt to contemporary challenges and needs, such as climate change and urban growth.

Accessibility and facilities: Infrastructure and facilities
A map of infrastructure and facilities show the movements and hotspots of people in the region.

3.2 Continuity
Rupture and continious landscapes

When continuity strengthens the identity, old places strengthen the identity of a place more than young places. On the map on the right, today's landscape is compared with the landscape of around the year 1900: Since 1900, some landscapes have changed dramatically, especially the urban expansions, infrastructure like highways, and reclaimed lands. Others have been changed modestly, for example inner cities that kept their structure and most of their buildings. Furthermore, most agricultural areas have been changed modestly, for example land reparcellation projects with new farms, deeper drainage and as a result other crops instead of grasslands. In most cases the openess of the landscape did not change. In some cases, like Staphorst, the reparcellation changed the landscape dramatically, eventhough the use of the landscape did not change significantely.

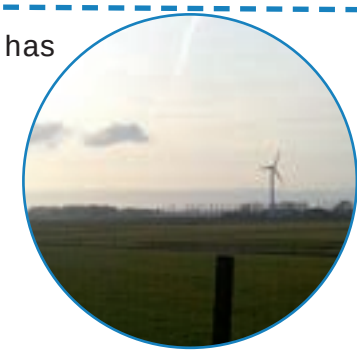
Especially nature areas, water surfaces as well as agricultural areas, where no reparcellation has taken place, are the areas that are mostly comparable with the situation of the year 1900.

Interesting to this map is the fact that most people live in relatively new environments, while the older environments can be found around these neighbourhoods both in the rural area, with in many cases sharp edges, as well as in the urban centres. The water network connects the inner cities with the rural areas, including the nature areas.

Furthermore, it seems that new landscapes dont especially have less landscape values compared to old landscapes; new nature projects and the whole North East polder have their own values for example.

New polders

During the 20th century many sea has been reclaimed for agriculture like the North East polder, resulting in complete new landscapes.



Industrial zones

This industrial zone at Hasselt can be seen as a rupture along the Zwarte Water river.

New nature

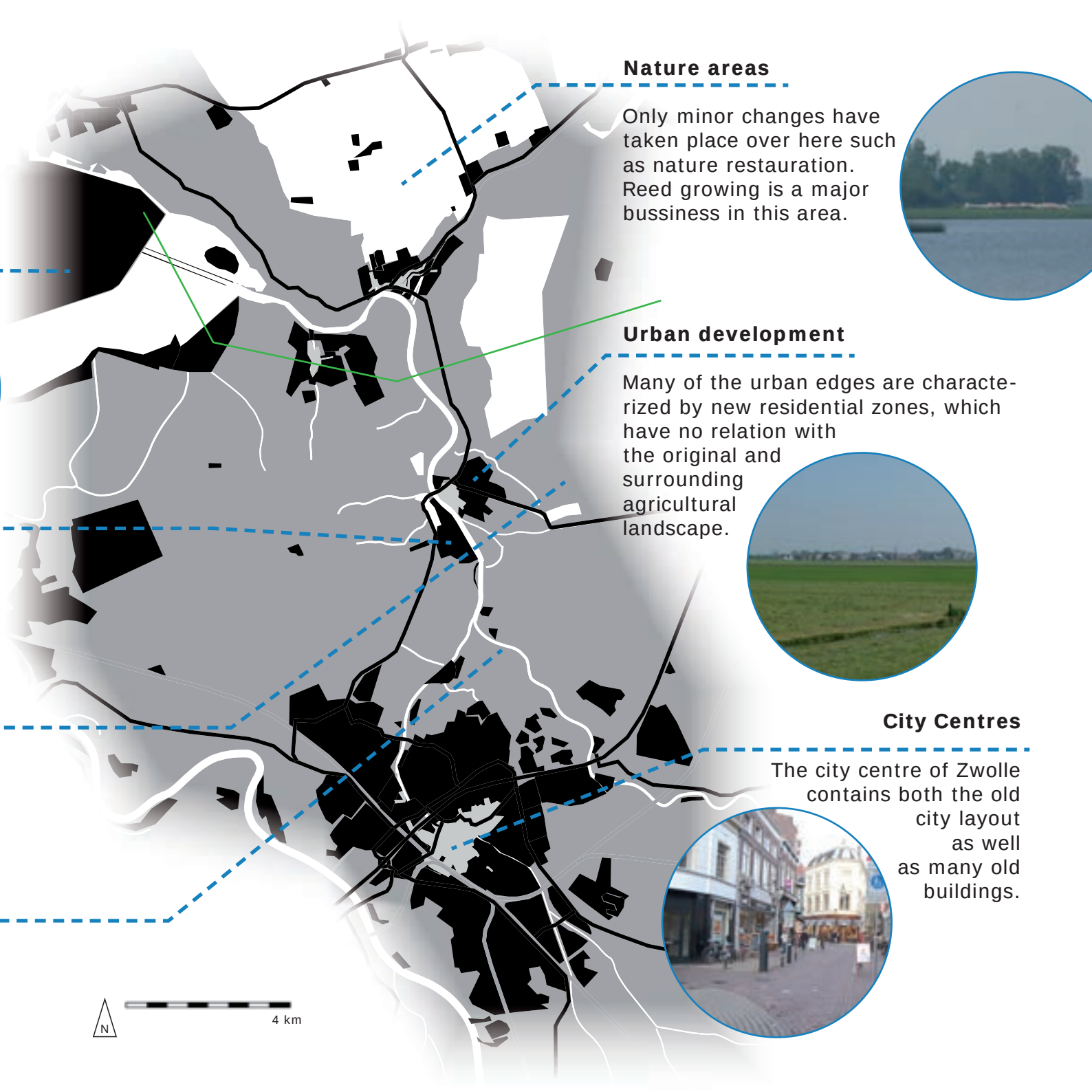
Agricultural land replaced by nature. The openess and landscape experience does not change dramatically.

The river and its floodplains

The floodplain area has not been changed much.

Legend

- No significant change since 1900
- Moderate changes since 1900
- Dramatic changes since 1900
- Section figure 3.1



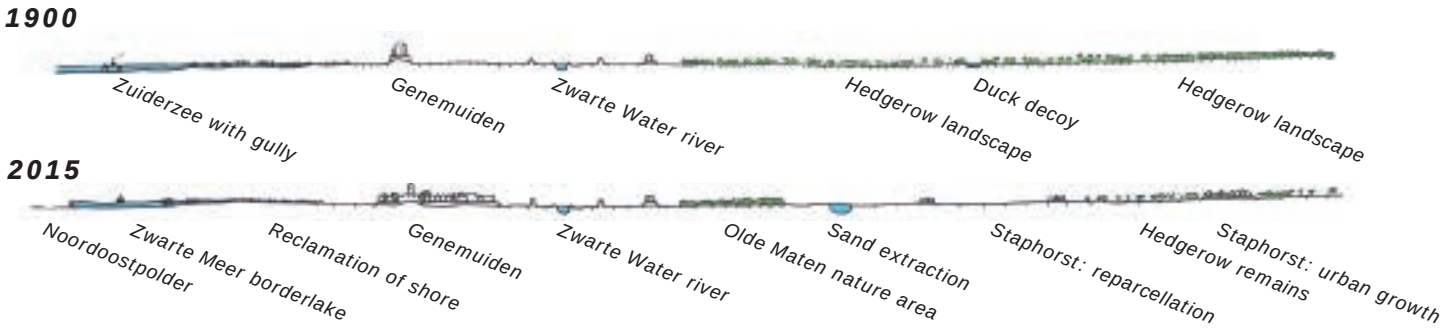


Figure 3.1 | *The changed landscape from the sea landscape towards the sand landscape of Staphorst, from 1900 to now.*

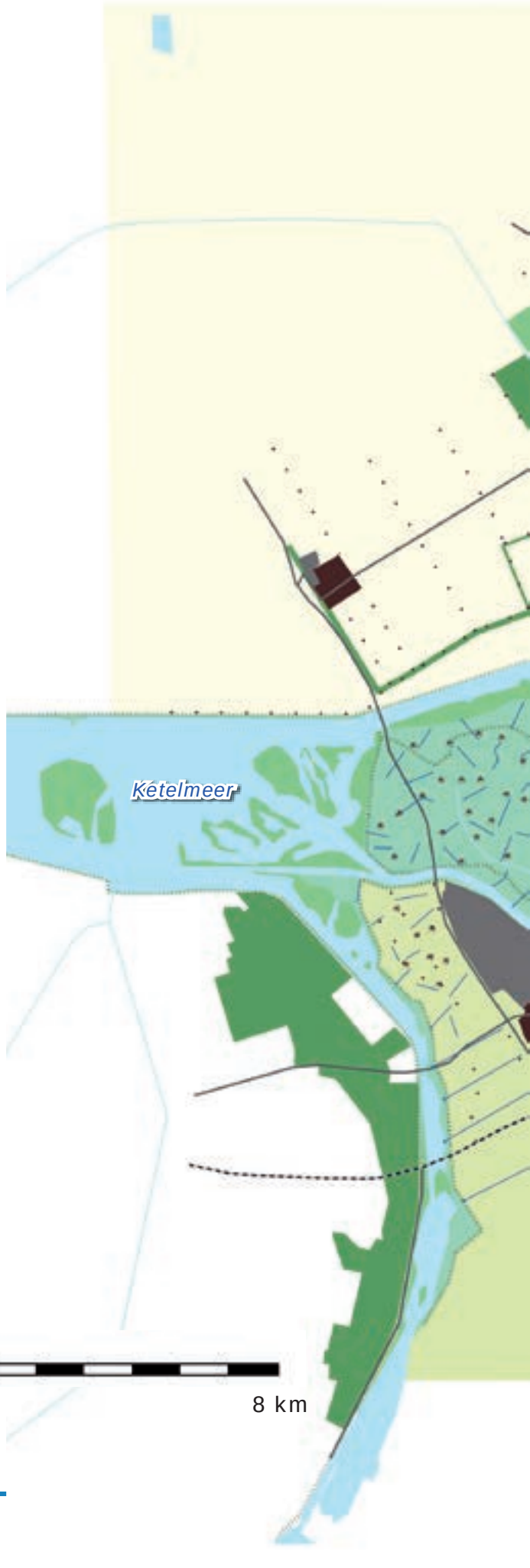
3.3 Legibility of landscape characteristics

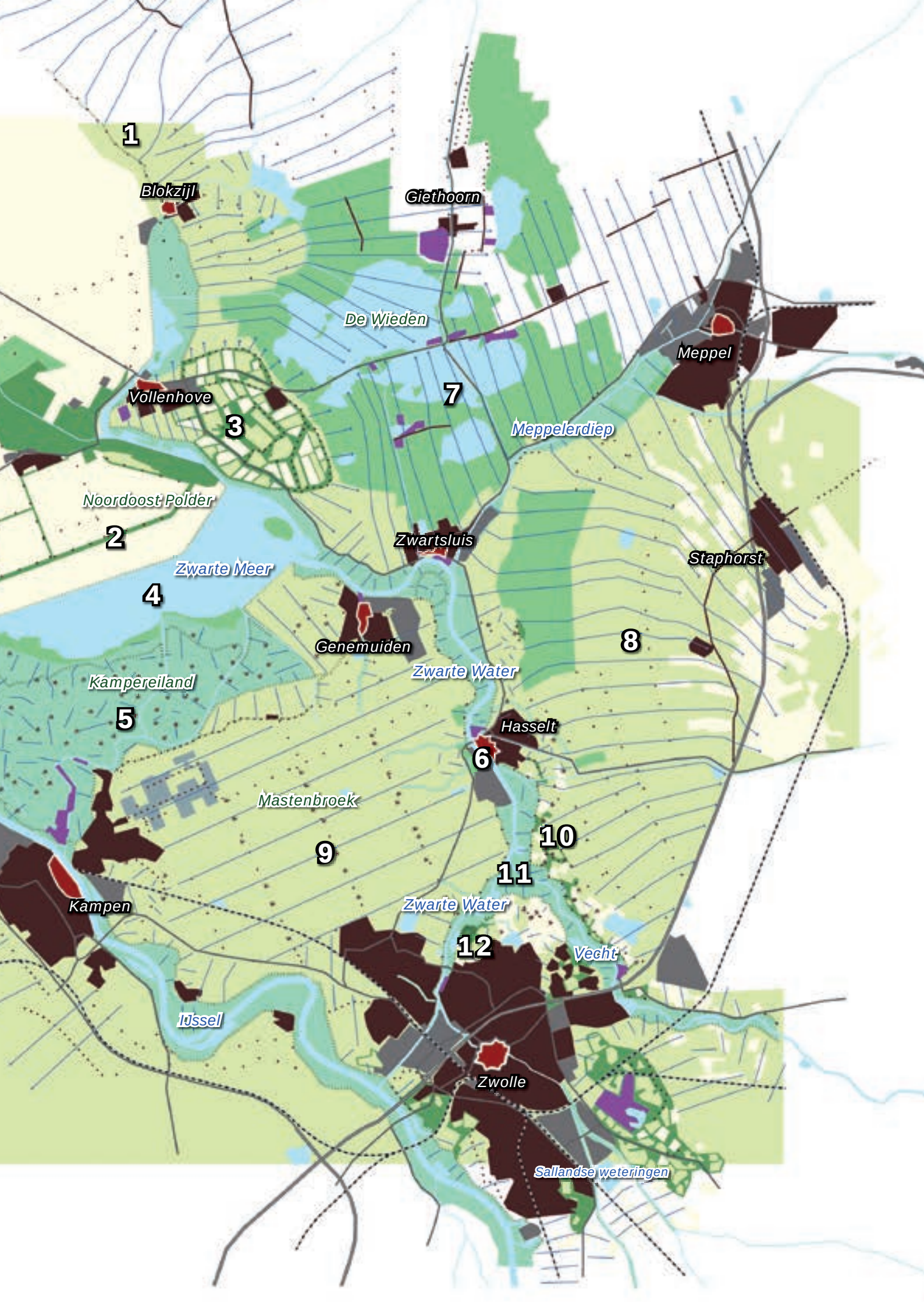
Landscape types

The region around the Zwarte Water river is a diverse mix of landscapes, due to its location as mouth area and its history as can be seen on the right. The numbers correspond with the sub landscapes on the next pages.

Legenda

- Residential/commercial
- Industry
- Historical city centre
- Recreation and tourism
- Residential and farms
- Mounds with farms
- Mainly Dairy
- Mainly Arable
- Greenhouses
- Forest
- Swamp
- Floodplains, mainly grass
- Water
- Railroad
- Highway
- Regional road
- Dike
- Parcel direction



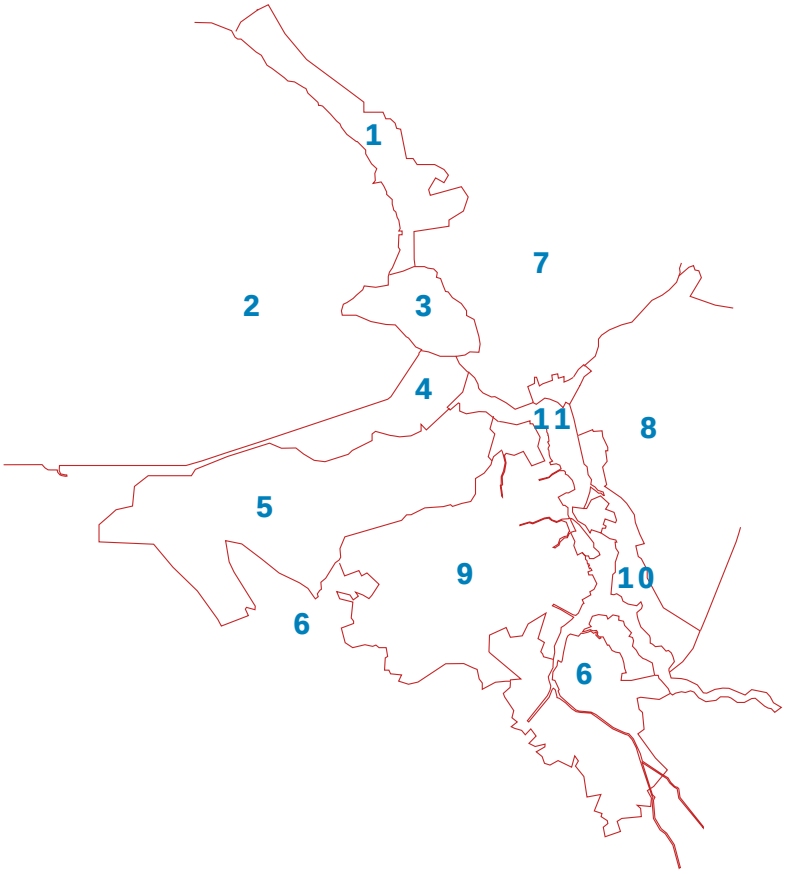

1
Blokzijl
Giethoorn
De Wieden
Meppel
7
Vollenhove
3
Meppelerdiep
Noordoost Polder
2
Zwartsluis
Staphorst
Zwarte Meer
4
Genemuiden
8
Zwarte Water
Kampereiland
5
Hasselt
6
Mastenbroek
10
9
11
Kampen
Zwarte Water
12
Vecht
IJssel
Zwolle
Sallandse weteringen

Sub landscapes

In order to define the qualities of the lower scales within the Zwarte Water region, we will now analyse the sub landscapes that are present in the Zwarte Water region that form a certain unity concerning the landscape appearance, the settlement patterns and its athmosphere.

Those sub landscapes are:
1. Former coastline Vollenhove-Kuinre
2. Noordoost Polder
3. Moraine of Vollenhove
4. Zwarte Meer
5. Kamper Island/IJsseldelta
6. Urban and urban edges
7. Wieden-Weerribben
8. Staphorster field
9. Mastenbroek polder
10. Sandy east of the Zwarte Water
11. Zwarte Water

The borders between those landscapes are not always clear. Sometimes particular landscape elements form the borders between those landscapes, such as the dikes, villages and former creeks between the Zwarte Water river and the Mastenbroek polder. Both the contrasts as well as the similarities between those landscapes can be interesting, like the Mastenbroek polder, the Wieden and the Staphorster field. These are all peat soils, but still provide very different landscapes.



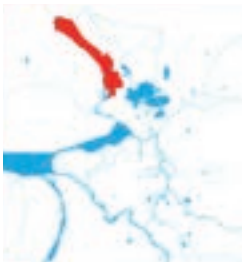


Figure 3.3.1. | *The grassy landscape, seen from the dike, with in the distance the Wieden-Weerribben swamp landscape.*

Figure 3.3.2. | *The dike as central axis.*

Former coastline Vollenhove-Kuinre

The former sea dike between Vollenhove and Kuinre is the basis for this sub landscape. South west of the dike the sea has been replaced by a sea of farms, while the old peat cultivation land in the north east, and especially the Weerribben and Wieden nature areas behind the grasslands, are located higher, but lowers due to seepage to the polder. This water shortage is contrasting with the battle against the water in the past, which has resulted into a winding dike, around several breakthrough ponds, and a fertile clay layer along the dike. However, together with the farmhouses and the inaccessibility, this sub landscape is characterized by tranquility and picturesqueness.

Figure 3.3.3. | *Section from south west to north east: behind the former dike breakthrough ponds and farmhouses are located, in the middle grasslands, and the landscape is bordered by the Wieden-Weerribben nature area in the north east.*

Figure 3.3.4. | *Settlement pattern*

Zwarte Water

For centuries the Zwarte Water river has been adjusted by humans. The former estuary river was surrounded by peat areas, where several creeks run into. People then placed dikes, cultivated the floodplains and peat areas, reclaimed lands, especially near the mouth, and built cities and infrastructure around the river. Due to shipping, recreation, the function as ecological main route and water discharging, the river is the basis for the identity of this region.

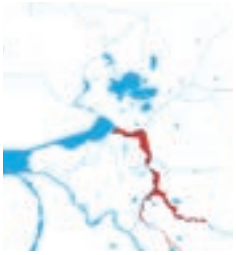


Figure 3.3.6. | *The Zwarte Water river near Hasselt.*

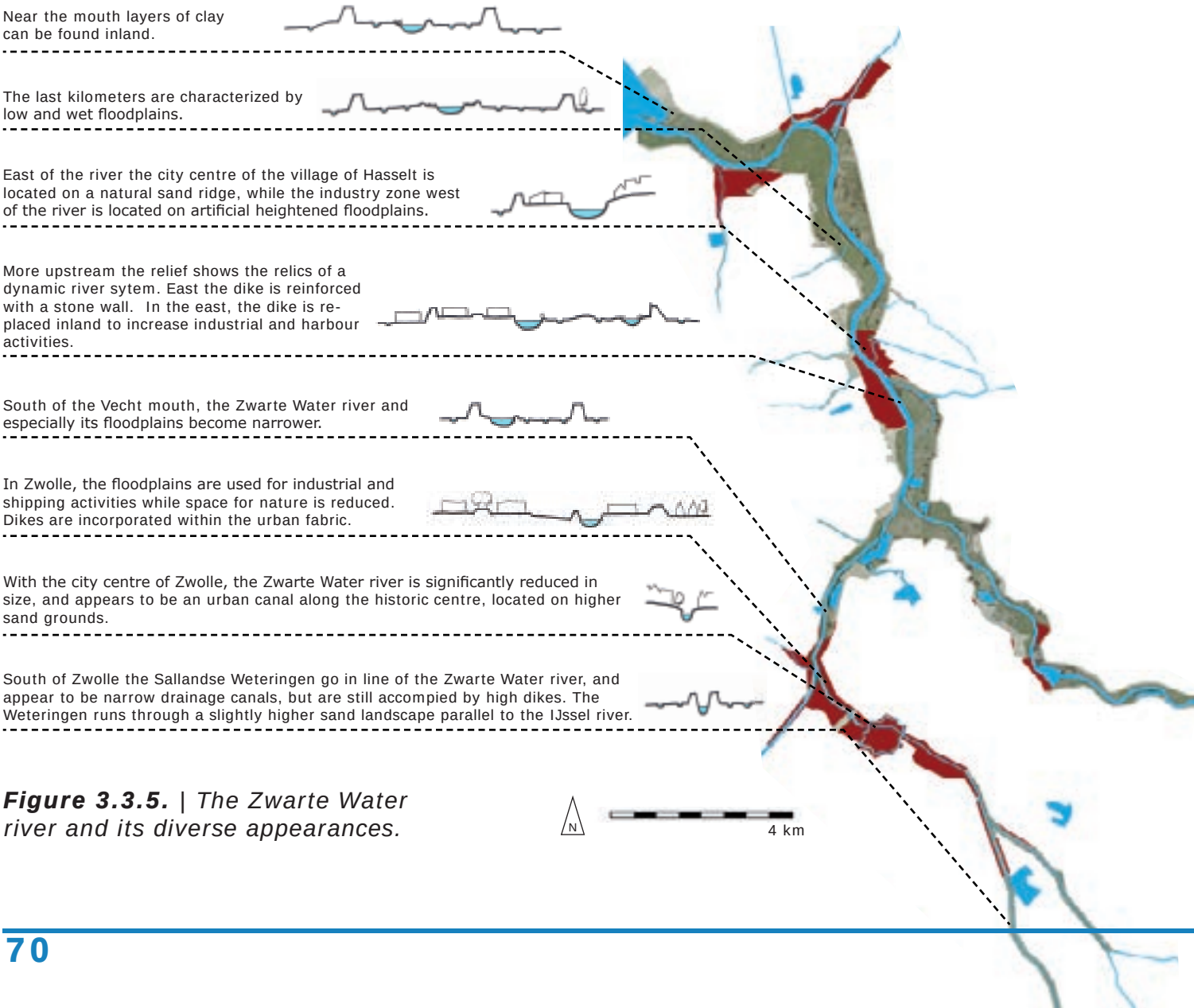
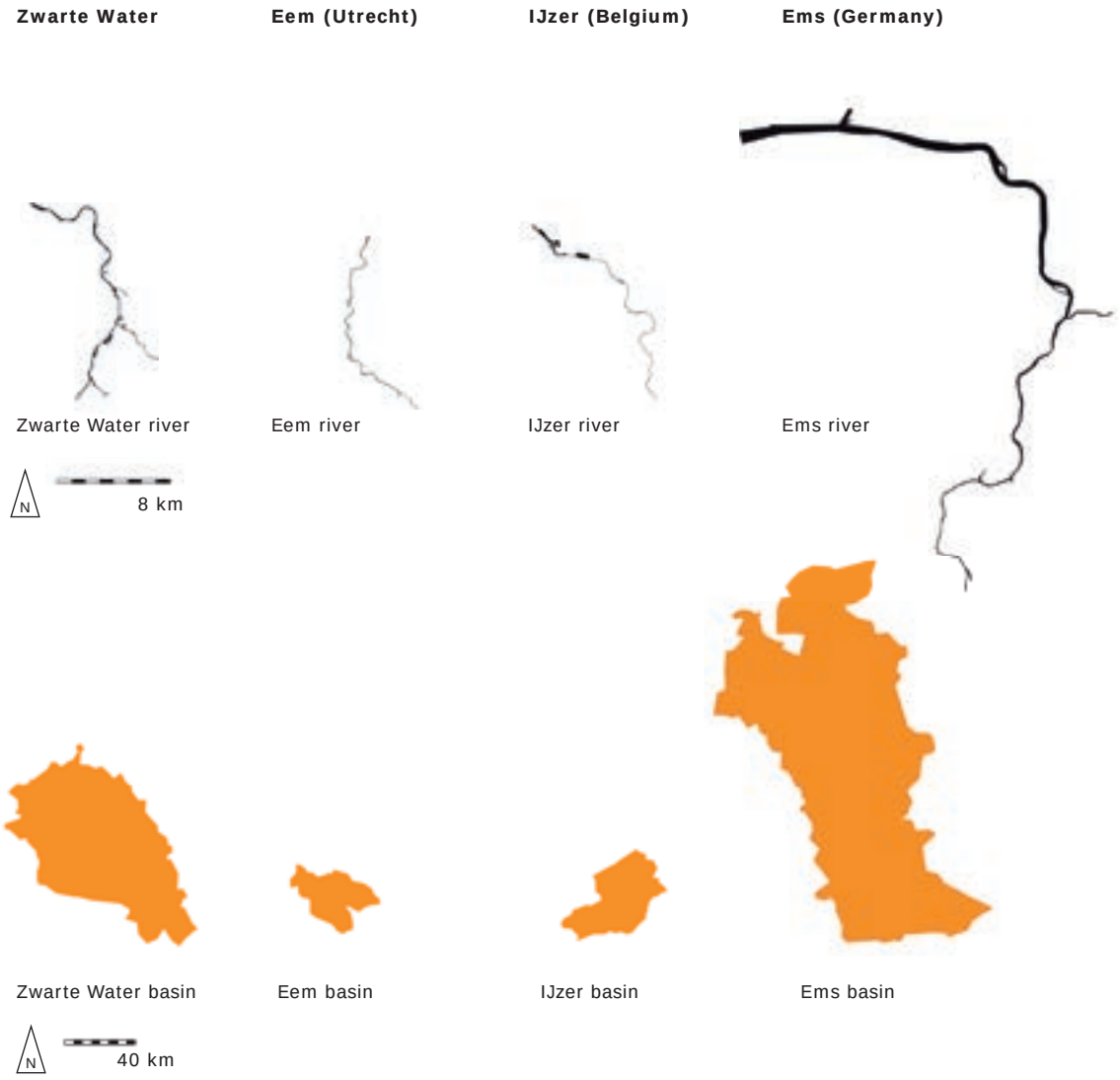


Figure 3.3.5. | *The Zwarte Water river and its diverse appearances.*



The Zwarte Water river is a former estuary river and is accompied with former creeks and breakthrough ponds, resulting in an ecological diverse fresh water zone. The rain fed river is the biggest of the small rivers in the Netherlands.

Comparable to the Zwarte Water river is the Eem river, also flowing towards the former Zuiderzee. Just like the Zwarte Water river, it is surrounded with peat and later on also sand areas, and furthermore the width of the river reduces when it meets a major city, Amersfoort. However, the width of the river and the size of the basin are significantly smaller than the Zwarte Water river.

The French/Belgian river of the IJzer becomes significantly wider when it meets the North Sea, resulting in major harbour activities near the mouth.

The Ems river in Germany, near the border of the Netherlands, is a typical estuary river, including a tide system. The unbalance between the tidal river and the flood plain surface, due to upstream harbour activitieits resulted into a major amount of sludge, as elaborated in Papenborg and Togt (2012).

Figure 3.3.7. | *The Zwarte Water river compared with 3 similar rivers.*

Noordoost Polder

The Noordoostpolder is a recent polder landscape, made half way the 20th century. The efficient structuring of the polder and nutritious soil results in a high agricultural production. This also results in a relatively open landscape. The height map (fig. 3.3.9), however, shows interruptions in this landscape of for example former islands and higher edges that were part of the former coast. Near the Vollenhove moraine this former shallow coast is being arranged with forest. However, most of the edges are dikes, resulting in a sudden transition to a water landscape.

Figure 3.3.8. | *The open landscape with major and straight landscape elements like rows of poplars and wind turbines.*

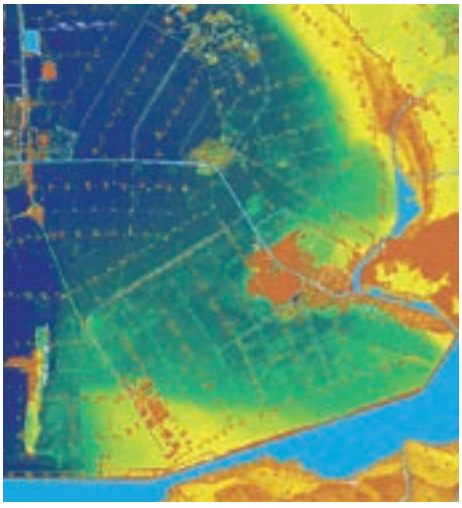


Figure 3.3.9. | *Height differences within the Noordoostpolder. Range from <-4m NAP (Dark blue) up to >+1m NAP (Red).*

Figure 3.3.10. | *The open polder landscape.*

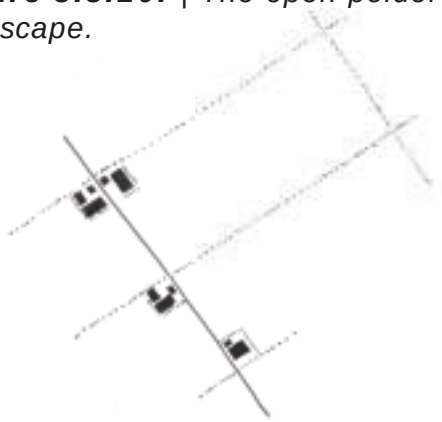


Figure 3.3.11. | *Straight and major parcels.*

Figure 3.3.12. | *The Noordoostpolder.*

Moraine of Vollenhove

The moraine of Vollenhove is a strange element in the smooth surrounding peat, sand and clay landscapes. The highest parts, in the north east, could be up to 10 meters, making this landscape less dependent from a water level rise. In the west and south the area borders the water system of the Zwarte Meer, Kadoeler Meer and Vollenhovermeer, in the north and east it borders the Wieden area. This edge is mostly a sudden transition from a flat landscape into a rising moraine landscape. In the middle a lower open landscape exists as well. On the higher parts a semi closed hedgerow landscape with regular parcels but curved ways exists. In the past, this higher landscape along the coast resulted into the early presence of people, and a major role of the city of Vollenhove in regional governance.

Figure 3.3.13. | *The semi closed hedgerow landscape.*

Figure 3.3.14. | *The height of the landscape reduces from north east to south west.*

Figure 3.3.1. | *The typical landscape is bordered with sharp edges.*

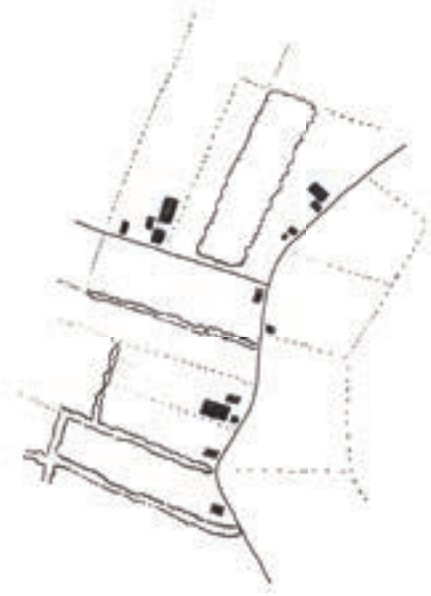


Figure 3.3.15. | *Regular parcels, curved roads.*

Zwarte Meer

With the creation of the Noordoostpolder, the Zwarte Meer has been formed half way the 20th century. Before, it was a coastal zone within the brakish Zuiderzee. The past 70 years the fresh water border lake is constantly in transition to find its ecological balance. The lake is used for water recreation, but there are no towns directly along the lake, making the lake a tranquil area.

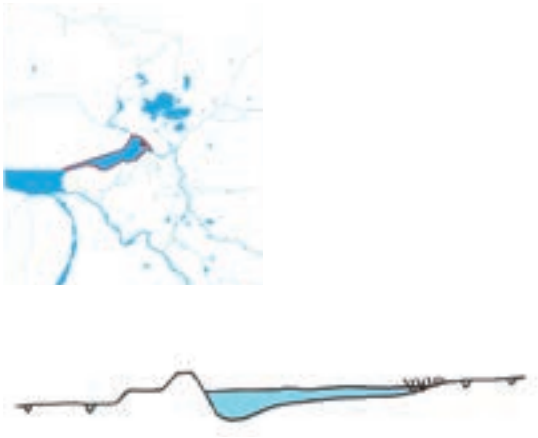


Figure 3.3.18. | *In the south east (right) the former delta of the IJssel runs slowly into the lake, while in the north west (left) the sharp edge with the Noordoostpolder appears.*

Figure 3.3.19. | *The Zwarte Meer and its edges with in the west the Ramspol, and in the east the artificial Bird Island and the Zwarte Water mouth.*

Figure 3.3.16. | *The open water landscape.*

Figure 3.3.17. | *The Ramspol dam, between the Zwarte Meer and Ketelmeer.*

Kamper island

The Kamper island represents the delta of the IJssel river. The city of Kampen received the rights to grow the delta for agricultural puproses, which it already received in the middle ages. Since then the delta has been changed and has grown with former gullies and former coastlines as witnesses in the current landscape. The area is mostly used for agriculture, and to a lesser extent for recreation. The open and tranquil landscape is especially interesting as cycling area.

Figure 3.3.20. | *The Kamper island is an open and tranquil landscape.*

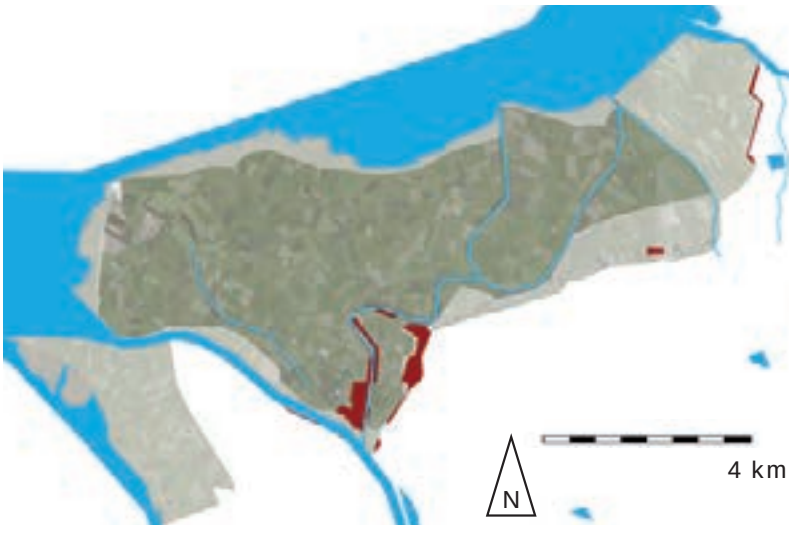


Figure 3.3.21. | *The Kamper island or IJssel delta landscape. Its edges are formed by natural zones along the water, by dikes, and by transition zones to other landscapes, especially peat landscapes.*

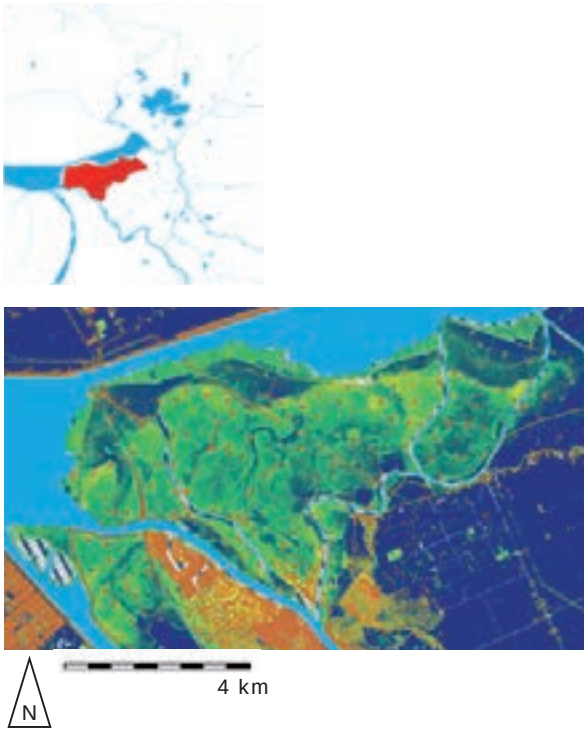


Figure 3.3.22. | *On the height map the IJssel delta becomes visible, with elements like former gullies and former coast lines. The relative height (dark blue is <-0,5m NAP, red is >+1,5m NAP) compared to its surroundings, like the Mastenbroek polder, is clearly visible.*

Figure 3.3.23. | *The irregular silted landscape.*

Figure 3.3.24. | *Irregular parcels, following former coastlines and gullies, with farm mounds.*

Urban and urban edges

As can be seen on figure 3.3.28, the first settlements in the region were located along the water. In figure 3.3.30 we see this is still the case in the 19th century where major urban concentrations could be found within the surrounding fortification canals. This is in contrast with the small concentrations of farmhouses on river dunes, integrated within the urban grid later on. Outside the city rings along the water small scale industries appeared, like wharfs. Furthermore, Zwartsluis had many activities going on along the water. On the higher grounds surrounding Zwolle, urbanisation went on. In the Interbellum period the first plan wise urban developments took place, and in the second half of the 20th century major urban expansions took place, this time on the wet soils as well, and this expansions still takes place. However, the development of the three smaller cities along the Zwarte Water fell behind on the development of Zwolle, especially in the first half of the 20th century, making Zwolle the major city in the region (fig 3.3.30).

When working with identity, the cities and their edges (fig 3.3.29) matter, because these are the places where people live, and create their existential identity. The surrounding rural landscape and the city are different worlds, although the link between those worlds differs from place to place. On the other hand, the edge and the rural landscape are never far away, and especially along the rivers it runs deep into the city.

Figure 3.3.25. | *The historic city centre of Hasselt.*

Figure 3.3.26. | *Industry and highrise buildings in Zwolle.*

Figure 3.3.27. | *The urbanisation front.*

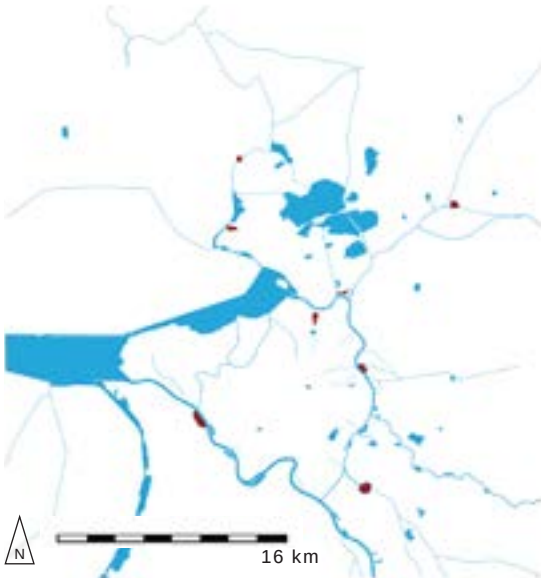


Figure 3.3.28. | *The historic city centres in the area are only located along the water, representing the major role of the water system in past centuries.*

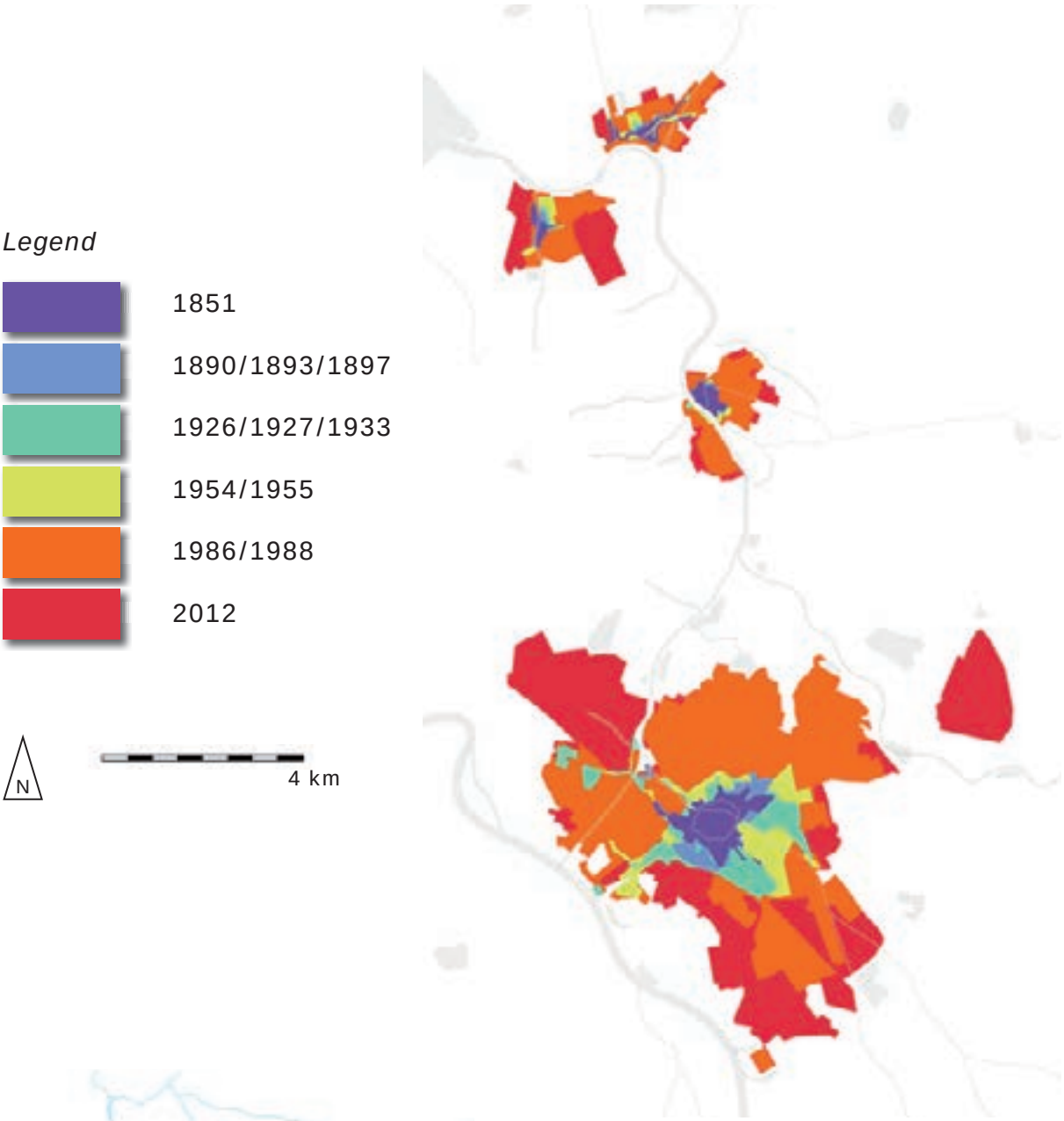


Figure 3.3.30. | *The development of the cities along the Zwarte Water since 1851. (Based on: Watwaswaar.nl)*

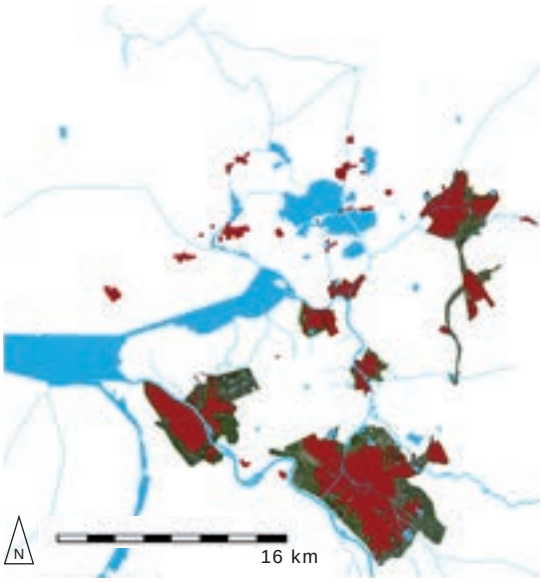


Figure 3.3.29. | *The cities and their surroundings. The urban edges are for example used for parks, recreation and intensive agriculture.*

Sandy east of the Zwarte Water

East of the Zwarte Water river a sand landscape can be found. This is mostly a river dune landscape, starting as a sandy arm coming from the sand area in the south east. These areas are inhabited as first in the region, which can be seen in the parcelation structure. Furthermore, in this area many mounds can be found. Small farm villages are located within this region, as well as the city of Hasselt. The semi open and picturesque landscape just beyond the dike includes some arable lands, in contrast with the open grassland landscape more inland.

Figure 3.3.31. | *A mix of grasslands and arable lands in a semi open landscape.*

Figure 3.3.32. | *The zone behind the dike slowly transforms into an open grassland landscape.*

Figure 3.3.33. | *Irregular parcels and some of the farmhouses on mounds.*

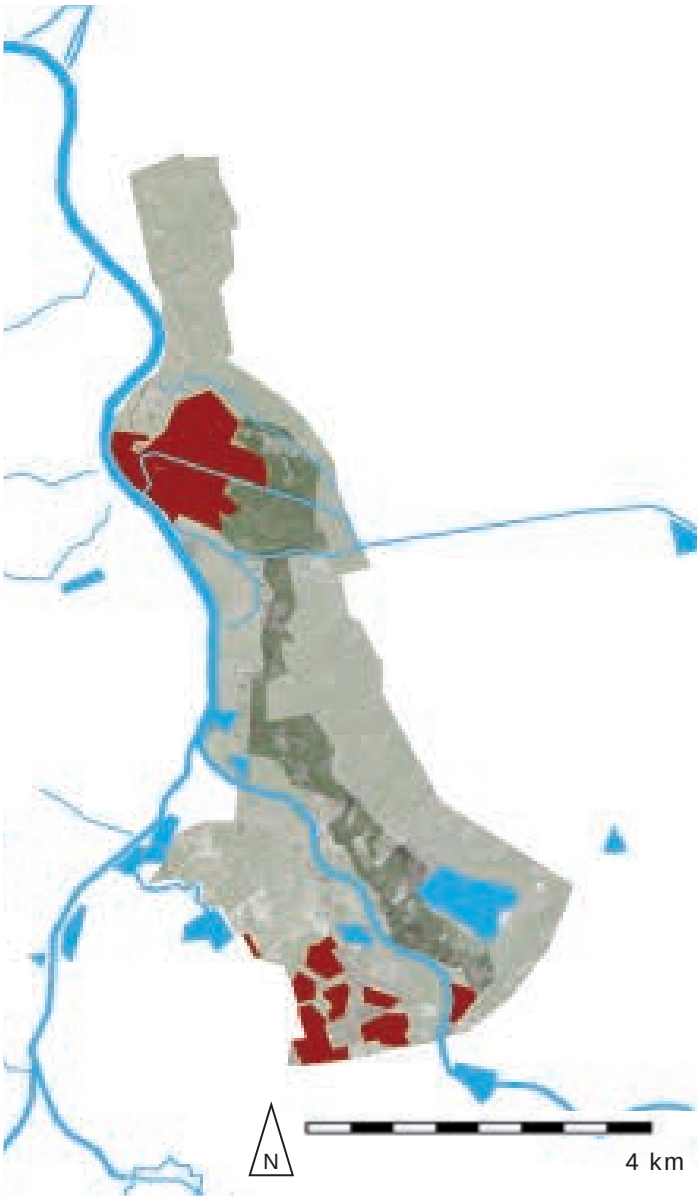


Figure 3.3.34. | *The small zone east of the Zwarte Water river.*

Staphorst

This landscape is a typical peat cultivation, starting from along the Zwarte Water and Meppelerdiep. Most farmhouses, except for the land consolidation farmhouses, are concentrated along the central axis where houses are built behind each other when space ran out. This concentration also means that the rest of the landscape is mostly free of houses making it a tranquil area. The axis is roughly the border between the higher sand soils and the peat in the west. In the utmost west along the river the lowest area is arranged with wide ditches and nature.

Figure 3.3.35. | *The axis runs parallel to the Zwarte Water and Meppelerdiep.*

Figure 3.3.36. | *The open landscape is varied with a nature area in the utmost west.*

Figure 3.3.37. | *West of the axis grasslands can be found, east of the axis a mix of grasslands and arable lands with tree rows can be found.*

Figure 3.3.38. | *Farmhouses are concentrated along the axis.*

Polder Mastenbroek

This polder is a peat cultivation originating from the middle ages. Its straight lines makes the polder comparable to for example the known Beemster polder (fig. 3.3.43B) from the seventeenth century, although the Mastenbroek polder is more connected to its surrounding river and delta landscapes by for example the creeks and irregular parcels on the edges. Therefore it can also be compared with the Biesbosch area (fig. 3.3.43C), where the creeks flow through the agricultural landscape.

The basis of the polder are three canals with farm houses along, with many of them on mounds. Perpendicular to this, bayonet shaped roads are the connection with the surrounding region.

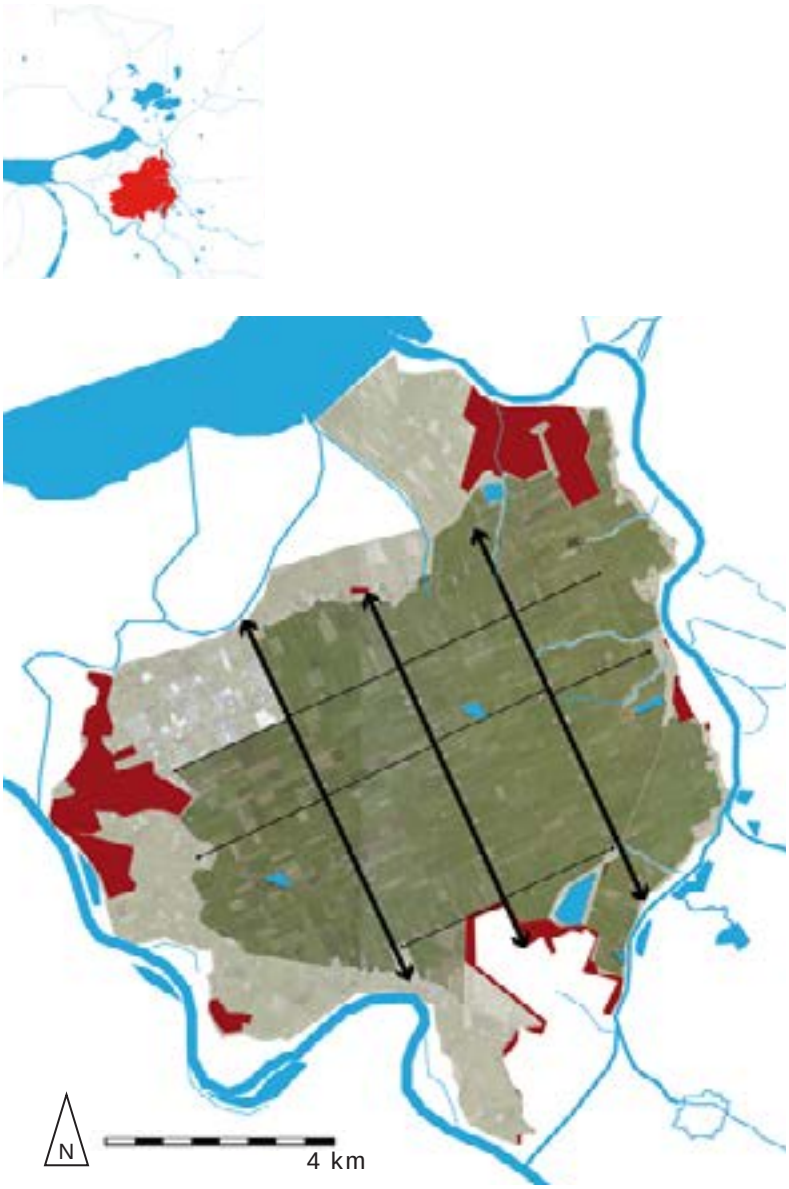


Figure 3.3.39. | *The straight lines make the Mastenbroek polder a distinguishable area. Edges are mostly formed by dikes, creeks and older parcels along the rivers.*

Figure 3.3.40. | *The flat and open landscape.*

Figure 3.3.1. | *Many farmhouses are built on mounds.*

Figure 3.3.41. | *Rectangular parcels and a bayonet shaped crossroad.*

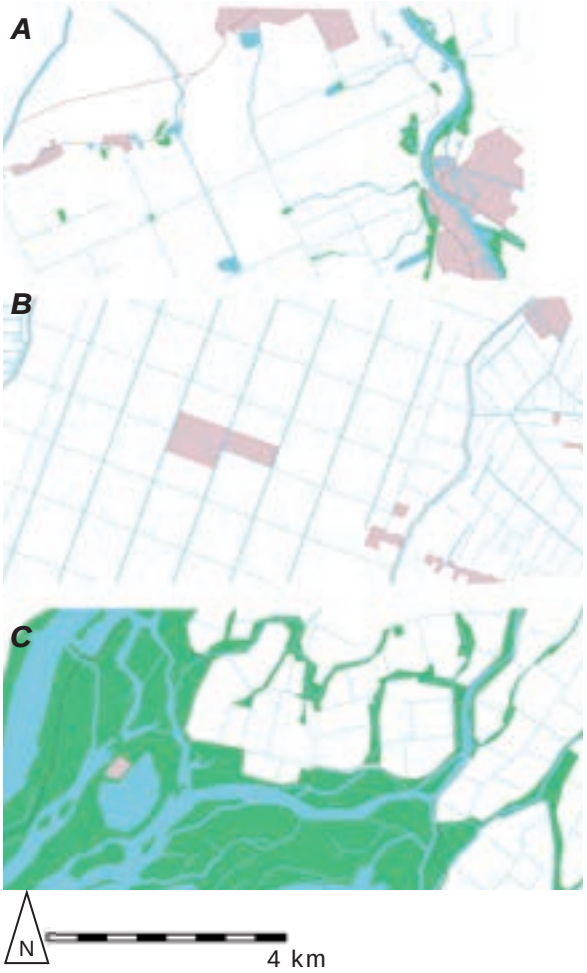


Figure 3.3.43. | *Three different polder landscapes and their surroundings: The Mastenbroekpolder (A), the Beemster polder (B) and the Biesbosch (C).*

Figure 3.3.42. | *Panorama view from the Kamperzeedijk near Genemuiden towards the Mastenbroek polder.*

Wieden and Weerribben

North of the Zwarte Water a major peat area is located: the Wieden and Weerribben area. This region started as peat cultivation, but was later used as a peat excavation area, resulting in lakes later on. The semi closed and mixed landscape harbours reed growth, nature, some grasslands, and recreation. Around the area especially wet grasslands and polders are located. The several axes include recreational facilities and picturesque living environments.

Figure 3.3.46. | *Lakes, reed fields and nature are mixed into an semi closed landscape.*

Figure 3.3.44. | *The canals with farmhouses are surrounded with wet lands, like reed fields.*

Figure 3.3.45. | *Farmhouses are located along the canals.*

Figure 3.3.47. | *Many axes are present in the mixed water and nature landscapes.*

Appearances of the 3 peat cultivation landscapes

The three peat cultivation landscapes in the region, Mastenbroek, Staphorst and the Wieden, all have their own characteristics, making their appearance significantly different from the others. The main characteristics are summarized below:

Staphorst

Type of cultivation:
An edge peat cultivation. Low in the west, higher in the east towards the sandy soils.

Soil types:
Cultivated peat with a basis of sedge, reed or swamp (mainly alder) peat, which reduces towards the east, and becomes a sand soil.

Cultivation direction:
Along the Zwarte Water river, up to the sandy east.

Settlement structure:
One main axis on the border of the peat and sand soils, resulting in a dense concentration.

Current landscape:
Mainly grasslands, open landscape with some three rows, wetland in the utmost west.

Wieden

Type of cultivation:
Continuous cultivation behind existing parcels.

Soil types:
Cultivated peat with a basis of sedge, reed or swamp (mainly alder) peat, with probably some peat domes. More to the east the sandy soil appears.

Cultivation start:
From different sides, especially along the Meppelerdiep.

Settlement structure:
Several axes, mostly along canals.

Current landscape:
Mainly wetlands, with nature and reed growth, as well as grasslands and some polders. Open, closed and semi closed landscapes.

Mastenbroek

Type of cultivation:
Structured cultivation with 3 straight axes.

Soil types:
Clay layer on top, with a basis of sedge, reed or swamp (mainly alder) peat, to the south east a sandy soil appears.

Cultivation start:
The whole area between the Zwarte Water and IJssel rivers is planned in one time.

Settlement structure:
Farmhouses along the 3 axes, the oldest on mounds.

Current landscape:
Open grassland landscape, farmhouses along the 3 axes.

3.4 Legibility of stories and traditions

The history of the Zwarte Water region

The IJssel river, Vecht, and Zwarte Water river come together in a broad valley, between ice age originated moraines. With the rising of the sea level after the last ice age, clay and peat covered the former sandy landscape. This sandy landscape is still visible in the presence of sand dunes along the north-east side of the rivers. This were the spots where the first people lived in this region, which stood in contrast with the inhospitable peat areas around. Much peat areas had already dissapeared later on, and formed the Zuiderzee, the water that is now the IJssel lake and the Flevo polders. (Bazelmans, J. e.a. 2011)

The influence of the sea did not stop at the shoreline but went deep into the landscape by using the river system, and formed the Zwarte Water river mouth into an estuary landscape with a wider river near the mouth, and creeks intruding the surrounding peat landscapes, leaving layers of clay. Today these creeks have sunken together with the surrounding peat landscapes due to subsidence (fig. 3.4.1).

Figure 3.4.1 | *Some creek left-overs are filled with reed, others with swamp forest like this one.*

In Carolingian times, the cultivation of the Zwarte Water area started, but only at a small scale and along the rivers and streams. The people probably lived on mounds because of the flexible sea and river water levels. The borders of the peat areas were used for example for grazing pigs, for cutting wood and peat extraction on a small scale. (Berkel, G. van, 2006)

During the ruling of the 12th and 13th century bisshops from Utrecht, the peat areas were being cultivated, using the rivers and streams as the starting axes with long straight parcels right angled on them. Examples are the area of Staphorst and the area of the Wieden, both started from the Zwarte Water and Meppelerdiep. Dikes ('Stouwen') and sluices ('zijlen') made it possible to control the water levels of these arable peat fields. One of the last bigger peat areas in the region that was ready to be cultivated was the polder of Mastenbroek, between the IJssel and Zwarte Water. With the promise of a very fast parcellation in 2,5 years, the parcellation became a very rational straight one, centuries before for example the famous polder of the Beemster. The farmhouses were still built on mounds (fig. 3.4.2).

Figure 3.4.2 | *Farmhouse on mound in the Mastenbroek polder.*

In Carolingian times, the cultivation of the Zwarte Water area started, but only at a small scale and along the

Together with the great cultivations, cities started to develop. Located at the mouth of several rivers along the

coast of the Zuiderzee, they became important trade cities. Another development is the digging of the Sallandse weteringen, drainage canals parallel to the IJssel river, but draining into the Zwarte Water, to be able to be independent from the IJssel river which could rise high above workable levels.

When the peat areas became drained, another development started, which was the subsidence of the landscape. In the fourteenth century dikes were built, and already in the fifteenth century mills were built to keep the polder of Mastenbroek dry. This was also the time that major peat excavations started in the Wieden-Weerribben area, resulting in todays 'left over landscape'. These developments were also the reason for the building of new settlements on the transshipment spots.

At the same time, trade made the region flourishing, resulting in a membership of the 'Hanze' by several cities (fig. 3.4.3). Due to silting of the IJssel, and an increased water flow in the Zwarte Water, trade shifted from the IJssel towards the Zwarte Water, with Kampen loosing its trade position, while Zwolle became more important. These and other regional struggles where one of the reasons the region lost its trade position to the cities in the west of the Netherlands.

Apart from the transport and drainage function of the rivers, these rivers were also important in the defense system because of the location at the northern end of the IJssel line which originated in the 17th century. This included inundation possibilities for a major part of the Zwarte Water region, and several urban and smaller fortifications (fig. 3.4.4).

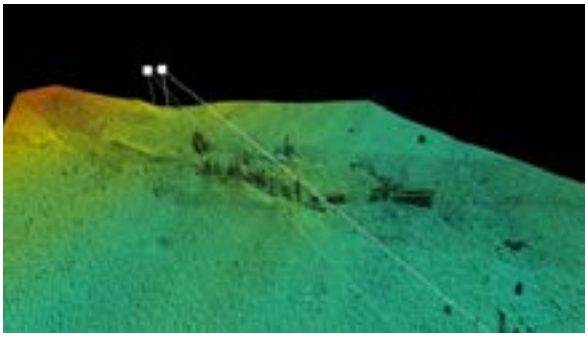


Figure 3.4.3 | *Recently a wreck has been found of a trade ship from the late middle ages on the Zwarte Water near Hasselt.*

Except for transport by land –a bridge in the small city of Hasselt had just been built-, the rivers were ideal for transport. The canal from Zwolle to the IJssel, as built in the 19th century, helped out as well. However, due to silting the Zwarte Water was not interesting for sea ships anymore, shipping with national destinations were a booming business. Examples are the peat ships coming from the peat mores of Overijssel and Drenthe, fishing ships, and the ferries to Amsterdam and many other destinations, transporting not only people but also cattle and other goods. (Coster 2003)

But the water did not only bring wealth. High river water levels and an unreliable water pumping system caused the grasslands within the diked zones to be flooded nearly every winter, a good reason to built the farmhouses on mounds. But even worse is a dike breakthrough. Negligence and the costly protection measures against the floods resulted in a mostly weak water defence system. In times of danger for a flood, cannons were fired to warn the inhabitants behind the dike for the coming water. Next to this, sails from ships were put on weak dikes to prevent

Figure 3.4.4 | *View on Hasselt in the 18th century, where trade activities can be seen, as well as the defense walls around the city.*

it from breaking through. In case of a broken dike, ships were sunken in those breakthrough gaps. During the dike breakthroughs, sluices, bridges, roads and farms were destructed, and a lot of animals as well as some people did not survive. Furthermore, after a breakthrough the land was not useful for the coming period of time to be used for agriculture because of the salty water. A flood also resulted in logistic problems. Rural inhabitants were not able to buy food, farmers were not able to bring their products to the markets, and the cities did not get food from the surrounding area. The many dike ponds (fig. 3.4.5) are the silent witnesses of these floods, like the one from 1825 (fig. 3.4.6), resulting in many water security measures and the first plans for the Afsluitdijk. The flood of 1916 and the fact that water security became regulated nationally instead of local and regionally, were the reason to finally built the Afsluitdijk. (Coster e.a. 2003, Petersen 1978, Pelkwijk 2002)

Modern times also changed the Zwarte Water area significantly. The rush plant craft work has been transformed in a major carpet industry, the shipbuilding industry developed into yacht building and maintenance of commercial ships, and transport is still an important part of the economy. The city of Zwolle already developed itself in an early stage into a national hub in the infrastructure network, while the other Zwarte Water villages remained at their rural scale as commuter villages with a high amount of voters on Christian parties, a high degree of association participation and a relatively high number of children, in combination with a low urban density.

Figure 3.4.5 | *Ponds along the dikes as silent witnesses from dike breaches.*

Figure 3.4.6 | *In the 1825 flooding disaster, the whole Zwarte Water region was flooded.*

Although these modern times started with the wish to cultivate all rough terrains in the region, with fulfilled examples like the reparcellation of the area around Staphorst, the drainage of the swamps of the Wieden, and the creation of the Flevopolders, the rise of tourism and the appreciation of ecological values resulted in a big amount of former 'left over landscapes' in the Zwarte Water region, like the Wieden-Weerribben area with its otter population, the Olde Maten with its bluegrasslands and the Zwarte Water floodplains with the fritillary flowers. Together with picturesque hamlets and historical cities, the area is still an attractive area for tourists. Due to common insights during the last centuries, nature conservation became nature development, the Wieden and Weerribben became a National Park and the Polder of Mastenbroek and its surroundings became the National Landscape IJsseldelta.

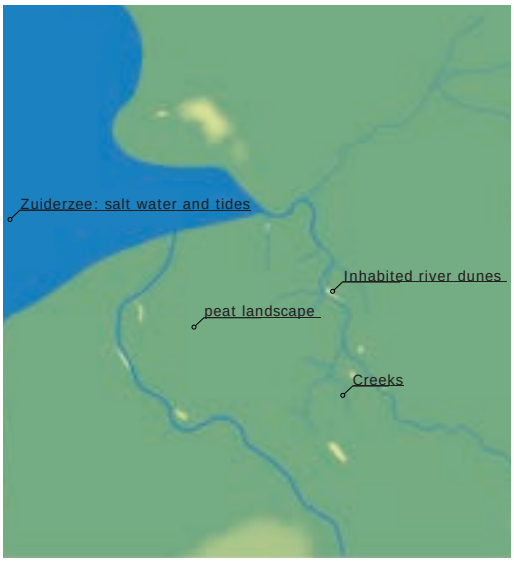
The largest benefit of the modern times for the Zwarte Water area is perhaps the water safety. After centuries of terror by the sea, the water was tamed more and more. The Afsluitdijk had cut the sea off from the former Zuiderzee and this way also from the Zwarte Water area. The building of the Noord Oost Polder and the new dike safety norms after the flood disaster of 1953 made the area much safer. After the floods of 1993, 1995 and 1998 the safety of the area has increased even further by building the Ramspol Dam to protect the Zwarte Water region from IJssel lake water which would, in case of a north-western storm due to a funnel shape, flow in the direction of the Zwarte Water region. This rubber made air and water filled dam only closes in times of storms, occurring roughly once a year.

The danger of dike breakthroughs has been reduced significantly by heightening and strengthening of the dikes in the area, but despite of the high standards for these dikes the risk for a dike breakthrough cannot be reduced to zero. For example, the flood of 1998 made the inhabitants aware of this risk when the water rose high enough to overflow quays and low dikes, and several measures where taken to control the situation (fig. 3.4.7). This also illustrates the idea that in former times people where used to the danger of water and due to under capacity of pumping, their wet feet remembered them constantly of their location behind the dikes.

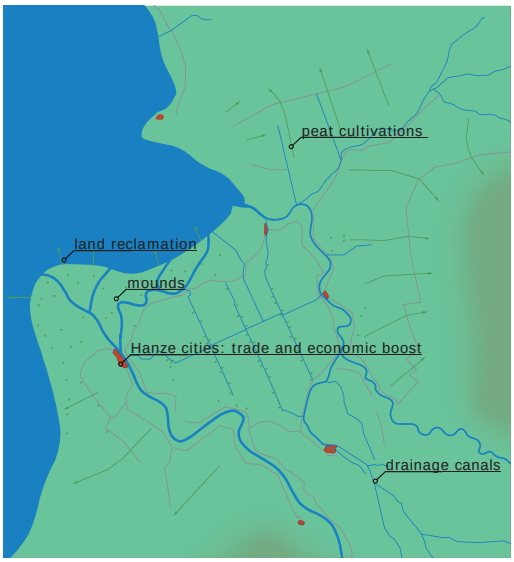
Figure 3.4.7 | *Temporary increased pumping capacity in Zwartsluis during the 1998 flooding.*

The functions and way of living in the landscapes of the Zwarte Water region have always evolved and this will also continue on and on. Furthermore, ecological values can be changed or replaced in this context, because a new situation with a higher water level does not guarantee contemporary characteristics. The same applies to the vision of society on how we deal with our landscapes. Today the Zwarte Water region is made safe using modernistic ideals, using high dikes, dams, sluices and pumps, but looking back at the past centuries we can assume this can be only temporal. We should remain critical to the system we use and keep thinking about alternatives. Examples of what the future may bring are the IJssel Bypass in Kampen and the IJssel broadening at Westenholte, Zwolle, both examples of giving space to the river.

Figure 3.4.8 | *The history of the Zwarte Water region, summarized in 6 main periods and their typical characteristics.*

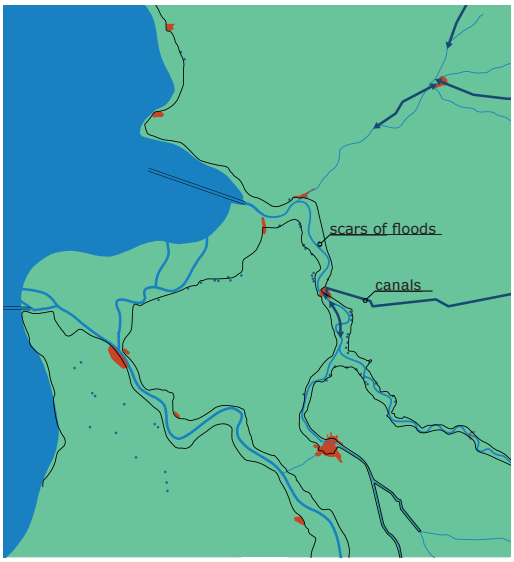


Around 1000: Peat, streams and creeks

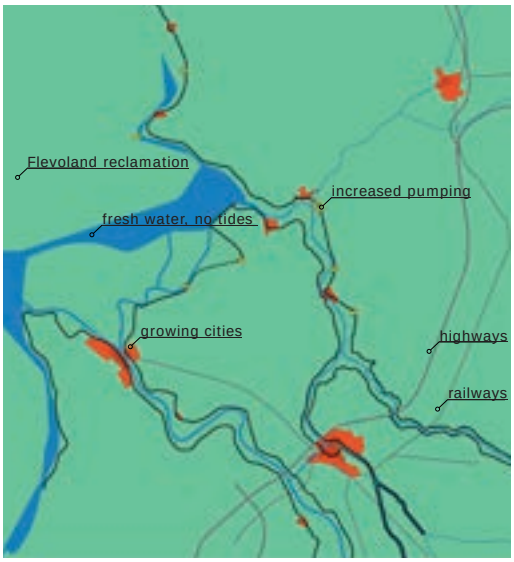


Around 1400: Cultivations and Hanze

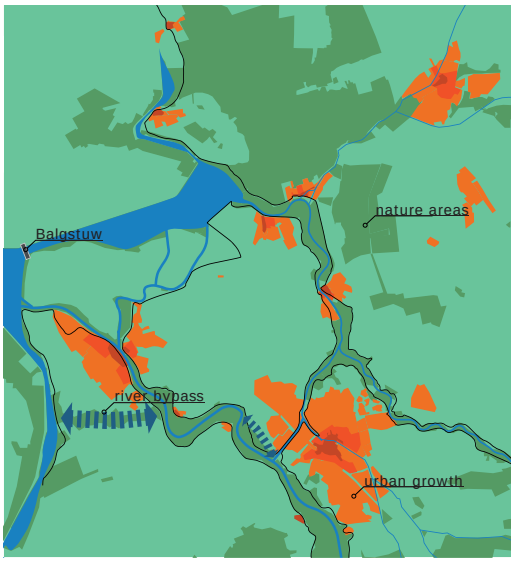
Around 1700: Peat excavations and fortifications



Around 1850: Canals and dikes



Around 1950: Modernisations



Around 2010: Wealth

3.5 Legibility of interventions and processes:
Water experiences

We can already see that the water has an important role in the Zwarte Water region identity, but how could this water be experienced? Within this analysis chapter we will analyse the accessibility and visibility of the water system of the Zwarte Water river. This way we can determine whether the water could be experienced even more, to increase the consciousness and understanding of the dynamics (fig. 3.5.1) and the changes in the river system.

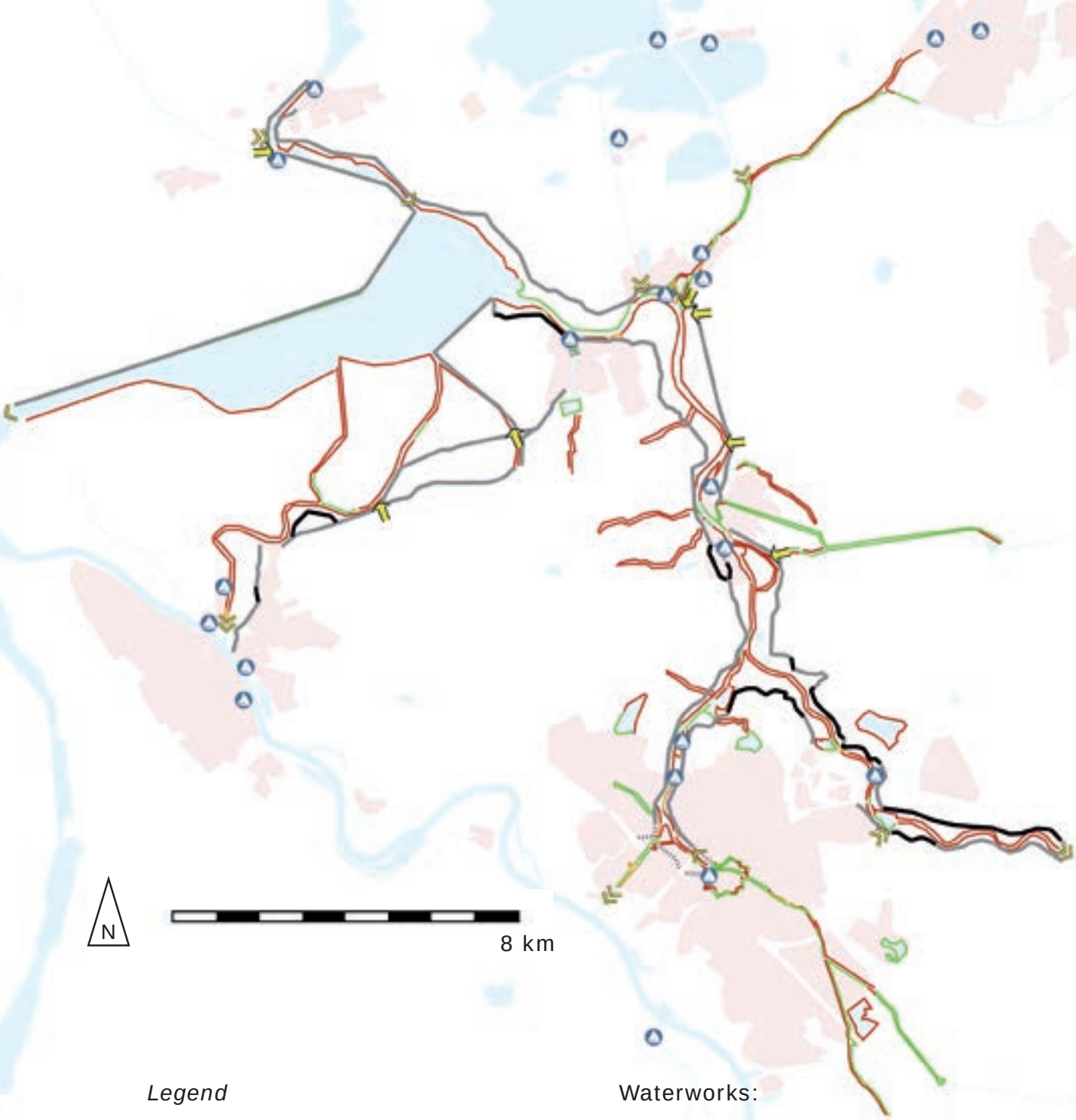
Figure 3.5.1. | *Dynamics in the Zwarte Water like the yearly flooding of the floodplains.*

For this analysis a map has been made (on the right side page), based on a hiking website (wandelnet.nl), a website with the local marinas (anwbwatersport.nl), streetview from google maps, the maps from bing.com, and most important: site visits. The hiking website and google streetview do sometimes contradict each other; a proposed hiking route is appearing on streetview as a fence with muliple 'no entry' signs (fig. 3.5.2). It is possible that many dikes have recently been made accessible, although this would only be for hikers. Therefore on this map these routes are shown as 'unaccessible'.

Figure 3.5.2 | *Two signs to make clear to not use this possible hiking route to the dike.*

Many ways to experience the water can be named. First of all the view from dikes, which can be seen as the connection between polder and floodplain landscapes, as ways to 'fly over the landscape' and have many panoramic views during a cycling trip over the meandering dike network, which also connects the villages along the water. On the map it can be seen that not all dikes are accessible and cyclists are directed towards main roads, as well as through characteristic rural hamlets. As stated before, some of these dike segments seem to be made accessible for hikers recently. Furthermore, some dike segments are located directly along streets, but block the view to the water. Sometimes the dikes are not even visible, think for example about a dike in an urban context with a broad lane on top, and buildings along on the same ground level.

Similar to dikes are hills, bridges as well as towers. They offer vistas from high positions over the water landscape. Examples are the bridge at Hasselt (fig. 3.5.3), a former landfill near Zwolle (fig. 3.5.4), and two examples from the Vecht, upstream near Dalf-



Legend

Water

Urban

Marina

Waterworks:

floodgate

sluice

pumping station

Waterfronts:

Accessible

Semi-accessible

Inaccessible

Dikes:

Accessible

Inaccessible

Unrecognisable

sen, with a former landfill (fig. 3.5.5) and a tower (fig. 3.5.6) with a major view over the Vecht landscape (fig. 3.5.7).

Figure 3.5.3 | *View from the bridge near Hasselt, resulting in a 'water experience'.*

Figure 3.5.4 | *View from a former landfill near Zwolle on the Zwarte Water river. The spot has an exotic athmosphere due to the height difference, although trees block most of the views towards the river.*

Figure 3.5.5 | *A former landfill near Dalfsen along the Vecht river offers a view on the Vecht river.*

Figure 3.5.6 | *Tower near Dalfsen along the Vecht to see the view from fig. 3.5.7.*

Figure 3.5.7 | *View on the Vecht from the tower from fig. 3.5.6.*

When we want to reach to the water, for example to go fishing, to picknick or to swim, it appears that this is mostly forbidden as shown on the map. The uiterwaarden are mostly in use as nature area where people are not allowed (fig. 3.5.8). However, this does not mean that these signs are always respected, during field visits this has been noticed several times. As another example, the former creeks in the Mastenbroek polder are not accessible and mostly not even visible from nearby, real ecological hotspots. In urban areas the floodplains have been build with for example harbours and industries, blocking both the view and the accessbility towards the river, but this also decreases the recognisability of the river. Waterfronts that are accessible are for example canals and artificially recreation ponds. Furthermore, urban quays are popular, although they mostly consist of high quays, so small changes cannot be noticed easily.

Figure 3.5.8 | *The floodplains are mostly unaccessible due to nature values or farms.*

Another way to experience the water is by entering it by boat, such as for example the ferry near Genemuiden (fig. 3.5.9). Another example of sailing on the river offers another experience as well compared to the experience from the riverside (fig. 3.5.10). The map shows the marinas in the region.

Figure 3.5.9 | *The ferry near Genemuiden.*

Figure 3.5.10 | *Sailing on the Zwarte Water.*

Hotspots of the dynamics of the water system are the sluices, pumps and dams. They for instance show the water level differences between different water bodies. In some cases, this is legible, like the Beukers sluice (fig. 3.5.11), or the Vechterweerd dam, which is accessbile for the public (fig. 3.5.12). Other hotspots, like a pumping station near Zwolle do not promote the same connection with people (fig. 3.5.13). In some cases many of these

hotspots come together in a village, like Zwartsluis, determining the local identity as water village.

Figure 3.5.11 | *The sluice as legible water dynamics hotspot.*

Figure 3.5.12 | *The dam as legible water dynamics hotspot.*

Figure 3.5.13 | *This small pumping station near Zwolle has visually dominant fences around.*

In short:
- The waterfronts of ponds and canals are mostly accessible, although the accessibility of the dynamic river system is much lower.
- Dikes, which offer great panorama views on the river system, are not always accessible, such as a lot of dikes near Zwolle.
- Hotspots for views on the river are for example bridges and hills.
- Some villages along the water, like Zwartsluis, are hotspots for all kinds of water related activities like marinas, sluices, pumps and recreative quays.
- The Zwarte Meer is a lake that does not have much activities around, and is hardly accessible, making it a very tranquil area.
- Sometimes dikes become unrecognisable within the city.
- Innercities are the places to come close to the water, in many cases with high quays.

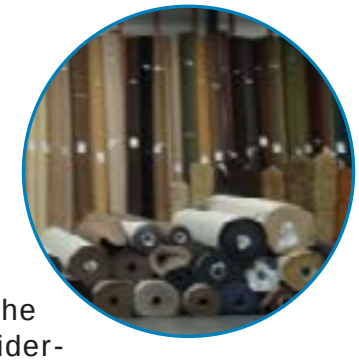
3.6 A healthy economy, community and ecology

A healthy economy helps to strengthen the identity. Some typical businesses in the region are shipping, the carpet industry, farming and recreation. Besides that, especially the city of Zwolle offers a major range of other bussinesses.

Shipping

Shipping has always been important for the region, which includes bussinesses like transport by water, and ship construction and maintenance. This also results in the fact that most industrial zones, except for the newest, are located along the water. However, some of these become abunded, but are a chance for new developments like residential projects along the water, nearby the city centre.

Carpet industry



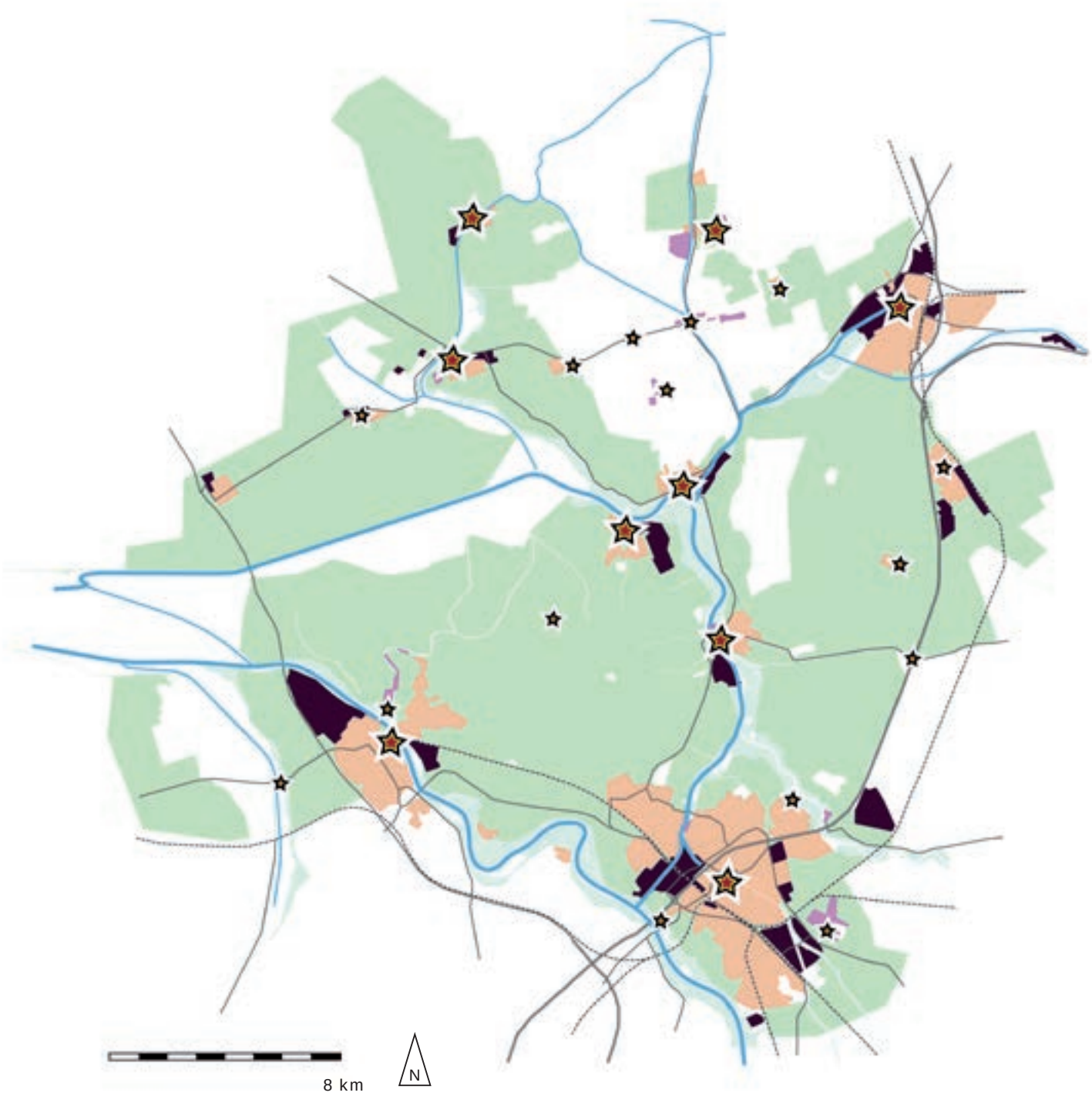
In the three smaller villages along the Zwarte Water a major carpet industry can be found, an industry originating from the rush mats industry. These plants have been growing along the former Zuiderzee coastline. Nowadays the industry buildings of the small villages have a major impact on the appearance of the local landscape.

Farming

The major rural areas like Mastenbroek and Staphorst are hotspots for farming. Within these peat grasslands, dairies are located on the higher sandy soils and in the deeper polders we mainly find arable lands. Near Kampen there are multiple glasshouse complexes located.

Recreation

The water, the historical cities, and the nature in the Wieden and along the Zwarte Water are the reason for many recreation possibilities like cycling, boating, or simply enjoying a drink.



Legend

- Farming
- Residential
- Industrial areas
- Major recreational centres
- Minor recreational centres
- Rail road
- Highway
- Regional road
- Major shipping route
- Minor shipping route

The community is the basis for the existential identity of the Zwarte Water region. However, this community is quite diverse. While Genemuiden, Zwartsluis and Hasselt have their close communities and their relation with the Zwarte Water river, Zwolle is a much bigger city and is dealing with large city issues. Zwolle is oriented along the highway and railroad, and provides regional facilities like hospitals and shopping. However, all four cities have their typical identities, resulting in local events and nicknames.

Besides the culture, the density could be notified as well; the city of Zwolle is much larger than the surrounding smaller cities. As most of the people live here (Zwolle), we can state that the need for identity is the highest in this area.

Legend

Residential

Historical city centres

Water

Agriculture

Municipality border

Province border

Other

Zwartsluis

Also known as “De Sluus”, inhabitants’ nickname: Bleistaart. Typical local event: Tug boat days.

Genemuiden

Also known as “Gaellemuun”, inhabitants’ nickname: Koolraap. Typical local event: Biestemarkt.

Hasselt

Also known as “Asselt”, inhabitants’ nickname: Skoape- kuukies. Typical local event: Euifeest.

Zwolle

Inhabitants’ nickname: Blue fingers.


Meppel:
32.860 inwoners
Steenwijkerland:
43.338 inwoners
Zwartewaterland:
22.145 inwoners
Kampen:
51.278 inwoners
Zwolle:
123.507 inwoners
8 km
N

The Zwarte Water region has a rich ecology, mostly because of its floodplains and peat areas due to its location on the foot of a sand plateau and former coast in the west.

Among the rare species the fritillary flower in the Zwarte Water area and the otter in the Wieden-Weerribben are the most familiar. They are part of the identity of the region, and therefore they should be handled with care.

Legend

- National Park Wieden-Weerribben
- National Landscape IJsseldelta
- Natura 2000 (included in N.E.N.)
- National Ecological Network
- Rural
- Urban
- Water

Fritillaria along the Zwarte Water

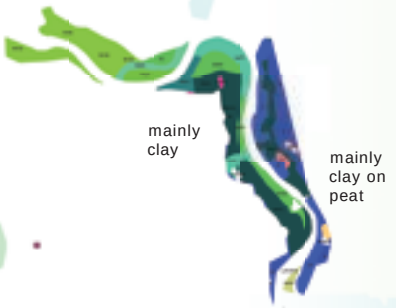
The floodplains of the Zwarte Water habits the very delicate fritillary flower, and is one of the few places in the world where the plant grows in such large numbers. The plant needs regular flooding in order to spread its seeds.

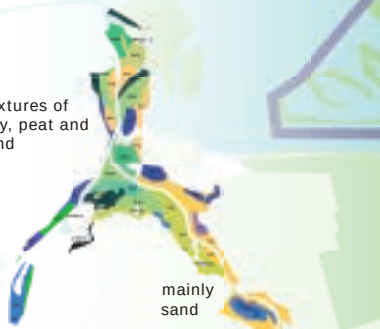
This map is based on Provincie Overijssel (2009).

Legend

- Zwarte Water and down stream Vecht
- Fritillary habitat in Zwarte Water area
- Fritillary presence in 1998

Soil types along the Zwarte Water





8 km

N

Wieden-Weerribben: the otter

The otter is seen as one of the most unique species of the region. About a decade ago it is reintroduced in the Netherlands in the Wieden-Weerribben area, and although the population is still small, the otter has been seen in several wet areas around the Netherlands. Furthermore, when the otter population flourishes, the quality of the ecology flourishes as well.

3.7 Distinctiveness
Landmarks

Iconic landmarks distinguish regions from other regions. In the Zwarte Water region many of these icons can be found, think about church towers, bridges and high rise buildings.

Besides the iconic landmarks, also the water related but mostly low landmarks are shown in the map on the right page, like sluices, pumps and dams, which can be seen as landmarks within the water system.

The Lichtmis

A former water tower that can be seen from afar.

Ramspol dam

This water related landmark is generally not inflated, but is still an icon for the region.

View on Hasselt

Many landmarks combined: Stone dike, mill, 2 church towers and the bridge.

Legend

Water

Urban

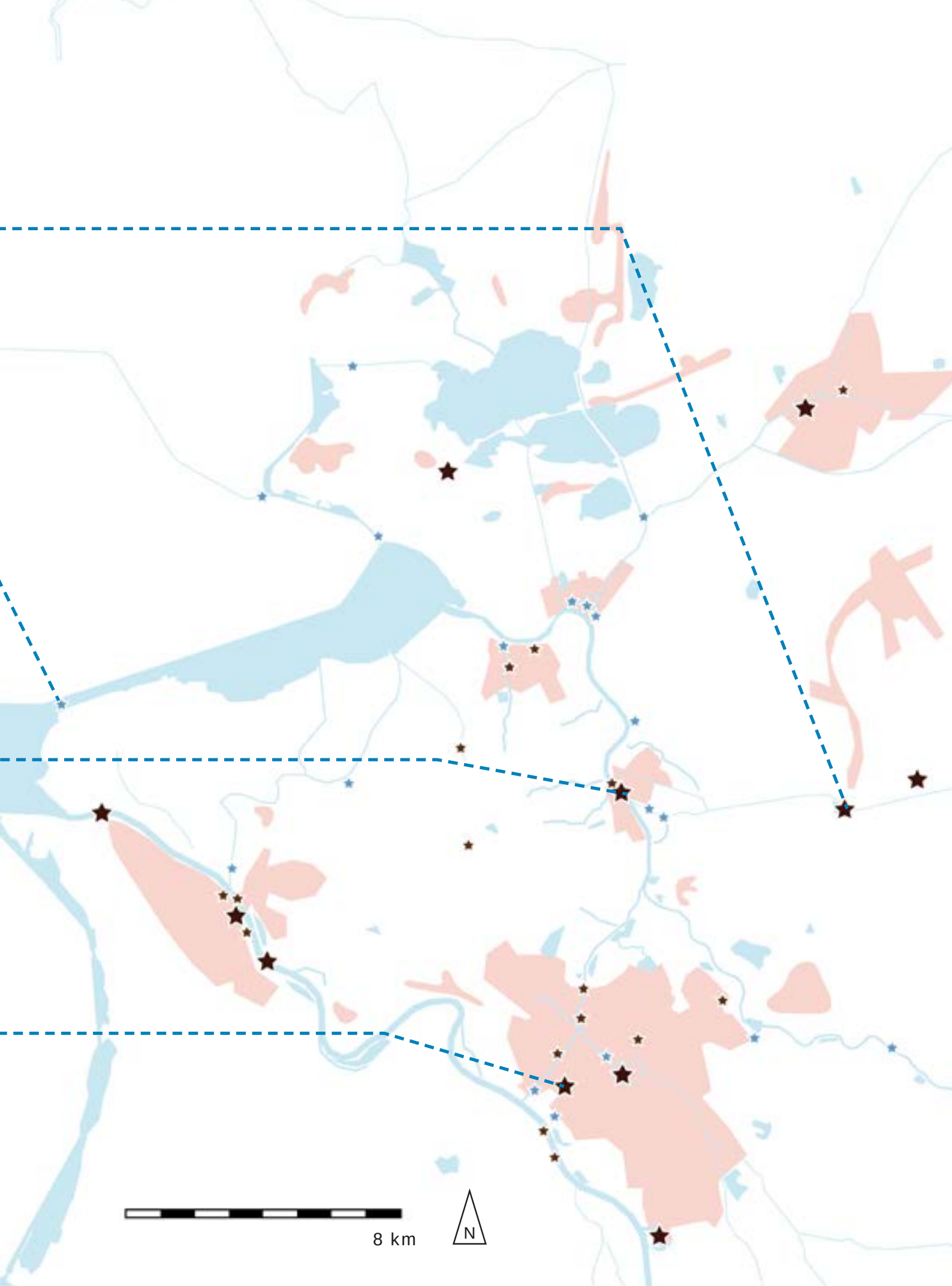
Major landmark

Minor landmark

Low water related landmark

Zwolle skyline

Especially the high rise towers can be seen from afar.


8 km
N

3.8 Diversity, complexity and mystery

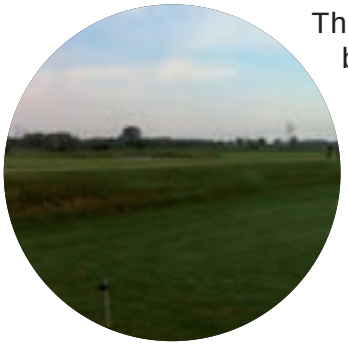
Landscape density

Diversity and especially mystery have a relation with the landscape density. In open landscapes surprises are rare, although in closed landscapes every road corner offers new surprises. This also means for instance that for recreation more people can be attracted to the dense areas, to avoid seeing other people too often. On the other hand, open landscapes have more overview. Furthermore, scale plays a role as well, the large scale polders are contrasting with the small scale historic cities and closed landscapes.

Dense sandy landscape

The sandy landscape east of the Zwarte Water can be determined by semi-closed landscapes.

Dike near Zwolle



The dike is a border for the ones looking at the dike, but offers open vistas from the top of the dike.

Dike near Hasselt

Not every dike has an open view towards the landscape.

Mastenbroek

A giant openess.

The Wieden

As nature area a semi-closed landscape with both open water, reed fields and swamp forests.

Legend

Open landscape

Semi closed landscape

Closed landscape


8 km
N

3.9 Adaptivity and supporting a dynamic landscape

Dynamic landscapes

A dynamic landscape is a healthy landscape, a landscape needs to change in order to stay relevant, it should be a landscape where its people could be proud of. With this map, the changing Zwarte Water region becomes visual with several examples showing that landscape is not static. However, major changes could provoke resistance among the population, so a balance is required. Based on the 'Nieuwe Kaart van Nederland' (Vrije Universteit, 2014)

Legend

Water

New space for water

New water directions

Increased water supply

Stopped water dynamics

Urban

Urban expansions

Urban expansion directions

Nature

New nature

Nature expansion directions

Agriculture

Agriculture developments

8 km

N

Stopped estuary dynamics

Tide-dependent creeks have already been dammed a long time ago.

Upscaling in agriculture

Ongoing upscaling in agriculture with increasing farm sizes.

Urban expansions

Every city has its urban expansion projects, such as Stadshagen near Zwolle.

Stopped delta dynamics

The side rivers from the IJssel delta have been dammed since a long time, stopping the local delta dynamics.

Flexible water level

A flexible water level is the expected level policy in the IJssel lake for the coming years.

Space for the River

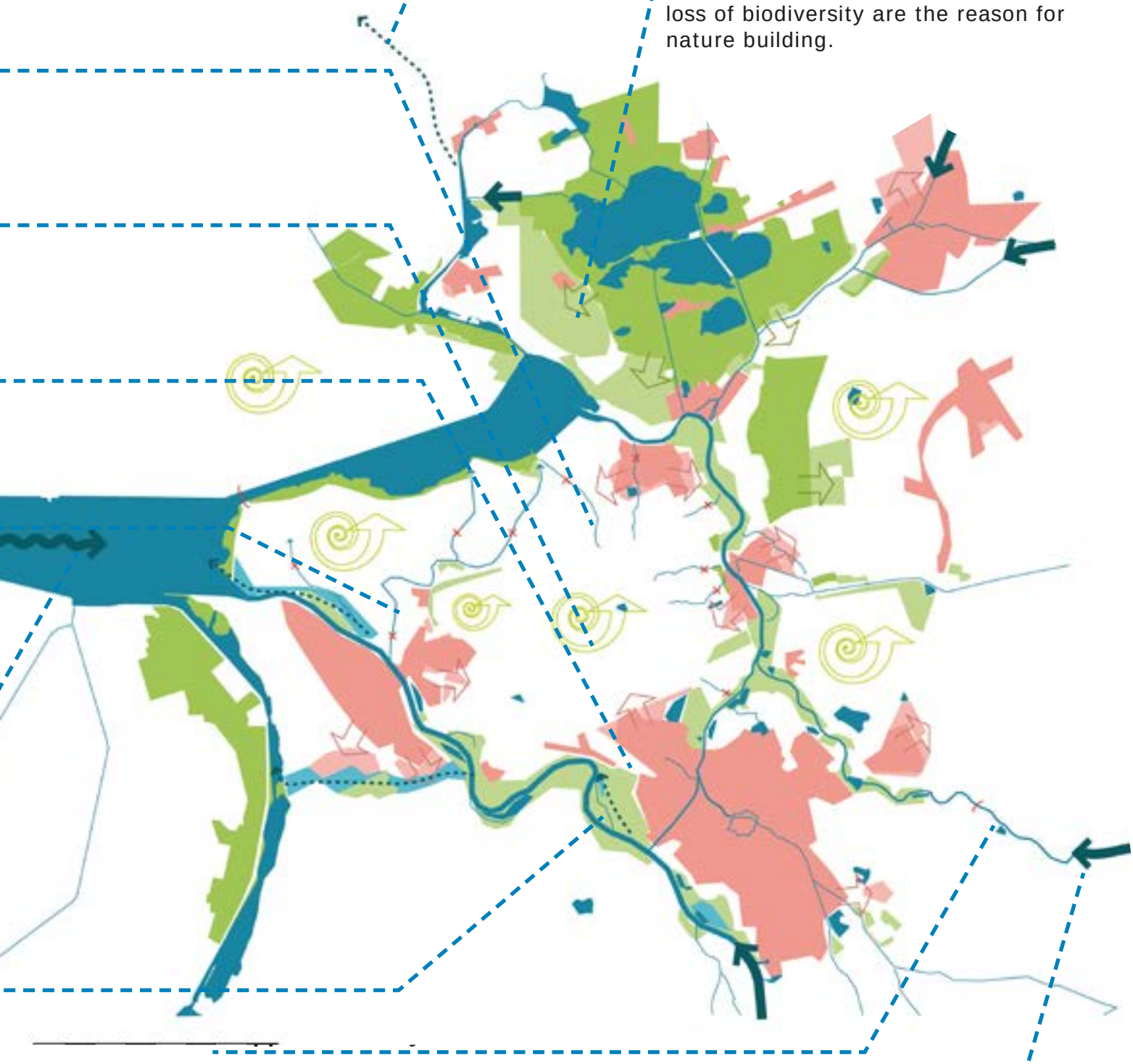
Several projects along the major rivers give more space to the river, examples are the IJssel bypass and the Westenholte side channel.

Border lake proposal

Seepage is one of the reasons for a borderlake between the old and new land.

Nature expansions

Nature corridors and prevention of loss of biodiversity are the reason for nature building.



The dams in the Vecht prevent sedimentation movements and irregular water levels.

Increasing water discharges

Climate change increases river discharges.

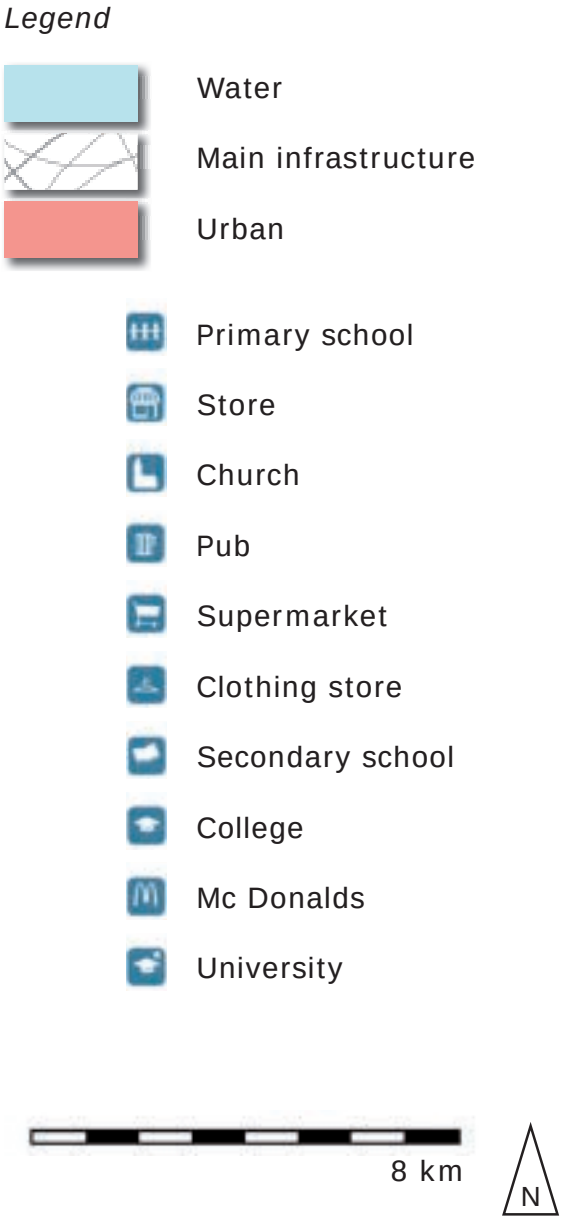
3.10 Accessibility and facilities

Infrastructure and facilities

Self efficacy could be translated to the idea to have a good accessibility and have proper facilities to support the way of life a person wants to live.

Based on the central places theory from Kristaller in Everson (1969), a map could be made with all settlements and their representing facilities. The smallest rural hamlets do not have any facility while the more central hamlets have a primary school, church and a store like a butcher or car seller. Bigger towns also house supermarkets or even secondary schools, while only the biggest cities in the region have a college. These cities are also the ones that are connected with the highway network and railway network.

This map shows that a healthy region is about good connections with the villages with facilities; many facilities are found in nearby villages, but some facilities can only be found in the biggest cities.



3.11 Conclusion

In general, the roots of the landscape and the community are found in the water system. However, within the past century this connection decreased more and more, making the landscape less unique, and less recognizable as estuary landscape. The inherent link between the water system and the landscape could be used when the water system should be made more clear: making the landscape itself more clear could result in understanding of the water system.

Every landscape identity value as determined in the previous chapter has been used in this chapter to create an understanding of the landscape identity of the Zwarte Water region. This is not only about the characteristics of the Zwarte Water region, but also about the chances we see that can be used within the concept and design phase.

The following conclusions can be determined on the basis of the analyses of the landscape of the Zwarte Water region:

Continuity: Rupture and continious landscapes
The most people live in relatively new landscapes, which have been changed dramatically the last 100 years. However, modestly changed landscapes are relatively close by, namely the innercities and the rural areas. The areas that have not been changed significantely are the nature areas and river and water landscapes, making them the places that represent the local landscape identity the most. As especially rivers and streams are axes through the landscape, they could connect innercities, residential areas and the surrounding landscapes with eachother.

Legibility of landscape characteristics: Landscape types
The Zwarte Water region has a major diversity of different types of landscapes, based on the soil types, the use of and the relation with the water system. Some sublandscapes are recognizable by their sharp edges, for example the Noordoostpolder, the Vollenhove morain, and the Zwarte Water floodplain area. Areas like the sandy zone east of the Zwarte Water do not have sharp edges, making it less recognizable. However, the characteristics of each sub landscape could be integrated when interventions are needed to make them more contrasting and recognizable, for example the mounds in the Mastenbroek polder.

Legibility of stories and traditions: The history of the Zwarte Water region
The Zware Water region has a rich history as an estuary landscape, and is highly related to the water system. The first settlements were along the river, which brought wealth, but also many floods. Nowadays the water safety has been on such level that the relation with the water becomes less relevant and also less visible. However, historical hotspots that represent the identity of the connection with the water system could be made more experiencable, for example urban water fronts (shipping), creeks (the natural estuary), fortifications (water inundation) and dike breach ponds (flooding disasters).

Legibility of interventions and processes: Water experiences
Accessible waterfronts and dikes, but also hotspots like bridges, sluices and pumping stations are the places that make the water system visible and

experiencable. However, most river water fronts and as well as some dike segments are not accessible. Urban areas are the places to come closer to the water, but here they consist mainly out of high quays and invisible dikes. One reason for the inaccessibility of the water are ecological qualities, like around the Zwarte Meer. However, in general the accessiblity of the water system should be improved significantely when the experience of water should be increased.

A healthy economy, community, culture and ecology
The economy is mainly based on the landscape, like the carpet and shipping industry. The community has typical identities, different from place to place. However, Zwolle is the biggest city in the region by far. Nature is well represented, with a National Landscape and a National park, and the presence of the otter and the fritillary flower. We see that the economy, demography, and ecology have their roots in the estuary landscape. Making this more clear could increase the connection between the community and the water landscape.

Distinctiveness: Landmarks
Around the region several landmarks are visible, like church towers, bridges, and high rise buildings especially in the bigger cities. Furthermore, landmarks relating to the water system could be found as well, such as the Ramspoldam, sluices and pumping stations.
Because landmarks increase the distinctiveness of an area, they should be promoted. Views towards higher landmarks like towers could be improved, and the lower water system icons should be made more experiencable.

Diversity, complexity and mystery: Landscape density
The small scale and closed cities contrast to their open en wide rural surroundings. Nature areas and the sandy areas are mostly semi-open, resulting in surprising landscapes with recreational possibilities. The sandy area east of the Zwarte Water, the urban edges and the swamp areas of the Olde Maten and Wieden are examples of this. Interesting places are the borders where closed landscapes and open landscapes meet, for example the urban edges.

Adaptivity and supporting a dynamic landscape: Dynamic landscapes
The landscape is constantly changing, with for example expanding cities and nature areas. Water dynamics have been stopped by diking and dams, but due to increasing river discharges more space is made for water. Water system adaptation could be combined with other developments in the landscape, like nature and urban developments.

Accessibility and facilities: Infrastructure and facilities
The bigger the city, the more facilities, and better connections. Interesting is the fact that many urban areas and their facilities are located along the river, while the river is not used for public transportation.

4

Water management strategies

4.1 Introduction

In the previous chapter we determined the values of the Zwarte Water in relation with the community. In this chapter we will use these values to determine how the Zwarte Water water system could be adapted in the best way, based on which strategies could contribute the most to the identity of the local landscapes.

To do that, first of all we need to know which water strategies are possible. Literature shows a major amount of possibilities to adapt water systems. However, a few basic approaches, or strategies, can be distinguished in which these possibilities could be integrated, which will be elaborated in the coming paragraph.

The relevant water system adaptation possibilities, ordered by the basic water system strategies, are then determined for each sub landscape, which could solve the local water challenges. Then it is determined what influences these strategies have on the values as determined in the second chapter, to be able to state which effect the strategy has on the landscape. The outcome of this step is a map of one or more strategies per sub landscape that could be used to adapt the sub landscape to the challenges in the water system. Within the last paragraph this map of sublandscapes is translated into a map of interventions, here the concrete interventions are elaborated that are possible to adapt the Zwarte Water region. This map will be the basis for a design for the Zwarte Water region further on in this thesis, in which the local landscape will be adapted for the challenges in the water system, taking the local community as basis.

4.2 Water management strategies

To be able to know which water interventions are possible, a few lists (Bruin et al. 2014, MHW 2012) have been combined for a list of possible ways to intervene in the water system. The original lists however, are full of general climate change adaption interventions, like drought, urban health and even mitigation solutions like alternative energy sources. Water system intervention possibilities like coastal defense can also be found on the lists. Because only spatial water nuisance and flooding measures are being integrated in this thesis, these elements are being combined in the list which can be found in appendix 7.3.1.

To test all individual items on the list per landscape type, per identity element, would take too much time. Therefore the list will be ordered in a few themes, or strategy directions. Preferably, these have to be 'corner stones' of the field of water management strategies. Remmelzwaal (2000) states that all water management strategies could be ordered into 4 types, namely, resistance, buffering, resilience and isolation.

Resistance is about controlling the system against the dynamics of the natural system, with for example dikes and pumping. Buffering is about topping off the peaks of a dynamic system. Resilience is about the adaptation capability towards the dynamics of the natural system, to restore from disturbances like floods. Isolation is about cutting an area off from the dynamic system.

With this, we can now order the individual water system interventions in these four types. As Remmelzwaal (2000) stated, all the elements could be put in one of the four strategies, but also into multiple strategies (appendix 7.3.2). For example, isolation and resistance are both about controlling an area outside the dynamic system.

Overlapping of the interventions makes them general, while we want to have opposite strategies and therefore they should be revised. When we state resistance is about controlling the system, and buffering about topping off the peaks, we already have 2 defined strategies. With the rest of the elements 2 directions can be suggested, namely 'system resilience', and 'disaster resilience', where system resilience is about natural processes than can restore balances in the water system, and disaster resilience about how to reduce damage when an area is flooded (appendix 7.3.3).

The next step is to summarize these lists into more general lists. For example, 'green roofs' and 'green spaces' have the same effects, namely water retention (appendix 7.3.4).

The four strategies are elaborated on the next pages, including the water management intervention types.

Resistance:

The traditional way to deal with the water in the Netherlands, in the last centuries, is the resistance approach, using dikes, pumps and sluices to control the water system. To increase resistance, dikes could be made even higher, and pumping capacities could be increased too.

Seepage walls

Dike heightening

Pumping and sluices capacity increase

Buffering:

Topping off peaks is a widely used approach in the Dutch landscape. For the Dutch creek landscape the 'retaining, storage and drainage'-approach is used to prevent water nuisance (Nationaal Waterplan 2009). These measures top off the discharge peaks in down stream regions in case of heavy rainfall periods, but also during droughts. The approach first of all states that upstream water should be retained, in for example soils, small streams and swamp areas, or the green roofs in urban environments. Second of all, water storages should be used to store a surplus of water, for example agricultural lands and ponds could be used for this purpose. Third, the water should be drained towards other places in a controlled way. The approach is especially used for creek landscapes. For storm water coming from the IJssel lake other measures could be thought of, like bottom lowering of the IJssel lake, which reduces storm water level peaks (Quick Scan IJsselbypass, 2009). For river systems, bypasses, lowering floodplains and widening floodplains could for example decrease the tops of peaks.

Storage by soft surfaces and buildings

Flexible local water level

Water storage zones

Upstream water retention

Deepening of summer and winter bed

Lengthening discharge routes

Side channels and bypasses

Dike relocation

Local lowering of ground level for storage

System resilience:

Withdrawing from the system is an option to let the system recover itself towards a natural balance. However, people want to make use of the area, for example for agriculture, recreation, living and to conserve existing nature values. Therefore we should look to the field of the landscape machines, with design projects like the Ems Full Hybrid by Papenborg and Togt (2012). The landscape machine includes ecological processes to recover or produce landscape (landscapemachines.com, 2014). Pols et al. (2012) states that flooding, salty and fresh water transition, erosion and sedimentation are elements of a resilient water system, elements that could be used when a landscape should produce. An example is the recovery or stimulation of sedimentation processes in order to heighten the landscape to prepare it for a rising water level due to climate change.

Sedimentation processes

Abandoning

Disaster resilience:

Traditional water safety is based on the acceptable flooding risk. When a rare flood occurs, the system is not prepared, and the flood will have a disastrous effect on the landscape. Furthermore, with higher dikes the potential disaster becomes even worse, which is an argument to not heighten dikes anymore. This approach, disaster resilience, is about the design of a landscape to reduce the damage and is similar to the Multi Layered Safety approach (Nationaal Waterplan 2011). This three step approach starts with the prevention of floods, by for example dikes. Widening dikes helps to prevent dike breakthroughs. The second step is about the design of a region, with interventions like the building of compartment dikes and mounds, isolating the economical and social values from those floods, and steering the flood in the right direction. The third step is about disaster management and is about evacuation possibilities like higher roads and near mounds.

Clustering and steering of urbanisation

Waterproof building

Building above water

Mounds

Floating buildings

Compartmentalisation

Dike broadening/overtopping proof

Higher evacuation routes

Temporal dams

Emergency water channel or overflow

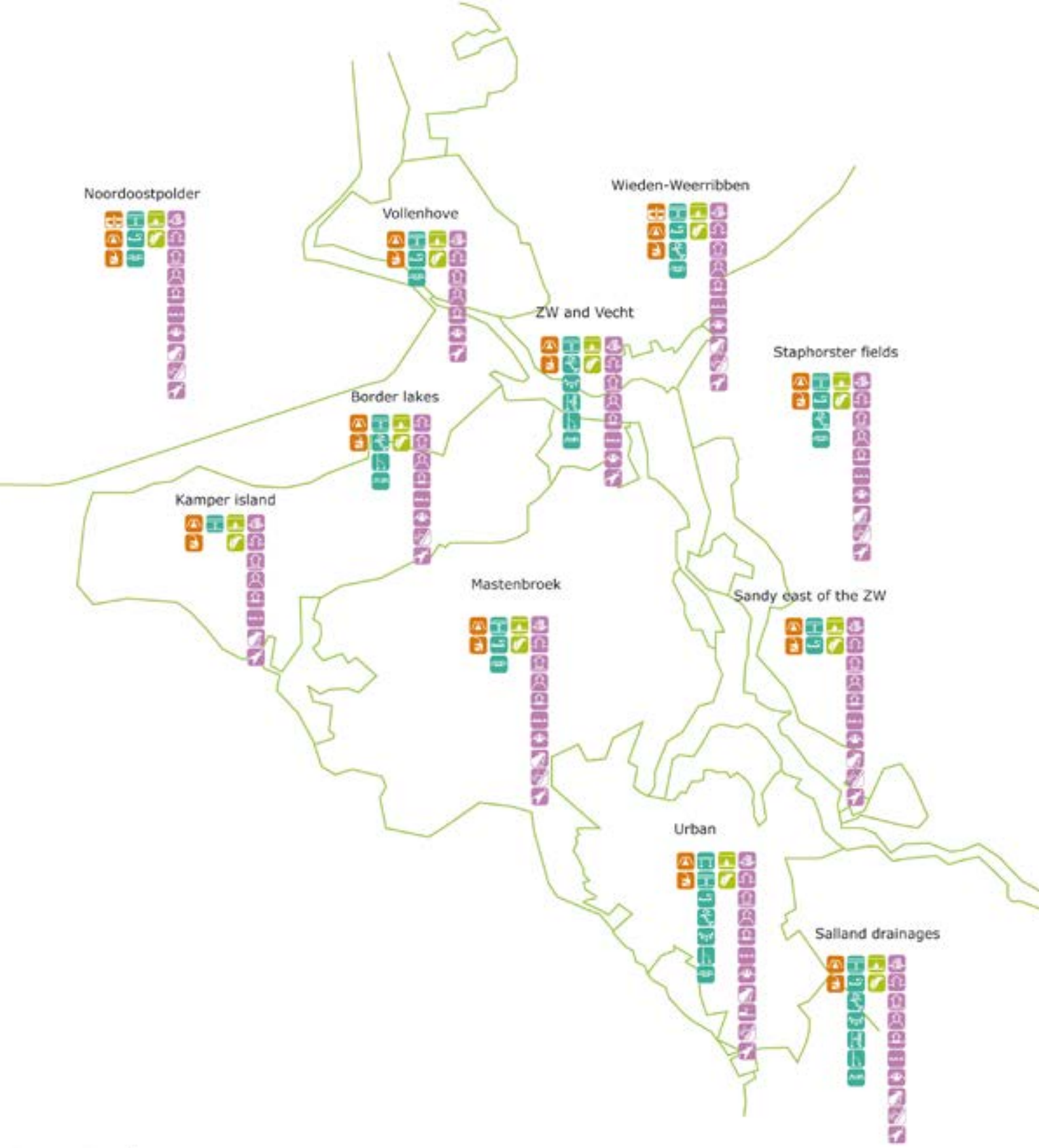
Movable buildings

4.3 Possible interventions

Now we know what the possible water management strategies are, we can now implement them in the Zwarte Water region.

On the map on the right page the interventions are implemented in the Zwarte Water region per individual landscape. Only those interventions that are relevant and that are technically possible in each region, according to our basic knowledge, are selected, which could help to solve the local water challenges as determined in the introduction chapter. For example, an intervention like the deepening of the winterbed of a river is not relevant in a polder landscape. However, most interventions are still possible when the lists of icons on the right page is compared with lists on the previous page.

What we will get is a map with all possible interventions to adapt the water system, collected in 4 strategies, and which will be per sub landscape. With this map we can now compare each strategy on the local scale.


Noordoostpolder
Vollenhove
Wieden-Weerribben
ZW and Vecht
Staphorster fields
Border lakes
Kamper island
Mastenbroek
Sandy east of the ZW
Urban
Salland drainages
8 km
N

4.4 Strategy evaluation

The next step is to analyse each strategy in each sub landscape. Therefore we determine whether the effects of each strategy have a positive, neutral or negative effect on the individual landscape values, as determined in the second chapter.

To be able to show these data easily, the list of identity values has been translated to the scheme of figure 4.1, in which the individual values are placed.

Second, for each strategy the values are tested for each sub landscape, to analyse whether they have a positive, neutral or negative effect.

To give an example, the Resistance strategy as implemented in the Mastenbroek landscape includes pumping and raising dikes according to the map on the previous page. This means that around the Mastenbroek area the dike is raised, and the pumping capacity, also located on the dike ring, is increased. The effect on each landscape value is elaborated in box 3.

Then this analysis has been done for all the sub landscapes in all 4 strategies, which results in the 4 maps on the page on the right.

Figure 4.1 | *The landscape values placed in a model, to visualize the landscape values in the maps on the right page.*

Box 3: An evaluation example

The effect of the resistance strategy on the Mastenbroek landscape values

Continuity
Pumping and dike raising secures the progress of the area, no major interventions in the landscape are necessary, beside some minor dike raising and the capacity increase of pumping: positive effect.

Legibility of landscape characteristics
Pumping and dike raising do not influence the appearance of the landscape, which is about the openess, the grasslands, the grid of streets, and the farms on mounds: neutral effect.

Legibility of stories and traditions
Many floods in the past have occured in this landscape, resulting in the many mounds. Pumping and raising dikes make these mounds redundant and alien objects in the landscape: negative effect.

Legibility of interventions and processes
The connection with the river landscape and the dynamic estuary of which the creeks are the remainder of, become even less visible by increasing pumping and raising dikes: negative effect.

A healthy economy, community and ecology
Because of the control on the water system and the reduced flood appearance, the local economy, community and ecology are hardly disturbed, and could improve in the future: positive effect.

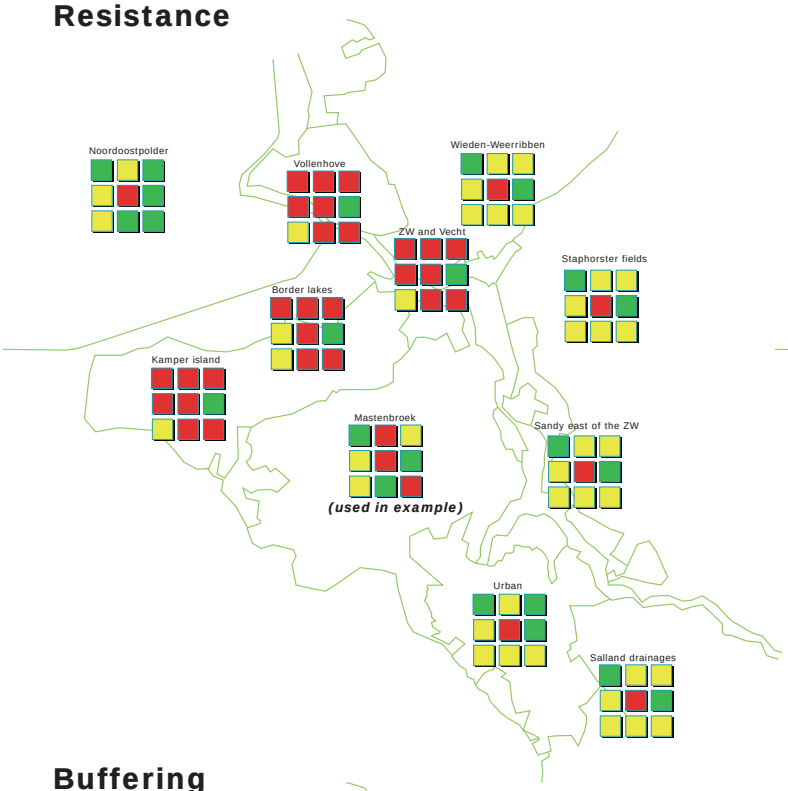
Distinctiveness
The existing pumping stations are local architectural icons in the landscape. The new pumping stations could also become distinctive for the region: positive effect.

Diversity, complexity and mystery
The landscape appearance is not changed significantely by raising dikes and increased pumping: neutral effect.

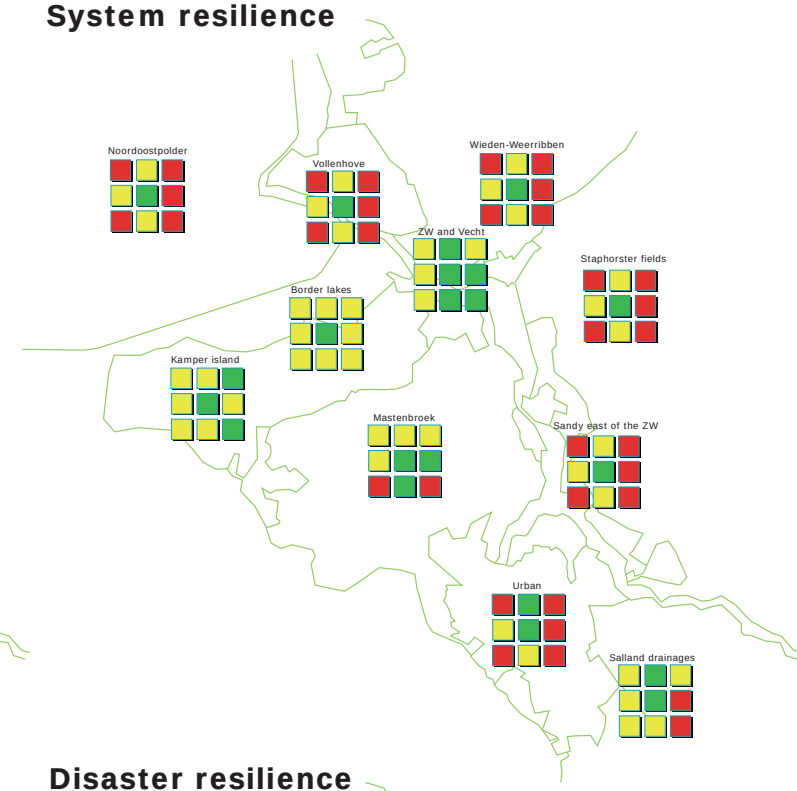
Adaptivity and supporting a dynamic landscape
The peat landscape is slowly pumped downwards, creating a problem for the future: negative effect.

Accessibility and facilities
The accessibility and the amount of facilities does not significantly change by raising the dikes and increase the pumping capacity: neutral effect.

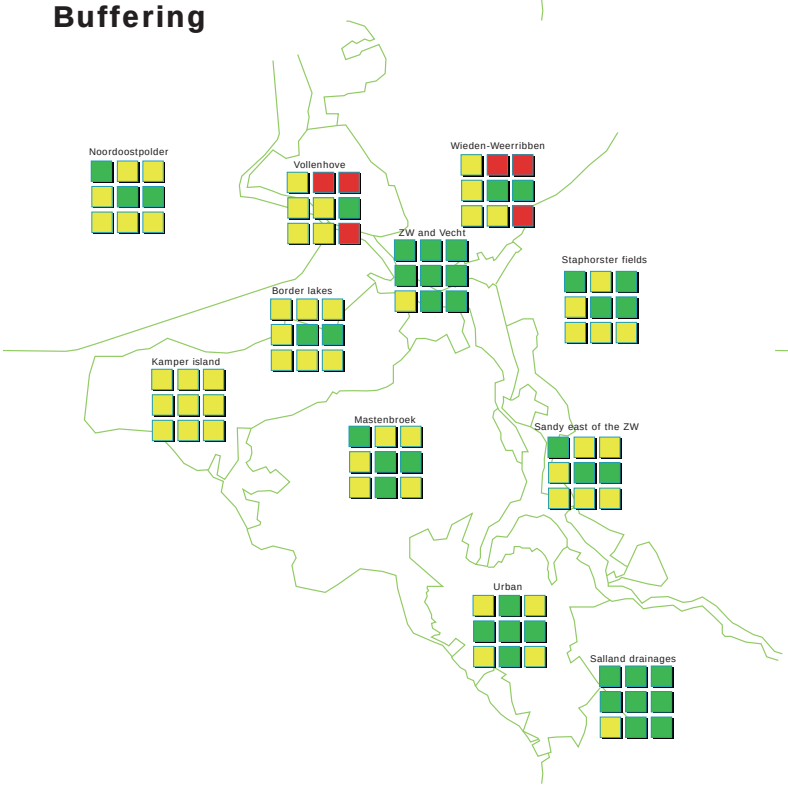
Resistance



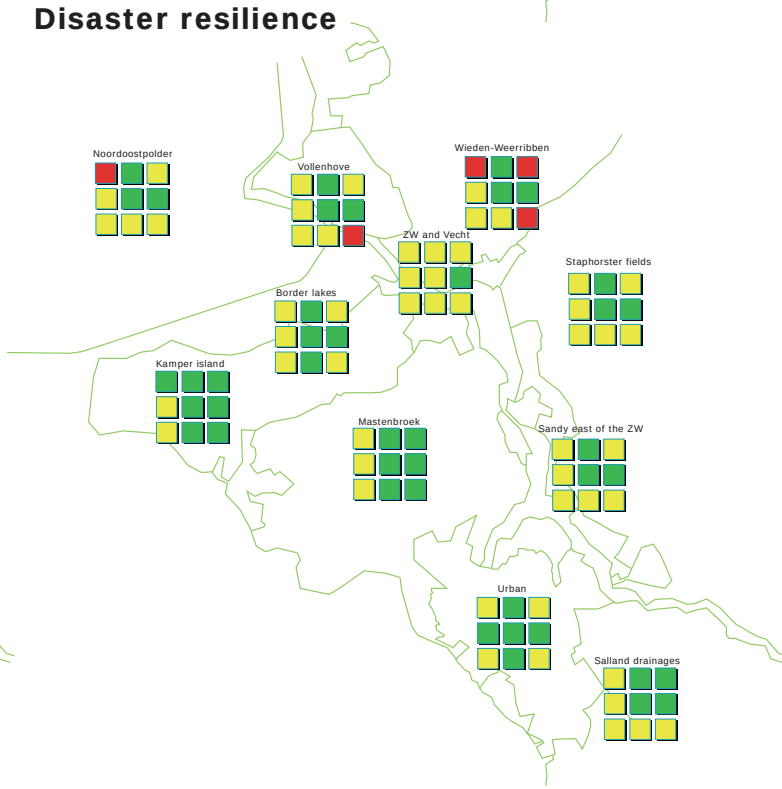
System resilience



Buffering



Disaster resilience



Legend

The effect of the water strategy on the landscape value:

- Positive
- Neutral
- Negative

8 km

N

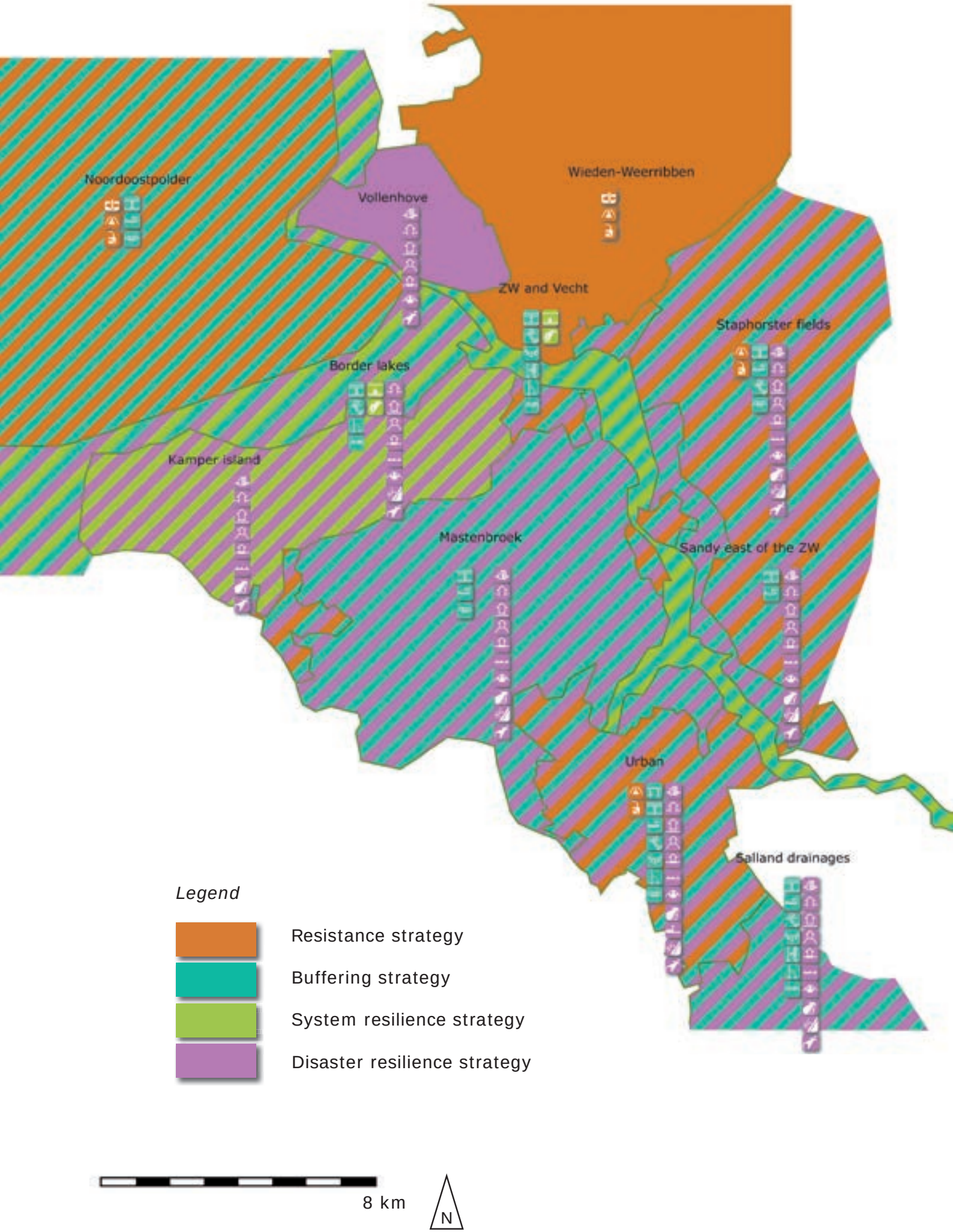
4.5 Determining the strategies

The next step is to determine which strategy is the best for each sub landscape, relating to the landscape values. Within the previous paragraph we have analysed for each sub landscape which influence each strategy has on each landscape value. The result is a map per strategy in which we can see that some strategies have a mostly positive or a mostly negative effect on the local landscape identity, and in some case it has both positive and negative effects. When we compare the 4 strategies, we can determine which strategy is the best. For example the Mastenbroek region:

Here we can state that the Resistance strategy and System resilience both have negative effects on the landscape values, and only a small amount of positive effects, while Buffering and Disaster resilience have no negative effects, and mostly positive effects on the landscape. Therefore a combination between the Buffering and Disaster resilience strategies is advisable when the Mastenbroek landscape should be adapted to the challenges in the water system.

The strategies are also compared within the other landscapes, resulting in the map on the right page. Here we see that in some cases one strategy turns out to have a best fit, while in other cases 2 or even 3 strategies fit the best. For example when one strategy has 3 positive effects, and the other strategie has 4, this is not considered as a significant difference. The challenge to combine 3 of the 4 strategies could then result in a design that integrates many interventions, which all do not have a major influence on the landscape: when for example both dike raising and winter bed widening are possible, dikes do not have to be raised that high for the same flooding risk when both interventions are used. On the other hand, areas where only one or two strategies are selected, they can help to characterize the landscape and contrast it with the surrounding landscapes even more. An example is the floodable delta landscape in which only the Disaster resilience strategy is used, making use of for example mounds and compartment dikes.

The map on the right, showing the lists of interventions that are possible to use to adapt each sub landscape, will be translated into concrete interventions for the Zwarte Water region in the next paragraph.


Noordoostpolder
Wieden-Weerribben
Vollenhove
ZW and Vecht
Staphorster fields
Border lakes
Kamper island
Mastenbroek
Sandy east of the ZW
Urban
Salland drainages
Legend
Resistance strategy
Buffering strategy
System resilience strategy
Disaster resilience strategy
8 km
N

4.6 Visualizing the adaptations

The interventions as mentioned in the previous chapter are integrated in the landscape as follows, per sub landscape:

Noordoost Polder:
Within this area the resistance and buffering strategies are used. This results in the fact that the dikes around are heightened, and the pumping capacity is increased. For the landscape itself the buffering approach results in the fact the water level will be flexible, and retention areas have to be found. To respect the existing landscape as much as possible, broadening existing drainage canals (fig. 4.2) is a better alternative than for example designing retention zones.

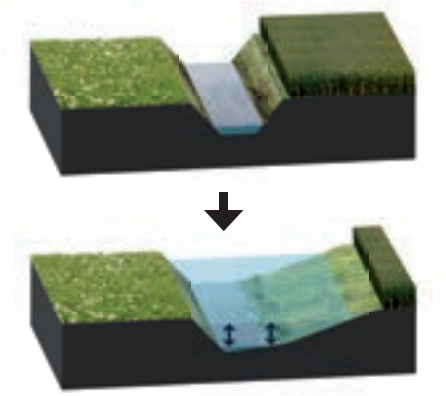


Figure 4.2 | *Water retention by widening drainage canals and a flexible water level.*

Vollenhove Moraine:
This landscape rises far above the expected maximum water levels, and due to the natural run off of the water, only disaster risilience measures are taken, which are especially relevant for the lower edges like the south side where a broader dike protects the lower meadows. Also the waterfront of the village of Vollenhove should be adapted, using floodproof buildings.

Wieden-Weerribben:
The peat landscape of the Wieden-Weerribben is known for its ecological values, which does not tolerate a flexible water level of any sort. The high amount of surface water makes the area capable of retaining sudden water inputs like rain and creek discharges. Therefore only the resistance strategy is used here, were the dikes around are heighened, and the pumping capacity is increased.

Border lakes:
The water system of the border lakes is a connection between the IJssel lake and the upstream rivers and streams, resulting in the fact that the dynamic water levels here could danger surrounding inhabited landscapes. Besides the fact that measures have to be taken in the area itself, for example sedimentation on surrounding floodplains to rise with the water levels, upstream measures have to be taken as well that increase water retention. Furthermore, alternatives for water run-off have to be created like a new border lake between Blokzijl and Lemmer. This border lake is both a bypass route and a retention area for water that could not be drained via the Ramspol route, for example during storms. Any occupation in the area should be made flood proof.

Kamper Island:
The dynamic delta landscape of the Kamper Island has been cut off from the IJssel river system, which means no delta processes are going on today. In order to restore the process of heighening the landscape, the landscape is connected to the water system again. The long tradition of building of mounds in this landscape is of great importance when the landscape should both be cultivated and dynamic: The

lower parts of the delta will be flooded permanentely, and could be used for, for example, reed and swamp nature. The higher parts of the delta, harbouring the mounds, will be used for agriculture and are flooded yearly. Especially the IJssel river is transporting sediments, but due to the fact that IJssel water will flow in the direction of the Zwarte Meer, and which would probably both silt the lake and influence the ecological situation, this effect should be little, and sedimentation should especially come from the Zwarte Meer side. The recreational site in the south of the area should be adapted for floods, for example by floating elements.

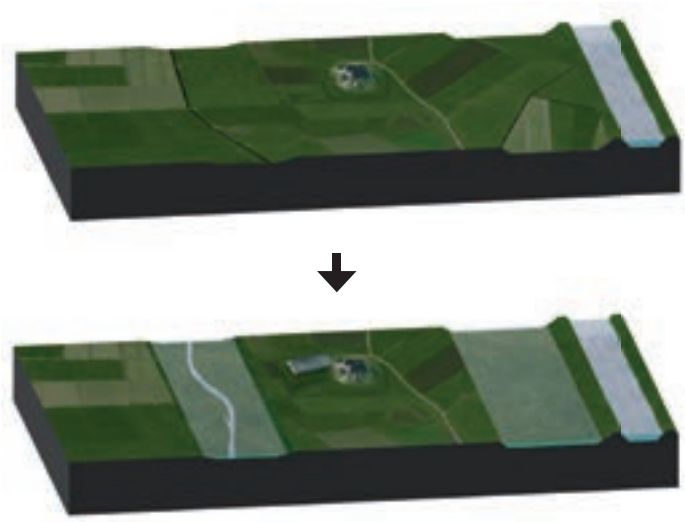


Figure 4.3 | *The lowest parts of the Kamper island landscape could be used for sedimentation in combination with swamp and reed plantation.*

Mastenbroek:
Within this area the focus is especially on disaster resilience and buffering. This means the mounds will play an important role again in the low peat landscape which, next to compartment dikes in the landscape, reduce flood damage. To be able to cope with extreme water fall, retention is increased, for example by widening existing drainage canals, just like in the Noordoost Polder (fig. 4.2), and introduce water retention zones. Especially the Koekoekspolder and its surroundings are used for this purpose. This former peat excavation polder attracts seepage from the surrounding landscape, resulting in subsidence of the peat soils around. By flooding the polder, and introducing floating glasshouses and by transforming the surrounding peat landscape into swamp, the seepage and subsidence process will be stopped. This also creates a landscape which is more resilient towards flooding. (fig 4.4)

Zwarte Water and Vecht river:
Within the river landscape of the Zwarte Water and Vecht the buffering and system resilience strategies are used. The buffering helps to reduce the risk of flooding its surroundings, the system resilience helps to let the river system grow naturally together with the rising water levels. For the buffering strategy this means that first of all upstream measures have to be taken to increase retention. For the area itself it means that by lowering the bottom of the river, by winterbed widening, and by introducing bypasses, the water can flow away faster. Winterbed widening is a less used measure as this affects the local landscape characteristics. A bypass concept that can help to reduce the water level heights in the Zwarte Water river is the Noordoost polder border lake, from Blokzijl towards Lemmer in the north west. With this border lake the area is less dependent on the Ramspol route and the new border lake could retain a significant quantity of water. The idea of a border lake from Blokzijl to Lemmer is not new (Mei et al. 2000),

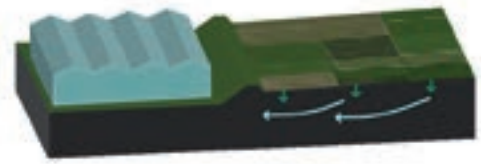


Figure 4.4A | *The situation now: seepage from the Mastenbroek peat polder towards the lower Koekoekspolder.*

Figure 4.4B | *The situation in case of a flood disaster: the Koekoekspolder functions as the shower drain of the region.*

Figure 4.4C | *The solution: floating greenhouses in the Koekoekspolder, and a swamp zone around, reducing seepage.*

Figure 4.4D | *In case of flooding, the floating greenhouses will rise with the water level.*

and has been issued to, for example, reduce the seepage from the Wieden-Weerribben swamp area to the lower polder, to increase the local liveability, and to introduce water recreation and wetland nature. The sedimentation process in the Zwarte Water river system is highly related to the report 'Ruimte voor Kleine Rivieren' (Corporaal et al. 2007), where the upstream Vecht is being discussed. The authors propose to introduce a natural river management where dams are removed and sedimentation and erosion processes are restored. These processes could lead to sedimentation in the downstream area of the Vecht, the Zwarte Water river, and could help this region to grow together with the water level rise.

Sandy east of the Zwarte Water:
This area, inhabited for a long time due to the presence of river dunes, takes the buffering and disaster resilience strategies in order to be adapted. Especially building mounds, building compartment dikes, and widening the Zwarte Water river dike reduces the possible damage in case of flooding. Retention areas and a flexible water level will avoid small water nuisances.

Staphorst fields:
For this area, the resistance, disaster resilience and buffering strategies are combined. The combination of 3 strategies here could help to reduce the effect of the individual interventions. First of all, the surrounding dikes (especially along the Zwarte Water river and Meppelerdiep) are heightened, and the pumping capactiy is increased.

To reduce the chance of possible water nuisance, the buffering stragies are used, including the flexible water level, retention areas and upstream retention, especially for the Meppelerdiep. For the disaster resilience, compartment dikes, mounds, as well as routes for water in case of flooding disasters, are introduced in the area.

Salland drainages:
Within the Salland drainages landscape, measures have to be taken to reduce the effects of a possible dike breach of the IJssel and to reduce the effects of heavy rainfall. The combination of the disaster resilience and buffering strategies will help in this area. For the buffering strategy, a flexible water level will be introduced. Furthermore, retention areas are introduced, such as for example widening of drainage canals. Besides this, upstream retention and winterbed widening helps to buffer the water in this area. Next to compartment dikes and mounds in the area, a bypass is introduced which direct both extreme water discharges as well as the water originated from dike breaches. This bypass, which gives an alternative route for the water besides the city centre of Zwolle, is already introduced by Goor (2010) in which the author states that a bypass from just upstream of Zwolle towards the place where the Vecht and Zwarte Water meet could decrease the water level of the Sallandse Weteringen significantely during discharge peaks.

Urban:
Within the urban areas in the Zwarte Water region, the resistance, buffering, and disaster resilience strategies are combined. This means that most urban areas will have their own dike safety ring, including their own pumping management. To reduce the effects of rainfall peaks, buffering concepts like water retention squares, roof gardens and green public spaces are used. Besides that, most urban areas contain minor streams, such as the Salland drainages in Zwolle and the Meppelerdiep in Zwartsluis. To reduce the flooding risk by discharge peaks of these streams, upstream retention measures have to be taken, dikes along these streams have to be heightened, and pumping capacity from these streams towards the Zwarte Water river has to be increased. The many functions around the water, including new functions, have to be made floodproof. Think for example about recreation facilities like marinas, houses, and industry zones.

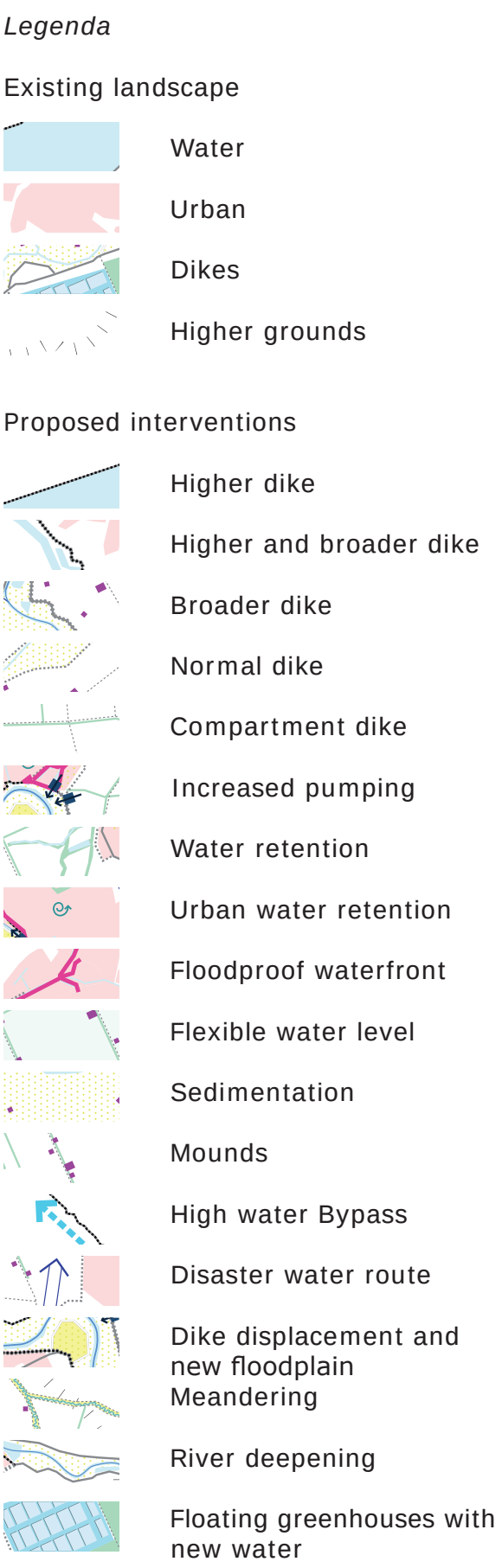
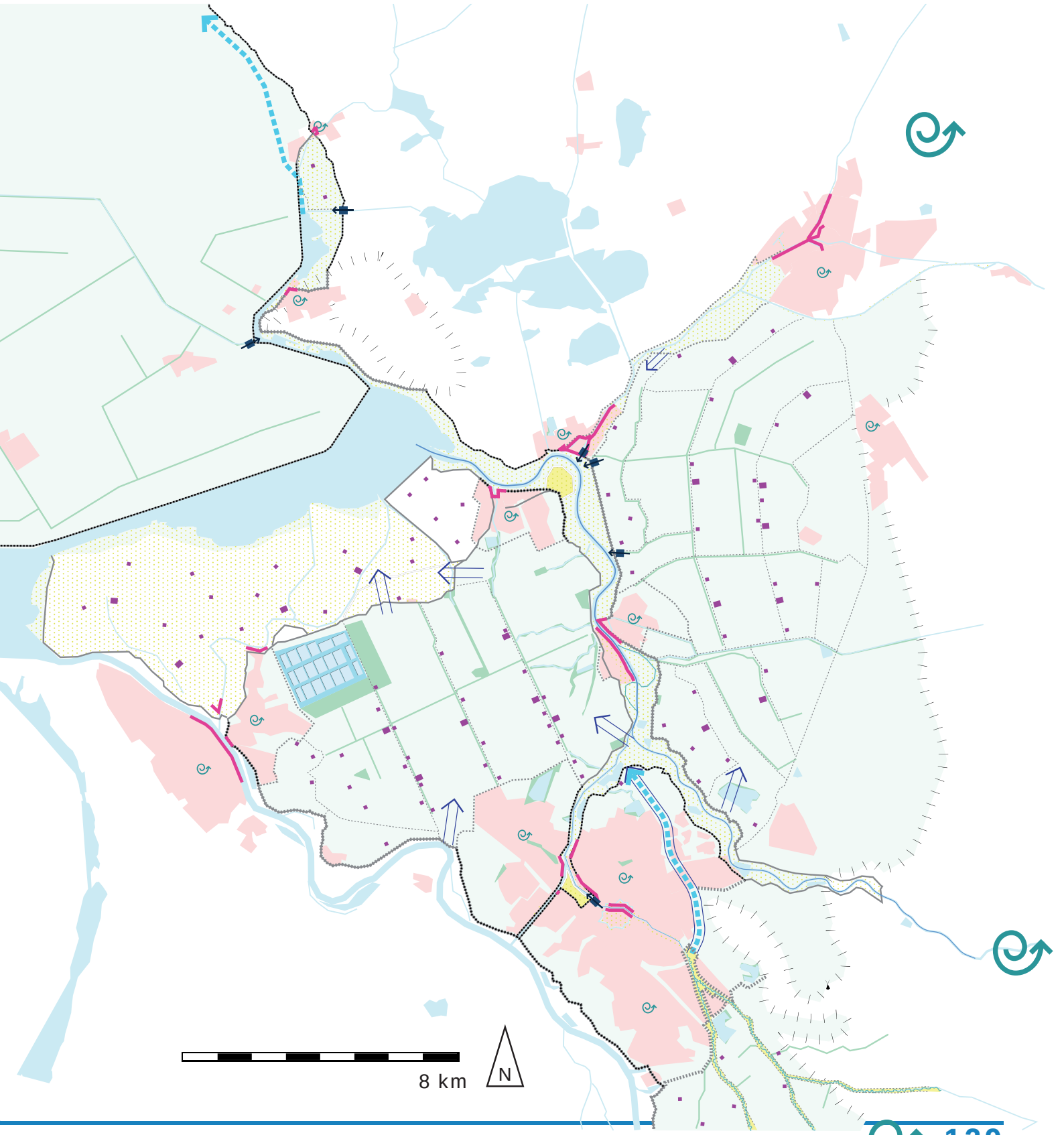


Figure 4.5 | *The interventions as mentioned in the previous chapter are integrated in the landscape as can be seen in this map.*


8 km
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4.7 Conclusion

Within this chapter the interventions are determined to adapt the region towards the challenges in the water system, which are about water level flexibility, water level rising, peak discharges, and the norms of the dike system. These interventions are determined by evaluating different strategies on the landscape identity values as determined in chapter 2.

First of all, we have determined 4 water management strategies based on several lists and approaches in water management:

- Resistance
- Buffering
- System resilience
- Disaster resilience

The interventions that are related to each strategy are then determined for each region. The next step was to evaluate each strategy for each sub landscape in the Zwarte Water region based on the landscape identity values as determined in chapter 2, and to determine whether the strategy has positive, neutral or negative consequences for each value. It turned out that for most regions more than one strategy could be used which has a positive effect on the local landscape and community. Within the last paragraph the interventions related to the positive strategies are visualized.

The sub question that had to be answered in this chapter was: “How should the water system be adapted, taking the identity of the Zwarte Water region into account?”. The answer is the map of figure 4.5, showing the several interventions in the region to adapt for the challenges within the water system. However, to create this map the landscape values were used to determine whether a strategy should be used or not, but not how the interventions could be shaped, and by which process they could be implemented to satisfy for the landscape identity values. For example, the continuity value is important, but the choice for an intervention does not state anything about the planning through time. For the next chapter, an approach is developed to embed the interventions in the landscape even more: By taking the landscape identity values as basis during the design of the interventions in the region, even better places could be designed.

A process towards adaptation

5.1 Introduction

In order to adapt the Zwarte Water region towards the challenges in the water system, the best fitting interventions, in relation with the values that connect the community and the landscape, have been determined in the previous chapter. Here we concluded that with the choice of the best strategies, the landscape identity values are not yet fully integrated in the design for the Zwarte Water region. Therefore we will first determine an approach in this chapter that fits these values. With this approach in mind, we will zoom in and design on the low scale the interventions for that particular area as determined in the previous chapter in such a way that the values are integrated even further. These low scale designs also show the visual impact of the interventions and the way they are implemented within the landscape. In the end these insights are combined with the intervention map of chapter 4 into a regional design approach for the Zwarte Water region.

5.2 The concept: process thinking

Chapter 4 shows that in most sub landscapes in the Zwarte Water region many interventions are possible to adapt the water system. However, when they will be required mainly depends on the speed of climate change, but also on new insights in dike strength, the growth of the economy and developments in society. In this thesis we take the interventions as mentioned in chapter 4 as more than sufficient for the expected challenges in the water system for the coming century. The exact moment when the individual interventions are needed is in fact not relevant for this thesis. More relevant is the way the interventions are embedded in the dynamic landscape. In this thesis this is linked to the values of the landscape identity, which connect the landscape with the community.

The several values of landscape identity, as determined in chapter 2, could be summarized and translated into design principles: most of the values are about legibility. Legibility about the stories within the landscape, and about what is already there, but legibility is also about the understanding for landscape additions and the dynamics in the landscape. Or in short, the legibility of the existing, and the legibility of the new.

Legibility of the existing – Subtle transformation

In chapter 2 we have seen that continuity is an important value within the landscape to keep the community and their individuals connected to the places that they have memories about. If we want to design with this value, it will be about the subtle transformation of an area. It will be about a long term approach and about 'acupuncture' in the landscape where this is possible.

For the Zwarte Water area this for example means that land already has to be reserved for major interventions later on. The 'integral areal developments', like the Kampen Bypass, where a river bypass is combined with urban development and the building of a new railroad, showed that this major scale means a major rupture for the landscape, resulting in social unrest and less connection with the new landscape. The alternative would be to spread the implementation over the coming decades, to better integrate the combination of interventions in the existing landscape.

Legibility of the new – Awareness

New elements in the landscape, additions to the landscape, should be made understandable for the community that lives in this landscape. First of all this means that the water system in general should be made clearer to understand how the system works, and what its characteristics and dangers are. Making a design based on these elements will result in a more experiencable water landscape.

Accessibility of the landscape, and of water itself, should be increased. For example by cycling routes on dikes to be able to oversee the whole water landscape and by hiking routes along the water. Places where you can touch the water, for example beaches, sandbanks and shallow water could also help to connect people with their water landscape. However, accessibility is not only about recreation, but especially about everyday activities, such as cycling to work, or making a short walk.

Experiences should be created, to create a positive image or attractiveness of the water system, which could also create distinctiveness. Think about places where people could reach close to the water. But again, it is mainly about everyday experiences meaning that for example cycling routes should be made attractive.

Landscape characteristics show how the landscape works. To create a better understanding of the water system, the landscape should be made more clear. The creeks for example are more or less invisible lines of reed through the Mastenbroek polder, which could be made much more clear to see that the river Zwarte Water is originally a system that is highly connected with its surroundings.

An example to create awareness of the dynamic water system is shown in figure 5.1, where a quay is compared with a slight slope.

Besides creating awareness in general, the awareness for specific interventions should be mentioned as well. The specific interventions that have to be implemented in the coming decades could be visually prepared for, by landscape design, for example by demarcation. To do this, subtle transformation and awareness are combined to prepare the local community for the expected changes in the landscape.

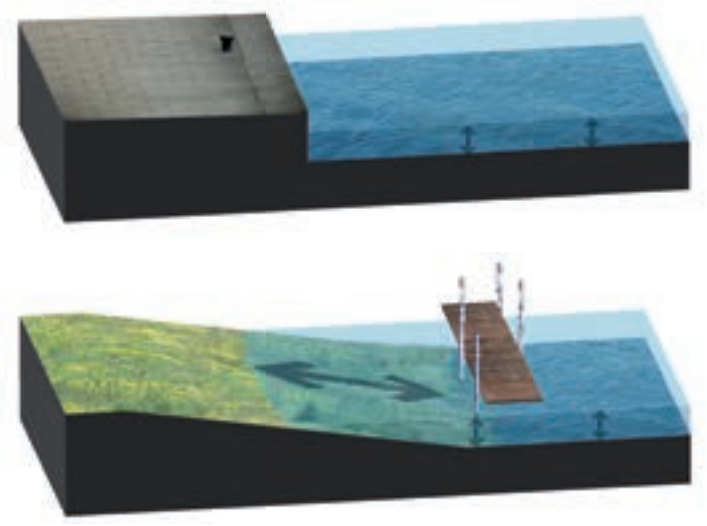


Figure 5.1 | *Standing on the quay on the picture above, the dynamics are not as visible as the water edge on the picture below, where the water also moves in horizontal ways on the ecological slope.*

The approach

The legibility of the existing and the legibility of the new, result in a process approach. With this process approach the landscape will be transformed step by step to make the region safe for the water, with respect to the local community. We can translate this into a time line, as visualized in figure 5.2. The process approach has the advantage that major decisions about the water system interventions could be spread over time.

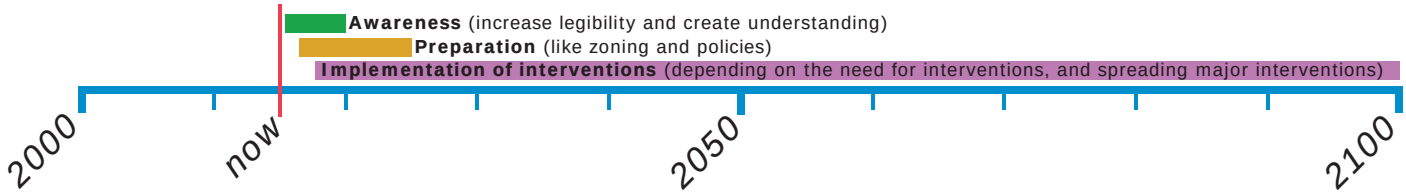


Figure 5.2 | *The process approach timeline, which could be used to give interventions in the landscape a better connection with the community.*

This time line first of all shows that the coming years **awareness** has to be raised before any interventions are done to improve water safety. This means for instance that paths have to be made, places have to be created to experience the water, and landscape elements should be restored.

The next step is to **prepare** for the interventions. Land for bypasses that is being threatened by urban expansions should for example be reserved. Furthermore, when an area will have a higher flood risk in the future, we can already state that new buildings should be built on mounds.

The **interventions** itself do not have to be implemented all at once or immediately. Interventions that appear to be more effective could be implemented in an earlier stage, and the building of major interventions that have a major impact on the landscape and the community like bypasses should be spread over time. The interventions should be implemented when they are needed in time, so when climate change appears be slower or faster than expected, economic or societal developments arise, insights in dike building change, interventions could be combined with other projects within the landscape, or the community shows a major discomfort with one of the interventions, the interventions could be placed in another order, or implemented in a faster or slower rate.

Testing

To show the advantages of this approach, it needs to be tested. Therefore two hotspots within the Zwarte Water region are selected for which a low scale design will be made, to show the visual effects. These designs integrates the interventions as determined in chapter 4, with the process approach as just mentioned, and which incorporates the values of landscape identity. The 2 hotspots that are selected will be the rural area of Wolfshagen in Mastenbroek and the bypass which is planned through the urban area of Zwolle. These 2 hotspots together represent the majority of the interventions and shows how they could be implemented on the low scale.

Mastenbroek – Wolfshagen
This area, just west of Hasselt, is a transition area from the former dynamic Zwarte Water estuary river into the flat peat Mastenbroek polder. Over here new mounds are planned, together with increased water retention within the old creeks.

Zwolle – Nieuwe Westerveldse Aa
The plan for a bypass through the urban area of Zwolle sounds controversial but could be successful when the process approach is used to prepare the local landscape for this intervention.

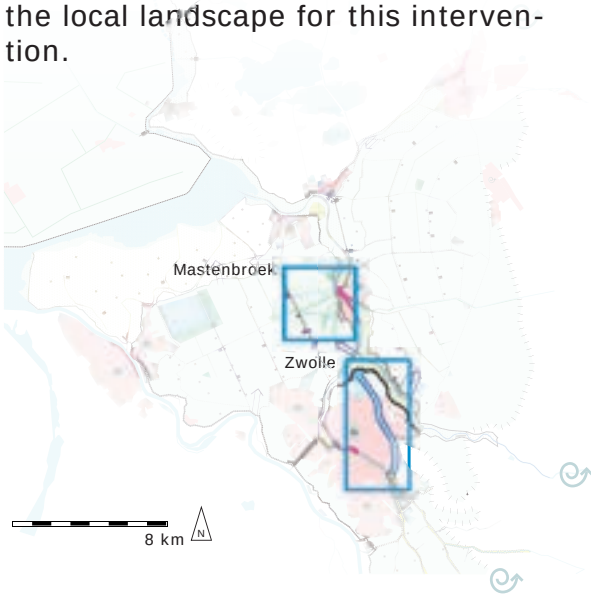


Figure 5.3 | *The choice for the low scale designs in the intervention map of chapter 4 (fig. 4.5).*

5.3 Mastenbroek - Wolfshagen

The creek system

The creeks around the Zwarte Water river are the remains of a more dynamic estuary landscape in the past (fig. 5.4A). Nowadays these creeks are strange meandering lines in the rectangular polder landscape of Mastenbroek (fig. 5.4B). Making the landscape more legible starts with making these creeks more visible in the landscape (5.4C).

In chapter 4 the restoring of creeks were mentioned as part of the solution to increase the water retention capacity in the Mastenbroek polder. Therefore these creeks are widened and a swamp edge is added around.

In the previous paragraph we have read that awareness should be the first step before doing any interventions. However, in the case of these creeks, the retention solution combined with creating awareness could be combined from the start, because the restoration of these creeks combined with an increased accessibility show the dynamic water system and the interconnectiveness with the river on the other side of the dike.

Figure 5.4A | *On height maps many creek remains can be identified in the Mastenbroek polder. They were the connection between the Zwarte Water river and the wet peat land of Mastenbroek, which was not yet drained.*

Figure 5.4B | *Nowadays, the dike has separated the river landscape and peat landscape into two different worlds, with no visual connection. The characteristic polder lines are the dominant structures in the landscape, and the creek remains are strange elements in the rectangular landscape.*

Figure 5.4C | *The task to enlarge the water retention capacity is a chance to restore these creeks, and to restore the visual connection between the river and the polder, to increase the awareness of the interconnectivity of the dynamic water system. That is why it includes the accessibility of the creeks, for example by hiking paths and canoe routes.*

To show that these creeks have a connection with the river and the other creek remains on the river side, a cortensteel stairs is added on top of the dike (fig. 5.5). This stairs could be used as a portage, or an 'overtoom' in Dutch, to be able to cross the dike with for exampe a canoe. Cyclists on the other hand will experience this interruption in the dike as the visual connection between the water surfaces on both sides of the dike.

The accessibility of the area is increased with new paths along the creeks (fig. 5.6A), but also with a canoe network (fig. 5.6B). The restored creek system increases the retention capacity as seen in fig. 5.6C.

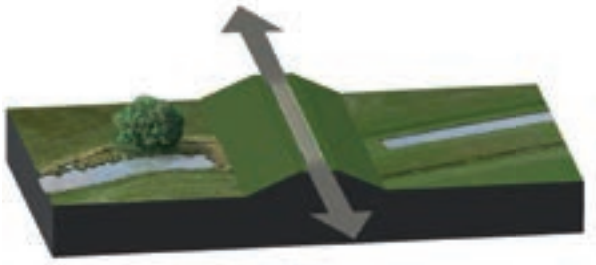


Figure 5.5A | *The old dikes, but also the new compartment dikes, are the elements that disturb the connection between the several creek segments. The fact that the water level is different on both sides, around 0,5m to 1m, makes it impossible to have a connection through the water.*

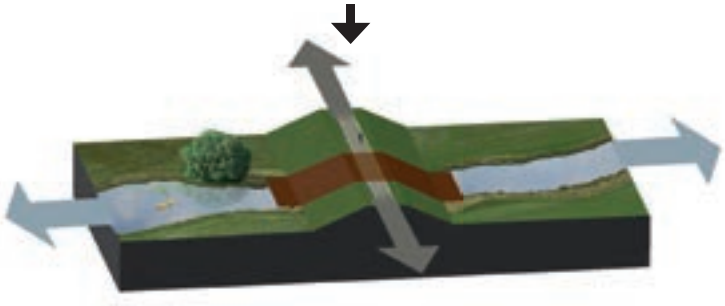


Figure 5.5B | *Therefore an old concept is introduced: the portage, or in Dutch, the 'overtoom'. This corten steel stairs creates a visual connection between both sides of the dike, and can be used to carry canoes and kayaks to the other side.*

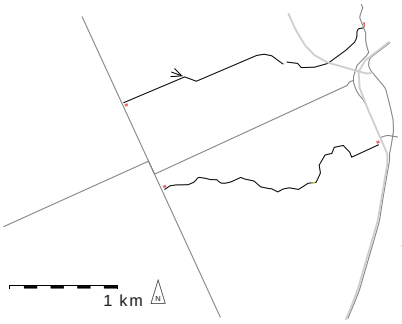


Figure 5.6A | *The hiking routes and other roads.*

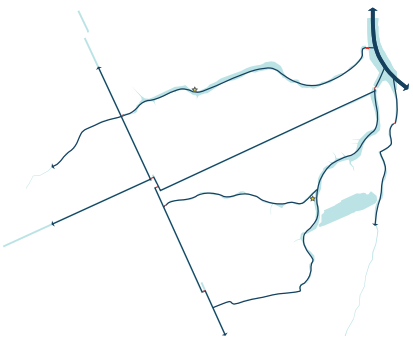


Figure 5.6B | *Canoe routes through the polder area.*

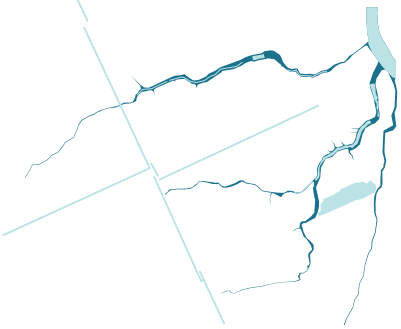


Figure 5.6C | *New surface water, which increases the retention capacity.*

The mounds

The other main intervention in the Wolfhagen area are the new mounds. The flooding risk in the polder will grow slightly together with the growing water levels. This means that for the coming years there is no reason to worry. However, when we want to prepare the landscape for the longterm, which means for more than a century, building on mounds becomes inevitable if we do not want to rise the dikes till infinity as this is related to new risks as well.

The obligation to built new buildings on mounds starts with a zoning policy, which can only be accepted when the awareness in the region is being increased. On the other hand, waiting to built on mounds should be avoided as much as possible. Therefore this zoning policy is part of the second phase, which means that in the coming years the decicion to built on mounds can be taken from then on.

The figures 5.7A untill 5.7F illustrate the process of getting all buildings on mounds. Now only the oldest farms are placed on mounds, new farms are built on the ground surface (fig. 5.7A). The new compartment dike and the new mega-farm which is built on a mound, represent the new robust landscape of the Mastenbroek polder of the coming decades (fig. 5.7B). In case of a flooding in this period, when the modern farm is not yet placed on a mound, the old farm mound and the new mound act as evacuation locations, connected with the compartment dike. The modern farm is being flooded (fig. 5.7C). In the coming century, the policy to built new buildings on mounds result in the fact that most buildings are placed on mounds (fig. 5.7D). In case of a low flooding, the compartment dike prevents that the whole polder is flooded (fig. 5.7E), and in case of a more worse flood, the new mounds act as evacuation places, also for the older lower mounds.

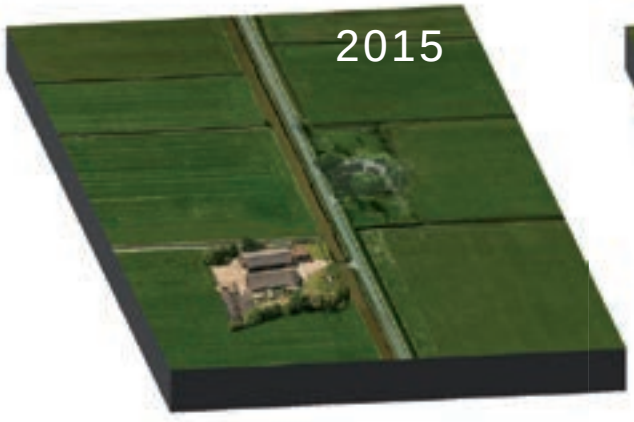


Figure 5.7A | *The situation now. On the right side we see an old farmhouse built on a mound, on the left side a modern farm, built on the ground surface, with the idea that the risk of flooding is negligible.*

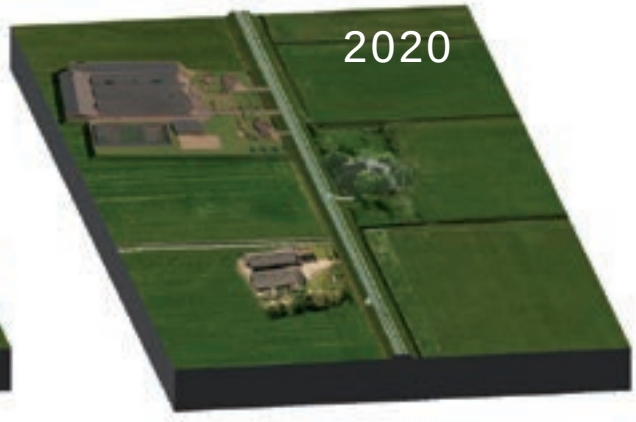


Figure 5.7B | *The situation around the year 2030. It is mandatory to build new buildings, like this mega-farm, on mounds. The local road is being transformed into a compartment dike.*

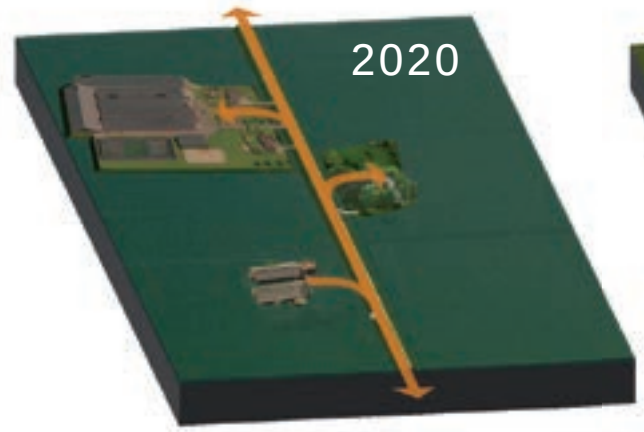


Figure 5.7C | *In case of a flooding of the area, the old and the new mound are used as evacuation places, and the compartment dike as an escape route. Unfortunately the 20th century farm is being flooded.*

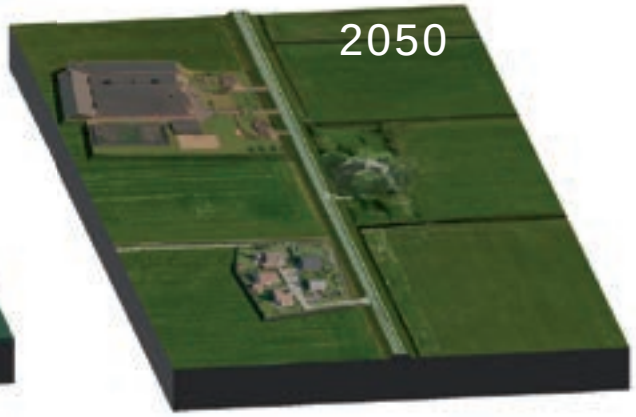


Figure 5.7D | *The situation in 2050. The 20th century farm has been replaced by, for example, houses, which are built on a mound.*

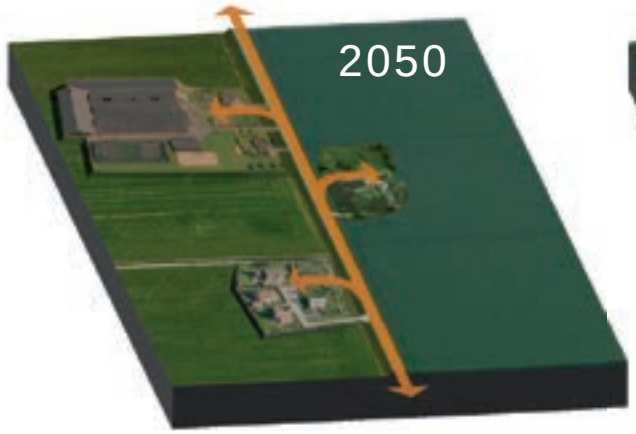


Figure 5.7E | *In case of a low flooding, the compartment dike could help to reduce the damage in the area, and all mounds could be used as evacuation places.*

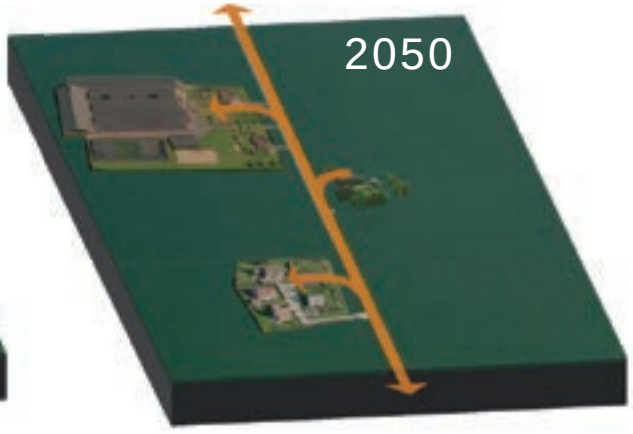


Figure 5.7F | *However, in case of a rare higher flooding, the old mound could also be too low and its residents have to evacuate to for example the newer mounds on the left side.*

The design for Wolfshagen

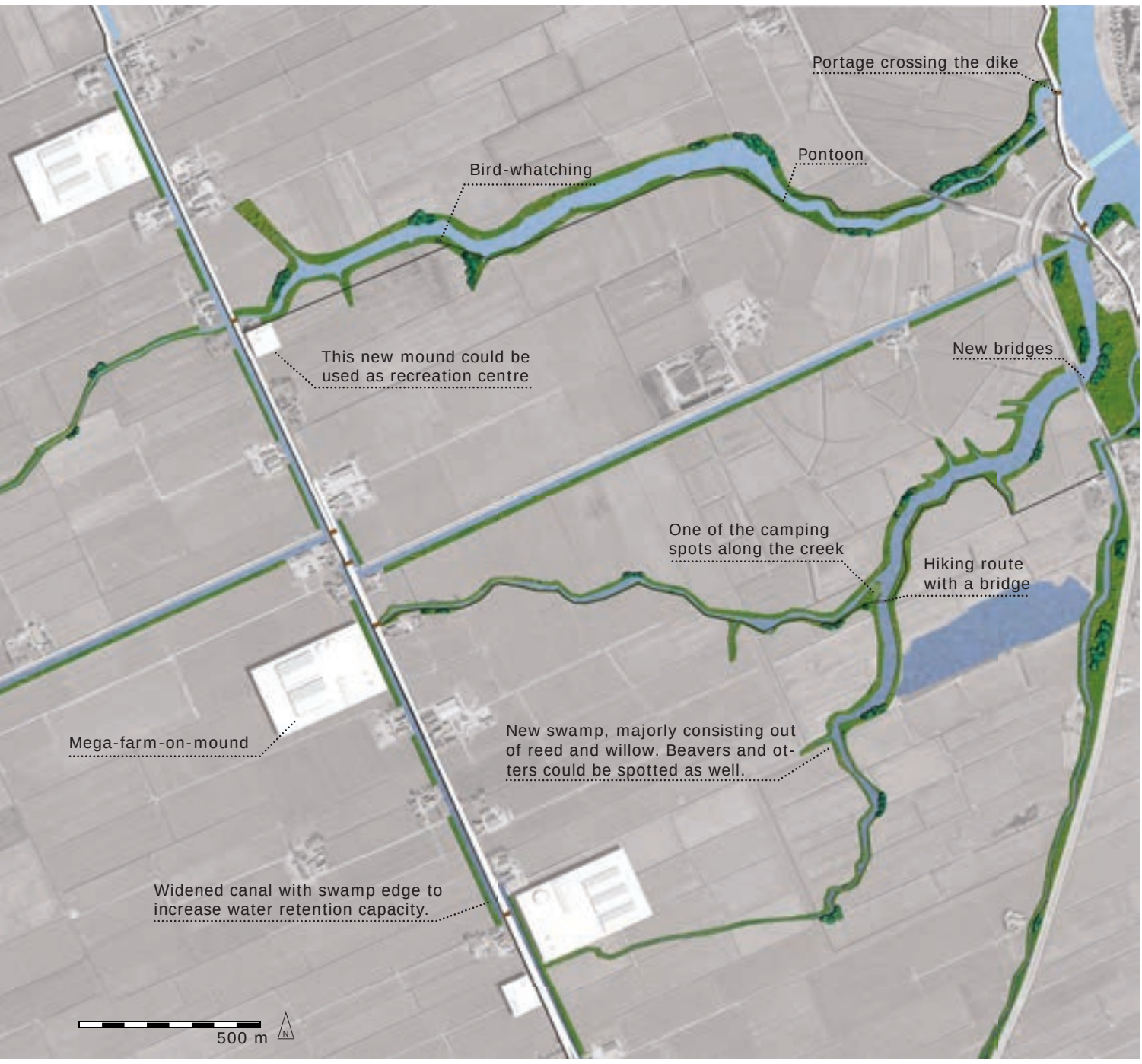


Figure 5.8 | *The natural shaped creek system contrast with the rectangular shaped new mounds and compartmentdikes.*

The two main interventions in the Wolfshagen area are the restored creeks and the mounds along the compartment dikes. The creeks form a robust nature and recreation network, meandering through the landscape. The mounds and compartment dike are a robust version of the rectangular polder landscape (fig. 5.8).

In figure 5.9 an impression is made of a creek meeting a dike showing the accessibility of the creek system, with in the background the building of a mound.

Figure 5.9 | *An impression of a portage ('overtoom'), where a dike and a creek meet. In the distance a modern farm is being built on a mound.*

5.4 Zwolle - Nieuwe Westerveldse Aa

Concept

The 'Nieuwe Westerveldse Aa' is a bypass through the urban area of Zwolle. Discharges coming from the south, including dike breaches along the IJssel are now directly going through a narrow canal in the city centre of Zwolle (fig. 5.10A). The solution as explained in chapter 4 is a bypass to connect the Sallandse Weteringen with the point where the Vecht and Zwarte Water river meet, to decrease the pressure on the water system and to offer an alternative route for the water. The only possible route, when as little as possible buildings have to be removed, is just 300m parallel from the Westerveldse Aa, a drainage canal which has been integrated in the urban structure and which is invisible on a major part of the route (fig. 5.10B). This route for the new water route is now mostly in use for agriculture, but also for sporting facilities, like soccer, tennis, hockey and horse riding, and has to be replaced within the area itself in the coming decades. This new bypass could then transport a major quantity of water, but it could also retain water (fig. 5.10C).

Preparation

The first step to embed this bypass in the landscape is to start with zoning policies. First of all it should be prohibited to built within the borders of the bypass area. Besides that, the sporting facilities have be replaced within the area (fig. 5.11A).

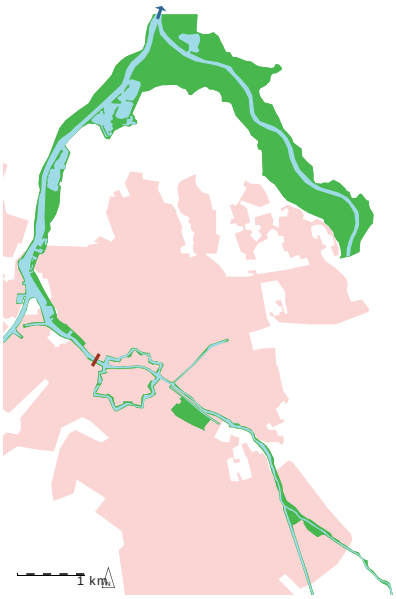


Figure 5.10A | *The situation now, where discharges have to go through the city centre of Zwolle.*

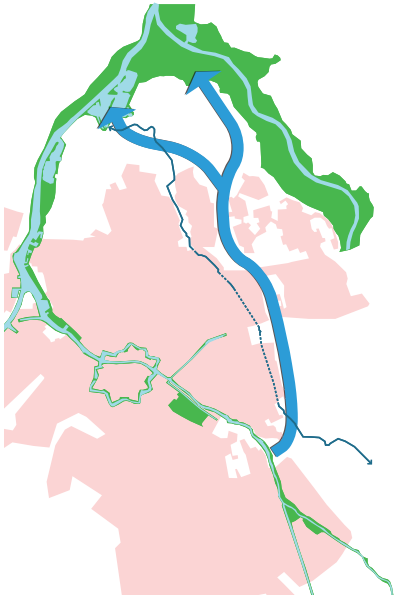


Figure 5.10B | *The alternative route for the water is located east of the city centre, parallel with the remains of the Westerveldse Aa.*

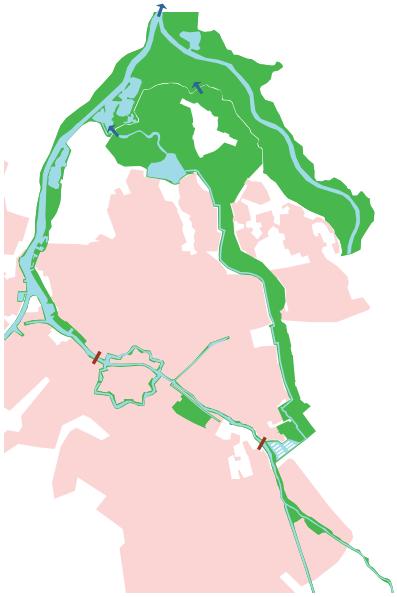


Figure 5.10C | *The bypass zone, which could not only drain, but which could also be used for water retention.*

The second step is to create awareness, in this case with 2 solutions (fig. 5.11B). The first one is to highlight the borders of the future bypass with fluorising paths (fig. 5.12), in all kinds of appearances. The second one is to introduce elements that represent the use of the area in the future: boats. A small steel boat, placed temporarely, and filled with plants, could be both an attractive icon in the area, as well as a statement to increase awareness.

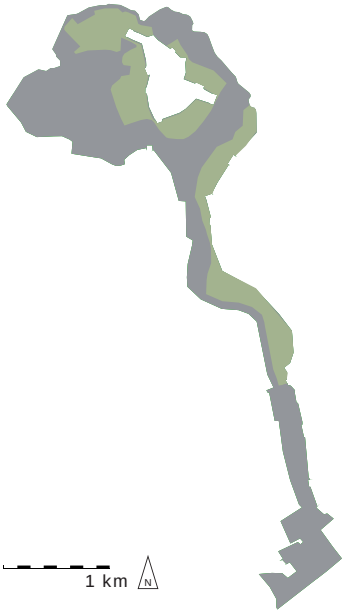


Figure 5.11A | *The area should be prohibited for new building projects (grey and green). Besides that, the many sports facilities in the bypass area should be shifted to other places within the bypass (green), located on the higher grounds.*

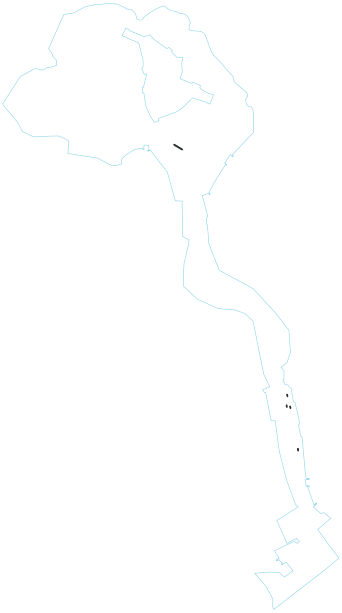


Figure 5.11B | *To create awareness for the changing situation, 2 interventions are introduced: an iconic line which follows the future bypass outline, and boats that are put on the land to become aware of the future function of the area. The iconic line is elaborated in the figures below (fig. 5.12A and fig. 5.12B).*

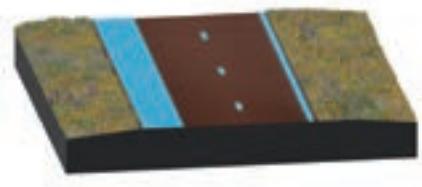


Figure 5.12A | *A cycling path with blue fluorescent edges show the borders of the bypass. The blue color represents both the water and the eco-friendly approach.*

Figure 5.12B | *Small hiking paths which are part of the border could be made fluorescent as well.*

Figure 5.13 | *The bypass design represents the existing landscape as much as possible. For example highlighting farmhouses by dikes and using the high grounds for sports facilities.*

The design

The third step is the intervention itself. It already starts with the replacement of the sporting faclities, these new terrains are heightened using soil material from the new dug canal and swamp areas in the west side of the bypass. Later on, also the dikes have to be built with this material, and the bypass will appear in the landscape steadily.

As shown in the design for the bypass in figure 5.13, it has been tried to integrate the existing landscape as much as possible. The lowest parts are used for swamp nature and together with the draining canals they will be flooded often (fig. 5.14A). The lower grasslands can be crossed with aesthetical hiking routes, and will be flooded every once in a while (fig. 5.14B). The existing heights in the landscape are made even higher, and are used for sports terrains, combined with public parks. They will be flooded only in major floods.

Besides that, landscape elements like farmhouses and tree rows are highlighted in the new landscape, for example with smooth skips in the dike structure.

On the next pages the development phases in the bypass area are visualized (fig. 5.15A - 5.15E)

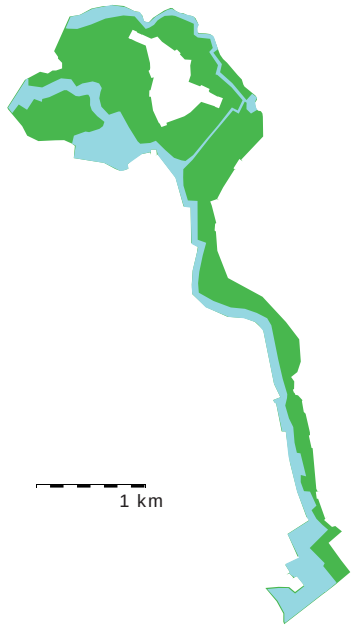


Figure 5.14A | *The bypass with a small flood. Only the swamps are flooded.*

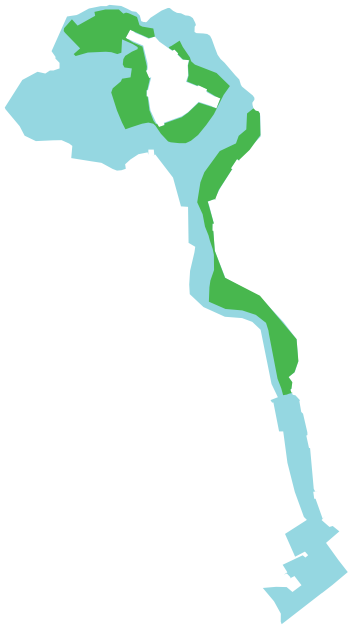


Figure 5.14B | *The bypass with a moderate flood. The swamps and meadows are flooded.*

Figure 5.14C | *The bypass with a major flood. The higher grounds, including the sport facilities and a few farmhouses will be flooded.*

Figure 5.15A | *The urban edge of Zwolle, consisting out of farmland, farm-houses, and recently built cycling routes and swamp.*

Figure 5.15B | *The fluorescent paths represent the shape of the future bypass. The boat on the background represents the future function.*

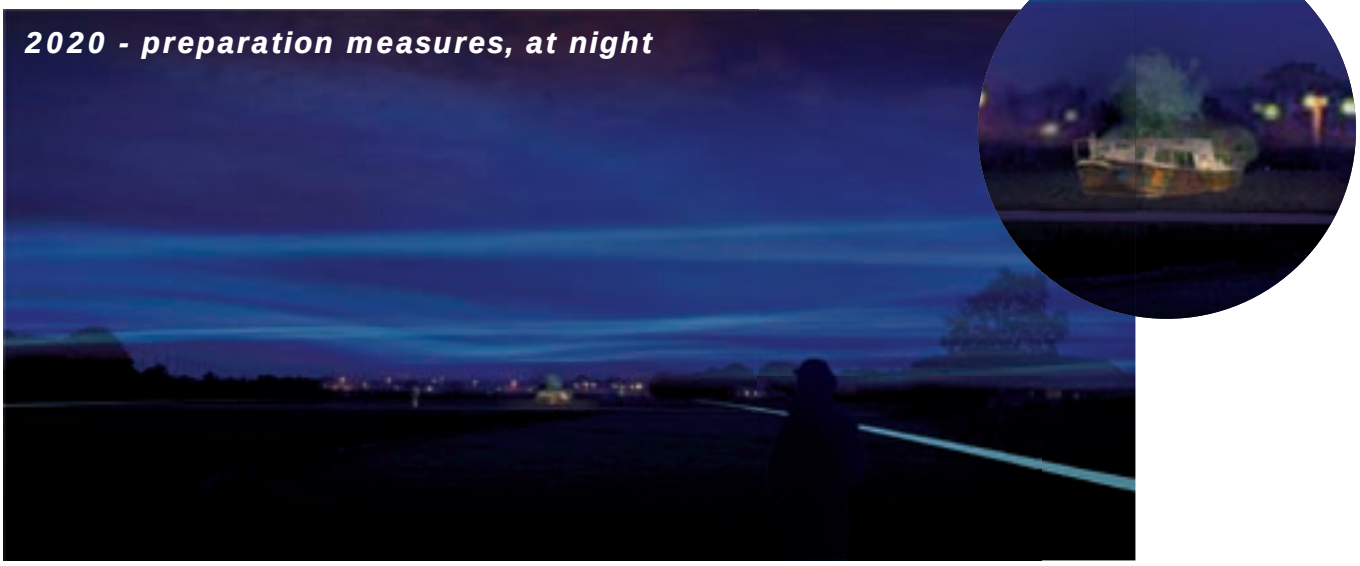


Figure 5.15C | *At night, the bypass becomes even more interesting using several light effects. Making the bypass experiencable when it is not there yet prepares the inhabitants as well as decision makers.*

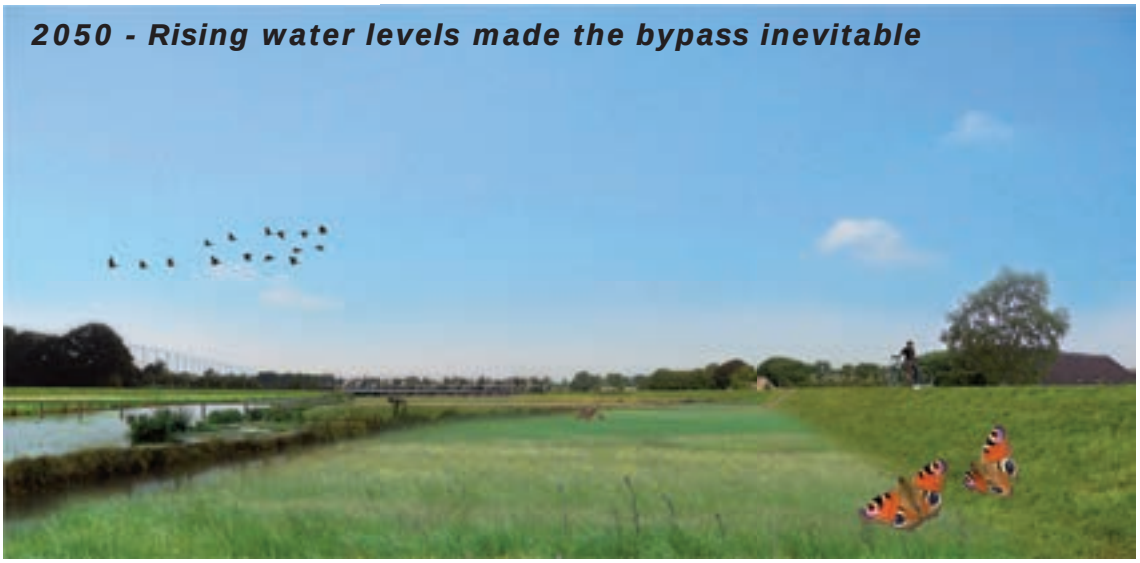


Figure 5.15D | *The bypass is being made when it is needed, within several decades, and includes recreation, nature and agriculture within the city.*

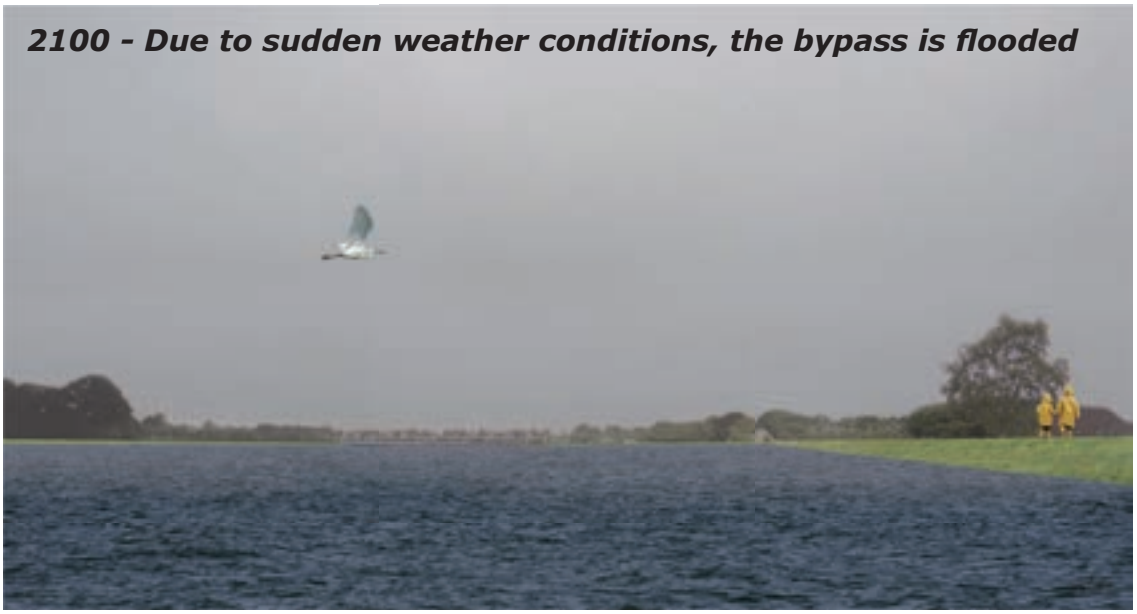


Figure 5.15E | *The risk for a flood grows together with the water level rise due to climate change, but the actual flood for which the bypass is built could show up at any moment, or could wait for many decades.*

5.5 Regional approach

The process approach as introduced witin the first paragraph, showed that before the implementation of the interventions, awareness had to be created and zoning preparations had to be done. The local designs of Wolfshagen and the bypass showed that creating awareness could be combined with interventions, like broadening and restoring the creeks in combination with making paths and ‘overtooms’. In fact, many interventions could raise awareness when they are designed for this purpose, for example waterfront adjustments and dike heightening could be combined with making water more experiencable. However, the more controversial interventions like dike heightening should be postponed until later date. These insights result in an updated timeline (fig. 5.16).

Translating these ideas to the region, with the intervention map of chapter 4.5 as foundation, means that in phase 1 (fig. 5.17A) awareness interventions like the bypass outlines, as well as cycling and hiking paths and watersport routes, could be combined with water system interventions like the broadening of the local water system and the flood adaptation of waterfronts.

In phase 2 (fig. 5.17B) zoning measures have to be implemented to prepare for the future landscapes, which in this case includes the obligation to only built in mounds in some areas, the promotion of urban water retention measures to civilians and policy makers, and the prohibition to built in bypass areas.

Within phase 3 (fig. 5.17C) the other interventions could be implemented during the coming century when they are required. These include the interventions with a bigger impact on the landscape and the community.

When all phases are completed, a landscape emerges which includes all the interventions mentioned in chapter 4 (5.17D).

In short, a process approach helps to embed the set of interventions, as determined in chapter 4, in the landscape and the community even more. (5.18)

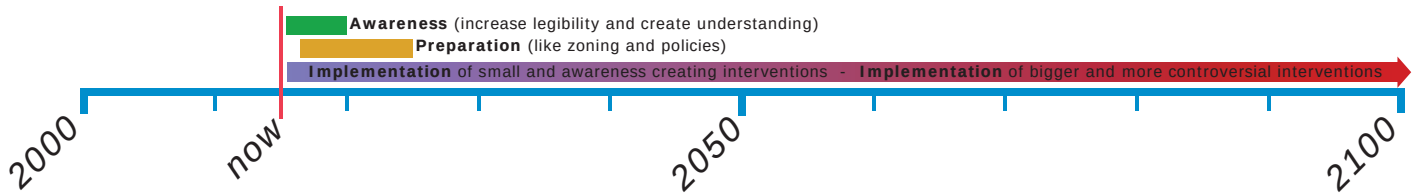


Figure 5.16 | *The improved process approach timeline*

Legend

Adjusted creeks and canals

Adjusted waterfront

Bypass outline

8 km

N

Figure 5.17A | *Awareness interventions like creating access to the water, could be combined with water system interventions like the restoration of the creek system.*

Legend

Mound obligation area

Urban water retention

Building prohibition

Upstream retention

8 km

N

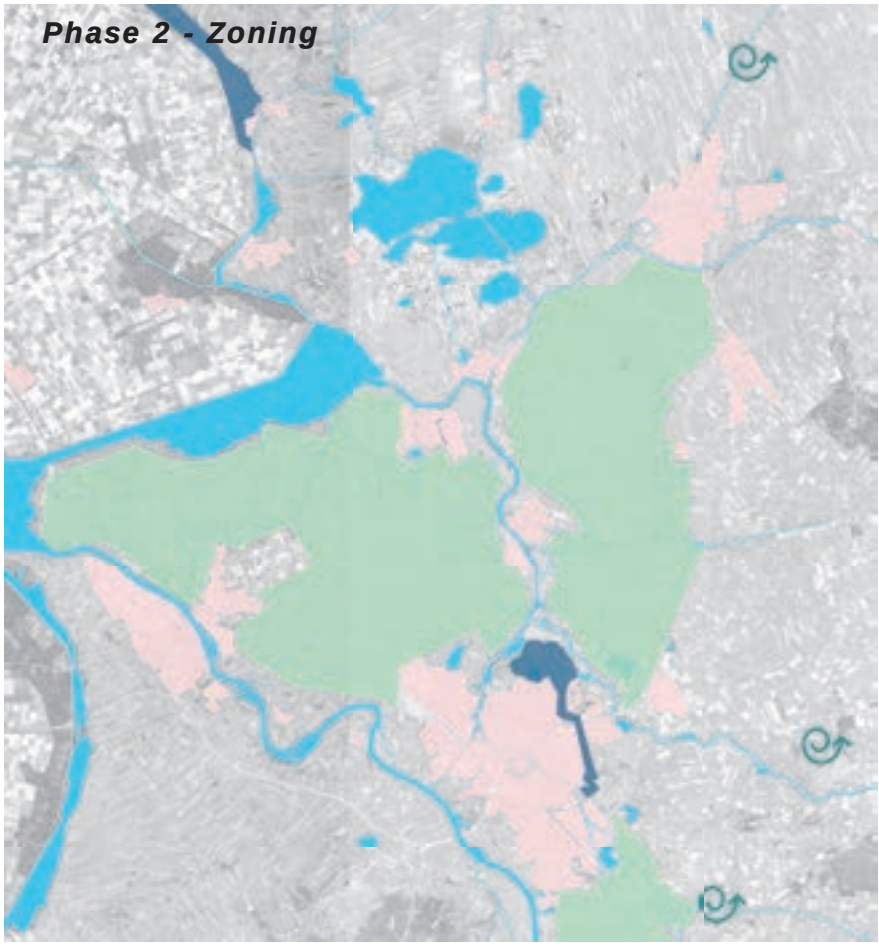
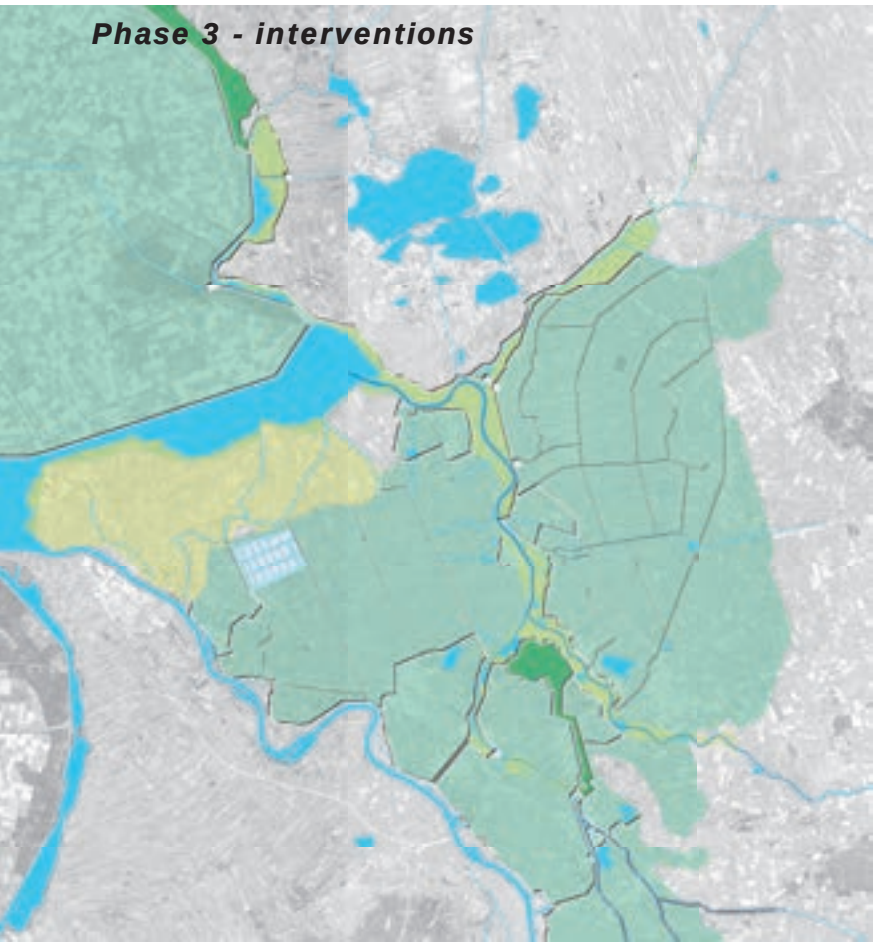


Figure 5.17B | *Zoning measures help to prepare for future interventions.*



Legend

- Adjusted/new dikes
- New compartment dikes
- Bypass
- River bed adjustments
- Floating greenhouses
- Sedimentation
- Flexible water level
- Adjusted/new pumping station

8 km

N

Figure 5.17C | *The other interventions, like the adjustments to the dike system, are implemented in this phase.*

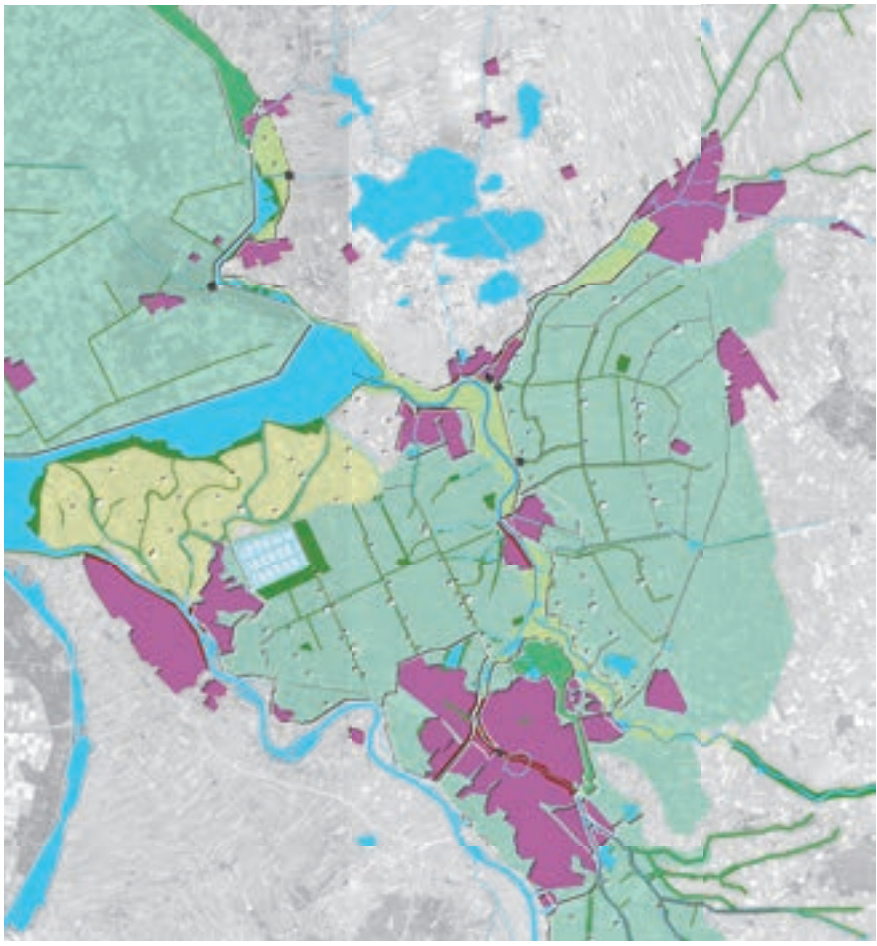
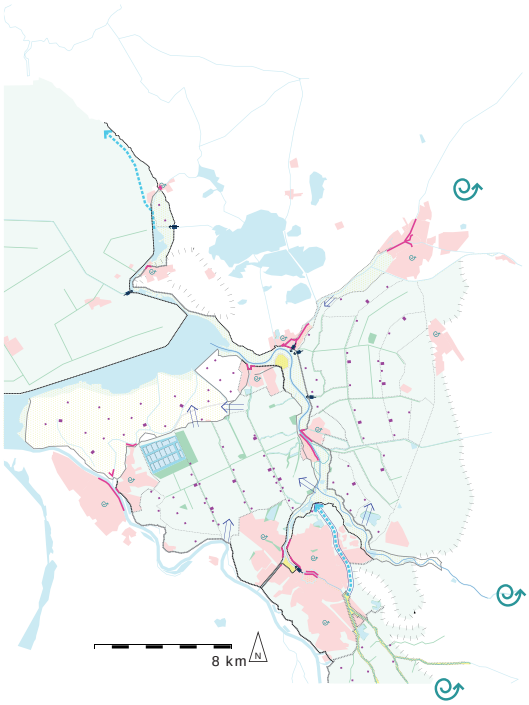


Figure 5.17D | *The 3 phases combined, resulting in a fully transformed landscape.*



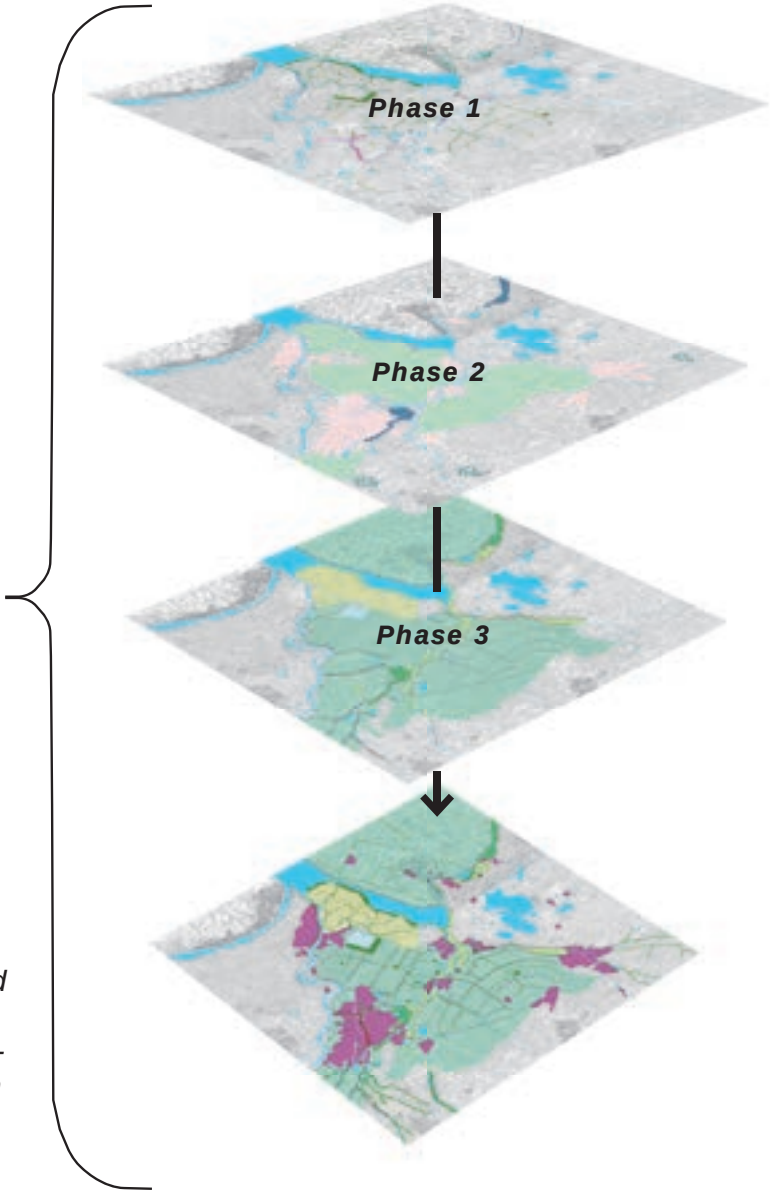


Figure 5.18 | *The interventions as determined in chapter 4 are combined with the process approach, resulting in 3 phases that will lead to the transformation of the regional landscape in order to compete with the challenges in the water system.*

Legend fig. 5.17D

Adjusted creeks and canals
Adjusted waterfront
Bypass
Mounds
Urban water retention
Upstream retention
Adjusted/new dikes

New compartment dikes
River bed adjustments
Floating greenhouses
Sedimentation
Flexible water level
Adjusted/new pumping station

5.6 Conclusion

Within chapter 4 we concluded that only determining the right strategies for an area does not completely integrate the landscape identity values as determined in chapter 2. Therefore in this chapter the process approach is introduced. A process approach results in a settling down of the interventions within the landscape and the community. 2 principles are determined: the legibility of the existing, and the legibility of the new. The first is about conserving what is already there, what people value, which results in subtle transformation like design by 'acupuncture'. The second is about creating awareness for the new situation, and getting used to the change and dynamic landscape, and to individual interventions which could be reached with a more experiencable water landscape. This results in a process approach with 3 phases: first awareness has to be created, second the landscape should be prepared with zoning, and in the third phase the interventions could be implemented.

The detailed design of Wolfshagen in Mastenbroek shows, however, that interventions in the water system of the Zwarte Water system could also make the water landscape more clear and experiencable, especially when they are combined with for example paths and other elements to make the intervention more experiencable. An example are the creeks that are broadened and are combined with hiking paths, canoe routes and making the creeks more clear by introducing the 'overtoom' to connect both creek parts on both sides of the dike. The design of Wolfshagen shows the balance between the robust Mastenbroek polder, with compartment dikes and new farm mounds, and the restored creek system, which neglects the rectangular grid, and brings back the visual connection with the dynamic estuary river system.

Furthermore, the approach to introduce a long term implementation process of the bypass is an interesting idea to create awareness and to settle the intervention in the landscape even better. On the one hand, this is about zoning, like the reservation of space for sport facilities that have to be replaced. They are not forced to do this suddenly but it can be done when they are ready in the coming decades. And it is about the prohibition of building on the reserved bypass land. On the other hand it is about creating awareness by introducing iconic borders and iconic objects related to the future function as bypass: boats.

These insights are then used as basis for the implementation of the interventions in the Zwarte Water region, and results in the adjustment of the 3 phases: The first is to combine awareness interventions with less controversial water system interventions, like creek broadening, and the visual preparation for more controversial interventions like the bypass or dike heightening. The second phase is still about zoning and policies, and the third phase is about the subtile implementation of the more controversial interventions during the coming decades.

6

Conclusion

6.1 Discussion

This thesis has the goal to reconnect people with the landscape in this period when water system adaptation projects to react on the climate change and growing social economic wealth, increase in scale more and more. The reason for this is not only to reduce opposition, but especially with the idea that landscapes belong to the people that live in it, and that interventions should conform to their requirements. In addition to that, the multi layer safety approach demands people to become aware of how to react on the dangers that a possible flood causes.

In this thesis it turned out that the relation between these people and the landscape could be defined with a small list of values. These values could then be both the basis for a choice for which water strategy every sub landscape fits best, as well as the approach of how these interventions have to be embedded in the landscape.

The approach, in which not the landscape itself, but the people that live in the landscape are the basis for choices in the design of the landscape, is not a widely spread approach within the subject of landscape architecture. This means for example that the values that were collected in chapter 2, had to be extracted from literature one by one, resulting in the fact that the determined values could be overlapping with each other, as well as that the list could possibly be incomplete. In chapter 5 this list has been brought back to 2 main values that have to be incorporated in a design: the legibility of the existing, to conserve what is and already has been there, and the legibility of the new, to explain the reasons for adaptation as well as how interventions are imbedded in the landscape. The outcome of these requirements leads to a process approach: the first step is to increase awareness by making the landscape more legible and accessible, the second step is to reserve land, and the third to steadily embed the needed interventions in the landscape.

This process approach fits within the field of landscape architecture, in which we do not work with a final image of a place, but to steer processes, for example in ecology and geomorphological processes. In chapter 5 we have presented a regional design for the Zwarte Water region, but due to the speed of the climate change we can not state when all interventions as determined in chapter 4 have been built. This also means that when all interventions have been built, within multiple centuries, or when climate change appears to be much faster, the process approach could still be the basis although new interventions could be added that, for example, are more controversial, or become available due to new techniques.

The connection between scale levels, also an approach that is typical for landscape architecture, has been integrated in this thesis. To increase awareness of the people in the region, which is the higher scale, for the need of interventions in the water system, especially low scale interventions are proposed such as the ‘overtoom’, to show the connection between the creek remains on both sides of the dike, representing the dynamic water landscape.

Both the process approach as well as the connection between scale levels show landscape architecture has the tools to deal with social challenges in the regional landscape. The method

that is proposed in this thesis, to take the values that connect people and their landscape as the basis for landscape design is new however. But does another method, based on the landscape itself instead of the community, lead to another outcome? The process approach and switching between scale levels are only proposed in this thesis because of values of people, while in the introduction we have seen that those tools are an inherent part of landscape architecture. We have also stated that community is an inherent part of the ecology of the landscape. With this we could state that the community is an inherent part of the regional landscape but that this community is neglected often in regional landscape designs.

Together with this thesis, the public discussion is going on about the lack of regional designs, both in the academic world as well as in the professional world. Instead, we see all kinds of low scale initiatives, both by landscape architects as well as others, highly integrating the local community. However, the challenges that climate change offers to the world demand for large scale solutions, for example on the scale of dike rings. This thesis shows that a community based regional design approach could be a solution to interventions on the regional scale.

This thesis also confirms that landscape designers are not working with ‘space’, but with ‘place’, and that the land is filled with stories and memories of individuals and the community in general. They live, work and recreate on an everyday basis in the landscape which is being transformed by the landscape architect. I would not state that experiments and designs with a major impact should be banned, but when designs are created with keeping the people in mind, which includes the creation of understanding and a process approach, the chance that those designs are implemented will be increased.

In the introduction the idea of landscape affection is being discussed, in which the landscape activates people to transform their landscape. In the design in this thesis this idea has been integrated. Not on a way that people change their landscape on basis of design, but how a landscape design could affect the vision and opinion of a landscape that people have.

6.2 Conclusion

This thesis started with the problem that the connection between people and their landscape has been decreased, which could have a negative effect on how we adapt water landscapes to future developments. We stated that landscape architecture has the right tools to solve this, because of the holistic approach of the discipline. Using the Zwarte Water region as test case, we had the possibility to test the tools landscape architecture provides on a climate change affected delta region with a rich history. This resulted in the following research question:

How could a water system be adapted on the basis of a landscape architecture design strategy, with the focus on the local community?

The focus on the community became the basis of this thesis. The people are highly connected with the landscape, and the landscape provides values that are essential for its inhabitants. These values have been the basis for a landscape analysis, to determine how these developments have developed in the test area, both to determine the gaps as well as the advantages of the region, which can be used in later stages. In the next step 4 water management strategies (fig. 6.1) to adapt the landscape to new norms within the water system have been determined: resistance, buffering, system resilience and disaster resilience. Which of these water management strategies fits the best for each sub landscape in the Zwarte Water region had been determined by testing whether the strategies had a positive, neutral or negative effect on the values in the sub landscapes (fig. 6.2), resulting in 1 until 3 water management strategies per region. Next, the landscape values are combined with landscape architectural tools to embed the interventions in the landscape, whereby the values have been brought back to 2 main values: the legibility of the existing, and the legibility of the new, in which the first is conservation of what is already there, and the second about the introduction of new elements and dynamics in the landscape. This resulted in a process approach, in which 3 phases can be identified: the first to increase awareness for the need of interventions, the second to prepare the landscape by zoning, and third, the interventions itself, for the moment they are needed. Low scale interventions in the landscape have been introduced that make the landscape in general more clear and understandable. The designs showed that the first phase, raising awareness, could be combined with some of the interventions (fig. 6.3).

In short, a landscape architecture design strategy to adapt regional water systems should take the local community as its basis, represented by the values that connect people and their landscape, as determined in chapter 2, to determine which water management strategies fit the best in each sub landscape, and to determine how these water management strategies should be embedded in the landscape.

Step 1:

Figure 6.1 | *Determine which water strategies fit the best in each sub landscape.*

Figure 6.2 | *The water strategies are tested by determining whether the values that connect people and their landscape have a negative, neutral or positive effect on the landcape.*

Step 2:

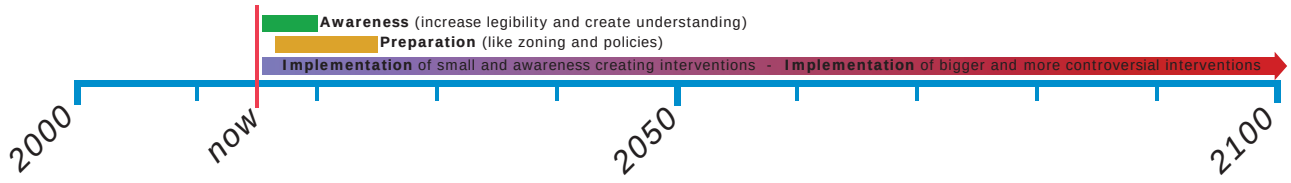


Figure 6.3 | *Embedding the interventions in the landscape should be based on a process approach.*

6.3 Further research

To complete the research on how the landscape and community could be integrated when dealing with water management adaptations, some additions could be made:

First of all the values need to be verified by further research. Some values overlap with others, and it is possible that a value is missing. The step to summarize the values to two main values, the legibility of the existing and the legibility of the new, make the core idea of the values more clear but neglect the others, like the accessibility and facilities value. It would be interesting to make clear which impact each value has on the relation between the people and the landscape.

We concluded that the community should be taken central in regional landscape designs. However, the discipline of landscape architecture already takes the genius loci, the spirit of the place, central, in which also the community plays a major role. Research is needed to point out the differences, and with this the advantages, between the community-based method as determined in this thesis and the classical landscape architecture, which especially focusses on the triplex layer model including the biotic, abiotic and occupation layers of the landscape.

A major gap in this thesis is the fact that it is stated that the community should be taken as basis while the community itself is not involved within the research process. It is advisable that when further steps in the research are taken, or that elements in this thesis are actually implemented, local people should be involved from the first moment. This involvement can make clear to what extent the people are aware of the need for interventions in case of fast climate change, but also to what extent people embrace interventions in the landscape and what the effect is of interventions that have the goal to increase awareness for the dynamic situation.

Finally, the proposed strategy is highly based on the situation of the Zwarte Water region. To verify the method as a legitimate tool to prepare regions for water system adaptation it should be applied to other regions, for example on other rivers, on the small stream valleys of the higher sand soils, and on the coastal zones. Possibly these could result in interesting design proposals as well.

7

Appendices

7.1 Bibliography

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7.2 Figures

Composed illustratations by the author are not mentioned in the following list. Satellite images used in illustrations originate from maps.bing.com. Reference details of documents could be found in the Bibliography.

Preface

Photo	Author's photo collection

Chapter 1

Cover	Author's photo collection
1.1.1	In: Delta Commissie 2008
1.1.2	In: Inspectie V&W 2011
1.1.3	In: Delta Commissie 2008
1.2.1	In: Verbeek 2011
1.2.2	http://vorige.nrc.nl/multimedia/dynamic/00246/eng-polder_246991a.jpg
1.2.3	http://www.rtvoost.nl/nieuws/default.aspxid=172460#prettyPhoto[pp172460]/0/
1.3.1	In: Papenborg & Togt 2012
1.3.2	In: Duchhart 2007
1.3.3	http://www.hnsland.nl/index.php?option=com_content&view=article&id=140:projects&catid=28:projects&Itemid=62&lang=
1.3.4	http://stadsarchief.amsterdam.nl/presentaties/amsterdamse_schatten/plannen/rij_en_wandelpark/index.html
1.3.5	http://www.efl-stichting.nl/pub_vaneesteren_4_10.php
1.3.6	Author's photo collection
1.3.7	Based on: Koh 2010
1.3.8	In: Gobster et al. 2007
1.4.2	Maps.bing.com
1.4.3	Author's photo collection
1.4.4	Author's photo collection
1.4.5	Author's photo collection
1.4.6	Author's photo collection
1.4.7	Author's photo collection
1.4.8	Maps.bing.com
1.4.9	In: Deltacommissaris 2012
1.4.10	In: Deltacommissaris 2012
1.4.11	In: Deltacommissaris 2012
1.4.12	In: Deltacommissaris 2012
1.4.13	In: Strootman 2013
1.4.14	In: Inspectie V&W 2011
1.4.16	http://www.xbloc.com/about-xbloc/consultant-services/item517
1.4.17	Author's photo collection
1.4.18	Partly based on: http://www.pbl.nl/nieuws/nieuwsberichten/2013/hoe-beschermen-we-ons-land-tegen-het-water & www.anh.nl/viewer

Chapter 2

Cover	Author's photo collection
2.1	In: Pedroli et al. 2011
2.2	Based on: Pedroli et al. 2011
2.3	http://www.knooperven.nl/actueel/nieuws/bekijk-het-ontwerp-van-de-veldboer/
2.4	Author's photo collection
2.5	http://www.projectenbankcultuurhistorie.nl/projecten/landschapsvisie-drentsche-aa
2.6	Author's photo collection
2.7	Author's photo collection
2.8	http://nl.wikipedia.org/wiki/Station_Dronten
2.9	http://straatkaart.nl/3071JV-Stieltjesstraat/media_fotos/erasmusbrug-nacht-7Ik/
2.10	http://static.panoramio.com/photos/original/1426348.jpg
2.11	Author's photo collection

Chapter 3

Cover	Author's photo collection
3.2 New Polders	Author's photo collection
3.2 Industrial Zones	Author's photo collection
3.2 New nature	Author's photo collection
3.2 The river	Author's photo collection
3.2 Nature areas	Author's photo collection
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3.3.1	Author's photo collection
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3.3.9	www.anh.nl/viewer
3.3.13	Author's photo collection
3.3.16	Author's photo collection
3.3.17	http://www.xbloc.com/upload/images/sidebar/Storm_Surge_Barrier_Ramspol_Inflatable_Dam_Ramspol_The_Netherlands.JPG
3.3.20	Author's photo collection
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3.3.30	Based on: Watwaswaar.nl
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3.4.3	http://www.rijkswaterstaat.nl/actueel/nieuws_en_persberichten/2013/oktober2013/historisch_schip_gevonden_in_het_zwarte_water.aspx
3.4.4	http://historiek.net/geschiedeniswinkel/wp-content/uploads/2014/07/Hasselt-De-stadt-Hasselt-van-over-het-water-te-Zien-Isaak-Tirion-1790.jpg
3.4.5	Author's photo collection
3.4.6	http://www.henkvanheerde.nl/schokland/images/overstromingen-feb1825.jpg
3.4.7	http://www.genealogie-kaempff.nl/images/Wateroverlast-3-klein.jpg
3.4.8	Based on: watwaswaar.nl & Bazelmans et al. 2011.
3.5 Map	Based on: http://www.anwbwatersport.nl/jachthavens/zoek-jachthavens-op-kaart.html & http://wandelnet.nl/wandelroute planner
3.5.1	http://home.online.nl/m.langeler/ZwarteWater_00179290.jpg
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3.5.9	http://upload.wikimedia.org/wikipedia/commons/7/74/Zwarte-Water,_Genemuiden,_veerpont.JPG
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3.5.11	http://www.destentor.nl/polopoly_fs/1.2676616.1350819080!/image/image.jpg_gen/derivatives/landscape_800_600/image-2676616.jpg
3.5.12	http://img.rtvoost.nl/T3/28099.jpg
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3.6 Shipping a	http://www.kustvaartforum.com/viewtopic.php?f=13&t=1802&start=120
3.6 Shipping b	http://www.hmo.nl/uw_files/voorst5_29.jpg
3.6 Carpet Industry a	Author's photo collection
3.6 Carpet Industry b	http://www.verhoektapijt-genemuiden.nl/tapijt
3.6 Farming	http://www.zwartewaterland.nl/plaat.php?fileid=1119&f=f349537ce817a4542f58b4adbcc81b65b8570be3016b14b2f6b895f6d08be318e4f6c63d971b667cc2de9726777a3a5ae1a2818edbfdeb9959167df9c010be6d
3.6 Recreation	http://www.nederlandfietsland.nl/knooppuntroutes/zwartewaterroute
3.6 Zwartsluis	http://media.nu.nl/m/m1cziqvaldi6.jpg
3.6 Genemuiden	http://www.toeristeninformatie.nl/user/loc/83cd2a94a6.jpg
3.6 Hasselt	Author's photo collection
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3.6 Community map	Partly based on Wikipedia (2014)
3.6 Fritillary	http://www.vogeldagboek.nl/node/1025
3.6 Fritillary map	Natuur en Mileu (2009) 'Natura 2000 ontwerpbeheerplan Uiterwaarden Zwarte Water en Vecht', Zwolle: Provincie Overijssel
3.6 Fritillary soil map	Data: Geodesk Alterra
3.6 Ecology map	http://gisopenbaar.overijssel.nl/viewer/app/atlasvanoverijssel_basis/v1
3.6 Otter	http://asjfk.wordpress.com/2011/10/12/het-gaat-goed-met-de-otters-in-de-alde-feanen/
3.7 The Lichtmis	Author's photo collection
3.7 Ramspol dam	http://www.xbloc.com/upload/images/sidebar/Storm_Surge_Barrier_Ramspol_Inflatable_Dam_Ramspol_The_Netherlands.JPG
3.7 View on Hasselt	Author's photo collection
3.7 Zwolle skyline	Author's photo collection
3.8 Dike near Hasselt	Author's photo collection
3.8 Mastenbroek	Author's photo collection
3.8 The Wieden	Author's photo collection
3.8 Sandy landscape	Author's photo collection
3.8 Dike near Zwolle	Author's photo collection
3.9 Map	Based on: http://geoplaza.vu.nl/gpzviewer/gpzViewer.php?cdm_id=243

Chapter 4

Cover	Author's photo collection

Chapter 5

Cover	Author's photo collection

Chapter 6

Cover	Author's photo collection

Chapter 7

Cover	Author's photo collection

7.3 Water system interventions

7.3.1 The total list of possible interventions

This list takes the spatial water system interventions as mentioned by MHV (2012) and Bruin (2014).

Water storage in soil

Water storage by lowering water level

Seepage walls

Drainage

Wadis

Soft surfaces

Green roofs

Green spaces

Water storage zones

Upstream water retention

Deepening of open water

Seasonal water storage

Lowering floodplains

Lengthening discharge routes

Water park

Water square

Storage in sewage

Blue roofs

Bassin storage

Open draining by streets

Cleaning and broadening of small canals and streams

Highrise buildings (clustering)

Waterproof building

Building above water (like on poles)

Water reclamation by filling

Artificial islands

Steered urbanisation

New river or channel

Local lowering of ground level for storage

High water channel

Mounds

Ground level heightening

Movable buildings

Floating buildings

Temporal dams

Dike heightening

Dam

Dike

Dike relocation

Building as dike

Dike broadening/overtopping proof

Super dike

Small inland dikes

Wall dike

Natural dike

Waterproof infrastructure and utility

Higher evacuation routes

Emergency water channel or overflow

Abandoning

Secondary dikes for compartmentalisation

Pumping and sluices capacity increase

7.3.2 The water system interventions ordered

Ordered into the four water management strategies by Remmelzwaal (2000). In italic the overlapping interventions.

Resistance

Seepage walls

Waterproof building

Water reclamation by filling

Temporal dams

Dike heightening

Dam

Dike

Building as dike

Super dike

Wall dike

Pumping and sluices capacity increase

Buffering

Water storage in soil

Water storage by lowering water level

Wadis

Soft surfaces

Green roofs

Green spaces

Water storage zones

Upstream water retention

Deepening of open water

Seasonal water storag

Lowering floodplains

Lengthening discharge routes

Water park

Water square

Storage in sewage

Blue roofs

Bassin storage

Cleaning and broadening of small canals and streams

Open draining by streets

Drainage

New river or channel

Local lowering of ground level for storage

High water channel

Temporal dams

Dike heightening

Dike relocation

Small inland dikes

Emergency water channel or overflow

Secondary dikes for compartmentalisation

Resilience

Waterproof building

Steered urbanisation

Movable buildings

Floating buildings

Temporal dams

Dike relocation

Dike broadening/overtopping proof

Natural dike

Higher evacuation routes

Emergency water channel or overflow

Abandoning

Isolation

Seepage walls

Highrise buildings (clustering)

Waterproof building

Building above water (like on poles)

Steered urbanisation

Mounds

Ground level heightening

Floating buildings

Temporal dams

Dike heightening

Dam

Dike

Building as dike

Super dike

Small inland dikes

Wall dike

Natural dike

Waterproof infrastructure and utility

Secondary dikes for compartmentalisation

7.3.3 Reordered water sytem interventions

Defining themes to prevent overlapping of water intervention possibilities.

Resistance

Seepage walls

Dike heightening

Dam

Dike

Building as dike

Super dike

Wall dike

Pumping and sluices capacity increase

Buffering

Water storage in soil

Water storage by lowering water level

Wadis

Soft surfaces

Green roofs

Green spaces

Water storage zones

Upstream water retention

Deepening of open water

Seasonal water storage

Lowering floodplains

Lengthening discharge routes

Water park

Water square

Storage in sewage

Blue roofs

Bassin storage

Cleaning and broadening of small canals and streams

Open draining by streets

Drainage

New river or channel

Local lowering of ground level for storage

High water channel

Dike relocation

Resilience

Ground level heightening

Abandoning

Natural dike

Water reclamation by filling

Isolation

Highrise buildings (clustering)

Waterproof building

Building above water (like on poles)

Steered urbanisation

Mounds

Floating buildings

Temporal dams

Small inland dikes

Waterproof infrastructure and utility

Secondary dikes for compartmentalisation

Dike broadening/overtopping proof

Higher evacuation routes

Emergency water channel or overflow

Movable buildings

7.3.4 Summarized list of water system interventions

Generalized the items on the list.

Resistance

Seepage walls

Dike heightening

Pumping and sluices capacity increase

Buffering

Storage by soft surfaces and buildings

Flexible local water level

Water storage zones

Upstream water retention

Deepening of summer and winter bed

Lengthening discharge routes

Side channels and bypasses

Dike relocation

Local lowering of ground level for storage

System resilience

Sedimentation processes

Abandoning

Disaster resilience

Clustering and steering of urbanisation

Waterproof building

Building above water

Mounds

Floating buildings

Compartmentalisation

Dike broadening/overtopping proof

Higher evacuation routes

Temporal dams

Emergency water channel or overflow

Movable buildings

7.4 Glossary

Buffering
One of the determined water management strategies: Topping off peaks of extreme water levels

Community / People
In this thesis referring to all the inhabitants that live in a certain landscape, with their individual or common relation with the landscape.

Delta
River mouth area, in which the sea has less influence on due to a relatively high river discharge, in combination with sedimentation by the river on the coast, like the IJssel river. Also a common name for river mouths, including estuary mouths, like the IJssel- and Vecht delta region.

Disaster resilience
One of the determined water management strategies: Introducing interventions to reduce social-economic damage in case of a flooding disaster. **Estuary**
River mouth area, in which the sea has a major influence on due to a relatively low river discharge, resulting in case of the Zwarte Water river a wide profile in the first part of the river, and the presence of creeks.

Interventions
The individual transformation of a landscape by adding or removing landscape elements.

Landscape approach
An adaptive, poetic, context based, participatory, integrative and process based approach to implement landscape design.

Landscape architecture
The discipline that combines science and art to create integral solutions for challenges in the physical landscape.

Landscape identity
“landscape identity is the unique psycho-sociological perception of a place defined in a spatial–cultural space” (Pedroli et al. 2011), in this thesis especially is focused on the mutual relation between landscape and their inhabitants.

Landscape values
From the landscape identity theory 9 values have been determined in which the people and landscape affect each other.

Legibility
Whether people recognize how the landscape is structured.

Mound
Man-made hills, to keep houses dry in case of flooding. Many mounds can be found in clay landscapes in the low parts of the Netherlands, mostly originated from the period in which dikes were not in use yet.

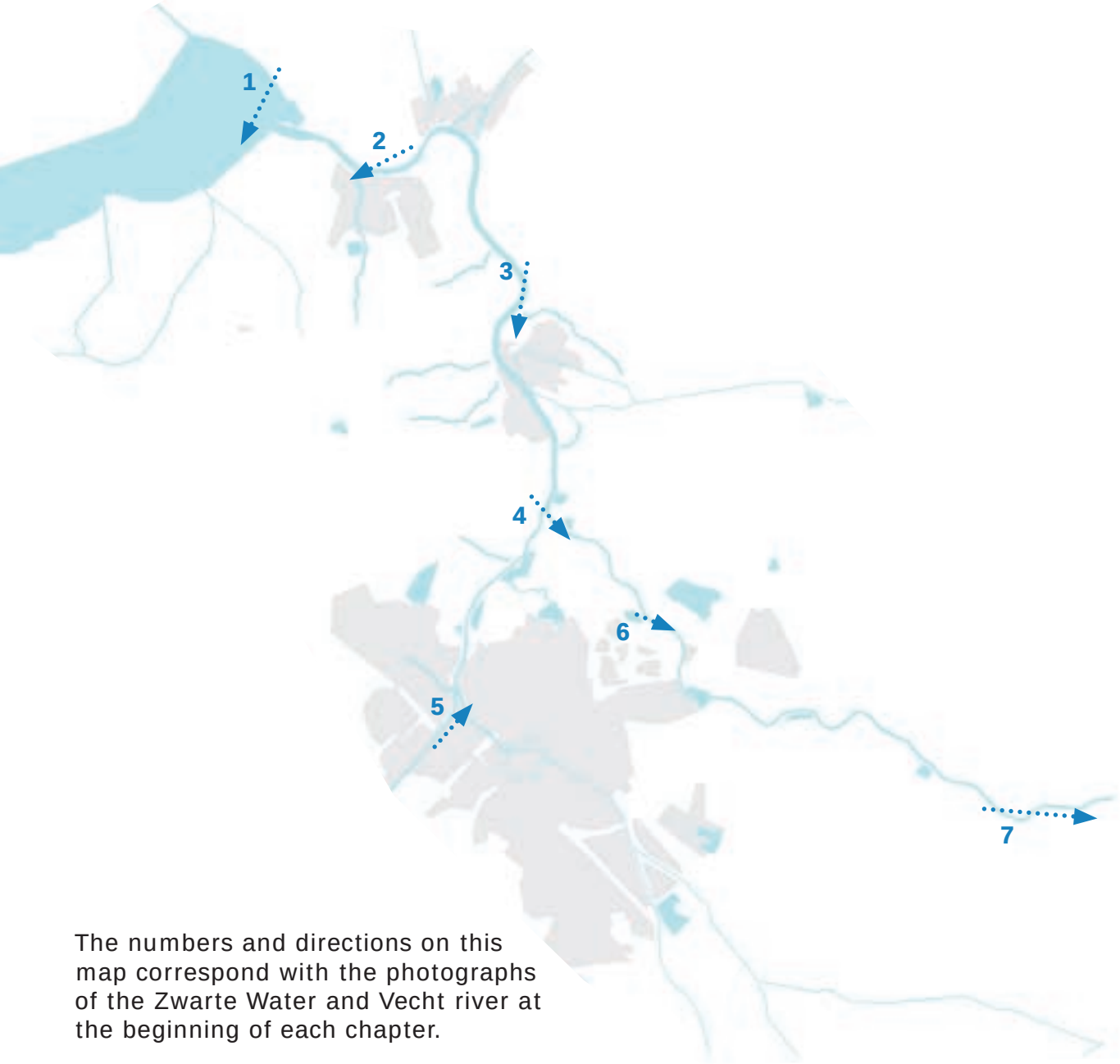
Resistance
One of the determined water management strategies: Controlling the water system by steering natural processes.

River basin
The whole area that drains its water towards one river. In case of the Zwarte Water river and Zwarte Meer it contains most of the province of Overijssel, half of Drenthe and also a part in Germany.

System resilience
One of the determined water management strategies: Regenerating a natural system by reintroducing dynamics.

Water management strategies
In this thesis 4 strategies have been determined that could be used to adapt water systems.

Water system
The presence or movement of water in a certain landscape, whether this is regulated by people and is dynamic.



The numbers and directions on this map correspond with the photographs of the Zwarte Water and Vecht river at the beginning of each chapter.

A PEOPLE'S WATER LANDSCAPE
A community based regional landscape design approach for a changing water system

Master Thesis Landscape Architecture - Wageningen University and Research Centre - 2015

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