

# ZEELANDIA

REDESIGNING DELTA

Studio Hartzema  
Feddes/Olthof  
Witteveen en Bos

It is about time in  
Delta Design to  
create a new Dutch  
condition

# REDESIGNING DELTAS

An initiative led by Delta Urbanism Interdisciplinary Research Programme, Delft University of Technology, the Netherlands.

The RDD Design Study's aim is to explore the potentials of the synergy between spatial design and engineering (design) of the Delta territory to create a sustainable and safe Delta. The knowledge gap we address is the lack of understanding of the mechanisms design thinking has to offer to generate interdisciplinary approaches. The scientific research question of the study is "How can spatial design support a transformative 'prospect for action' (handelingsperspectief) in delivering pathways to a resilient Delta future in which assertion (beweren/tekenen) and proof (bewijs/rekenen) are synergised?"

To this end 15 practice partners from the domains urban design, landscape architecture and engineering were invited to work on 5 design challenges specific for the Dutch Delta system. They were supported by experts representing various domains (covering social sciences and economics) to work in multidisciplinary groups delivering an interdisciplinary strategy that addressed the design question: What is a visionary future (and pathways to get there) on the Dutch Delta where life, work and recreation can be safe and sustainable in a climate responsive territory from a system perspective, considering the environmental and socio-economic challenges? How to envision and support this with plausible arguments on basis of sound principles and design strategies? The challenges are Limburg, Waal River Corridor, Rotterdam polder city, South-West Delta and the Rotterdam Coast.

The Design Study consisted of masterclasses, local ateliers, public presentations, and methodological workshops with the aim to reveal the impact of design thinking in creating new research directions and governance challenges.

Deltas worldwide are struggling with the challenges of climate change, increasing urbanisation and spatial pressure on rural areas. Unsustainable growth (urbanization) and shifting time horizons increase the urgency of the environmental crisis in deltas. In the Dutch Delta we are faced with the challenge of building a million more houses and goals to mitigate climate change by transitioning to renewable energy and increasing the biodiversity. Beyond that there is also subsidence as a major future risk to which the sea level is rising and changing weather patterns make the challenges even more urgent.

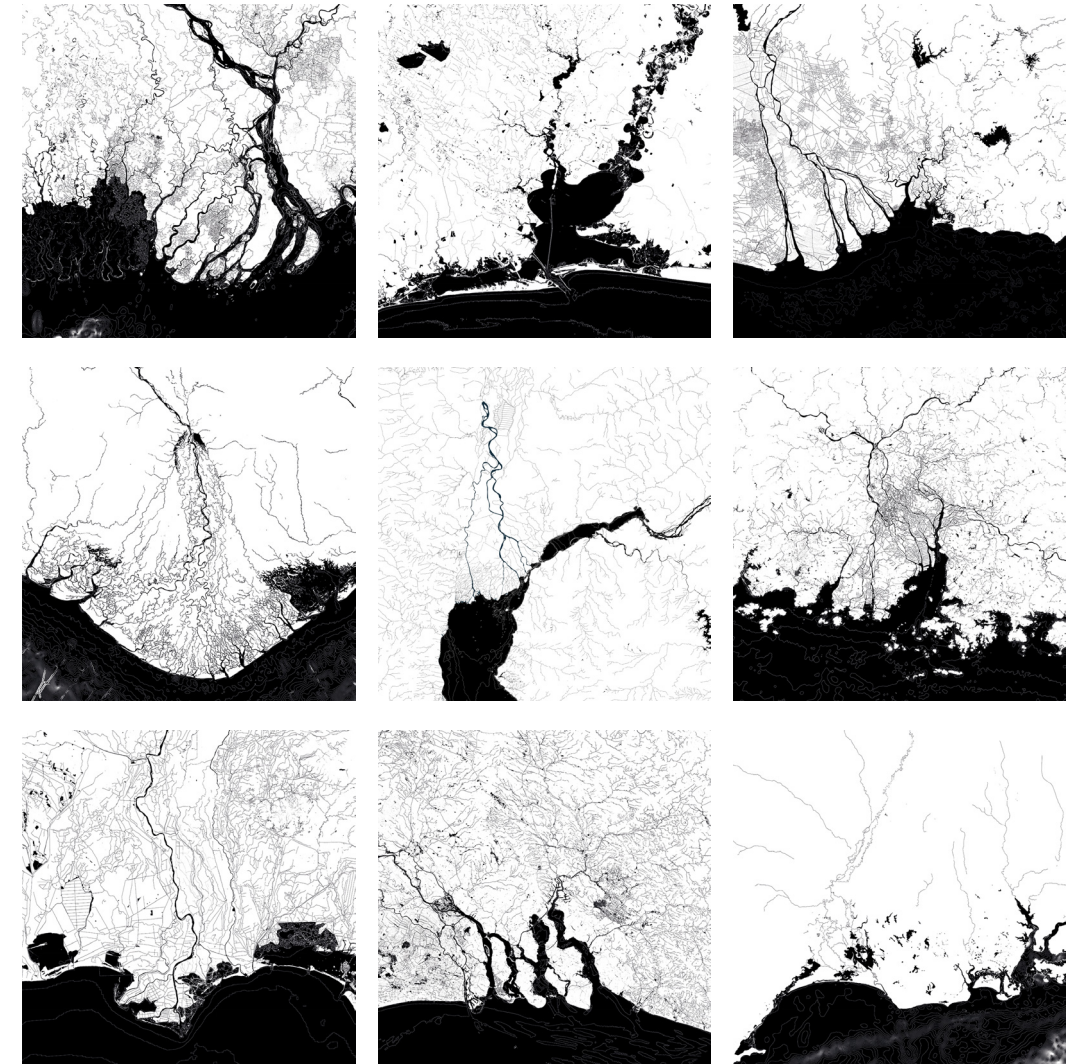


Figure 1: 9 Deltas objects of study.  
Ganges River Delta (India),  
Houston Bay (USA)  
Mekong Delta (Vietnam)  
Niger Delta (Nigeria)  
Paraná Delta (Argentina)  
Pearl River Delta (China)  
Po Delta (Italy)  
South West Delta (NL)  
Tana River Delta (Kenya)

# INTERACTIVE APPROACH

The design study is at the centre of the program in which practice was involve practice in a methodological approach with clear steps. They were given a shared scope: to deal with 2-3 meter sea level rise, climate adaptation, subsidence, sustainability transitions, housing shortage and boundary conditions of the context (social/economic/ climate scenario) for current and desired society.

The scope was explained further in four masterclasses, organized to give participants specialist knowledge input for their challenge. Topics included: the Dutch delta, international deltas, delta governance and delta economy.

This scope was first explored in a Sandpit setting. Sandpit is a (interdisciplinary design) methodology that is used to create a body of knowledge to be able to integrate and utilize knowledge of different nature. In the two-day 'Sandpit', the participants from engineering, urban design and landscape architecture firms are working together in defining the challenges and needs in the five geographical 'challenges' that represent different parts of the Dutch (delta) territory in the study.

Starting in (first disciplinary) groups to discuss these challenges, the practical experience from professionals in the field is gathered and used to build a preliminary understanding of the design-challenge(s) at hand, to further define the design brief and preliminary proposition.

The conclusions of the first day was the assembly of 5 teams, with each an urban, landscape and engineering firm, and division of the (defined) challenges over the teams. The second day the developed strategies were presented and

again in the disciplinary groups conclusions were drawn for the overall scale connecting the 5 propositions.

The collaborative approach was appreciated so much that the participants were interested in creating a manifesto as a group. This was done in an iterative approach, translation the position on the challenges to the system scale and these are brought together in one manifesto.

ReDesigning Deltas is focused on integration and academic consolidation of what is learned in the design study and to feed the study with the other lines of inquiry. The Synergy line of the program describes the outcomes of deliverables for their scope and validity, but also analyses and develops methods. H+N+S Landscape Architects has been commissioned to review the instruments of the Dutch Layers approach (a planning instrument) and the Casco Model (an instrumental elaboration of the Layers Approach).

Although both have become mainstream over the last decades, the question remains how they can be made instrumental for design of future deltas. H+N+S analysed the instruments (that originated from their offices) on their perspective and how they were used at the national (Belvedere, Ecological Main Structure, Room for the River) regional and local scale (VINEX and the Green-Blue Buffer in Delfland, with the design of Berkel-Rodenrijs).

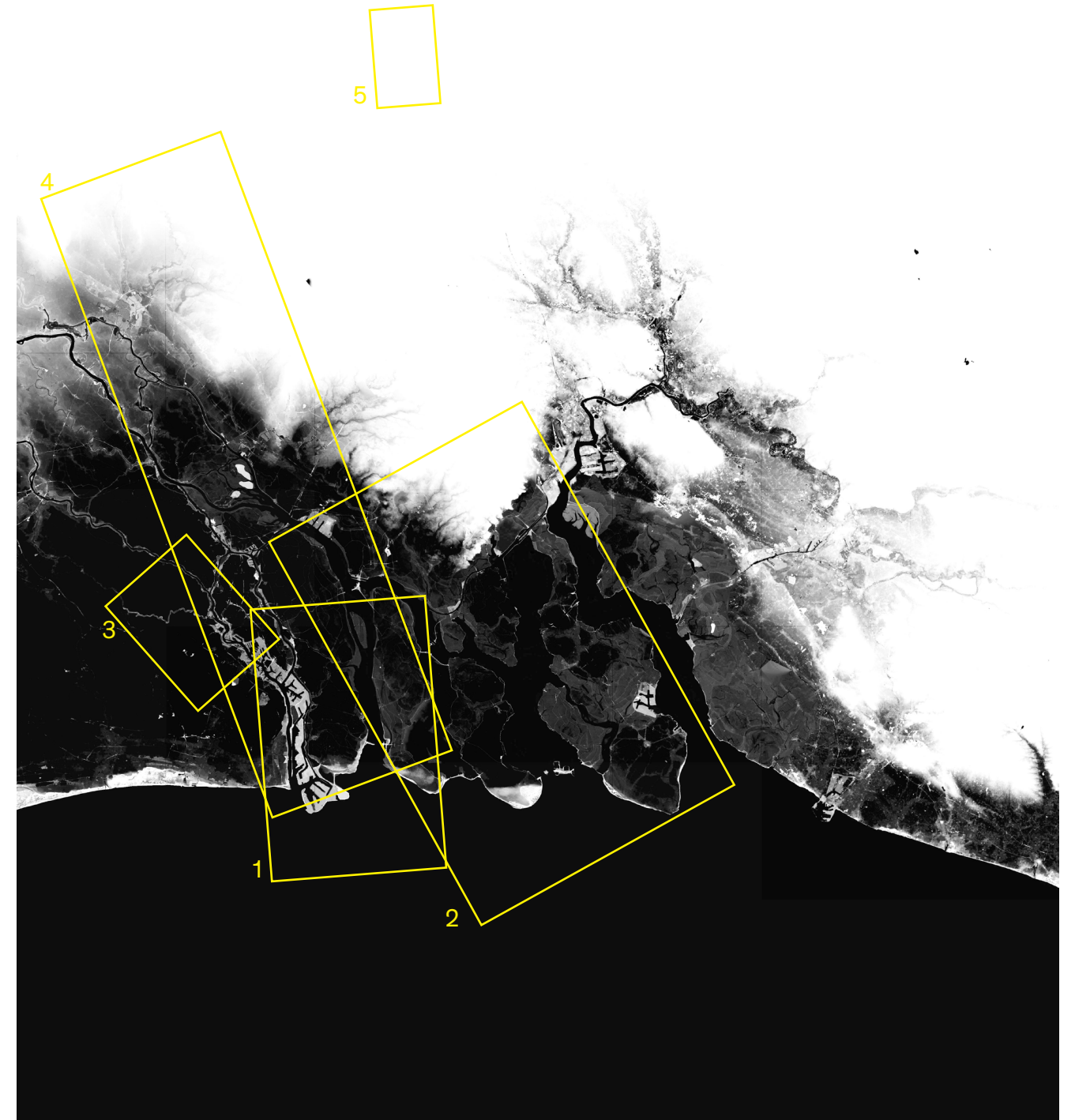
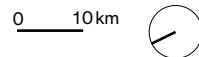
The outcomes of the analysis of H+N+S were used in the methodology workshop of the Design Study, where a new interpretation of the Casco Model was used by the design-teams. This affected to the constitution of the 5 propositions and brought them together in the overall manifesto.

# 5 CHALLENGES

Table 1:  
System description,  
contextualization of the  
challenges in relation to  
each other.

	<u>Challenge 1</u>	<u>Challenge 2</u>	<u>Challenge 3</u>	<u>Challenge 4</u>	<u>Challenge 5</u>
	'Seaside' Rotterdam + port	Zeeland Zuidwestelijke delta	The low west, urbanised polders Rotterdam'	The rivers Waal transport corridor	The high east Limburg / Valkenburg
Issues	Fresh & salt, ecology, urbanisation, coastal defence, port	Fresh & salt, ecology, flooding, salinization, agriculture, energy transition, transport	Pluvial & fluvial flooding, urbanisation	Transport, drought, water discharge, drinking-water, ecology, agriculture, energy transition (in transport)	Drought, pluvial & fluvial flooding, demographics, urbanisation
Scale	Regional, local, section	Regional, local and impact on national level	Local Urban	Regional, section	Regional , local
Preliminary challenge	How can urbanisation and port development target to support responsive coastal zone management?	How can the Zuidwestelijke Delta develop to stay a safe region beyond 2100, considering the societal challenges they will face, aimed at the future societal values?	How can the urbanisation target function as a catalyst for a resilient water system?	How can the multiple regimes of transport and strategic drink water supply in rivers be synchronized together with the other functions along the river (agriculture, industry, recreation and so on?	What is the potential for the high east to respond to drought and shrinkage, or drought and densification?

Figure 2: Image of the South  
West Delta in the Netherlands,  
within 10m below the sea level.



# DELTA MANIFESTO

It is about time in Delta Design to create a new Dutch condition. To arrive at resilient Delta in 2122 we need to manifest a new approach how to live in harmony with the dynamics of the delta. Beginning with the projection on the Water State Map 1873 the main properties of proposition for the 5 delta moments are drawn, acknowledging the time-lapse back in the era where more resilience with the dynamic delta system was tradition

## #WE ARE HERE TO STAY, AND WE TAKE RESPONSIBILITY, WE CAN CHANGE

*There is a state of paralysis, doubts on who, what, how and when responsibility and steps towards a safe and secure future should be taken.*

## #WE NEED TO KNOW MORE

*There is a lot of sectoral knowledge and experience on the delta system, but it lacks integration and evaluation.*

## #WENEEDDARETOMAKEPAINFULDECISIONS

*To design with uncertainties and without 20 years of research, and without trusting 'protection' only.*

## #WE UTILIZE THE DELTA-PARADOX: REGULATION WITHIN THE DYNAMICS

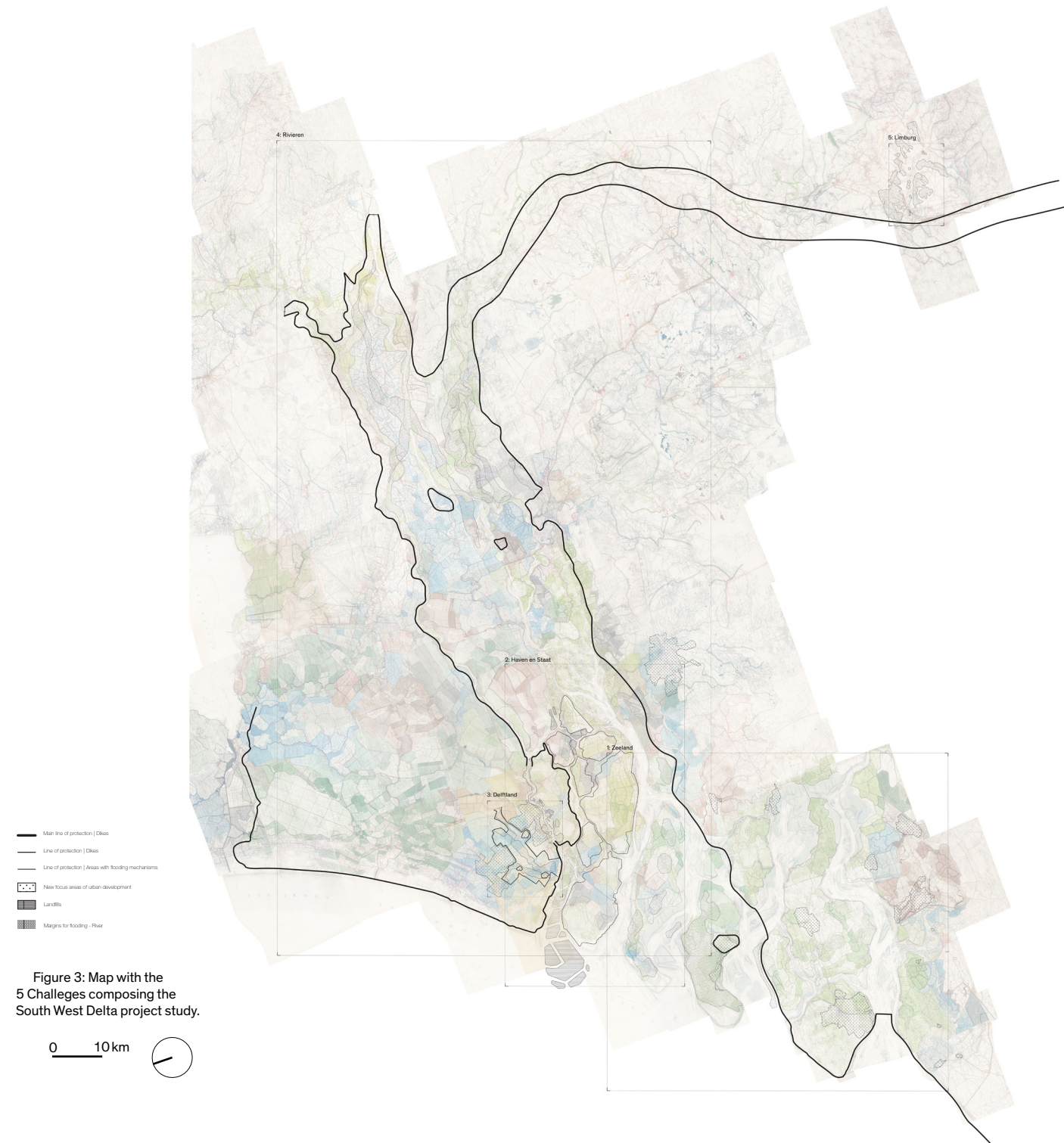
*We are now regulating the delta system top down and controlling its dynamics. With a set of 'measures that fits all'- approach whilst there are many morphological, social and economical differences in the Delta.*

## #WE DESIGN THE DELTA BOTTOM UP

*The design of the Delta is done by the natural system. This is the first boundary condition for an approach wherein the natural - ecological, soil and water - system comes first. Soil and water systems are setting the stage for the occupation.*

## #THE DESIGN OF THE DELTA STARTS WITH THE SECTION

*There is still a silo approach to the management of the territory. The interdisciplinary design of the delta should be done through scales and disciplines from the section to the international situation.*



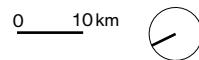
# INTRODUCTION TO THE CHALLENGE

## PROJECT PRESENTATION

Climate change, global warming and associated sea level rise are as urgent as they are elusive. Climate skepticism and climate fatigue are therefore both lurking. In this study, a hypothetical sea level rise of 3 meters was used, without knowing the (im)probability of this. In any case, it is a change with enormous impact and therefore relevant to be able to recognize a gradual change as a fundamental reversal.

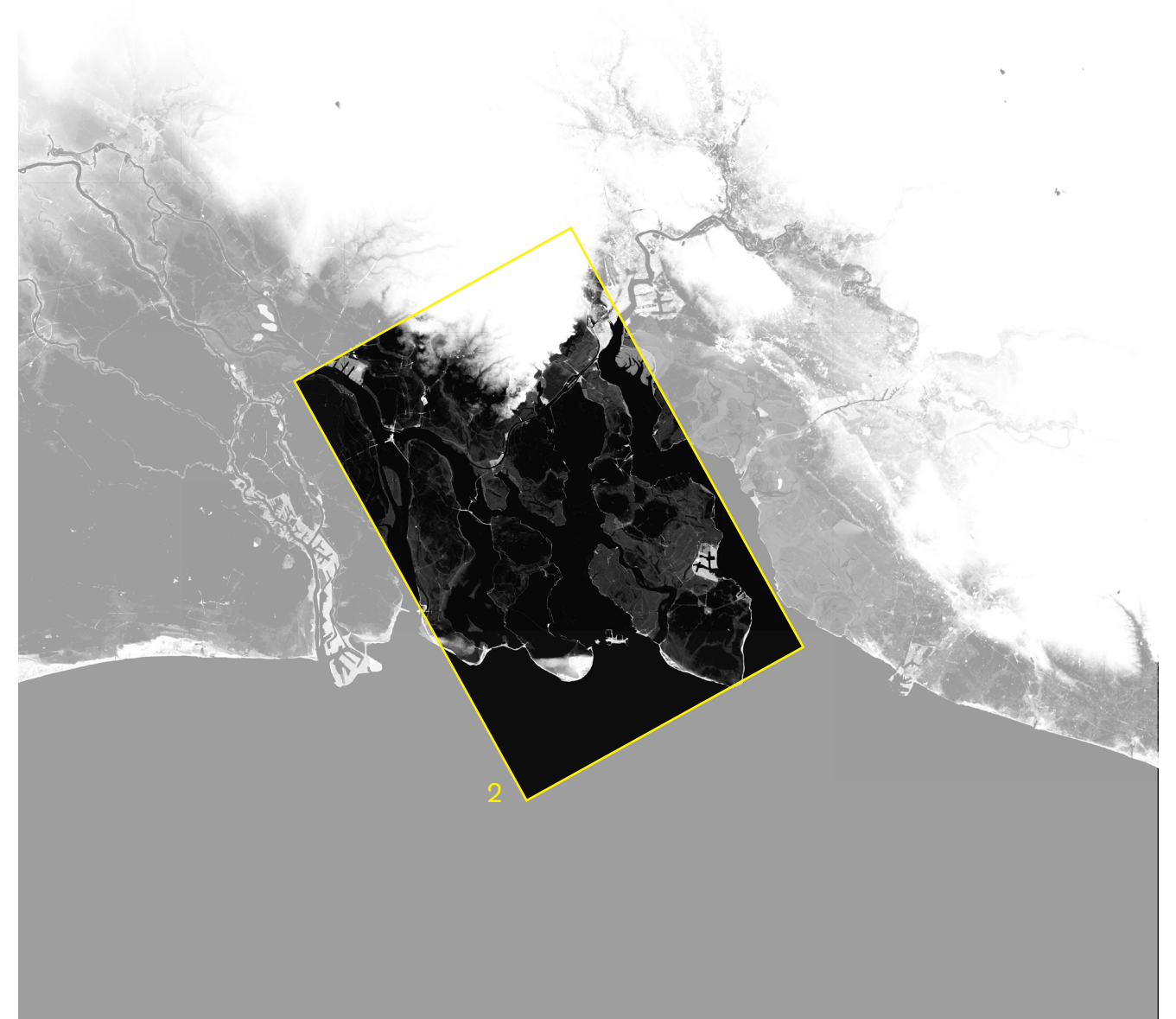
In exploring and understanding the impact, team Zeelandia has calculated how much the South Pole needs to melt in order for the world's oceans to rise by 3 meters. The answer is shocking. With an average ice pack of 2200m, a fully melted South Pole would cause a global average sea level rise of 58m. If 5% percent of land ice were to melt, the North Sea would rise to the 3m+NAP that has been included in this design study.

Figure 4: Image of the South West Delta in the Netherlands, within 10m below the sea level, and the project location.



# ZEELANDIA

A provocative, though appealing, spatial concept for the Netherlands





## ZEELANDIA

Zeelandia is a green metropolis, flanked by Rotterdam and Antwerp as it tops the new urban banana located on Netherlands' higher grounds. Depending on the chosen scenario for water protection the land use and the scale of interventions in the landscape will vary.

Zeelandia is using the sea level rise to investigate the spatial potentials of the Southwestern delta of The Netherlands. The mouth of our river area is considered a spatial laboratory. The character and the pronunciation of the landscape is presented through its waterworks, food production, energy production, nature and habitation that reinforce each other in reciprocal relationships.

Zeelandia experiments with a flexible collision between urbanity, nature, agriculture and energy production. Building a new and proud monumental landscape that unites sea and land.

Figure 5: Zeeland seen from the sky

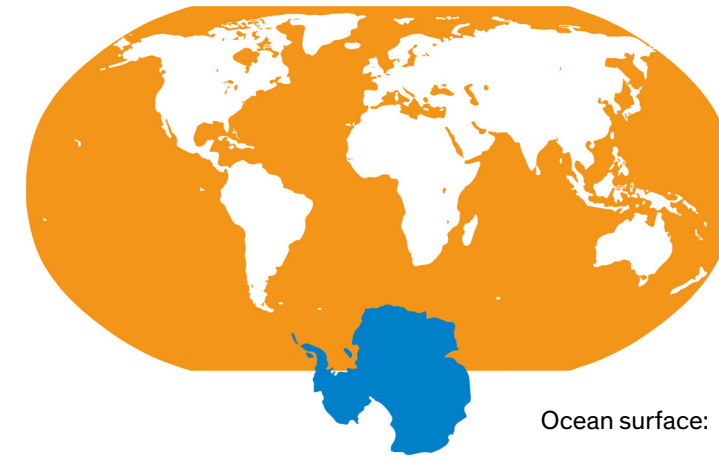
Figure 6: Future map of the Netherlands





# PREAMBULE

Climate change, global warming and associated sea level rise are as topical as they are elusive. Scepticism and sluggishness are therefore both lurking. In this study, a hypothetical sea level rise of 3 meters was used, without knowing the (in)probability of this. In any case, it is a change with enormous impact and therefore relevant to be able to recognize a gradual change as a fundamental reversal. As an exercise and eye opener, calculated is how much the South Pole needs to melt in order for the world's oceans to rise by 3 meters. The answer is shocking. With an average ice pack of 2200 meters thick, a fully melted continent would cause a global average sea level rise of 58m! If 'only' 5% percent of Antarctica's land ice were to melt, the North Sea would rise to the 3m +NAP (Nieuw Amsterdams Peil) that was used in this design study.



Ocean surface:	362.200.000 km <sup>2</sup>
Antarctica surface:	14.200.000 km <sup>2</sup>
Land ice:	21.000.000 km <sup>3</sup>

Figure 7: Netherlands in current situation and with sea level rise



Current Netherlands  
NAP+0m

Future Netherlands 2100  
NAP+3m

Future Netherlands  
NAP+58m

Figure 8: Antarctica compared to the sea



Figure 9: Sea level rise due to melting of Antarctica



Holland as the dominating cultural factor in the Dutch tradition made land a commodity. Something that can be traded. In contrast to this, the tradition in the Southwestern delta, where the land is made and reclaimed by human hands from the sea, land about pride.

# ANALYSIS

## NEW ROADS FOR THE WATER

The rivers of Northwest Europe all flow towards the North Sea. A territory of 285,000 km<sup>2</sup> (7× the Netherlands) drains through our country. In total, approximately 20,000m<sup>3</sup> of water is

discharged from the Rhine, Meuse and Scheldt at peak times. Of this total amount of water, about 10% goes via the IJssel and the IJsselmeer towards the North Sea. The remaining water passes through our main rivers. Today, the vast majority of this is discharged via the Haringvliet and Nieuwe Waterweg (Port of Rotterdam).

The sea level rise turns this situation completely upside down. The biggest challenge will then be to let the rivers discharge their water to the North Sea. The sea is coming further and further into the land. Today the water that enters the Netherlands at Lobith is approximately at 12m +NAP, From here it has 150km to reach the North Sea. With a sea level rise of 3 meters, the runoff will be blocked 40km inland. At high tide and in the event of a major storm, the water level can rise to 8m +NAP. That is over half of the country, at the height of the city Tiel!

An extra complexity is that, in order for the port of Rotterdam to be future proof, a barrier and a lock will have to be constructed in the Nieuwe Waterweg. Therefore, the rivers' discharge must run around the port and the city.

Figure 10: The Netherlands as drainage basin of North-West Europe

Figure 11: Oyster farm. By Jeroen Hofman, 2010



1 Amount of days that it takes for the water of the rivers Rhine, Meuse and Scheldt to reach the Netherlands

In this study, three scenarios were identified to protect the Netherlands from the high seas, to allow the rivers to discharge and the Port of Rotterdam to operate; Full defence, Seawards and Superdelta.

Systematically, choices have been made in the past that have resulted in a landscape that shows itself more powerful and resilient every decade. The interplay of dikes, dams, windmills, vast fields and the ever-present threat of the raging sea form an impressive interplay.

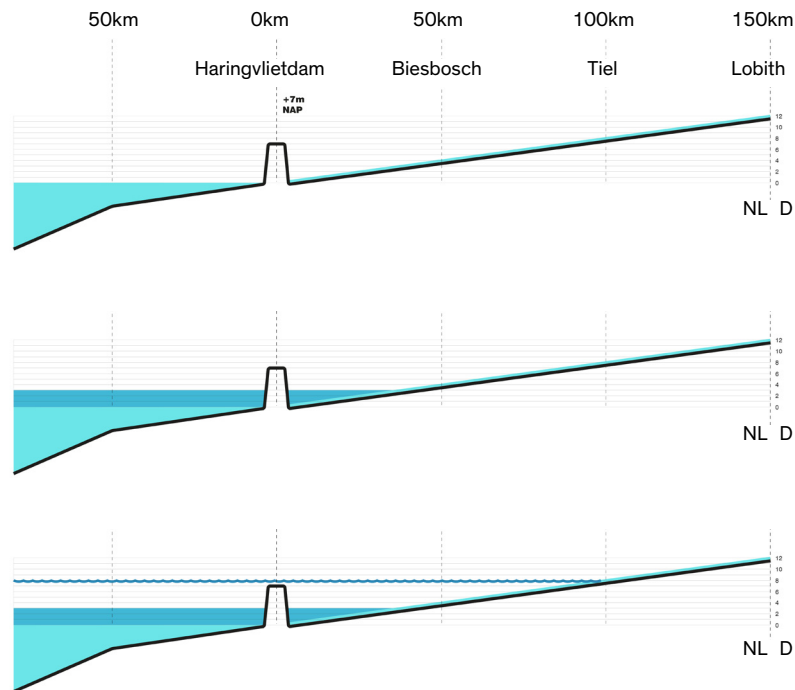


Figure 12: Current section of the Netherlands

Figure 13: 3m sea level rise

Figure 14: Sea level rise plus storm

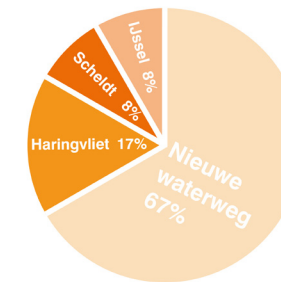
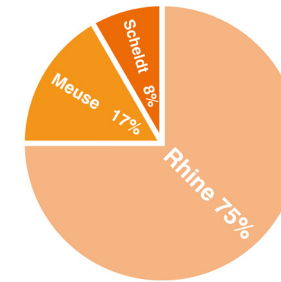
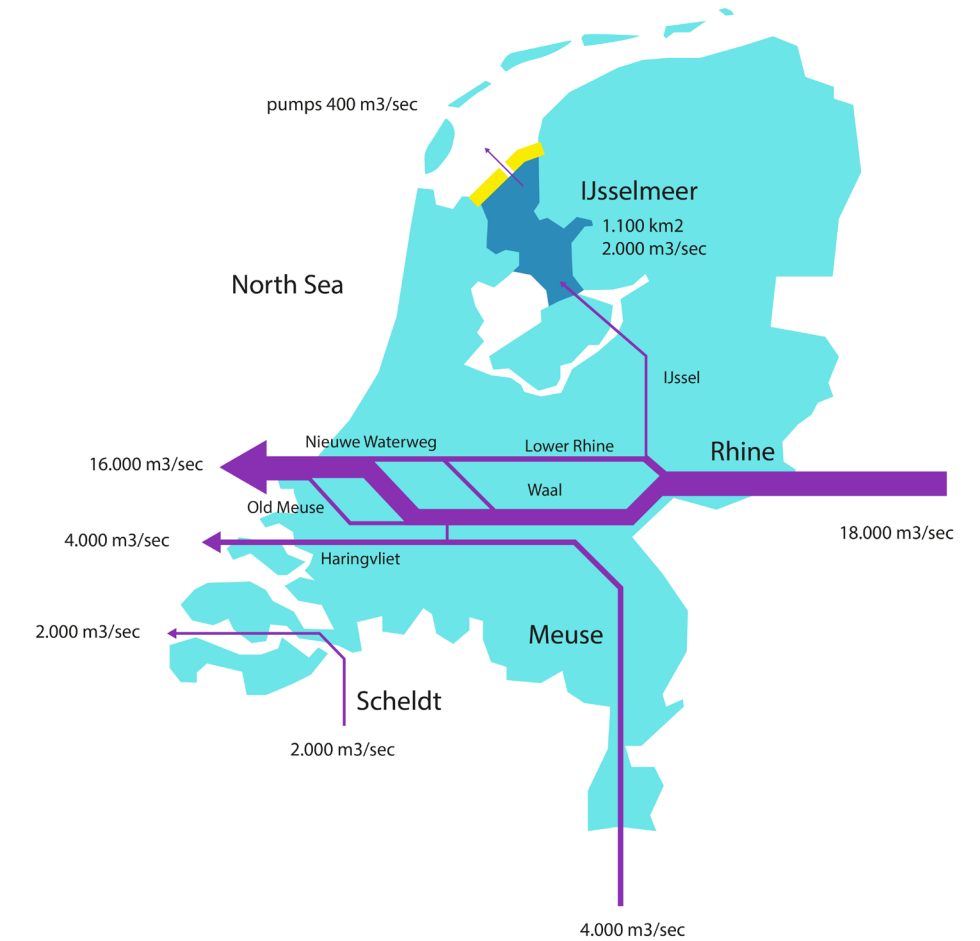


Figure 15: river inflow

Figure 16: river outflow

Figure 17: current river flow scheme



## RENEWED OPPORTUNITIES FOR SPATIAL DEVELOPMENT

The Netherlands is changing. Fixed values are under pressure, and we get uncertainties in return. The Netherlands is a vessel full of contradictions. Our country is becoming full, more mobile, wetter and drier, more and more people have an opinion about this. All changes will have to be resolved within the same limited space. This requires smart ideas, innovative solutions and clear choices. And that's not for the first time. Our country has a long tradition of dealing with change. Our territory is unstable and faces many challenges and our adaptability is phenomenal. Just like our urge to control the situation. In the rich Dutch planning tradition, change and progress usually work together.

At the same time energy and climate issues, the empowered citizen and the political mainstream are not balanced by a common narrative. Where the feeling starts to prevail, that things get stuck for lack of direction. Change seems to be equal to paralysis due to lack of values, to the lack of a goal.

Zeelandia wants to make the planning more accurate, holistic and idealistic. An exercise in the reversal of our planning tradition. It results in a new manmade territory based on coalitions and resilience. Both the scale of the Southwestern delta and its nature makes it a fertile ground to overcome contradictions and close new deals. An imaginary grid has been laid over these layers that gives direction to the discoloration of the land use.

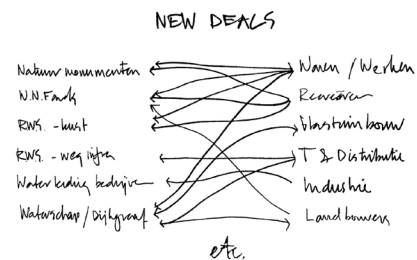


Figure 18: Collaboration instead of division

Figure 19: Broadacre city



We foresee the rescaling of agriculture, an increase of energy production, residential development and recreational possibilities. The promise of a spatial symbiosis all in combination with the incremental presence of water and natural (re)development of the delta.

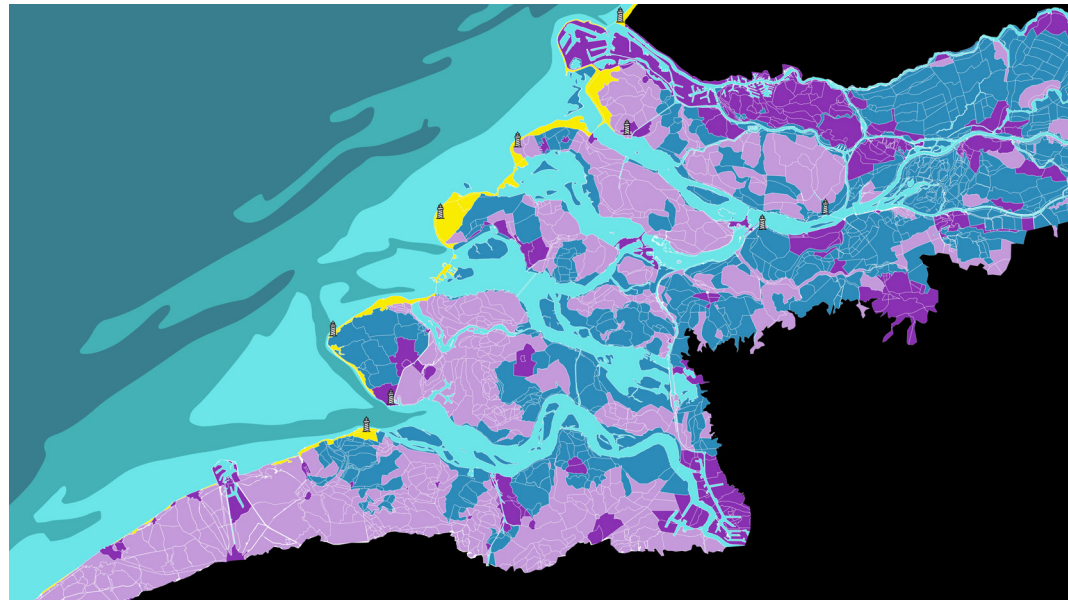


Figure 20: components of the regional framework planning

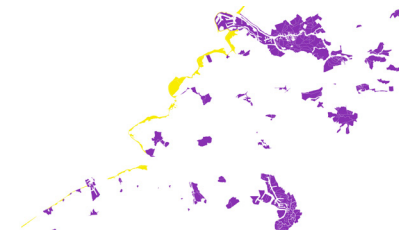


Figure 21: fixed elements



Figure 22: areas above NAP



Figure 23: areas below NAP

The tipping point in the planning is approached optimistically because there is a broad understanding of larger themes with a spatial impact, with sea level rise leading the way. No moralism or scepticism is needed to study the effects of change. We think that in our pragmatic nature lies not to ask why, but to decide how. It's about vision and ideals. In return we get back our certainties. Our fundamental, unbiased sense that the future of our territory and its potential are in our hands. The Southwestern delta for this research delimited by Dike-ring 14 (the protective water barrier surrounding the Randstad) in the north and the 3-meter contour line in the south. Within this width the delta was explored on the basis terrain height with a distinction was made between higher soils (above 3m +NAP) and soils below current sea level. The latter is very suitable for becoming part of the natural environment or water. In between is an occupation layer. Soil between 0m and 3m +NAP that, depending on spatial choices to be made, connect to the fixed layer or are added to the natural environment.

In the approach of Zeelandia the combination of watermanagement and the local pride supports the synergy between self-confidence and a progressive attitude. The water guides the land use and spatial development in response to the societal challenges.

# FINAL PROJECTION

## SCENARIO'S

For the test phase of the spatial design research, three water scenarios were investigated, based on a sea level rise of 3 meters:

- Full defence, the raising of all existing sea barriers to 10m +NAP
- Seawards, creating a large offshore Battery Lake
- Superdelta in which the sea can penetrate the land up to the German border.

The three distinct water scenarios lead to different forms of spatial development, and each expresses the future of the Netherlands and specifically the Southwestern delta in its own way.



## FULL DEFENCE



Figure 24: dikes in planview

The current delta height of dikes and other barriers is the Delta-height of 7m+NAP. With a sea level rise of 3 meters, the sea barriers should be raised to 10m + NAP. This part of the operation is relatively clear. In the Southwest delta, the dikes, dams and barriers will have to be raised over a length of about 100 km. The existing open connections with the sea, the Westerschelde and the Nieuwe Waterweg should be closed to protect the land behind. The port of Rotterdam can continue to function through a lock in the Nieuwe Waterweg. Due to the closure of all estuaries, approximately 15,000 to 20,000 m<sup>3</sup>/s of river water will have to be 'put over' the dikes at peak times. This requires the energy equivalent to the consumption of one million households. A power that can only be supplied with a nuclear power plant. The average energy consumption is equal to that of 70,000 households. The defensive act allows the status quo in the Southwest Delta to be maintained. The separation between land and sea remains intact, with the chances of interaction between the two decreasing due to sea level rise. The land use in this scenario more or less follows the current use.

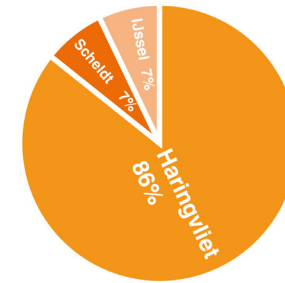


Figure 25: river outflow

Figure 26: river flow scheme

Figure 27: in section

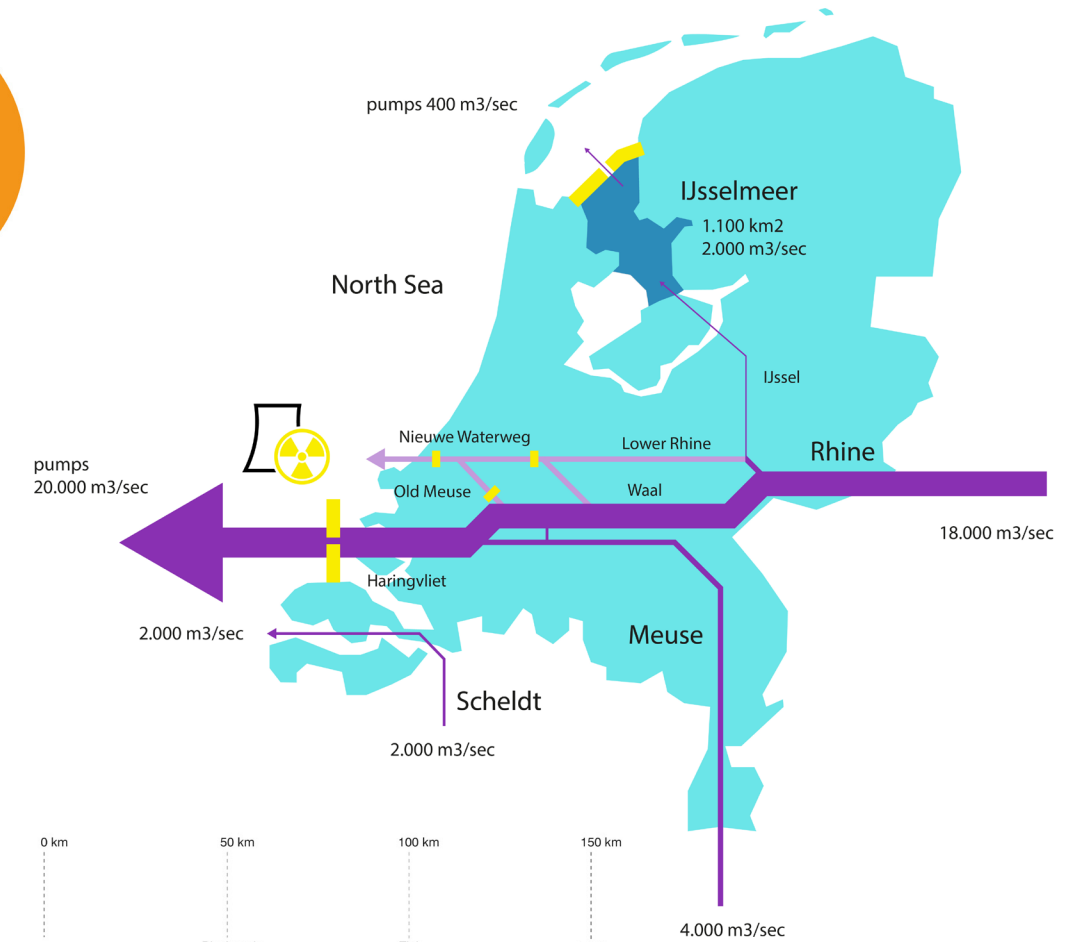
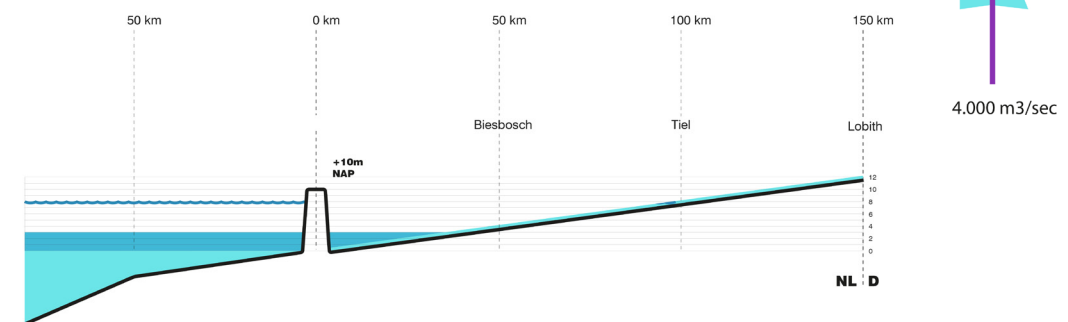
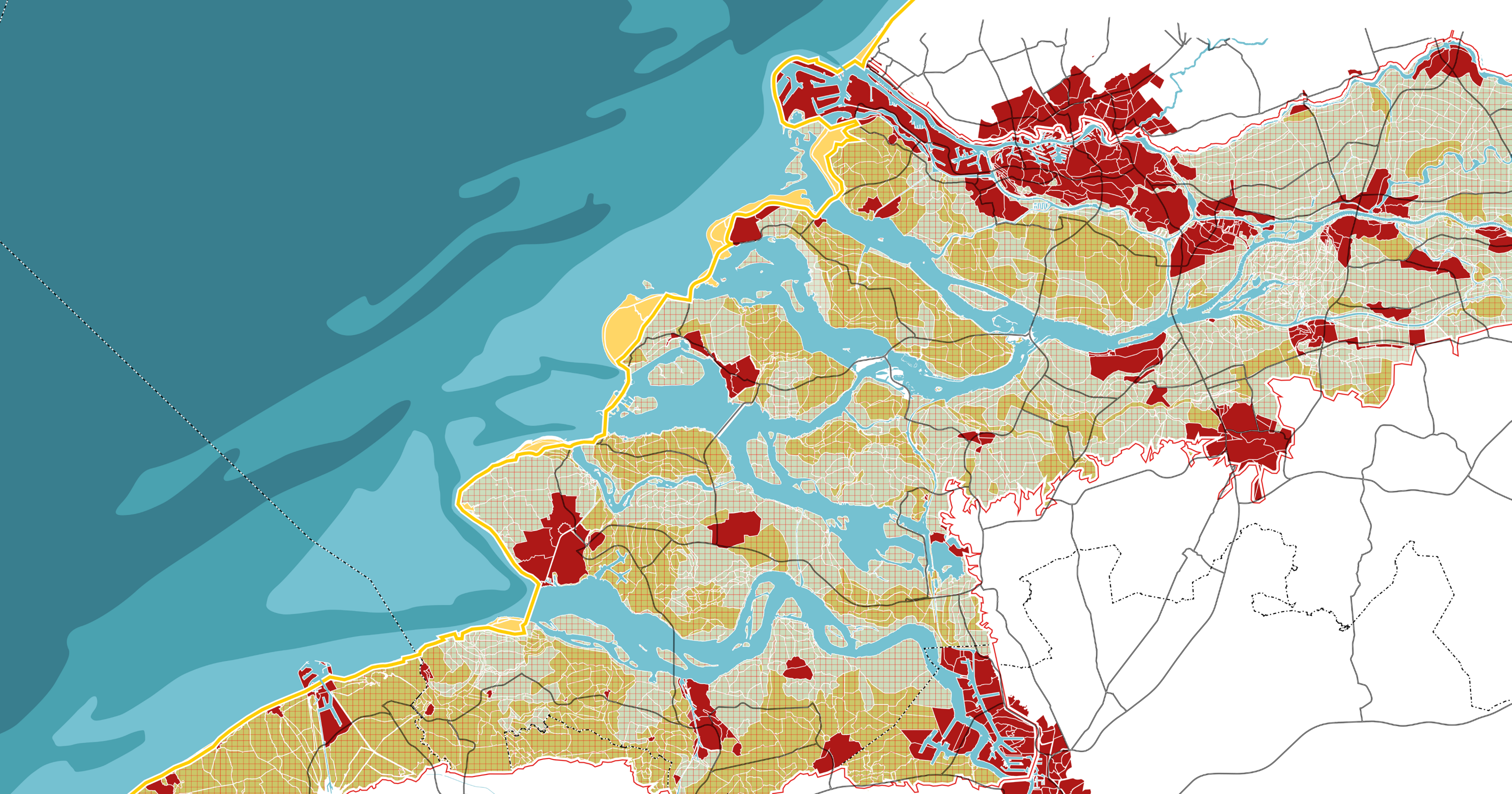


Figure 25: river outflow

Figure 26: river flow scheme

Figure 27: in section





## SEAWARDS



Figure 28: dikes in planview

With the construction of an offshore Battery Lake creates a two-for-one situation; the entire energy transition and storage is combined with climate adaptation. A large, 10m high ring dike encloses an offshore lake of about 200 km<sup>2</sup>. The Lake is located within the Dutch waters and outside the main shipping routes to the port of Rotterdam. Given that the North Sea is about 35m deep, the construction requires innovative construction method (caissons sinking, etc.). On the one hand, this 100km long dike protects the southwestern delta behind it. On the other hand, it provides water storage at high tide. At low tide, the lake flows empty into the North Sea. In addition to pumping stations for extreme situations, turbines are also being constructed in the dike for tides and energy and/or sweet-salt osmosis. After all, the Battery Lake will also serve as a super battery that can be pumped full in case of surplus energy and can flow empty for energy generation.

The ecological connection between the sea and the rivers will be created in a technical way, in gradual brackish transition areas, so that fish migration becomes possible. Battery Lake marks the next step forward for the Netherlands in the process of reclaiming land at sea. The intimate and renewed entanglement of land and sea is the epitome of engineering and faith. This scenario is based on the manufacturability of the landscape, and builds on the proud attitude whereby large-scale and technical solutions form a robust and powerful landscape.

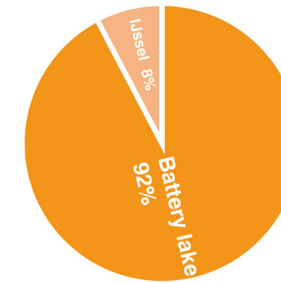


Figure 29: river outflow

Figure 30: in section

Figure 31: river flow scheme

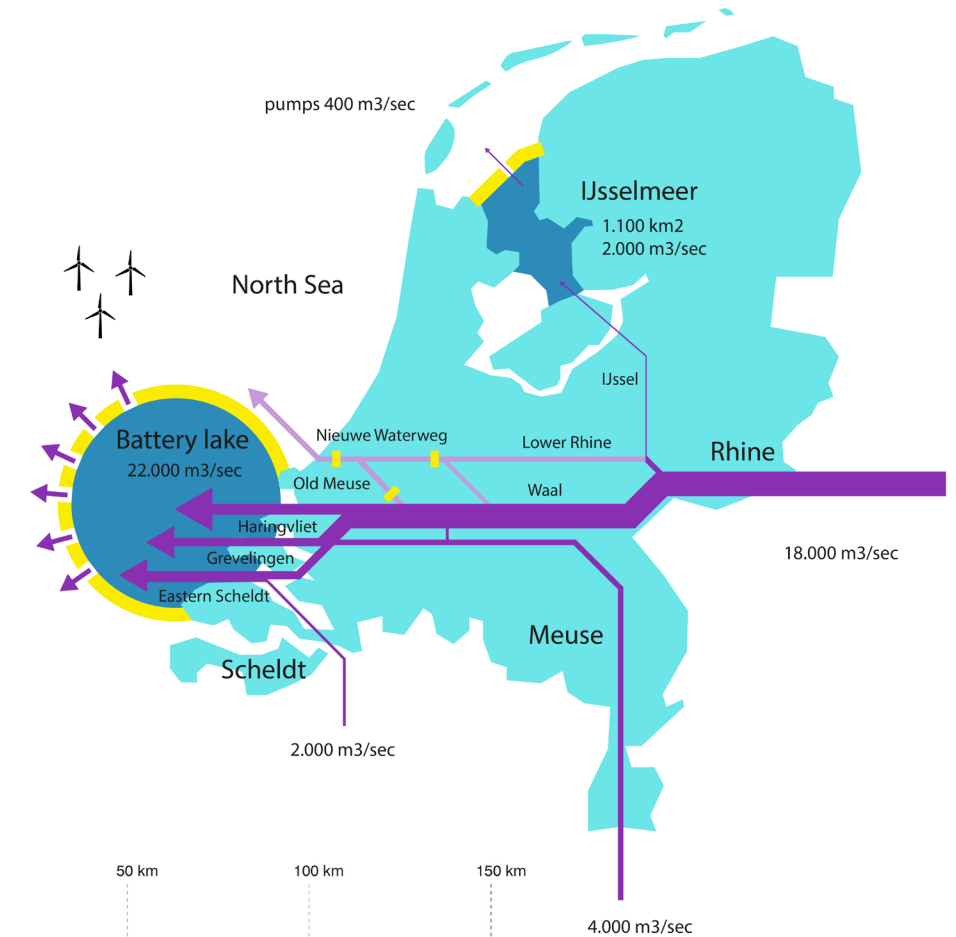
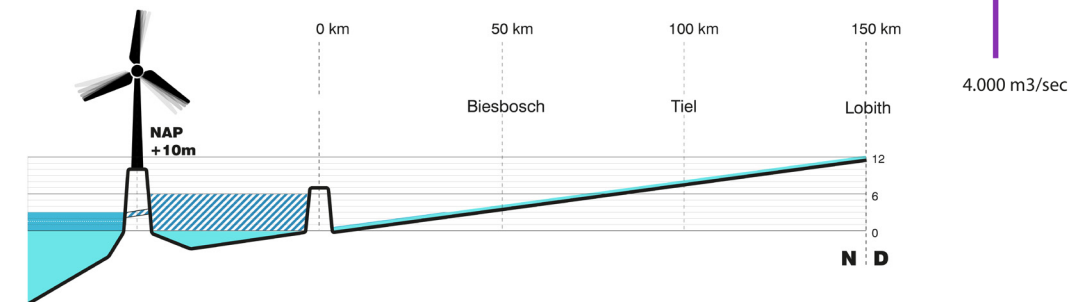
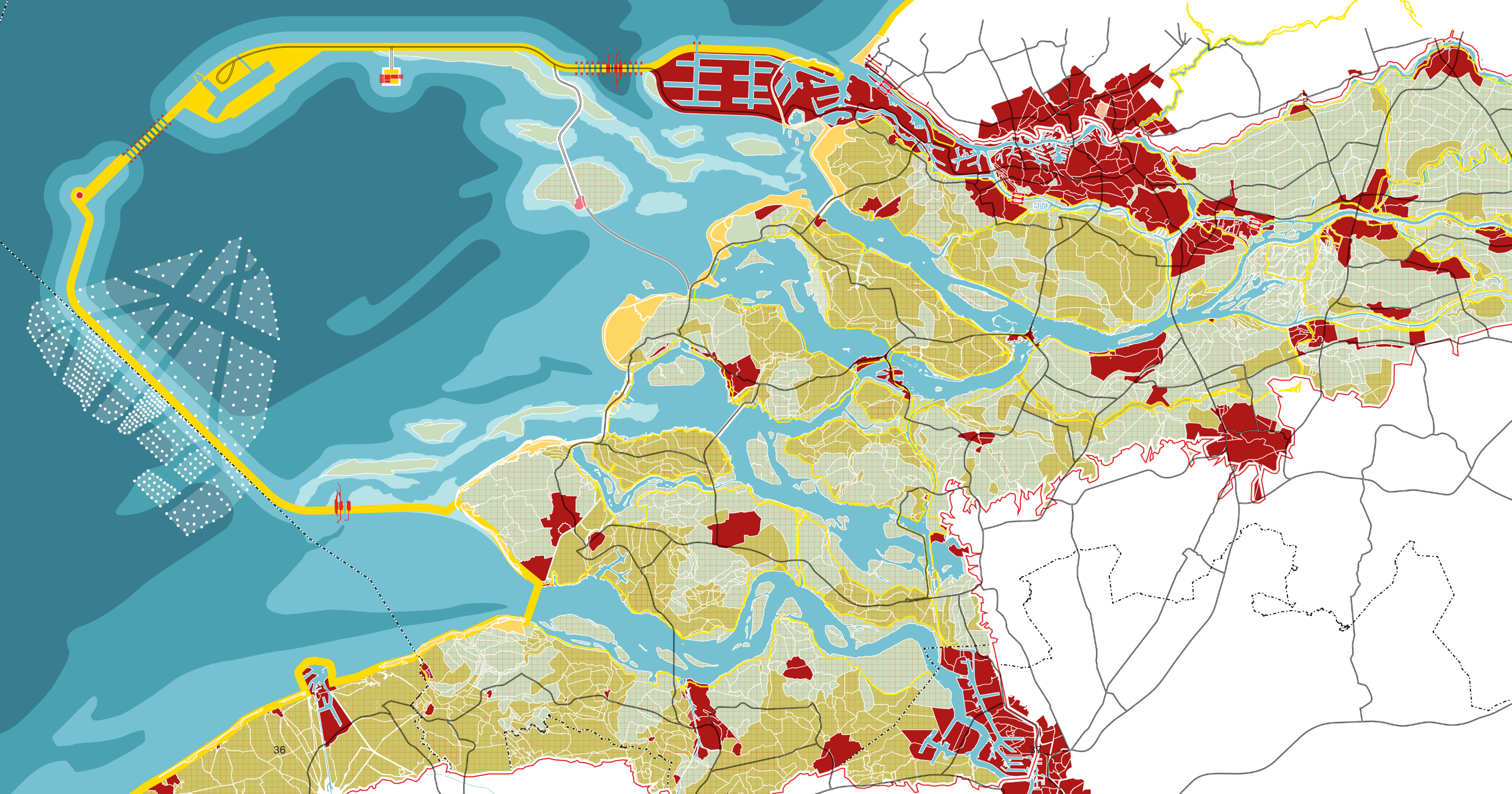


Figure 29: river outflow

Figure 30: in section

Figure 31: river flow scheme



## SUPERDELTA



Figure 32: dikes in planview

The Superdelta scenario is based on the partial opening of the connections to the sea. Along the major rivers, all dikes are raised so that sea and river water are given space. Depending on high and low tide, storms and peak discharges from the rivers, Super delta flows full and empty. In total, over a length of approximately 350km, the existing dikes must be raised from 7m+NAP to 10m+NAP. Between these dikes a natural and dynamic green-blue wadden landscape is created, wetlands of international importance for birds, fish and other animal species! In this wadden landscape there is also room for aquaculture and other innovative forms of food production. The habitation and use of this river area is limited to places where flooding can be absorbed or by means of safe havens; fortifications that are protected as islands in the water in case of calamities. The landscape of the Superdelta is a natural phenomenon within an increasingly urbanized Netherlands. The crossing from north to south revives the awareness of the power of nature and the way in which our country knows how to deal with it. The land use in this scenario embraces the new relationship with the new nature. Moving along instead of against moving. A diverse landscape, in which nature, small-scale agriculture, recreation and adaptive living go hand in hand. The Delta as the new national park of the low countries.

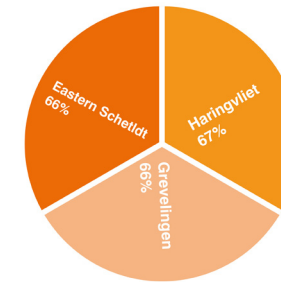
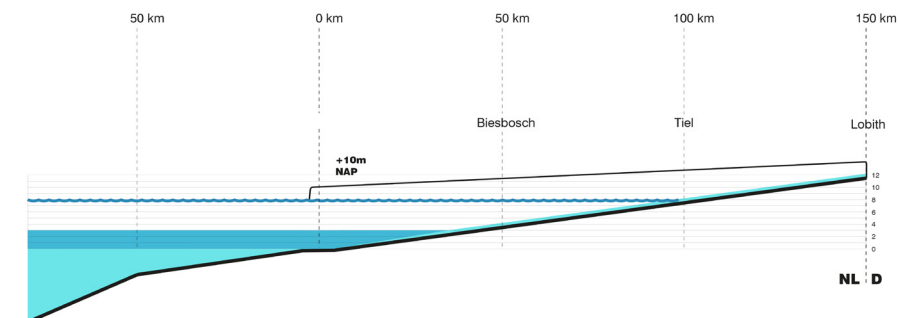
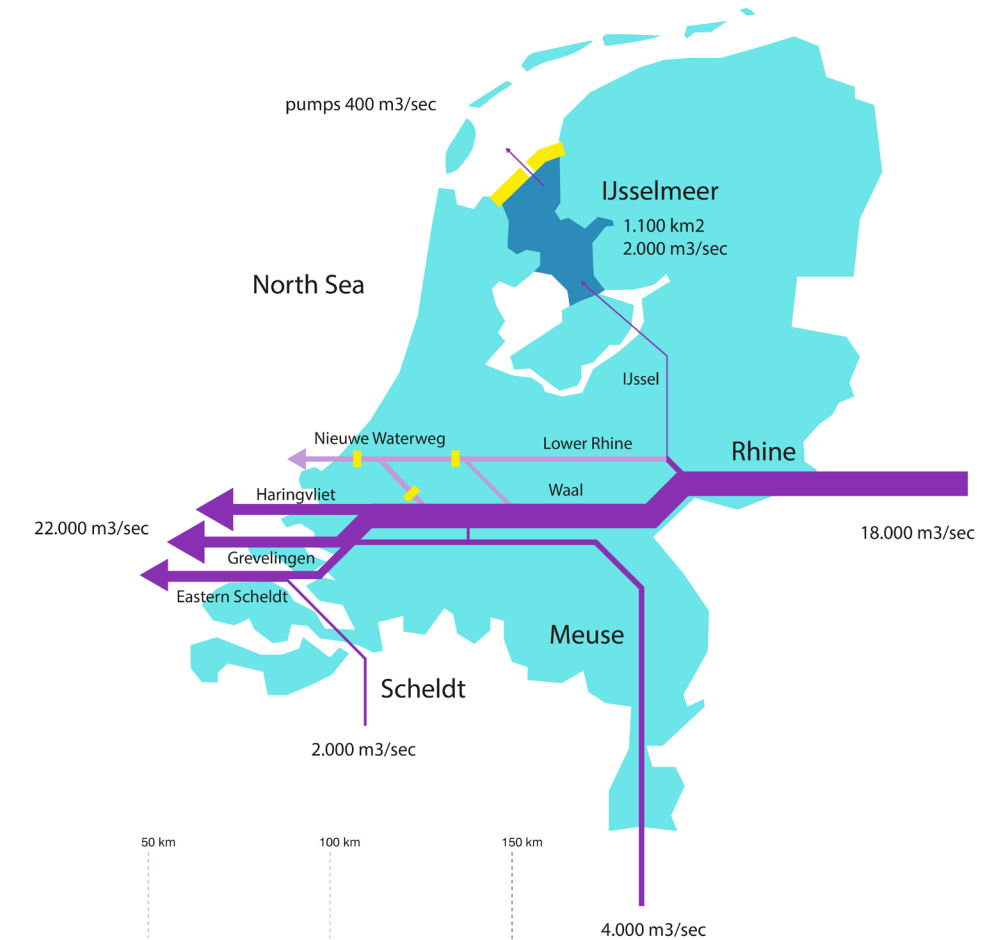
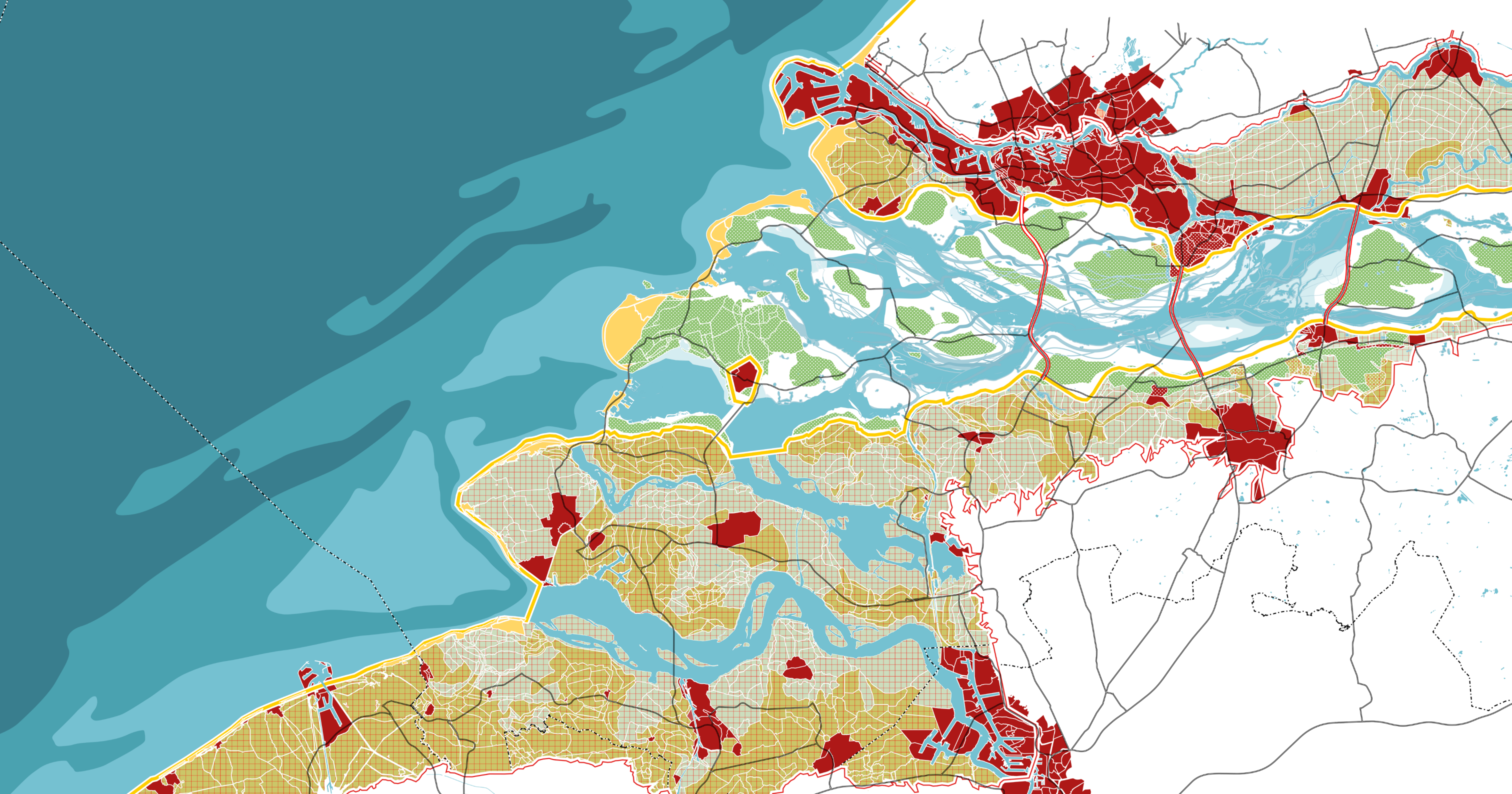


Figure 33: river outflow

Figure 34: in section

Figure 35: river flow scheme





## CONCLUSION

In contrast to common practice in the Netherlands where soil is a commodity, in the Southwestern delta, where the land is made and reclaimed by human hands from the sea, there is room for pride and progress.

From the fundamental and critical choices to make from the scenarios of water management the layout takes different directions. From there, considering a complex of challenges

and social forces, possible futures for the Southwestern delta can be mapped out.

Various ways in which forms of land and water use coexist and reinforce each other. We think it is a way in which both the necessities and the possibilities of a new future-proof planning tradition become apparent. A promising spatial laboratory in which the possibilities of the outlines of the Netherlands are made visible and imaginable.

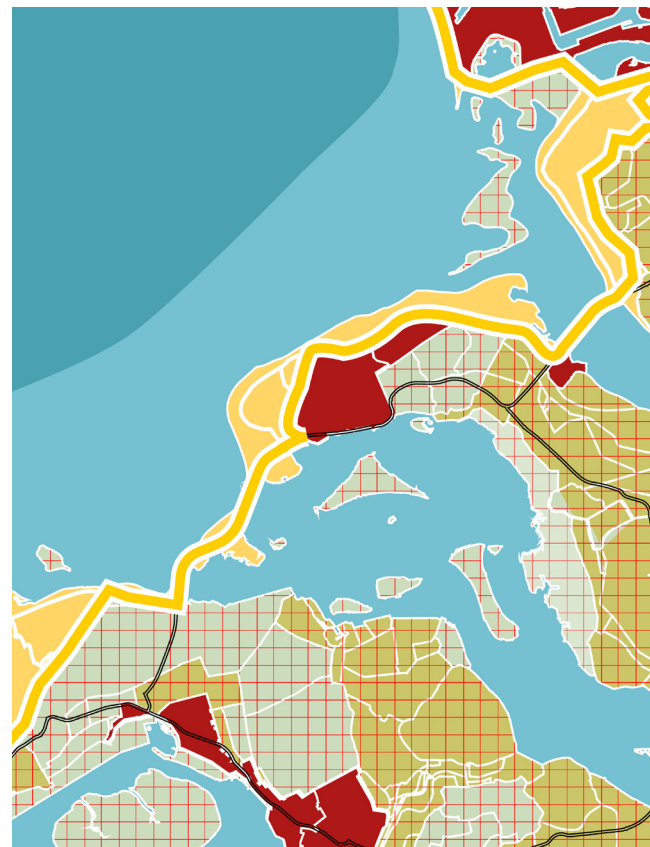
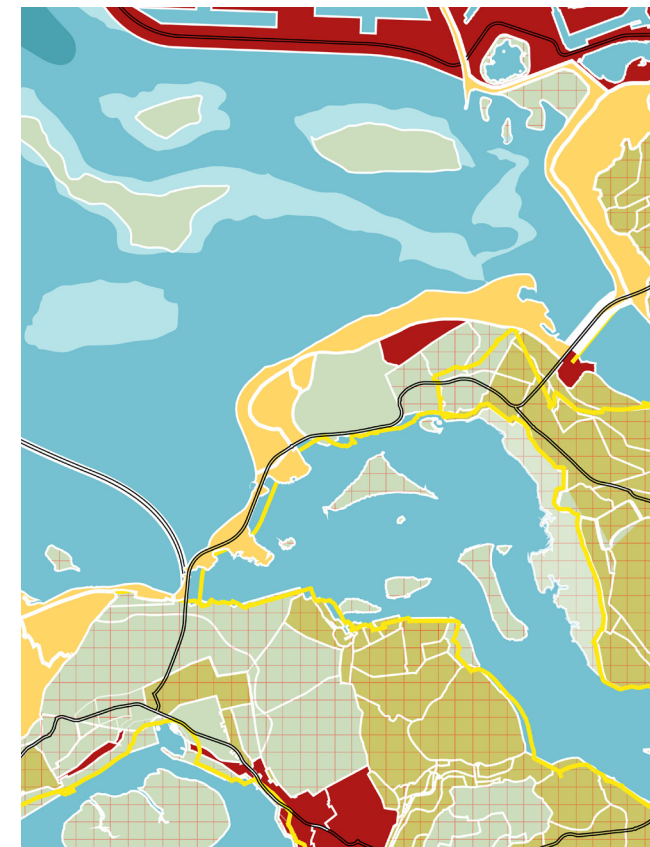


Figure 36: full defence  
Figure 37: seawards  
Figure 38: superdelta



## COLOPHON

Redesigning Deltas, the Netherlands, 2022-ongoing

Redesigning Deltas Program Partners: TU Delft, Deltares, Convergence Alliance-Resilient Delta, The Delta Commissioner, PBL Netherlands Environmental Assessment Agency, Wageningen University & Research, EUR, IHE Delft

Redesigning Deltas Program Coordination: TU Delft, Faculty of Architecture and the Built Environment, Delta Urbanism Interdisciplinary Research Group. Chris Zevenbergen, Fransje Hooimeijer, Taneha Kuzniecowa Bacchin. TU Delft, Policy & Strategy Department, Nikki Brand, Geneviève Girard. Deltares, Ellen Tromp,

Redesigning Deltas – Design Study Line Project Leaders: Fransje Hooimeijer, Taneha Kuzniecowa Bacchin

Redesigning Deltas – Design Study Line Advisory Board: Chris Zevenbergen, Erik Luiten, Like Bijlsma, Hans de Boer, Remon Pot, Ellen Tromp, Nikki Brand

Redesigning Deltas – Design Study Line Design Exhibition Production: Fransje Hooimeijer, Taneha Kuzniecowa Bacchin, Julia Ferreira de Sousa Daher, Francesca Rizzetto, Luca Iuorio



<https://www.redesigningdeltas.org>



Give your response to the design study

Redesigning Deltas – Design Study Teams:

### Team Limburg

Defacto: Defacto: Anne Loes Nillesen, Mona zum Felde, Yizhuo Zhang, Ke Zhou  
Vista: Adriaan Bicker, Saline Verhoeven, Rik de Visser  
Arcadis: Marco Veendorp, Richard Marijnissen

### Team River Corridor

FABRICations: Eric Frijters, Mark Slierings, Madeleine Fagalde  
Bosch Slabbers: Stijn Koole, Ian Officer, Ian Officerin, Niels van Hasselt,  
Wendy van der Horst  
Tauw: Coen Riemsdag

### Team Rotterdam Port and City

De Urbanisten: Florian Boer, Malu Kawasaki, Dirk van Peijpe, Timo Stevens  
LOLA (LOst LANDscapes): Eric-Jan Pleijster, Martin Garcia Perez, Borui Xuiiong  
Royal Haskoning DHV: Nanco Dolman

### Team Rotterdam Delftland

ZUS [Zones Urbaines Sensibles]: Kristian Koreman, Elma van Boxel, Willemijn van Manen,  
Marina Dondras, Lea Hartmeyer  
Flux landscape architecture: Gerwin de Vries, Kris Kersten, Britt Piek  
Sweco: Jan Kollen, Nikéh Booister, Renée Swinkels

### Team Zeeland

Studio Hartzema: Henk Hartzema, Niels Verdonk, Crispijn van Sas, Pieter Scholten,  
Aikaterina Myserli  
Feddes-Olthof: Yoran van Boheemen, Daniel Barrero  
Witteveen & Bos: Herman Mondeel

R R

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Erasmus MC  
University Medical Center Rotterdam

NATIONAAL DELTAPROGRAMMA



Witteveen + Bos

STUDIO.  
HART  
ZEMA.

FEDDES/OLTHOF

