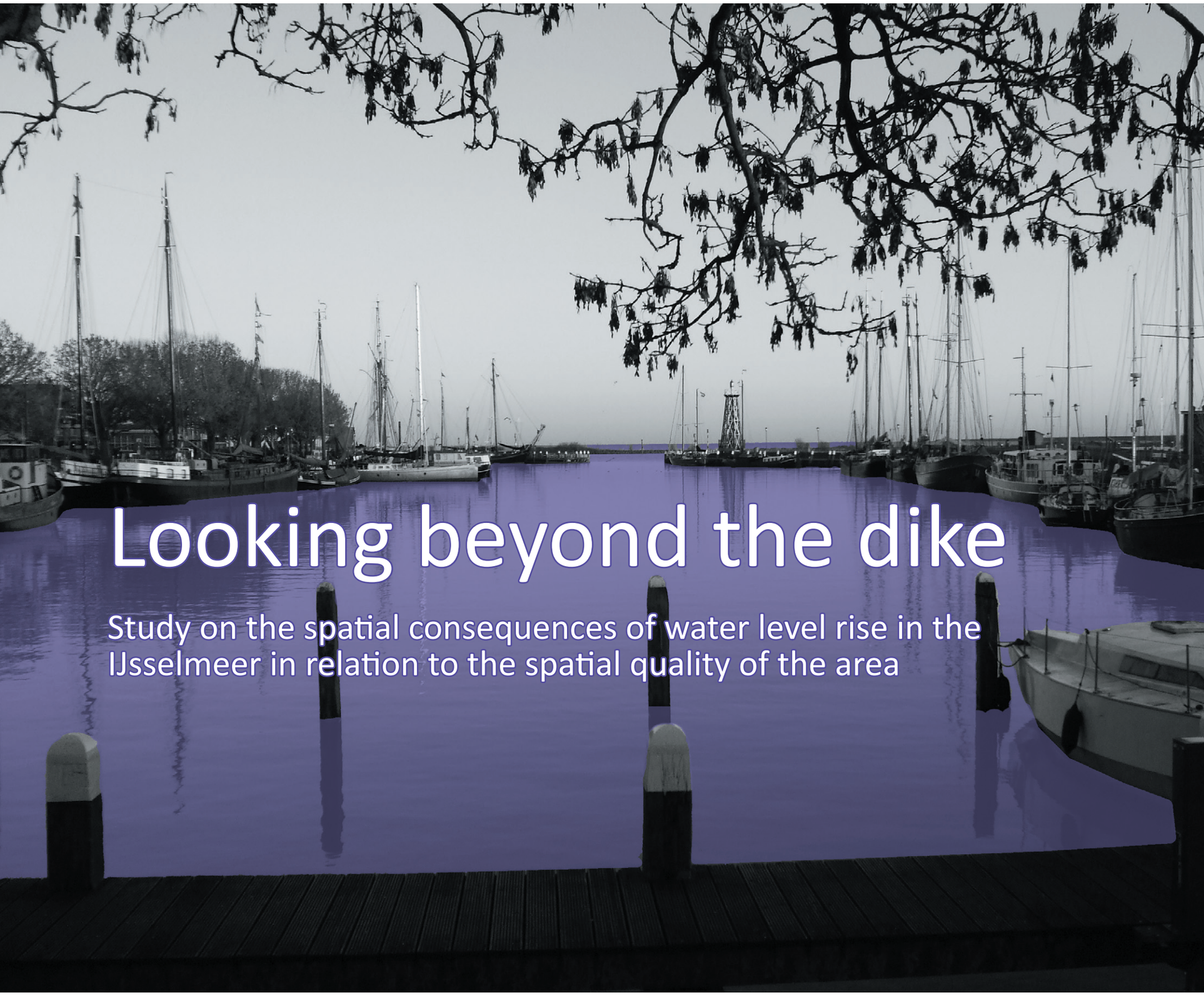

Looking beyond the dike

Study on the spatial consequences of water level rise in the IJsselmeer in relation to the spatial quality of the area

Master Thesis Landscape Architecture
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Wageningen, September 2011
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Study on the spatial consequences of water level rise in the IJsselmeer in relation to the spatial quality of the area

Thesis Report
Master of Landscape Architecture and Planning
Specialisation Landscape Architecture

LAR 80436

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Preface

After nine months of work the report of my thesis is finally finished. This does also mean that six years of studying landscape architecture in Wageningen will soon come to an end. My years in Wageningen helped me to develop myself as a person and as a landscape architect. I want to thank everybody who helped me with that process, both friends, study mates and teachers.

In the past months that I worked on my thesis I got to know a new part of the Netherlands. The 'Kop van Noord-Holland' was not a part of the country that I was familiar with. Now that I almost finished my thesis I can add this part of the country to the list of parts I know quite well. During my research I realized that there are so many beautiful sites and landscapes in the Netherlands and in the world. I am happy to be able to say that I know quite a lot of those places. This has been one of the advantages of studying landscape architecture.

The time working on my thesis have been months of hard work. However, it were also months of good discussions, interesting discoveries and funny moments. I would like to thank my supervisor Ingrid Duchhart for helping to find out what I wanted with this thesis subject. She guided me through the process in a way it really became my own thesis, and she helped to develop the ideas that were wandering around in my mind. I also want to thank my external tutor, Maaike Bos of Deltares, for her very down to earth look at my work, which helped me to focus on the important parts of it.

Last but not least I want to thank all people who supported me during these past months, my parents, friends, study mates at Gaia and house mates. Without them it would have been much harder to write this thesis, and maybe even impossible. Thank you all!

Samenvatting

In 2008 heeft de Tweede Delta Commissie (Commissie Veerman) voorgesteld het water niveau in het IJsselmeer met 1.5 m te laten stijgen voor 2100. Dit is nodig om een tekort aan zoet water in Nederland in de toekomst te voorkomen. Een tweede reden om het water te laten stijgen is dat dit er voor zal zorgen dat het ook in de toekomst mogelijk blijft om vanuit het IJsselmeer onder vrij verval te spuien op de Waddenzee. Met het Nationaal Water Plan is het voorstel van de Delta Commissie omgezet in actueel beleid.

Het IJsselmeer heeft al veel veranderingen ondergaan in de afgelopen eeuw. Het zoet water meer bestond een eeuw geleden nog niet, het was een zoute binnenzee (Zuiderzee), met een open connectie naar de Noordzee. Het meer is nu afgesloten van de open zee en grote delen van het meer zijn ingepolderd. Het gebied heeft nu grote waarde voor commerciële en recreatie scheepvaart, en ook de randen van het meer worden intensief gebruikt. De natuurwaarden van het meer zijn belangrijk, ook al is er nog steeds geen evenwicht sinds de afsluiting. Met de waterstijging zal de natuur opnieuw verstoord worden, maar ook het gebruik van het gebied zal veranderen. De dijken moeten versterkt en verhoogd worden, en de havens en steden moet worden beschermd door sluizen.

De waterstijging, en de maatregelen die hiermee samen hangen, hebben ook invloed op de ruimtelijke kwaliteit van het gebied. Ruimtelijke kwaliteit is de (positieve) waarde van een landschap, die door veel mensen aan een landschap wordt toegekend. Wanneer wordt gezegd dat een landschap ruimtelijke kwaliteit heeft, dan betekent dit dat het landschap waardevol is. Ruimtelijke kwaliteit kan worden toegekend aan landschappen of plaatsen van iedere schaal, en wordt beïnvloed door het moment en de samenleving, en door wat bekend en nieuw is. Om ruimtelijke kwaliteit toe te kunnen kennen aan een plek, deze plek moet toegankelijk en bruikbaar zijn, zodat de plek te beleven is. Beleving heeft te maken met open staan voor de belevenis, de belevenis structuren en een mening vormen over de belevenis. Deze mening kan leiden tot het toekennen van ruimtelijke kwaliteit aan een plek.

De ruimtelijke kwaliteit van de dijken rond het IJsselmeer zal veranderen, omdat alle dijken versterkt moeten worden. Dijken worden vaak genoemd als elementen met veel ruimtelijke kwaliteit, mede door hun historische karakter, en door hun hogere ligging in het landschap. Dijken bieden een goede mogelijkheid om het landschap te beleven, en verbinden verschillende landschapselementen. Het studiegebied is het gebied tussen Enkhuizen en Medemblik, onderdeel van West-Friesland, een oude kust van de Zuiderzee. De dijk is onderdeel van de West-Friese Omringdijk. Het gebied, en met name het gebied aan de dijk, is dicht bebouwd, maar er zijn ook enkele grote open gebieden. De ruimtelijke kwaliteit van het gebied is gebaseerd op de grote open gebieden en de historische elementen langs de dijk. Ook het water van het IJsselmeer speelt een belangrijke rol voor de ruimtelijke kwaliteit.

Veranderingen aan de dijk zullen te maken hebben met de dijkversterkingen die nodig zijn in verband met de waterstijging. De versterkingen kunnen plaats vinden op en rond de dijk, maar het is ook mogelijk om een brede beschermingszone te creëren, aan de binnen- of buitenzijde van de dijk. Dit betekent mogelijk dat de dijk minder hoog hoeft te zijn. Dijkverhoging is een mogelijke oplossing voor de dijk tussen Enkhuizen en Medemblik, maar op sommige stukken kan dit negatief uitpakken voor de ruimtelijke kwaliteit. Op andere stukken is verhoging wel een goede oplossing.

Voor de gebieden waar dijkverhoging geen goede oplossing is zijn er andere mogelijkheden. Golfslag kan gereduceerd worden door de aanleg van vooroevers en luwtedammen, wat betekent dat de dijk minder hoog hoeft te zijn. De oevers en dammen vergroten de ruimtelijke kwaliteit, omdat de variatie en de gebruiksmogelijkheden vergroot worden. Deze oplossing heeft ook een positief effect voor de natuur. Een andere optie is de bouw van dammen op enige afstand van de dijk, zodat aparte meren ontstaan waarin het waterniveau lager is dan het toekomstige waterniveau in het IJsselmeer. De nieuwe meren zullen veel nieuwe gebruiksmogelijkheden bieden zodat de ruimtelijke kwaliteit wordt vergroot.

Beide eindontwerpen voor het gebied bieden mogelijkheden om de ruimtelijke kwaliteit niet alleen te behouden, maar ook te vergroten. Er zal echter wel verschil zijn tussen de ruimtelijke kwaliteit van de beide ontwerpen. Het is niet mogelijk om een keuze te maken tussen de ontwerpen alleen op basis van ruimtelijke kwaliteit. Ruimtelijke kwaliteit zou een rol moet spelen in elk ontwerp en op elke schaal.

Summary

In 2008 the Second Delta Committee proposed to rise the water level of the lake IJsselmeer (in the north-western part of the Netherlands) with 1.5 m before 2100. This should be done to prevent the country from shortage in fresh water in the future. Another reason to rise the water level of the lake is to make sure it will be possible to be able to discharge on the Waddenzee under free flow, also in the future. With the 'Nationaal Water Plan' the proposal of the Second Delta Committee are turned into policy.

The IJsselmeer has been a lake that already faced many changes in the past century. A century ago the fresh water lake did not exist, it was a salt water sea, with a different name (Zuiderzee). The connection with the open sea has been closed and many parts of the lake have been turned into land. The area is now an important area for commercial and recreational shipping, and also the edges of the lake are heavily used. The lake has many nature values, although there is still no balance after the closure of the sea. The nature will be disturbed again if the water level rises, but also the use of the area will change. The dikes around the lake have to be reinforced, and harbours and cities have to be protected with locks.

The water level rise, and the changes that are related to water level rise, do not only influence the use and the nature value of the area. The spatial quality of the area will also be influenced. Spatial quality is the (positive) value of a landscape, which is assigned to that landscape by many people. If is said that a landscape has spatial quality, the landscape is valuable. Spatial quality can be assigned to landscapes and places of every scale, and is influenced by the moment and the society, and by both what is known, and what is surprising. To be able to assign spatial quality to an area the area has to be usable or accessible, so the area can be experienced. Experience (or perception) has to do with being open or able to experience, structure the experience and adding a meaning to it. This meaning can result in assigning spatial quality.

While all the dikes of the IJsselmeer have to be reinforced, the spatial quality of these dikes will change. Dikes are often mentioned as elements with a lot of spatial quality, mainly because their historical grown character, and while they are elevated above the landscape. Dikes offer an excellent possibility to experience the landscape, and connect several small and large scale landscape elements. The study area is the area between the cities Enkhuizen and Medemblik, which is part of West-Friesland. This is an old coast of the Zuiderzee. The dike in the area is part of the West-Friese Omringdijk. The area is heavily built, especially along the dike, but there are also some large open areas. The spatial quality of the area is based on these large open areas, and the historic elements that can be found along the dike. Also the water of the IJsselmeer plays an important role for the spatial quality.

Changes to the dike will be related to the dike reinforcements that will be necessary, while the flood risk will increase because of the water level rise. The reinforcements can take place on the actual dike, yet it is also possible to enlarge the safety by creating a flood protection zone, either on the inner or outer side of the dike. This means that the dike possibly has to be less high. Heightening the dike is a possible solution for the dike between Medemblik and Enkhuizen, but on some stretches this does have a negative effect on the spatial quality of the area. On other stretches dike heightening turned out to be a good solution.

For those areas where dike heightening is not the best solution there are other possibilities to increase the safety. Waves can be reduced by the creation of foreshores and shelter dams, which means that the dike can be less high. The shores and dams increase the spatial quality, while the variation and usability in the area will be increased. This will also have a positive effect on the nature value in the area. An other option is the building of dams on a distance from the dike, so that new lakes evolve with a water level which is less high compared with the future water level of the IJsselmeer. The new lakes offer more possibilities for use, so that the spatial quality increases.

Both final solutions for the area offer possibilities to not only maintain the spatial quality, but also to enlarge the spatial quality. There will be a difference between the spatial quality of both solutions. Spatial quality however is not the basis on which a choice can be made. Spatial quality should be incorporated in every design and on every scale level.

Table of content


1

Introduction

1.1 Occasion for research

1.1.1 The First Delta Committee and the Delta Act

In February 1953, a storm surge broke through the dikes in the provinces Zeeland, Zuid-Holland and Brabant and inundated the southwest of the Netherlands with metres of water. Property destruction was devastating and over 1800 people were killed. The central government set up a committee, the (first) Delta Committee, to chart a course of action to prevent future disasters (Kabat et. al., 2009). The so called Delta Act was implemented, that stipulated flood safety levels and the means to reach these levels (Olsthoorn et. al., 2008). In addition, the implementation of the recommendations radically altered the appearance of the south-western Netherlands and secured its long-term safety (Deltacommissie, 2008). The safety standards set by the first Delta Committee in the 1960's, with per region a maximum acceptable flood return period, are still current.

Nowadays, flood protection in the Netherlands is regulated under the Flood Defences Act (Wet op de Waterkering), which was implemented in 1996 after a series of floods and near-floods along the rivers, such as in 1993 and 1995 (Olsthoorn et. al., 2008). The project 'Ruimte voor de Rivier' (Room for the River) is one of the projects that practically is working on preventing the river areas from flooding, by giving the river more space. In the 'Room for the River' project the idea that only the reinforcement of dikes is not enough first came up. The 1996 Flood Defences Act also stipulates decadal evaluation of the safety standards, like set by the first Delta Committee (Olsthoorn et. al., 2008).

All actions in flood risk management policy have been and still are strongly related to flood events that occur. Before action is taken a policy window, or window of opportunity, needs to be opened (Goverde, 2008). Flood events make that all actors are aware of the necessity of flood protection measures (Olsthoorn et. al., 2008) (see figure 1.1). The events function as a symbolization of the problem, and actions need to be taken immediately, as policy windows close quickly. The 'Room for the River' project is a great example (Goverde, 2008). The ideas were already there among scientists, but it took until the flood event in 1995 before it was set as general policy in the Netherlands. In general can be said that ideas, in order to be taken seriously, have to meet three criteria. These are: technical feasibility, fit to the national political mood and fit to dominant values within society (Kingdon in: Olsthoorn et. al., 2008). A well-developed communication strategy is essential to convince people of the usefulness and necessity to adopt a new policy strategy against climate change, sea level rise, land subsidence and flooding (Brouwer et. al., 2004).

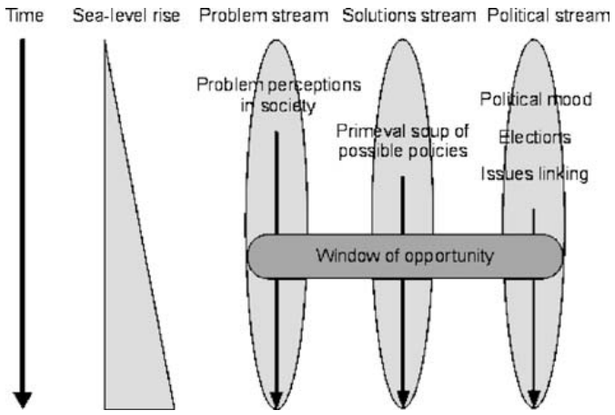


Figure 1.1: model to describe societal response to sea level rise (Olsthoorn et. al., 2008)

1.1.2 The Second Delta Committee

But the climate is changing, and new measures should be taken. A new Delta committee has been established in 2007 by the Dutch government, the so called Second Delta Committee. This committee is also known as the Commissie Veerman, named after the chairman Cees Veerman. The difference with the first Delta committee is that a disaster did not happen (yet). The committee was asked to evaluate the potential effects of climate change in the Netherlands and to propose measure to 'climate proof' the country: to keep it safe from flooding, while preserving its status as an attractive place to invest in, work and live (Werners et.al., 2009). We have to prepare ourselves for the consequences of the climate change, the threat is not acute, but nevertheless it is urgent. The Delta Committee has been asked to give an advice on how to prepare the Netherlands for climate change for the long term (2100-2200). In September 2008 the Second Delta Committee came up with a report called 'Samen werken met water' (Working together with water).

In the report a list of twelve recommendations for the future is presented. Recommendation number eleven is about the IJsselmeer area:

The level of the IJsselmeer lake will be raised by a maximum of 1.5 meter. This will allow free discharge from the lake into the Wadden Sea beyond 2100. The level of the Markermeer lake will not be raised. The IJsselmeer lake retains its strategic function as a fresh water reservoir for the Northern Netherlands, North Holland and, in view of the progressive salt water intrusion in the Nieuwe Waterweg, for the Western Netherlands.

(Deltacommissie, 2008)

The plans for the IJsselmeer will be further explained in chapter 2. Another recommendation that influences the IJsselmeer area is about the safety standards (see chapter 5) of all dikes in the Netherlands. These safety standards should be heightened with a factor 10, which means that the chance of flooding is lowered (Klijn et. al., 2010). In highly occupied areas the safety standards should maybe even been heightened with more than a factor 10.

After the Delta Committee presented its report and its recommendations, the government reacted with the publication of the first 'Nationaal Water Plan' (National Water plan, NWP). The government has decided to take the advices as a starting point for further elaboration. The NWP can be seen as a first start towards the realization of the plans. With the NWP the plans are actually turned into policy, and it replaces all other water policy plans, a new Delta Act and Delta Program are being prepared. The goal is clear: 'The Netherlands, a safe and livable delta, now and in future' (Rijksoverheid, 2008). Compared with the old policy plans, the NWP is more focused on the spatial consequences of the policy. In the NWP is spoken about target images for future Netherlands. With the NWP the government also tries to improve the cooperation between local and regional governments to work together to realize the plans and to make the Netherlands safer.

In the two years after the presentation of the report 'Working together with water' and the 'Nationaal Water Plan' more research has been done on measures that should be taken and the effects these measure will have. The national government appointed Wim Kuijken as the Delta Commissioner in 2010, who should develop the Delta Program. In the Delta Program, the national government, provinces, municipalities, water boards and non-governmental organizations are represented (Deltaprogramma, 2010). For the Delta Program three base values (solidarity, sustainability, flexibility) and three

Figure 1.2: the Delta Programme (Deltacommissie, 2008)

starting points (integral, coherent, transparent) have been defined (Werners et.al., 2009). The Delta Program is working furthermore on the implementation of the plans in the NWP, on the field of safety and fresh water supply. Besides that, the Delta Program can place new developments on the agenda for the next NWP (Rijksoverheid, 2010).

The Delta Program has split its work into 10 sub-programs, 4 of these are generic sub-programs and 6 are regional sub programs, of which the IJsselmeer area is one (Werners et.al., 2009). Reports are and will be presented focusing on these sub-programs. It is a difficult task to think about the development of the IJsselmeer for the coming century. Think back a century: the whole IJsselmeer did not even exist in that time (Projectteam, 2010). The Delta Program intends to do a proposal for the water level ordinance in the IJsselmeer in 2014, both on long and short term. Short term means the water level ordinance until 2035, and both propositions will be presented at the same time so that consistency is guaranteed. The decision about the water level ordinance after 2035 will be made in the second NWP (Deltaprogramma 2011, 2010). In 2015 the cabinet will decide on the degree and phasing of the water level rise in the IJsselmeer, and the following plan periods (Rijksoverheid, 2008).

1.2 Methods

1.2.1 Problem definition

For this study the recommendations of the Delta Committee for the IJsselmeer are taken as a fact and are therefore the starting point for this research. In case of the proposed water level rise of 1.5 meter it can be expected that the present level of protection will not be sufficient. This will be the case both for the lake dike as well as for the flood protection of the cities (for example quays, sea walls and city dikes). This means that (technical) measures need to be taken in order to prevent the area from flooding. These measures will have effect on the landscape, its spatial quality and the way the landscape is experienced. These effects can be negative, but the measures can also offer possibilities to strengthen the spatial quality and to improve the way the landscape is experienced. While it can be expected that the proposed water level rise will have the most impact on the spatial quality of the old coasts of the Zuiderzee, with old dikes and cities, one of these parts is chosen as study area (see paragraph 1.3).

1.2.2 Purpose statement

The purpose of this qualitative study will be to understand the possible spatial consequences of the proposed water level rise in the IJsselmeer on the western IJsselmeer coast and cities. Using the lens of a landscape architect, the focus will be on the consequences for the spatial quality of the area and the way the area is experienced, both by people living in the area as well as people visiting the area. Next to that, the safety of the area also plays an important role. The goal of this study is not to come up with one complete design for the area, but to do research on which aspects should be taken into account, and which method should be followed, when looking at both safety and spatial quality. The research will make clear what the knowledge of landscape architects can add to a technical design question like a dike reinforcement in the IJsselmeer area.

The result of this explorative research will be an advice on which methods can be followed when looking at this or a comparable project. The designs that will be presented at the end of the research both function as an example of the different possible solutions for the area as well as a check to sharpen the proposed methods, to be able to come up with a final advice.

1.2.3 Research questions

The main research question is:

What are possible spatial solutions to maintain and improve the spatial quality (focussed on landscape experience) along the IJsselmeer border of West-Friesland, while preventing the area from flooding (Dutch: wateroverlast) due to the proposed water level rise in the IJsselmeer?

To be able to answer the main question there are several sub questions that each cover different parts of the research. The answers of the sub questions come together in the last sub question to be able to answer the main research question.

- *What is already known in literature about the **consequences of the water level rise** for the IJsselmeer and for the flood protection around the lake?*
- *What are the **characteristics** of the IJsselmeer, its borders and the old Zuiderzee cities, how did they change over time, and which places and points should be **taken into account** when redesigning the area?*
- *What different **(dike) reinforcement measures** can be taken in order to prevent an area from flooding, especially in populated areas?*
- *What are the **possibilities** of flood protection along the IJsselmeer coast between Medemblik and Enkhuizen when the water level of the IJsselmeer will rise?*
- *What is **spatial quality** and what is the spatial quality of the IJsselmeer border between Enkhuizen en Medemblik?*
- *How are dikes and water **experienced**, and what are the consequences of water level rise and flood protection measures for the (landscape) experience of the area?*
- *Which possible flood protection measures have a **positive effect** on the spatial quality and landscape experience in the area?*

1.2.4 Outline of report

Every chapter in this report will be concluded with a set of design guidelines and conclusions on the method that should be followed and which aspects should be studied in further chapters. In the end the guidelines from all the chapters should lead to one set of guidelines which are checked during the designs, and if necessary adapted to the new gained knowledge.

This report starts with an exploration of the present appearance of the IJsselmeer, and the historic developments that led to this appearance. The plans of the Delta Committee for the IJsselmeer are further studied, including facts and assumptions on the changes that will occur due to the water level rise. Chapter 2

The next chapter is a theoretical part about spatial quality and the role of (landscape) experience. Both terms are studied, and the outcomes are applied to a general description of the spatial quality and experience of dikes, and of lake (IJsselmeer) dikes in particular. Chapter 3

The landscape of the study area is further studied in the next chapter, which includes a landscape analysis of West-Friesland and the IJsselmeer coast between Enkhuizen and Medemblik. The landscape analysis is based on the study on the IJsselmeer, and on the research on spatial quality and experience. Chapter 4

The technical possibilities with respect to flood risk and flood protection are further studied in a technical chapter. This chapter also includes information about flood risk in the IJsselmeer area and the technical appearance of dikes. Several ways to increase the safety are presented. Chapter 5

The guidelines derived from the earlier chapters are used in the next chapter. In this chapter the first design is presented, which is a design that is based on the traditional way of enlarging the safety by heightening dikes. This concept is checked on the usefulness for this area and the consequences for the spatial quality. Chapter 6

Alternative designs are presented in the next chapter. Two design concepts are presented, focussing on the areas that showed up as potential problem areas in the previous design chapter. The result will be two concepts with details which show the broad range of possibilities for the area. The guidelines are used and checked during the designs. Chapter 7

The last chapter is a concluding chapter. The final set of design guidelines is presented, and the usefulness of the guidelines is discussed. There will also be looked back at the usefulness of the guidelines and the designs for the whole IJsselmeer, and how this method can be useful in future for the designs for this lake and other projects. Chapter 8

1.2.5 Research outline

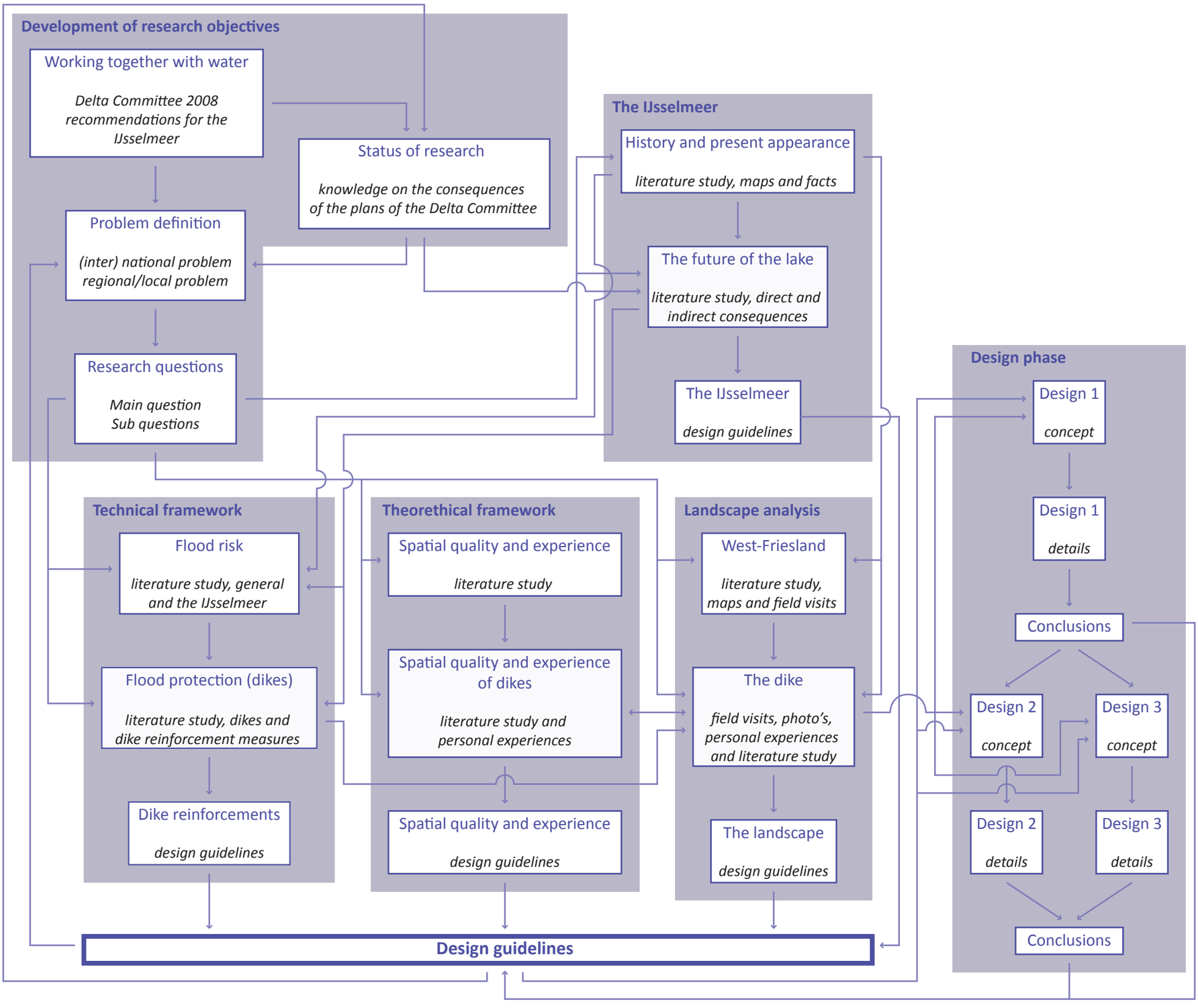
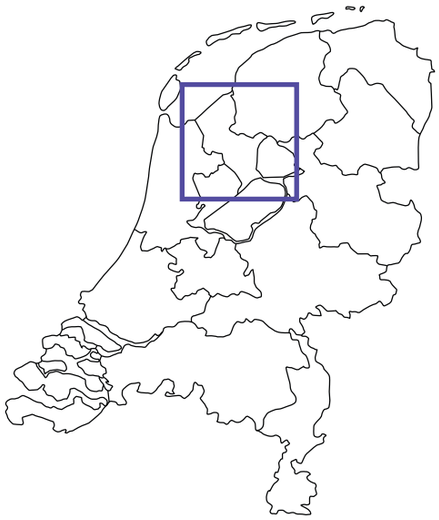


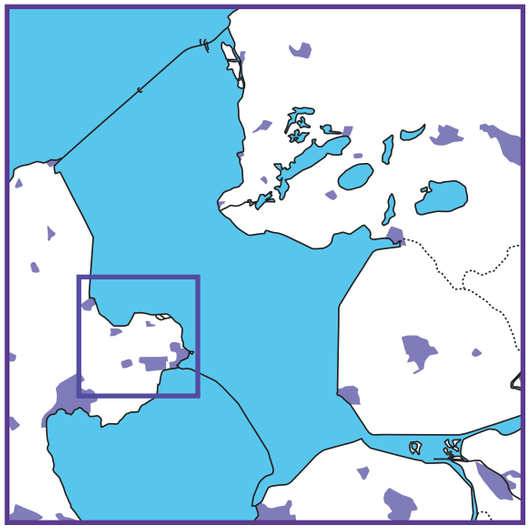
Figure 1.3: research scheme

1.3 Study area

1.3.1 Location

The study area is the IJsselmeer, a fresh water lake in the middle of the Netherlands, north-east of Amsterdam and the other main cities. Within the study area the focus is mainly on the south-western part of the lake and its shore, between the cities Medemblik and Enkhuizen. This part is relatively old and part of the coast of the former Zuiderzee. On the south side the focus area is bounded by the Houtribdijk, a dam which connects Enkhuizen with Lelystad in Flevoland, and which separates the IJsselmeer from the Markermeer. On the north side the focus area is bounded by the Wieringermeer polder, a polder which evolved during the implementation of the Zuiderzee works in the beginning of the 20th century.





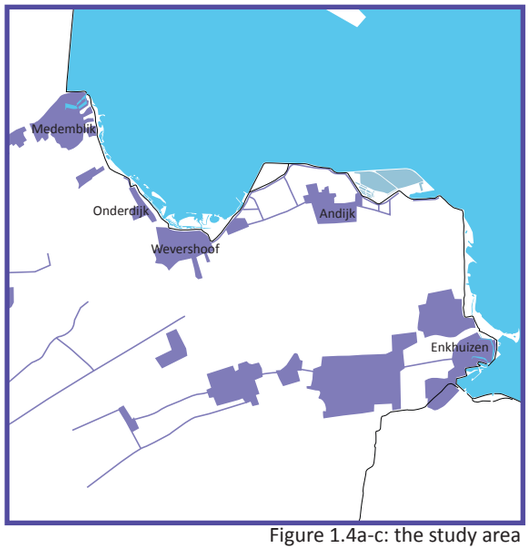


Figure 1.4a-c: the study area

1.3.2 Photo impression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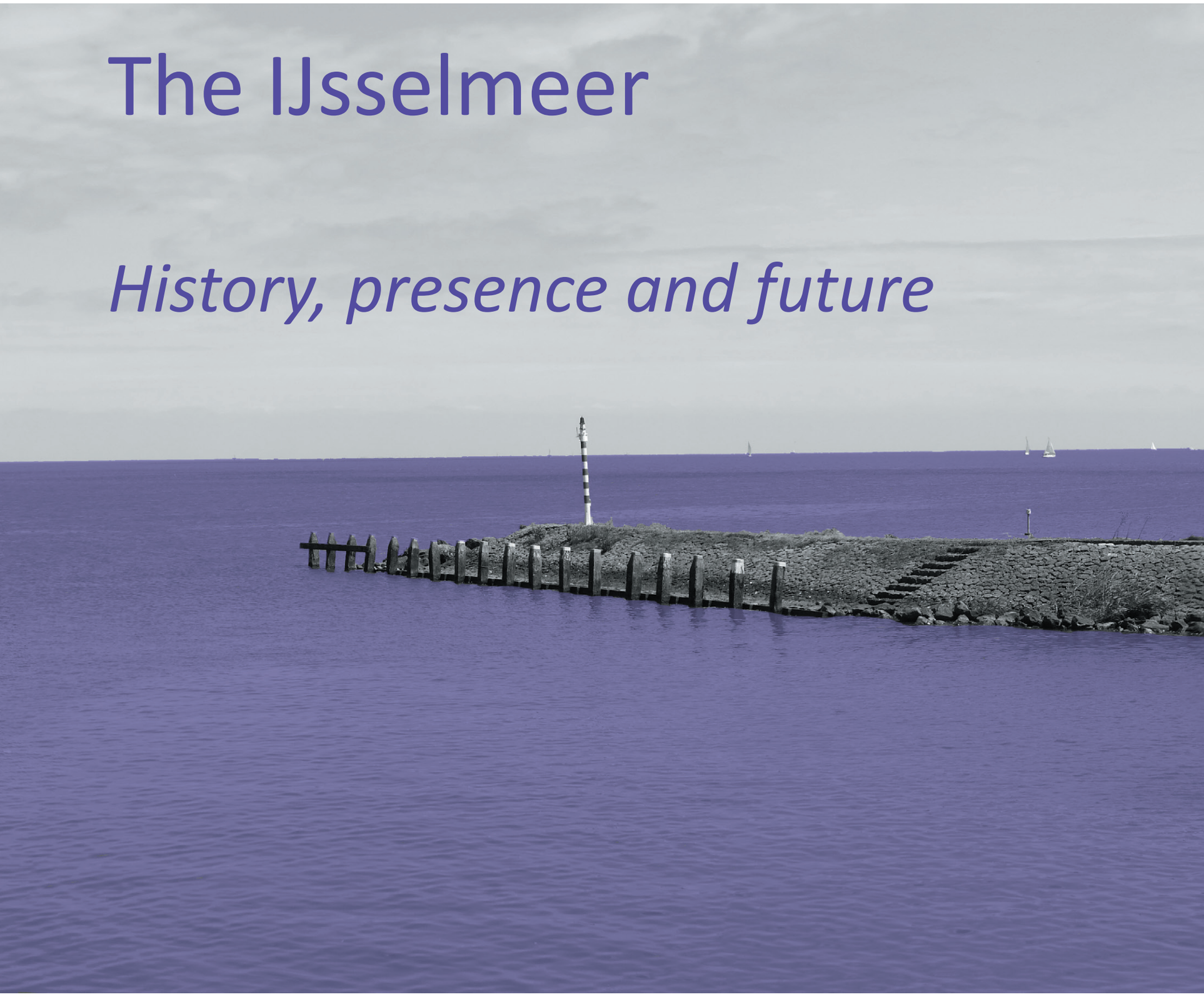
2

The IJsselmeer

History, presence and future



2.1 History of the Zuiderzee

2.1.1 Before the Zuiderzee

It is not easy to say from which date the Zuiderzee originated, due to a very difficult history (Bosscher et. al., 1973). Before the last ice age the area of the IJsselmeer and large parts of Holland and Friesland were part of the Eemzee, but this sea disappeared as the sea level all over the world was getting lower. During ice ages glaciers pushed up soil bodies built up from boulder clay on the north side of the Zuiderzee in the province of Friesland. At the start of the Holocene time the area of the IJsselmeer appeared as a large sandy area, while the sea level was approximately 20 meters below the present level. The area was influenced by several rivers flowing across it, such as the IJssel and the Vecht (Bosscher et. al., 1973).

When the sea level was rising due to better (warmer) weather conditions the North Sea evolved. Along the coast of this sea beach barriers aroused due to sand deposits. Behind these beach barriers large swamp lands evolved where peat could grow. This was also the case in the area of the IJsselmeer. During later times the peat layer was covered by a clay layer due to flooding's. The rivers kept flowing through the area and during the Roman times several lakes evolved from these rivers due to destruction of the peat soil. The Zuiderzee as it was known originated from this complex of lakes. In the Roman times this lake complex was known as Flevo (Lacus) or Flevum (see figure 2.1a). This system of fresh water lakes was fed by rivers and rain water and must have had an open connection with the North Sea through the Vlie, a peat river. This place is now known as channel the Vlieter, but it is not sure whether this is exactly the same location (Bosscher et. al., 1973).

The area was subject to large changes while the coast of the lakes was eroding due to continuous attacks of wind and water. The old Flevo lake system was growing as a result of this land loss, and the Roman name disappeared. The lake was now known as Aelmere or Almere (see figure 2.1b). It is not sure when this name was mentioned in written sources for the first time, but this must have been in the early Middle Ages. The Aelmere still was a fresh water lake but there is no doubt it was connected with the North Sea (Bosscher, et. al. 1973). Due to further land loss, also caused by human activities such as digging into the peat to win salt (Dutch: moernering), the area of the Aelmere was getting bigger, such as the connection with the North Sea. A storm surge in 1170 made a definitive connection between the Aelmere and the North sea through the Marsdiep, south of the island Texel (van der Ham, 2007). This also meant that the fresh water lake changed into a salt water sea (Schaap, 1982).

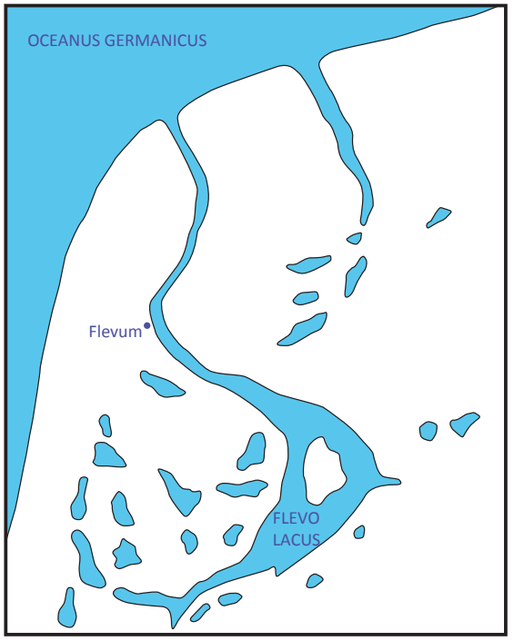


Figure 2.1a: 1st century

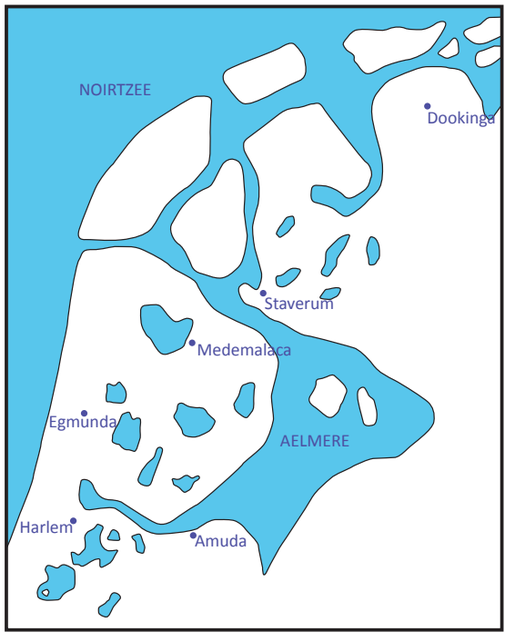


Figure 2.1b: 10th century

Figure 2.1c: 13th century

2.1.2 From Zuiderzee to IJsselmeer

Also the name Aelmere disappeared, and the name Zuiderzee was first mentioned in written form in 1272 (Provincie Flevoland, 2008) (see figure 2.1c). Over the following centuries more land loss took place until the end of the 16th century (see figure 2.1d). By that time the surrounding, low lying peat and clay areas were protected by dikes so the lake could not take much more land. On the north side the higher boulder clay bodies formed an impregnable obstacle for the sea, and they now appeared as higher cliffs in the landscape (Sleeuwenhoek, 2006). In the south eastern part of the Zuiderzee the sand dunes of the Veluwe reached the sea and protected the land. The Zuiderzee was a shallow sea, and the water level fluctuated relatively much under tidal and weather influences. While the sea was so shallow, the water was relatively warm (Sleeuwenhoek, 2006). The Zuiderzee functioned as a nursery for all kinds of young fish (van der Ham, 2007).

In the 17th century the Zuiderzee played an important economic role in the Republiek der Zeven Verenigde Nederlanden (Republic of seven interconnected Netherlands) (Provincie Flevoland, 2008). Trading ships were passing the area from and to Amsterdam and other cities in Holland, while the area itself was important as a fishing area. It was in those days that the Dutch, and especially Hendric Stevin in 1667, started to think of closing and partly drying the Zuiderzee, to protect the economic important places from flooding and further land loss due to storm surges. Parts of the old Aelmere, such as the lakes Beemster, Schermer and Purmer were already dried with the help of windmills (see figure 2.1e and 2.1f). But people were not yet technically capable to close and dry such a large water body as the Zuiderzee (Provincie Flevoland, 2008). Besides that there was resistance from the city of Amsterdam, while the open sea was too important for trading ships.

In the middle of the 19th century the land reclamation of the large Haarlemmermeer with the help of steam power resulted in new plans to dry parts of the Zuiderzee. This also had to do with further flooding's and a small amount of land loss during storm surges in 1824 and 1825 (Sleeuwenhoek, 2006). The first plan was made in 1848, which was a plan for a dam between Stavoren and Enkhuizen. This was followed by a plan in 1849 to connect the Wadden islands and to dry the Waddenzee and Zuiderzee completely (Sleeuwenhoek, 2006). On the world exhibition of 1876 another plan is presented which was a dam between Enkhuizen en Kampen. The plans get more serious in 1886 when engineer C. Lely is asked to make a plan by the non-governmental 'Zuiderzeevereeniging' (Zuiderzee association). In 1891 a map visualises the plans of Lely, which was given to the government for judgement (see figure 2.2a). The government changed some parts of the plan and proposed to do the work under supervision of the government (see figure 2.2b).

Figure 2.1d: 15th century

Figure 2.1e: 17th century

Figure 2.1f: 19th century (2.1a-f based on; Provincie Flevoland, 2008)

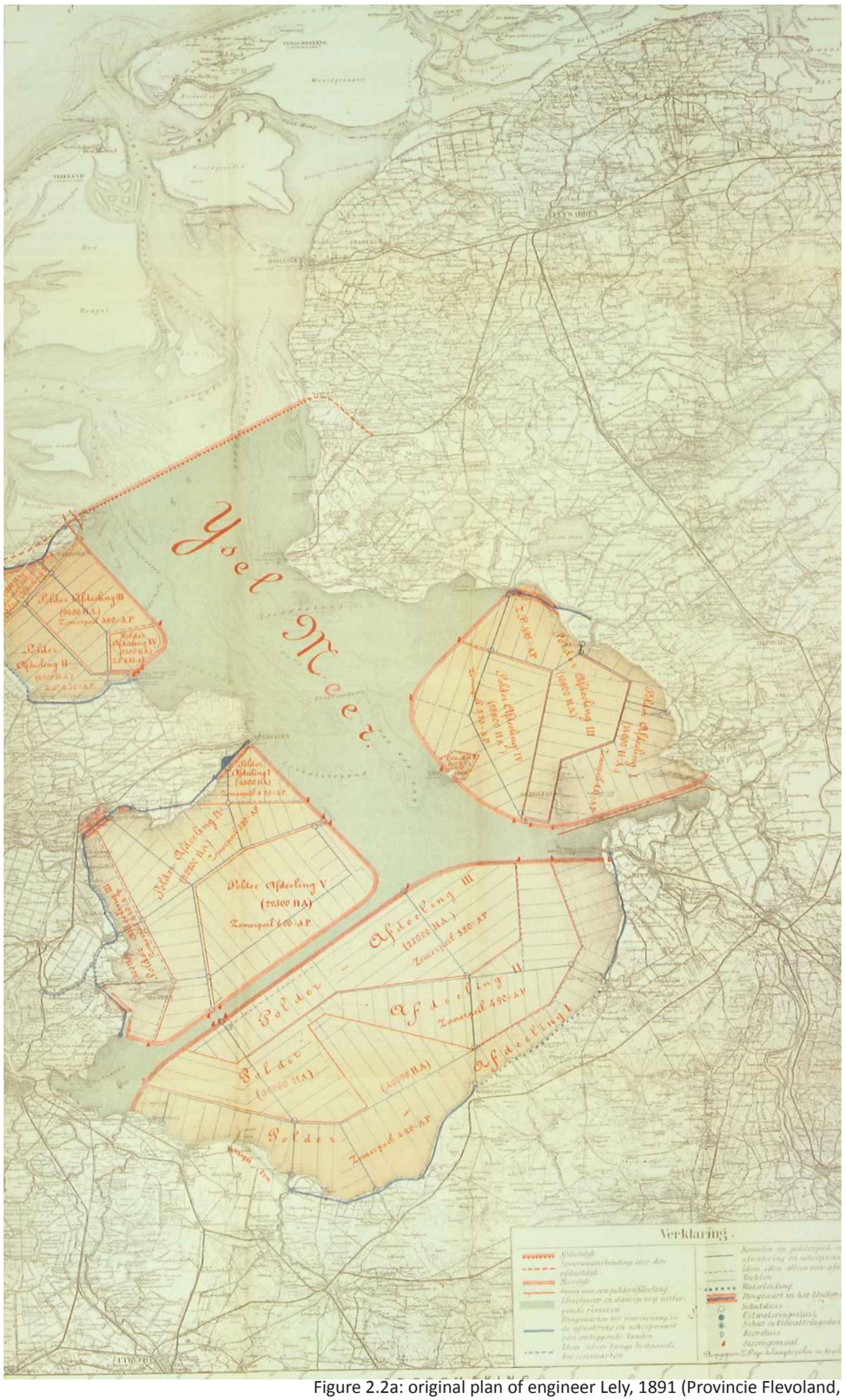


Figure 2.2a: original plan of engineer Lely, 1891 (Provincie Flevoland, 2008)

However, it took several years before the law that intended to dry and close the Zuiderzee passed the parliament. Action is motivated by the wish to prevent the areas for flood disasters, such as happened in January 1916. Due to a north westerly storm, large parts of Noord-Holland flooded and many people died. So like in many flood protection management cases in the Netherlands a disaster was necessary to open a policy window. Besides the flood risk there was a growing need for farmland, while there was shortage of food during the first world war (1914-1918) (Provincie Flevoland, 2008). For the province of Friesland, which suffered from salinization and shortage in fresh water during the summer, the change from salt to fresh water could make the new lake function as a fresh water reservoir. There was no resistance from Amsterdam like there was before, as the Zuiderzee had become far less relevant as a shipping water as ships from Amsterdam could sail to the North Sea over two new canals (Huitema, 2002). On the 14th of June in 1918 the bill to close the Zuiderzee and for the reclamation of the land passed the parliament.

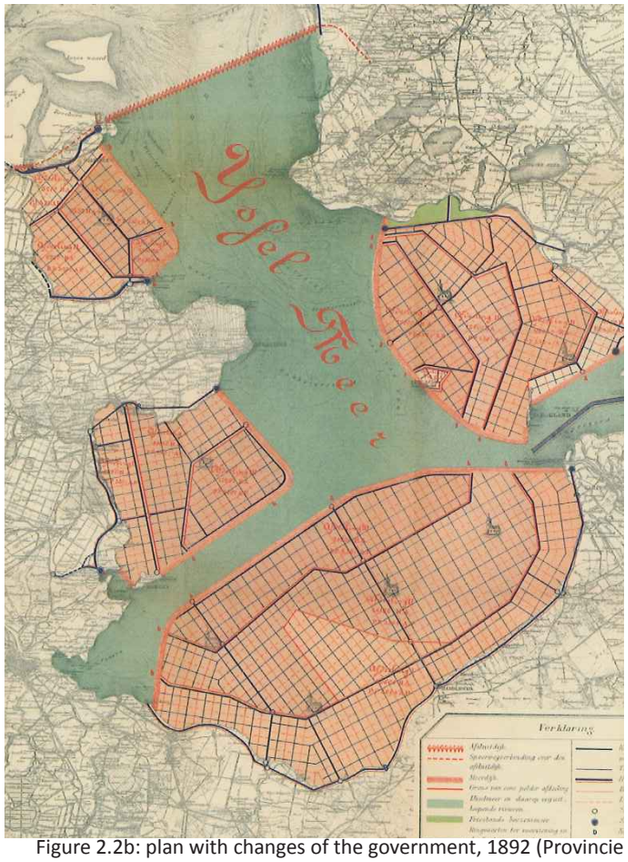


Figure 2.2b: plan with changes of the government, 1892 (Provincie Flevoland, 2008)

2.2 Changes in the past century

2.2.1 The Afsluitdijk

The first works started in 1920 with the building of the Amsteldiep dike, which since 1924 connects the former island Wieringen with the main land of Noord-Holland. The building of the Afsluitdijk (Enclosure dike) started in 1927, and the dam was closed in 1932, on the 28th of May, two minutes past one in the afternoon (van der Ham, 2007). From that moment on the former Zuiderzee did not have an open connection with the sea anymore, and was now called IJsselmeer. The salt water sea changed into an almost complete fresh water lake in less than five years (Bosscher et. al., 1973). The building of the Afsluitdijk did not only mean a closure, with the building of the Afsluitdijk the provinces Noord-Holland and Friesland also got connected with each other. The Afsluitdijk became one of the main connection roads in the Netherlands (Rijksoverheid, 2008). The road was opened on the 25th of September in 1933, a year after the dam was closed. The railway that was originally planned on the dam by engineer Lely has never been built, but due to increased traffic the road has been doubled to a highway in the early 1970's.

The Afsluitdijk proved itself in 1953, during the heavy north westerly storm surge in the beginning of February, that caused more than 1800 human lives in the south-west of the Netherlands. Although the water in the Waddenzee was very high, due to the wind and extreme high water tide, the Afsluitdijk kept the water out and the areas around the IJsselmeer did not flood. As a result of the advices of the first Delta Committee the Afsluitdijk was reinforced after 1953 until it reached a height of 10 meter above NAP, the so called Delta height (Sleeuwenhoek, 2006).

Figure 2.3: the 'Vlieter', one day for the closure (Sleeuwenhoek, 2006)

2.2.2 Land reclamations

In the same period as the building of the Afsluitdijk started, the Dienst der Zuiderzeewerken (National Agency for the Zuiderzee Works) started with the reclamation of the land in the Zuiderzee area. All the polders were built with the same method. First a dike was built existing of two small dams of boulder clay, filled with sand. After that, pumping stations pumped out the remaining water from the polder (Barends et. al., 1986).

In 1926/1927 a small (40 hectares) experimental polder is realized, the Andijk polder, between Enkhuizen and Medemblik. In 1927 is started with the reclamation of the Wieringermeer polder, which is finished on the 21st of August in 1930. Formally both polders have to be called Zuiderzee polders while the Afsluitdijk was not closed yet. The first official IJsselmeer polder is the Noordoost polder, with which is started in 1936 and which was completely dry in 1941. The next polder was the Zuidoost polder or Flevoland polder, which was the largest polder. For practical reasons this one was split up in two pieces, the eastern part with which was started in 1950 and which was finished in 1957, and the southern part which has been built between 1959 and 1968 (see figure 2.4). It took until 1986 before these last three polders were incorporated into a new province called Flevoland (Huitema, 2002).

In the plans of Lely the next polder would have been the Zuidwest polder or Markerwaard polder. For this reason the Houtribdijk between Enkhuizen and Lelystad was finished in 1975. The IJsselmeer was getting smaller and a separate lake was developed, the Markermeer. It was planned to turn this lake in to the Markerwaard polder in future. Since there was not that much need for new farmland, but more need for living space and leisure areas, and since there was an increased interest in nature values, the government started to think of other possibilities for the Markerwaard. Specifically the somewhat unexpected natural value of the peripheral lakes behind the Flevoland polder, which attracted many tourists and recreationists, seems to have helped recognize the importance of the area, both by the society and politicians (Huitema, 2002). In 1990 the decision is made to postpone the land reclamation in the Markermeer, which became definitive in 2003 (Provincie Flevoland, 2008).

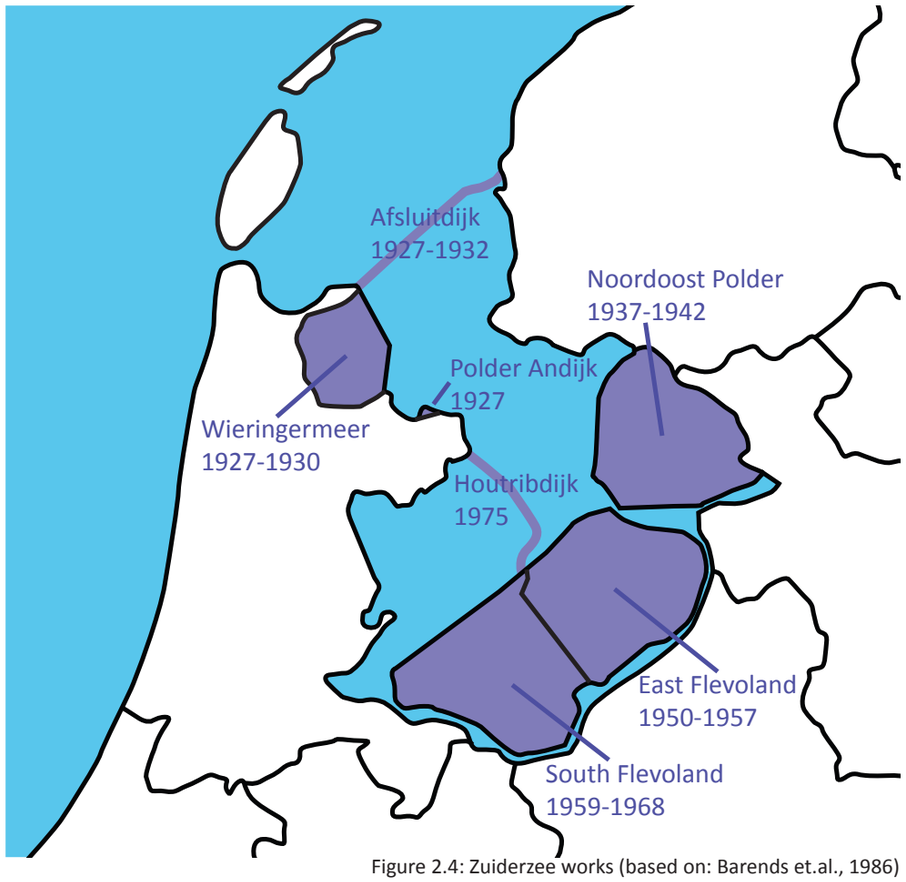


Figure 2.4: Zuiderzee works (based on: Barends et.al., 1986)

2.2.3 Changing character

Due to the closure of the Zuiderzee the character of the lake, its borders and the cities and villages changed a lot. The reclamation of the land lead to a smaller IJsselmeer and new borders. The old borders of the Zuiderzee disappeared behind the new dikes and farmlands. Only the West-Friesland border between Medemblik and Enkhuizen (except the polder Andijk), and the Frisian border between Lemmer and Zurich, and parts of the former islands Urk and Wieringen are still directly connected with the water, as they were during the times of the Zuiderzee. Behind the Flevopolders and a small part of the Noordoost polder, the old borders are still connected with the water of the peripheral lakes. But the size of these lakes differs a lot from the original size of the Zuiderzee. The open character of the large inland sea has disappeared.

Also the character of the areas surrounding the IJsselmeer changed due to the closure. Before the closure of the Zuiderzee most of the area was poor and isolated, with an empty hinterland. Many people worked in the fishing industry, and there were no possibilities or reasons to change profession (Sleeuwenhoek, 2006). Although the fishing industry on the Zuiderzee was not flourishing anymore at the beginning of the 20th century, most fisherman were against the closure. On the day of the closure the ships in the harbours lifted their flags half-mast (Sleeuwenhoek, 2006 and van der Ham, 2007). The professional fishing industry completely disappeared in many places around the former Zuiderzee. But in some places, like Urk, the fishing industry has been modernized and still plays an important role in the society of these places (Schaap, 1982).

The building of the Afsluitdijk and the land reclamations made that the IJsselmeer region was over flown with strangers and had to modernize quickly (Sintobin, 2008). While the area became less isolated, it industrialized quickly, which meant new job opportunities for many of the inhabitants. This had also to do with the building of railroads in the area, a few decennia before the building of the Afsluitdijk. In West-Friesland for example the cultivation of seeds and plants became important. We know now that not only the closure of the Zuiderzee caused changes in the society, and the way of living. Also better infrastructure and communication, increasing mobility and tourism, improvement of agriculture and (inter)nationalization influenced these changes (Zijp and Kerkhoven in: Sintobin, 2008). This is not different from changes that happened to other places in the Netherlands in the last century.

Figure 2.5a-f: pictures of Zuiderzee villages during the time of the closure of the Afsluitdijk (Sleeuwenhoek, 2006)

2.2.4 New opportunity: tourism

Next to the closure of the Zuiderzee, the emerging tourism changed the IJsselmeer borders, cities and villages. Old places that had to change due to the closure of the Zuiderzee found a new goal in tourism, but also without the closure this would have happened. The first signs of growing tourism were already visible before the closure, especially in areas that were easy to reach by train or ferry, or that were close to more densely populated areas. Especially the south side of the sea, close to Amsterdam, was already popular early in the 19th century (Sleeuwenhoek, 2006).

The Zuiderzee works helped to increase the number of tourists in the area. Especially a unique constructional work like the Afsluitdijk and the new made polders attracted many tourists in the years after the closure. The Zuiderzee association also stimulated the tourism, while the expensive project could use some positive publicity during the years of crisis in the 1930's (Sleeuwenhoek, 2006). Also the increased interest in the Zuiderzee culture helped to increase the number of tourists in the area. People were afraid that the culture around the Zuiderzee would change or even disappear as a result of the closure and land reclamations. In the early 1930's, the first commercialization of traditional regional products can be seen, while there was more interest in the authentic Dutch Zuiderzee culture in the Netherlands, caused by the coming changes. The fear for loss of culture made that some cultural traditions were strengthened, such as traditional clothing (Henkes in: Sintobin, 2008).

After the second world war tourism increased even more, and besides the leisure activities on the borders of the lake, also water sport activities on the lake increased. This was something completely neglected in the original plans of the Zuiderzee association. Sailing for instance was originally confined to professional boats men and the elite of the country, but this form of recreation has increasingly become popular (Huitema, 2002). In the Zuiderzee cities where the relationship with the water partly disappeared after the closure, the water recreation helped to restore and even increase this relationship. Many places became economically dependent on the water again.

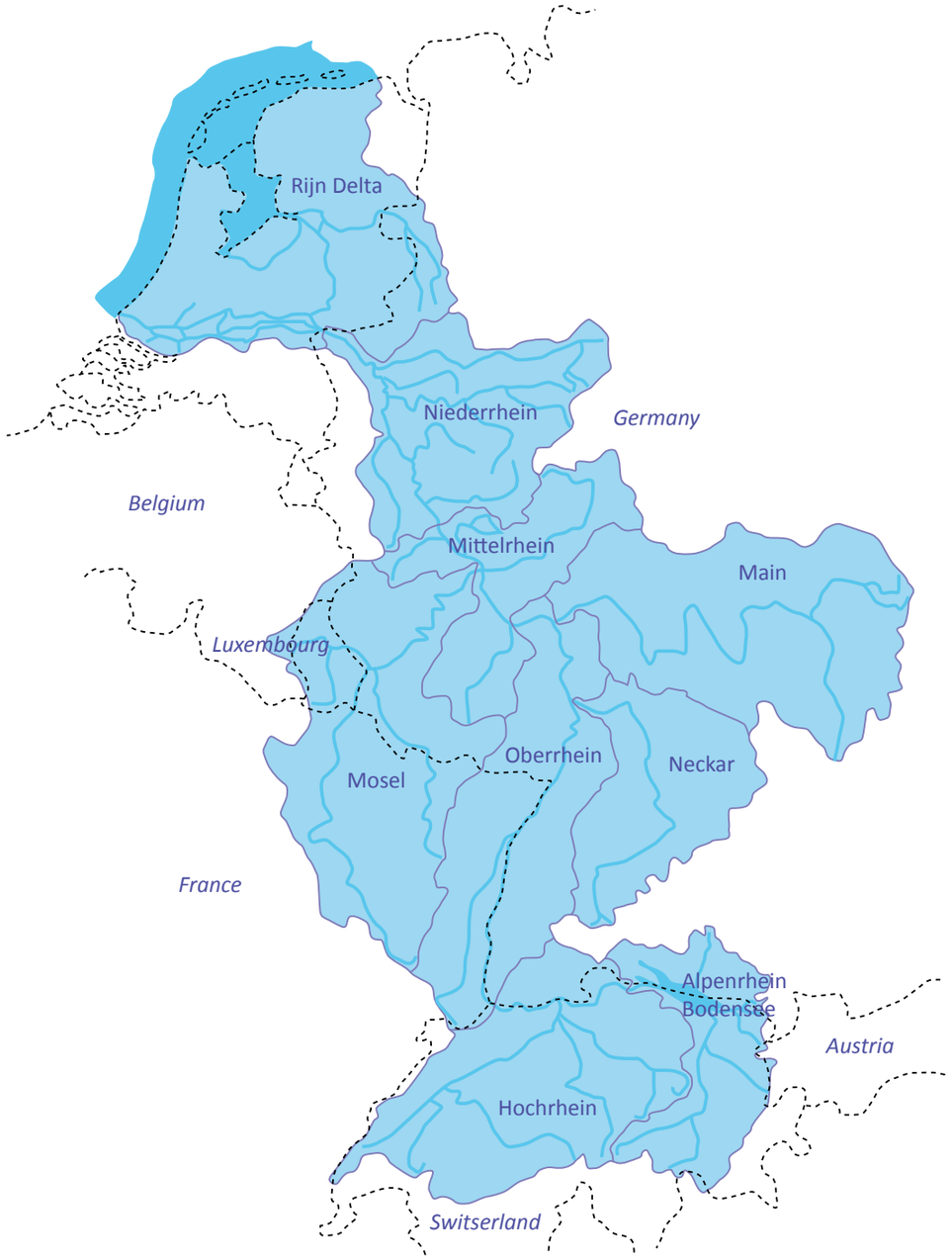


Figure 2.6: international stream area of the river Rhine, with the nine sub-parts (based on: Projectteam, 2009)

2.3 Present appearance of the IJsselmeer

2.3.1 Topography and public authorities

The IJsselmeer is part of the stream area of the river Rhine, which covers parts of Switserland, Austria, Germany, Belgium, Luxembourg and the northern part of the Netherlands (see figure 2.6). The stream area of the rhine is divided in several sub areas, and the IJsselmeer is part of the Rijndelta area. This sub area includes the whole Dutch stream area and some small parts in Germany (Projectteam, 2009). In the north the Rijndelta area is bordered by the stream area of the river Ems, in the south it is bordered by the stream area of the river Meuse.

Most of the water enters the area through the river Rhine, which splits into the rivers Nederrijn, Waal and IJssel. The water is dispersed over these rivers with the help of barriers. Another main water source in the Rijndelta area is the river Overijsselse Vecht. Both the rivers IJssel and Overijsselse Vecht flow into the IJsselmeer. The IJssel is the main source of the water in the IJsselmeer, 70% of all the water in the IJsselmeer comes from this river. The rest of the water in the lake comes from the (Overijselse) Vecht and surrounding areas that drain on the IJsselmeer (see figure 2.7). The total amount of land area draining on the IJsselmeer is approximately 20.000 square kilometre (Projectteam, 2010).

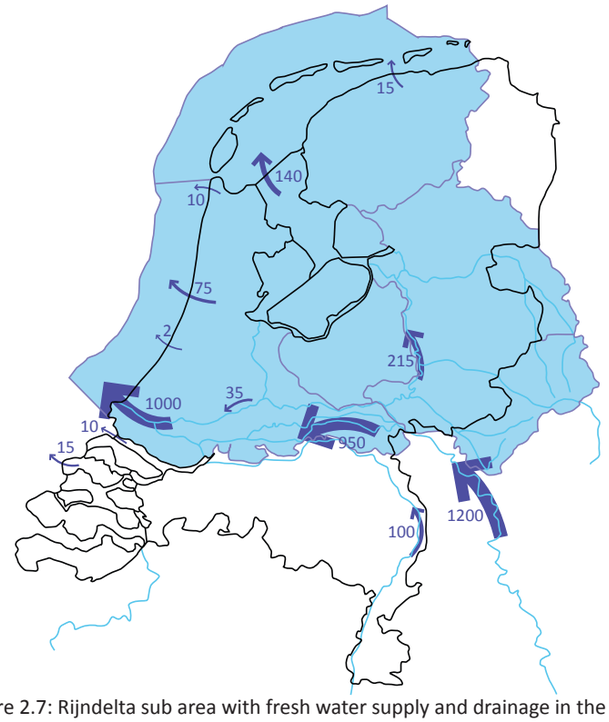


Figure 2.7: Rijndelta sub area with fresh water supply and drainage in the Netherlands in m^3/s during the normal supply of 1200 m^3/s through the river Rhine (based on: Rijksoverheid, 2008 and Projectteam, 2009)

The water management in the Rijndelta area is organized in 18 different water boards. Nine of them are more or less involved in the water system of the IJsselmeer area and its surrounding areas. The water boards Noord-Hollands Noorderkwartier, Fryslan and Zuiderzeeland are directly responsible for the dikes around the IJsselmeer (see figure 2.8). These water boards cover the IJsselmeer coast of the three provinces that are connected with the IJsselmeer, Noord-Holland, Friesland en Flevoland. The IJsseldelta lies in the province of Overijssel.

Figure 2.8: water boards involved in the (Dutch) Rijndelta area (based on: Projectteam, 2009)

When speaking about the IJsselmeer, a difference can be made between the lake IJsselmeer itself and the so called IJsselmeer area. The IJsselmeer area includes IJsselmeer, Ketelmeer, Zwarte water, Markermeer, IJmeer, Veluwe Randmeren and the river IJssel delta. So this is actually the area of the old Zuiderzee, except the polders originating from the land reclamation. The IJsselmeer area is split in three compartments which are separated by dams, the Zwarte Water and the Ketelmeer are part of the same compartment as the IJsselmeer (see figure 2.9). The whole IJsselmeer area is the largest fresh water lake system in north-west Europe with a total area of 2000 square kilometre (Rijksoverheid, 2008). The IJsselmeer is the largest compartment with a total area of 1200 square kilometre (Rijksoverheid, 2009) The lake is surrounded by about 600 kilometres of shore (Huitema, 2002).

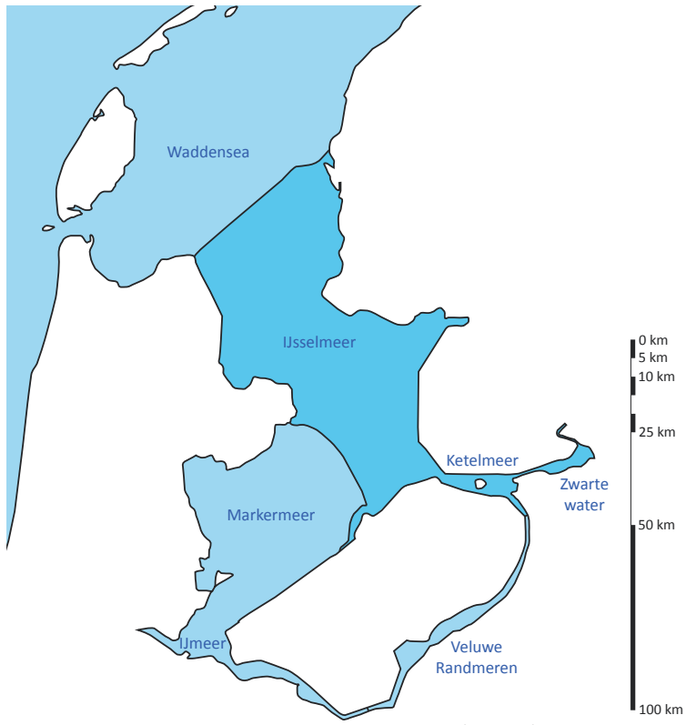


Figure 2.9: the IJsselmeer area

The IJsselmeer has two fixed, humanly controlled target water levels. The summer level (from the first of April until the beginning of October) is fixed on NAP -0.2 m (NAP means: Normaal Amsterdams Peil, Amsterdam Ordnance Datum, standard Dutch level). The winter level is fixed on NAP -0.4 m. This is not a natural situation, while normally there would be a peak level in spring, and falling levels during the summer (Deltares, 2009). The level of the IJsselmeer is not under direct influence of the level of the sea, but indirectly it is. The sluice gates on the Afsluitdijk now discharge under free flow during low tides, which is normally possible for several hours a day (see figure 2.10). In practice it is not possible to maintain the target water levels throughout the year, especially in fall and winter. The water level of the IJsselmeer rises if the supply of water is high and it is not possible to discharge due to northwesterly storms. In wet years the water level in the IJsselmeer has been risen up to NAP + 0.5 m, which is 0.9 m above the winter target level (Rijksoverheid, 2008).

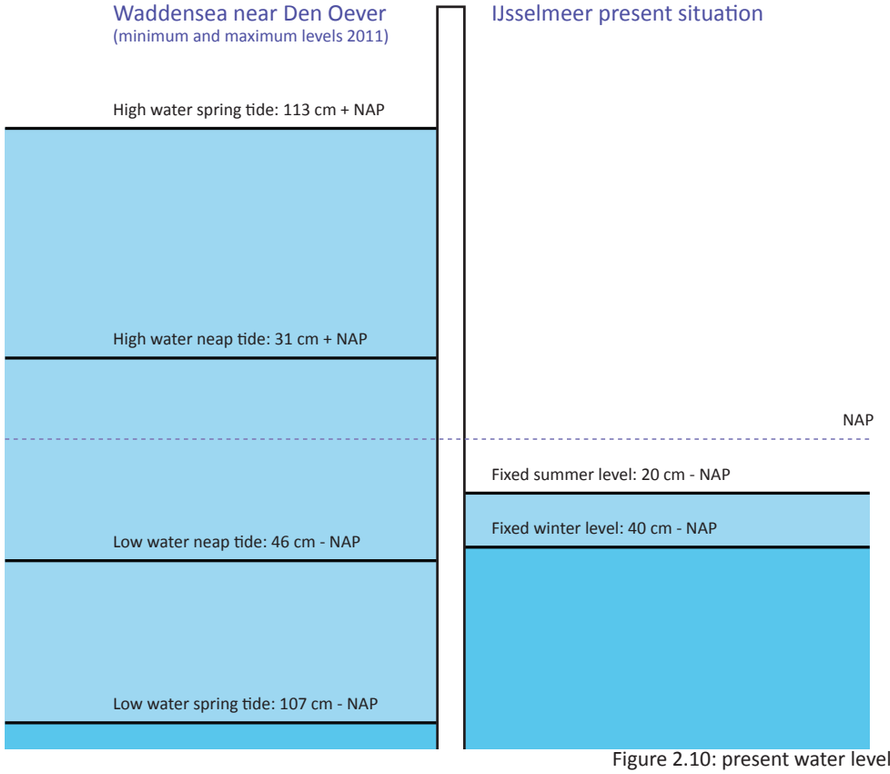


Figure 2.10: present water level

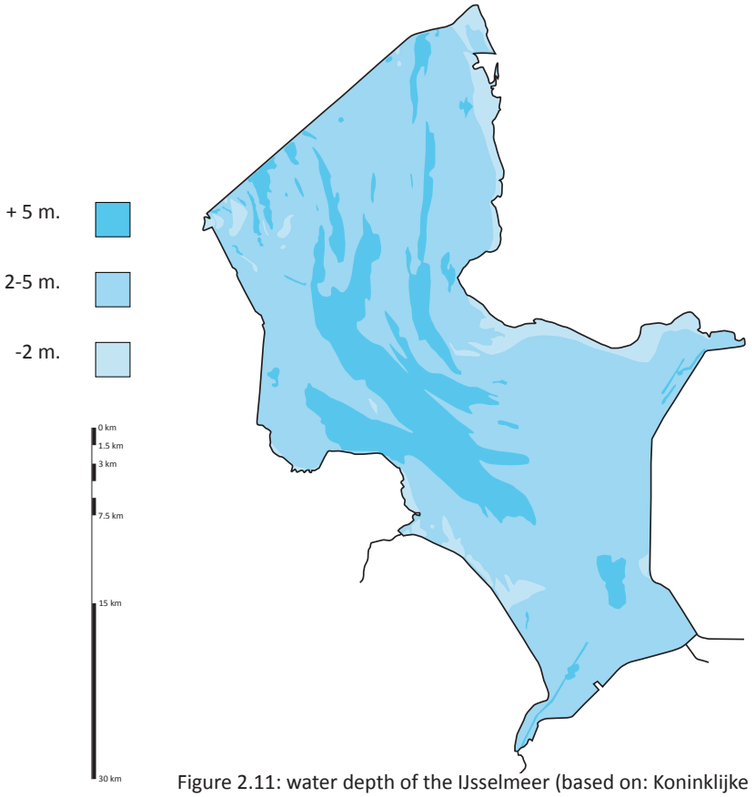


Figure 2.11: water depth of the IJsselmeer (based on: Koninklijke Marine, 2004)

The IJsselmeer is a shallow lake, on most places the lake is not deeper than 5 meter, although some old channels are much deeper (see figure 2.11). The average depth of the lake is 4.2 m (Bottema, 2007). This means that the water is not clear, while the soil is swirled upwards by wind and waves and the movements of boats. This can be a problem while this means that the light can not reach the lake bed, so water plants and animals can not live on it. However, this problem occurs more in the Markermeer, which has an average water depth of 3.5 meter (Bottema, 2007).

2.3.2 Use of the area

The area of the IJsselmeer and the water of the lake is used for several purposes. Within the Netherlands, the water of the lake is used as fresh water supply and, (on a local scale) cooling water supply. The lake itself (and its shores) are used for navigation (both professional and recreational), recreation, sand extraction, and fishery (Rijksoverheid, 2008).

The IJsselmeer is the main fresh water reservoir for the Netherlands. In total, more than 30% of the Netherlands (12.950 km^2) is directly or indirectly dependent on the IJsselmeer area for its fresh water (Rijksoverheid, 2009). Only a small amount of it is used as drinking water, one million people are served, mostly in Noord-Holland (Rijksoverheid, 2009). Most of the fresh water is used for agricultural purposes. Next to that, the fresh water is necessary in dry periods to prevent the surrounding areas from dehydration and salinization. In these dry periods the difference between summer and winter level (0.2 m) can be used (Rijksoverheid, 2008).

A problem that can occur due to shortage in fresh water is dehydration of peat dikes, so they become weak and even can break. This means that even in dry periods there can be a serious risk of flooding. For instance, in the hot and dry summer of 2003 a small local flood occurred near Amsterdam, when a centuries old dike made of peat failed due to desiccation (Olsthoorn et. al., 2008). These peat dikes mainly occur in the area that is called the ‘Groene Hart’, between the major cities Amsterdam, Rotterdam, The Hague and Utrecht. While this area is densely populated, flooding due to failing peat dikes is a major risk. The stability of peat dikes and other flood protection elements are of highest importance in fresh water supplies, even higher than drinking water. Also many nature areas are dependent on the supply of fresh water and are in risk of dehydration in dry periods.

Salinization is also a risk, a salt tongue is penetrating deeper into the Netherlands through the Nieuwe Waterweg, the so called passive salinization. In lower parts of the Randstad, like around Gouda, there already is a lack of fresh water in summer. In that case fresh water from the IJsselmeer needs to be transported to the area to give counter pressure to the salt water. In other parts active salinization is also the case, while the water system is changing from salt to fresh water due to human interventions. This is for example the case in the IJsselmeer area (land reclamations) and the Zeeuwse Delta. The soil in the areas around the IJsselmeer is still salt, so that it is necessary to flush fresh water through ditches to prevent the area from salt damage (Projectteam, 2010). Especially vulnerable crops suffer from damage due to salinization.

Besides its function as a fresh water reservoir, the IJsselmeer is a main navigational area for commercial shipping. The main navigational routes are from Amsterdam via the Houtrib sluices near Lelystad towards Lemmer in Friesland (connection with Prinses Margriet Kanaal). Another main route is via the Ketelmeer towards Kampen in Overijssel. But also the connections to the Waddenzee and the other inland waterways of Friesland are important (see figure 2.12). Next to freight shipping, there are also a few ferry services operating on the lake. These services are mainly for recreational purposes and most of them only operate in summer. The last form of commercial shipping on the IJsselmeer is fishing. The main fishing activities on the lake itself exist of fishing on eel with fykes and fishing on pike-perch with nets. Besides that, many fishing boats navigate over the lake towards open sea. Most fishing boats operate from the village Urk, which has a large fish auction. The extended fishing activities on the lake have made that there is a lot of pressure on the fish stock in the lake these days. Especially the eel is now in danger of extinction. Next to commercial fishing the lake is also well known for sport fishing activities, both along the shore of the lake as well as from boats on the lake.

The IJsselmeer is of national and international importance for recreational shipping. There are many marina's and other berthing possibilities for recreational shipping on and around the lake. Through several locks the lake has connections with both the open sea and inland waterways. In 2002, 17.000 boats (mainly sailing boats) were home to the region (whole IJsselmeer area), finding a place in 44 marina's and several other harbours (Huitema, 2002 and Rijksoverheid, 2009). These are not only from Dutch origin, also many people from Germany, and to a lesser extend other countries, own a boat which finds a home-berth in the region (Rijksoverheid, 2009). Even more people from the Netherlands and other countries visit the area by boat during holidays. Especially the old Zuiderzee harbours, with their historic settings, are attractive places for boats men.

Next to recreational shipping the IJsselmeer area is used for many more forms of recreation. This mainly takes place on the edges of the lake. Recreational activities are spread from long stay possibilities, such as camp sites and holiday parks, as well as short stay possibilities. Short stay possibilities are museums, city visiting, walking, cycling and shore based water activities such as swimming. A problem in the area is that not all shores are easily accessible for leisure activities (Rijksoverheid, 2009). For the area, some places were decided to become focal points for the development of tourism. For the IJsselmeer these are Stavoren, Lemmer, Lelystad and Enkhuizen. The importance of recreational shipping, both as activity as well as something to look at, shows up again. All four focal places are situated on important junctions of waterways.

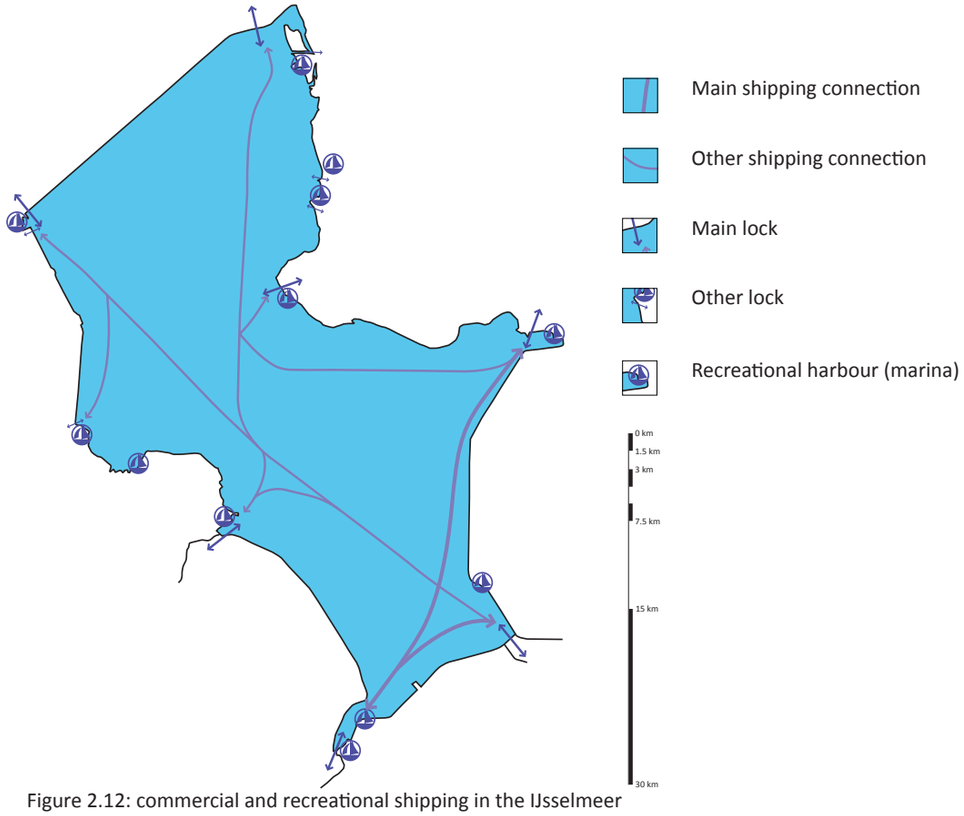


Figure 2.12: commercial and recreational shipping in the IJsselmeer (based on: Koninklijke Marine, 2004)

2.3.3 Core qualities

The 'Nationaal Water Plan' (NWP) mentions three core qualities of the IJsselmeer area. These are nature, cultural history and landscape quality (Rijksoverheid, 2008). In the NWP is stated that these core qualities should be preserved and if possible strengthened in the future.

The IJsselmeer is of great ecological importance, although the nature values of the IJsselmeer are under pressure. Some bird species in the area are decreased with 70% in numbers since the 1980's (Rijksoverheid, 2008). This has to do with the closure of the Zuiderzee, the ecosystem is still not in balance. The entire area, including the Markermeer and Veluwe Randmeren, has the status international protection area, related to the European bird regulation and Natura 2000 (Rijksoverheid, 2008 and Projectteam, 2010). The food rich waters of the IJsselmeer area are of great importance for birds migrating from Siberia to Africa. Most migrating birds visit the area during fall, winter and early spring (Rijksoverheid, 2009)

The fact that the IJsselmeer is relatively shallow is positive for water birds, while they are mostly able to dive 4.5 m into the water to search for food (see figure 2.13). These shallow waters can be found on the old sand banks of the Zuiderzee, and some unembanked alluvial lands along the old borders of Friesland, Noord-Holland and in the IJssel Delta. The food for the birds are both (water) plants as well as water fauna. An important species in the IJsselmeer is the zebra mussel (Dreissena polymorpha), which serves as food for birds and purifies the water (Harezlak et. al., 2009).

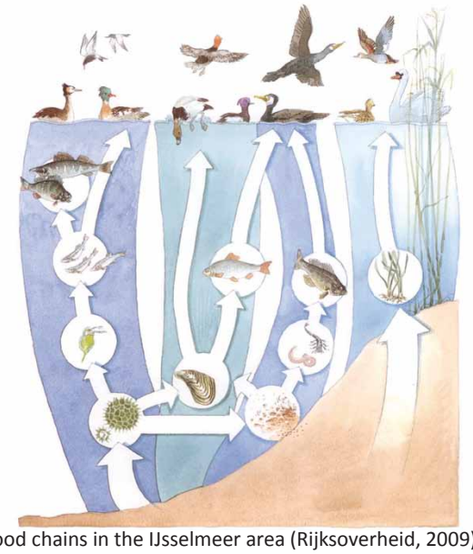


Figure 2.13: food chains in the IJsselmeer area (Rijksoverheid, 2009)

The new dikes built for the land reclamations are generally too steep, both above and under water. This means that nature values in these transfer areas between land and water can not develop. In the Markermeer, where the same problems occur, has already been started with the realisation of more gradual transfer areas between land and water, with wave screens and shelter dams (Deltares, 2009). These dams also have a positive effect on the zebra mussel.

Another core quality of the area that is named often is the cultural history, both derived from the Zuiderzee history as well as from the land reclamations. The Zuiderzee history brings the old Zuiderzee dikes, the Zuiderzee cities, the former islands, old water management artefacts (sluices, pumping stations) and the higher cliffs on the Friesland side. But there are also less visible elements, such as ship wrecks of the Zuiderzee period which are still present on the lake bed (Rijksoverheid, 2008). These elements form a contrast with the newer elements of the Zuiderzee works, such as the straight dikes and the new water management artefacts. Places where both new and old elements meet each other can be very interesting. The land reclamations also made that on some places the former lake bed, with all its treasures became visible.

As last core quality the NWP mentions landscape quality. The term landscape quality will be further explained in chapter 3, in this case the term will only be used in the way the NWP and the Rijksoverheid (2009) use it. According to the NWP the landscape quality of the IJsselmeer area can be indicated with scale, greatness and an open horizon. The term water landscape is often used when speaking about the landscape qualities. The experiential value of the landscape is high (Rijksoverheid, 2008). This has to do with the large water surface, which allows a far sights and the experience of emptiness, and even darkness, which is unique in the Netherlands and especially so close to the Randstad. The landscape quality is also related to the other core qualities nature and cultural history. For example, in the open landscape the silhouettes of the old Zuiderzee cities are important for the experience of openness and for orientation (Rijksoverheid, 2009). To maintain this quality, the policy is to be very careful with outer dike developments, such as residential construction activities. This is also the case for wind energy projects in the IJsselmeer. New developments need to add extra value to the present landscape qualities and characteristics.

2.4 Future of the IJsselmeer

2.4.1 The future water level

In 2008 the Delta Committee proposed to rise the water level of the IJsselmeer with 1.5 meter before 2100 (see chapter 1). The advice of the Delta Committee is to make sure that most of the water level rise will be realized before 2050. In the coming years the government needs to research in which tempo the water level rise can and must be realized (Rijksoverheid 2008). With the water level rise of 1.5 m, the possibility to discharge under flee flow will be maintained, also after 2100, and the IJsselmeer will keep (and even extend) its function as a fresh water reservoir (Deltacommissie, 2008).

While the sea level is rising, it will not be possible to discharge from the IJsselmeer on the Waddensea under free flow in the future. It is expected that it will not be possible to discharge in 2050 anymore. The Delta Committee presumes a relative sea level rise of 0.65 to 1.30 meter in 2100. Relative means that the expected soil subsidence is also taken into account. These values represent plausible upper limits based on the latest scientific insights of both national and international scientists (Deltacommissie, 2008). About the sea level rise after 2100 there are many uncertainties, locally this can be 2 to 4 meter. With the water level rise in the IJsselmeer that is proposed by the Delta Committee discharging under free flow will be possible until at least 2100, and possibly much longer. The Delta Committee thinks it is impossible to rise the water level with more than 1.5 m. A lake level rise of more than 1.5 m will require radical and expensive dike reinforcement along long stretches of the river IJssel's lower reaches (as far as Zwolle) (Deltacommissie, 2008).

The maximum water level in the IJsselmeer in 2100 will be NAP + 1.1 m. This means that the water level rises 1.5 m above the present winter level in spring, and falls down in summer with a maximum of 1.5 m (until the present winter level). In winter the water level will be approximately NAP + 0.6 m (Projectteam, 2010). So the water will not be fixed in the future, like it is now, but will be able to fluctuate throughout the season (see figure 2.14).

Next to rising the water level in the IJsselmeer to be able to discharge under free flow there is a second possibility. New pumping stations could be built on the Afsluitdijk to mechanically pump the water from the IJsselmeer to the Waddensea. The main reason to choose for rising the water level of the IJsselmeer and discharging under free flow is the function of the IJsselmeer as a fresh water reservoir. Besides that, a lot of energy will be needed to be able to pump the water up to the rising level of the Waddensea. The Delta Committee has decided that rising the water level is the most robust solution (Rijksoverheid, 2009). Building a pumping station on the Afsluitdijk would still be a possibility after 2100 if it is not possible to further rise the water level of the IJsselmeer. Whether this will be necessary and when this will be necessary depends on the sea level rise after 2100.

The higher water level in the IJsselmeer will make sure that the lake can keep its function as a fresh water reservoir. It is even possible that this function will be enlarged, which is necessary if the lakes in the southwestern delta area will become more brackish in future (Rijksoverheid, 2008). Also the amount of

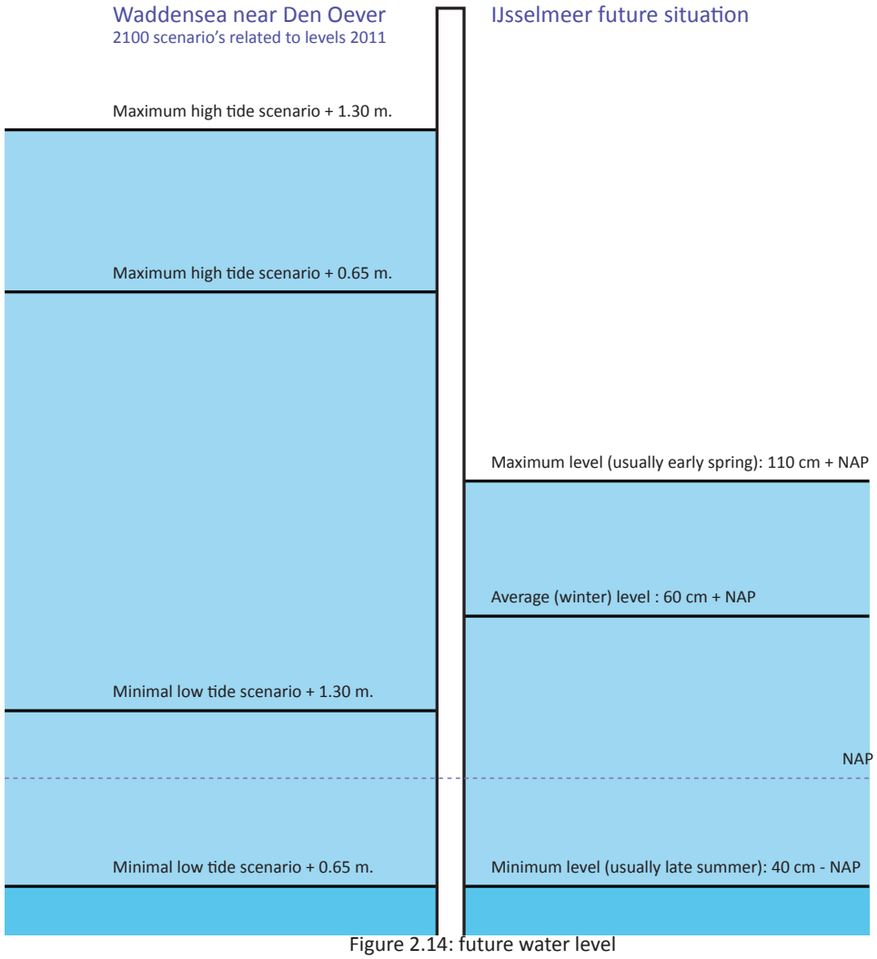


Figure 2.14: future water level

water that is used as drinking water can be enlarged, while we have to prevent ourselves from shortage in drinking water in the future. If the water level rises, the fresh water of the IJsselmeer can even be used for export to southern Europe, which may be at increased risk of drought at the end of the century (Kabat et. al., 2009). The IJsselmeer can also be necessary in the future when more water is flowing through the river Rhine. This means that more capacity is needed in all the Rhine arms, and while the river IJssel is part of the Rhine system, more water will flow into the IJsselmeer. So positive influences of a higher water level in the IJsselmeer can be seen in large parts of the country.

The problem of shortage of fresh water for agricultural use is an acute problem. When the water level of the IJsselmeer in summer is 0.2 m lower than the normal summer level, there are already problems with the inlet of water in the surrounding areas (Deltacommissie, 2008). This problem especially occurs on the Friesland side of the IJsselmeer (Projectteam, 2010). If the water level drops down even more in dry periods, depth problems occur for shipping on the lake (Deltacommissie, 2008). It is expected that in extremely dry periods in the future a water slice of 1.1 m is required in the whole IJsselmeer area, and a slice of 1.5 m in the IJsselmeer alone (without the Markermeer). This necessary water slice of 1.5 m is even more than the most extreme expectation of the sea level rise of 1.3 m. This means that with a water level rise of 1.5 m it is both sure that discharging under free flow will be possible until 2100, and that there will be enough fresh water stored in the IJsselmeer until those days.

The water level of the IJsselmeer is now the same as the water level on the Markermeer. The two lakes are separated by the Houtribdijk on which a new pumping station is being build. With the new pumping station it will be possible to split the water levels of both lakes. This means that the water level in the Markermeer does not have to rise like the IJsselmeer. This has several advantages, the urban developments of the cities Almere and Amsterdam are not influenced, and the Noord-Holland coast, with its high landscape value, does not have to be reinforced. The water level in the Veluwe Randmeren is already separated from the water level in the IJsselmeer. It is now slightly higher than the level of the IJsselmeer, and also does not have to rise. However, while the shortage of fresh water is an acute problem, the space the IJsselmeer system has will be used in the coming years, before a decision for a longer term is made. This means that the water level can rise 0.3 m above the present level, without any changes in the heights of the dikes (Rijksoverheid, 2008). This is not only the case in the IJsselmeer but in the whole IJsselmeer area. This small amount of water level rise also helps to overcome the sea level rise until 2035, which in the most extreme case can be 0.20-0.25 m (Rijksoverheid, 2008).

2.4.2 Measures to take

If the water level in the IJsselmeer rises, it is necessary to take measures around the entire IJsselmeer. It is likely that the areas outside the dikes (including some beautiful little harbors) will flood more frequently, for which flood-proofing arrangements will have to be made (Deltacommissie, 2008). A large part of the Netherlands will profit from the extra fresh water reservoir capacity, but the negative effects will mostly occur in the areas directly related to the IJsselmeer (Projectteam, 2010).

All the IJsselmeer dikes will have to be reinforced, including the Houtribdijk and the Afsluitdijk. The future dike height on the eastern side of the lake is influenced by high water levels and waves during strong westerly winds. This means that the eastern dikes are generally 2.5 m too low (Projectteam, 2010). On the western side the future dike heights are influenced by the average water level, while this side is usually more sheltered. These dikes are generally 2 m too low. This means that the necessary dike reinforcements are higher than the proposed water level rise. This is because some dikes are now too low, and while in other areas the protection level is extended with 10%, as proposed by the Delta Committee. The lack of dike height, and therefore the necessary dike heightening, is relatively low for the old Zuiderzee dikes, while there is some over height there (Projectteam, 2010).

The water level rise in the IJsselmeer has also impact on the IJssel delta and the river IJssel. The IJssel delta needs to be protected against water blown up by strong westerly winds. For this a dam or storm surge barrier needs to be built near the Ketel bridge (between the IJsselmeer and the Ketelmeer). Despite this barrier, it will still be necessary to reinforce the dikes in the IJssel delta and along the lower parts of the river IJssel. Some of the dike rings in the IJssel delta area need to be connected. The water level in the IJssel will rise up to 0.6 m near Kampen, and still 0.1 m near Zwolle (Sybe Schaap in: VEWIN, 2009).

Next to measures to protect the areas inside the dike, it is also necessary to think of the outer dike areas. Many of them will (partly) flood, and it will not be possible to protect them all. This means that some elements need to be removed from these areas. Some outer dike areas are densely build or have an important purpose that can not be lost or removed. These areas need to be embanked. It will not be possible to allow new outer dike building activities in the lake. Important places that are often also situated outside the dikes are the harbours and their surroundings in the old Zuiderzee cities. Most of the harbours have an open connection with the water, and while it is often not possible to heighten the quays and dikes within the cities, the harbours need to be protected with new built locks (Projectteam, 2010). It is even likely that new dams need to be built around the harbours and cities to make sure that these are completely protected against flooding.

The water level rise has also consequences for the areas draining on the IJsselmeer. Some areas drain under free flow, while in other areas the water is mechanically pumped into the IJsselmeer. New pumping stations need to be built and the capacity of the existing pumping stations needs to be enlarged. It is also likely that some areas will become more wet as a result of seepage from the IJsselmeer to the lowest areas. This seepage can be rich in phosphates (Deltacommissie, 2008). Drainage and seepage problems can also occur in cities. It is possible that basements will flood and that problems occur with the sewage system. Especially in cities seepage can cause problem that are difficult to solve. The sewage system needs to be adapted and retention areas are necessary to store water during precipitation, while it is not possible to pump all the water immediately to the IJsselmeer (Deltacommissie, 2008).

2.4.3 Consequences for the environment

The consequences of water level rise for the environment of the IJsselmeer can be both direct as well as indirect. Direct consequences are consequences that are directly related to the water level rise and the measures that need to be taken. This means for example an increased water depth, loss of outer dike areas or higher dikes. Indirectly there will also be consequences, which sometimes will show up years after the measures have been taken or the water has risen. But these consequences can still be related to the water level rise in the IJsselmeer. The indirect consequences are more complicated to predict, while they can also be influenced by other changes that can happen in future, such as changes in economy, culture or population.

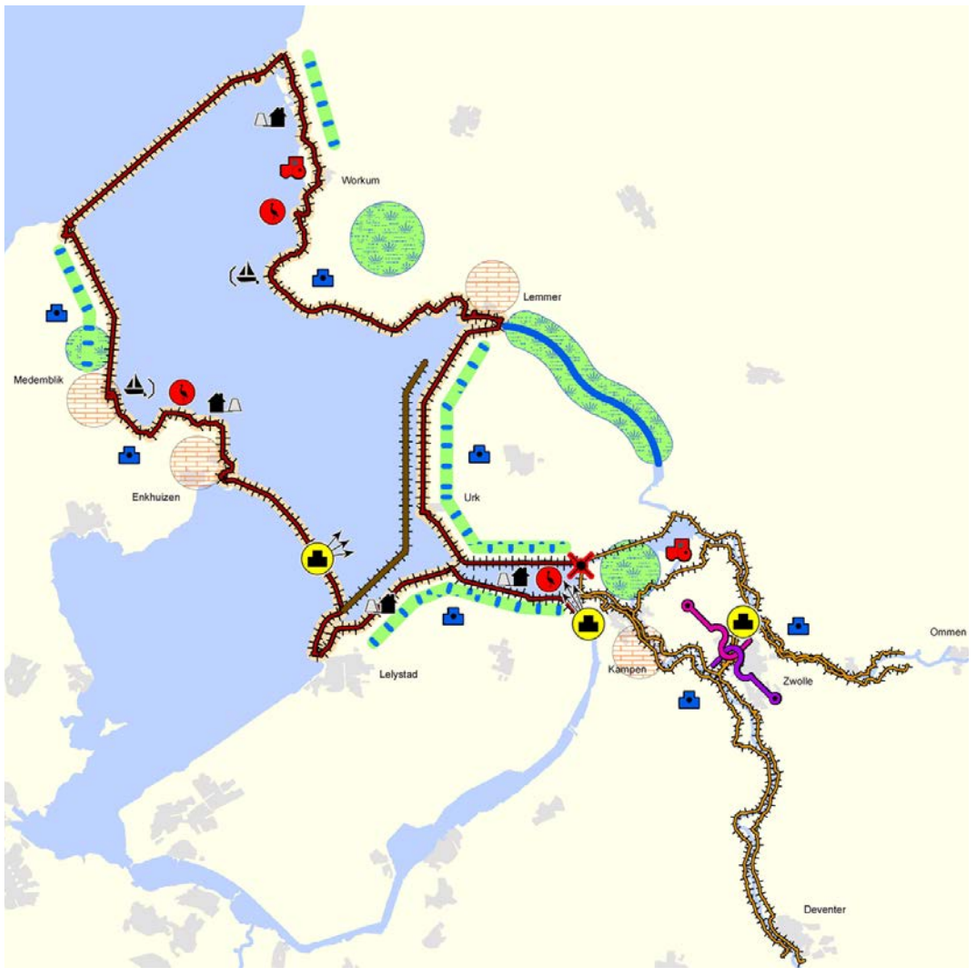


Figure 2.15: first indication of necessary measures in case of 1.5 m. water level rise in the IJsselmeer (Projectteam, 2010)

The proposed water level rise will have large impact on nature of the IJsselmeer. The ecosystem in the lake will face another major disturbance after the closure, and change from salt to fresh water, of which it was still not recovered. It can be expected that the water level rise will make that it will take even longer to find a new balance in the ecosystem. With a water level rise of 1.5 m average depth in the lake will increase with 36% to an average water depth of 5.7 m. While most birds in the area are dependent on the shallow waters for their food (and are only able to dive down to 4.5 m), the water level rise of 1.5 m can possibly be disastrous for some bird species. The old sand banks will become too deep and so are the shores along the old Zuiderzee dikes. Also water plants, pondweed and reed are dependent on the water depth and the area for these plants will also decrease as a result of the water level rise (Harezlak

et. al., 2009). Almost the same is the case for the zebra mussel, who likes to live in water which is between 2 and 5 m deep (Harezlak et. al., 2009). So besides the fact that the water will be too deep for birds to dive to the water bottom, the amount of food will also decrease.

The fact that some areas that are now permanently dry will flood will not be enough to solve this problem, in the end the amount of water that is shallow enough will decrease (Harezlak et. al., 2009). While new areas will flood, that are now permanently dry, the amount of permanent dry land will decrease. These outer dike areas are especially important for breeding birds. Along some old Zuiderzee dikes the outer dike areas will completely disappear under water, so that the old dikes will go as steep into the water as the new dikes do. This means that the edges of the IJsselmeer become even more hard and abrupt as they are now. The amount of important transition areas between land and water, for both birds, (water) plants and water fauna, will decrease.

However, the water level rise does not only have bad consequences for the ecosystem. The plan to let the water level follow a more natural curve over the year will have positive effect on nature. In summer, the water level can drop down to the present winter level, which means that many outer dike areas will fall dry. When this happens in the right time these places will be ideal for birds to find food, which partly compensates the loss of forage area (Projectteam, 2010). In plans for the ecology of the IJsselmeer is suggested to compensate the rest of the lost nature with new inner dike nature areas. These areas even can profit from a higher water level in the IJsselmeer, while they will possibly be more wet due to seepage, if they are situated close behind the dike. These areas should replace the permanently dry outer dike areas that will disappear. The loss of inner dike agricultural land due to these new nature areas is an indirect consequence of the water level rise.

Next to the consequences for the ecology, the water level rise will also have influence on the use of the area. While many of the present harbours in (Zuiderzee) cities need to be protected with locks, the harbours will be less accessible. It is likely that for this reason new marina's will be built outside the villages, which can cope with water level fluctuation and are open to the IJsselmeer. This means that less boats will visit the inner city harbours, which has consequences for the liveliness in these cities. The movement of (recreational) boats in harbours is often an attractive view for tourists, and it helped the old Zuiderzee cities to keep their relation with the water after the closure of the Zuiderzee. While the cities will not be directly connected with the IJsselmeer, the way people experience the cities will change. The character and identity of the historic cities changes (Deltares, 2009). Many (small scale) economic activities in these cities are now based on the present experience, and it is likely they will be influenced. So indirectly the water level rise can have consequences on many fields, like for example on restaurants in the cities.

Outer dike areas that can not or will not be embanked will flood, which means that they lose (some) of their functions, although it is possible that new functions are added to these areas. Especially extensive recreational areas will suffer from these problem. These areas are often important for the local inhabitants as leisure areas. More intensive, regional and national recreation areas are more likely to be protected, while both the value in money as well as the experiential value is higher. So the consequences of the water level rise are, also indirectly, very local. The loss of outer dike land area will also mean that some qualities of the area are strengthened. The openness and overview over the water, especially from the dike, will increase, while the sight will be less blocked by plant growth or buildings.

2.4.4 Reactions on the plans for the IJsselmeer

Most people living in the IJsselmeer area are interested in the future developments of the area and the water level. Research proved that 62% of the people are (highly) interested in these future development of the water level rise. Compared with the interest in the future of the Afsluitdijk, which is 53%, this is significantly higher. This is probably because of the consequences of water level rise for the direct living area of people (van Winsum-Westra, 2010). On the other hand, the same people do not all realize they are now living under sea level (only 54%), so the risk perception is quite low (van Winsum-Westra, 2010). A low risk perception can cause resistance in the society against collective, risk lowering measures, while the inhabitants think the negative effects of the policy (on short term) are more important than the positive effects (on long term) (Terpstra, 2008).

The reactions of politicians and the society on the plans of the Delta Committee in general were mainly positive. Most of the plans follow the present policy. Although a flood event did not happen, and therefore there is not a real policy window,

the society and politicians seem to be aware of the urgency of the problem. The plans of the Delta Committee seem to be convincing enough to meet all three criteria for an idea to be taken serious. But while the implementation of the plans is long term project, there is a risk of change in the perception of the risk of flooding and the necessity of the measures. There are already some critical remarks made. Especially the costs that need to be made for the realisation of the plans are a point of worry.

The plans of the Delta Committee for the IJsselmeer caused different reactions from the society, both positive as well as negative. Compared with the other plans of the Delta Committee, the plans for the IJsselmeer are more progressive, and are less based on present policy. Agriculture organisations reacted very positive in general, while they are glad to be sure of the fresh water supply in future (Deltares, 2009). The same is the case for the (fresh) water company in Noord-Holland (PWN), although they are not sure if the water of the IJsselmeer can be used in the 'Groene Hart' (VEWIN, 2009). Most politicians were also positive about the plans of the Delta Committee in general, although the plans for the IJsselmeer are the most controversial. Most other plans follow the present policy. Politicians are mostly worried about the financial consequences of the water level rise.

The water boards are also positive about the plans of the Delta Committee, but they state that the plans for the IJsselmeer should be further studied. Sybe Schaap (chairman of the Unie van Waterschappen) states: 'the Delta Committee has opened the discussion. The think process about the future water management has started' (VEWIN, 2009). But on the other hand, Sybe Schaap states: 'the water level rise has enormous physical and financial consequences' (VEWIN, 2009). The consequences for nature and water quality are unsure and the consequences for the dikes and historic cities are high (Unie van Waterschappen, 2008). Also the consequences for the IJssel delta and the river IJssel's lower reaches should be studied, according to the water boards. Besides that, the water boards are not sure whether the water slice of 1.5 m is really necessary, this also needs some further study.

The provinces surrounding the IJsselmeer are in general worried about the same things as the water boards (Deltares, 2009). Especially the province of Friesland is doubting if it is really necessary to rise the water level that much. Some national politicians now also doubt about the necessity of the water level rise. In a radio interview state secretary of infrastructure and environment Joop Atsma stated: 'I believe much more in a strong Afsluitdijk instead of saying "lets rise the dikes around the IJsselmeer with 1.5m" on just an afternoon'(TROS Kamerbreed, 2011). On the other hand, Joop Atsma stated in the same show: 'we don't want more salt water in Friesland' (TROS Kamerbreed, 2011). This shows that it is important to make sure that the reason why the water level should rise should be communicated clearly to all involved parties, from local inhabitants to national politicians.

Nature organisations react mostly negative on the plans. The sentence 'Help, het IJsselmeer verdrinkt!' ('Help, the IJsselmeer is drowning!') is often mentioned. This is mainly because of the loss of valuable nature areas, and while the balance in the lake, that is still not there after the closure of the lake, will be disturbed again. Also the validity of the expected sea level rise is a point of critique, especially since some other researches, like the IPCC report, included wrong numbers. The Delta Committee used the numbers of the IPCC, but combined them with the expectations of the Dutch weather institute KNMI, and insights of several other national and international experts. Some people state that if you look at the present sea level rise, it can be expected that the sea level is 0.2 m higher in 2100 compared with the present level. This is much lower than the expected sea level rise of 0.65 – 1.30 m of the Delta Committee. But the chairman of the union of water boards thinks it is good that the Delta Committee based its plans on the most pessimistic scenario. It is like a wake-up call for the Netherlands (VEWIN, 2009).

Also form the scientific world some critical remarks were made. Professor in hydraulic engineering Han Vrijling states in a newspaper: 'That the sea level is rising and dike reinforcement can not protect our polder land anymore is the message of so called "new hydraulic engineers". This message is taken without remarks by the media and the public, which is incorrect.'(Vrijling, 2008). Han Vrijling thinks that the statement of the Delta Committee, that only the heightening of dikes is not enough anymore, is nonsense. The Netherlands has been protected by dikes all over the past, and will be in future. Although he is not the only one who is critical, most actors seem to accept and understand the plans of the Delta Committee, and are working on the implementation of the advices.

2.5 Conclusions and guidelines

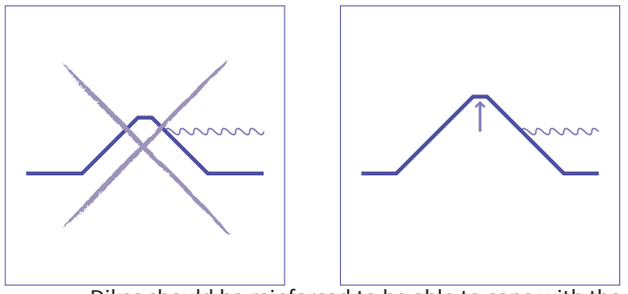
2.5.1 Conclusions

This chapter shows that the IJsselmeer and the surrounding areas have faced major changes in the past century and will face more changes in future. With the proposed water level rise it will be necessary to protect the surrounding areas of the lake. Although it will take at least two decades before the water level rises, it is necessary to start to adapt to the new situation as soon as possible.

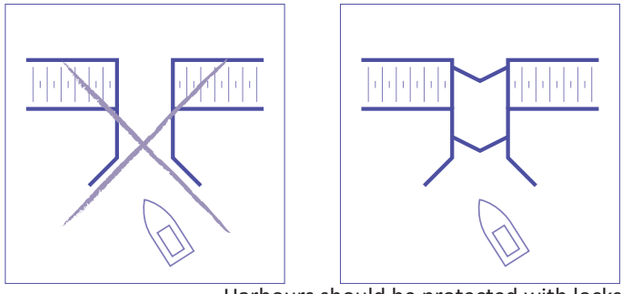
Besides starting with taking measures against flooding, it is also important to carefully look at the policy in the area. This has not only to do with safety issues, but also with the qualities of the area. With the changes in the past some qualities of the area got lost, but other qualities have been strengthened or have newly aroused in the past century. It is likely that the changes that will happen to the area in the coming century will have influence on the qualities of the area. In the next chapter the concept of 'spatial quality' will be described to be able to better understand the qualities of the area, and to be able to study the specific qualities of the focus area in the following chapter.

2.5.2 Guidelines

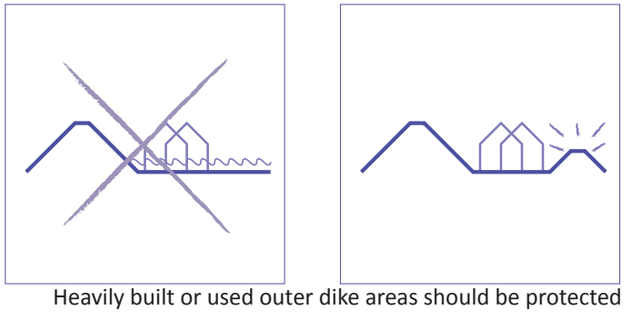
The guidelines derived from this chapter are based on the research that already has been done on the consequences of water level rise in the IJsselmeer. These guidelines are not place specific, they are relevant for the whole IJsselmeer and its dikes. While these are the first guidelines the relevancy for the study area will be checked in the following chapters and some of them will possibly be complemented with new guidelines.



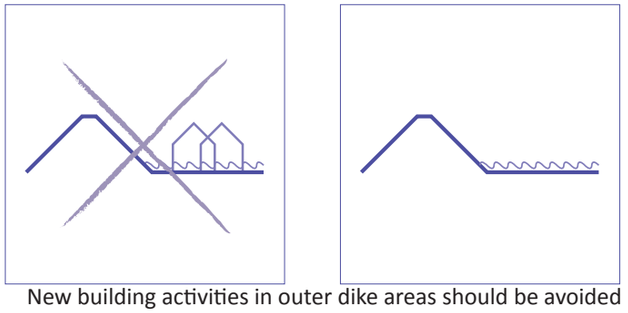
Dikes should be reinforced to be able to cope with the proposed water level rise



Harbours should be protected with locks



Heavily built or used outer dike areas should be protected



New building activities in outer dike areas should be avoided

3

Theorethical framework

Spatial quality and landscape experience

3.1 Spatial quality

3.1.1 Quality, architectural quality and landscape quality

Quality is a difficult concept, because quality has both an objective, descriptive meaning as well as a subjective, criticizing meaning (de Smidt, 2005). The quality of an object or space depends on how much it meets a certain goal, but quality is also determined on the basis of non-utilitarian grounds, like beauty or reference. Quality normally depends on several criteria, and these criteria are strongly related to the context in which they are used (Hooijmeijer et. al., 2001 and Vroom, 2005). Rutledge (1971) states that the best or highest quality is a product which has no weaknesses, but on the other hand he realises that such an explanation is very difficult in case of a landscape (design). Coeterier (1987) has a different opinion on qualities. He states: 'qualities are characteristics, which make that things are distinguished from other things'. According to Pirsig (1999) in Werksma (2003), quality is a product of thoughts and statements, that are recognized through a thoughtless process. While definitions are products of strict and formal thinking, quality can not be defined.

In architecture and landscape architecture, a difference has been made between architectural quality, landscape quality and spatial quality. According to Dijkstra (2001) in Vroom (2005) architectural quality is determined by:

- The consistency between form and function
- The relation between building, terrain and surroundings
- Clearness in the architectural concept
- The way is dealt with associative meanings in the concept
- The way is dealt with dimensions and proportions

Although this explanation is about architecture and buildings, all conditions can be applied to landscape architecture, and return in the theories about spatial quality in landscape architecture.

According to Van Zoest (1994) in Vroom (2005) landscape quality is described in the 'Nota Landschap' of 1991 (policy document about the landscape) as:

- The landscape has to be aesthetic valuable
- It has to be able to function well in ecological perspective
- It has to form a good economic-functional basis

According to the Nota, landscape only has quality if all these conditions are fulfilled and if there is a certain cohesion between them (Vroom, 2005). According to De Smidt (2005), landscape quality is often used as a synonym for landscape value in Nota's and other policy documents. Some critical remarks can be made on this description of landscape quality. What is for example aesthetic valuable and who decides when something has aesthetic value? It has been found that the judgments of landscape quality may significantly vary between different experts assessing the same landscape (Karmanov, 2009). According to Van Assche (2003) in Vroom (2005), the qualities of a landscape are not an element of that landscape, but quality originates while people assign a certain meaning to it, and these meanings depend on the images people have of the world. The quality of a landscape does not exist (Vroom, 2005).

3.1.2 Spatial quality

Spatial quality is a relatively new term, that evolved in the 1980's under influence of a growing prosperity and more leisure time. Especially experience got more attention in those days, while only functionality was not that important anymore. This is also known as the emergence of the experience-economy (Beun, 2009). The term spatial quality is used both by landscape architects as well as spatial planners, with the planners focussing on the policy making and development part of it, and landscape architects focussing on design. This can mean that some characteristics of spatial quality that are named are not that relevant for both fields. Spatial economists see spatial quality as the 'soft' value, next to 'hard' values like real estate value (Bayer, 2009). Spatial quality is a normative concept, which will be considered differently from different disciplines and which will have a changing fulfilment during time (Hooijmeijer et. al., 2001).

Spatial quality seems to have similarities with landscape quality, but if the government mentions spatial quality, this includes more than landscape quality (Vroom, 2005). Yet this seems to be a Dutch way of separating terms. In foreign documents and articles, both terms are used for (practically) the same, in that case the characteristics of landscape quality can also be used to describe spatial quality. In some other documents (for example Lynch, 1976 and Saito, 2007) also the term environmental quality is used. The term environmental quality is used both for a good, pleasurable environment (both for people and in ecological perspective) as well as purely for a clean, ecologically well-functioning environment.

There are different ways to look at spatial quality, but the contradiction between objective and subjective returns in most of them. A clear definition of spatial quality for landscape architects does not exist, and also for other professions most definitions can be questioned. De Smidt (2005) defines spatial quality as: 'the spatial quality of an area consists of (objective) described objects and characteristics that are necessary to fulfil the societal use that is (subjective) chosen (by people) for that area'.

On one hand this definition is vague, it does not explain what spatial quality really is. It seems to relate spatial quality with societal use, but it is not clear what this is and how this can be chosen. Besides that, this definition seems to state that an area should be usable to have spatial quality. On the other hand there are some important things in this definition. Spatial quality is about objects and characteristics of an area, which can be described or pointed out (objective). But to speak about spatial quality it is also necessary to look at the thoughts and meanings (subjective) which people attach to these objects and characteristics (see figures 3.1a and b). Spatial quality is also about a specific area. The same objects and characteristics in a different area do not make the same spatial quality. This depends both on other characteristics of that area as well as on the people in that area and how they value the area.

The term value is important when talking about spatial quality, it is about how people (subjective) value an area and its characteristics. Coeterier (1987) points out that value is about interest and importance, especially when valuing the landscape. Valuing has to do with seeing landscape qualities, characteristics that give meaning to the landscape. Both spatial quality and value are area specific. Naming the spatial quality has to be an area specific, societal process (de Smidt, 2005). Like the opinion of Van Assche on landscape quality, spatial quality can not be seen as a separate element of the landscape. Spatial quality is not the same for everybody, everyone describes and perceives it in its own way (Sperling, 2009).

To be able to work with the term spatial quality it seems to be necessary to measure or weigh the spatial quality of an area. To evaluate the spatial quality of an area there has to be consensus about the value of subjective aspects (Rijkswaterstaat, 2007). In Dutch policy two main theories about evaluating spatial quality have been developed, both with their own strengths and weaknesses. Both theories are described in block 3.1 and 3.2.

Besides the presented theories there are other ways developed in Dutch policy to look at spatial quality, sometimes influenced by one of the theories. These ways of thinking are not clear and can not be called theories. The VROM-raad (part of the ministry of housing, spatial ordering and environment) uses the terms economic effectiveness, ecological sustainability, cultural identity and social justice to determine spatial quality (Hooijmeijer et. al., 2001). Social justice seems a little bit strange in this case and is mainly used to legitimate policy (Hooijmeijer et. al., 2001). In the Vijfde (Fifth) Nota Ruimtelijke Ordening even more terms are introduced: spatial diversity, economic and societal functionality, cultural diversity, social justice, sustainability, attractiveness and human proportions (Vroom, 2005).

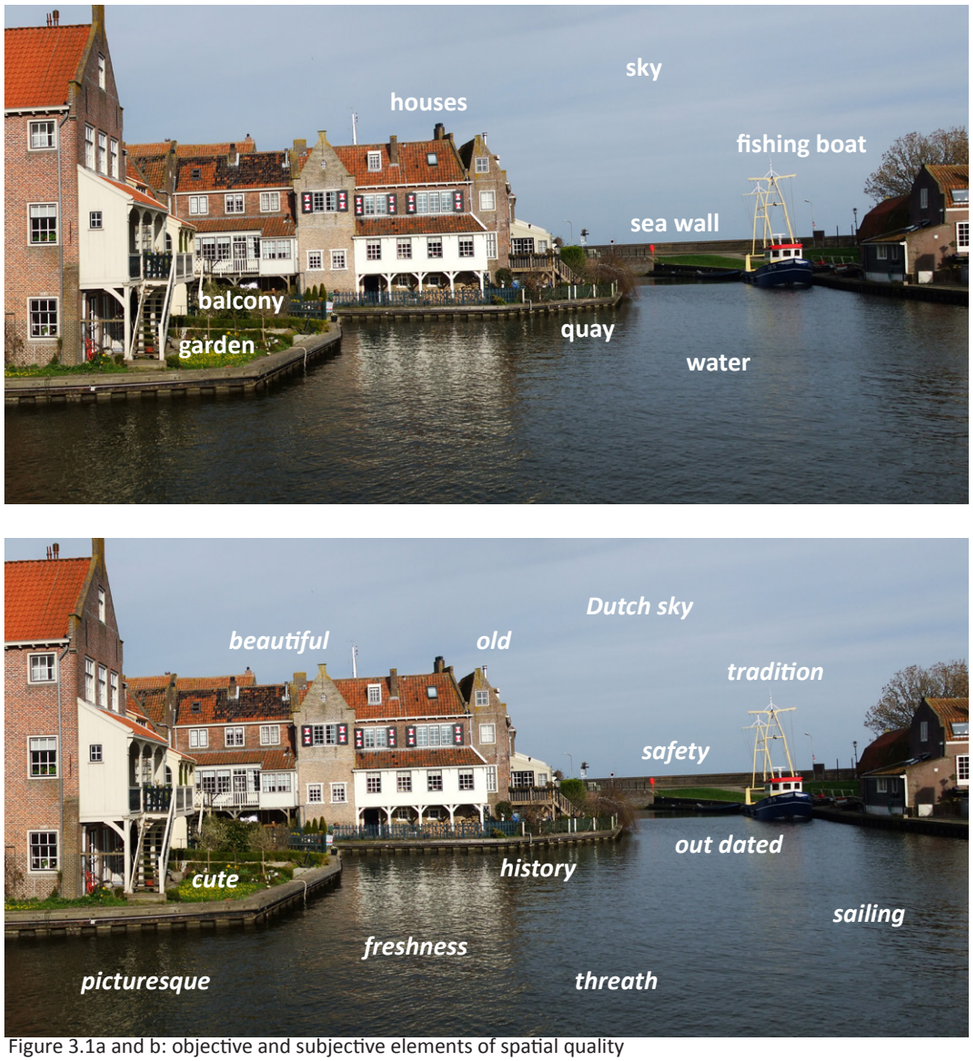


Figure 3.1a and b: objective and subjective elements of spatial quality

Block 3.1: practical, experiential and future value (three pronged theory)

This is named the traditional way of looking at spatial quality, first mentioned in the Vierde (Fourth) Nota Ruimtelijke Ordening (policy document of the ministry of housing, spatial ordering and environment) (Hooijmeijer et. al., 2001). In the document of Rijkswaterstaat (2007) is said that spatial quality is about functional, attractive and sustainable. In the three pronged theory of spatial quality the terms practical value, experiential value and future value are used (Hooijmeijer et. al., 2001). These three parts are related to the classical terms of Vitruvius (60 B.C.), utilitas (effectivity), venustas (beauty) and firmitas (sustainability), which were used to judge the quality of a building (Hooijmeijer et. al., 2001). During the development of this way of thinking about spatial quality more terms were mentioned, which all have their own basis. This gives a clue about how this theory is developed (Hooijmeijer et. al., 2001) (see figure 3.1.1).

structure	*pattern*	*process*	*(geography)*
function	*form*	*time*	*(acting)*
integration	*composition*	*development*	*(design)*
consensus	*diversity*	*sustainability*	*(basis line of terms)*
practical value	***experiential value***	***future value***	***(final line of terms)***

Figure 3.1.1: development of the three pronged theory

According to Rijkswaterstaat (2007) and Hooijmeijer et. al. (2001), the three parts are described as:

- *The practical quality is high if the space can be used in a safe and efficient way by different functions, and if these function do not hinder, but if possible strengthen each other. It is also about adequacy, efficient construction, efficient maintenance and accessibility.*
- *The experiential quality is high if the living environment is recognizable and diverse, if there is spatial variation and identity (appearance of characteristic elements), if cultural history and beauty are readable in the landscape and if the landscape has a human scale.*
- *The future quality is high if the area is suitable for new forms of use and new cultural and economic meanings. Sustainability, a clean or fresh environment, biodiversity, robustness, adaptability and flexibility in time are important characteristics a high future quality.*

The three prongs are often connected with economy (practical), social (experiential) and ecology (future) (Hooijmeijer et. al., 2001). This is closely related to the idea about landscape quality presented in the Nota landschap, resulting in a faded differentiation between landscape quality and spatial quality.

By naming and valuing the aspects of these qualities it is possible to judge what the present spatial quality is, or it is possible to judge whether a project influences the spatial quality and if this influence is acceptable (Rijkswaterstaat, 2007). Hooijmeijer et. al. (2001) try to bring the original three pronged theory together with the four fields that are introduced by the VROM-raad in a matrix. They state that the matrix helps to see fields of spatial quality that are easy to forget. It now becomes clear that the VROM-raad only laid accents on three fields of the matrix. The terms used in the Vijfde Nota lay accents on more fields of the matrix. The matrix is worked out by Hooijmeijer et. al. (see figure 3.1.2) and it becomes clear that there are many fields on which spatial quality can be judged. The matrix is not complete, it is possible to add or leave characteristics in specific situations. It is also clear that some characteristics return in different fields or layers.

	Economic	***Social***	***Ecologic***	***Cultural***
Practical value	*allocation efficiency*	*accessibil-ity*	*safety/ hinder*	*freedom of choice*
	accessibil-ity	*division*	*pollution*	*diversity*
	external effects	*participa-tion*	*drying out*	*meeting*
	multi-purpose	*freedom of choice*	*fragmenta-tion*	
Experien-tial value	*image*	*inequality*	*space/rest*	*identity*
	attractive-ness	*solidarity*	*beauty*	*beauty*
		safety	*health*	*contrast*
Future value	*stability/ flexibility*	*enclosure*	*supplies*	*heritage*
	agglomera-tion	*cultures of poverty*	*ecosystems*	*integration*
	cumulative attraction			*renewal*

Figure 3.1.2: filled in spatial quality matrix (based on: Hooijmeijer et.al., 2001)

Block 3.2: Static quality vs. dynamic quality (balance theory)

Another way to look at spatial quality is to look at dynamic and static quality. Dynamic quality is characterized by the new, the liveliness and the surprising, but this means that the quality does not stay, newer things are always necessary. The static quality is characterized by sustainability and that what people are used to and that is sometimes only recognized if it has disappeared. Spatial quality is the balance between dynamic and static quality (Vroom, 2005).

Werksma (2002/2003), who works in the field of spatial planning, relates static and dynamic spatial quality to societal and spatial components that interact with each other and strengthen each other. He states that spatial planning concerns the planning of the physical living environment in a reflexive relation with the societal process. There is only spatial quality if the spatial and societal components strengthen each other (Kleefmann, 1986 in: Werksma, 2002). The spatial components are derived from the classical layer approach (ground layer, networks and occupation). These layers represent the static quality, they are all dependent to change, but at their own speed. The occupation layer for example will transform quicker compared to the ground layer (see figure 3.2.1). The societal components are separated into four dimensions, economic, social, cultural and ecological, which are the same terms as introduced by the VROM-raad and used by Hooijmeijer et. al.. The dynamic quality of the societal components represent the personal, subjective and fast changing opinions about functionality and experience. These opinions are strongly related to the local situation (place), the moment (time) and local standards and values (culture) (Werksma, 2003).

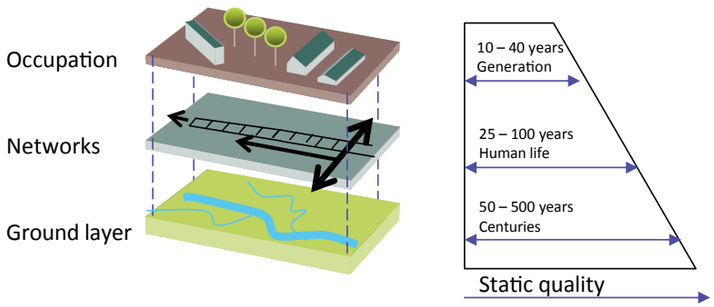


Figure 3.2.1: layer approach (based on: Werksma, 2002 and Werksma 2003)

Werksma states that the societal component has become more dynamic in the past century, as a result of (technological) developments and a larger play field while borders have faded. While the society is so dynamic these days, there is a bigger discrepancy between spatial plans and the spatial reality. That is why there is a plea for a different approach in spatial planning: from ordering to development (IPO, 2001 in: Werksma, 2002). This should lead to more spatial quality, which is similar to the question for adaptability and flexibility in the three pronged theory for spatial quality.

The spatial and societal components are brought together and confronted with each other in the so called quality matrix (see figure 3.2.2), which has almost the same look as the matrix of Hooijmeijer et. al.. It becomes clear that there is more static quality in the underground layer and more dynamic quality in the occupation layer. Werksma (2002) sees similarities with the traditional three pronged theory. He states that the practical value represents the static quality, the experiential value represents the dynamic quality and that the future value represents the fact that both qualities should be in balance.

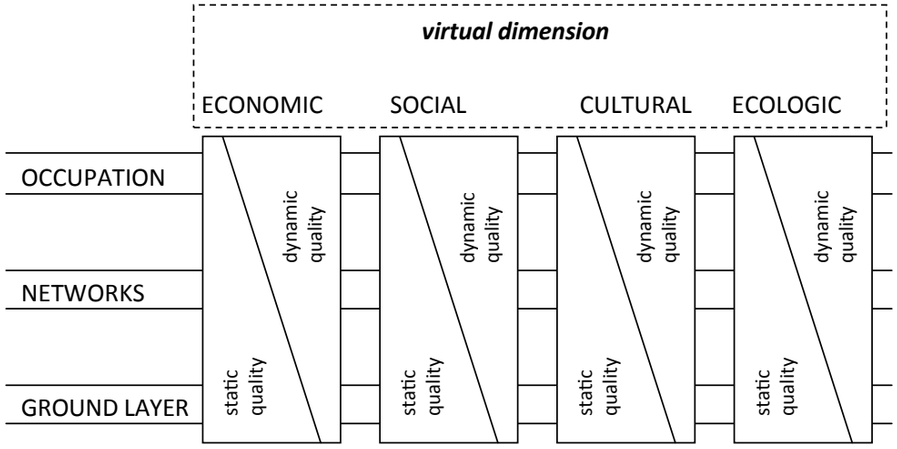


Figure 3.2.2: quality matrix (based on: Werksma, 2002)

3.1.3 Usability of the theories in landscape architecture

Both theories end up with a matrix that should be filled in to evaluate the spatial quality. This should make it an objective activity, but the evaluation is still dependent on subjective and personal choices. The matrixes seem to make it more complex and generate questions, and do not give answers. Klijn et. al. (2010) ask a good question related to the matrix of Hooijmeijer et. al.: 'when do we have spatial quality? Only if all fields of the matrix are filled?'. Besides that, the matrixes are both more suitable for planners than for (landscape)architects while they do not give a clue how to deal with spatial quality in a design. But although both theories end up with complex matrixes, they can still be used in developing theories about spatial quality.

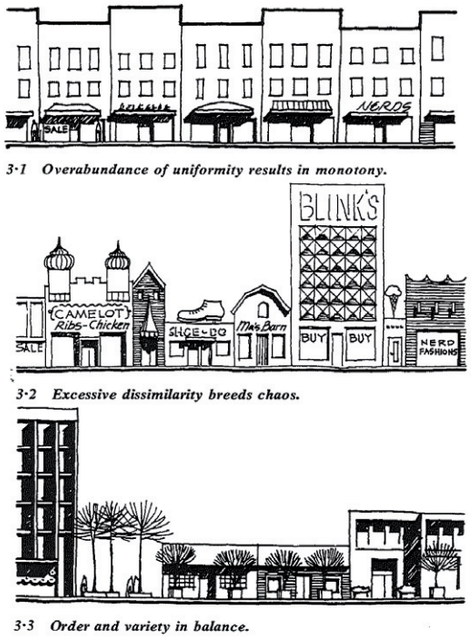
The three pronged theory is based on the classic architectural literature of Vitruvius, who developed a theory to evaluate the quality of buildings. This theory is still often used by many architects and landscape architects. But while translating the terms of Vitruvius to the three values of spatial quality, some of the clarity got lost. The prongs are so strongly connected and overlap each other to such a degree that it is unclear which characteristics should be placed under which prong. Especially the translation from venustas (beauty) to experiential value is a though one. Experiential value can include much more than beauty, and this is the point where the overlap between the prongs occur. This is something Saito (2007) also mentions when saying that the functional and aesthetic (experiential) are fully integrated, and that you lose some aesthetic value if you remove the functional value. In some environmental art works the aesthetic and the practical are inseparable (Saito, 2007). Klaasen (in: Steenbergen, 2002) agrees on this opinion by saying that the use of an area is a necessary condition for the capacity to experience it. De Jong (2011) also agrees on this opinion, by stating that if an area is less accessible, it is also less easy to experience the area.

For many people, including many landscape architects the experiential value is the most important prong. This importance returns in the opinion of Beun (2009) who states that by changing the experience in an area, the practical value and future value will also change. But there are also other opinions. Hooijmeijer et. al. developed their matrix for Habiforum, a research program based on multifunctional use. They state that spatial quality can be enlarged by a multifunctional use of a space (Hooijmeijer et. al., 2001). This means that the practical value is actually the most important prong, which is strongly related to the classical statement 'form follows function'.

What the three pronged theory clearly points out is that spatial quality is not only about use or beauty, there are many more fields that define the quality of an area. Especially the attention to future value is important, while time and changes can strongly influence the quality of an area or design. This works though all three prongs. The value of the use and experience of a new constructed site can be very high, but if the area is not maintained well or can not adapt to changes, this value will drop after years. On the other hand, some areas will get more (spatial) quality as they become older, and are maybe used in a different way (Saito, 2007). The attention to experience is also an important point of this model, especially for landscape design. But the model shows also that the experiential value is the hardest value to evaluate and to describe. This is the reason that experience (and perception) are further studied in the next paragraph.

Although the balance theory is not developed for or by a landscape architect, the theory has relations with theories that are well known by and useful for landscape architects. The balance theory is comparable with the classical way of looking at beauty as a balanced combination of order and variety, like mentioned in Rutledge (1971). The need to perceive order or a logical correctness about what is experienced stems from man's need to understand and find reason and regulation in his work. The desire to witness variety or contrast. A touch – but only a touch – of disorder, difference or change from the expected is rooted in man's need to exercise his senses (Rutledge, 1971) (see figure 3.2). Order and variety can be seen on more fields than form and placement, functions and (sensory) experiences are also fields you can apply it to.

Order is necessary to make the world understandable and to prevent people from uncertainties (Vroom, 1986 and Leupen et. al., 2005). Haapala states in Saito (2007): 'ordinary everyday objects lack the surprise element or freshness of the strange, nevertheless they give us pleasure through a kind of comforting stability'. Like with order vs. variety, static quality without dynamics results in monotony and deterioration due to ageing. Dynamic quality without static anchoring results in chaos, which is never pleasurable (Lynch, 1960). The interchange between static and dynamic quality is never without tension. Often they are unbalanced and a new balance needs to be found (Rutledge,



3·1 Overabundance of uniformity results in monotony.

3·2 Excessive dissimilarity breeds chaos.

3·3 Order and variety in balance.

Figure 3.2: order vs. variety (Rutledge, 1971)

1971 and Werksma, 2003). Loidl et. al. (2003) state: 'the key to the quality in every design solution lies in the field of tension between uniformity (coherence, order) and variety (diversity). The static qualities are also often hidden qualities, qualities that are not named by people if you ask them. But without these hidden qualities the landscape would not function or would not be experienced the same way.

Werksma stated that there is a relation between his theory and the three pronged theory. His way of thinking seems logic if you look at the way the three pronged theory has developed (consensus vs. variety, sustainability). However, Werksma misses the fact that the experiential value is built up of dynamic elements like diversity and variation, but needs to be anchored in static qualities like cultural history and recognisability. Otherwise it will result in chaos. On the other hand, practical value also includes a variety of functions that function together in an orderly way. Without a variety of functions a place would be boring, and not adaptable for the future. Like the theory of Hooijmeijer et. al., also in the theory of Werksma the limits of the different parts are not clear, while they overlap each other.

3.1.4 Characteristics of spatial quality

Both the three pronged theory as well as the balance theory show that it is hard, or even impossible, to measure, judge or weigh spatial quality. But it is possible to predict whether it is likely that a group of people (or groups of people) will ascribe spatial quality to an area. To evaluate the possible spatial quality of an area it is important to look at the characteristics to which spatial quality is related. These characteristics are derived from the literature and the theories on spatial quality. It can be said that spatial quality is related to:

- place
- all layers and scales of the landscape
- the ability to experience
- accessibility and usability
- time and moment
- the society
- a combination between known and new
- a combination between recognizable and surprising
- a combination between order and variety

These characteristics do not function as a checkbox, but show the different fields that should be studied if the spatial quality of an area is studied. All fields are interrelated. For example, the ability to experience is strongly influenced by accessibility and usability, and the society is influenced by the time and moment, but also by the place.

3.2 Landscape experience

3.2.1 Experience and perception

The discussion about spatial quality started with an increased interest in experience. Bosch Slabbers (2008) states that spatial quality exists of layers (natural landscape, cultural landscape en urban landscape) crossed by experience (see figure 3.3). So for these landscape architects experience is the most important and connecting element of spatial quality. It also became clear that the term experience is subjective and hard to describe. In this section the term (landscape) experience will be further described.

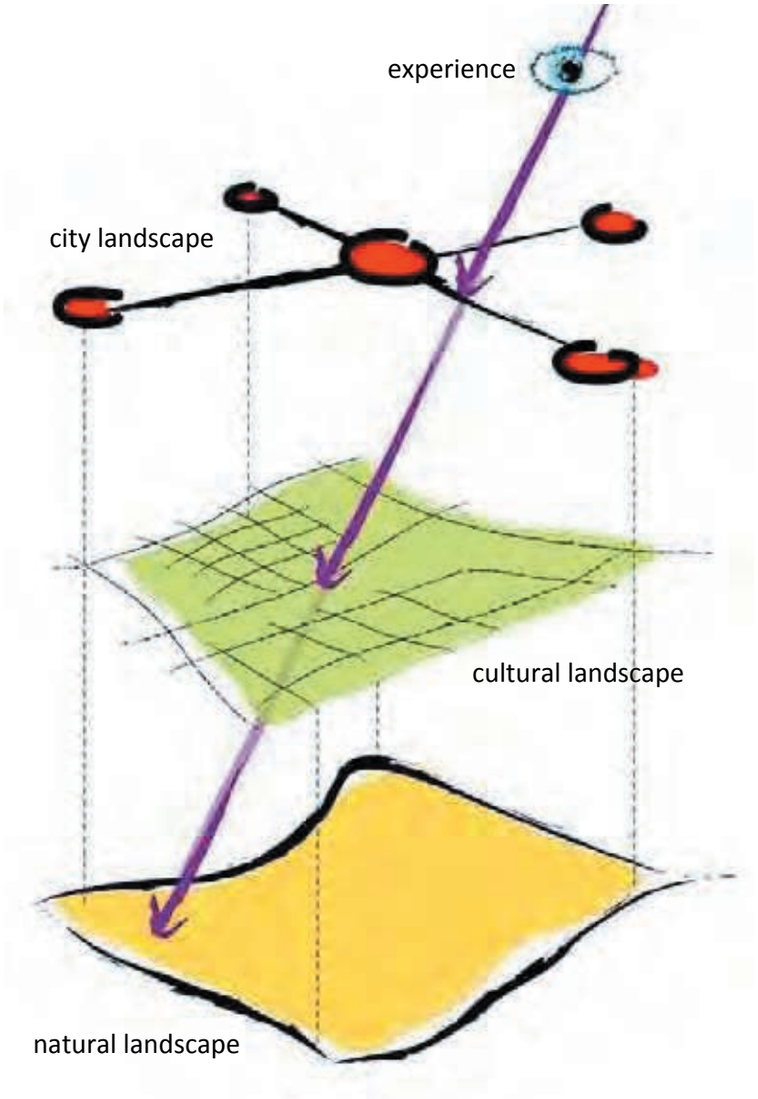


Figure 3.3: experience as the connecting element (Bosch Slabbers, 2008)

Experience is first and foremost a psychological phenomenon (Karmanov, 2009). Experience is not only about aesthetics, although aesthetic effects have a large potential of influencing the experience (Lynch, 1976). In the dictionary the term experience is described in two ways: '(the process of getting) knowledge or skill from doing, seeing or feeling things' and 'something that happens to you that affects how you feel' (Cambridge advanced learners dictionary, 2011). So experiencing is both an activity as well as a sensory impression. Experience has to do with knowledge and what you already know or have experienced earlier in your life, which affects how you feel about a situation. Feelings (and next to that emotions) are important aspects of experience (Karmanov, 2009). Experience as a sensory impression is subjective to its core, that is highly dependent on the particularities of places and people (Lynch, 1976).

When we experience something by means of our sense organs, the experience is called perception (Hesselgren, 1975). According to Coeterier (1987), perceiving exists of three parts: structuring, adding a meaning and action founding. Three psychological functions of experiencing can be added to these parts: thinking, feeling and wanting (cognitive, affective and conative) (Coeterier, 1986 in: Vroom, 2005). The search for connections, for characteristic units, is an essential part of our view of the world around us. We work on a number of individual pieces of information and sensory impressions, constantly and 'automatically' searching for units that we recognize because of our prior experience and as a rule can name as well (Loidl et. al., 2003). This is the structuring part of perceiving and experience, seeing separate elements as part of a whole. Nothing is experienced by itself, but always in relation to its surroundings, the sequences of events leading up to it, the memory of past experiences (Lynch, 1960).

Adding a meaning to things is strongly related to structure. The structure in which a phenomenon occurs defines its meaning (Coeterier, 1987). The term meaning means that the observer has, in practical or emotional sense, a relation with the object he is observing (Vroom, 1986). By the use of meanings an emotion can be connected with a perception (Hesselgren, 1975) Adding a meaning (especially to a landscape) is always subjective and is done spontaneously (Hesselgren, 1975 and Kolff in: van Nieuwenhuijze, 1994). Adding a meaning or forming an image of a landscape is mentally processing all the impressions (Vroom, 1986).

The last part of perceiving is called action founding, which can be seen as wanting to perceive the landscape. Taking action is necessary to structure and add meaning to something. Observing is also part of taking action (Coeterier, 1987). Lynch (1960) describes a slightly different third part of perceiving and (landscape) image founding. In his opinion the third part is identity, or identification of an object, which implies its distinction from other things (Lynch, 1960). On the other hand, identification of an object to perceive also has similarities with the idea of action founding of Coeterier.

3.2.2 Experience, senses and movement

Perception is steered by our sense organs (see figure 3.4). In perceiving the landscape this means: 'the experience of the environment through all senses', which expresses that it is not only about seeing with the eye (Vroom, 1986). Sensuous (or sensory) quality does not refer to any sinful or voluptuous dimension (Lynch, 1976). The good experience is described as a 'sensory delight', the pleasure and joy of feeling, hearing, smelling, tasting and seeing things in the landscape (Lynch, 1976 and Vroom, 1986). Sensory stimuli activate latent information in the mind and bring forth mental images (Motloch, 2001). Especially scents play an important role for the identification of a landscape through its characteristic set of sensory qualities (Coeterier, 1996).

The relation between senses and experiences is a special one. Lynch (1976) states: 'our senses are local, while our experience is regional'. This means that a set of small sensations are the basis for the experience of an entire area. This does however not mean that when talking about experience the focus should only be on these small sensations, it is always about a bigger whole. Specific sensations can possibly even be unpleasant, like noise or heat, but together with other elements and sensations they give a whole qualitative experience (Saito, 2007). Saito uses the terms ambience or atmosphere to describe this sensational experience of a whole area. Vroom (1986) points out that the sensory experience is strongly related to differences, contrasts and variety. A longer period of the same weakens the stimulation of the senses. We desire to perceive variability (Rapoport, 1977 in: Motloch 2001). However: it is not good to stimulate all senses all the time, people are not able to handle too much information at the same time, in that case chaos is perceived (Vroom, 1986).

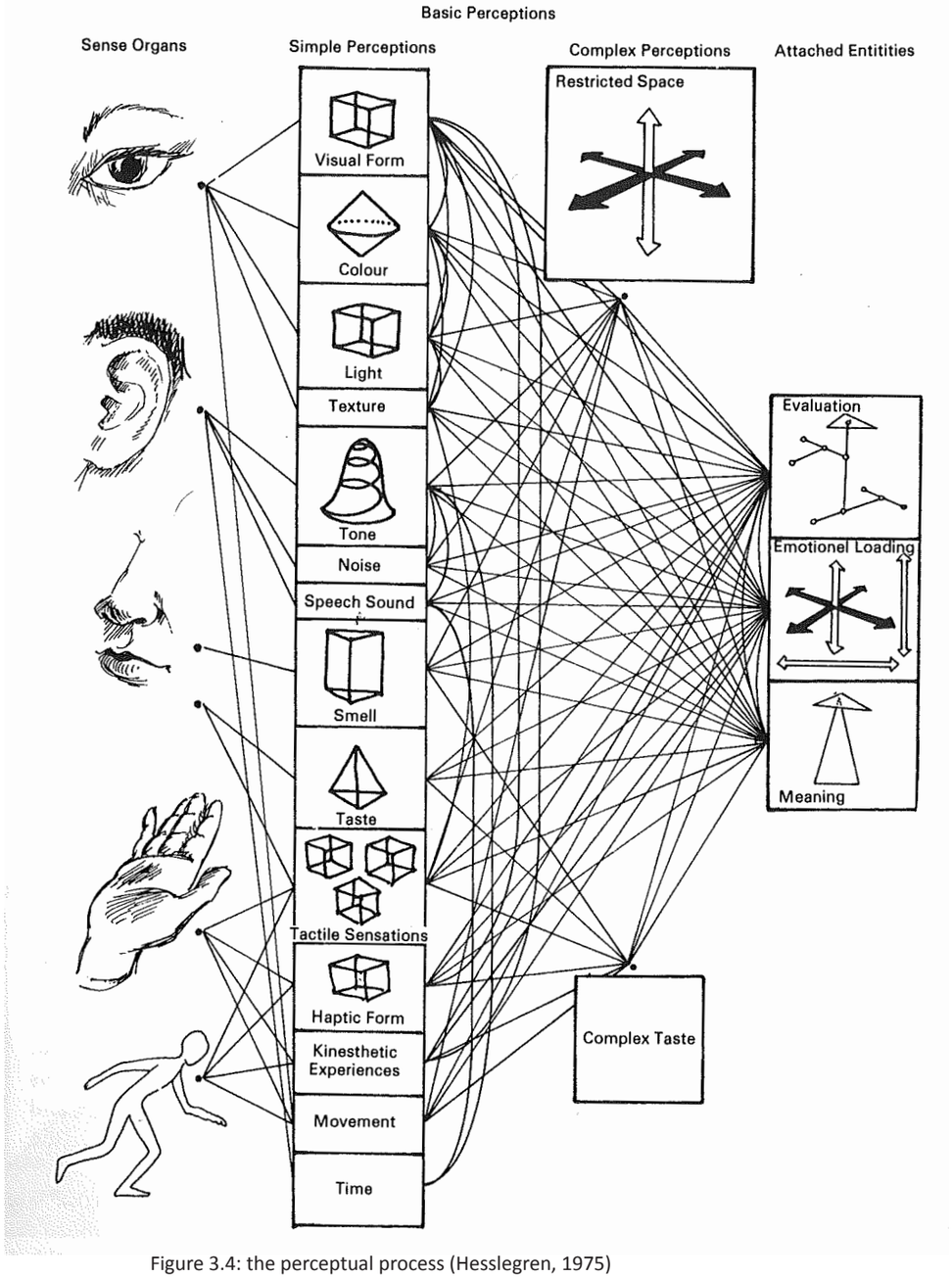


Figure 3.4: the perceptual process (Hesslegren, 1975)

Our perception of the world is formed as we move from place to place, changing our location helps to understand the landscape (Motloch, 2001). Movement, speed, and the time it takes to travel a certain distance, influence the senses that are stimulated. Speed influences the time available to perceive a setting, and to recognize that setting as a place. Moving quickly, we are relatively unaware of details (Motloch 2001). At a high speed our viewpoint is concentrated right in front of us, at a relatively far distance. Elements that are close by, or placed rectangular to the direction of the movement, will not be perceived (see figure 3.5). The perception of distance is strongly related to the perception of the time it takes to travel that distance. This has a relation with order and variety. In a pleasant (and varied) landscape, we tend to move slowly, yet the trip seems to take less time. We move more rapidly through boring landscapes, but the trip seems longer (Motloch, 2001).

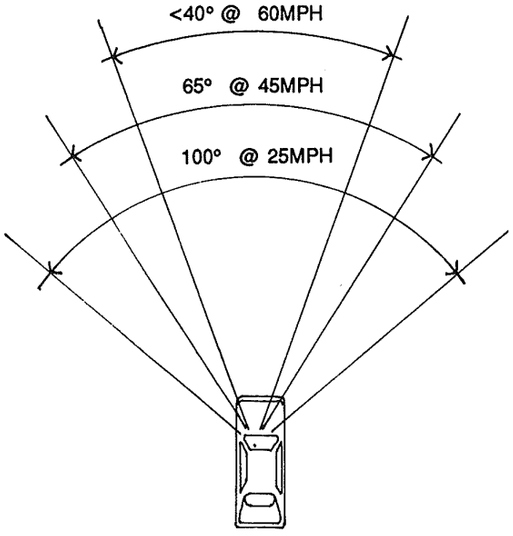


Figure 3.5: travel speed and peripheral vision in a car (Motloch, 2001)

3.2.3 Experience of the landscape

Experiences are necessary for people to build a relationship with their environment (Vroom, 1986). Or as Karmanov (2009) states: 'experience is at the very centre of the human-landscape relationship'. The emotions that are connected with experiences are important for the relation people have with the landscape. The experience of landscape is a holistic phenomenon, a flow of experiential qualities, images, thoughts and meanings (Karmanov, 2009). In fact the landscape as we see it is a result of this, a construct of mind and of feeling (Arriaza et. al., 2004). This is not general, but personal, and often hard to describe in words. The way the landscape is used is important for the experience and valuing of the landscape (Coeterier, 1986). The use of the land often defines what the landscape looks like, but it has also to do with accessibility. If a landscape is not accessible, or not accessible for certain groups of people, the landscape is experienced differently, maybe even in a bad way.

Looking at the experience of landscape the term recognizable returns. The human experience of encountering a new place or knowing how to act or go on in a familiar place is intimately bound up with previous experiences (Tilley, 1994). People are able to value the landscape and add meaning to it because they have already experienced landscapes before and they see connections within the landscape. Perceiving (landscape)form means summing up (supersizing) individual visual pieces of information by using our prior experience (Loidl et. al., 2003). If a place is not connected with its surroundings or underlying pattern, it is harder for people to understand the landscape. The characteristic 'unity' is the main characteristic which people both try to find (as an observer) as well as on which people value landscapes (Coeterier, 1987). Next to the characteristic 'unity', the perception of the characteristic 'spaciousness' is important. Spaciousness has to do with the size and form of open areas, but also with textures, arrangements, and heights of elements. In the north of the Netherlands for example, a large open space is valued positively; it gives an overview over the land (Coeterier, 1996). In other parts of the country or the world the value of such a large open space can be different.

Lynch (1960) relates experiences and perception of the city to the mental image or map of the city, which people make up in their mind. His ideas about the mental map existing of five elements (paths, edges, districts, nodes and landmarks) has been used in many other theories about city images and landscape images. Lynch (1960) states: 'districts are structured with nodes, defined by edges, penetrated by paths, and sprinkled with landmarks'. Indeed these elements can also be seen outside cities, and actually express how people structure the landscape they are perceiving. By adding importance to elements of this structured landscape people also already start to add meaning to the landscape. With different circumstances of viewing, the image of a landscape may shift occasionally (Lynch, 1960). This also means that (part of) a city can be perceived as one district when looking at the larger landscape, but can be divided in several districts when looking only at this particular city.

The experience of the landscape asks for ‘awareness’ of the observer: the ordinary environment is experienced less intense compared with a new one (Vroom, 2005). The balance between order and variety returns, ordinary environments are not experienced that intense since they are already ordered in peoples mind. New landscapes are seen as variety, but they need to be rooted in what people already know. The knowledge of the ordinary landscapes is necessary to help understanding and ordering the variety in new environments. The importance of the ordinary (known) landscape becomes clear if you look at how people try to make things their own. This can be their own house, but people also name other places their own, although they are not in practice, like an own bench in the park (Vroom, 1986). Stating that something is your own is an example of adding a meaning to a certain spot, personal identification with the landscape is important. This has also to do with interest, it is our intensely personal experience of landscape in the first place that motivates our involvement with landscape (Karmanov, 2009).

Preferences for certain landscapes are culturally based and therefore variable in time (Meinig, 1979 in: Vroom, 2005). Many factors affect landscape perception and experience, such as knowledge, educational background, personality, professional role, memory, individual history, nationality, membership of some cultural and social group, and religion (Karmanov, 2009). What is experienced as ordinary by one person can be completely new (and even not understandable) for somebody else, especially when this person is from a completely different landscape or culture. And the favorite landscapes of your childhood are not automatically favorite at an older age. Preferences change over time, and not only because somebody gets older and has seen more landscapes and has had more experiences; preferences within a culture do also change.

3.3 Spatial quality of dikes

3.3.1 The discussion about spatial quality

Over centuries, dikes were not recognized as beautiful elements in the landscape. In 17th and 18th century paintings for example, dikes are practically never pictured as the main subject of a painting (Sleeuwenhoek, 2006). But over the last century, fed by large projects like the Afsluitdijk, people started to appreciate dikes as important elements in the landscape. The increased appreciation of dikes lead to protests against dike reinforcements in the 1970's. It has been since those days that the spatial quality of (river) dikes is discussed. People were and are afraid that ambitious dike reinforcement projects would damage the spatial quality of the dikes (Feddes et. al., 1988). Society thinks it is important that the river area offers possibilities for use and that the landscape is attractive, now and in the future (Rijkswaterstaat, 2007).

The spatial quality of dikes is often discussed as part of the spatial quality of the river area. According to the 'Nota Ruimte' (2004) in de Smidt (2005) the goal is to keep the present safety level in this area and to improve the spatial quality. To reach the last goal the Nota has the following suggestions:

- Enlargement of spatial diversity between different river streams
- Conservation and strengthening of the open character with characteristic water fronts
- Preservation and development of landscape, ecological, geological and cultural historic values and improvement of the environmental quality

The Nota does not give clear criteria, but these suggestions already give a clue about what is seen as the most important aspects of spatial quality of river areas, and indirect of dikes.

But what can be seen as the specific spatial quality of a dike, so that it is also useful for dikes that are not located in the river area? Vroom (2005) states that dikes are an integrating part of the landscape. According to Feddes et. al. (1988), the two main characteristics of dikes, which are part of the spatial quality of dikes, are both separation and connection. In the direction rectangular to the dike the dike forms the separation between two parts of the landscape. In the direction parallel to the dike, the dike forms a connection between different parts and places. The separation and connection are both visual as well as practical.

Looking not only at the dike, but at the landscape as an entirety, it becomes clear that separation and connection are meanings that are attached to the dikes, while they are experienced from the dike. It is important to realise that the water body the dike is built along is actually the primarily element that separates and connects. On a lower scale level the dike is indeed the separating and connecting element. It soon becomes clear that the balance theory of static and dynamic quality (and order vs. variety) is useful to look at the spatial quality of dikes. The balance between separation and connection makes that a dike is able to function as an integrating part, and the separating and connecting function will often return, in different fields, when analysing the spatial quality of dikes.

But also the three pronged theory is useful to look at the spatial quality of dikes, although it is possible to discuss how the model is interpreted. Klijn et. al. (2010) have a down-to-earth view upon the concept of spatial quality of (delta)dikes. While both utilitas (does the dike function as it should?) and firmitas (will the dike keep functioning as it should?) should always be answered with a yes, spatial quality of dikes is only about venustas (Klijn et. al., 2010). On the other hand, looking at the interpretation of for example the practical value of a dike by Rijkswaterstaat (2007), this should also be about the practical value of the dike for multi-functional use. According to Hooijmeijer et. al. (2001), multi-functional use is even essential for a good spatial quality. In this case the dike is not just seen as a technical element to keep the water out, but as an element that has more functions within the landscape.

In this paragraph the focus will be on the way dikes are experienced, or the experiential value of dikes. Besides that, also other qualities of dikes that make or influence the spatial quality of dikes will be discussed. The knowledge gained from the theories on spatial quality will be used to evaluate the spatial quality of dikes in general, with in mind that the study area is a lake dike. This means that the spatial quality has both differences and similarities with the spatial quality of the more often studied river dikes.

3.3.2 Spatial quality of the dike and its surroundings

The spatial quality of a dike has become more important during the last decades, strongly connected with the increased recreational function of many dikes. In literature several characteristics are named that are important for the spatial quality of dikes. The line formed continuity in the landscape is mentioned as one of the most important characteristics (van Nieuwenhuijze et. al., 1994). The shape of a dike is easy to recognize as a landscape element and so is the specific and readable consistency between the dike and other landscape patterns and processes (Feddes et. al., 1988). For the river landscape Rijkswaterstaat (2007) mentions the unity in the landscape with area specific diversity on every place, which is the basis for an attractive river landscape. Continuity, unity and readability are characteristics that are often mentioned when talking about the spatial quality of dikes, but looking at the landscape around the dike diversity is an often named characteristic. It seems that the (river) dikes most people know are a perfect example of the balance between order and variety, and static and dynamic quality. It is likely that the same characteristics count for a lake dike, although the element of the other side of the river, which adds some diversity, is not present. On the other hand, the openness of the large water body, and the diversity of passing ships adds an extra element which is lacking on a river dike.

The visual richness of dikes and their environment is mainly determined by the dense mixture of different ways of use and the historical grown character of this (van Nieuwenhuijze et. al., 1994). The dense mixture of use makes that many different people, and different groups of people, experience the dike. This can be during their work, while commuting, and during leisure time. The experience will be different, but the fact that all those people are experiencing the dike makes that they all have a relation with the dike. The historical grown character of the dike makes that this relation is also historical grown and embedded in families and the society. But the historical character also contributes to the recognisability and diversity of the dike. This is the case for river dikes as well as for old sea or lake dikes, like in the study area. New lake dikes of the land reclamations lack the historical grown character, which means that they are probably experienced in a different way.

The spatial quality of the dike is fed by the surrounding landscape. Or, as Coeterier (1987) states: 'the valuing of a landscape is also influenced by the surrounding landscapes'. In case of a dike, the dike is actually an element of the surrounding landscape, but it is an element that seems to be, because of its height, an independent part of that landscape. The height makes that the structure of the landscape, and its rhythm, is something that can easily be experienced on the dike.

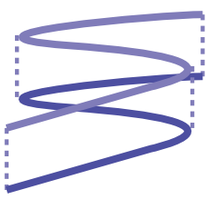
On the inner side of the dike the parcelling plays an important role. The parcelling is normally oriented rectangular to the direction of the dike, with ditches that seem to flow endlessly through the landscape rectangular to the dike (Feddes et. al., 1988). The parcelling expresses the soil and landscape types of the landscape along the dike, and by that influences the experience. In the areas with peat soils all heavy functions are concentrated along a thin line, with the buildings sometimes on the dike, and most fields are open grass meadows, separated by many ditches. In the clay and silt areas, heavy functions are not so strictly concentrated along the dike, buildings are often built on a distance from the dike, and fields are used for all types of agriculture. This means that the view from the spectator is blocked more often compared with the peat areas, so that it is harder to get an overview over the whole landscape. It is more difficult to experience the order of the landscape, but the variety in elements that pass by is increased.

Different from the rectangular direction of the landscape on the inner side of the dike, the outer side of the dike normally is developed with a structure more parallel to the dike, or actually parallel to the river or other large water body (Feddes et. al., 1988). But because most people experience the landscape from the perspective of the dike, it is experienced that the landscape is developed parallel to the dike. So the dike forms a separation between two rectangular structures (and is actually part of the outer dike structure parallel to the water). Because the dike lies higher in the landscape, the dike as a sharp border is accentuated even more (Feddes et. al., 1988). Along a lake dike the outer dike land area is not always present, sometimes the dike slope flows straight into the lake. This can be found along the new lake dikes, but also along some old lake dikes. This means that the experience of an outer dike landscape is not present, although the presence of water so close to the dike adds another experience, which expresses the protection function of the dike. Because of the influence of the water, the area outside the dike is normally more dynamic compared with the area inside the dike. The area inside the dike needs

a certain static quality, while people are living and working in this area, which needs stability. This means that the dike is not only experienced as a separation between structures, but also as a separation between static and dynamic quality. While the dike is the main protection element, and should therefore be a static element, the dike is in this case part of the inner dike, static area.

3.3.3 Experience: visual effects along the dike

The usual appearance of dikes, as a line formed element that is higher than the surrounding landscape and follows the natural curves of the water body it is built along, contributes to the spatial quality. Being on a dike gives the experience of 'flying' above the landscape (van Nieuwenhuijze et. al., 1994). You are part of the landscape, but you still have the feeling that you are just a spectator that does not have to participate. This is because the dike, with its steep slopes that form a physical barrier, forms a well-defined linear space, which is clearly separated from the rest of the landscape (see figure 3.6a-c). Lynch (1960) points out that visual exposure (by being elevated) gives importance to paths in peoples mind. People like to be in clear defined spaces and along edges of spaces, it is an essential act of self-location (Vroom, 1986 and Loidl et. al., 2003). This is easy on a dike, to participate in the surrounding landscape it is necessary to leave the dike, which is only possible at a few places.



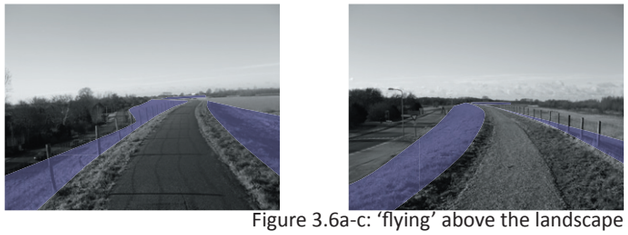
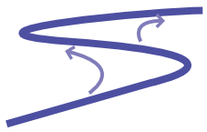


Figure 3.6a-c: 'flying' above the landscape



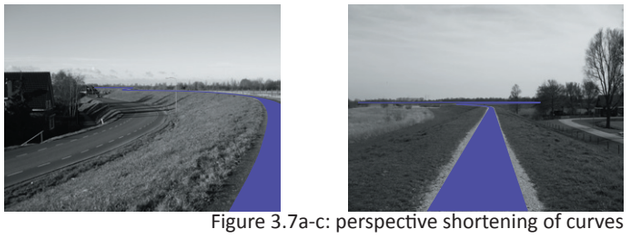


Figure 3.7a-c: perspective shortening of curves

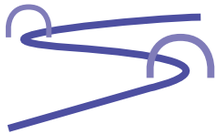


Figure 3.8a-c: gate-effect

The linear space also directs the visitor of the dike, it seems to say GO, move (Rutledge, 1971). This direction is both applicable to the eye as well as the movement of this person. To experience a dike it seems to be necessary to move along the dike, which explains why most leisure activities along the dike are moving activities. The fact that most people are moving also improves the experience of variety. While staying in the same and orderly linear space, different landscapes, elements and situations pass by. Like the spatial axes in architecture, a dike tacks up the different elements, enfillade in French (Leupen et. al., 2005). The dike is like a movie, played by the spectators movement through it.

The fact that most dikes are curved is important for the experience of the dike. Shifting the line provides visual access to changing scenes/images (Loidl et. al., 2003). Because of perspectival effects, the curves of the dike are experienced very well, it seems that the dike curves more than it actually does (Feddes et. al., 1988) (see figure 3.7a-c). While (higher) elements are situated next to the dike, there is also a so called gate-effect when moving along the dike (Feddes et. al., 1988). Because of the curves of the dike and the sight blocking elements it is not possible to overview the entire landscape, it stays a surprise what will come next. If passing a higher element in a curve it seems that you enter a new space through a gate (de Jong, 2011) (see figure 3.8a-c). So the ordering function of a dike is present, it connects visually, but the variety is also increased because the views change. Both perspective shortening as well as the gate-effect are necessary to make the dike more interesting. If everything over a long length of the dike can be overviewed it soon gets boring and people are not triggered anymore to move along the dike. A wide range of images increases the attraction of the progress made (walking, cycling etc.) considerably (Loidl et. al., 2003). Compared with river dikes, lake dikes are more straight so these effects appear less often. But some older lake dikes still have a lot of curves so that there still is enough potential. Another important difference is the height of the dike, lake dikes are much higher so that elements that contribute to the gate-effect need to be much higher, which means that there will be less places where this effect will occur.

An important characteristic for the spatial quality of dikes is the human scale. People are used to the traditional (river) dikes, with the narrow dike top and the steep slopes. The old dikes used to be very steep, for example with a slope angle of 1:1.5. People tend to dislike the new, broader and flatter dikes, compared with old 'traditional' dikes (van Nieuwenhuijze et. al., 1994). This is because the difference between the top, the slope and end of the dike is not clear, so it is more difficult to perceive the different elements. But a steeper dike would also be better for the spatial experience of 'flying' above the landscape (van Nieuwenhuijze et. al., 1994). Increasingly higher and broader dikes, that have lost their human scale, can even turn the experience of people into a bad one. It is expected that some of the people living behind increasingly higher dikes will feel increasingly uncomfortable with the idea that dikes might perhaps breach one day (Brouwer et. al., 2004).

3.3.4 Use, movement and experience of the dike

As already said many different (groups of) people use the dike. This also means that all these people use the dike in a different way, with a different type of transport, and on a different speed. The (sensory) experience of the dike is dependent on the way of travelling and the speed of movement somebody has on the dike (Sperling, 2009). The way of travelling influences the senses that are stimulated, the speed of movement influences the perceived level of detail (see figure 3.9). Motion itself also stimulates senses, and can be perceived visually, auditory, tactily, and kinaesthetically (Hesselgren, 1975). The water the dike is built along also contributes to the sensory experience of dikes. Motloch (2001) points out the importance of the element water: 'the sight, sound, scent and feel of water on skin are stimuli that enrich the sensation of place'.

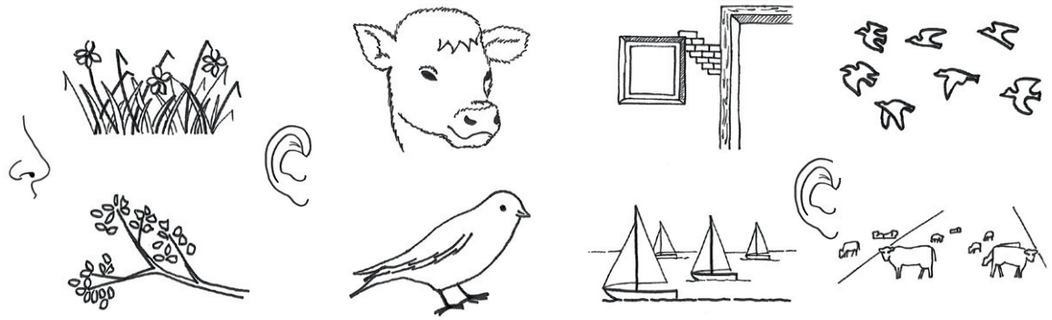
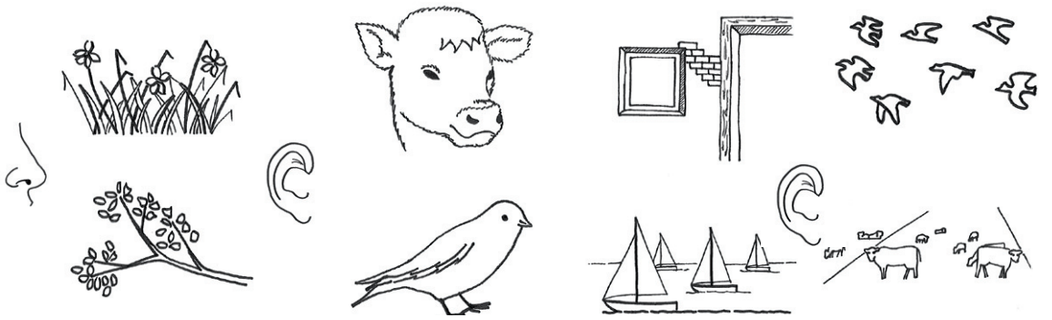
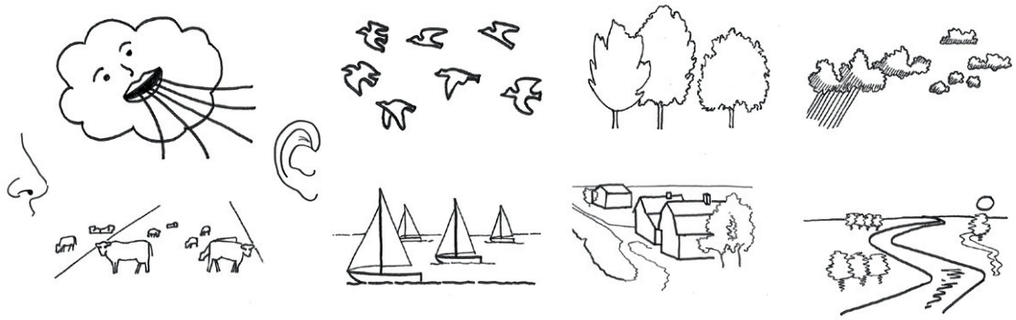
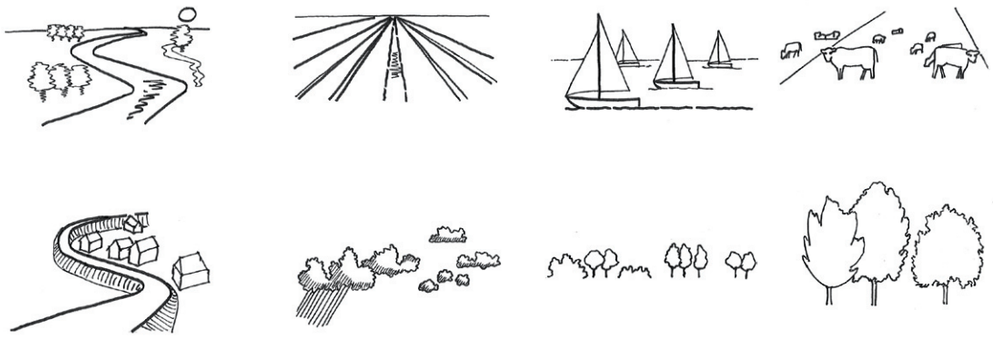
Sitting on the dike (both on top of the dike as well as on its slopes) means that there is no movement. This means that what is visible stays practically the same, apart from other elements that are moving, like travellers on the dike, birds and boats. When sitting on the dike it is easy to experience details, for example the sight, sound and scent (and possibly also the feeling) of water can most easily be experienced. However the lack of movement means that it is harder to understand the landscape as a whole. On the other hand, people sitting on the dike normally had to move at least a certain distance to arrive at their spot. This means that their understanding of the landscape was already formed by the way they travelled to the spot they are sitting.

While walking along the dike with an average speed of 6 km/h many details can be seen and felt, just like sitting along the dike. A pedestrian is in direct contact with the environment (Motloch, 2001). Yet the short distance that can be travelled by foot means that there will not be that much variation in landscape types along the dike, and the odour of a fresh fertilized field can be experienced for a long time. This means that the perceived distance can be very long, although it is not that long physically seen. An attractive dike for walkers has to include many small scale elements, with a lot of detail.

Cycling or skating (along the dike) gives a different environmental awareness and scale perception (Motloch, 2001). With an average speed of 18 km/h some details are missed, but a longer distance can be travelled, so that more landscape types will be seen and understood. A rhythm in landscape types and elements that can not be experienced by foot will be easier to experience by bike. An important natural element that is experienced on a dike is the wind, which includes both the feeling as well as scents (Rijkswaterstaat, 2007). The curves in the dike make that the wind can be your friend at one moment, and turn into a cyclers enemy the other moment.

The experience of a dike by car also gives a different experience, while the average speed is much higher, approximately 60 km/h on most dikes in the Netherlands. While driving, people are overwhelmed with signals, many of them trivial or redundant (Lynch, 1976). This means that details, including natural elements like wind, sounds and smells, are completely missed, except from when the car stops. This also is the case with the element water, which can only be experienced with the eyes in a car. On the other hand the large scale and rhythm of landscape types can be experienced very well by car, because of the higher speed it is easy to travel a large distance and see similarities and differences on a large scale.

The various users on the dike also influence each other if they all use the dike together. Cars or motorcyclists produce noise, and drive much faster than the other users. This means that they can possibly be experienced as a threat by the other users, and that they at least hinder them. On the other hand, the slow cycling or walking users can also hinder faster motorized users. The same counts for cyclists and walkers, while there also is a difference in speed between those users. Even within a group of users there can be hinder because of difference in speed or the way the small space on the dike is used.

	Most experienced ←
Sitting	
Walking 5-6 km/h	
Cycling/skating 15-18 km/h	
Car driving 50-60 km/h	

Less experienced

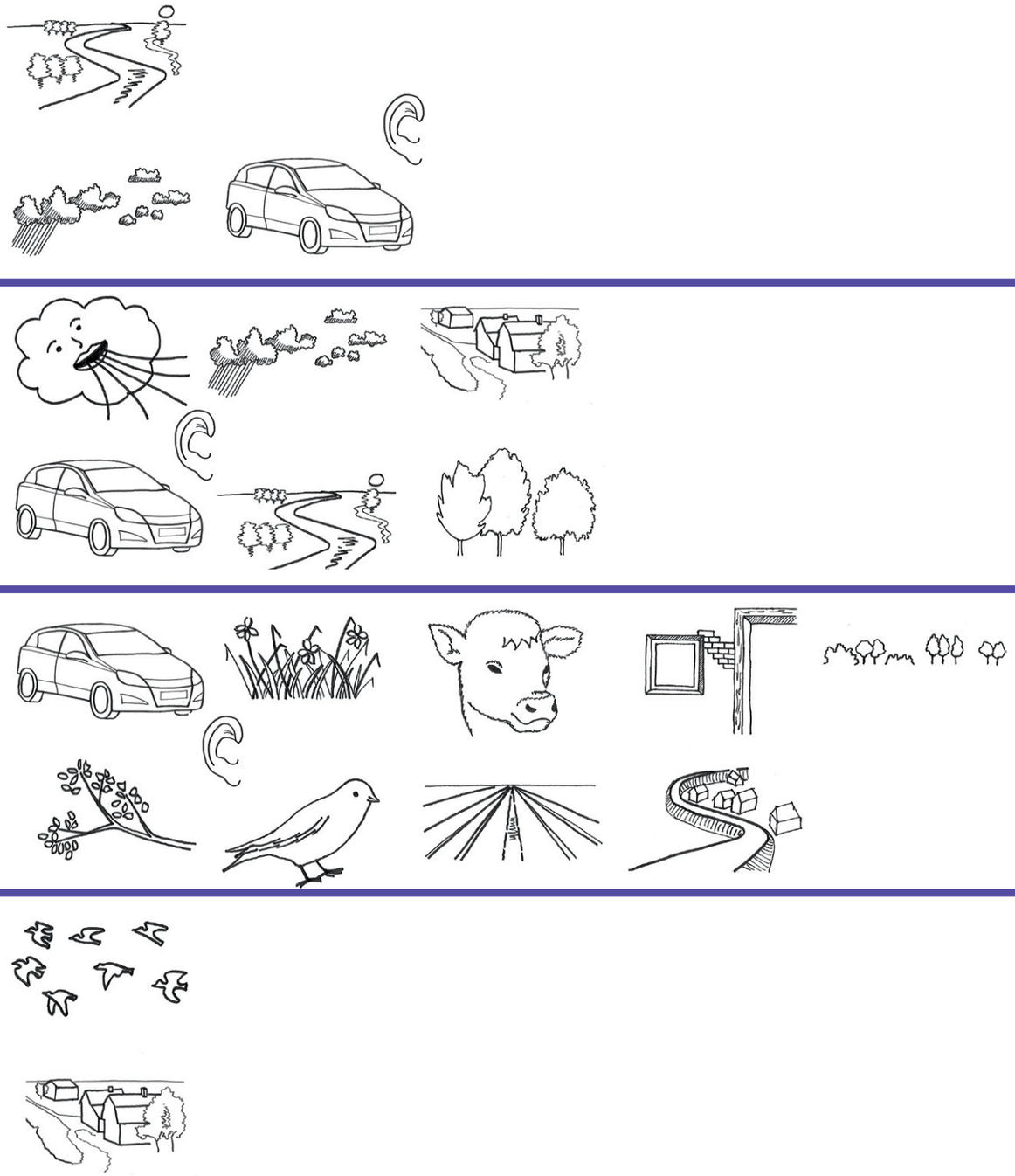


Figure 3.9: experience on the dike with ways of travel

3.3.5 Spatial quality and use of the dike

A dike is first and foremost built to protect the hinterland. Part of the experience and beauty of dikes exists of this function as flood protection element (van Nieuwenhuijze et. al., 1994). People are fascinated by the fact that such a man-made element is able to protect them against flooding, which contributes to the spatial quality of the dike. Especially during times of high water people are visiting the dike to experience the high water against the dike slopes. So the static quality of the dike as a flood protection element has a dynamic quality in it, in which the static quality is proved. Along river dikes these times of high water normally are longer compared with lake dikes, which differs between hours or one day along a lake dike, and several days or even weeks along a river dike.

Figure3.10: connecting function of the dike

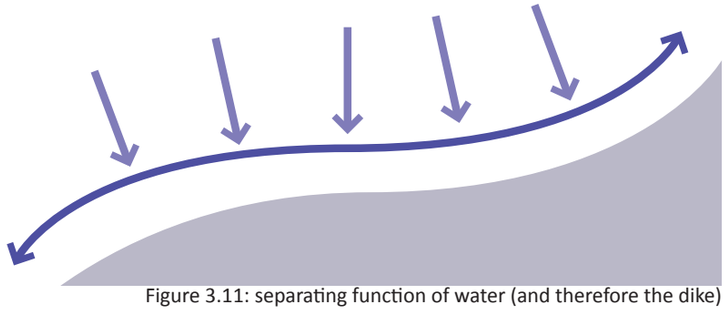


Figure 3.11: separating function of water (and therefore the dike)

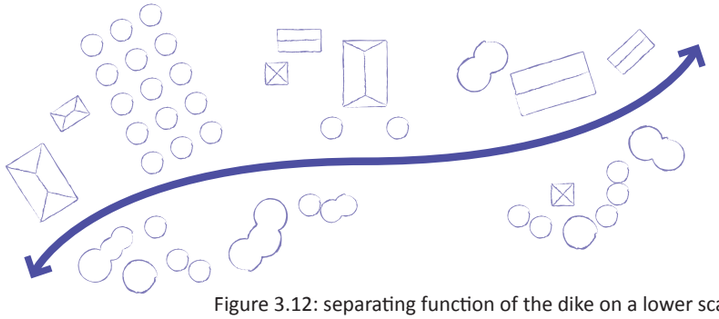


Figure 3.12: separating function of the dike on a lower scale

The main function of the dike as a flood protection element has influence on all other functions that are situated on or along the dike. The flood protection function, and the maintenance that is necessary to maintain this function, may never be hindered as a result of other functions. An important other function is the infrastructural function of dikes, which contributes to the experience of the dike as a connection between places. This connection function has been a very old one, while, especially in the river area, the dike was often the only connection between villages (see figure 3.10). After the second world war this function changed while new connection roads were built, situated behind the dike and the villages (van Nieuwenhuijze et. al., 1994). This however does not mean that the infrastructural connection function of dikes is gone. Most dikes still function as connection roads, and especially recreationists, both walking, cycling and driving a car, like to use dikes. For that reason, elements that serve recreationists have been added to the dikes, such as places to rest. Along the lake dikes of the IJsselmeer the main road was and is mostly situated next to the dike and not on top of it. This means that the dike top is mostly only used for recreational traffic like walkers and cyclists. Both functions (safety and infrastructure) normally do not hinder each other. In fact, a maintenance road on the dike top is necessary, which can be easily used for recreational purposes (van Nieuwenhuijze et. al., 1994).

The infrastructural function of the dike also contributes to the experience of the dike as a separating element. The dike is often the end point for many roads rectangular to the dike. This is the case in the river area, although there are normally few places where it is possible to cross the river, but it is especially the case with dikes that are built along lakes, where there is often no possibility to cross the water (see figure 3.11). On a smaller scale the dike does often physically separate different functions, like we have already seen that a dike is a separation between rectangular and parallel, and between dynamic and static quality. The Dutch fixation on flood protection makes that we see a dike as an absolute border. Behind the dike it seems to be safe; people are allowed to live and work in the, unsafe, river forelands, but that is their own responsibility (Pols et. al., 2007). The fact that there is a chance of flooding outside the dike means that functions that are of high value and will be damaged by flooding will not be found in these areas. On the other hand, functions that are only used in summer, when there is a low chance of flooding, can easily find a place in the floodplains. The human land use is subordinate to the function of the floodplain as an overflow area for the river (or other large

water body) (Feddes et. al., 1988). This results both in order, while it is clear which functions find a place on which side of the dike, as well as variety, while looking at both sides of the dike, the functions differ (see figure 3.12). In this case the dike is not part of one of the areas, the dike is really the border between different functions.

Near populated areas more functions are added to dikes. Reasoning from the idea of Habiforum this should immediately mean that there also is more spatial quality in these areas because of the multi-functional use. But in case of hinder, the spatial quality gets lower. The infrastructural function of the dike becomes more important and more various groups of people will use the dike. Buildings are built close to or on top of the dike. On both sides of the dike there is a large spatial claim. This means that conflicts between functions can occur, especially related to the space different functions need. Also maintenance of a dike can become harder if the dike is heavily built. In the end the main function of a dike will always be the most important and steering all other functions on the dike. The fact that the dike is sometimes hidden behind all the functions that are situated on and next to the dike means that the separating character (between inner and outer dike area) of the dike is less clear (Meyer et. al., 2006). Looking at the variety of functions that claim the area around the dike it even can seem to be chaotic, like along some (touristic) boulevards (van de Bijl, 1997 in: Vroom, 2005). On the other hand, many water fronts of cities and villages along rivers do have a lot of spatial quality, and so do the water fronts of the old Zuiderzee cities along the IJsselmeer. This has to do with the historic grown character of these heavily used water fronts.

3.3.6 Spatial quality of dikes and the future

It is possible to look in two ways to the future value of dikes. Both the future spatial quality (both practical and experiential) of dikes that will be reinforced can be studied, as well as the adaptability and robustness of an already existing (reinforced) dike and its surrounding landscape in future. The discussion about the future spatial quality of dikes after a reinforcement is actually where the discussion about spatial quality of dikes started. While the future value of the dike had to be enlarged by strengthening, so that the dike was robust and adaptable again, people were afraid that the experiential value and sometimes the practical value would become lower, and by that the spatial quality. People are not opposed to change (dike reinforcement), they are opposed to a loss of quality; they seek to preserve qualities, not objects (Coeterier, 1996). With dike reinforcements it is clear that resistance comes from the fear of changes in a landscape that is experienced as touching and beautiful (van Nieuwenhuijze et. al., 1994). While the characteristics of these qualities people want to preserve are already mentioned in the previous paragraphs, this paragraph will be about the future value of a dike with respect to adaptability, flexibility, robustness and sustainability.

Adaptability is mainly about being adaptable to changes that are expected, and changes that are not expected (Rijkswaterstaat, 2007). For dikes this is mainly climate change, and by that more extremes like higher and lower water levels. But although research has been done on the expected changes, it is not possible to predict all the changes exactly. An adaptable dike should be able to deal with these uncertainties, which does not (always) mean that the dike should be so high that it can stand the most extreme prediction. Flexibility is strongly related to adaptability, but has also a relation with possible other functions of the dike and its surroundings in the future. By that it has also relation with experience, while a dike which is not flexible with respect to future changes in use, can cause a bad experience. For example, if functions are added to the dike which do not fit to the space there is, or do not fit to the size of the other functions, the dike can be experienced as a chaotic place.

Sustainability and robustness both have to do with the flood protection function of the dike, as well as with a clean and natural environment of the dike and its surroundings. Sustainable measurements should be effective and robust enough to serve on a longer term (Rijkswaterstaat, 2007). The longer term also includes adaptability and flexibility. A sustainable environment of the dike and its surroundings has to do with the nature value. Rivers and larger water bodies are often part of the ecological main structure (EHS, ecologische hoofd structuur) or other European protection structures. But the dikes as elements are also parts of the ecological structure. A sustainable dike (design) should also preserve, or even extend, this ecological function of the dike and its direct surroundings in future.

3.4 Conclusions and design guidelines

3.4.1 Conclusions

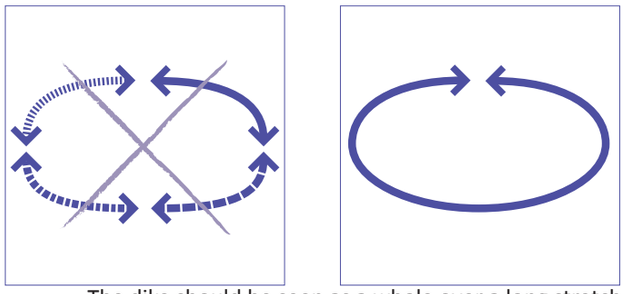
Spatial quality is the (positive) value that is assigned to a certain place by (a group of) people. It is not measurable, but it is possible to evaluate whether it is likely that people will assign spatial quality to a certain area, and why they will assign spatial quality to that area. The reason why people assign spatial quality to a certain area is important to take in to account during a design process, to be able to keep or enlarge the spatial quality of an area. To be able to assign spatial quality to an area it is important that an area can be experienced. To experience an area it is important that the area is accessible and can be used. A combination between recognizable and diverse is essential for spatial quality, while an area should be surprising enough to be seen by people, and known enough to be ordered in their minds.

Many people in the Netherlands assign spatial quality to dikes and dike landscapes, and the spatial quality of dikes has become more important the last decades. Dikes offer several possibilities to experience the landscape for several users, and most dikes are part of the public space and therefore accessible. Especially the fact that a dike is elevated above the landscape contributes to the experience, and makes that people see dikes as important paths. The history of dikes makes that they are part of our collective memory, the different landscapes and often small scale elements make that dikes always offer surprises.

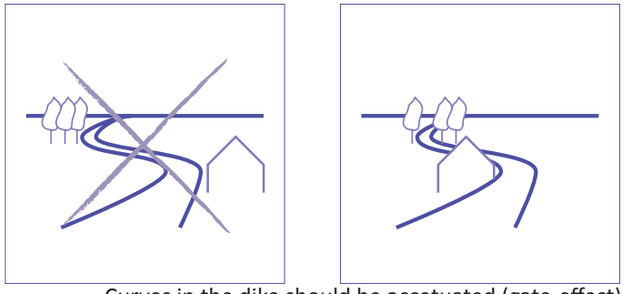
3.4.2 Guidelines

The guidelines in this chapter are based on the theories on spatial quality and the research that has been done on the spatial quality of dikes. While most of the research on spatial quality of dikes has been on river dikes it is likely that not all guidelines are relevant for a lake dike like the IJsselmeer dike. This will be studied in the following chapters.

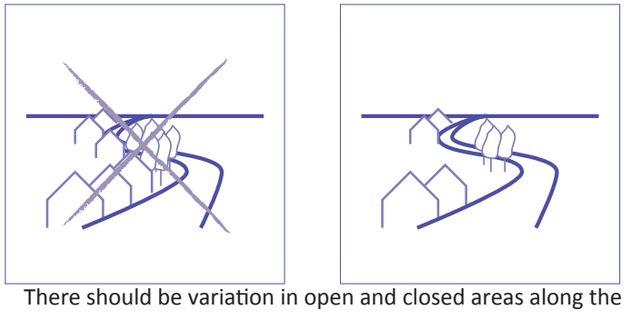
The guidelines derived in the previous chapter are still relevant. The dike heightening that is necessary can be a cause to accentuate the height of the dike, although this also can conflict with the human proportions of the dike. The adaptability to future changes can be seen as an adition to dike heightening, but also to the measures that should be taken for the outer dike lands.



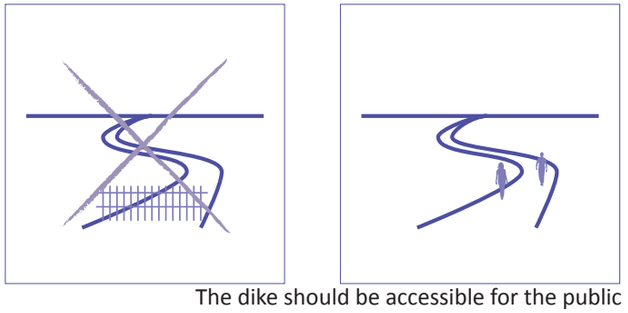
The dike should be seen as a whole over a long stretch



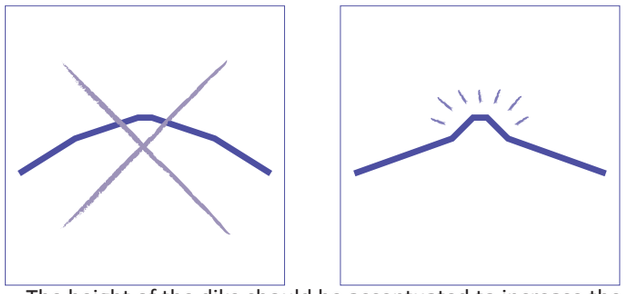
Curves in the dike should be accetuated (gate-effect)



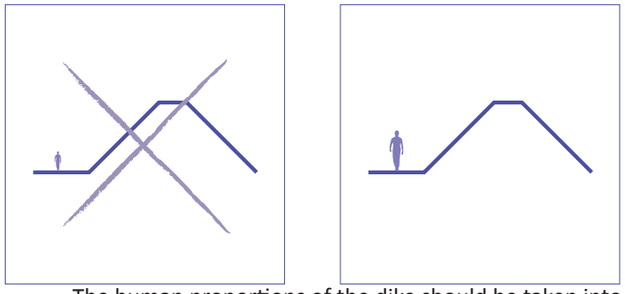
There should be variation in open and closed areas along the dike (look throughs)



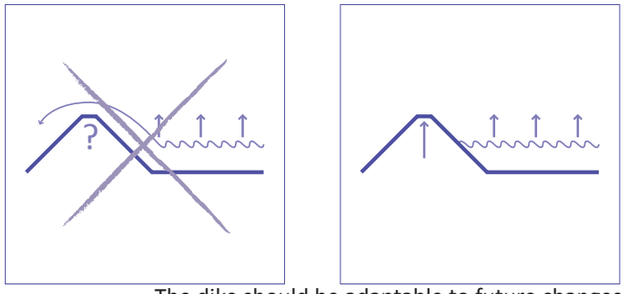
The dike should be accessible for the public



The height of the dike should be accentuated to increase the ‘flying above the landscape’ experience



The human proportions of the dike should be taken into account

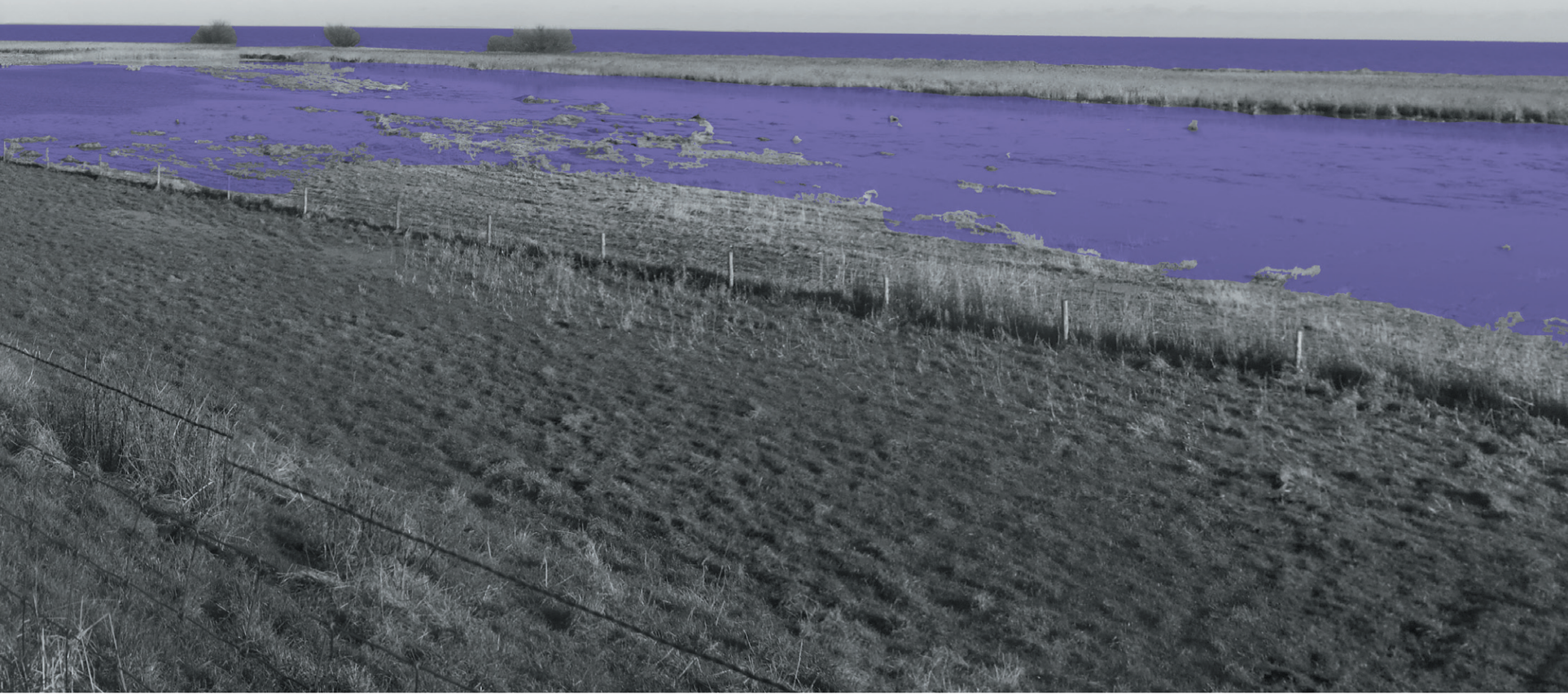


The dike should be adaptable to future changes


4

Landscape analysis

The Westfriese Omringdijk between Medemblik and Enkhuizen



4.1 The landscape

4.1.1 Historic development of West-Friesland

The study area between Medemblik and Enkhuizen is part of a much greater area that is called West-Friesland, which lies in the province of Noord-Holland. Soil exhumations in the area show that this area has been suitable for living since a long time, some exhumations date from the early stone age, for example in the eastern part of the area in the polder 'Het Grootslag' (Bosscher et. al., 1973 and Provincie Noord-Holland, 2006). Due to a rising sea level and flooding's, most people had left the area around 2000 BC. The area got occupied again for a while but people left the area again during the Roman times when the Flevo lakes developed. As a result of the wet conditions the area was not suitable for agriculture anymore. Due to these wet conditions a thick peat layer could develop in the area. In the early Middle ages the area got occupied again and people started to cultivate the peat land for agriculture (Bosscher et. al., 1973).

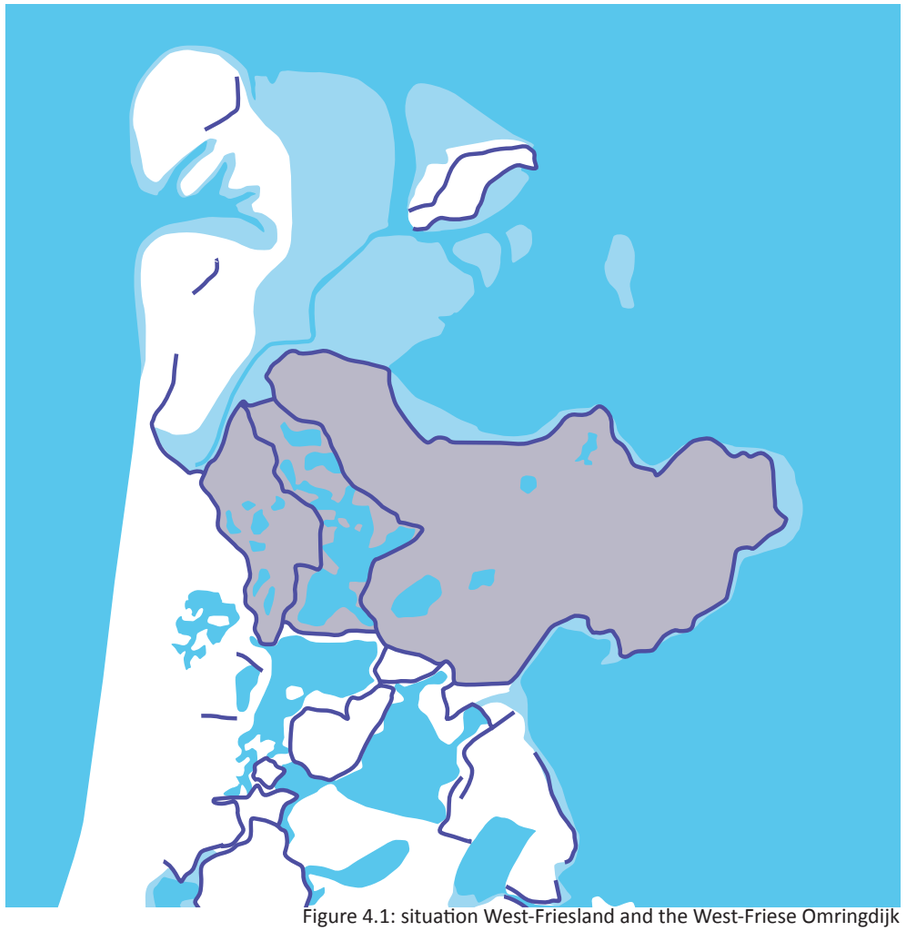


Figure 4.1: situation West-Friesland and the West-Friese Omringdijk arround 1350 (based on: Westfriese Omringdaik Sait, 2011)

Figure 4.2: West-Friesland

Due to several flooding's in the end of the 9th century in the northern part of West-Friesland, the first settlers started to protect their land with dikes. The first dikes were built around the year 900. Over the years more flooding's happened and the dikes were rebuilt several times on different places. In the beginning of the 13th century the 126 kilometre long Westfriese Omringdijk was developed, by connecting several of the older dikes and quays to enclose the area with one ring dike (Haartsen et. al., 2001 and Provincie Noord-Holland). In those days West-Friesland was an island almost completely surrounded by water during high tide (see figure 4.1).

Due to agricultural works and oxidation, the peat layer that was developed before the Middle ages disappeared in the years after the building of the Omringdijk. The landscape of West-Friesland is a so called inversion landscape. The stream beds of old (peat) rivers now appear as relatively higher places in the landscape (Provincie Noord-Holland, 2006) (see figure 4.3). But the landscape of West Friesland still shows the characteristics of peat land cultivation, which for example can be seen in the long and narrow parceling. Some of the old peat rivers are still visible, like the Kromme Leek, south of Medemblik. Looking at the present appearance of the landscape, it is clear that arrangement of the landscape and the soil does not fit each other (Haartsen et. al., 2001).

Next to the old sea clay landscapes, there are also some land reclamation polders within the area of West-Friesland. These were lakes that were originally included within the Omringdijk, and which lie mainly in the western, low and wet part of the area. In the 15th and 16th the smaller lakes were pumped dry, and in the 17th century people were also capable to dry a large lake like the Heerhugowaard (1631) (Provincie Noord-Holland, 2006). Land reclamation took also place in the lakes surrounding West-Friesland, like the Beemster en de Schermer, and on the sea side, like the Zijpe polder. The last century more land reclamation took place around West-Friesland with the reclamation of the Wieringermeer (see figure 4.4).

4.1.2 Structures

When the old peat layer disappeared due to the cultivation of the land the underlying soil layers became exposed. This makes that soil is now mostly built up from (sea) clay and sand (Haartsen et. al., 2001). In the area both heavy clay soils as well as more sandy clay soils are present. The original peat soil is almost completely disappeared, although there are few places where there is still a peat layer present, mostly covered with clay, and in the western part in the top soil (see figure 4.5a).

Over the years, the soil of West-Friesland has been subsiding, and it still is. The old stream beds of the peat rivers are the highest ridges in the landscape, but even these ridges lie below NAP. This means it is below the average sea level and mostly below the present water level of the IJsselmeer (see figure 4.5b). The lowest areas in West-Friesland are the areas of the internal land reclamations, and near the only peat river that did not disappear, the Kromme Leek.

As a result of the land reclamations several internal dikes and quays appear in the area. Some of them are still necessary for the internal water system of West-Friesland, like the dikes of the Heerhugowaard (see figure 4.5c). This makes that the area is actually separated into different compartments. Other dikes and quays have lost their function, mostly due to improved pumping techniques. The internal water system of West-Friesland used to be organized in four water boards, which were called 'ambachten' (Schilstra, 1974). While the area was subsiding it is since the 15th century necessary to pump water out of the area with the help of windmills (Schilstra, 1974). At first it was possible to pump the water to all the surrounding lakes, but with the land reclamations around the area it became necessary to pump the water directly into the Zuiderzee. Until

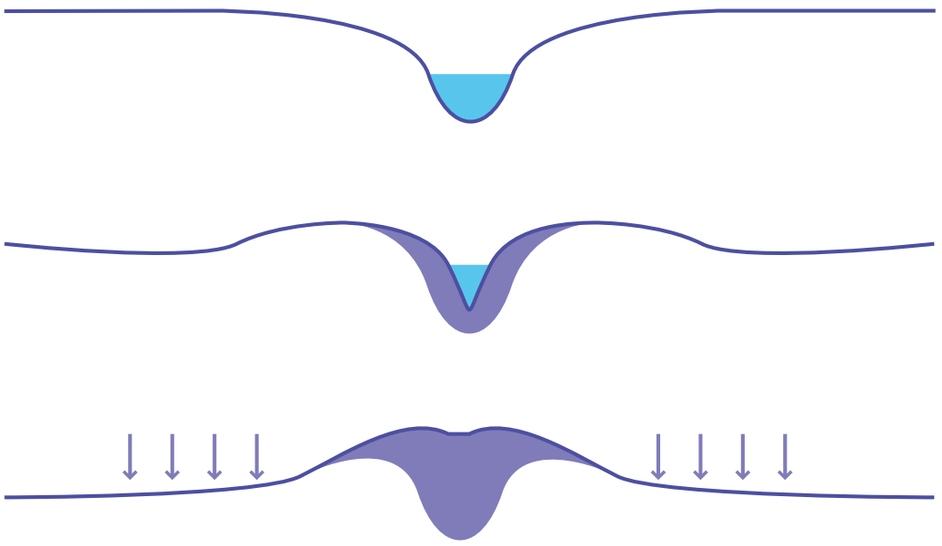


Figure 4.3: evolvement of an inversion landscape

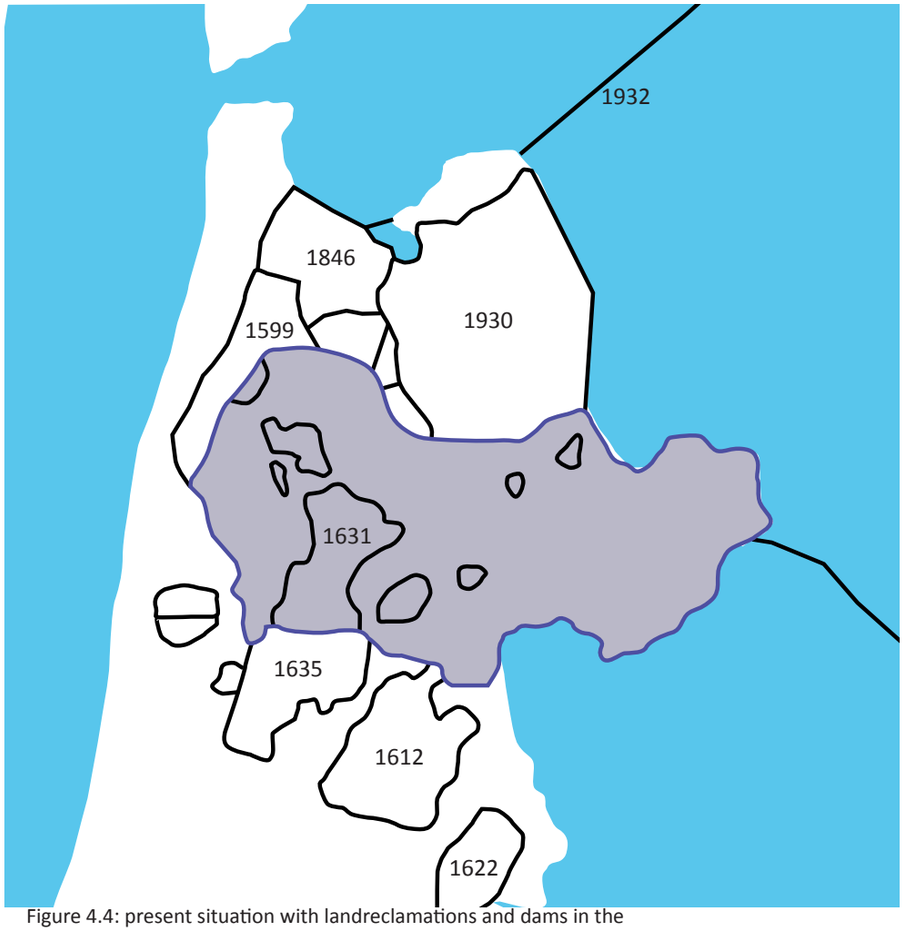


Figure 4.4: present situation with landreclamations and dams in the area (based on: Olthof et.al., 2009)

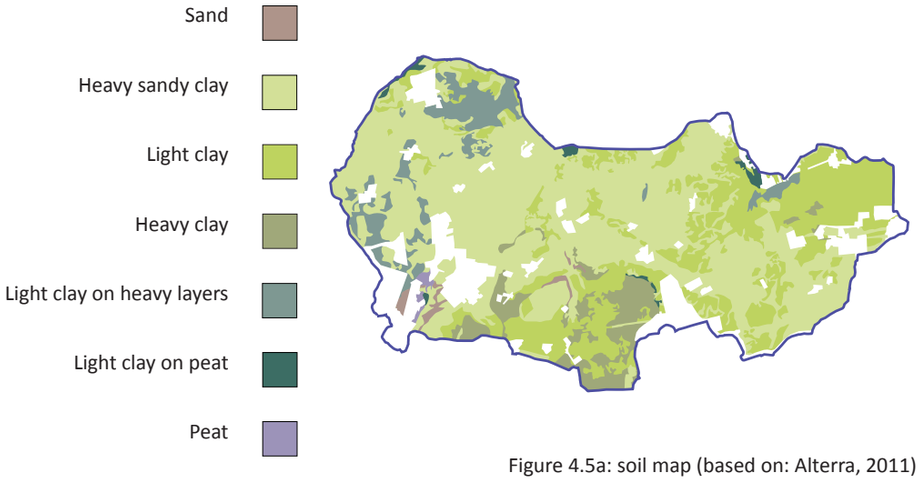


Figure 4.5a: soil map (based on: Alterra, 2011)

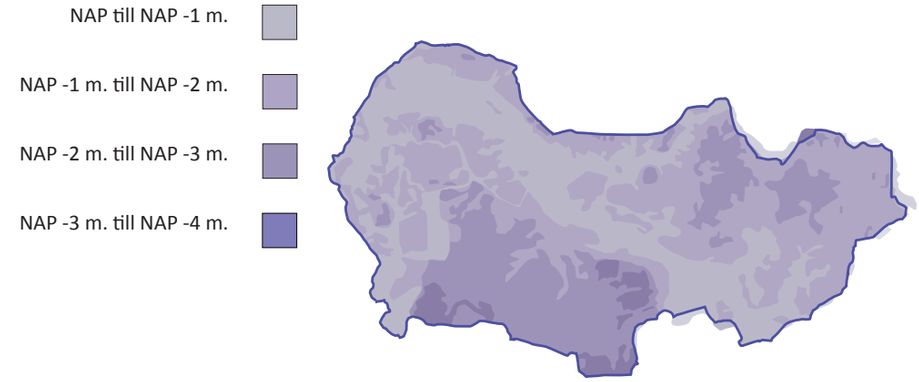


Figure 4.5b: elevation map (based on: AHN, 2011)

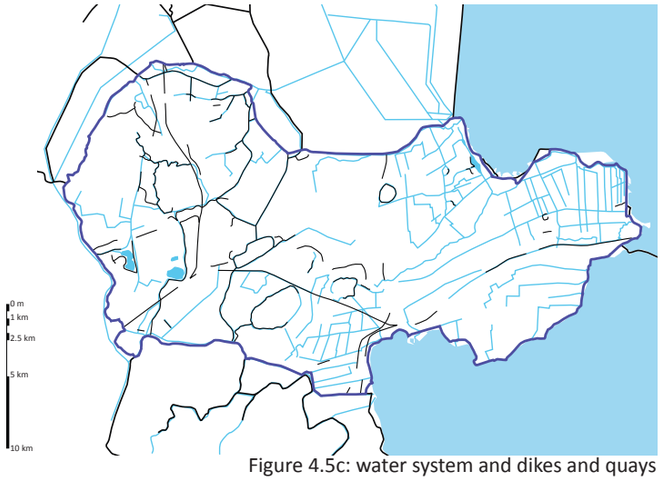


Figure 4.5c: water system and dikes and quays

the 20th century the four water boards controlled the water system in West-Friesland, although this was done under supervision of the province since 1864. In 1921 the water boards became included in one water board which was called West-Friesland (Schilstra, 1974). Later on this water board became included in a much larger water board called Noord-Hollands Noorderkwartier (NHN), and this is still the case. But the old 'ambachten' are still visible in the internal water system. The pumping areas of for example the pumping stations 'Het Grootslag' and 'De Vier Noorder Koggen' are separated from each other and still follow the borders of the original 'ambachten'. Since the water of the IJsselmeer became fresh due to the building of the Afsluitdijk, water is also transported into the area in dry periods for agricultural purposes. While the water level of the IJsselmeer is higher this is done under free flow.

4.1.3 The landscape between Enkhuizen and Medemblik

The landscape between Enkhuizen and Medemblik can be separated in two parts. The eastern part between Enkhuizen and Wevershoof is called 'Polder Het Grootslag'. The area can be characterized as an open area with a long north-south parceling. The western part between Wevershoof and Medemblik, the Noorder Koggen, is dominated by the remains of the old peat river Kromme Leek. This area has a more mosaic formed parceling (see figure 4.8).

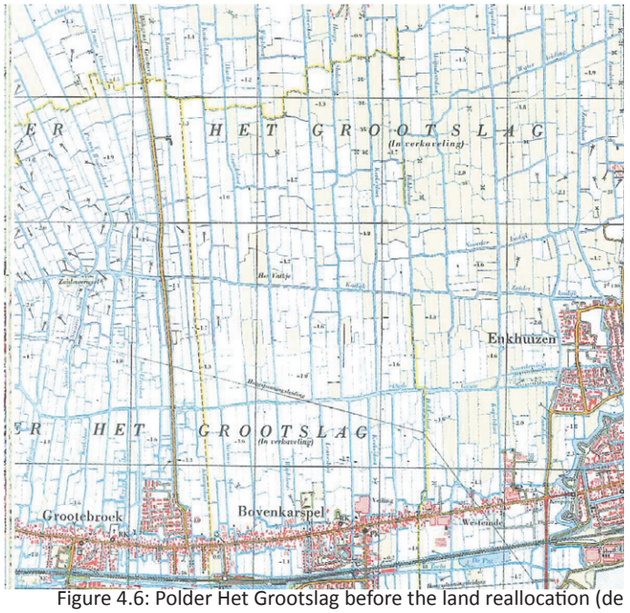


Figure 4.6: Polder Het Grootslag before the land reallocation (de Visser, 1997)

The ‘Polder Het Grootslag’ with its straight narrow parceling used to have many characteristics of a peat landscape, but this changed the last century as a result of land reallocations. The Polder used to be a wet area with a lot of ditches and canals. Most transport (of agricultural products) was done by boats.

In 1969 was voted for the reallocation plan of M.J. Vroom, and in the years after that the plan was implemented (de Visser, 1997). Many ditches and canals disappeared and the area was made accessible with roads. Only between the houses along the dike the old intricate water structure is still visible. Farms were moved from the edges of the polder to the middle of the area. With the roads, road planting and buildings the area became less open than it was before. Parallel to the original occupation line from Enkhuizen to Hoorn a nature and recreation area was planned. This so called ‘Natte Cel’ was in use as a high water zone, from which water could be transported to the agricultural areas in dry periods (de Visser, 1997). Except from the ‘Natte Cel’ this area has an important function for agriculture, and the cultivation of seeds and plants.

Figure 4.7a: view from Polder het Grootslag to the dike

Figure 4.7b: view from the dike to Polder het Grootslag

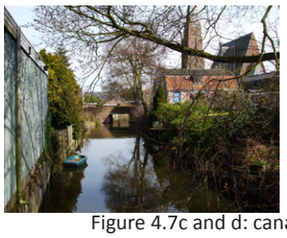


Figure 4.7c and d: canals between the houses along the dike

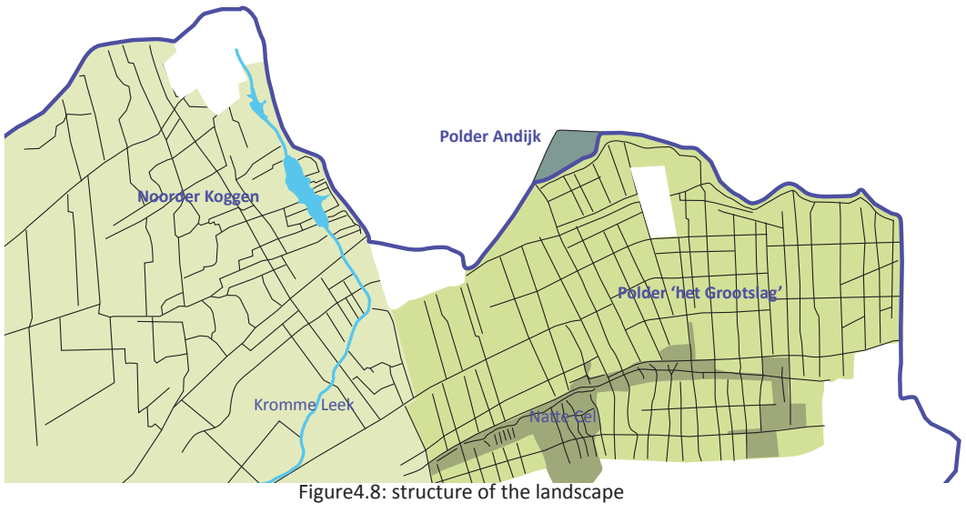


Figure4.8: structure of the landscape

Between Wevershoof and Medemblik the river Kromme Leek flows parallel to the Westfriese Omringdijk. The small river broadens into two lakes, the Grote and Kleine Vliet. The river used to flow through Medemblik into the Zuiderzee. Later on the water was pumped from the Kleine Vliet into the Zuiderzee and IJsselmeer. Since 1869 this was done by the steam pumping station De Vier Noorder Koggen, which was extended in 1907 (Schilstra, 1974). The old pumping station now functions as a museum and is replaced by an electric pumping station, a few kilometres to the south east between Onderdijk and Wevershoof. The area around the remains of the peat river is low lying, and peat can still be found in the soil, combined with (heavy) clay. With the two lakes and all the ditches along the mosaic formed parcels this area has a water rich look, with many characteristics of a peat landscape. Both lakes have an important function for recreation, both on the water as well as along the edges of the lakes. This means that especially the part of the area along the dike (between the dike and the main road to Medemblik) has mainly a recreational function.

Figure 4.9a and b: old and new pumping station De Vier Noorder Koggen

Figure 4.10a: the Groote Vliet

Figure 4.10b and c: the Kromme Leek near the Groote Vliet

A special part of the landscape of the study area is the small land reclamation area Polder Andijk. This area evolved in 1927 as a try out polder for the new polders of the Zuiderzee works. The polder is a small, low lying piece of land on the lake side of the old dike, so officially the polder is not part of West-Friesland. It was in use as a testing area for all kinds of agricultural crops that could possibly grow in the new to make polders. After the polder lost its function as agricultural testing polder the area got filled with recreational housing.

Figure 4.11a and b: recreational housing in the Polder Andijk

Figure 4.11c: Polder Andijk

4.2 Occupation

4.2.1 Urbanisation and infrastructure

The first settlements in West-Friesland were, like in peat landscapes, originally concentrated along long thin lines. These lines were situated along the Omringdijk as well as in the middle of the landscape, mostly in an east-west direction. Villages and cities evolved from these first line formed settlements in the centuries that followed. The population of West-Friesland grew impressively after the building of the Omringdijk, and so did the so called water cities Hoorn, Medemblik and Enkhuizen, which were the most important cities of the area (Haartsen et. al., 2001). The area flourished in economic perspective in the 16th century, the main economic activities were trade and activities related to water, such as fishing and shipbuilding. After some conflicts with Amsterdam and German Hanze cities, the economic prosperity stopped. This also had to do with several storm surges that occurred more than usual in the 17th century (Bosscher et. al., 1973). During the 18th and 19th century the area has known a period of decline. It took until the building of steam rail and tram ways before the area could flourish again.

Nowadays West-Friesland is a densely populated area (see figure 4.12a). The area functions as an overflow area for large cities like Amsterdam and Haarlem. The city of Alkmaar, which is situated south-west of West-Friesland, has been extended into West-Friesland, and has grown together with some originally West-Frisian cities and villages, like Heerhugowaard and Sint Pancras. Another urbanization line can be found near Enkhuizen, along the old main road from Enkhuizen to Hoorn. All villages that were situated along this road have been extended and almost grew together to one line formed urban area. Only the different names of the villages make clear that it is not one big line formed city.

The population of the area could grow because of the improved infrastructural connections. Since the building of the Afsluitdijk (and to a lesser extend the Houtribdijk), West-Friesland is not an infrastructural end point anymore. The main highway (A7) from Amsterdam to Friesland passes the area. Besides that, another highway (A9) to Amsterdam starts in Alkmaar. For the railway connections Noord-Holland still is an end point (Enkhuizen and Den Helder), but while the area is focused on Amsterdam and the rest of the Randstad, the railways are sufficient and form an important connection (see figure 4.12b).

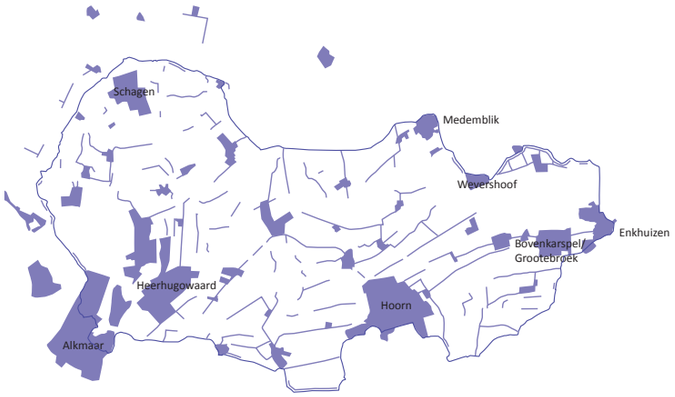


Figure 4.12a: urbanisation

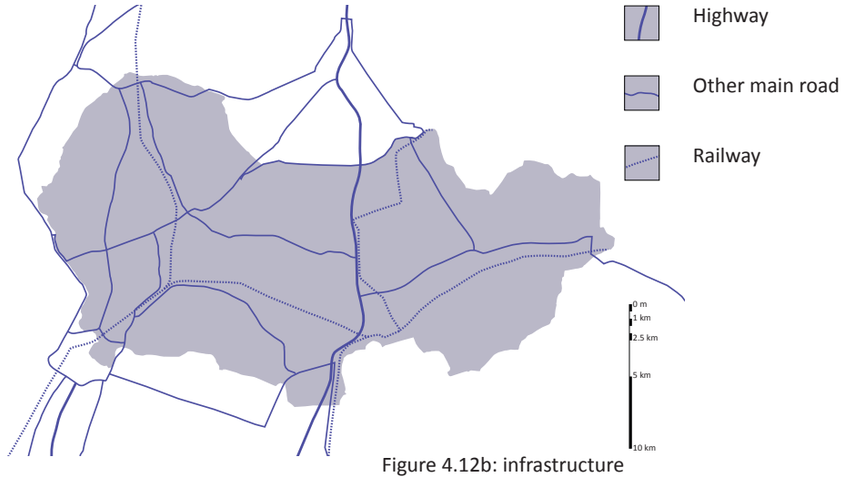


Figure 4.12b: infrastructure

4.2.2 Enkhuizen

Enkhuizen was already known in the 11th century when a neighbourhood developed east of the present city. Due to flooding and on-going pressure of the sea the neighbourhood was moved west to an embanked area in the 13th century. The first houses stretched along the Omringdijk, which is now known as the Breedstraat (Barends et. al., 2005). Together with the neighbourhood Gommerskerspel, Enkhuizen got its city rights in 1355, being the second city in West-Friesland (Bosscher et. al., 1973). In 1362 the first harbour was built just behind the Omringdijk, and Enkhuizen soon became an important harbour city. The first harbour was connected on both sides with the Zuiderzee, but it was also possible to close it with the help of sluices. This harbour is now known as the Zuider and Noorder Haven and got partly filled up. After the Elizabethvloed in 1421

and other following storm surges, again some of the eastern parts of Enkhuizen had to be given back to the Zuiderzee, and also the church was moved west.

In the beginning of the 16th century the first city walls were built. In 1540 the Drommedaris was built, a defence tower, mainly used to defend the harbours. In 1542 a new harbour was excavated, which is now called the Oude Haven (see figure 4.13a).

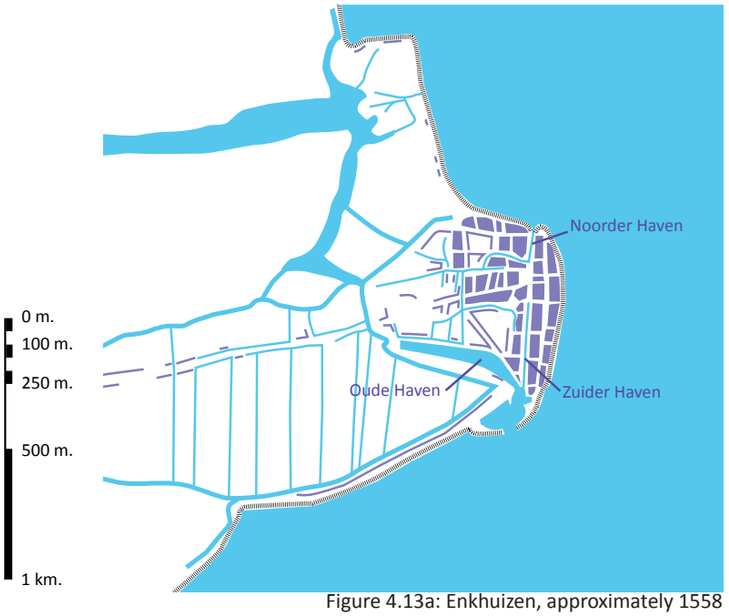


Figure 4.13a: Enkhuizen, approximately 1558

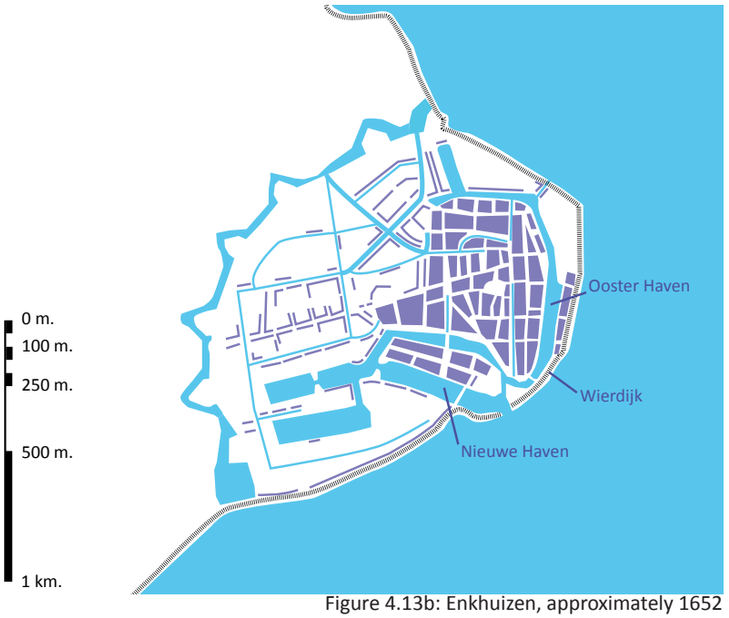


Figure 4.13b: Enkhuizen, approximately 1652

Most walls around the city date back to 1595-1600, and are still mainly intact (Haartsen et. al., 2001). Space for harbours was reserved within these walls. On the Zuiderzee side a new dike called the Wierdijk was built in 1590, so Enkhuizen was moving back east a little bit. Behind the Wierdijk a large harbour (Oosterhaven) came about which was necessary for the growing fleet of trade and fishery boats (Barends et. al., 2005) (see figure 4.13b).

Figure 4.14a and b: Zuider Haven and Oude Haven

Figure 4.14c and d: Wierdijk and Drommedaris

In the 17th century the importance of Enkhuizen as a place for trading and fishing was diminishing. Large parts of the walled city stayed vacant, and this situation stretched upon the beginning of the 20th century. Parts of the Oude Haven and other harbours got filled up, both due to natural silting up and human activities. At the place of the former Nieuwe Haven for example, a residential area was developed in 1897. The Snouck van Loosen park is one of the oldest garden villages in the Netherlands. To prevent the rest of the harbours from silting up, the Krabbersgat dams were built east of the harbours in the second half of the 19th century (see figure 4.16a). The city itself was now more focused on agriculture, and the city became well known for its cultivation of seeds.

In 1885 Enkhuizen got its railway connection, which helped the city to improve its position a bit. The railway was part of the rail connection between Amsterdam and Leeuwarden, which should be completed with a ferry service between Enkhuizen and Stavoren. During the building of the railway station, some of the old harbours were excavated again, and a new harbour

was built. This harbour was in use for the ferry services to Stavoren and other places along the Zuiderzee, and had an open connection with the sea (see figure 4.16b). Thanks to the railway, Enkhuizen was not as isolated as many other Zuiderzee cities. Already in the early years of the 20th century Enkhuizen has known some tourism, even from abroad. The occupied hinterland and the railway made that the closure of the Zuiderzee was not a big problem for the community of Enkhuizen. Many fisherman and their children could easily find other jobs or follow higher education (Sleeuwenhoek, 2006). Only a few fisherman kept practicing their original profession.

Nowadays Enkhuizen developed as a national place of attraction for tourists, with its beautiful city and old harbours where water leisure activities take place (Barends et. al., 2005). On the edge of the IJsselmeer on the Wierdijk the Zuiderzee museum developed since 1948 in several old buildings. Over the years, the museum developed a traditional Zuiderzee village with many buildings in the unbanked area between the Wierdijk and the IJsselmeer. Already in 1926 people spoke about a museum about the Zuiderzee in Enkhuizen, which was originally planned in the Drommedaris (Schmidt in: Sintobin, 2008). Parts of the old harbours are now in use for recreational shipping, but they are also the home of many traditional boats. Outside the dikes new marinas have been built.



Figure 4.15a and b: railway station and marina in Oude Haven



Figure 4.15c and d: new marina outside the Wierdijk and tourism in the city centre

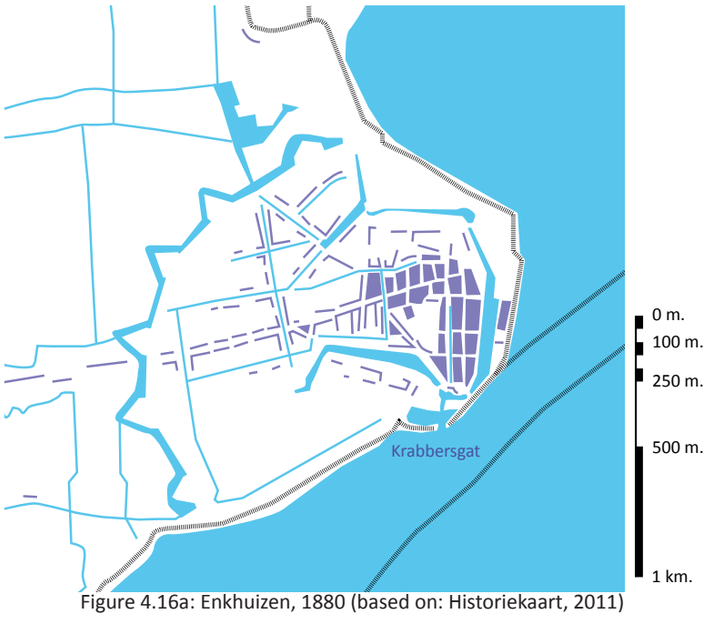


Figure 4.16a: Enkhuizen, 1880 (based on: Historiekaart, 2011)

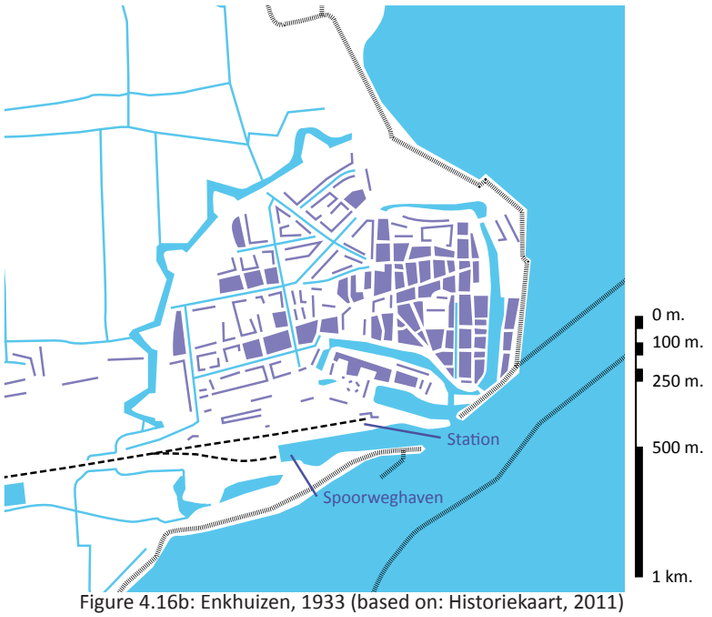


Figure 4.16b: Enkhuizen, 1933 (based on: Historiekaart, 2011)

4.2.3 Medemblik

Medemblik, with the old name Medumalaca, is oldest city in West-Friesland. This name comes from a small peat river that disappeared, called Midden-Leek. On the place where this river flowed into the lake Aelmere, a dam was built and around it the first settlements of Medemblik developed. The remains of the river can not be seen anymore, but the dam still exists, and has been the centre of town for long. The history of Medemblik dates back to the 8th century, and already in the early middle ages the place was important for trading (Haartsen et. al., 2001).

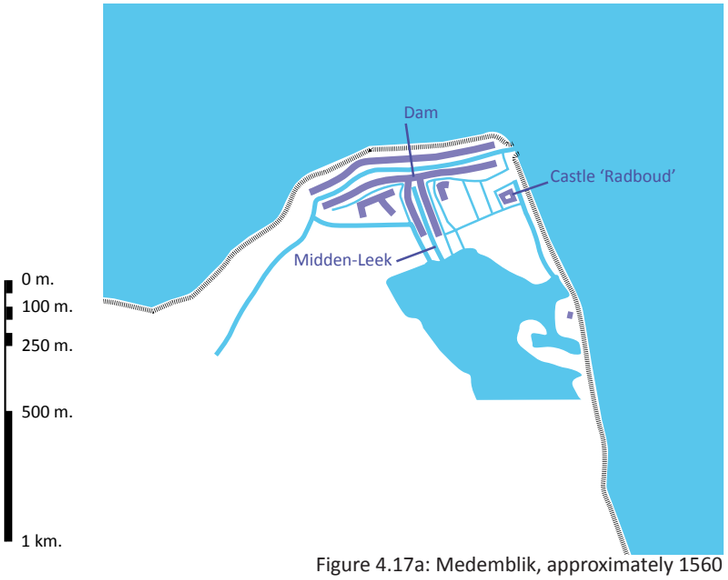


Figure 4.17a: Medemblik, approximately 1560

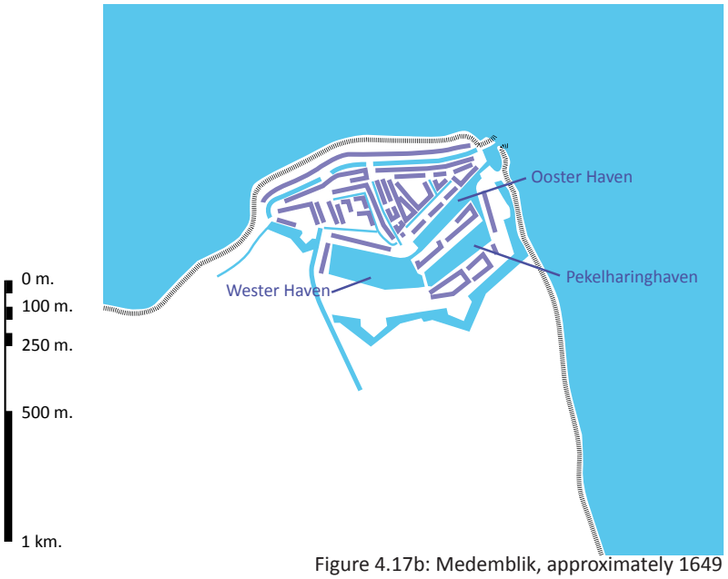


Figure 4.17b: Medemblik, approximately 1649

Medemblik got its city rights is 1289, at the time a fortified building was built (Bosscher et. al., 1973). The remains of this building, which have been restored, can still be seen, and are called the 'Radboud' castle, named after an old king of Friesland that lived in the 7th century. The city developed linear along the West-Friese Omringdijk, and so did the harbour canals that were built (see figure 4.17a). While Medemblik suffered from flooding several times the city could never flourish like the other water cites of West-Friesland, although the city has known its days of fortune. The flooding even made people think of leaving the city to give it back to the sea sometimes.

Figure 4.18a and b: Castle 'Radboud' and former fish auction

Figure 4.18c and d: municipality house on the former dam square and Wieringermeer with pumping station

During the 16th and 17th century the city has known a florescence period, although it was not as important as a trading city as other Zuiderzee cities. In 1572 a wall around the city was built and in 1630 the city importantly expanded with the construction three new harbours, including the east and west harbour (Bosscher et. al., 1973 and Haartsen et. al., 2001) (see figure 4.17b). These new harbours made that the facing of the city changed from the northwest, where the dam was built in the peat river, towards the northeast, where the entrance of the new harbours was built. In the beginning of the 19th century the harbours of Medemblik were used for the building of warships, but this function moved to Den Helder in 1828 (Haartsen et. al., 2001). Most of the fishing activities left Medemblik in those days, and the city got mainly oriented towards the land. One of the harbours built in 1630 got filled up, and so did many of the medieval harbour canals (see figure 4.20a).

Medemblik stayed a non-important provincial town over the years, it has been described by the Frenchman Henri Havard as a dead city in 1874, like many other Zuiderzee cities (Pater in: Sintobin, 2008). In 1887 the city was connected to the rail system by the steam tram Hoorn-Medemblik, but this did not help the city flourish like it did to Enkhuizen. The city hoped to take advantage from the land reclamation in the Wieringermeer, but the new inhabitants of the polder avoided the city (Ham, 2007). The development of the Wieringermeer even made the change in facing of the city more definitive, while a part of the sea dike in the northwest became a sleeping dike, and the city was not connected with the water on that side anymore. Before the building of the Wieringermeer, Medemblik used to be situated on a piece of land bulging into the sea, but after the land reclamation, the city became situated in a corner of the lake (see figure 4.20b).

Since the 1960's Medemblik has developed as a centre for all kinds of water sports. The harbours became in use as marina's and the silted up harbour was excavated again in 1989 to be used as recreational harbour. On the lake side, south of the castle, a new harbour was built. Medemblik now presents itself as the sailing centre of the Netherlands, and many international sailing competitions visit Medemblik during the year. Next to that, many tourists visit the city. The old steam tram way now functions as a museum tram way between Hoorn and Medemblik.

Figure 4.19a and b: sailing centre and Pekelharinghaven

Figure 4.19c and d: touristic tramway and station and main street (former location Midden-Leek)

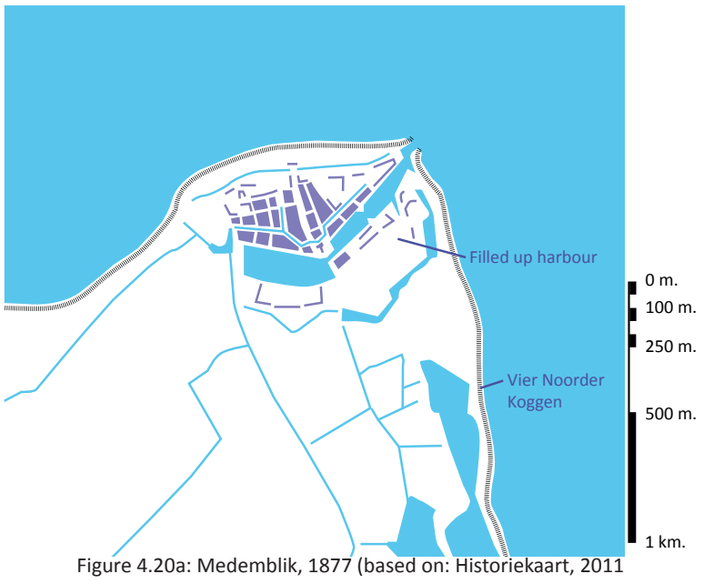


Figure 4.20a: Medemblik, 1877 (based on: Historiekaart, 2011

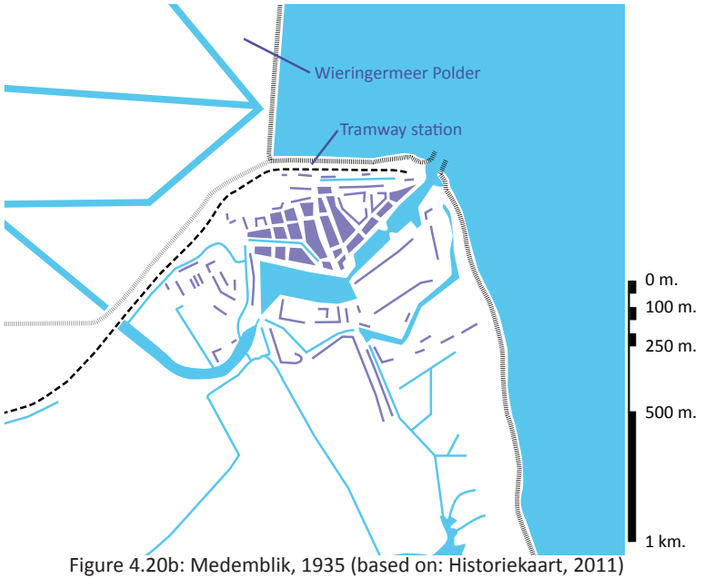


Figure 4.20b: Medemblik, 1935 (based on: Historiekaart, 2011)

4.2.4 Settlements between Enkhuizen and Medemblik

The area along the dike between Enkhuizen and Medemblik is densely built, the houses stretch along a thin line following the dike (see figure 4.21). This was because the dike was for many centuries the only passable connection in the area (Olthof et.al., 2009). The relation with the dike can be seen in the names of the settlements, like Onderdijk (under dike), Andijk (on the dike) and Oosterdijk (east dike).

All settlements can be characterized as villages behind the dike. Several settlements and village cores can be recognized within this almost closed building line. Some of these village cores have grown the past century into block formed built areas, while others are still line formed. The building line is not present between Medemblik and Onderdijk and between Oosterdijk and Enkhuizen, although some building activity took place in the past decades. Near Medemblik these are mainly recreational buildings, so that the building line is now almost closed over here. The different churches in the area express that the different villages that are now grown together were once independent from each other (see figure 4.22a-e).

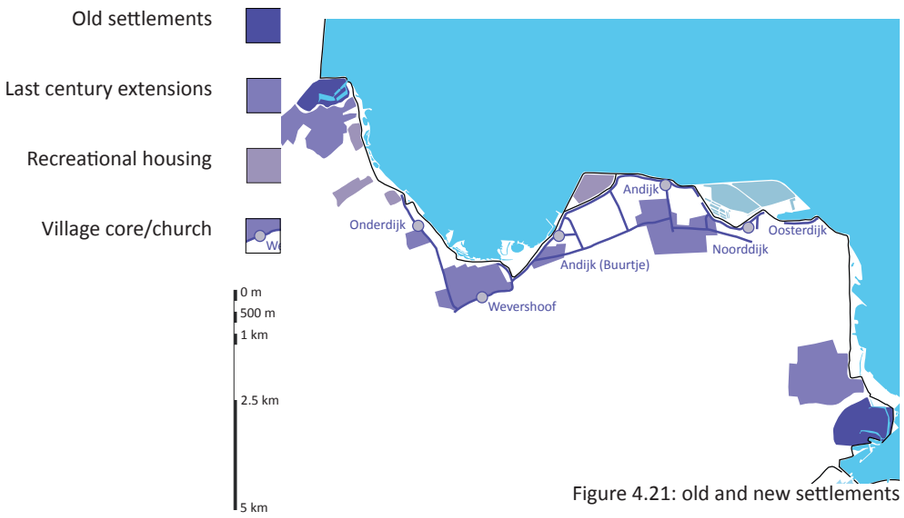


Figure 4.21: old and new settlements

All the villages in the area were focussed on agriculture, and did not have a relation with the Zuiderzee. This was also because there were no harbours. The area used to be focussed on cattle breeding, but especially Andijk developed as a centre for bulb-growing in the end of the 19th century (Haartsen et. al., 2001). With the building of the Proefpolder Andijk a harbour for the work boats was built near Andijk. This harbour has been extended after the second world war and is now in use as a marina. This means that Andijk now is the only village which has a relation with the water, although the harbour is not visible from the inner side of the dike.

All houses in the villages were traditionally situated on a very short distance from the dike. As a result of the storm surge of 1916 many houses in the northern part of Andijk needed to be demolished while the dike almost broke down (Schilstra, 1974 and Sleeuwenhoek, 2006). To create space for dike reinforcements many houses had to be moved backwards. This meant that the identity of the village Andijk changed a lot, while the old, traditional houses disappeared (Schilstra, 1974). The prosperity as a result of the bulb-growing industry made the building of a new, large church possible after the house relocation (Haartsen et. al., 2001).

Compared with the other villages, Wevershoof was an exception. This line formed village was built on a distance of arround 800 m. from the dike. The road through the villages was connected to the dike on the north-east side. The new neighbourhoods of this village were built between the dike and the original building line, so that the village is now situated along the dike. However, there is still slightly more distance between the dike and the first buildings, while there is a small park situated along the dike.

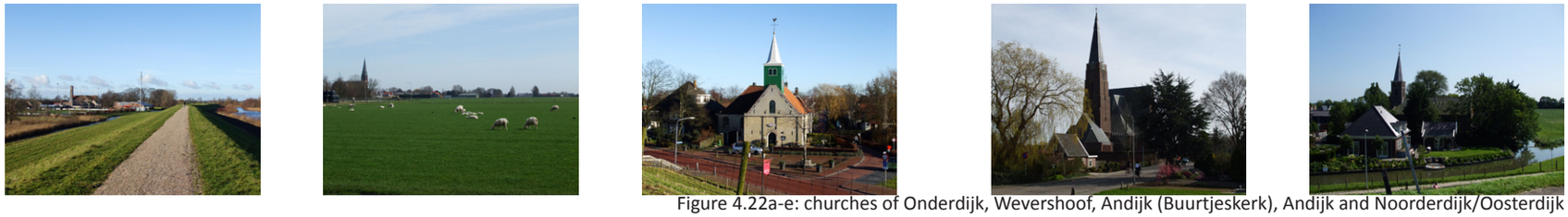


Figure 4.22a-e: churches of Onderdijk, Wevershoof, Andijk (Buurtjeskerk), Andijk and Noorderdijk/Oosterdijk

4.3 The dike

4.3.1 Building, material and maintenance

The Westfriese Omringdijk (or the Westfriese Zeedijk) was first mentioned in written sources in 1250 (Schilstra, 1974). The realization of the Omringdijk in those days is still so unique that it is one of the 25 elements of the so called Dutch 'watercanon: zoden aan de dijk', which shows the importance of water in the Dutch society and our daily lives (Rijksoverheid, 2008). When the Omringdijk was closed in the 13th century it was originally built up of layers of seaweed between wooden piles. From the 14th century on parts of the Omringdijk were strengthened with clay and new wooden piles (Schilstra, 1974) (see figure 4.23). The use of seaweed was unique for the western side of the Zuiderzee, it can not be found on the Friesland side for example. The name Wierdijk (Weed dike) in Enkhuizen refers to the use of the seaweed. The seaweed is now completely covered with clay, the weed dikes can only be recognized while they are quite steep compared with other dikes.

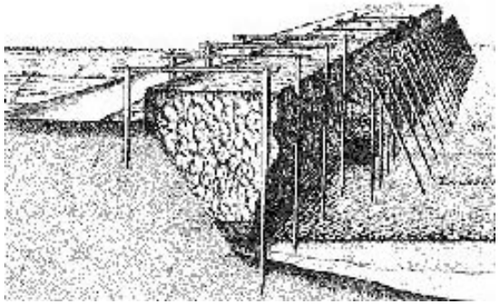


Figure 4.23: dike of seaweed strengthened with wooden poles (Schilstra, 1974)

In the 18th century, the old wooden piles along the Omringdijk were damaged by pile-worms, which formed a threat for the safety of the inhabitants of West-Friesland. From that moment people started to cover the dikes with stone, and made them less steep on the sea side (Haartsen et. al., 2001). Also rubble was used to heighten and strengthen the dike. With the stone covering of the dikes the importance of the forelands was diminished (Schilstra, 1974). Before the dikes were covered with stone they could only function if there was a foreland in front of the dike, otherwise the dike would break or erode. On the Friesland side of the Zuiderzee it took much longer before the wooden piles were replaced by stone, so the difference between both types of Zuiderzee dikes became even bigger (Sleeuwenhoek, 2006). The difference between both types disappeared in the years after the closure of the Zuiderzee, when the wooden piles were broken down, and can now hardly be seen. But the material composition of the dike of West-Friesland is still unique compared with other IJsselmeer dikes.

Since the land reclamations around and in West-Friesland started more and more parts of the dike became sleeping dikes, although they were still part of the flood protection system. The dike between Enkhuizen and Medemblik was under control of two of the four 'ambachten'. 'Drechterland', from Enkhuizen to Wevershoof, and 'De Vier Noorder Koggen', from Wevershoof to Medemblik. Nowadays, only the parts of the Omringdijk that are directly exposed to the IJsselmeer and Markermeer are part of the primary flood defence. These parts belong to a protection area which is much larger than West-Friesland. The dike ring includes everything north of the Noordzee kanaal, until Den Helder, except the Wieringermeer polder. This area is known as dike ring 13 (see figure 4.24). The acceptable chance of flooding in this dike ring area is set on once in 10.000 years, the highest possible (see chapter 5). The water board NHN is responsible for maintenance of the dike.

Figure 4.24: dike ring area 13

4.3.2 Look and use of the dike

The Omringdijk still has the characteristics of a sea dike, a flat outer dike slope and a steep inner dike slope. To prevent the steep inner dike slope from gliding, and therefore failure of the dike, high and short banks have been built on the inner side of the dike (see figure 4.25c-e). This gives the dike a multi-stage character (Olthof et. al., 2009). The inner slope of the dike is covered with grass, just like parts of the outer slope. The lowest parts of the outer dike slope are covered with cobble-stones (Olthof et.al., 2009). If there is a foreland the cobble-stones are not always present on the outer slope. In Enkhuizen the dike has a different look. The dike used to be situated in the centre of the city, and is now hardly recognizable in one of the main streets of Enkhuizen. After the extension of the city the Wierdijk was built, which was strengthened with a sea wall. The sea wall still functions as flood protection element (see figure 4.25f).

The height of the dike differs between less than four meters above NAP between Medemblik and Onderdijk, and in Enkhuizen, and more than six meters above NAP near Andijk and the lighthouse the Ven. While the dike used to be a sea dike the dike has some over height in relation to the present water level and flood risk.

1

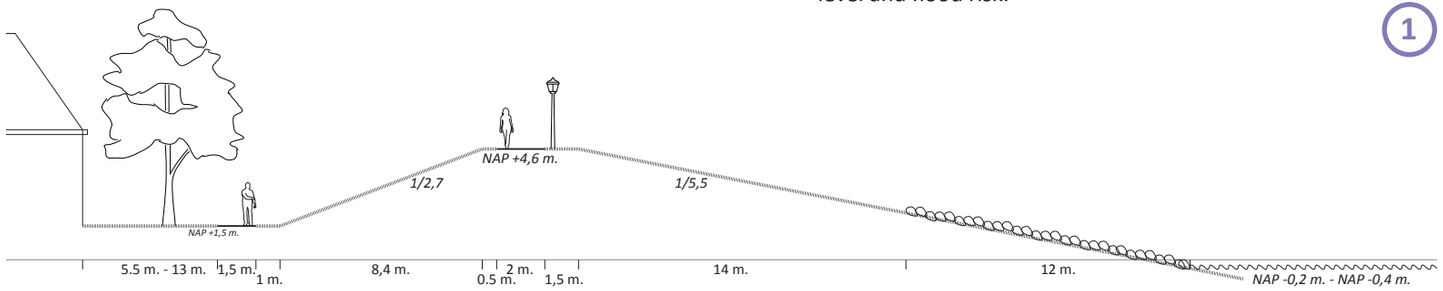


Figure 4.25a: Medemblik, north side of city centre, no foreshore

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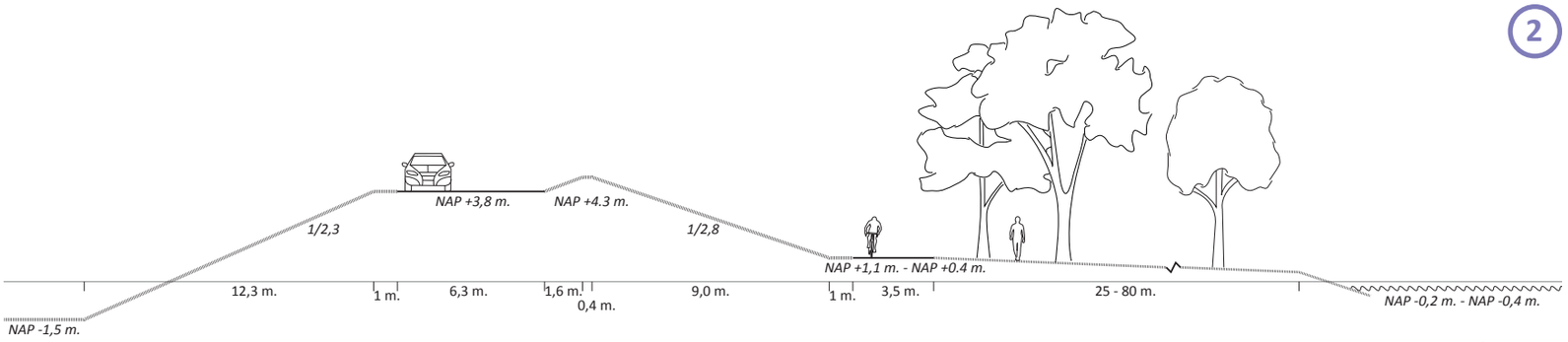


Figure 4.25b: between Medemblik and Onderdijk, car on the dike and foreshore

3

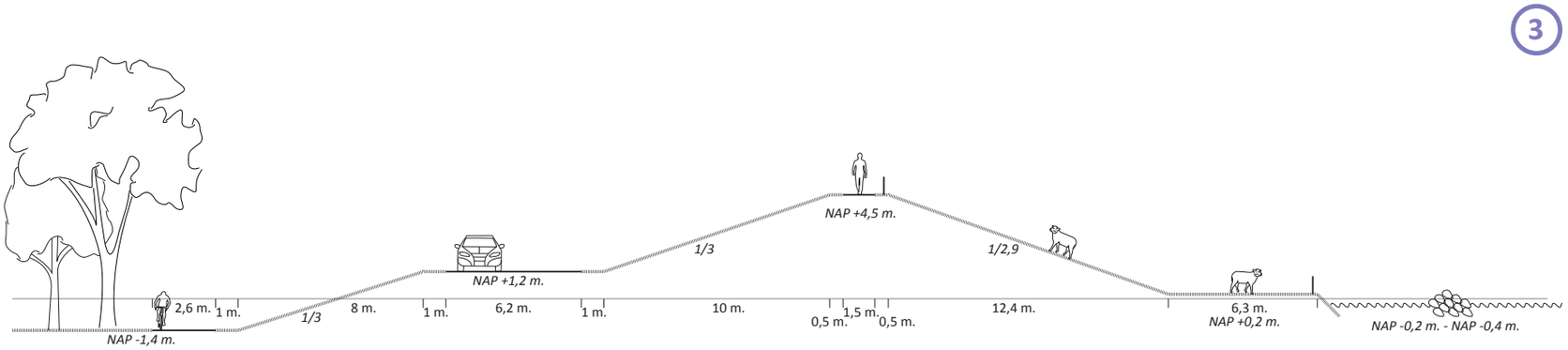
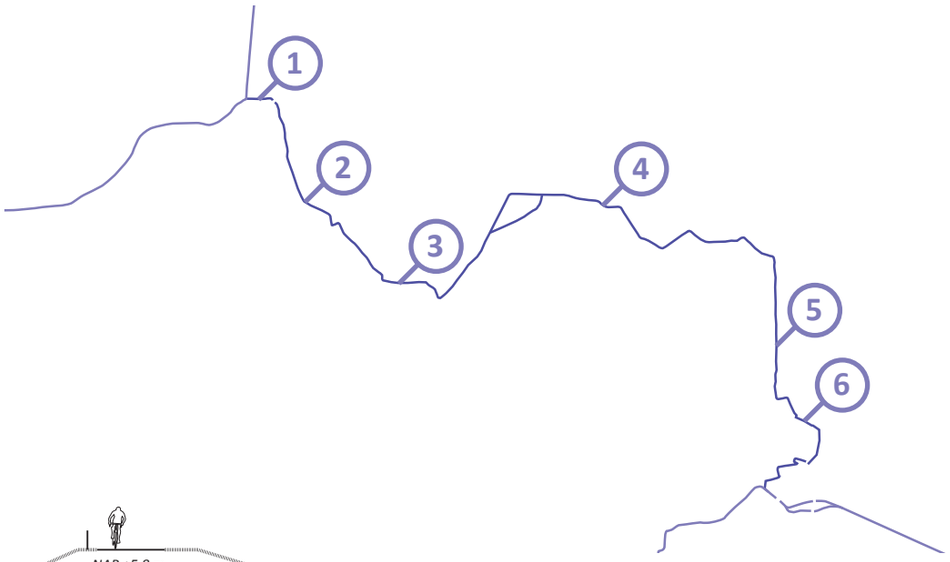


Figure 4.25c: Wevershoof, Nesserdijk, foreshore and shelter dam

For centuries the dike used to be the main infrastructural connection in the area, but between Enkhuizen and Medemblik the infrastructural function partly got lost in the last decades. The road is now often situated next to the dike, sometimes on the bank. There is a road on top of the dike, but this road is only accessible for cyclists or walkers, and is used for maintenance (Olthof et.al., 2009). Only between Onderdijk and Medemblik the road on the dike is still part of the main infrastructural network (see figure 4.25b and 4.26). On many places the dike slopes are grazed by sheep. If there is no foreland the sheep graze on the inner dike slope, if there is a foreland, the sheep can also graze on the outer dike slope.



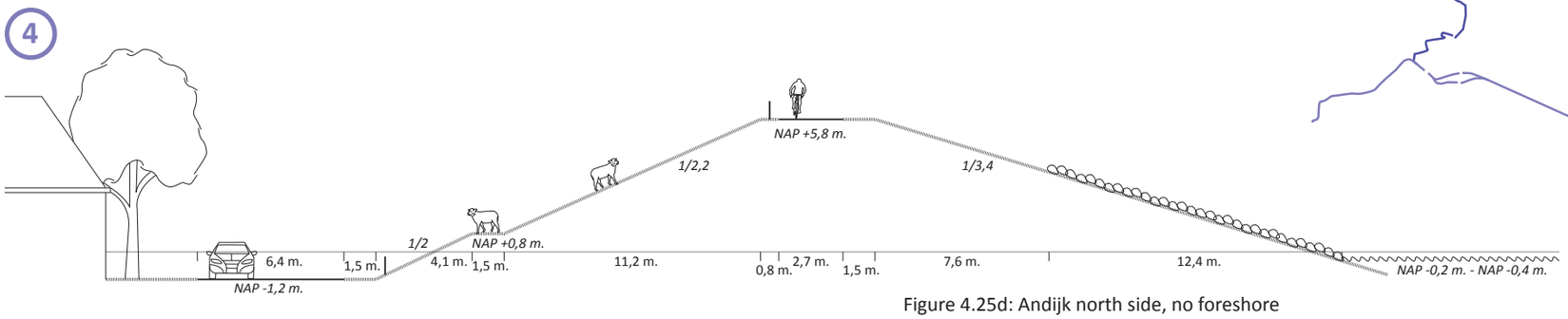


Figure 4.25d: Andijk north side, no foreshore

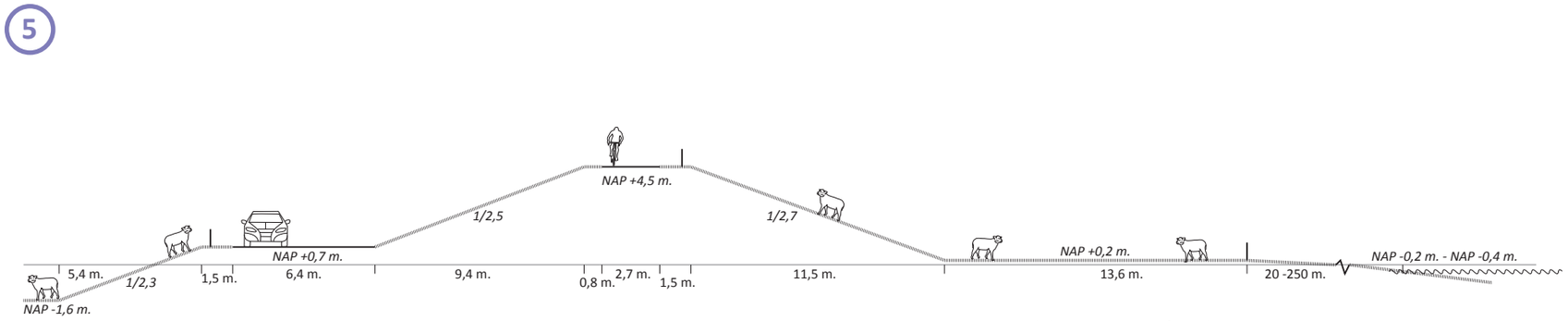


Figure 4.25e: Oosterdijk, low natural foreshore

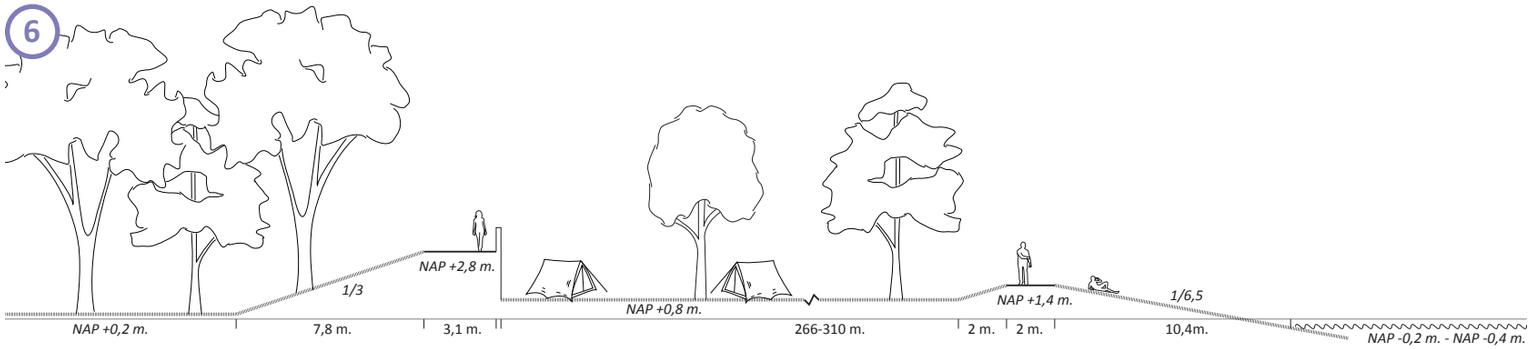


Figure 4.25f: sea wall Enkhuizen (Groene Wierdijk) with foreshore

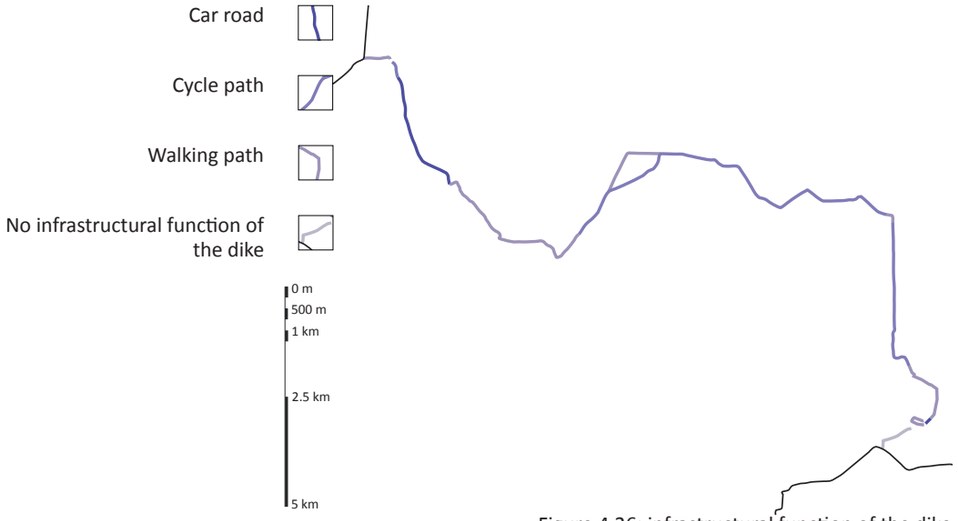


Figure 4.26: infrastructural function of the dike

On many places there are forelands in front of the dike. Some of these have always been there, and have fallen permanently dry after the IJsselmeer got a fixed water level, and others are humanly created after the closure of the Afsluitdijk. Next to the forelands, also some shelter dams have been created in front of the dike to protect the dike. Some other dams have been built to protect harbours and marina's, and around the fresh water reservoirs (see figure 4.27). The forelands both can have a nature function as well as a recreational function, and are sometimes densely planted. The (shelter) dams have an important function for nature.

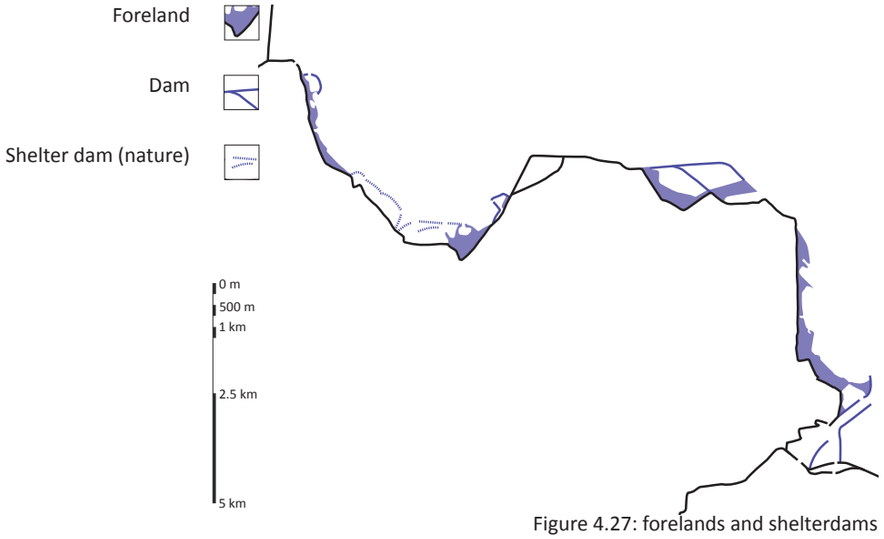


Figure 4.27: forelands and shelterdams

4.3.3 Route of the dike

Some parts of the present IJsselmeerdijk were part of the original Omringdijk, although many dike parts have been moved since the 13th century (Olthof et.al., 2009). This has to do with the way people were used to build dikes. The dike was built on a distance from the sea. During every storm surge parts of the foreland of the dike were washed away by the water until the sea reached the dike. A second dike was built behind the old dike, called an 'inlaagdijk' in Dutch. When the old dike finally broke down the new dike functioned as the new sea dike, with the land between the old and new dike as the new foreland (Schilstra, 1974).

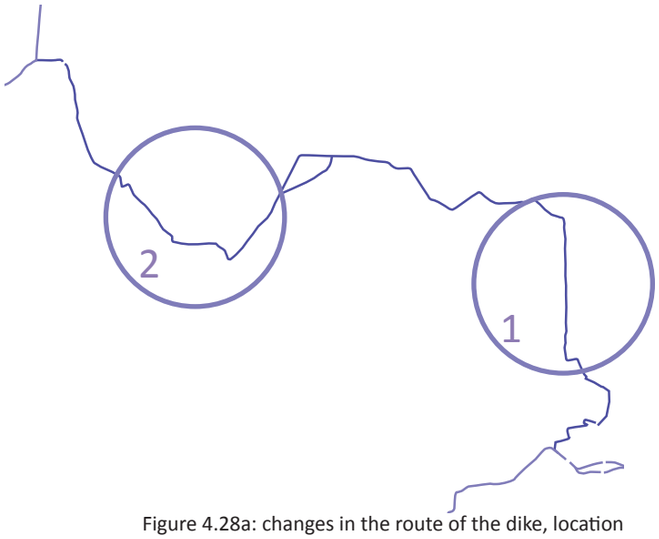


Figure 4.28a: changes in the route of the dike, location

An example of this principle can be found north of Enkhuizen, where the dike is very straight compared with other parts of the dike. The straight Oosterdijk originally was an inlaagdijk (build around 1400), but is now part of the Omringdijk (see figure 4.28b-d). In the corner of the dike, on the north side of the former inlaagdijk, a lighthouse was built to guide ships around this corner. Lighthouse De Ven was built in 1700 and this lighthouse is one of the oldest still existing and functioning in the Netherlands (OmringDaik Sait, 2011).

Looking at the large curve in the dike between Medemblik and Andijk it can also be expected that this part of the dike has been laid back, although an exact date is not known (Schilstra, 1974). On other places people tried to build new dikes on the sea side of the dike, 'uitlaagdijken' in Dutch, to extend the land and to create new forelands (Schilstra, 1974). Sometimes these dikes

are now part of the Omringdijk, but in other cases they appear as dikes around small polders attached to the Omringdijk.

Changes in the route of the dike took place until the 20th century, for example in the village Onderdijk. People used to build houses at the foot of the dike, first on the inner side, and after the building of a small polder, the Nespolder, also on the outer side. After the Afsluitdijk was finished the original dike was broken down. The location of the dike is still visible, while the main road in Onderdijk is very broad, with a main road and two side roads (OmringDaik Sait, 2011). In 1970 people started to realize that the absence of a piece of the dike was a potential threat. The dike of the Nespolder was strengthened and heightened so that this dike became part of the primary flood protection of West-Friesland (see figure 4.28e-g).

Figure 4.28b-d: changes in the dike route, Oosterdijk, Enkhuizen (photopraphs: straight dike)

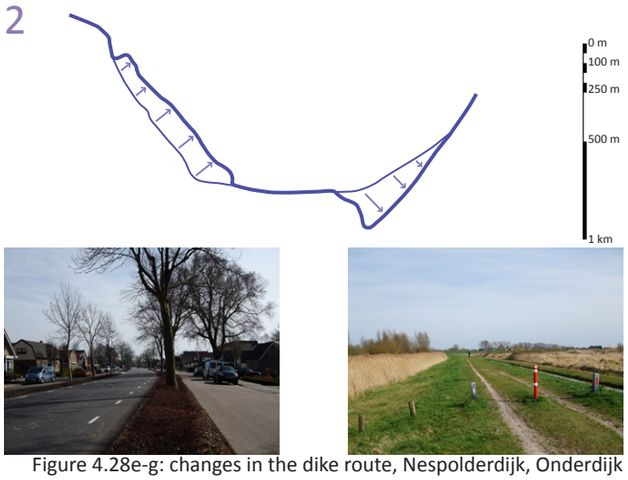


Figure 4.28e-g: changes in the dike route, Nespolderdijk, Onderdijk (photographs: former location of the dike in Onderdijk and along the small polder

4.4 Experience and quality

4.4.1 Introduction

This paragraph is based on the knowledge gained in the previous paragraphs of this chapter, and on the knowledge gained in the chapter on spatial quality and experience (chapter 3). The qualities of the area and the experience of the area are analysed. This is done with the help of the knowledge on what is experienced most by people, and with the knowledge on why and to which landscapes, areas and elements people add spatial quality. Although it has been tried to be as objective as possible, there are still some subjective influences. This means that it is possible to have a different opinion on the spatial quality of the area, or to have different experiences with the area. Especially personal experiences can make that other, different qualities are seen, which are not seen by most of the people.

4.4.2 Experience: landmarks

Several landmarks dominate the area, and the view when being on the dike (see figure 4.29). The landmarks are good orientation points, and have influence on the experienced travel time, but not all of them. They have to be or look attractive enough to be an interesting destination point. The wind turbines in the area for example are good orientation points, but they are not interesting or unique enough to mentally shorten the travel time.

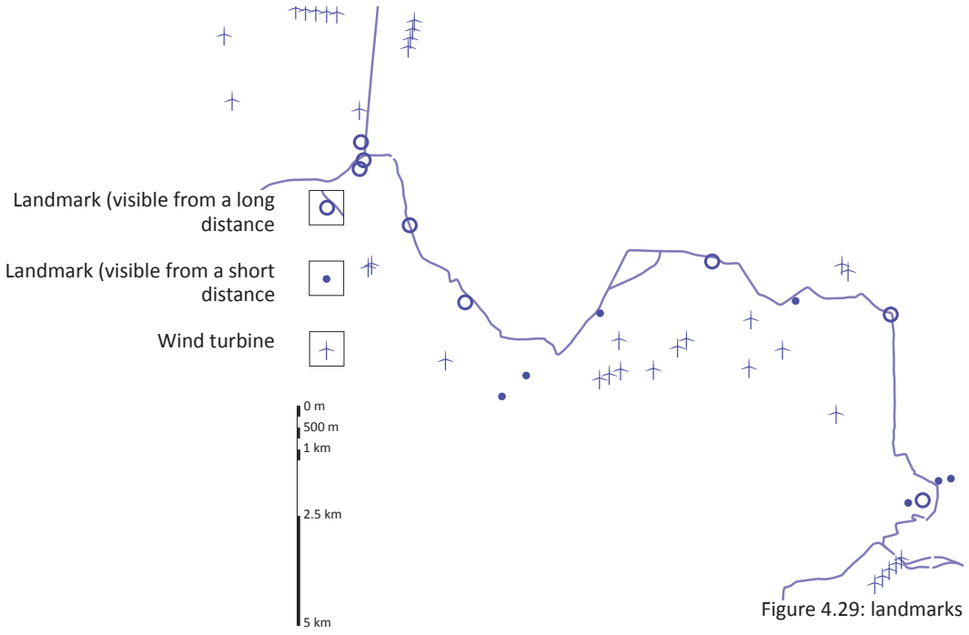


Figure 4.29: landmarks

Looking at the landmarks in the area some things become clear. Landmarks that are very clear from one point of view can be absent, and therefore less important, from a different point of view. There is a difference between the way landmarks are experienced from the internal landscape, from the dike and from the water. Especially from the water some landmarks are easy to recognize, while the view is not blocked by anything. Some of the landmarks were built for this goal, like the lighthouse and the harbour lights. Looking from the dike and the internal landscape, the view is more often blocked by vegetation. The churches of Enkhuizen for example are hardly visible from the dike, and parts of the internal landscape. This is a big difference compared with Medemblik, which is visible from a far distance, both from the dike as well as from the internal landscape (see figure 4.30a and b).

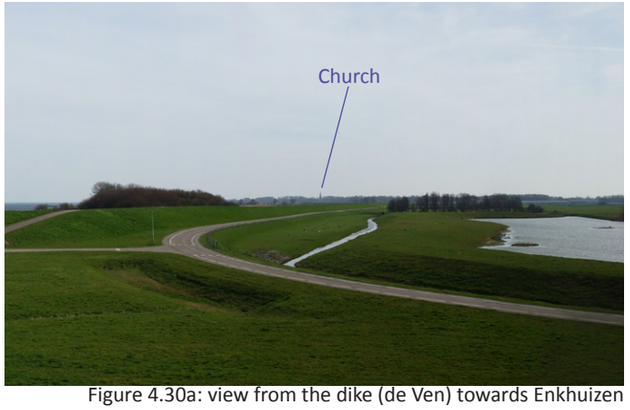


Figure 4.30a: view from the dike (de Ven) towards Enkhuizen

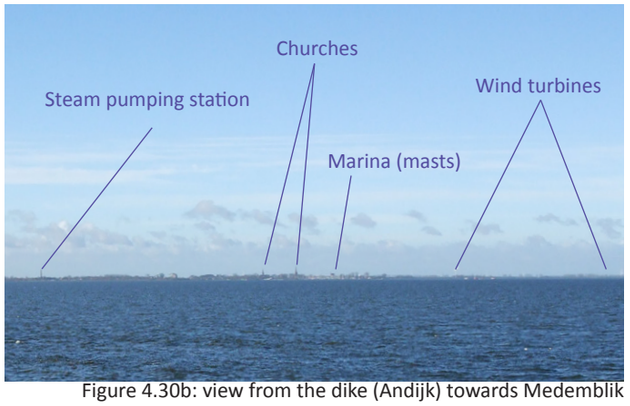


Figure 4.30b: view from the dike (Andijk) towards Medemblik

4.4.3 Experience: gate-effect and vistas

Compared with river dikes, the houses and trees are situated on a larger distance from the dike. This means that the gate-effect as mentioned by Feddes et.al. (1988) is not present that often along the dike. Because of the larger distance between the dike and the higher elements, the gates reveal their secrets sooner so that the surprise effect is less. But while the dike makes some sharp curves the gate-effect does exist in the area (see figure 4.31).

An important other effect that adds to the surprise effect are the vistas (see figure 4.32a and b). While the dike is, compared with most river dikes, more densely built, it is hard to see the landscape behind the first row of houses. On some places there is an almost complete closed building line. This means that the places where it is possible to look through the houses to the landscape that lies behind are real surprises. They even add to the readability and recognisability of the landscape. Normally, the height of the dike helps to give an overview of the landscape, to be able to understand the landscape. The feeling of flying above the landscape adds to the attractiveness of the dike. Although the dike between Enkhuizen and Medemblik is often even higher than most river dikes, there are places where it is impossible to look over the landscape on the inner side of the dike. So the landscape is less clear and understandable for people. Without the vistas this would be even more, the vistas make that the landscape stays understandable, and add to the feeling of flying above the landscape.

If the dike would be higher, it would not be possible to see more of the landscape behind the houses. This is because the view is often mostly blocked by the vegetation and not by the buildings. So the experience of the view on the landscape lying behind would not be enlarged. The experience can even turn into a bad one, while the contact with the ground level will be less, both because of the increases height as well as because of the enlarged horizontal distance between the top of the dike and the ground level. In that case details, for example on houses or in gardens, are more difficult to see and experience. Too much flying above the landscape results in too little possibilities for interaction with the landscape.

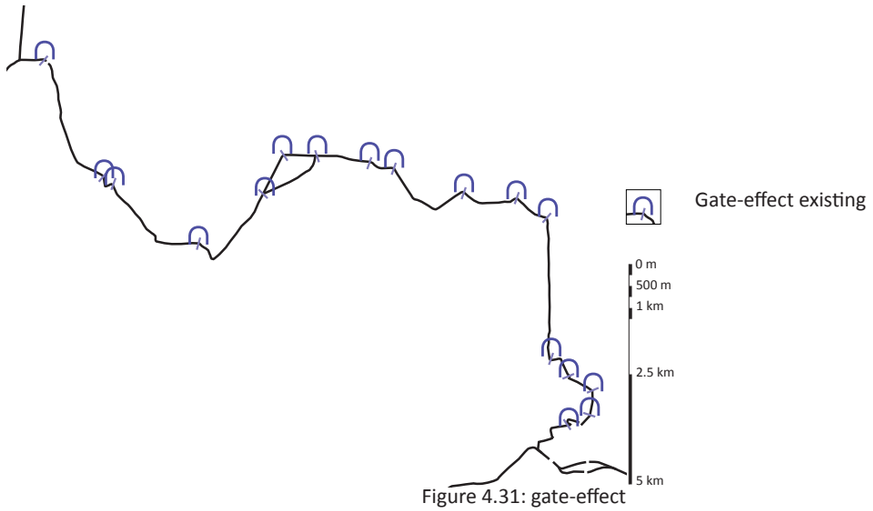


Figure 4.31: gate-effect

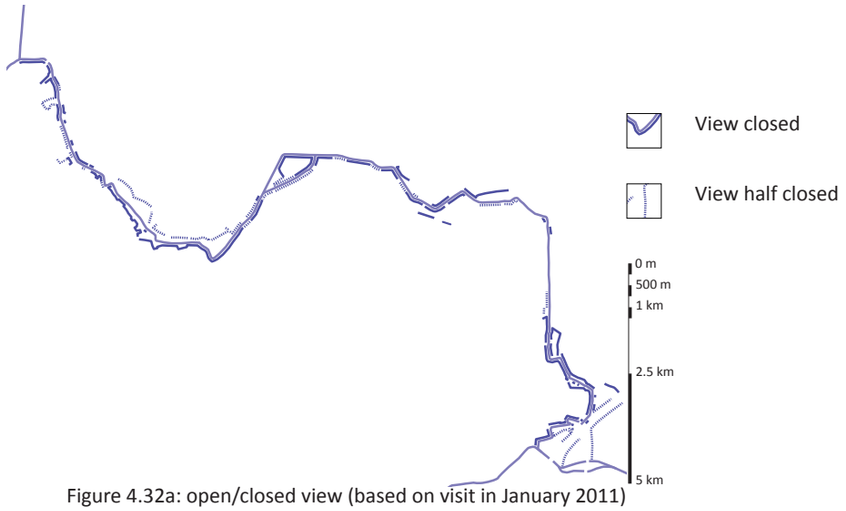


Figure 4.32a: open/closed view (based on visit in January 2011)

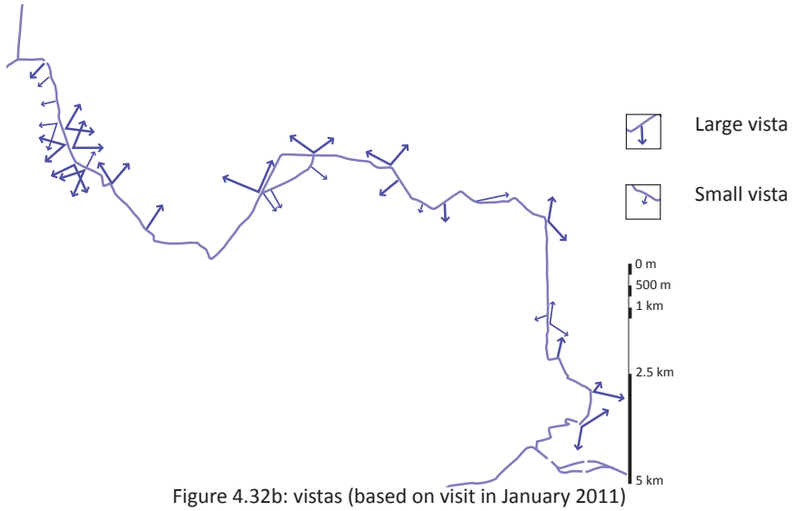


Figure 4.32b: vistas (based on visit in January 2011)

4.4.4 Experience: order, variety and chaos

The openness, the vistas and the possibilities to overview and understand the landscape have influence on the perceived level of order, variety and chaos. But this is also influenced by the elements that can be seen. Elements can be individual houses, groups of buildings or even neighbourhoods. But also other areas that mentally belong together and are separated from other areas. Together, the order of the elements and the order of the landscape, make the complete experience of order or variety. Varied elements in an orderly and understandable landscape are pleasurable, but if the landscape is not understandable there is a chance that people will perceive chaos.

Looking from the dike between Enkhuizen and Medemblik, it already became clear that there are places where it is hard to get an overview of the landscape. There are only few places where you can really look away, especially on the inner side of the dike. Looking at the buildings along the dike there seems to be a lot of variety within the houses, but as an entirety there is order. All the houses are placed at almost the same distance from the dike, and they have almost the same height. This makes that the landscape is still understandable. Also the old city centres are varied, but understandable because of their history. Some of the open areas where you can get overview over the landscape lack same variety and are therefore perceived as very ordered, or even slightly boring. This is just like the new neighbourhoods and some recreational housing areas, when looking from the dike.

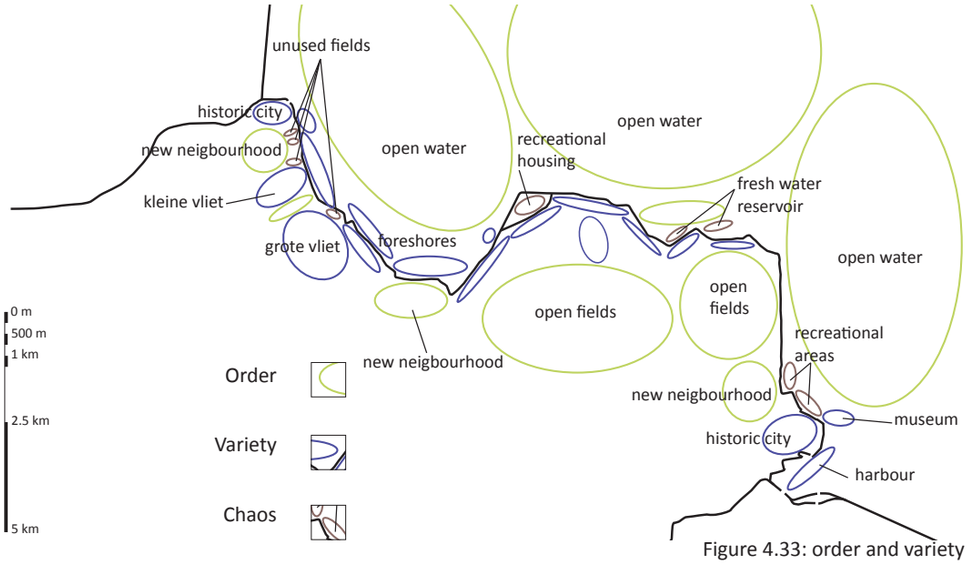


Figure 4.33: order and variety

But there are also some areas along the dike in which both order in the landscape and the elements is lacking, and which are hard to understand. These areas can be perceived as chaotic. This is especially the case near Enkhuizen, where the outer dike areas are densely used and densely grown. This means in this case that the water is invisible from the dike, and because of all the fences the area is not accessible. The fact that parts of the area are not accessible for those who did not pay for it contributes to the feeling of chaos. Also parts of the (inaccessible) fresh water reservoirs can be perceived as chaotic. Near Medemblik there are also some areas that potentially can be perceived as chaotic. There are some small areas in between the new recreational housing areas, of which it is not clear what their function is or will be. The same counts for some areas in between the neighbourhoods located next to the dike (see figure 4.33).

4.4.5 Qualities of the area

The qualities of the area, which can be pointed out, exist of both large scale elements or areas (which often exist of several small scale elements) as well as small scale elements that add to the quality themselves. In the case of the landscape between Enkhuizen and Medemblik (seen from the dike) the large scale elements often represent recognisability and unity. The small scale elements that stand on their own add to the variation and the surprise effect in the landscape. The small scale elements also make that the landscape stays interesting and that the travel time, especially along the dike, seems to be shorter.

On the largest scale both the dike and the view over the water add to the quality of the landscape, and it is clear that both are strongly interconnected. Without the water the dike would not be there, or look totally different, like parts of the dike that are sleeping dikes. Both elements are always present in the landscape between Enkhuizen and Medemblik. One scale level lower, the landscapes on the inner side of the dike are the next elements that add to the quality of the area. Two main landscape types can be seen, and together, because there is variation between the two of them, they add both unity and variation. Two other larger scale elements are the two old, historic cities, which can both be seen as elements themselves, as well as combinations of many elements. In this case the cities are seen as elements themselves. The history of the cities adds recognisability, but the liveliness of the cities and all different buildings add to the variation. Compared with the area in between the cities, which can be seen as unity, the cities are complete different elements.

The smaller scale elements are often related to the larger scale elements, and there even can be a discussion whether the small scale elements should possibly be seen as part of the large scale elements. In this case only the small scale elements are mentioned that are, can or will be experienced as separate, unique elements, such as special buildings like landmarks. Also the Zuiderzee museum and the steam pumping museum are pictured, while these musea can be found outside the city centres of Enkhuizen and Medemblik. Visiting the musea does not mean that people always visit the city, so cities and the musea are elements that can be experienced separate from each other.

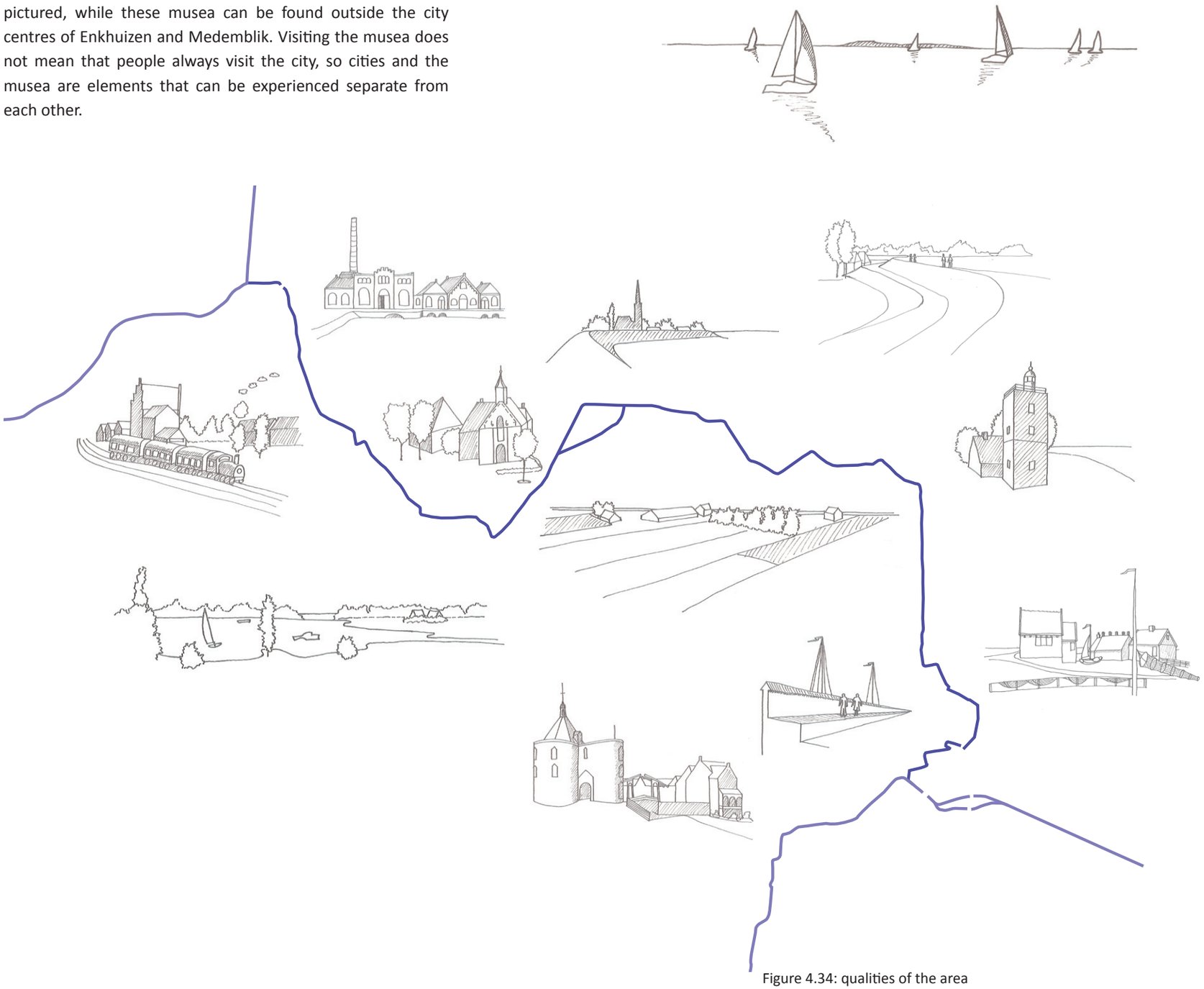


Figure 4.34: qualities of the area

4.5 Conclusions and guidelines

4.5.1 Conclusions

The dike between Enkhuizen and Medemblik is situated in a landscape which can be split in two main parts, one part more ordered and large scale, the other part more varied and small scale. The clear distinction between the two parts contributes to the readability of the landscape. Both cities add an extra, interesting dimension to the landscape, and have developed as touristic hotspots.

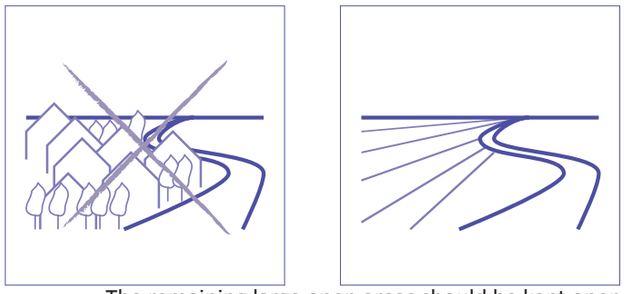
The readability of the landscape, from the perspective of the dike, is possibly in danger while the area next to the dike is already densely built, and will possibly be more densely built in the future. Therefore the vistas are important to protect, and if possible enlarge the number of them. Building activities also form a danger for the visibility of the landmarks, some are already now hardly visible from the dike. It is important to make sure that the landmarks stay visible, also in the future, while they are important for orientation and as travel goals. Some landmarks can even develop as more interesting travel goals by adding extra functions, for example catering.

The qualities of the area differ in scale level, some are local while others are more regional. Like the landmarks, the local qualities are important for variation and to keep the area interesting. The regional qualities are important for the unity in the area.

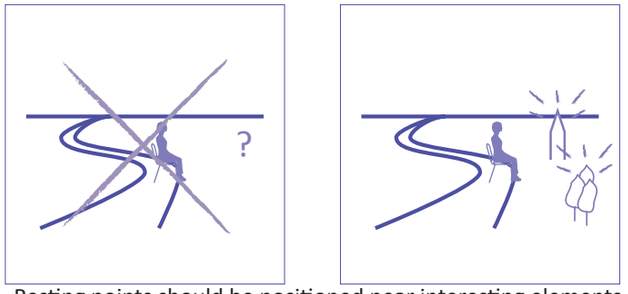
4.5.2 Guidelines

The guidelines of this chapter are based on the analysis of the area, the research on spatial quality and personal observations. Many of the guidelines derived from this chapter can be seen as additions to the guidelines derived from the previous chapter. Keeping open the large open areas is an addition to variation in open and closed areas, recreational traffic on the dike is a local addition to the accessibility of the dike. The human scale of the dike is further defined by stating that the dike should not be higher than the houses next to the dike.

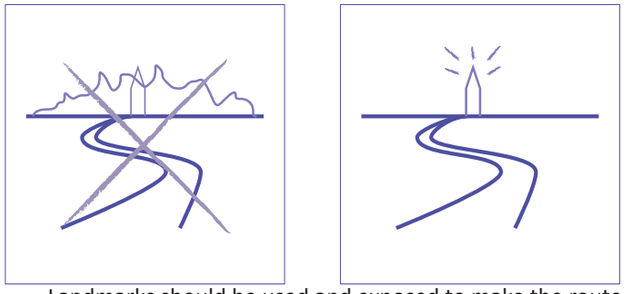
There is also a possible conflict between the guideline about harbours derived from chapter 2. This can conflict with Medemblik developing as water sports centre, while the accessibility of the harbour decreases. This does however not always have to be the case.



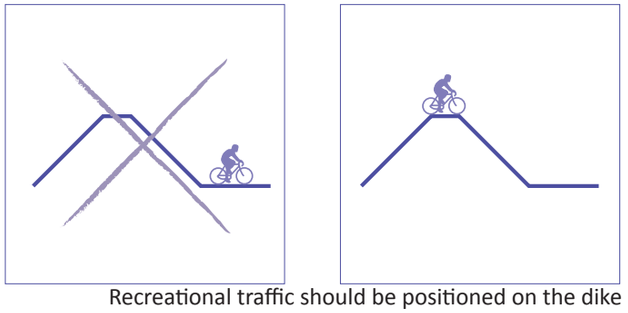
The remaining large open areas should be kept open



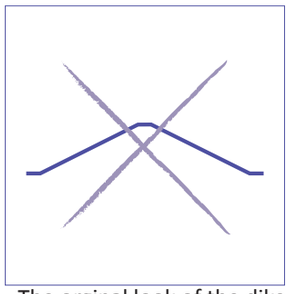
Resting points should be positioned near interesting elements and views

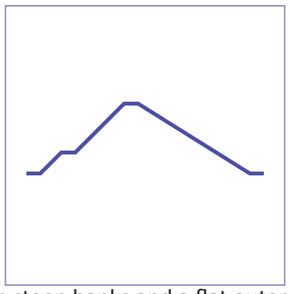


Landmarks should be used and exposed to make the route interesting

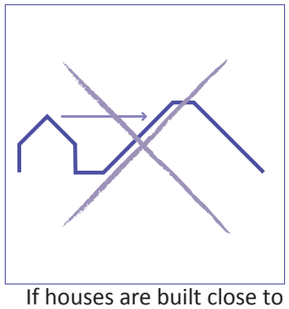


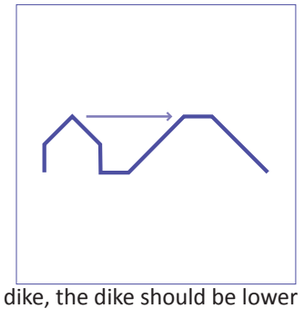
Recreational traffic should be positioned on the dike



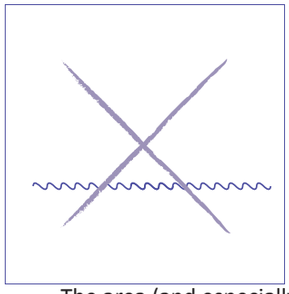


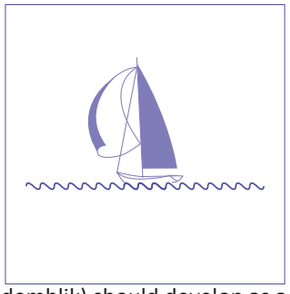
The orginal look of the dike (with steep banks and a flat outer slope) should be kept





If houses are built close to the dike, the dike should be lower or as high as these houses





The area (and especially Medemblik) should develop as a centre for watersports

5

Technical framework

Flood protection

5.1 Flood risk and policy

5.1.1 Flood risk

Risk is mainly about the possibility to lose something valuable. On the other hand, risk is also about the expectation of people to gain profit from a situation that forms a potential risk. If there is no profit to gain from a risky situation, there is no reason to take the risk (de Boer et. al., 2003). The risk of flooding is defined as the multiplication of probability and consequence, where probability is the chance of a particular event occurring and consequence is the potential damage of that event (Gersonius et. al., 2007). Risky places are locations with a high population density that are close to a dam or dike, where the warning time is relatively short and evacuation is relatively difficult (Klijn et. al., 2010). Large parts of low lying Netherlands have a high population density and high economic value, so a potential flood will lead to a big disaster (Pols et. al., 2007).

The consequences and therefore the risk of flooding is high in large parts of the Netherlands. People living in an area at risk of flooding mostly do so because they can take economic advantages from the location, or while they prefer the beauty of living next to water. The Dutch are clearly a risk averse society in the sense that its population and politicians consider disasters, like floods, unacceptable (Olsthoorn et. al., 2008). A difference can be made between personal or individual risk, where the individual person is responsible for the risk and the eventual loss of something valuable, and societal risk, where the society as a whole is responsible for both the risk and the costs. If people do not feel individual risk, this does however not mean that they are not willing to pay to prevent the society from a potential risk (de Boer et. al., 2003). Most people for example do not feel any personal risk of flooding, but there was hardly any resistance against the dike reinforcements after the near flooding's in 1993 and 1995.

Currently, the water awareness in Dutch society is considered to be relatively low, especially related to flood risk (Olsthoorn et. al., 2008). Due to all the measures that have been taken to protect the country in the last century, people feel safer about water security and the strength of the dikes. The Dutch population generally has great faith in the capacity of its engineers and its government to protect them against flooding (Werners et.al., 2009). People living nearby a dike do not consider themselves to be significantly more at risk of flooding than those living far away from flood prone areas (Olsthoorn et. al., 2008). Especially people in the IJsselmeer area feel safe, if you compare it with the river area, the south-west delta and the North Sea area. This is probably because they did not experience any flooding disasters since 1916, while flooding's and near flooding's are more recent in other areas (Terpstra, 2008). In the province of Limburg there was hardly any awareness of flood risk before the (near) flood in 1993. This was completely different before and after the (near) flood in 1995 (de Boer et. al., 2003). It is likely that the awareness of flood risk had decreased in Limburg in following years, and has increased during this years (January 2011) near flood. People's perception of risk of flooding is of high importance for the support for flood protection measures.

5.1.2 Flood risk policy in the Netherlands

The Netherlands as it is today is the result of centuries of water and flood management practices (Olsthoorn et. al., 2008). During the past 2000 years Dutch society has learned to live with the threat of flooding (Bouwer et. al., 2007). The first dikes were built during the middle ages to protect areas against flooding, at first on a local scale around settlements. Soon, flood protection became organized on a regional scale to protect larger areas, including the agricultural lands, from flooding. The protection was organized within water boards, which exist since the 12th century and were the first modern governmental organizations in the world. In the beginning of the 19th century, during the Napoleonic times, flood protection became centralized on the national level of public administration. While the flood protection management became a collective task, there was less room for private initiatives (de Boer et. al., 2003). Because of the long history in flood protection, flooding's are not perceived as 'acts-of-god' by the Dutch people. The population expects their government to protect them against flooding (Olsthoorn et. al., 2008).

Dikes are still the main objects of flood protection in the Netherlands, together with dunes and other places in the landscape that are naturally higher. With sluices and other water management structures dikes form closed flood defence structures. More than half of the Netherlands is protected by dikes and would be flooded if they would not be there. Both the shape of the country and the flood risk are largely man-made, and therefore manageable (Olsthoorn et. al., 2008). Water management is something of national pride in the Netherlands, especially projects like the Afsluitdijk and the Delta Works in Zeeland and Zuid-Holland.

The present safety policy in the Netherlands is based on safe dikes (Stoutjesdijk et. al., 2008). All areas that are low and in a risk of flooding are divided into so called dike-ring areas, which are areas that are protected by flood defence structures as separate units. This is the primary flood defence system with a total length of 3558 km. For all dike-ring areas an accepted chance of flooding is set, which means that a decision is made on which extreme situation, and its return period, a dike should be proof against. This flood probability differs between an extreme situation that occurs once in every 10.000 years in the provinces of Zuid-Holland and Noord-Holland, which are of high economic importance and are densely populated, and once in every 4000 years in other, less populated provinces. For the dike-ring areas along the rivers in the Rhine Delta, where high water discharges can be foreseen a few days in advance, the dikes have been constructed up such a level that a discharge that occurs once in every 1250 years (or 2000 years in some areas) can be safely accommodated (Bouwer et. al., 2007) (see figure 5.1). Along the river Meuse in the province of Limburg there are many small dike-ring areas with a flood probability of once in 250 years. These standards are set by the first Delta committee in the 1960's and laid out in the Flood Defences Act (Wet op de Waterkering).

Since 1996 the Flood Defences Act regulates that the primary flood defence structures are checked every five years. Whether the flood probability standards of the dike-ring areas are met depends on two factors. The first is the overtopping rate, which is the assumed probability of high water levels that would result in overtopping of dikes. The second factor relates to assumptions on the integrity-failure probabilities of the water defence structures (Olsthoorn et. al., 2008). The fail factor has been valued more important in the last decades. One may tend to think that overtopping of dikes is the main cause of flooding. In fact most floods occur due to dike breaches long before dikes are overtopped. This can be caused by processes such as sliding in the inner or outer dike slope, erosion of the dike revetment, and internal erosion caused by piping (Olsthoorn et. al., 2008) (see figure 5.2a-d). Some of these fail factor can lead to a suddenly and uncontained dike-burst: a breach evolves, that can grow quickly due to erosion (Klijn et. al., 2010). Research in 2003 showed that only 50% of all primary flood defence structures in the Netherlands met the requirements. When structures did not meet the requirements this was mainly because of the strength of the dike and the failure probability, and not because of the height of the dike.

The Netherlands as it is now is safer with respect to flooding than it has ever been. Compared with other countries our protection is much better organized, and our safety margins are high. In other countries the flood probabilities differ from once in every 100 years to once in every 1000 years, significantly lower than our Dutch standards (Pols et. al., 2007).

Figure 5.1: safety standards of dike-ring areas in the Netherlands (without Meuse areas in Limburg) (Kabat et. al., 2009)

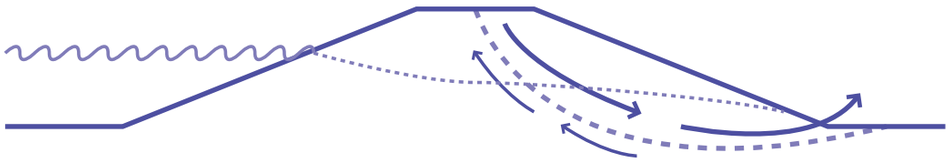


Figure 5.2a: fail mechanism: sliding of the dike slope

Figure 5.2b: fail mechanism: erosion of the outer dike slope

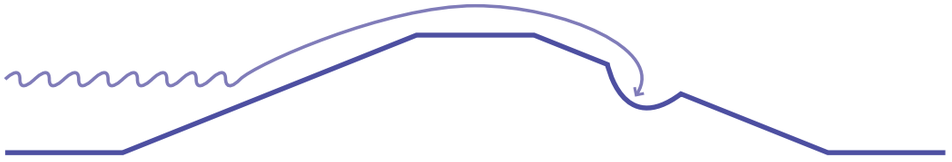


Figure 5.2c: fail mechanism: erosion of the inner dike slope

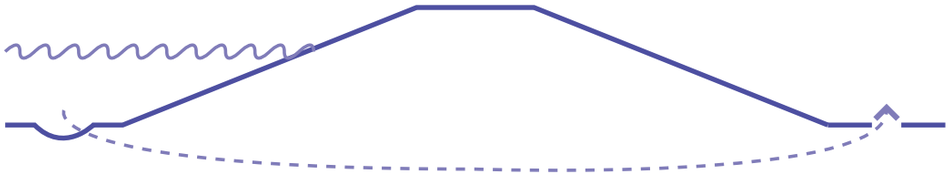


Figure 5.2d: fail mechanism: piping due to internal ersosion (5.2a-d based on: Feddes et. al., 1988)

5.1.3 Changes in flood risk policy

The fact that people feel safe about flood risk means that more people are moving to low lying parts of the country, and that the investments in these areas are high (Pols et. al., 2007). This means that the consequences of a potential flood are increasing, and so does the risk of flooding. 8 million people in the Netherlands are now living in areas below sea level. These are mainly the areas with a flood probability standard of once in every 10.000 years. The current 10.000 year level at least appears to be out-dated and a higher level of safety is likely to be justified given the number of people at risk and the property that is to be protected (Bouwer et. al., 2007). This is also the opinion of the Delta Committee (2008), who advises to increase the safety level of all dike-ring areas with a factor 10.

The provinces, who are responsible for the flood protection in their area, state that the present way of benchmarking is not sufficient anymore. A checked dike is accepted or condemned, with no possibility in between. The provinces state that in case of a condemned dike, an acute safety problem is rarely the case. The provinces plea for a more precise benchmarking system in which the safety of dikes is rated (Interprovinciaal Overleg, 2011). This joins with the opinion of Gersonius et. al. (2007), who state: 'key to improving flood risk management is to better understand the risks'. There are also other opinions about the benchmarking of flood risk in future. Pols et. al. (2007) state that flood risk should not be seen for a dike-ring area as a whole, there should be risk zoning within the dike-ring areas, while there is a difference in speed and depth of flooding within the areas, depending on local factors. This can also mean that some areas in river forelands are valued safer than some areas within the dike rings, while there would be less impact in case of flooding.

But it is not enough to only look at safety levels of dikes and areas. During the last decade of the 20th century the flood protection policy in the Netherlands shifted. Over centuries the policy was to protect the land and extend it by raising dike heights and building new dikes for the reclamation of new land. However, the flood events in the river area in 1993 and 1995, when more than 100.000 people had to be evacuated from areas along the rivers Rhine and Meuse, have shown that it is not possible to guarantee one hundred per cent safety (Stone et. al., 2008). In view of the expected impact of climate change, sea level rise and land subsidence, the long-term sustainability of traditional technical engineering approaches to flood control (dike strengthening and heightening) is questioned (Brouwer et. al., 2004). It is not possible to protect all areas with dikes, flood accommodation is now also part of the policy (Stone et. al., 2008). Nowadays, measures to obtain flood safety may even include a certain loss of territorial integrity. This change in approach is closely related to the rise in the value of ecology and nature in the public mind (Olsthoorn et. al., 2007). This already started with the protests in the society against the closure of the Oosterschelde, which is part of the Delta works. After societal pressure the decision was made not to close this estuary with a closed dam, but with an open dam that can be closed in case of a storm surge (storm surge dam). The environment has become an important aspect in flood safety policies.

There is also resistance against the new policy of 'giving back land to the water'. The aversion against such plans seems very deep seated (Olsthoorn et. al., 2008). This is mainly because reclaiming land is part of the Dutch culture and religion, and while people worked hard for land reclamation in the past. An example that still causes resistance is the Hertogin Hedwige polder in the province of Zeeland. To compensate nature loss as a result of dredging activities in the tidal estuary of the river Schelde, the polder needs to be given back to the water. Although the polder is not inhabited and in use as agricultural land, the people of Zeeland, who have a long history of flooding and battles against the water, strongly resist against the plans. At this moment it is still not sure what will happen to this polder. Compared with Zeeland, there is much less resistance against giving back land to water in the province of Friesland (de Boer et. al., 2003). So within the Netherlands differences in history, culture and religion has influence on peoples opinion on water policy.

Block 5.1 'Room for the River' (Ruimte voor de Rivier)

An example of the new policy is the 'Room for the River' project, in which the rivers in the river area get more space to flood in a controlled way. This project led to the adoption of the new policy aimed at giving more space to water through solutions that seek not only to increase safety levels, but also to garner social, environmental and economic benefits (Werners et. al., 2009). This project focuses on river forelands and uninhabited or hardly inhabited areas that can function as reservoirs if the river run-off is high. Elements and constructions that form an obstruction for the water are removed and old stream beds are excavated again. Besides the extra room in the river forelands, there are also inner dike areas that are indicated as reservoirs that only flood during extremely high water levels. The idea is that the water is contained in an area until the river run-off and water level is lowering again. The emphasis tends to be on finding space for flood water in rural areas in order to protect the urban areas (Gersonius et. al., 2007). There is still a remarkable attention and room for urban developments, compared to water policy. This means that the extra space for water stays limited (Pols et. al., 2007). The water image that is presented with the 'Room for the River' project is that of the wild water and nature, and not all people are convinced that it is a good policy (de Boer et. al., 2003). Especially near occupied areas, the wild water image does not match with the image and feeling of safety people want.

5.2 The flood risk around the IJsselmeer

5.2.1 Present flood risk

Since the closure of the Zuiderzee with the building of the Afsluitdijk, the areas around the IJsselmeer have not experienced any flooding's. The old Zuiderzee dikes were built as sea dikes and have not been significantly reinforced since that time, although some work on the covering and infrastructure on and around the dikes took place. According to the five year benchmarking of the primary water defence structures in 2006, some of the IJsselmeer dikes are not sufficient anymore. These are mainly the newer dikes of the new build IJsselmeer polders, many of the old sea dikes still meet the requirements set in the Flood Defences Act, including the Omringdijk between Enkhuizen en Medemblik (see figure 5.3).

A problem in the IJsselmeer area is that also the Afsluitdijk does not meet the requirements, its norm would now be that it is sufficient for extreme situations that occur once in every 1430 years. This however means that, in case the Afsluitdijk fails, there is a serious risk of flooding in the IJsselmeer area, while the dikes are designed for a fixed water level (Pols et. al., 2007). Most dike ring areas related to the IJsselmeer have a flood probability standard of once in every 10.000 years. This is because the area is of high economic importance and is densely populated, it includes larger cities like Alkmaar, Zaandam, Purmerend, and the northern part of Amsterdam.

Figure 5.3: results second safety assessment primary flood defences, 01-01-2006 (based on: Deltacommissie, 2008)

5.2.2 Future flood risk

With the proposed water level rise in the IJsselmeer the risk of flooding in the area will change. The future flood risk of the IJsselmeer area exists of two parts, first the water level rise of 1.5 meter, which will be a continuous and humanly controlled situation during longer times of the year, mainly in spring. Second is the risk of flooding as a result of temporary water level rise due to wind influences. The size of the IJsselmeer is large enough to allow for significant wave generation by the wind, and for significant wind-induced set-up of the mean water level (storm surge) (Bottema, 2007). The wind-induced set-up can reach up to one meter above the normal water level at the leeward side of the lake, and the wave run-up against dikes can reach three meter above the water level. This means that, along dikes, the waves can reach a height of four meter above the normal water level (see figure 5.4). Erosion due to waves and wave overtopping is the main threat for the strength of dikes, and has by that influence on the fail probability of dikes.

Temporary water level rise due to wind influences is an incidental situation, small scale water level rise due to the wind can occur several times a year, but extremely high levels will occur less frequent. Compared with other places and their risk of flooding, the risk in the IJsselmeer area can be compared with storm surges and sea flooding's, while it is influenced by the wind and can happen suddenly and can not be predicted in advance. Flooding's of rivers however, can normally be predicted earlier, at least 5 days in advance, while there is knowledge about the water run-off in upstream areas. Another difference is the duration of the flooding. The duration of a river flooding can be 3 to 4 weeks, while the duration of a storm surge lies in the order of 30 hours (Stone et. al., 2008).

On the other hand, there are differences between the risk of flooding in the IJsselmeer and the risk of storm surges along the sea coast. The water level in the IJsselmeer will only fluctuate under human supervision and will not face tidal influences. This means that the water level roughly stays the same during a longer period, and will not face high tide twice a day. It can also be expected that the duration of an extremely high water level in the IJsselmeer will be shorter than the average duration

of a storm surge, while the area is much smaller and the water is not blown up from a very long distance. Compared with other situations the situation in the IJsselmeer is unique, while the increasing risk of flooding in the future is caused by the human decision to raise the water level in the IJsselmeer. So a large part of the increased risk of flooding is only indirectly related to climate change and sea level rise. A small part is directly related to climate change, while it is expected that extremes will be bigger in future, like precipitation and stronger winds, which can cause higher waves.

The average wind direction in the Netherlands and the IJsselmeer area is southwest, which means that the West-Friesland side of the IJsselmeer border is normally sheltered (see figure 5.5). The average wind direction also counts in case of strong winds and gales (8-9 beaufort), although during the last two storm surge events (1916 and 1953) the wind direction was northwest. In the period between 1997 and 2006 16 gales occurred in the area (stronger winds did not occur), of which 13 were from a direction between south and west, and 2 came from a north westerly direction. Only in one case the wind direction was north east (Bottema, 2007). The West-Friesland side of the IJsselmeer is less sheltered in winds from northerly directions, although the coast of the Wieringermeer gives some shelter as long as the wind is from a north westerly direction. Also the part of the coast near Enkhuizen is still sheltered in that case.

While the IJsselmeer is a relatively shallow lake, the waves are depth limited, which means that the present design wave heights for the flood protection are 30-50% lower than they would be in a lake with a comparable size which is deeper (Bottema, 2007). With the proposed water level rise of 1.5 meter, the average water level in the IJsselmeer will increase significantly, from 4.2 meter to 5.7 meter in future. During winter times, when there is the highest chance of strong winds, the average water depth will be 5.2 meter (0.6 meter above NAP). It is not yet known whether the proposed water level rise also means that the design wave heights have to be adjusted to the new situation.

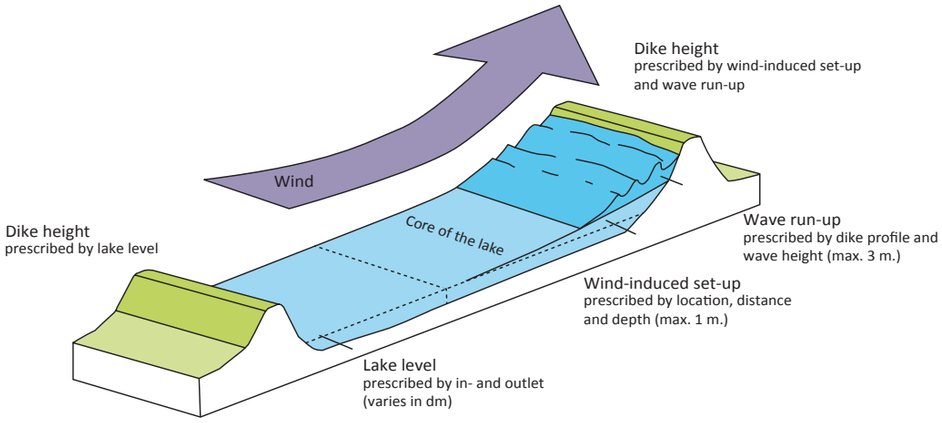


Figure 5.4: dike height based on waterlevel and wave height (based on: Projectteam, 2010)

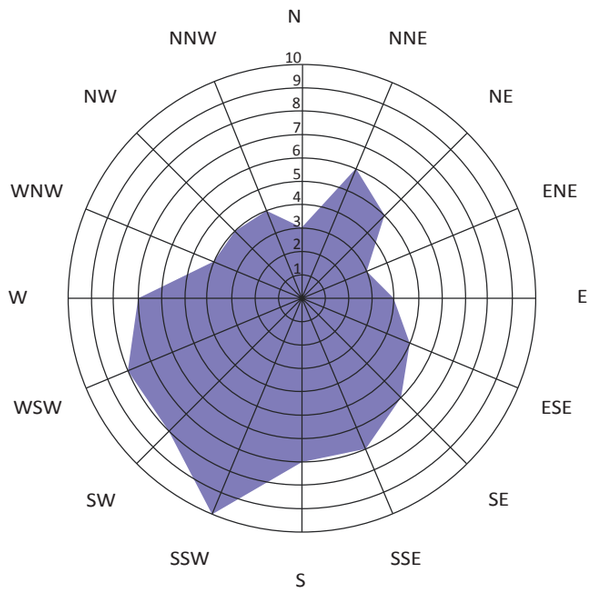


Figure 5.5: average wind direction Andijk, 01/2009-02/2011 (based on: Windfinder, 2011)

5.3 Flood protection: dikes

5.3.1 Dikes in the Netherlands

A dike is a man-made wall of earth (often strengthened with stone) that serves as water protection along or around any water body (higher than a quay) (according to van Dale dictionary in: Vroom, 2005). Most low lying areas in the Netherlands are protected against flood by dikes, which developed since the middle ages. Dikes form the most important symbol for the Netherlands as a man-made environment (Vroom, 2005). A difference can be made between river-, lake-, estuary- and sea dikes, although most of them originate from the first medieval dikes. Over the centuries the dikes have been reinforced and rebuild many times after breakthroughs and flooding's and as a result of increased knowledge and better techniques. In a delta area like the Netherlands, many river dikes fluently change into estuary- and sea dikes as the river broadens and flows into the sea. The sea dikes are usually higher and broader compared with river dikes. This has to do with tidal influences, which means that the water will hit the dike twice a day. Besides that, the forces of the water during high water are much stronger in areas with larger water bodies.



Figure 5.6a and b: sea dike Texel and lake dike Zoommeer



Figure 5.6c and d: old and new IJsselmeer dike



Figure 5.6e and f: 'sleeping' sea dike and river dike

In the last century, the total length of dikes under direct influence of the sea is strongly reduced by the closure of sea arms, like the Zuiderzee and the Zeeuwse Delta. These new built dikes, which officially should be called dams while they separate two water bodies from each other, are much higher and broader, and less steep, than the old ones. The Afsluitdijk for example is in total 90 meter broad (Sleeuwenhoek, 2006). The new sea dikes are normally straight compared with older ones, while the older ones are rebuilt and reinforced many times as a result of breakthroughs and other damages. Old sea dikes which kept their function have strongly been reinforced in the last century to keep to the promised level of security, and will need further reinforcement in future. The dikes along the closed sea arms lost their function as sea dikes and became lake dikes, but they are still important for flood protection. Due to wind and waves, the water in the new made lakes can still rise to a high level, although the threat of flooding is strongly reduced. Some of the old sea dikes still have some over height, while others will need reinforcements in the nearby future.

5.3.2 Technical appearance of dikes

Differences in form or appearance of dikes usually have to do with regional differences and the soil composition. But the variation in dike profiles is not big, as a result of functional requirements (Feddes et. al., 1988). In general can be said that dikes have the same appearance over great lengths, continuity has become the key characteristic of a dike (van Nieuwenhuijze et. al., 1994). Locally, differences can appear, for example due to a breakthrough.

Technically seen, a dike exists of three parts, the top of the dike, the slopes and the banks (see figure 5.7). For maintenance reasons, the top of the dike has to be at least 4 meter broad and if it is broader it is normally for traffic reasons (van Nieuwenhuijze et. al., 1994). The angle of the slope of a dike has to do with how steep the dike is. In the river area a slope of 1:3 is technically preferred, and this has also advantages for maintenance. When a dike is steeper than 1:3 there is a risk of waves breaking over the dike. In the IJsselmeer area the outer dike slope is even flatter, with a slope of 1:4 or even less steep (Bottema, 2007). This has to do with the difference in design between sea dikes and river dikes. Along sea dikes the waves have to be broken so the outer dike slope is flatter. A river dike has to stand the force of the water during a longer time in case of high water, which means that a stronger and flatter inner slope is necessary (Feddes et. al., 1998) (see figure

5.8a and b). Along older dikes, the inner dike slope is normally steep and protected by banks. There are two types of banks, banks preventing the dike from gliding, when the soil is weak or the dike is steep, and banks preventing the dike against piping (van Nieuwenhuijze et. al., 1994) (see figure 5.9a and b). Piping means the internal erosion of the dike due to seepage, which can be the case if there are sand layers in the dike. If the bank is broad enough it can, for example, be used for a road. Some of the newer IJsselmeer dikes along the polders also have banks on the outer dike slope, containing a maintenance road.

Dikes can be made out of different materials, like clay or silt, depending on the materials that are present in the area they are built. Along the IJsselmeer between Enkhuizen and Medemblik the first dikes existed of dried sea grass and this grass can still be found in the present dikes (Bosscher et. al., 1973). Over the years the sea grass became covered with layers of other materials. New dikes around the IJsselmeer are built up out of boulder-clay, that was brought to the area during the ice-age. It is important that the outer slope of a dike is impermeable to water, this can be realized with a clay deck on the outer side of at least 1 meter. For drainage reasons should the inner side of a dike be more permeable, and be covered with a more sandy layer (Feddes et. al., 1988) (see figure 5.10). Most dikes are covered with grass, but this has to be erosion resistant. The dike slopes are normally maintained by mowing, but it is also possible to let the slope be grazed by sheep, which adds another function to the dike. For safety reasons it is not possible to let other cattle graze the dike slopes (Feddes et. al., 1988). On dikes with a major risk of wave attacks a stronger covering of (part of) the outer dike slope is necessary, for example with stone or asphalt, or grass in an erosion resistant cement mixture (Feddes et. al., 1988). Because the facing of the dike is visible over a large distance, there is resistance against the use of too much stone covering, while a grass deck is perceived as more appropriate to a (traditional) dike (van Nieuwenhuijze et. al., 1994).

The height of a dike depends on the normative high water level, and on the expected wave heights and how much the waves are allowed to break over the dike. Waves are the most important threat for the strength of dikes, especially when they overtop the dike and erode the inner dike. In the river area a margin of 2% wave overtopping is allowed (Feddes et. al., 1988). Shoaling and breaking waves on foreshores is of great importance for flood protection. Wave heights and wave periods may be reduced significantly, so that the risk of wave overtopping is lower, and therefore possibly the design height of the dike. Even without foreshores, significant wave transformation may occur when the waves propagate from the open water over the lower (underwater) slopes of the dike (Bottema, 2007). A lower dike can have advantages, for example for the view of houses behind the dike. Besides shoaling and breaking waves, it is also possible to strengthen the inner dike slope, to make a lower dike height possible (van Nieuwenhuijze et. al., 1994). A stronger inner slope can be realized by choosing for a stronger facing for the slope, for example stone instead of vegetation.

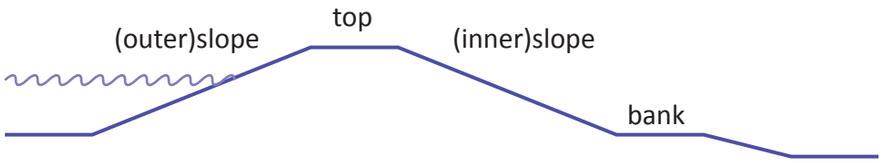


Figure 5.7: three dike parts

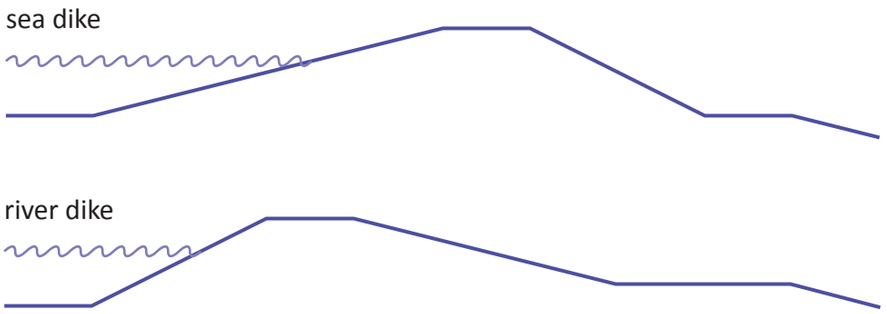


Figure 5.8a and b: difference between a sea dike and a river dike (based on: Feddes et. al., 1988)

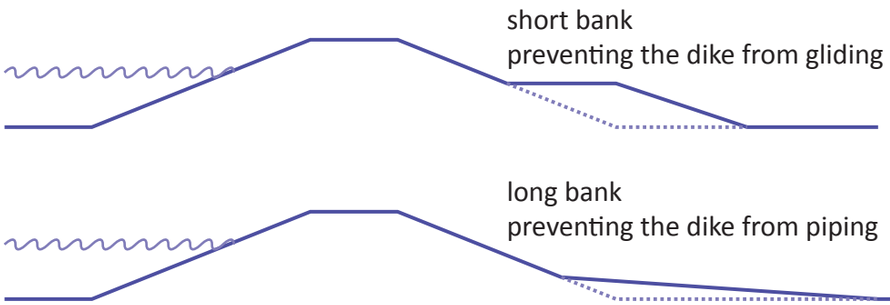


Figure 5.9a and b: two types of banks (based on: van Nieuwenhuijze et.al., 1994)

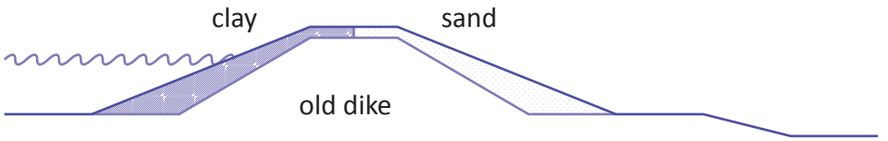


Figure 5.10: material composition of reinforced dikes (based on: Feddes et.al., 1988)

The facing of the dike slopes has not only to do with safety, the nature function of the dike is also influenced by it. Especially steep dike slopes used to have a unique and varied biotope, which is nutrient- and lutum poor (Feddes et. al., 1988). For nature, the dike often seems to be a separating element, but in fact it is also connecting. Especially river dikes form a corridor for stream valley flora, from higher Europe to the European lowlands (Feddes et. al., 1988). The small biotopes along the dike can function as steps between larger natural areas. The diversity is high, while the flat areas serve different types of flora compared with the slopes (Feddes et. al., 1988). Also seepage under the dike can form a unique biotope on the inner side of the dike. The nature and safety function can have a conflict, while steeper slopes are better in ecological perspective, but not in a safety perspective.

5.3.3 Special parts: urban areas

Special parts of the dikes are the waterfronts of cities and villages. The water protection is part of the quay, the city wall, a boulevard or even buildings (van Nieuwenhuijze et. al., 1994). The dike is often an important part of the public space of the cities and villages, and the waterfronts are highly valued by people because of their spatial quality (Meyer et. al., 2006).

In some cases the original appearance of a dike, as a wall of earth, is still visible. But the use of (hard) materials and furniture make that the dike is seen as part of the urban area and public space. The materialisation makes that the dike is perceived differently compared with a dike in a more rural area (or when the village or city stays on a distance from the dike). In other cases the dike is completely replaced by urban materials and looks. While the dike, and the road on top of it, were both high and dry, the dike became the main street in many cities (f.e. in Amsterdam, Rotterdam and Dordrecht)(Meyer et. al., 2006). The main road and its surroundings became densely built and so the dike as visible element disappeared, but if you look carefully it is often possible to recognize the dike slopes and top. In some cases the dike lost its flood protection function, but there are also examples of these dikes that still function, like in Dordrecht (Meyer et. al., 2006). In this city the flood protection is also integrated in the buildings, and both the external, as well as some internal walls of houses are part of the main flood protection (Meyer et. al., 2006 and Stone et. al., 2008). In places with a harbour the original dike is often replaced by or hidden behind a quay, on which boats could land. Instead of a dike slope, the flood protection is integrated in a vertical wall. Because a quay is restricted in height while boats should be able to land, there is often a second and higher line of flood protection, which can be both a dike as well as a wall (see figure 5.11).



Figure 5.11a and b: quays in Enkhuizen and Medemblik

Examples of in some cases visible and in other invisible flood protection in cities can also been found in boulevards, broad public spaces along the water (often in use as a promenade)(van Dale in: Vroom, 2005). A boulevard with a visible flood protection function can for example be found in Vlissingen, where the outer (sea) dike slope is strengthened with asphalt, so that the flood protection function is clear. Also the flood protection function of the Maasboulevard in Rotterdam is (partly) visible. In this case the boulevard dike is part of the main infrastructural system (Meyer et. al., 2006). But for example the boulevard in Scheveningen (which will be strengthened in the coming years), the flood protection function of the boulevard is hardly visible, especially in summer, when temporary buildings are placed on the boulevard and the beach. The actual flood protection in this case even lies behind the first rows of buildings.

While the dikes in urban areas are heavily used, there is also a threat for damage to the dike, and by that for the flood protection of large (and populate) areas. Elements within the dike body, like pipes and cables form a threat, but also trees with their root system, especially in case they fall down. In cases where the dike is disappeared behind urban materials the actual protection can not or will not be seen by people that do not have knowledge about it. This also means potential damage, while people do not realize that some activities damage the dike. Especially when the flood protection is integrated in houses, the owners do not always know it is not allowed to change anything to the walls (Meyer et. al., 2006). This is why water boards do not prefer to integrate the flood protection in buildings, and why they are afraid of too much elements, like trees, on the dike.

5.4 Dike reinforcements

5.4.1 The future of dikes

With the research on the expected climate change and the increased interest in the spatial quality of the (dike) landscape there has already been paid attention to the future flood protection in the Netherlands. The way dikes are traditionally reinforced is discussed, and new methods of flood protection are developed. The question is if dikes can protect the country in future like they do now, or if dikes should be used in a different way, new types of dikes should be designed and maybe even different solutions than dikes should be developed. In this paragraph several examples of new and old methods and projects to protect the land in future will be discussed. In some projects the same methods return, sometimes in a slightly different way. Also the usefulness of the ideas for the IJsselmeer dikes will be discussed.

Dike reinforcements are the most commonly known activities to protect areas against flooding in future. Dike reinforcement has long been seen as a strict technical question, which caused protests in the 1970 that made the dike reinforcement activities along river dikes stagnate (Feddes et. al., 1988). Dike reinforcement is much more than maintenance and adjustment of a functional object; the technical changes to the dike are so radical that the dike landscape, with its form, function and use, changes in its entirety (van Nieuwenhuijze et. al., 1994). Dike reinforcement interventions can have large influence on the landscape image. The notion that dikes are expressive elements that contribute to the form differentiation in the landscape is only recently known (Vroom, 2005). In general there are three possible ways of dike reinforcement: inner dike reinforcement, outer dike reinforcement or building a new dike (van Nieuwenhuijze et. al., 1994). The side where and the way how the reinforcement developments should take place differ per situation. The impact of the reinforcements on both sides of the dike should be weighted. It seems that it is logical to do the reinforcement on the outer side of the dike, while there are usually more houses and other elements on the inner side, but a stronger (reinforced) inner dike slope can sometimes mean a less higher dike (van Nieuwenhuijze et. al., 1994).

A new idea about future dikes is the delta dike concept. The term delta dike originates from the second Delta Committee. In earlier situations the term delta dike has been used for a dike that was reinforced following the advices about height and strength of the first Delta Committee. The term delta dike is used for a dike in which no breach will evolve (breach free) when it is overtopped by water, with as a result an uncontrolled and potentially catastrophic inflow of water (Klijn et. al., 2010). Breach free means in this case that there is a hundred times less chance of failure due to piping or internal destabilisation, compared with conventional (reinforced) dikes (Hartog et. al., 2009). These dikes are either so high or so wide and massive that the probability that these dikes will suddenly and uncontrollably fail is virtually zero, and should offer lasting protection over a long time (decennia) (Deltacommissie, 2008 and Hartog et. al., 2009). In recommendation number one in the document ‘working together with water’, the delta dike as a concept is described as promising for areas that need extra protection (Deltacommissie, 2008). According to the Nationaal Water Plan, the delta dikes can be used for multifunctional purposes, especially in urban areas, but this is not a goal in itself (Rijksoverheid, 2008).

Other terms that are used for dikes that are actually delta dikes are super dike and climate dike. A super dike is developed in Japan, and is a very broad dike, with an inner slope of even 1:30, which should be able to stand tsunami’s and earthquakes. Normally there has been built on these dikes (Klijn et. al., 2010). A climate dike is described as a multifunctional high water protection zone, that provides safety, even if the climate changes further in the future. While a climate dike should be very broad, it is possible that it can be lower (Klijn et. al., 2010). So both the super dike and the climate dike include multifunctional purposes in their concept. While both dikes are actually delta dikes, only the term delta dike will be used further on. In practice, several dikes in the Netherlands can already be called delta dikes, because they already fulfil the requirements of delta dikes (Hartog et. al., 2009). Half of all sea-, estuary- and lake dikes in the Netherlands are already breach free, but in the river area there are almost no breach free dikes (Klijn et. al., 2010).

Another idea about the future of dikes and flood protection is that of a flood protection zone, in which a dike can play a role. A flood protection zone is a broad zone, up to kilometres broad, in which the different flood protection elements strengthen each other to protect the hinterland. In fact this idea is similar to the way dikes were built and functioned during the Middle ages, with a broad foreland that protected the dike against waves, and an extra dike on the inner side of the dike (inlaagdijk) in

case the foreland was washed away and the dike broke through. The idea is also inspired by the 'Room for the River' project, while the flood protection zone can also be used for other developments than safety, like recreation, nature and even living.

An example of a project that focuses on flood protection zones is the ComCoast project. This project ended in 2007 and was subsidized by the European Union. The project focussed on spatial use in coastal zones. ComCoast means: 'COMbined functions in COASTal defence zones' (Hartog et. al., 2009). England, Belgium, Germany, Denmark and the Netherlands participated in the project. The flood protection zone can be found both on the seaward as well as on the landward side of the original dike (Oedekerk, 2006). The ComCoast project developed five concepts, which all are actually developed for tidal, salt water areas, but can also be applied to non-tidal, fresh water areas. Also the UFM (Urban Flood Management) project focuses on a flood protection zone, but different from the ComCoast project this project is focused on (river) cities. These cities are Dordrecht, Hamburg and London (Stone et. al., 2008). All three cities deal with unembanked areas along the rivers which would be, looking at the location, ideal for urban developments. This means that flooding is accepted within an urban area and is part of the design. The area is designed in a way that flooding's have minimal disturbance of daily life (Stone et. al., 2008).

5.4.2 Solutions on the inner side of the dike

On the inner side of a dike houses and other elements play a key role and can be a problem. The view, the way the houses are connected with the dike (for example with their front door) and the private gardens and belongings of people will be influenced (van Nieuwenhuijze et. al., 1994). On the other hand, it is favourable to use the firm, set deck of the old dike in the new outer dike slope, while this deck is normally already impermeable (Feddes et. al., 1988). The old outer dike slope disappears if the dike reinforcement takes place on the outer side, which makes that dike reinforcements on the inner side of the dike can be a favourable (Rijkswaterstaat, 2007).

While reinforcing the dike this can be done the traditional way, or the dike can be turned into a breach free delta dike (see figure 5.12a-c). While the inner dike slope should be stronger and flatter to become a delta dike, more space is needed on the inner side of the dike compared with the traditional way. On the other hand, a delta dike can possibly be lower compared with the traditional dike, which means that the view of houses is possibly kept as it is if there is enough space between the houses and the dike. Along the IJsselmeer the houses are built less close to the dike compared with the river area, which can mean that there is more space for inner side dike reinforcements. On the other hand, the space between the dike and the houses is often used intensively, for example for infrastructure. Along the new dikes of the land reclamations around the IJsselmeer less houses are built close to the dike, so along those dikes there is much more space for inner side dike reinforcements.

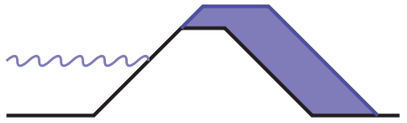


Figure 5.12a: traditional inner side dike reinforcement

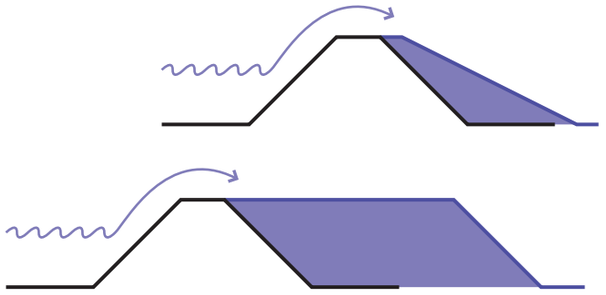


Figure 5. 12b and c: inner side delta dikes

If there is enough space on the inner side of the dike, it is also possible to create a landward flood protection zone. The ComCoast project offers three landward concepts. For the IJsselmeer the overtopping dike is the most relevant (see figure 5.12d). An overtopping dike is denoted here as a primary coastal defence that is able to cope with a substantial amount of wave overtopping, well above present wave overtopping standards. In this concept, the primary dike can be severely overtopped, but will not breach, whilst overall safety is obtained by the presence of the coastal defence zone as a whole (ComCoast, 2007). This has similarities with the delta dike, while overtopping is allowed, but the ComCoast project states that the area behind the dike should be adapted to this small amount of flooding. The other two landward solutions are based on tidal exchange. While there are no tides in the IJsselmeer these are not so relevant, although it is possible to think of a controlled inlet of water if the water in the IJsselmeer is high, for example in spring (see

figure 5.12e). This is called the regulated tidal exchange concept which uses pipes, sluices or tide gates through existing defences to allow water onto the land behind the defences in a controlled manner gradually converting the area to (ComCoast, 2007). The area can function as a kind of a retention area, where water is stored for a short time, like can be found in the river area (Rijkswaterstaat, 2007). But in the IJsselmeer area the retention area would not function like it does in the river area, while the risk of flooding is different from the risk of flooding in the river area. The IJsselmeer will in future have more possibilities, like discharging on the Waddenzee, to control the water level in the lake, compared with a river.

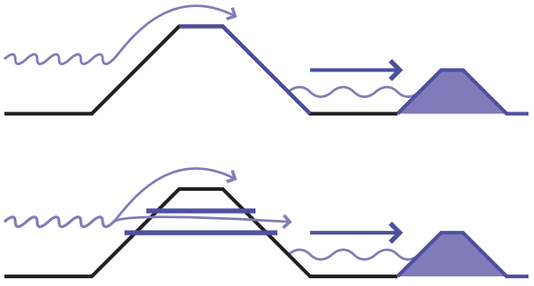


Figure 5.12d and e: ComCoast concepts

5.4.3 Solutions on the outer side of the dike

If developments take place on the outer side of the dike the present outer dike areas are influenced, which can mean that room for the water (especially in river areas) is narrowed (see figure 5.13a). But also historic characteristics or the ecology can be influenced by outer dike reinforcements. During traditional dike reinforcements, when the dike is heightened, the view of houses can change, like it also does with reinforcements on the inner side of the dike. Also the way the houses are connected with the dike can change when the dike is heightened. But when the developments take place on the outer side of the dike, the area on the inner side is less influenced, like the houses itself, gardens and infrastructure. If the dike is turned into a delta dike this can mean that the dike is broader but lower, which means less change for the houses, but more space needed on the outer dike side (see figure 5.13b). This can be a problem in the river area, but in the IJsselmeer area the amount of space for water that is lost is relatively low, while it is such a big area. So flattening the slopes on the outer dike side to make them into delta dikes can be a good solution in the IJsselmeer area. The present outer dike slopes are already quit flat, while they are former sea dikes, so flattening the outer dike slopes does also not break with the way the dikes were originally built around the IJsselmeer.

Figure 5.13a: traditional outer side dike reinforcement

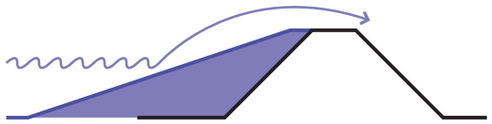


Figure 5.13b: outer side delta dike

On the outer dike side it is also possible to build a new dike which can be placed against the old dike or at some distance (see figure 5.13c and d). If the new dike is placed against the old dike the old dike gets the function of a bank with over height (van Nieuwenhuijze et. al., 1994). The old dike can get a new function, or can keep its function, for example as a road. In this case only one slope of the old dike disappears behind the new one, and the buildings inside the dike, and the way they are connected with the dike are not influenced. When a new dike is built in a certain distance from the old dike, the old dike keeps its original appearance. This can be an option in cases where the village core is formed around the old dike, or if there are unique historic characteristics on both sides of the dike (van Nieuwenhuijze et.al., 1994). In this case the area between the old and the new dike can function as a flood protection zone.

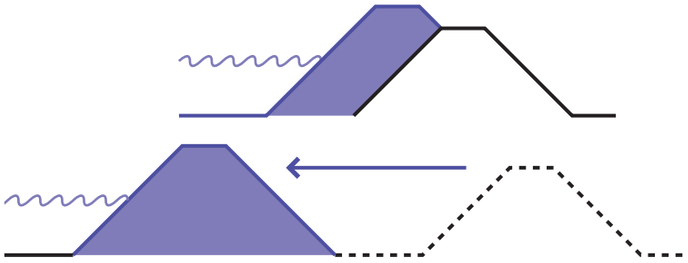


Figure 5.13c and d: new dikes

The ComCoast project offers two concepts, foreland protection and foreshore recharge, that are less radical compared with building a new dike (see figure 5.13e and f). Foreshore recharge is the placement of sediment such as sands, gravels and muds in front of existing flood defences (ComCoast, 2007). An interesting natural area with mudflats can evolve in front of the dike. In some cases it is possible to use natural processes to transport the sediment along the dike. This is known as the 'sand motor', but it is mostly necessary to mechanically spread the sediment on the fore shore (Oedekerk, 2006 and de Ruyter, 2009). While there are no tidal currents in the IJsselmeer it is not sure if a sand motor would function, although research has been done on a sand motor for the Frisian side. Foreland protection is the protection against erosion and enhancing sedimentation by maintenance of a foreland i.e. a terrain level (above normal high tide) in front of a coastal defence system (ComCoast, 2007). The area in front of the dike can be used for both recreational as well as natural purposes (Oedekerk, 2006). The protection can be placed both permanently under or on the water surface, so invisible, as well as above the water surface. Both concepts make sure that the wave attacks on the primary flood defence is diminished (Oedekerk, 2006). Both concepts are interesting for the IJsselmeer, but these concepts can be very expensive if there is not a foreshore at this moment, and where the water of the lake becomes deep immediately.

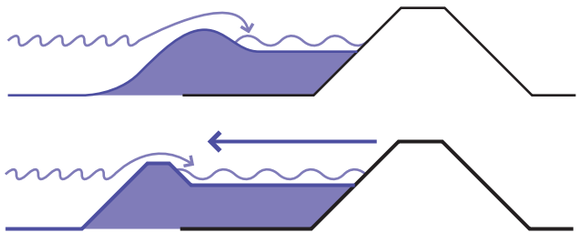


Figure 5.13e and f: ComCoast concepts

The UFM project offers three flood protection zone concepts for outer dike inhabited areas, these concepts are the mount concept (Terp), the integrated floodwall concept (Vloedfronten) and the water steps concept (Watertreden) (see figure 5.13g-i). In all concepts an infrastructural network is integrated that is called a lifeline, which is connected with higher grounds like the dike. This lifeline guarantees a minimal disturbance of daily life during flooding, and makes that all concept reach the minimal safety standards.

The mount concept is the most traditional one, while the whole area is protected against flooding, by raising the whole ground level up to a safe level. This means that the area will be as high as the dike that lies behind it. This means that the area actually changes into a part of a broad delta dike. No other measures against flooding, such as adjusted building concepts or infrastructure, need to be taken (Stone et. al., 2008). The integrated flood wall concept integrates flood defences into the buildings and public space forming a flood wall surrounding (part of) the urban area. Besides the integrated flood wall some buildings need to be built in such a way that they can withstand some flooding (Stone et. al., 2008). The concept is based on some examples that can be found in the historic city of Dordrecht. In the water steps concept the ground level of the area rises in an inland direction, like stairs. The different levels have different flood risk, and are adapted in different ways to flooding.. The water is not kept out of the area, but is integrated in the area. Some parts of the area are even permanently flooded. Water is welcomed within the sight adding to the attractiveness of the sight (Stone et. al., 2008).

For the IJsselmeer the UFM concepts can be interesting for some heavily built outer dike areas, and maybe even for new developments. On the other hand, most IJsselmeer cities are cities built behind the dike, and not, like the case in Dordrecht on the dike. So these concepts are not useful solutions on the large scale, but can become interesting if looking at problematic areas near the cities.

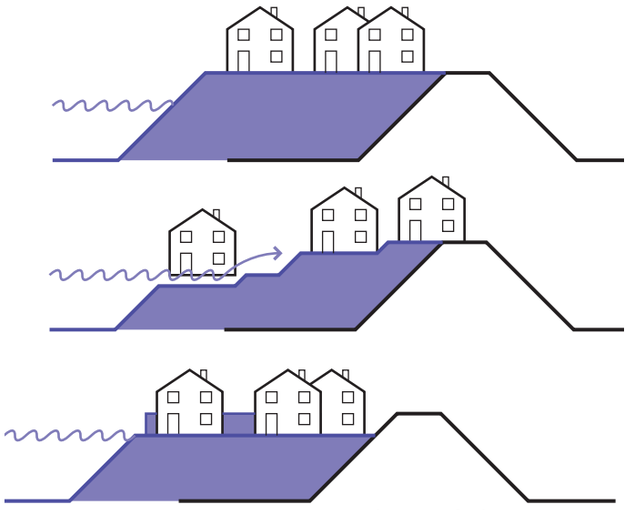


Figure 5.13g-i: UFM concepts

5.4.4 Internal dike reinforcement

If there is no space either on the inner or the outer side of the dike (or another reason) to reinforce the dike there is also the possibility to internally strengthen the dike. Internal strengthening is mainly focussed on increasing the stability of the dike, and not on increasing the height of the dike (CUR bouw en infra, 2007). The traditional way to do this was driving a sheet pile wall in to the dike, which was expensive and led to damage to nearby houses, and was not sustainable (van den berg, 2005 and CUR bouw en infra, 2007). So this method was only used if the economic, ecologic or cultural loss in case of using a different method was very high. Nowadays new techniques are developed that are less expensive, so that the costs are practically the same compared with techniques that ask for more space (van den Berg, 2005). An example of a project that works on those new techniques is the project INSIDE (see figure 5.15).

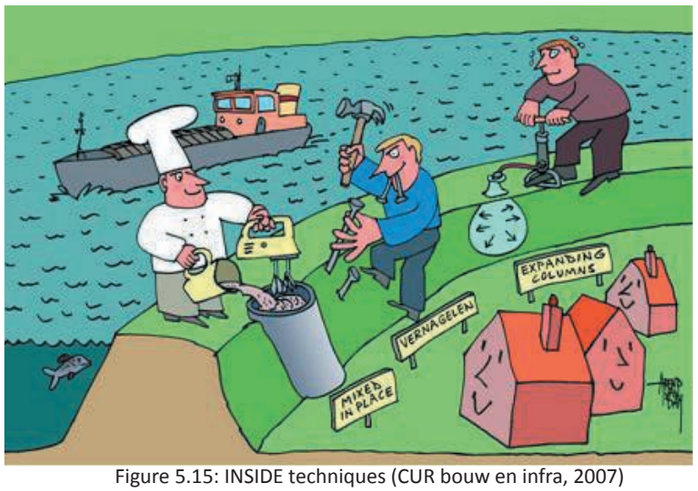


Figure 5.15: INSIDE techniques (CUR bouw en infra, 2007)

Internal strengthening can led to both normal dikes as well as breach free delta dikes (Klijn et. al., 2010). While the solutions are very technical they will not be explained. From a landscape architectural point of view they all have practically the same look externally. In some cases, like the sheet pile wall, it is possible that the construction is partly visible on top of the dike, and can be used in the design. In other cases, like the three techniques developed by the INSIDE project, the construction is not visible (see figure 5.14a and b). This means that the dike has the same look as before the reinforcement (CUR bouw en infra, 2007). For the IJsselmeer case internal strengthening can be a solution on places where there is a lack of space, but the present dike should already be high enough. While the water level rises it is likely that there will be a lack of dike height, which is not solved by internal strengthening.

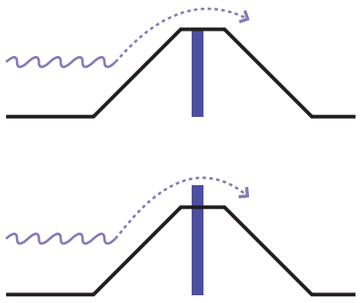


Figure 5.14a and b: internal strengthening, invisible and visible

5.5 Conclusions and guidelines

5.5.1 Conclusions

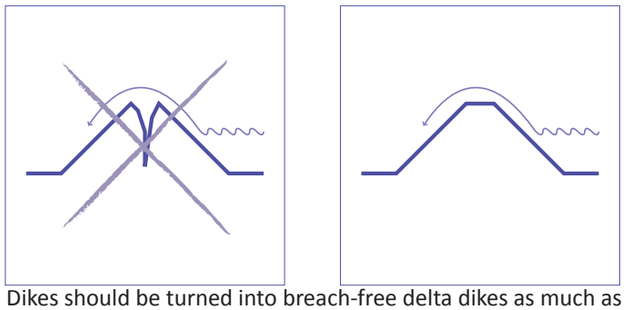
The flood risk in the area surrounding the IJsselmeer will increase in the coming years and decades. This has to do with the by the Delta Committee proposed water level rise and more whether extremes, but also because it can be expected that the population in the area will grow and more economic value will be added to the area. This means that the flood protection in the area, like dikes and quays, need to be strengthened and heightened in the future to enlarge the safety.

There are several ways to reinforce the flood protection, differing in side of the dike the reinforcement takes place and space that is needed for the flood protection. It depends on the local situation which solution or solutions would be possible. The fact that a lot of space is needed for flood protection does not mean there is no space for other functions. Many solutions offer possibilities for multi-functional use of space.

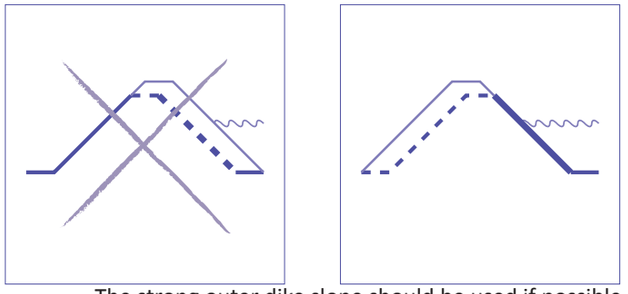
5.5.2 Guidelines

This set of guidelines is the final set before all guidelines will be brought together to be checked during the designs. The guidelines are mainly an addition to the earlier set guidelines on dike reinforcements, and define more precise what should be taken into account. But they are not only an addition, there also can be conflict, for example between keeping the original lay out and the wish to use the outer dike slope and turn the dike into a delta dike.

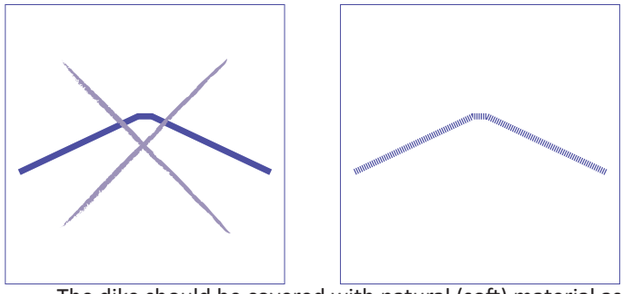
But there is also a connection with guidelines based on spatial quality, for example the grass-coverage and sheep, which contributes to the experience on the dike, and the visibility of the flood protection, which contributes to the openness. Both can also contribute to the experience of the dike as one whole.



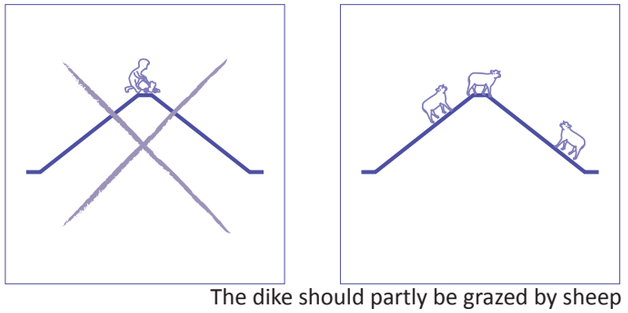
Dikes should be turned into breach-free delta dikes as much as possible



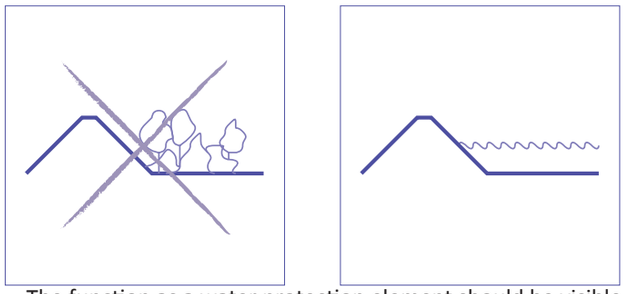
The strong outer dike slope should be used if possible



The dike should be covered with natural (soft) material as much as possible



The dike should partly be grazed by sheep

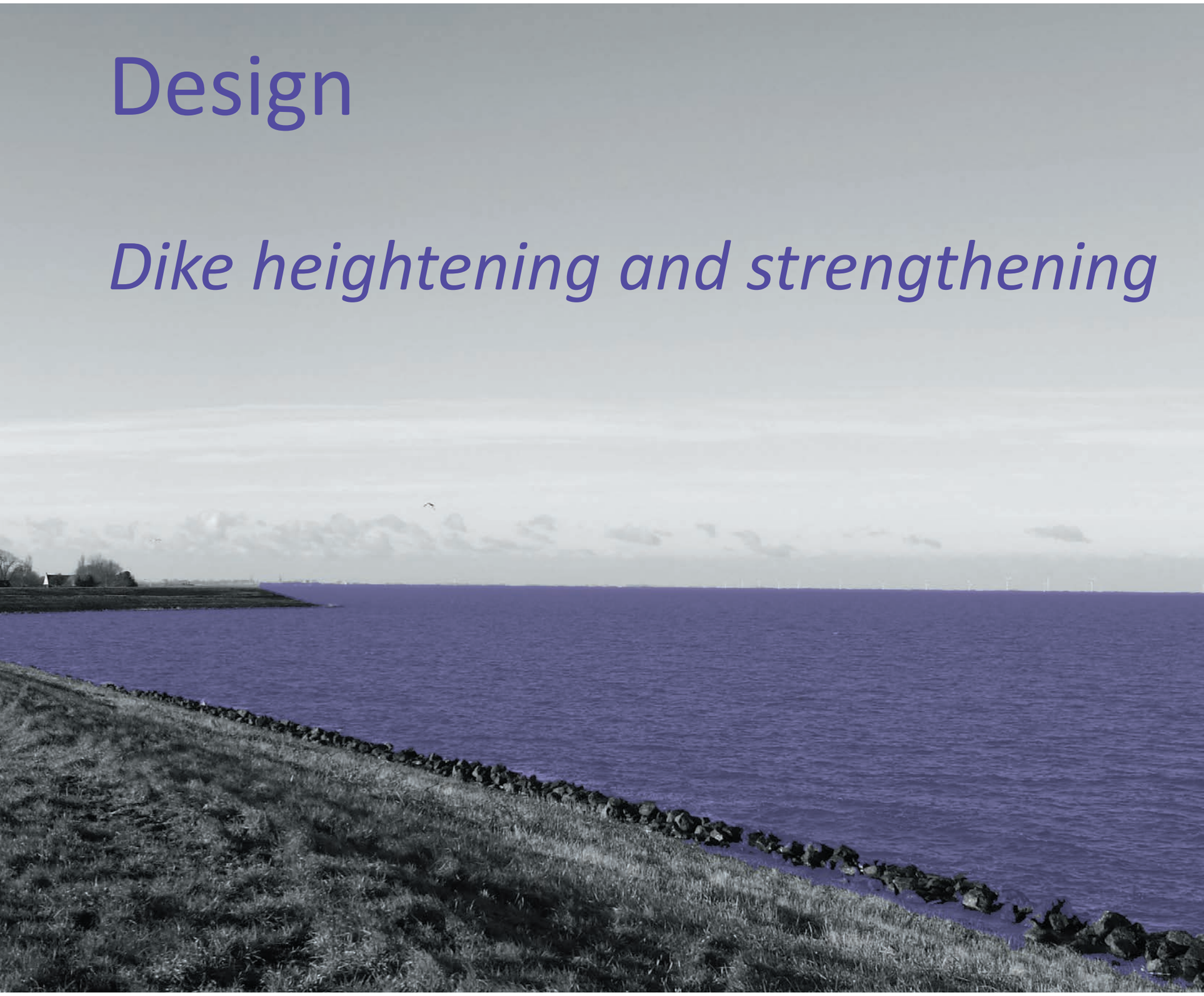


The function as a water protection element should be visible

6

Design

Dike heightening and strengthening



6.1 Design guidelines

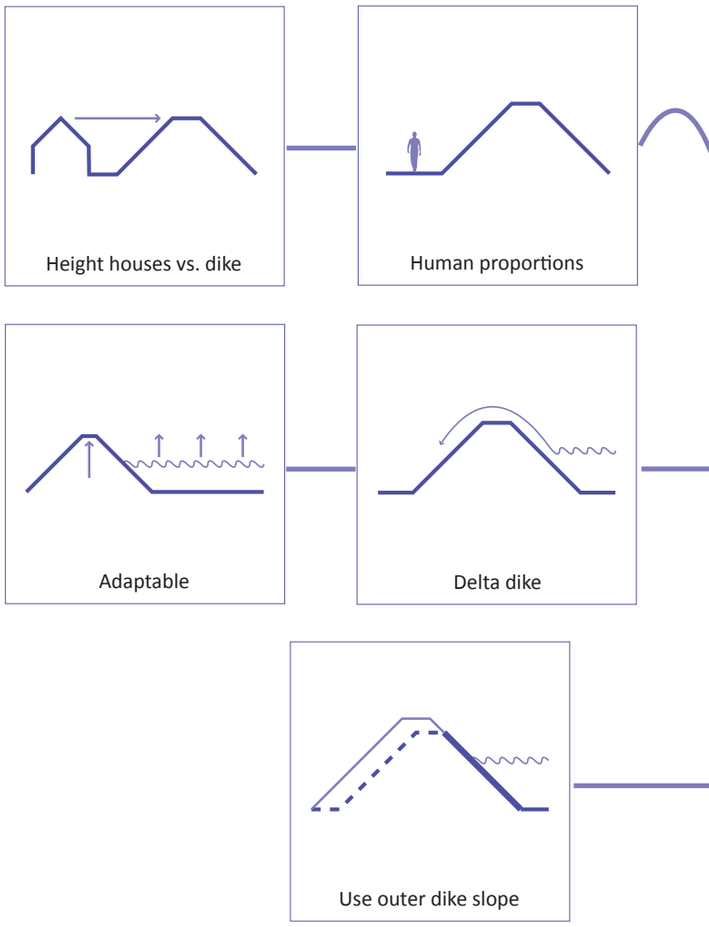
6.1.1 Bringing the guidelines together

If the guidelines derived from the previous chapters are placed together so the relation between all the guidelines becomes clear. The scheme on the right shows all the guidelines and the relation between the guidelines (see figure 6.1). The for the area most important guideline in case of water level rise, reinforce all dikes, is placed as much as possible in the middle of the scheme. It is clear that all other guidelines are in a way related to this important guideline. Some are related to and influenced by the actual activity of reinforcing the dike. Others are related to the environment of the dike and are not necessarily influenced by the reinforcement, some of them are however influenced by the higher water level.

Some of the guidelines are interconnected with each other, and even possibly strengthen each other. The interconnectedness of the guidelines can also mean that a guideline is an addition to a guideline set in an other chapter. Other guidelines can conflict with each other. This does however not mean that there will always be conflict. Whether there will be conflicts between guidelines depends on several factors. The way the guidelines are implemented is one of them. The guidelines can be used in different ways, and offer different solutions during the design process. So using the same guidelines means that there still can be several designs, in which guidelines can conflict or not. If guidelines conflict has also to do with the fact that some guidelines are very place specific. This means that the guidelines only conflict if they have to be implemented on the same place.

Where and how the guidelines should be implemented differs per guideline. Some have to be applied on the whole area, while others are place specific. For the guidelines that have to be applied on the entire area it is often the case that they should be used as much as possible, but not everywhere. They function as a guide and not as a set condition. This also means that it depends on the situation whether it is acceptable if a guideline is met on a specific place or not.

6.1.2 Relations between guidelines



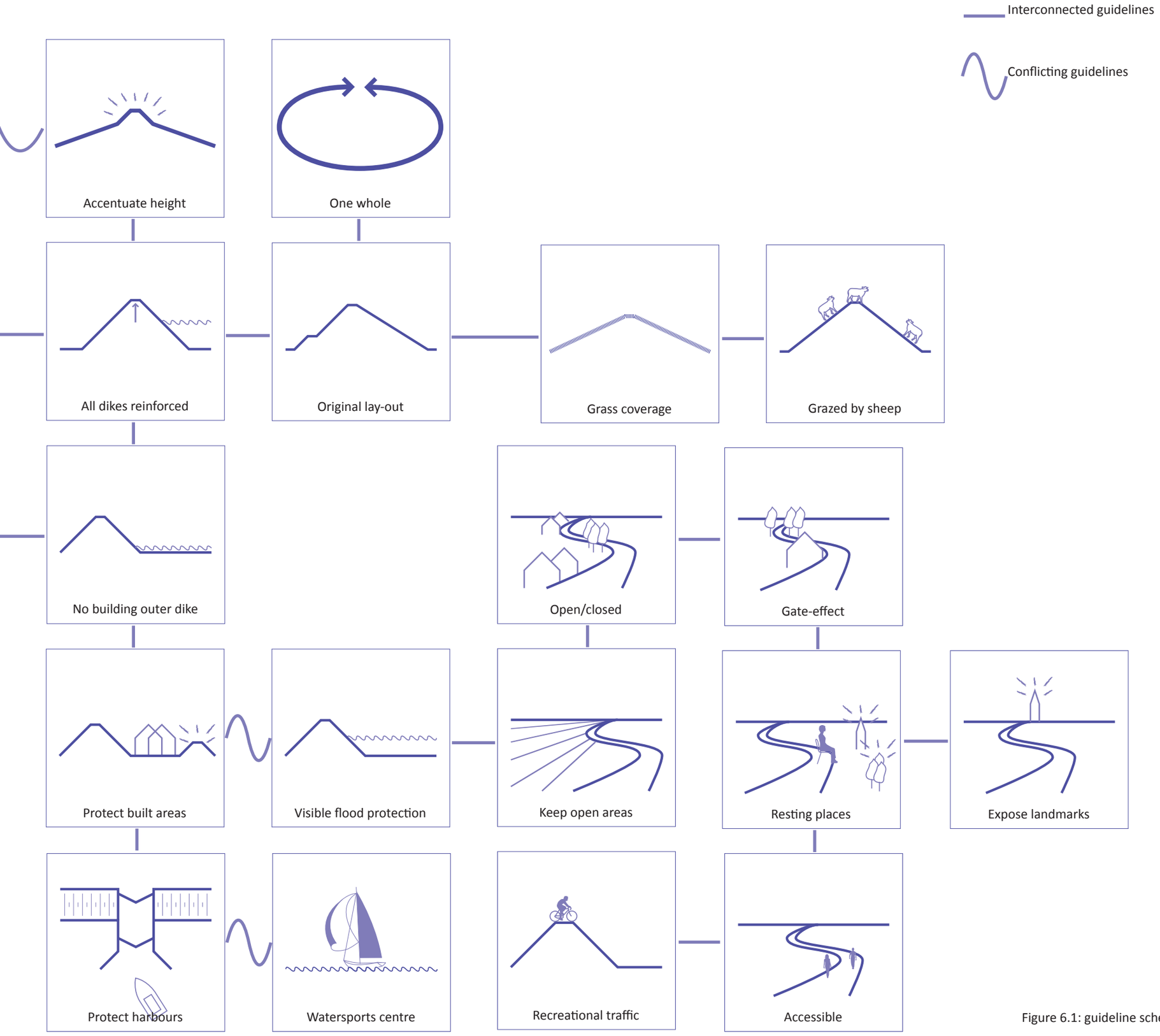


Figure 6.1: guideline scheme

6.2 Concept and design

6.2.1 Introduction

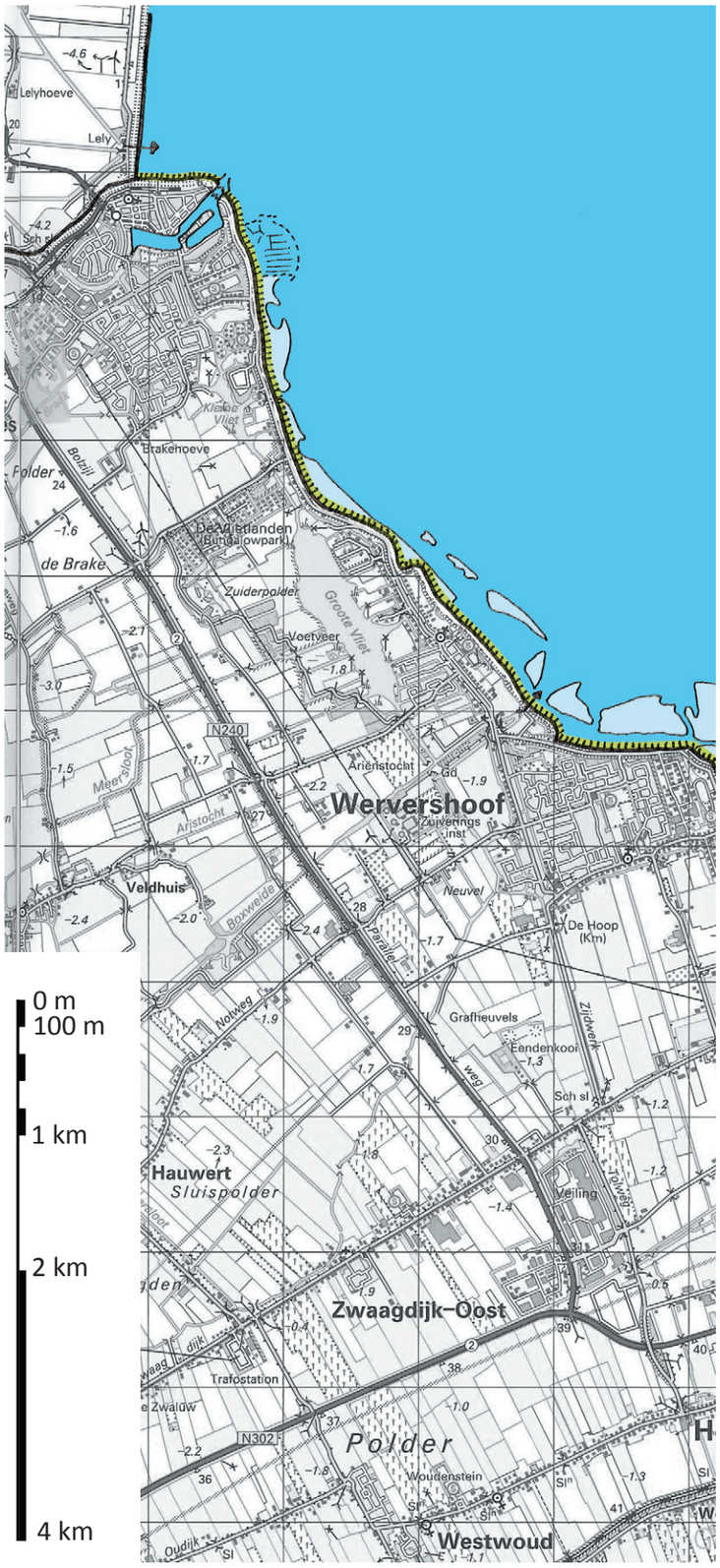
The dike heightening concept is used to be able to check whether it is necessary to heighten (or strengthen) the dike. The concept is also used to check whether it is possible to protect the area in future by using this traditional method of reinforcing dikes. If dike heightening causes any problems, this concept will show where, how and why these problems occur. Besides that, the concept also gives an overview of the usefulness of dike heightening for the area between Enkhuizen and Medemblik in general.

Three places are worked out in detail to show both positive as well as negative outcomes on these specific locations. The three locations can be seen as key locations, while they tell a lot about the effects of dike heightening on other places along the dike. During the design of this concept the design guidelines derived from the previous chapters are followed as much as possible. If necessary the design guidelines will be adjusted at the end of this chapter.

6.2.2 Concept

Dike reinforcement by heightening the dike is the traditional way to enlarge the safety of an area behind the dike. If the dike is high enough, but not strong enough, the dike has to be strengthened by flattening the slopes, by strengthening the slope cover, or by building or strengthening banks. In the case of the water level rise of 1.5 m in the IJsselmeer it is likely that the dikes lack some height, so that dike heightening is necessary. But while some of the dikes still have over height, while they were built as sea dikes, this does not mean that all dikes in the area should be heightened with 1.5 m.

For the area between Enkhuizen and Medemblik the minimal dike height will be at least 5.6 meters (1.1 m + 4.0 m + 0.5 m extra height, see paragraph 5.2), if the dike is the only protection element, so for example without foreshores. On places where there is an area of shallow water in front of the dike, which reduces the wave height, the minimal dike height is 5.1 meter. If there is a dry foreshore in front of the dike, or if the dike is protected in an other way, like a dam, the dike height can even be lower.



Deep water

Undeep water (former outerdike lands)

Fresh water reservoirs

Outer dike lands

Heightened dike (with flattened slope)

Dike with flattened slope

Sea wall in dike

Pumping station

Water inlet

Lock

Outer dike marina

Figure 6.2: dike heightening concept

While practically all foreshores will flood if the water level in the IJsselmeer rises, it will be necessary to heighten most of the dikes up to at least 5.1 m. Only the fresh water reservoirs will keep their function as foreshore. While it is not likely that the fresh water reservoirs will be replaced it will be necessary to heighten the dams around the basins (den Blanken in: Vewin, 2009). While the reservoirs function as a foreshore, it will not be necessary to heighten the dike behind the reservoirs, which is already quit high (4.9 m – 6.0 m (AHN, 2011)).

Also some other parts of the dike are already high enough (or almost high enough), so that massive changes are not necessary. This is for example the case for the part of the dike near Andijk. In this case it is only necessary to flatten the outer dike slope. But some other parts of the dike lack more height. Sometimes it will be necessary to heighten the dike with almost 2 meter. This does not only mean that the dike will be higher. It also means that the ground space that is needed for the entire dike body will be much larger, also because of the flattened slopes. While in general there is a lack of space on the inner side of the dike, the dike reinforcements mostly have to take place on the outer side. This means however that the present, strong outer dike slope disappears behind the new slope.

The harbours of both cities are the weak points of the flood protection in the area, in case the water level rises. The low quays will not be high enough, although they are protected against waves by dams around the harbours. This means that the historic quays should be heightened, or that the harbours should be protected with locks. The first option means that the historic quays and the look of the city changes, which means that building locks is a better option. This was also suggested by the Projectteam (2010). The locks are actually historically logic while the harbours used to be protected by locks during the times of the Zuiderzee, when there were tidal influences. But new locks need to be built, while the old locks are not sufficient anymore. They are too small for all the recreational boats, and also technically seen they are too old.

6.2.3 Details

The dike between Medemblik and Onderdijk:

South of Medemblik the dike is too low for the future water level rise, the average height of the dike is around 4 meter. This means that the dike needs to be heightened. The dike is now protected by foreshores, but they will flood if the water level is NAP + 1.1 m (see figure 6.3a). While the foreshores are quite high, they will partly fall dry if the water level drops in dry times. This means that the water in front of the dike will be shallow, and that the waves are significantly reduced. So the minimum height of the dike will be 5.1 m.

While the area on the inner side of the dike is very low and wet and the soil is weak (with peat layers), it would be a problem to reinforce the dike on this side (see figure 6.3b). So the choice is made to reinforce the dike on the outer side. The small extra dike wall that is already present next to the road is extended (see figure 6.6a). This means that the road as it is now stays the same, and gets a function of a high bank along the reinforced dike. The new dike top gives an opportunity to locate a cycle path on top of the dike, like along most of the dike route between Enkhuizen and Medemblik. This means that the unity is enlarged, and that it will be possible to see both sides of the dike from the cycle path. On the other hand it means that the water will not be visible from (low) cars anymore.

The dike near Andijk:

North of Andijk the dike height differs between 5.4 m and 6.0 m. While the water next to the dike is very deep, so the waves are not reduced, the dike should be at least 5.6 m. This means that there is some dike heightening necessary on some places, while other places are already high enough. But this does not mean that nothing has to be done. The slope angle, which differs between 1/3 and 1/3.5, should be flattened to reduce the waves. This means that the area necessary for the dike body is enlarged. This has to be done on the outer side, while there is no space on the inner side, where the slope is steep and the houses are built close to the dike (see figure 6.4a and b). Together with the flattening of the outer dike slope the dike top is broadened (see figure 6.7a). This means there is more space for a cycle and walking path, so that both users can use the dike and there will be less conflict between the two users.

The sea wall in Enkhuizen:

In Enkhuizen the dike partly exists of a sea wall, with a small dike body on the inner side of the wall (see figure 6.5c). If the water level rises, the present wall, which is between 2.5 m and 3.0 m high, will be too low. This means that either the wall should be heightened, or that a dike should be placed against or in front of the wall. A higher wall means adjustments to the historic wall. It also means that the inner side dike body should probably be heightened, which can be a problem while there is a lack of space on this side. Building a dike means that the wall will be hidden behind this dike, seen from the water side. But there is enough space to build a dike on the outer side of the wall. The space is the main reason to make the choice to build a new dike against the old wall (see figure 6.8a).

While the forelands in front of the wall are high and some parts will even not flood in case of the water level rise, waves are reduced significantly. There also will partly remain a small dam at 300 m from the wall. This means that the new dike should not be that high, 4.1 m will be enough. An advantage is that the view from the path along the sea wall is not completely blocked. On top of the new dike another, small walking path is created.



Figure 6.3a and b: outer and inner side of the dike near south of Medemblik


Figure 6.3c: dike south of Medemblik



Figure 6.4a and b: lack of space on the inner side of the dike, Andijk


Figure 6.4c: dike north of Andijk

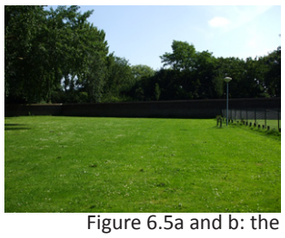


Figure 6.5a and b: the outer side of the sea wall in Enkhuizen


Figure 6.5c: dike with sea wall in Enkhuizen

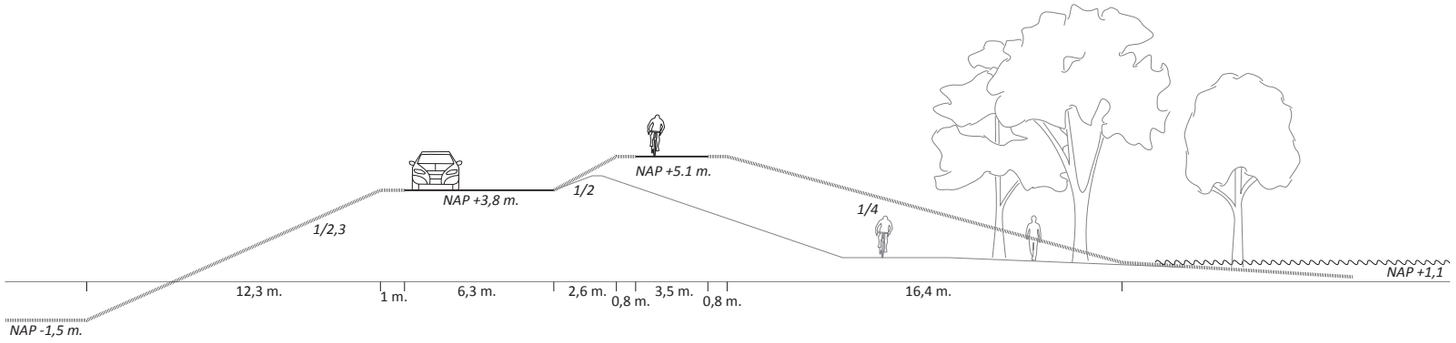


Figure 6.6a: cross-section dike heightening south of Medemblik

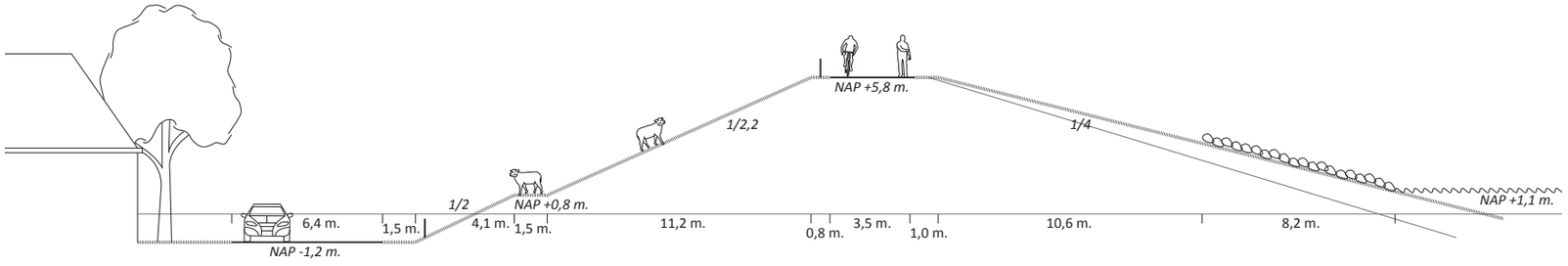


Figure 6.7a: cross-section dike heightening near Andijk

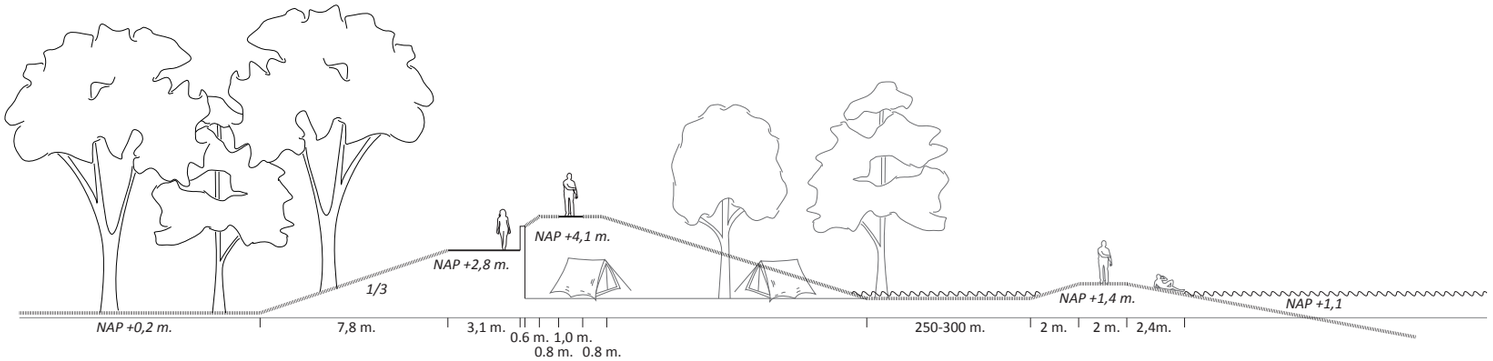


Figure 6.8a: cross-section dike heightening sea wall Enkhuizen

Figure 6.6b: visulisation of the dike south of Medemblik

Figure 6.7b: visualisation of the broad road on top of the dike near Andijk

Figure 6.8b: visualisation of the dike with sea wall in Enkhuizen

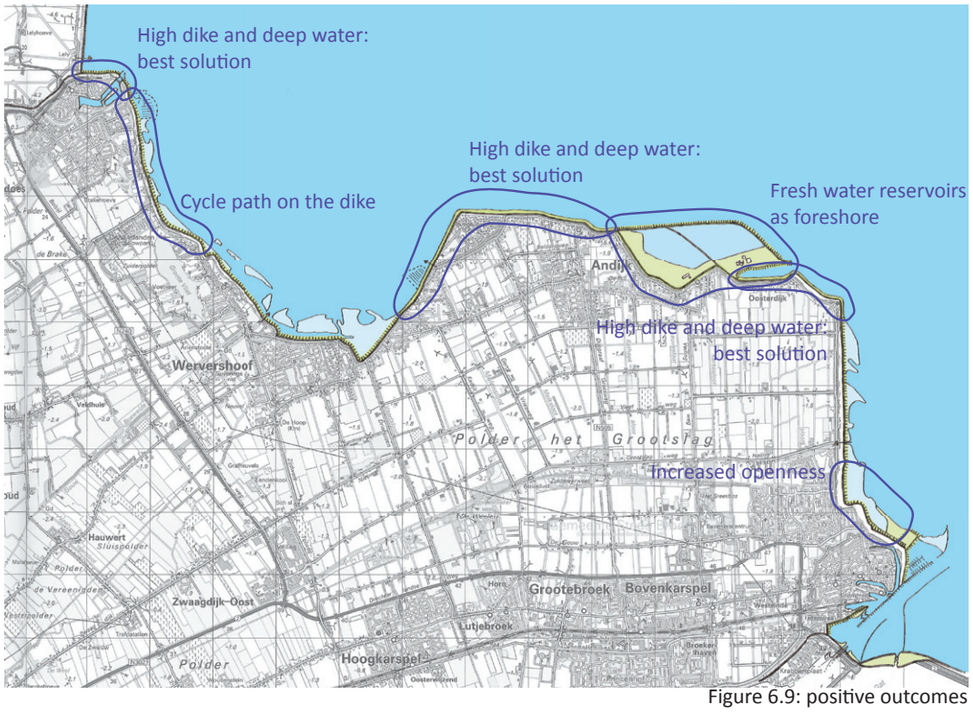


Figure 6.9: positive outcomes

6.3 Evaluation

6.3.1 Positive outcomes

Looking at the dike between Enkhuizen and Medemblik in total, dike heightening is a possible solution. On the outer side of the dike space is always present to reinforce the dike, also because functions that now find a place on the outer side of the dike need to be removed because of the water level rise. For parts of the dike, dike heightening is a very good solution. Especially along the parts where there is no foreshore, north of the centre of Medemblik and near Andijk, dike heightening does not really influence the image of the landscape. This has also to do with the fact that the dike is already quite high in these parts. The major adjustment to the dike exists of the flatter slope. This can have advantages, like broadening the dike top, so more users can enjoy the dike. For some places it would also be the only solution. These parts are located along the edges of the lake where the water is deep on a short distance from the dike. This also means that there would be no space for solutions that ask for more space. Other solutions than heightening and strengthening would therefore be very expensive.

This concept showed that dike heightening can have a positive influence on the spatial quality, but this depends on how it is done. The changes to the dike profile make that for example there is space for a cycle path on the dike. This contributes to the experience of the landscape and to the unity in dike profiles. The unity in dike profiles is also enlarged by choosing for one, flat slope angle. Concentrating the measures on the dike also means that the foreshores will flood which entails that vegetation and buildings in this area will disappear, so that the openness on the outer side of the dike is increased. This is especially positive for the part where there were no possibilities to overview the landscape, like the leisure area north of Enkhuizen.

This concept also made clear that investing in the heightening of the dams of the fresh water reservoirs is a good one. The reservoirs are an important part of the idea of the IJsselmeer being a fresh water reservoir, and keeping them as they are means that parts of the main dike does not need reinforcement. The changes to the dams also offer possibilities, nowadays they are not accessible, but it would may be possible to make them accessible, which can contribute to the experience and the spatial quality.

6.3.2 Negative outcomes

Although dike heightening is a possible solution for the whole stretch of the dike, this does not mean that all the direct and side effects of dike heightening are positive. One of the most important negative effects is the loss of human scale due to the higher dike. Especially between Medemblik and Onderdijk the houses near the dike are small and low. The present situation is that the roofs are about as high as the dike. An increased dike height with up to 1.5 m means that the dike will be much higher than the houses. This has effect on the experience from the dike and from the ground level. From the perspective of the inhabitants of the houses, and to a lesser degree of other people standing on the ground level, the perception of the risk will change and possibly turn into fear. Besides that the dike will look very massive from a close distance. It has also effect on the landscape experience of people on top of the dike. There will be more overview, but the distance towards the houses will be longer so that less details are perceived. The contact between the people on the dike and the rest of the landscape probably gets lost.

On a more local level the changes to the sea wall in Enkhuizen are a negative effect. The sea wall will not be visible on the lake side anymore, and also the experience from the land side will change. It is not a wall of stone anymore that protects the land, it is a dike with a wall inside. The effect of the increased experience of the wall as a flood protection element (while there is more water near the wall) is diminished by the fact that there is a dike in front of the wall. It is not clear that the wall used to be the main flood protection element.

A negative effect that is not related to dike heightening but to the higher water level is the decrease of outer dike land area, and therefore nature and leisure areas. But the dike heightening concept does not offer any solutions to diminish this negative effect. The negative effect has not only to with the loss of nature and leisure areas, it has also effect on the experience form the dike. If there are almost no outer dike land areas there is more openness, but less variation compared with the present situation. This means that the route on the dike is potentially more boring, so that the perceived travel time is longer.

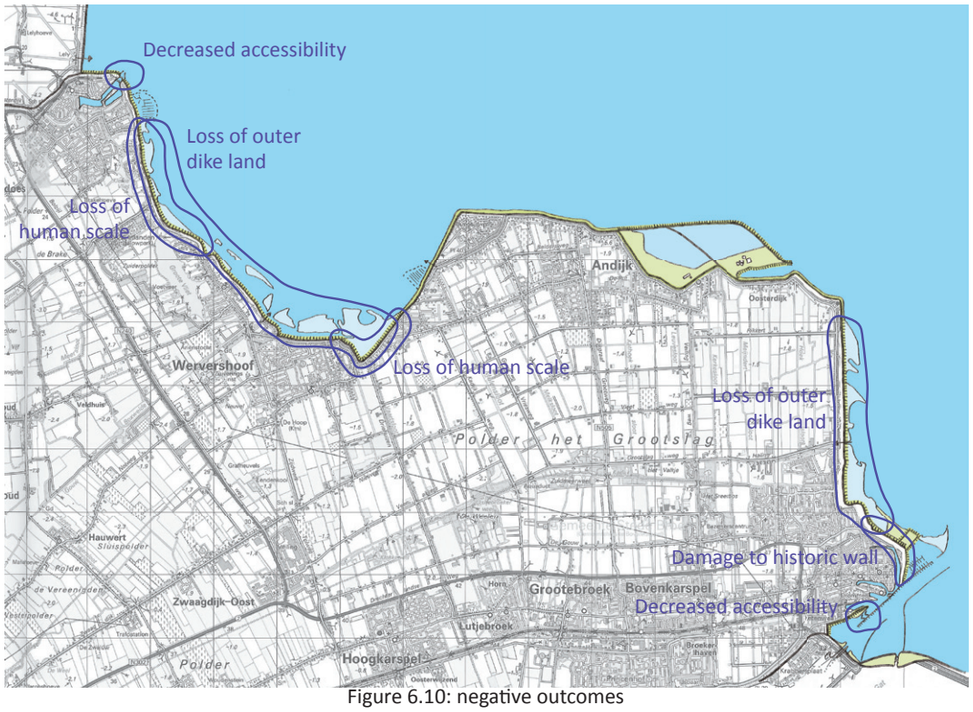


Figure 6.10: negative outcomes

6.4 Conclusions and guidelines

6.4.1 Conclusions

Dike heightening is possible for the dike between Enkhuizen and Medemblik, but this solution does have some negative effects, both for the experience and spatial quality, as well as for nature and the preservation of historic elements. On the other hand, dike heightening also offered opportunities to enlarge the accessibility, and therefore possibly the spatial quality. For the northern part of the dike (near Andijk), dike heightening and flattening the slopes is the best solution to protect the area. This is both because the dike does not have to be heightened that much, but also because there is no space for other possibilities, on both sides of the dike.

For the other parts of the dike it seems to be good to look at solutions which offer more opportunities to keep and enlarge the spatial quality, but without forgetting the good ideas from this concept. While there is few space on the inner side of the dike, these solution should be found on the outer side of the dike.

6.4.2 Guidelines

The guidelines derived from the previous chapters were used and checked during this design. Some of them were clear and easy to use, but others caused more difficulties or conflicted with each other or with the design concept. The scheme to the right shows which guidelines where achieved during the design, which were partly achieved, and which were not achieved.

During the design process the question came up when outer dike areas are so heavily used that they should be protected. The area north of Enkhuizen is quite heavily used, but reasoning from the spatial quality (the view towards the water should be free from obstacles, to increase the openness) this area being flooded should be better. It maybe would be better to state that outer dike areas with a high value (both money as well as spatial quality) should be protected. The protection of the fresh water reservoir is in this reasoning logic.

It was possible to enlarge the unity in dike profiles, so that the dike is seen as one entity. The dike can be turned into delta dikes, and still be covered with grass. Also the height can be accentuated. One of the questions is if the even higher dike can adapt to future changes. While the dike will run direct into the water it will not be possible to let the dike be grazed by sheep on the outer side. The present outer dike slope will often disappear behind a new one.

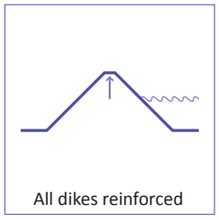
It also became clear that this concept did not offer possibilities to make more use of the gate-effect. While the distance between the dike top and the houses and trees next to the dike will be even larger, while the dike is higher, the gate-effect will possibly even be diminished. Also on the outer side of the dike the gate-effect could not be extended. One of the major problems for the experience is the human scale and the height in relation to the houses. The dike will look much too massive on some places.

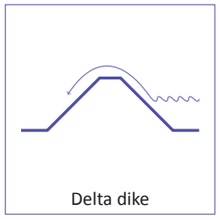
Not all harbours are protected in this concept. Only the harbours which are situated within the cities can be protected with locks. This means that the other marina's need adjustment or will disappear. The last option is not in line with the wish to develop Medemblik as an international sailing centre.

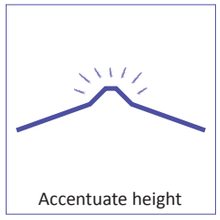
6.4.3 The next step: experimental design

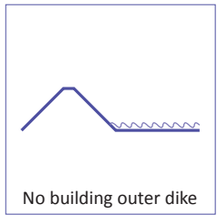
The next step of this research through design process will be the design of two alternatives for those areas for which dike heightening and strengthening is not the best solution. The alternatives can be seen as experimental designs; exploring a possible or predictable future (Steenbergen, 2008). While the designs are experimental, they mainly will show the range of possibilities they offer, and to what extend they are able to meet the guidelines. They will not be total designs in which every single spot is designed in detail. This is not necessary, while it is all about exploring new territories. As Steenbergen (2008) states: 'With experimental design it is not the confrontation with practice that is most important, but rather the internal logic of the mental experiment that has been carried out'.

Achieved guidelines

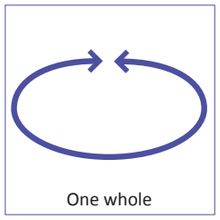

All dikes reinforced

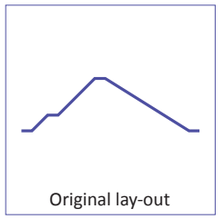

Delta dike

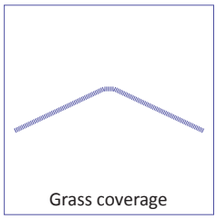

Accentuate height


No building outer dike


Protect valuable areas


One whole


Original lay-out

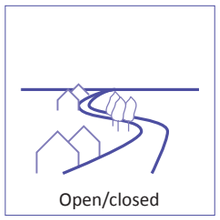

Grass coverage


Keep open areas

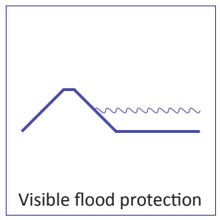

Accessible

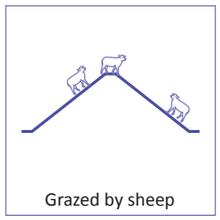

Recreational traffic

Partly achieved guidelines

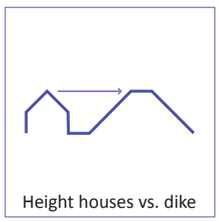

Open/closed

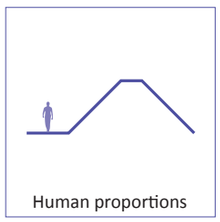

Expose landmarks

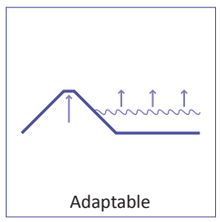

Visible flood protection

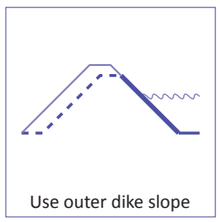

Grazed by sheep

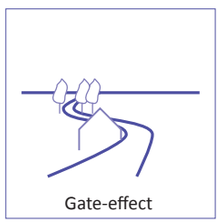
Not achieved guidelines


Height houses vs. dike

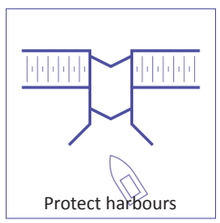

Human proportions


Adaptable


Use outer dike slope


Gate-effect


Resting places


Protect harbours


Watersports centre

7

Design

Alternatives

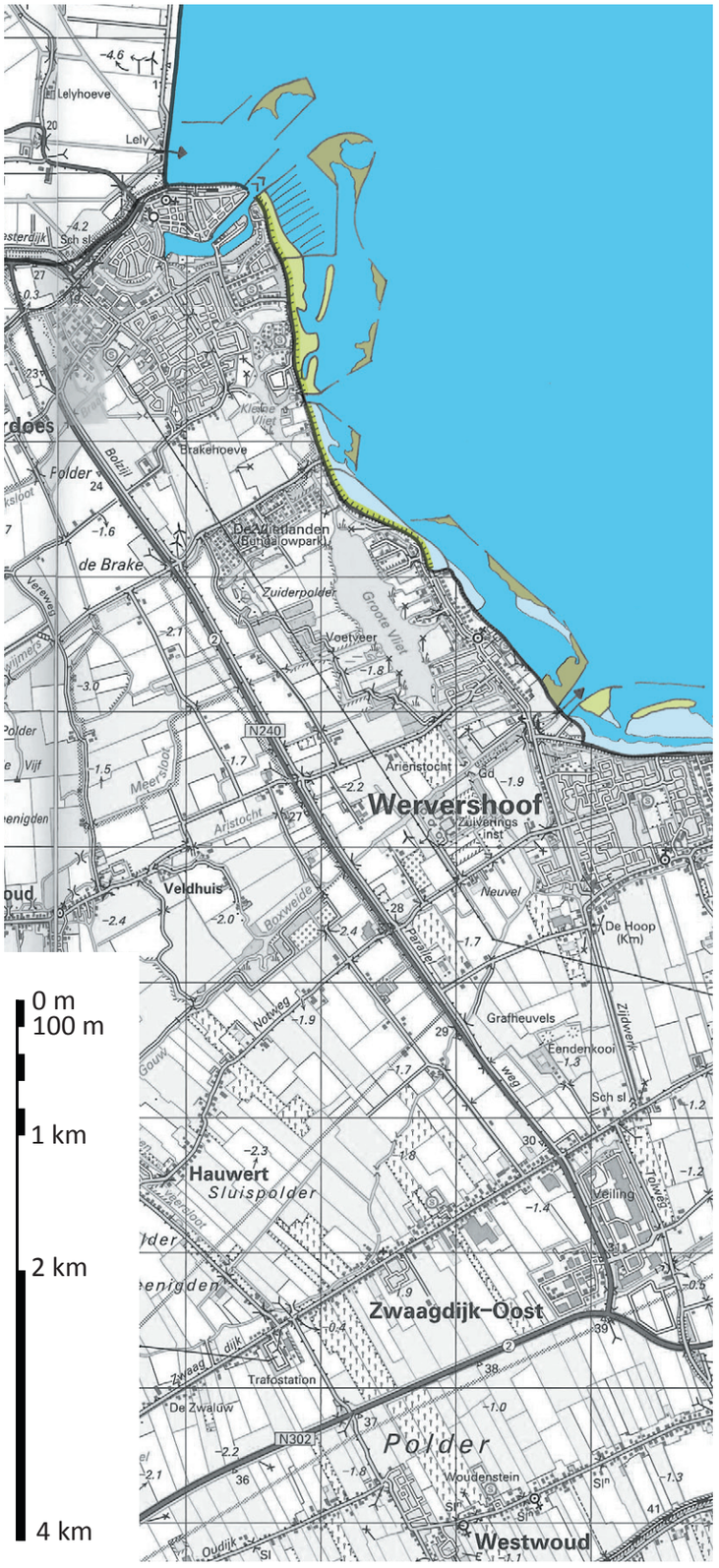
7.1 Design alternative: broad shores

7.1.1 Concept

This concept is based on the way dikes traditionally functioned: with a foreshore that broke the waves. At this moment foreshores and shelter dams are present along large parts of the dike. While the water level in the IJsselmeer will rise, all these foreshores will flood. This does have consequences for the protection of the dike, as well as for nature and leisure functions. In this concept the parts of the dike where dike heightening is not the best solution (see chapter 6) will be protected by new created shelter dams and foreshores. The flooded remains of the old foreshores will partly be used in the new design. Using shelter dams and foreshores does however not mean that no adjustments to the dike will be necessary. The adjustments will be less radical compared with the dike heightening concept. With the broad shores the dike should be at least 4.1 m.

The area in front of the dike will exist of pieces of land attached to the dike (foreshores), which are easily accessible, and therefore ideal for leisure purposes. Next to that, shelter dams and artificial islands will be placed in front of the dike. Both the islands and the dams create areas of sheltered water which are ideal for birds. While these areas will be shallow, while they are the remains of the present foreshores, they will fall dry during dry times. The dams and islands will be ideal for nature developments, but will also be partly accessible, for example by bridges, paths that partly flood, or by boat.

While all present foreshores and shelter dams will flood, they need to be (re) built. This means that material has to be moved within the area, and that some materials need to be brought to the area. For the forelands and the islands material from the area can be used, like clay and sand. The dredging activities will make that a combination between deep and shallow water evolves. The dams and some of the edges of the islands will be built out of sand covered with large cobble stones, for which some of the old stones can be used (Perk et. al., 2010). The stones are safe from erosion and have an ecological function. Plants, both under and above the water, and shellfish, like the zebra mussel, can grow on them and fish can hide between the stones. Especially for the zebra mussel, artificial mussel beds in the IJmeer have been proved to be significant for the population (Steenbergen et. al., 2011).



Deep water

Undeep water (former outerdike lands)

Fresh water reservoirs

High outer dike lands (recreation and industry)

Low outer dike lands (nature and extensive recreation)

Shelter dam

Heightened dike (with flattened slope)

Dike with flattened slope

Pumping station

Water inlet

Lock

Outer dike marina

Figure 7.1: broad shores concept

7.1.2 Detail 1: Medemblik

In the past decades, a recreational and nature area called 'De Vooroever' (the Foreshore) has been developed between Medemblik and Andijk, and the area is still under development (Perk et. al., 2010). The area exists of an open grass areas with trees and some small bushes near Medemblik. There are also some sand beaches in this area. Several paths make the area accessible, manly for walkers. Near Onderdijk the area exists of shelter dams with reed lands. This part of 'de Vooroever' is not accessible with paths. Near Andijk there is a nature area with densely planted bushes. The area is partly open for the public with bird watch spots. There is also a leisure area with a sand beach (see figure 7.2a and b).

Figure 7.2a: leisure area near Medemblik

Figure 7.2b: shelter dams near Onderdijk

Almost the whole Vooroever area will flood due to the water level rise, although some parts are so high that they will fall dry as soon as the water drops. In the broad shores concept the old Vooroever area will be used to build new foreshores and shelter dams (see figure 7.3). Near the harbour entrance of Medemblik the shelter dams will be built far into the lake. This is based on the old situation of Medemblik (before the building of the Wieringermeer polder) as a land area pointing out into the Zuiderzee. The new dams will include a new marina and while the harbour dams will be extended, there will also be space for a lock.

South of the marina a leisure area is planned based on the present leisure area (see figure 7.4 a and b). Between the marina and the steam pumping station museum the outer dike land is heightened. This area will be primarily for leisure purposes. Two sand beaches will be built, one sheltered with shallow water, the other in an area with deep water. On a distance (max. 800 m) from the dike low shelter dams are created, so that a sheltered lagoon is formed. On the inner side of the shelter dams low islands are spouted up. These islands will regularly be overtopped by waves so that the planting stays low and the islands are reshaped by waves over the years. In the middle of the lagoon an island will be built. This island will only be accessible by small boats, or by experienced swimmers. During the winter this island will be a paradise for birds. Near the museum a jetty is built. Having a berthing possibility is a long wish of the museum (Perk et.al., 2010).

South of the museum the developments are concentrated more closely to the dike. The dike of the Nespolder is heightened so that an area of around 150 m broad between two dikes evolves (see figure 7.5 a and b). In the Nespolder dike sluices will be built so that water can enter the area. The area between the dikes will be a swampy area with reed and small trees. The Nespolder dike will accessible for walkers and cyclists, but will possibly be closed during times of high water and strong winds, while the dike can regularly be overtopped by waves.

Near Onderdijk the present shelter dams are rebuilt. In the area between the dike and the dams some smaller dams are built. These dams can grow into small islands as a result of sedimentation and plant growth on the dams. Near the pumping station an island is created which is accessible. This offers an opportunity to watch birds in the sheltered lagoon. There will also be a jetty so that boats can take a berth on this island too.

Figure 7.3: detailed map: near Medemblik

Figure 7.4a: visualisation of one of the the sand beaches near Medemblik, with the island and shelter dams visible on a distance. The area in between the shelter dams can be used for all kinds of small boats. During the winter the area behind the dams will be ideal for water birds.

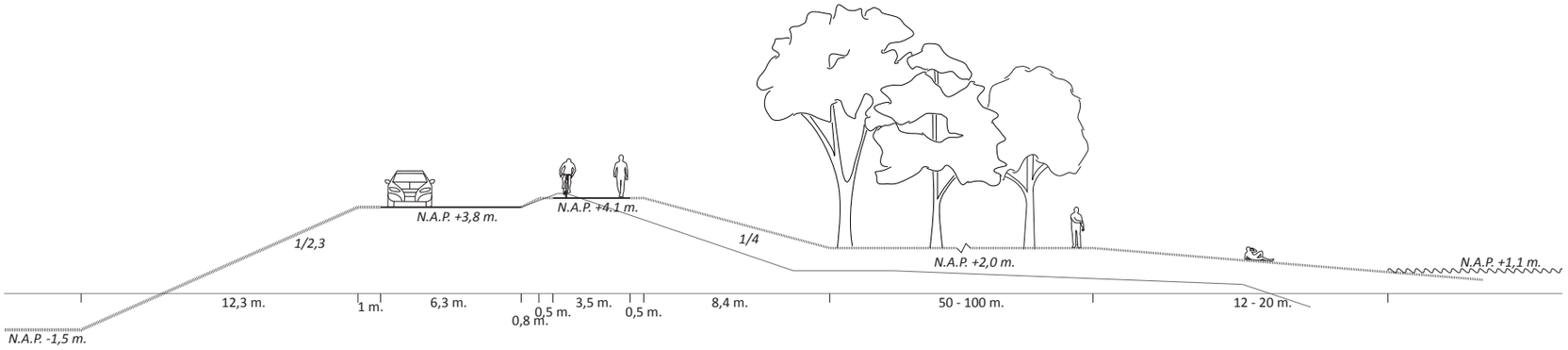


Figure 7.4b: cross-section of the dike and the sand beach

Figure 7.5a: visualisation of the Nespolder and the Nespolder dike. the area in between both dikes is a swamp area which offers a lot for all kinds of birds. The water level will be dependend on the water level in the IJsselmeer, so that the area can become dry in dry periods. The birds can be watched both from the main dike as well as from the Nespolder dike, which will only be accessible during the summer months, while the dike can be overtopped by waves.

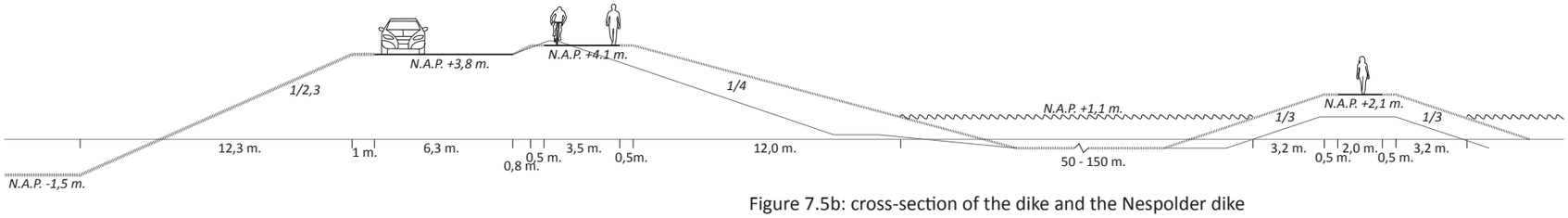


Figure 7.5b: cross-section of the dike and the Nespolder dike

7.1.3 Detail 2: Enkhuizen

The area north east of Enkhuizen is called the Enkhuizer Zand. It used to be an shallow area due to continuous sand deposits, which also threatened the harbours of Enkhuizen from silting up. After the closure of the Afsluitdijk the area partly felt dry. In the 1960's and 1970's the southern part of the area, near Enkhuizen, was heightened so that a leisure area could evolve in front of the sea wall of Enkhuizen (Enkhuizen 2030, 2009).

A diked area includes the Zuiderzee museum, an open air museum with buildings from the time of the Zuiderzee, which is only opened in summer (see figure 7.6 a). North of the museum there is a camp side, with both permanent trailers as well as an area for temporary camping (see figure 7.6b). There is also an amusement park for young children (Sprookjes Wonderland). The water side is dominated by a sand beach, and there is also a roofed swimming pool.

Figure 7.6a: Zuiderzee Museum

Figure 7.6b: campsite near sea wall Enkhuizen

Figure 7.6c: nature area north of Enkhuizen

The northern part of the area is more natural with low (NAP + 0.1 m – + 0.5 m) and wet forelands, where many birds, like gooses, find a place (see figure 7.6c). Parts of the area are protected against erosion by small dams. The higher places near the dike are grazed by sheep.

Most of the Enkhuizer Zand area will flood, although parts of the area are heightened so much that they will stay dry, although just above the water level. The Zuiderzee Museum area is diked, with dikes that are now max. 3.6 m high. This means that the dikes are high enough to withstand the higher water level, but they are not high enough to withstand waves. For this reason the dike around the museum will be heightened up to 4.1 m max. (see figure 7.9 a and b). In front of the museum low shelter dams will be built. Within these shelter dams there will be place for anchorage, and there will be a jetty for excursion boats.

The area north of the museum will partly flood. This means that the sea wall will be directly exposed to water again. While the sea wall is not high enough, it needs to be protected against waves by shelter dams, and the remaining parts of the present Enkhuizer Zand (see figure 7.8 a and b). The area in front of the sea wall will be a leisure area, with two sand beaches. The area between the shelter dams will be a lagoon with both deep and shallow water. In the middle there will be an island, which is only accessible by boat or for swimmers. Some of the dams will be accessible by bridges.

The most northern part will be a more natural area. To keep the view over the water of the IJsselmeer the dams and planting will be kept low. Most parts will be flooded, shallow water areas, but some parts will be heightened so that there will remain some permanently dry areas. Other parts will fall dry if the water drops. It is likely that as a result of sand deposits more areas will fall dry in future, especially in the sheltered corners of the shelter dams.

Figure 7.7: detailed map: near Enkhuizen

Figure 7.8a: visualisation of the new situation along the sea wall in Enkhuizen. The sea wall is again directly exposed to the water, so that its function is clear. The area in front of the dike which will not flood is visible nearby. On a distance the shelter dams, which are partly grown with plants, are visible.

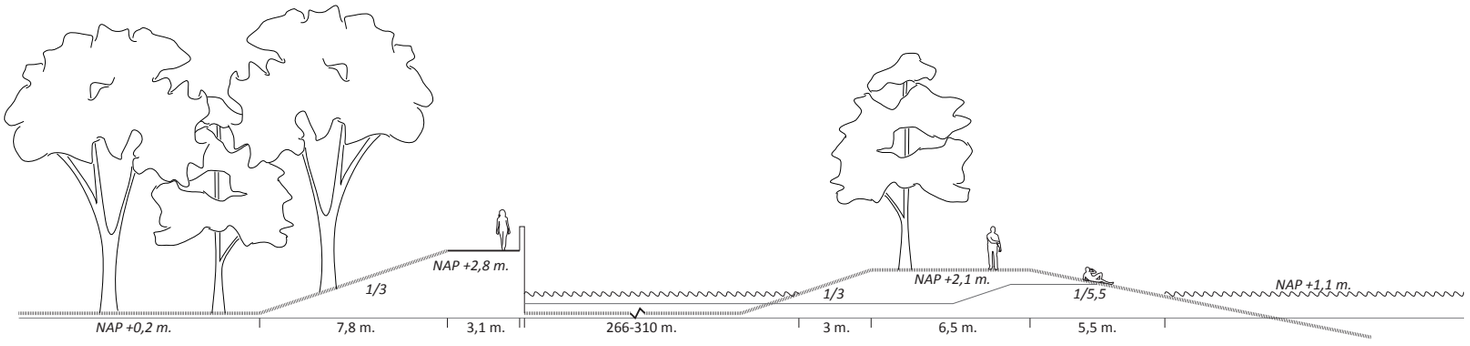


Figure 7.8b: cross-section of the sea wall and the partly flooded area in front of it

Figure 7.9a: visualisation of the anchorage area in front of the Zuiderzee museum. the shelter dams are kept low, and without high plant growth, so that the view from the museum towards the open water is not blocked. The area will offer a sheltered place for both traditional and modern boats. There also will be a jetty where ferry boats for the museum can land.

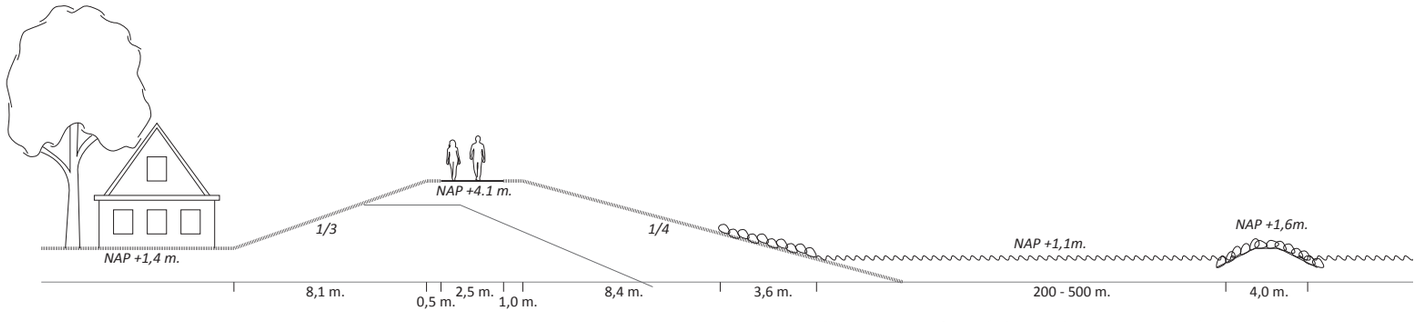


Figure 7.9b: cross-section of the anchorage area in front of museum

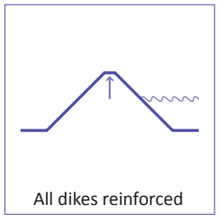
7.1.4 Guidelines

Compared with the dike heightening concept more guidelines are achieved, or at least partly achieved, in the broad shores concept. While the dike can have less height on some places, the human scale, and the height in relation to the houses, is better respected. However, on some place the dike can still be a bit too massive. While there will be less changes to the dike, the dike itself will possibly partly not function as a delta dike, and the height of the dike is less accentuated. Since the foreshore and shelter dam area can be extended at any time, the area becomes more adaptable to future changes. Also the dike can still be reinforced. While less changes happen to the dike itself, the outer dike slope stays as it is, or is used in the new design. With the foreshores it is likely that the outer dike slope will more often be grazed by sheep.

Compared with the heightening concept more harbours are protected in this concept. The concept also offers more possibilities for Medemblik to develop as a water sports centre, although these possibilities are mainly for small boats. The foreshores also offer possibilities to develop in relation to other kinds of leisure activities.

Along the foreshores the knowledge on the experience of the gate-effect is used. This means that the gate-effect is enlarged with elements on the outer side of the dike. The foreshores and shelter dams also offer more possibilities to create resting places on interesting places. The variation in open and closed areas is enlarged, this however means that there sometimes is less view on the large open space of the IJsselmeer. It is even likely that the view on some landmarks which are now clearly visible will be blocked by plant growth on the foreshores or shelter dams. This is also the case for the visibility of the flood protection elements.

Achieved guidelines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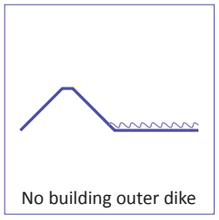
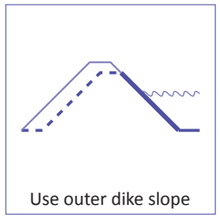
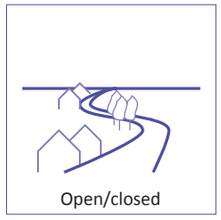
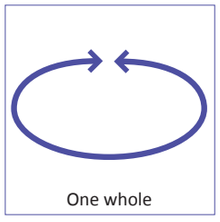

No building outer dike


Protect valuable areas


Use outer dike slope


Open/closed


Resting places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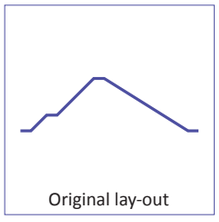
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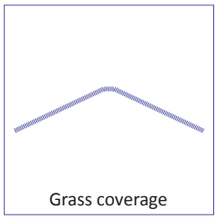
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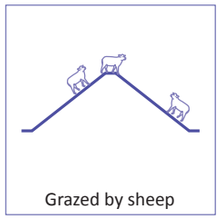
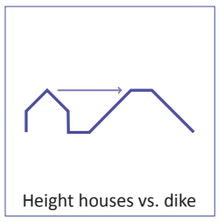
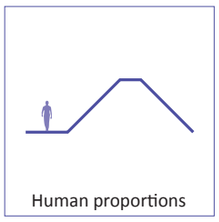

Grazed by sheep

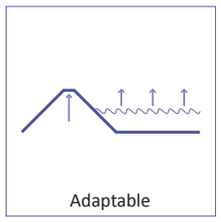

Accessible

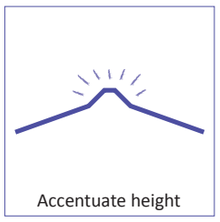

Recreational traffic

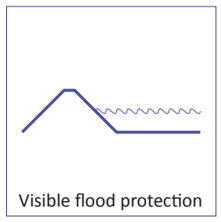
Partly achieved guidelines

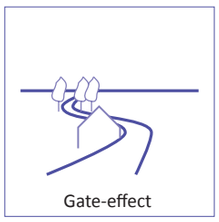

Height houses vs. dike


Human proportions

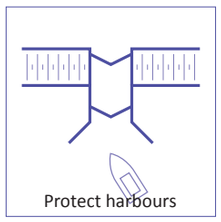

Adaptable


Accentuate height


Visible flood protection

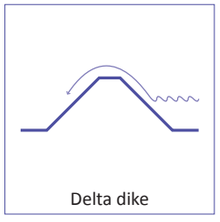

Gate-effect


Keep open areas


Protect harbours


Watersports centre

Not achieved guidelines


Delta dike

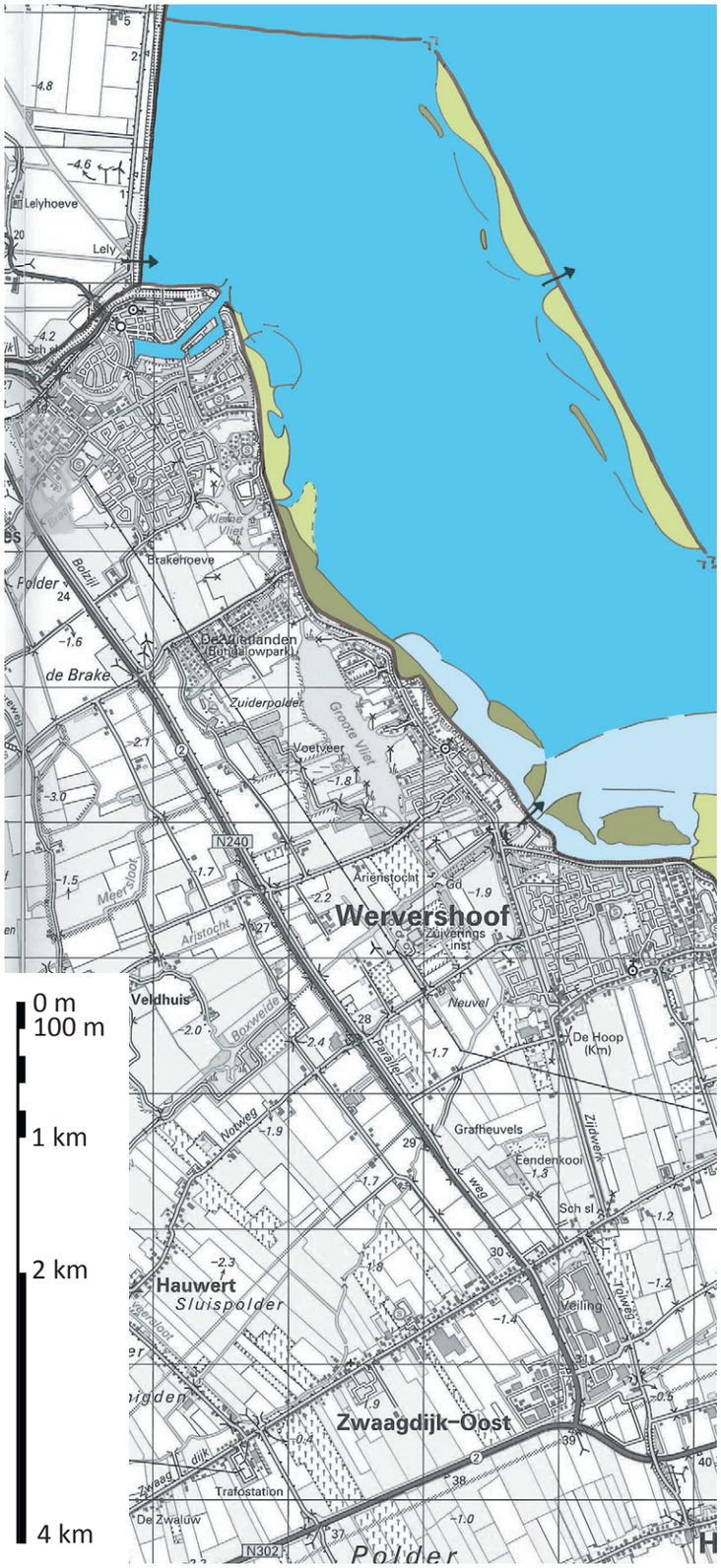

Expose landmarks

7.2 Design alternative: new dams

7.2.1 Concept

In this concept the areas where dike heightening is not the best solution (see chapter 6) are protected by new built dams, on a distance from the present dike and shore. The water level in the new created lakes behind the new dams will only rise a little up to NAP + 0.1 m. This means that the present areas outside the dike can stay the same and that dike heightening or strengthening will not be necessary. While it will be allowed that the dams are regularly overtopped by waves the dams do not have to be that high. The height of the dams will be NAP +3.6 m. This means that they will be 2.5 m above the maximum water level in the IJsselmeer. While the dams are quite low and built on a distance from the shore they will be visible as thin lines on the horizon.

The new created sheltered lakes will be accessible for all kinds of boats, and will also offer possibilities for all other types of water related activities. Especially for small scale activities, like sailing with small boats and rowing, these lakes will offer possibilities that the large IJsselmeer does not offer. All present marinas are included in the new dams, so that they do not need any adjustments. Locks will be built so that there is an easy connection with the IJsselmeer. The dams will partly be broadened (on the land side of the dams) so that island like leisure areas will evolve, which are accessible by the dams, and by boats. These islands offer extra possibilities so that there will not be extra recreational pressure on the existing recreational areas on the foreshores.



Deep water

Undeep water

Fresh water reservoirs

High outer dike lands (recreation and industry)

Low outer dike lands (nature and extensive recreation)

Heightened dike (with flattened slope)

Dike with flattened slope

Dam

Pumping station

Water inlet

Lock

Figure 7.10: new dams concept

7.2.2 Detail 1: Medemblik

The dam between the dike of the try-out polder Andijk and the dike of the Wieringermeer polder is built on a distance of at least 2 km from the shore. This means that a lake of 17.5 km^2 evolves. The size of the lake will be comparable with for example the Fluessen (one of the largest Frisian lakes). From the place where the dam attaches to the shore the dam will be a narrow line for 2 km (see figure 7.12a and b). In both corners of the dam locks will be situated. Between the locks the dam is 4.2 km long, and here the dam will be broad, between 25 m and 150 m (see figure 7.13b). While the narrow parts of the dam will be hardly visible this broad part will be visible as an island if looking from the shore (see figure 7.13a).

The broad part of the dam will be a leisure area, with both possibilities for walking, cycling and water related activities (see figure 7.11a). The dams are accessible by car, and a car parking is created on both ends of the broad part of the dam. Cars are not allowed in between both car parking's. All leisure activities will be focussed on the new lake. This can be compared with the new created leisure areas along the dams of the Delta plan in Zeeland, like the Brouwersdam and the Grevelingendam. In front of the dam island and dams will be placed to create interesting and sheltered spaces. During winter times the broad dam will be a good place for all kinds of birds.

Three pumping stations discharge on the area of the new lake. This means that a pumping station on the dam will be necessary to be able to discharge the water into the IJsselmeer. To clean the water that comes from the pumping stations, dams and a helophyte filter area will be created in front of the pumping stations in the south east. The dams will make that the water will be slowed down so that sediment can subside. The helophyte filter will make that the water is filtered even more.

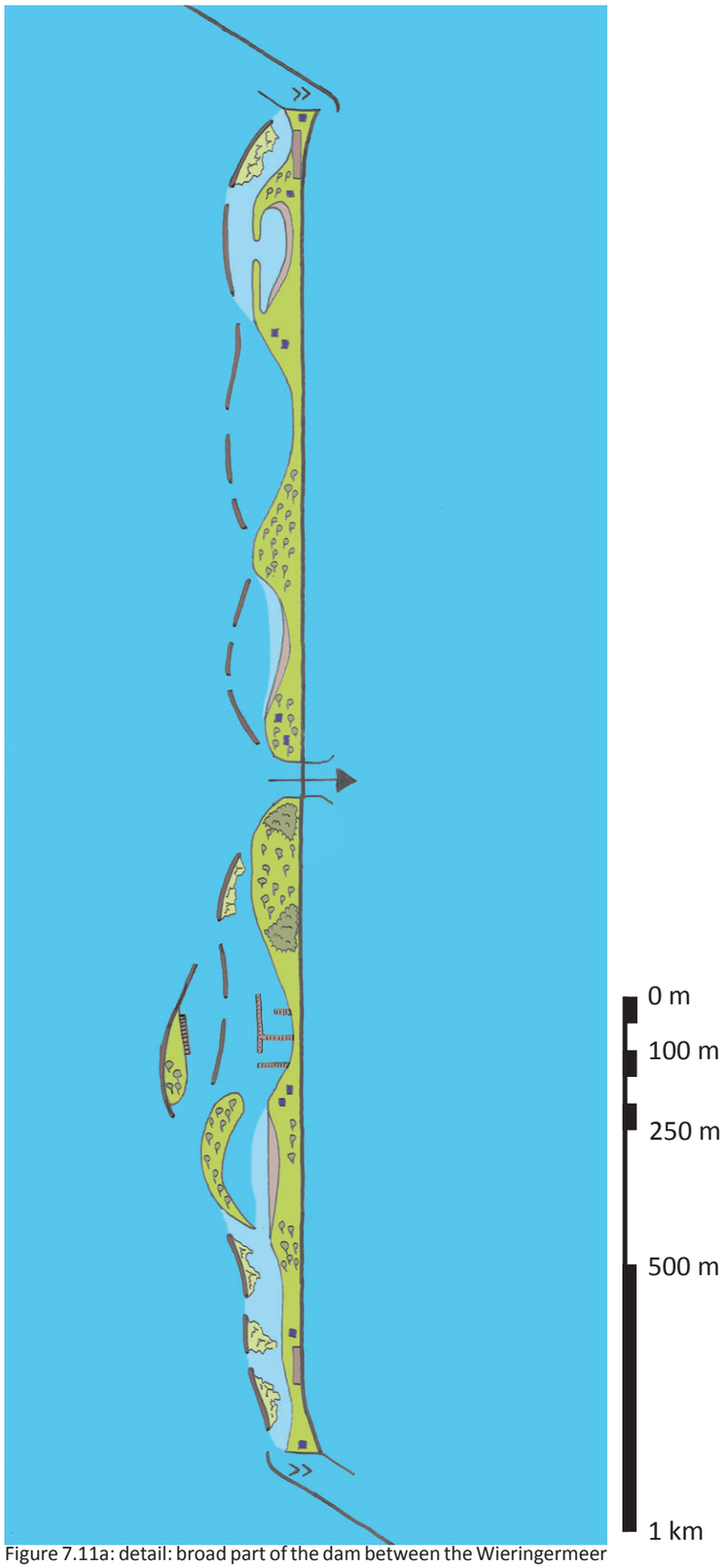
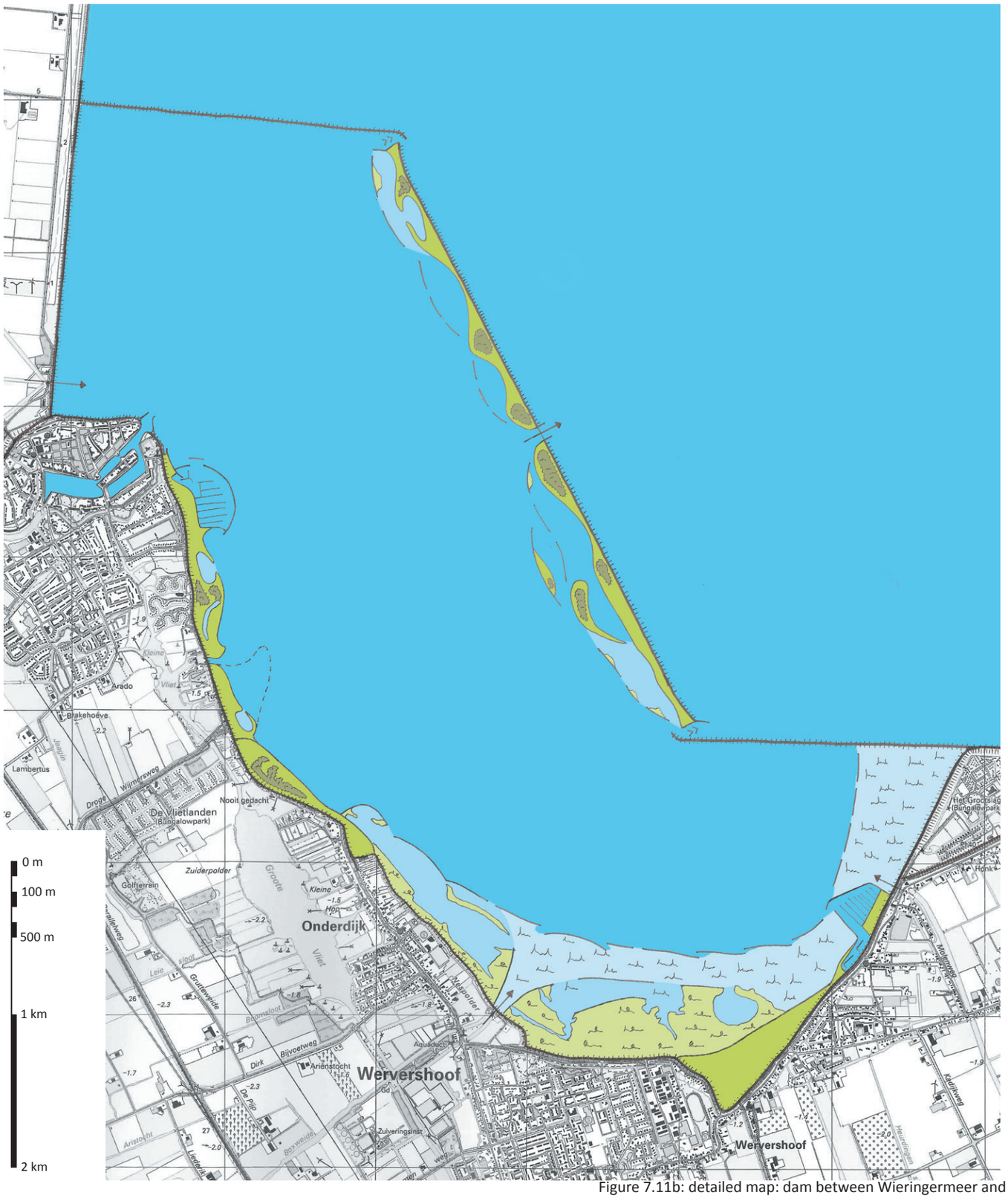


Figure 7.11a: detail: broad part of the dam between the Wieringermeer and Andijk



Deep water

Undeep water

Undeep water with helophytes

High outer dike lands

Low outer dike lands (nature and extensive recreation)

Dam (narrow)

Dam (broad)

Trees and bushes

Pumping station

Lock

Marina

Figure 7.11b: detailed map: dam between Wieringermeer and Andijk

Figure 7.12a: visualisation of the narrow part of the new dam, from the Wieringermeer to the broad part of the dam. This part of the dam will be accessible for cars, also because the locks need to be accessible. On the left side the IJsselmeer is visible, on the right side it is the new created, sheltered lake which can be seen.

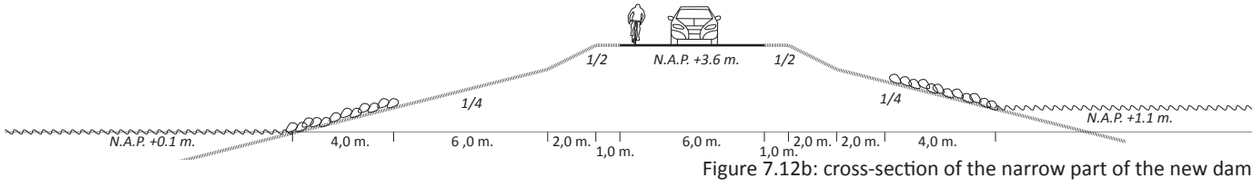


Figure 7.12b: cross-section of the narrow part of the new dam

Figure 7.13a: visualisation of the view from the harbour entrance of Medemblik towards the new dam. The narrow part will be visible as a thin line on the horizon, and will not even be visible on hazy days. The broad part of the dam will appear as an island on the horizon. The sheltered but large lake will help Medemblik to develop as a centre for watersports.

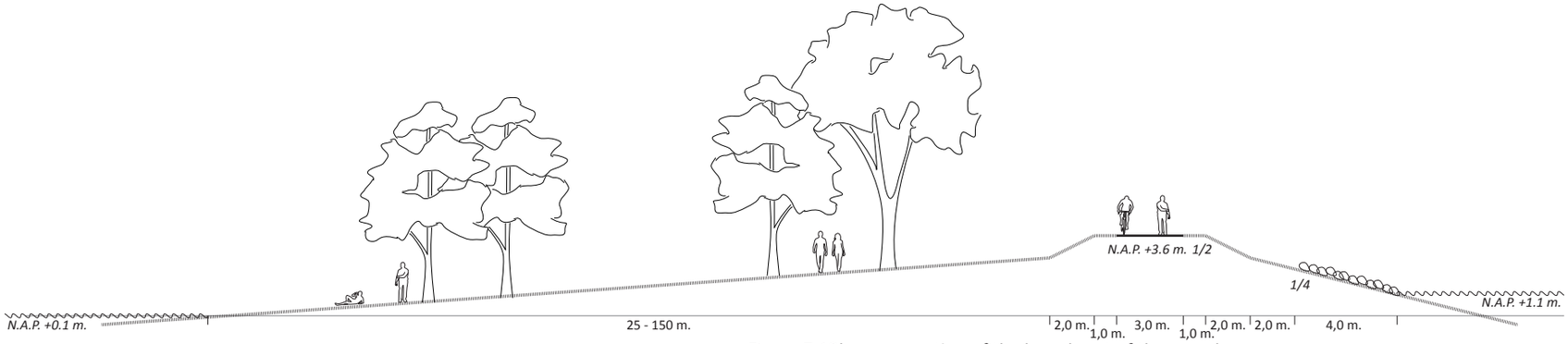


Figure 7.13b: cross-section of the broad part of the new dam

7.2.3 Detail 2: Enkhuizen

For the dam in front of Enkhuizen the present Krabbersgat dam will be extended. This dam used to prevent the harbours of Enkhuizen from silting-up. The new evolved lake in front of Enkhuizen will be less smaller compared with the lake in front of Medemblik. This means that this lake is not suitable for larger boats, although they can find a place for anchorage. This means that the lake will be more focussed on small scale water sports, compared with the lake in front of Medemblik.

Like the dam in front of Medemblik, the dam in front of Enkhuizen will also get a recreational function and include a sand beach (see figure 7.17 a and b). The dam will only be accessible for boats near the locks, although rowing boats can land everywhere. A lock complex with two or even more locks will be created within the dam. Although the present locks of Enkhuizen are not part of the main shipping routes, they are still very busy. This means that the new locks will not only serve boats that want to visit the harbours of Enkhuizen, but also boats passing from the Markermeer to the IJsselmeer and reverse. The activities near the locks will also contribute to the attractiveness of the dam.

A water inlet station is situated on the dike north of Enkhuizen. This means that during dry times water will be discharged from the lake into the polder under free flow. To maintain the water level in the lake it will be necessary to let water in from the IJsselmeer to the lake. This will result in a continuous flow of water. During wet times it will be necessary to pump water from the lake into the IJsselmeer so a pumping station is built on the dam. To filter the water in the lake a helophyte filter area is created in the northern part of the lake.

Although it is not necessary to do any adjustments to the areas which are included in the new dams, it is advisable to do so. Both earlier concepts showed that the spatial quality of the area could be enlarged by making the sea wall more visible. The area in front of the sea wall is now chaotic and partly not accessible (see figure 7.14a-d). While there is no overview in the area people can easily start to feel uncomfortable, especially on days when there is hardly any activity in the area, like in winter. In this concept the foreland is narrowed, and an open view towards the lake has been created (see figure 7.16a and b). The area will be accessible for everybody, and include grass meadows and two sand beach areas.


Figure 7.14a and b: chaotic area in front of the sea wall; permanent recreation houses and fence Sprookjeswonderland


Figure 7.14c and d: chaotic area in front of the sea wall; narrow beach and parking space near the beach

Figure 7.15: detailed map: dam near Enkhuizen

Figure 7.16a: visualisation of the new situation of the sea wall near Enkhuizen. The area in front of the wall will be redesigned, to create an open view from the wall to the water. The wall will not be exposed directly to the water, but it will be clear that it is a wall with a protection function. On a distance the new built dam is visible, and the area in between the wall and the dam is in use for all kinds of small scale watersports.

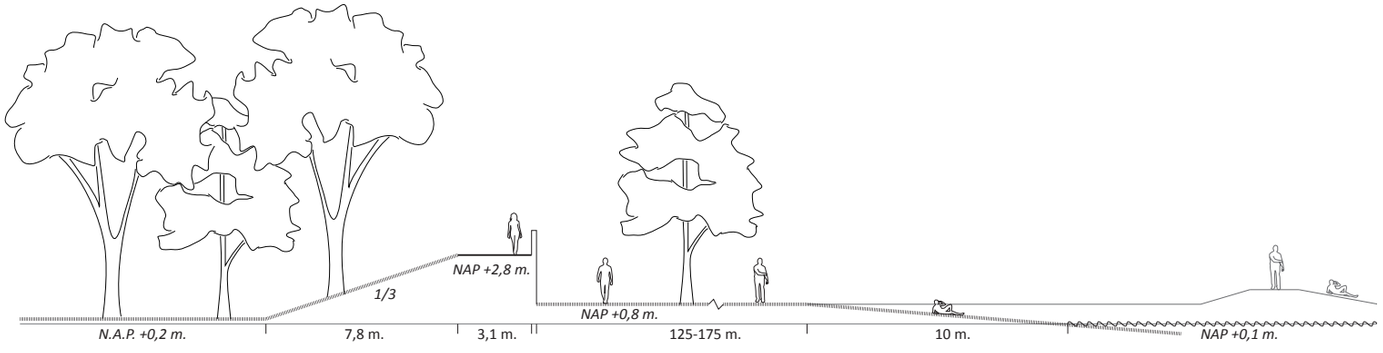


Figure 7.16 b: cross-section of the sea wall and the area in front of it

Figure 7.17a: visualisation of the dam in front of Enkhuizen. The dam will be accessible for cyclists and walkers, and also for cars with a maintenance function. The area on the side of the new lake will be mainly a grass area with some trees spread arround, so that it will look quite open. Also a small beach will be created. On the IJsselmeer side the dam will run straight into the lake, so that boats can come close to the dam.

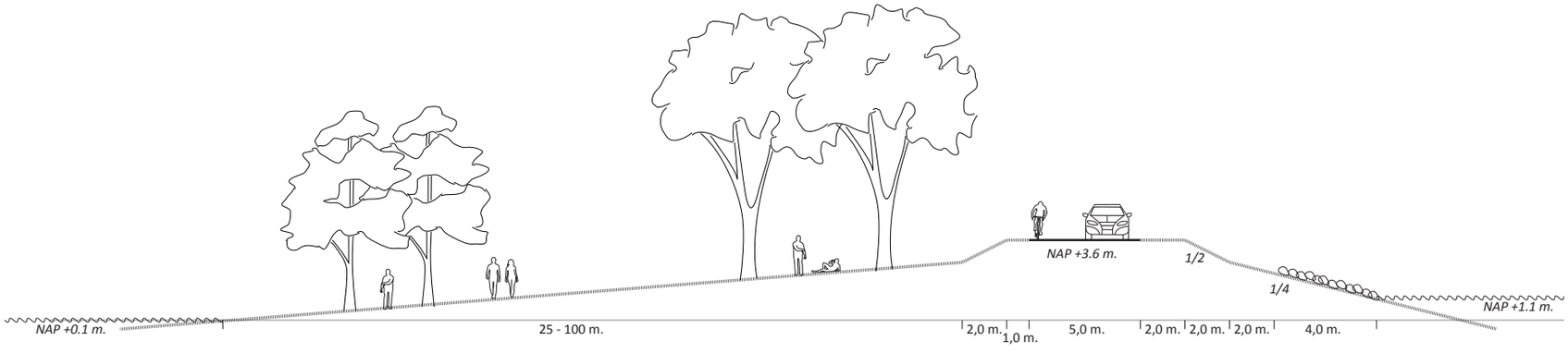


Figure 7.17 b: cross-section of the dam in front of the Enkhuizerzand

7.2.4 Guidelines

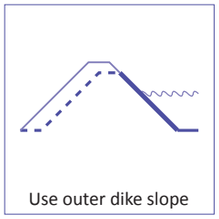
Compared with both other concepts even more guidelines are (partly) achieved in the new dams concept. While the present dike is not reinforced the outer dike slope stays as it is, and has still a flood protection function. While both the present dike and the new dam can be reinforced in the future the concept is adaptable to future changes. The dam as a flood protection element will be very visible, and also the visibility of for example the sea wall in Enkhuizen is enlarged. While most outer dike areas are protected, it is not necessary to forbid any building activities in the outer dike areas, although the openness of the area should always be respected.

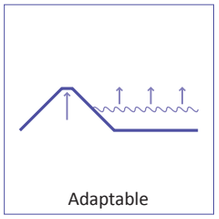
While the dike is not changed, and the dams stay relatively low, the human scale of the flood protection elements is respected. The height of the dam has been accentuated, however, while there were no adjustments to large parts of the present dike, the height of the dike has not been accentuated. Also the gate-effect is used on the corners of the dam, but has not been extended along the dike. There is no possibility to let the dam be grazed by sheep permanently, however, inviting a shepherd is a possibility.

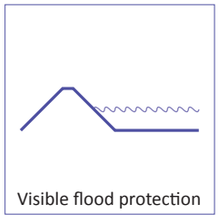
The dams offer many possibilities for recreation. Resting places can be created along the dams on interesting places, and circular routes over the dike are possible by bike. Also for water sports the dams and the lakes offer possibilities. While the lake in front of Medemblik will be big enough, also for large boats, this will help Medemblik to develop as an international sailing centre. All harbours are included within the dams so they are protected against the water level rise. The increased activity on the water will also help to enlarge the experience on the present dike.

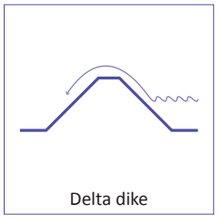
Achieved guidelines

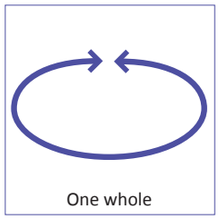

Protect valuable areas

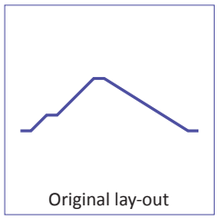

Use outer dike slope

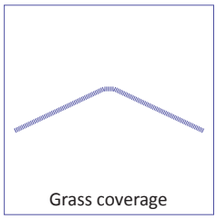

Adaptable

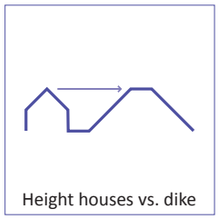

Visible flood protection

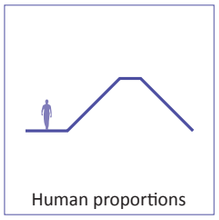

Delta dike


One whole


Original lay-out


Grass coverage


Height houses vs. dike

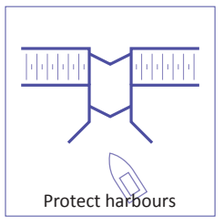

Human proportions


Accessible


Recreational traffic

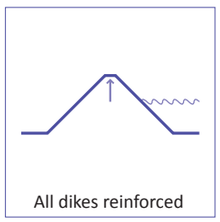

Keep open areas

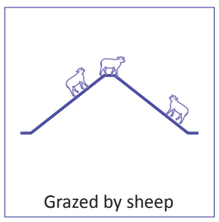

Resting places

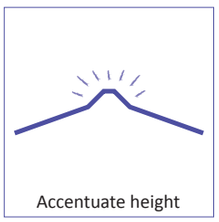

Protect harbours

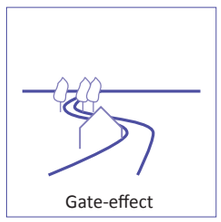

Watersports centre

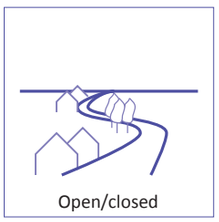
Partly achieved guidelines


All dikes reinforced

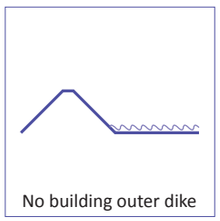

Grazed by sheep


Accentuate height


Gate-effect


Open/closed

Not achieved guidelines


No building outer dike


Expose landmarks

8

Conclusion and discussion

8.1 Conclusion

The future water level rise in the IJsselmeer is an unique situation, while it will happen under human control. This means that there are less uncertainties, both about the moment and the time it takes as well as the amount of water level rise, compared with an uncontrolled sea level rise. This means that it is easier to start to adapt to the water level rise in an earlier stage. This is not only because of the knowledge we already have on the future water level rise, but also because the necessity of the adaptation measures is more clear while there are less doubts about the water level rise. This offers possibilities; the extra time can be used to work on integral designs for larger regions. The focus should not only be on the design of the actual flood protection. In situations where places are more or less influenced by either the water level rise or the flood protection measures, it is also possible to start to adapt to the new situation in an earlier stage, both in policy as well as in designs.

The main question of this thesis is related to the possibility to start to think about the future of the IJsselmeer, and especially the area between Enkhuizen and Medemblik, in an early stage. It is clear that all dikes and other flood protection elements need to be reinforced in case of water level rise. The main question focussed both on the flood protection as well as on spatial quality, which is related to the line formed flood protection element dike and to the surrounding landscape.

What are possible spatial solutions to maintain and improve the spatial quality (focussed on landscape experience) along the IJsselmeer border of West-Friesland, while preventing the area from flooding (Dutch: wateroverlast) due to the proposed water level rise in the IJsselmeer?

Spatial quality is the (positive) value which is assigned by people to a specific place or area. Spatial quality is based on objective elements (which can be both static as well as dynamic) and subjective meanings which are related to these elements. Spatial quality is never based on one single element, usually groups of elements together define the spatial quality of an area. In every design case the spatial quality is influenced by elements which are incorporated in the plan area, and which are therefore impressionable by the design. But spatial quality is also influenced by elements which are not impressionable, either while they are outside the plan area or while they can not be directed at all, like weather conditions or other natural elements. Spatial quality is present on every scale level in every landscape, and therefore in every design project. This means that spatial quality should be incorporated in every design process. This is already been done in almost every project but often in a subconscious way. Everybody has an idea about qualities of an area, but it is hard to name them specifically.

Assigning spatial quality or adding a meaning to a place is strongly related to the experience of the landscape. Experiences are influenced by sensory perceptions. Although the first experience of a landscape is often visual, all other senses also play an important role. This is especially the case in relation to memory. Previous experiences and memories help to add meanings to new experiences and to order them in people's minds. The senses have to be triggered, new and surprising sensations help to keep the observer alert.

The design question for the IJsselmeer area is about enlarging the safety in case of water level rise. This means that the dikes in the area are involved and will be influenced by the measures that will be necessary. Dikes, and dike landscapes in the Netherlands are perceived as elements with a lot of spatial quality. A dike offers unique possibilities to experience the landscape, because it is elevated above the landscape. Curves in the dike help to keep the dike, and the experiences on the dike, interesting. Besides that the elevated position of the observer helps to be able to understand the landscape.

In the area between Enkhuizen and Medemblik the dike is mainly in use for recreational infrastructure, and the areas next to the dike are also often in use for recreation. This means that the spatial quality is even more important, while people who want to spent their leisure time want to do this in an area with a lot of spatial quality. This also means that both local inhabitants as well as strangers will form an opinion on the spatial quality of the area. Both need to be able to recognize the landscape, but they also need to be surprised by the area. The spatial quality in the study area is influenced by the water area, the dike and the old elements that are brought together by the dike.

A large, integral plan to enlarge the safety around the IJsselmeer in case of water level rise offers possibilities to enlarge the actual plan area. This means that the future spatial quality of the area as an entirety can profit from both the water level rise and the measures that are necessary to the flood protection. Not only trying to preserve the present spatial quality, but also

try to enlarge it is important in this case. In case of the area between Enkhuizen and Medemblik this means that there should not only be looked at the dike itself, when talking about the future flood protection.

Flood protection can be organized on a thin line, for example a dike, but it is also possible to organize it as a broad flood protection zone. There is not that much space on the inner side of the dike to function as a flood protection zone, but the spatial quality of this area will be influenced by measures that are taken on the dike. On the other hand, the spatial quality, and the experiences, on the dike are influenced by the landscape on the inner side of the dike. On the outer side of the dike there is space for a flood protection zone, and for the two way relation between the dike and the outer dike landscape with respect to spatial quality the same is the case as on the inner side of the dike. Both influence each other.

The fact that the outer side of the dike offers possibilities for a flood protection zone adds an extra reason to look outside the borders of the actual dike when redesigning the area to adapt to the water level rise. It offers the possibility to have influence on the future spatial quality. While spatial quality exists of an objective and a subjective part, it is not possible to 'design' the spatial quality of an area. It is important to look at the characteristics of spatial quality (see paragraph 3.1.4) to determine whether it is likely that people will add a positive meaning to the elements which are incorporated in or influenced by the design.

During the design process became clear that there are several solutions to enlarge the safety in the area between Enkhuizen and Medemblik. These are dike heightening, broadening the shores in front of the dike and building new dams to create new lakes (see chapter 6 and 7). In all solutions it is possible to maintain the present spatial quality, although this can be difficult on some places. Some solutions however offered possibilities to not only maintain, but also enlarge the spatial quality of the dike and the surrounding areas. This is possible if the plan area is enlarged so that the design question is not only about the dike. Comparing the two solutions (and the four detailed areas) it becomes clear that the spatial quality in both cases is enlarged by enlarging the possibilities to use the area, and by offering interesting and varied views on the outer side of the dike, without blocking the view on the water.

Looking at both solutions which are based on a large plan area it becomes clear that the actual spatial quality between the two of them will differ a lot. This does however not mean that is possible to state, on the basis of spatial quality, which one of them is the best or has the highest spatial quality. Both do have their advantages. To make a choice between the two should be done on other grounds than spatial quality. For example the image the area wants to have, but also finances can play a role. In general it is not possible to make a choice between conceptual designs on the basis of spatial quality. Spatial quality should be incorporated in every design and on every scale level.

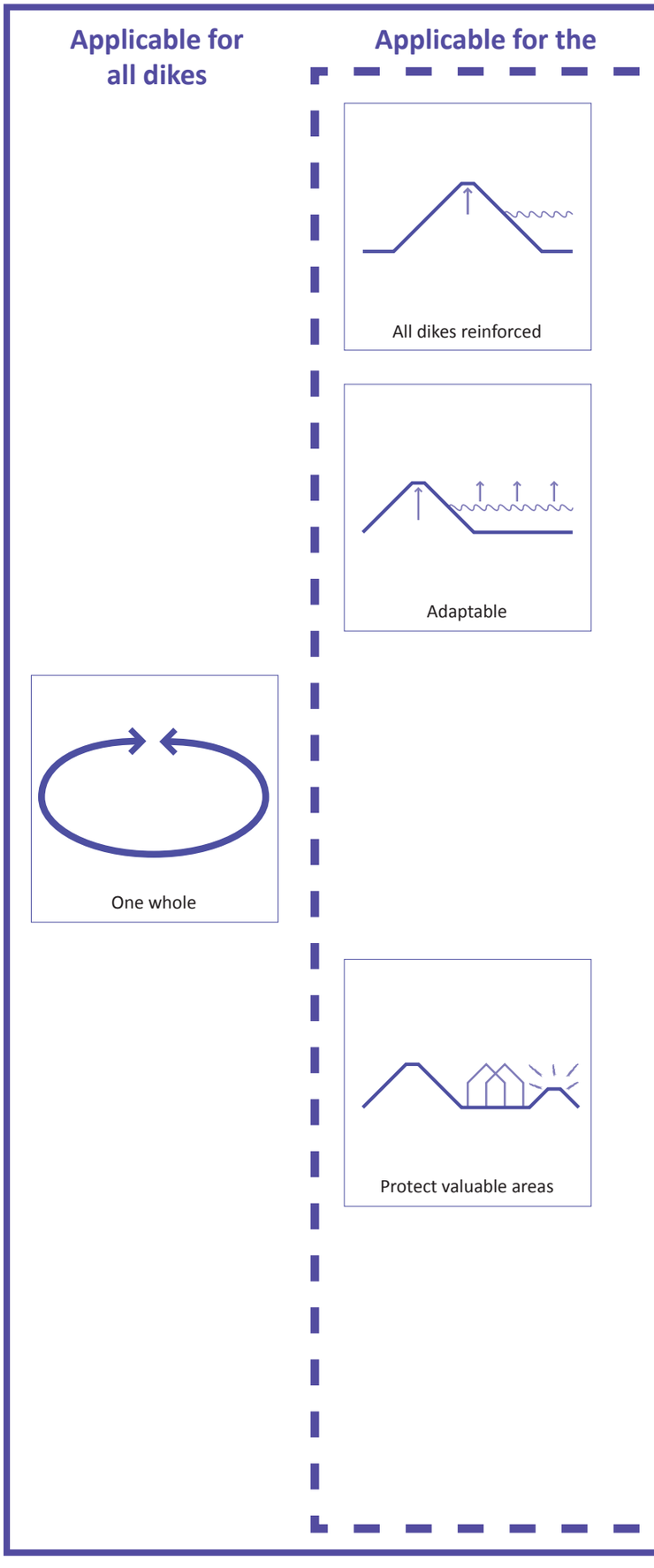
8.2 Guidelines

The guidelines are ordered in a way it becomes clear which guidelines are applicable for the whole IJsselmeer area. In case of a design project for a different part of the lake these guidelines can be used without much further study. These guidelines are the more general guidelines, which do not give a clue on how things should be worked out exactly. They however do give a clue on where the main points that should be taken into account during the design process.

Other guidelines are more place specific. Some will often be applicable to other stretches of the dike, especially to other old parts of the IJsselmeer (Zuiderzee) dikes. This means that these guidelines should be studied during another design project. It also means that it is likely that much of them will return, maybe in a slightly different way.

The last guidelines are very place specific. Some of them will be applicable to other situations, but only in specific cases. An example is the guideline which says that the open areas should be kept open. This is much less relevant for real open areas like Friesland and the new polders. Also the developing as an international water sports centre is really place specific, although it is likely there are other places around the IJsselmeer with the same goal.

The overall guideline is the guideline that the dike should be seen as one whole. This is not only the case in this project or other projects around the IJsselmeer. This is the case in every design project in which dikes are involved.

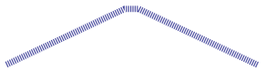


whole IJsselmeer area

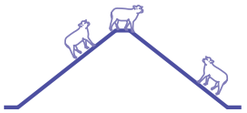
Applicable for long dike stretches

Applicable for specific, local situations

Delta dike



Grass coverage



Grazed by sheep

Original lay-out

Use outer dike slope

Accentuate height

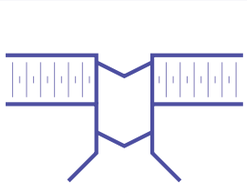
Human proportions

Height houses vs. dike

appearance of the dike

No building outer dike

Visible flood protection



Protect harbours

Open/closed

Gate-effect

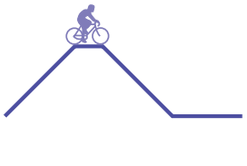
Keep open areas

Expose landmarks

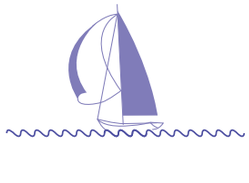
environment of the dike

Accessible

Resting places



Recreational traffic



Watersports centre

leisure function

8.3 Discussion

The results in this thesis show that a landscape architectural approach, with a focus on spatial quality, can lead to several and interesting solutions to enlarge the safety along the West-Friesland border of the IJsselmeer. The method of looking to a broad plan area, to be able to influence the spatial quality of a large area, can also be used for all other (old Zuiderzee) borders of the IJsselmeer, while the question to enlarge the safety will be the same. However, due to local difference the designs will probably be completely different. This is something which can be learned from the study on spatial quality, which is always based on local circumstances. This means that the local circumstances would be the main focus point if the results of this study would be implemented on other borders of the IJsselmeer.

Some notions can be made on the results of this thesis, beginning with the starting point of this thesis. Whether the water level rise and the amount of water level rise that is proposed by the Delta Committee is really necessary has not been studied. It would have been possible to write an entire thesis about this subject alone. This means that this thesis is based on the assumption that the proposed water level will become reality. This does however not mean that this thesis is not worth anything if the water level does not rise with 1.5 m. Although the exact outcome of the designs would be different in case the water level would rise less high, the ideas can still be used, also on other places. Besides that, the outcomes of the study on spatial quality are even relevant if the plans of the Delta Committee would be postponed completely.

The second notion can be made on the designs, which are not complete. The concepts and designs presented in this thesis should be seen as inspiring ideas or visions and not as complete designs for the area. While the goal of this thesis was to show that there are several ways to deal with the spatial quality and water level rise, and the measures that are needed, it was not possible to fully detail all different designs. This means that the designs should be evaluated on the basis of the ideas which are incorporated in them. If one of the ideas would be turned into final designs much more research and design activities would be needed. It is also likely that other concepts with other ideas can be developed, the htree mentioned concepts are not the only possible concepts.

The third notion can be made on the technical uncertainties within the research and the designs. While this thesis is written from a landscape architectural point of view, some knowledge on technical questions is lacking. This also means that there are some uncertainties within the designs, for example related to the dike height, wave run-up and soil conditions within the IJsselmeer. But also some knowledge on the technique of building new (shelter) dams, and the height they should have, is lacking. During a normal, real-life process of designing much more specialists would have been involved in the process. However, during the design process has been tried to estimate as precise as possible what for example the heights should be. And after all, while the designs only function as inspirations, technical discrepancies do not harm the ideas incorporated in the designs.

I hope the results of this thesis will help other designers to open their minds and to be able to look beyond the usual borders during the design process. Besides that I hope that the research on spatial quality will help to see and name the spatial quality of areas, and to be able to use spatial quality within the design process.

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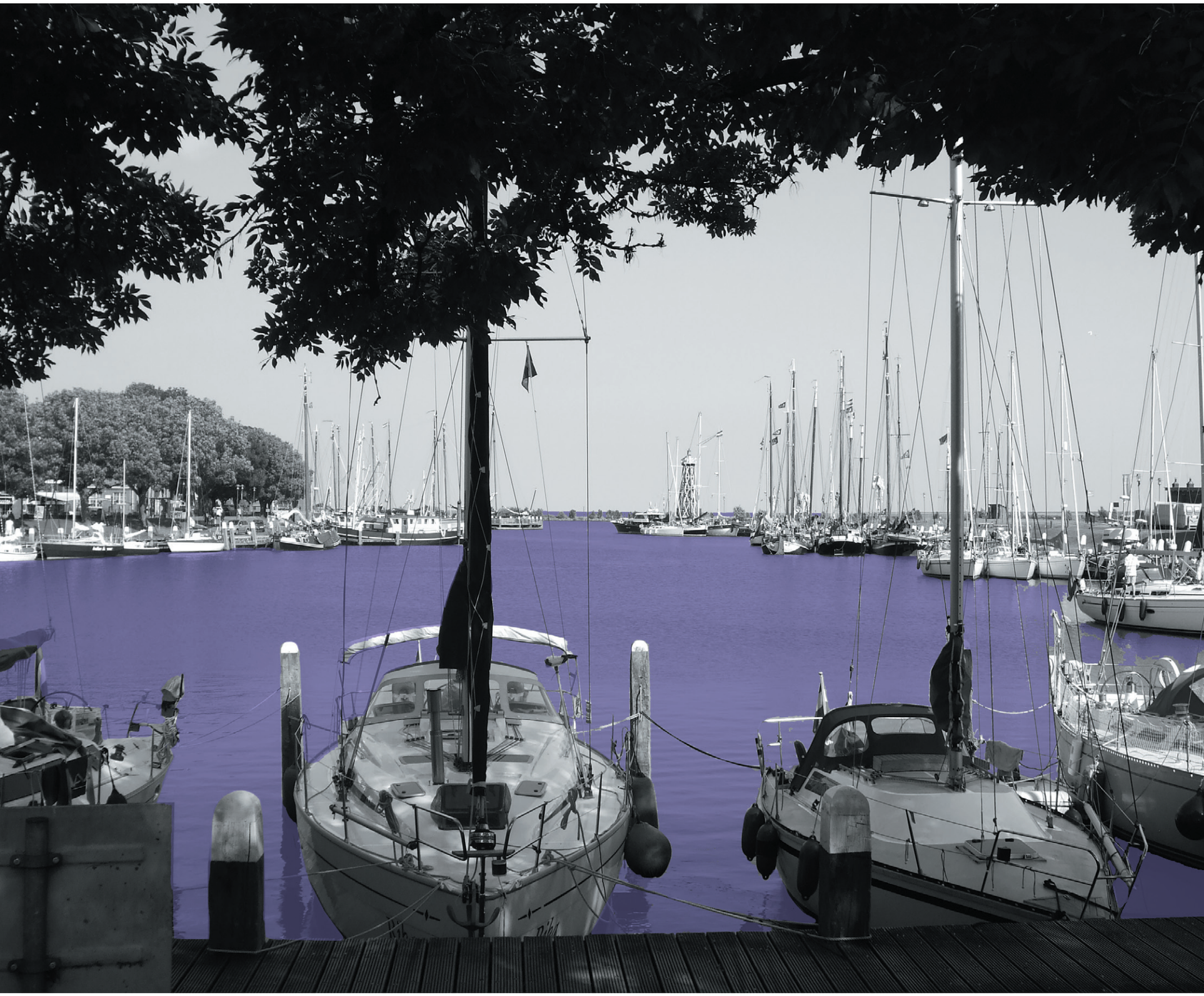

Nieuwe Haven, Enkhuizen
Pictured in January 2011 (front) and July 2011 (back)