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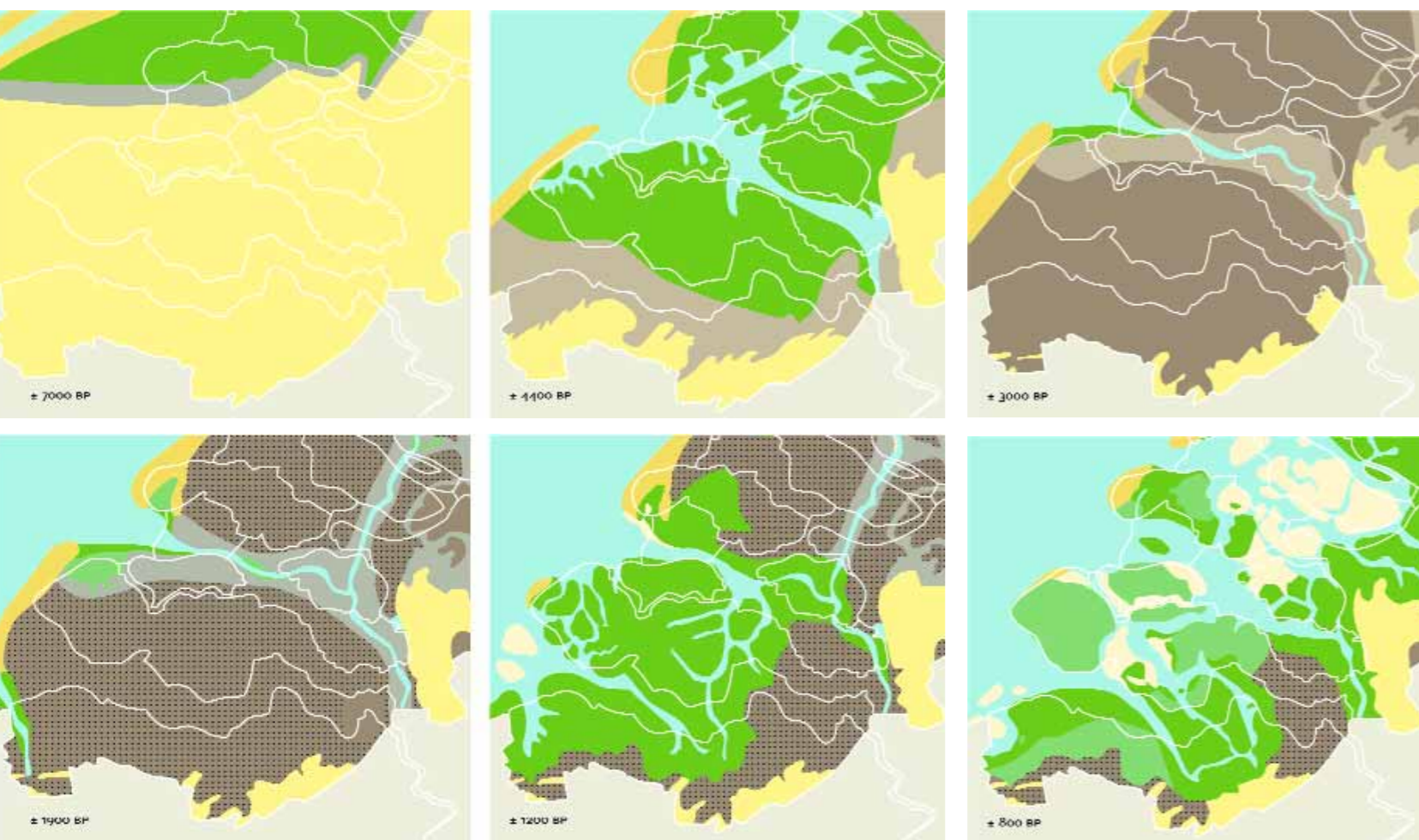
Water

Resource and Threat

USA LOS ANGELES RIVER REVITALIZATION; SPONGE PARK IN BROOKLYN; STRATEGIES FOR NEW ORLEANS • **INDIA** SABARMATI RIVERFRONT IN AHMEDABAD • **MOROCCO** FEZ RIVER REHABILITATION • **CHINA** NEW WATER CULTURE FOR TIANJIN • **UK** SUSTAINABLE DEVELOPMENT AND FLOOD-RISK • **NETHERLANDS** ROOM FOR THE RIVER; RIJN-MAAS-SCHELDE DELTA PLAN • **BELGIUM** DE-POLDERING IN BEVEREN NORTH • **GERMANY** COASTAL ADAPTATIONS; DESIGNING TIDAL LANDSCAPES IN THE HAMBURG REGION



Designing a Safe and Sustainable RIJN-MAAS-SCHELDE DELTA



A new master plan for a complex estuarine system in the southwest of the Netherlands seeks to reverse damage done by decades of human dominance.

For thousands of years, people had little choice but to adapt themselves to the forces of nature. If the delta region where they lived flooded, they simply moved elsewhere. Over the last millennium or so, however, people have progressively learned how to adapt such regions to their own needs, without realizing that, in so doing, they were interfering in the long-term processes involved in the very formation of such areas. The disturbance of natural processes by these civil engineering works has caused ecological and water quality problems that must be solved. On top of that, climate change is forcing such regions to prepare for even higher sea levels, erratic river water levels, and saltwater intrusion. The Rijn-Maas-Schelde Delta region in the southwest of the Netherlands is a perfect example – one that is also benefiting from recent integrated planning efforts.

Genesis of the Rijn-Maas-Schelde Delta

During the Roman era, the coastline of the delta was still essentially closed, only interrupted by the mouth of the Schelde River. The river – on which the port city of Antwerp later developed – flowed to the sea through a region of thick peat. In the run-up to the Middle Ages, the sea level rose more sharply than it ever had before. In the same period, the mouth of the Rijn shifted southwards. Storm tides (combinations of river floods and storms from the North Sea to the west) washed away the peat area and an archipelago was formed.

Beginning in the Middle Ages, the first attempts (initially undertaken by monasteries) were made to protect the land side of the islands with dikes. Polders (low-lying former seabed) and dikes created a risky situation, because

reclaimed land does not silt up anymore but instead subsides due to drainage activities. During storm tides, the sea would wreak great havoc in the archipelago. The St. Elizabeth storm tide and a series of other storm tides in the 17th century (occurring sometimes thrice in a generation) are still notorious. Yet it is no wonder that people continued to return and persevered so resolutely: after all, it is home to extremely fertile agricultural land washed in by distributaries extremely rich in fish and shellfish.

At the end of January 1953 the delta was startled by an extreme storm surge. A heavy north-west storm forced sea water into the funnel-shaped distributaries of the delta. The dikes burst at hundreds of separate locations. There were 1,836 victims, 200,000 hectares of land were flooded and an enormous amount of damage was done.

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The “impoldering” of the water

Shortly after the catastrophe of 1953, work began on the Delta Project, whose ideas had been long in the drawer. The plan was implemented in stages until the 1990s and this marvel of engineering still draws a great many admiring visitors and delegations from all over the world. Essentially, the Delta Project consisted of raising

and strengthening the dikes and dunes and shortening the coastline by over 700 kilometers, thereby reducing the risk of collapses through a series of dams. Furthermore, as a result of a series of compartmentalisation works, a number of freshwater lakes were created on the land-side of the delta. The construction of the Maeslant Flood Barrier in the Nieuwe Waterweg (New Waterway) in 1997 marked the completion.

Before the construction of the Delta Project, the Southwestern Netherlands was an estuarine region. An estuary is an area of transition between the river and the sea where river water mixes with sea water. This results in a gradual transition from fresh water to salt water and a landscape still subject to tidal influence. As a result of the Delta Project, the original estuary was transformed into a series of water basins physically separated from each other. Fresh water from the river and salt water from the sea were also kept strictly separated, and the influence of the river was no longer felt in most of the delta. The only estuary that retained its original character was the Westerschelde.

The Delta Project, particularly in its original form, was a prime example of the belief that man can control nature with the help of technology. It fits perfectly into the postwar reconstruction period and that period’s authoritarian perspective. But social beliefs and attitudes changed in the 1960s, and these changes also impacted the Delta Project. In the 1970s, an impassioned battle was fought between the established order on the one hand and the environmental movement – together with local fishermen – on the other because the shellfish nurseries in the estuaries were perishing.

The result was a typical Dutch compromise: a new type of storm surge barrier in the Oosterschelde, leaving that area not completely closed or completely open, but something in between. The storm surge barrier – the crown jewel of the Delta Project – is still a marvel of hydraulic engineering and human ingenuity to this day.

Drawbacks of the Delta Project

As time passed, it became increasingly evident that elimination of the dynamic processes characteristic of an estuary (involving river and tidal flows, salinity gradients, morphology, etc.) had ecological drawbacks. Each of the delta water basins suffers from problems that can be traced to the reduced flow of sediment- and nutrient-laden water through the basins.

In the original estuarine situation, these nutrients, as they flowed from the river to the sea, were gradually consumed by algae, zooplankton, bottom-dwelling invertebrates, and shellfish, which in turn served as food for populations of fish and birds. However, in a stagnant freshwater lake situation, excess nutrients lead to excessive blue-green algae blooms.

The specific negative effects of the Delta Project can be further tabulated.

- The freshwater Volkerak-Zoommeer and Binnenschelde basins suffer from annual blue-green algal blooms.
- The brackish lake referred to as the Veerse Meer has witnessed a massive infestation of sea lettuce and green algae, and has also suffered from oxygen depletion in the deeper layers.
- As a result of reduced dynamics and water flow, polluted river sediments have been deposited in the freshwater Haringvliet and Hollands Diep basins, resulting in heavily polluted bottom layers. Fortunately, the quality of the river water has greatly improved in recent years and the quality of the sediments

now being deposited is much better, but these accumulating sediments are becoming an increasingly serious problem for the discharge of river water.

- The saltwater Oosterschelde suffers from “sand hunger.” The tidal channels are too large for the smaller quantities of water now flowing through the storm surge barrier in the entrance. The morphology of the basin is therefore being reshaped by natural processes to reach a new dynamic equilibrium. In the process, valuable areas of mud flats, salt marshes and shoals are disappearing and eroding as bottom sediments are redistributed to fill in the deeper channels. In addition, the biological productivity of the

Oosterschelde has diminished over the last 10 years due to it no longer being fed by nutrient rich river water.

- In the past, the saltwater lake referred to as the Grevelingenmeer suffered from oxygen depletion in the deeper layers. The construction of an opening through the Brouwersdam in 1987 (the dam closing off the original channel to the sea) has partially restored the original situation, in which water is exchanged between the lake and the sea, and has therefore partly resolved this problem. Nevertheless, the Grevelingenmeer is still a fragile ecosystem in which the natural dynamics present are insufficient to maintain a healthy balance, leading to oxygen depletion in the deeper layers. The



Katse Heule connects the Oosterschelde to the Veerse Meer. By utilizing the natural forces of tidal flows, it has been possible to improve the water quality of the saltwater lake.

data show that water transparency in this system is also decreasing and that the bottom fauna is undergoing changes.

- In the Westerschelde estuary, intertidal areas have disappeared as a result of a great many activities involving impoldering and strengthening of dikes. Although this estuary has retained its character as an estuary, hundreds of hectares of intertidal areas have been sacrificed in the process. The successive rounds of

dredging over the years aimed at increasing the navigable depth of the shipping channels has also contributed to these developments.

Double challenge

When viewed against the background of the centuries-old battle waged by the Dutch against the sea, the negative effects summarized above might very well be classified as “collateral dam-

age.” In the “Vierde Nota Waterhuishouding” (Fourth Memorandum on Water Management, 1998), a policy goal for the delta is described that involves restoration and strengthening of the natural processes, emphasizing a greater degree of exchange and gradual transitions between the various separate water systems.

On top of the ecological problems, the Rijn-Maas-Schelde Delta will have to deal with the consequences of climate change. The expected

consequences are faster relative sea-level rise (ranging from 65 to 130 centimeters in 2100) and higher peak discharges of the rivers Rijn and Maas (respectively 17,000 to 22,000 cubic meters per second for the Rijn and 4,600 cubic meters per second for the Maas in 2100 with a chance of 1/1250) due to heavier rainfall in the catchment area of the rivers.

There is a particular risk in the whole northern part of the delta comprising the Rotterdam and Dordrecht region that water will simultaneously come from the east (a peak in the discharge from the rivers) and the west (high sea water levels due to storm). The storm surge barriers will be closed and the rivers will not then be able to get rid of their discharge into the sea. In order to avoid this risk, there are plans to use the upper distributaries (Volkerak-Zoommeer and Grevelingenmeer) for the peak discharge and the temporary storage of water from the rivers Rijn and Maas.

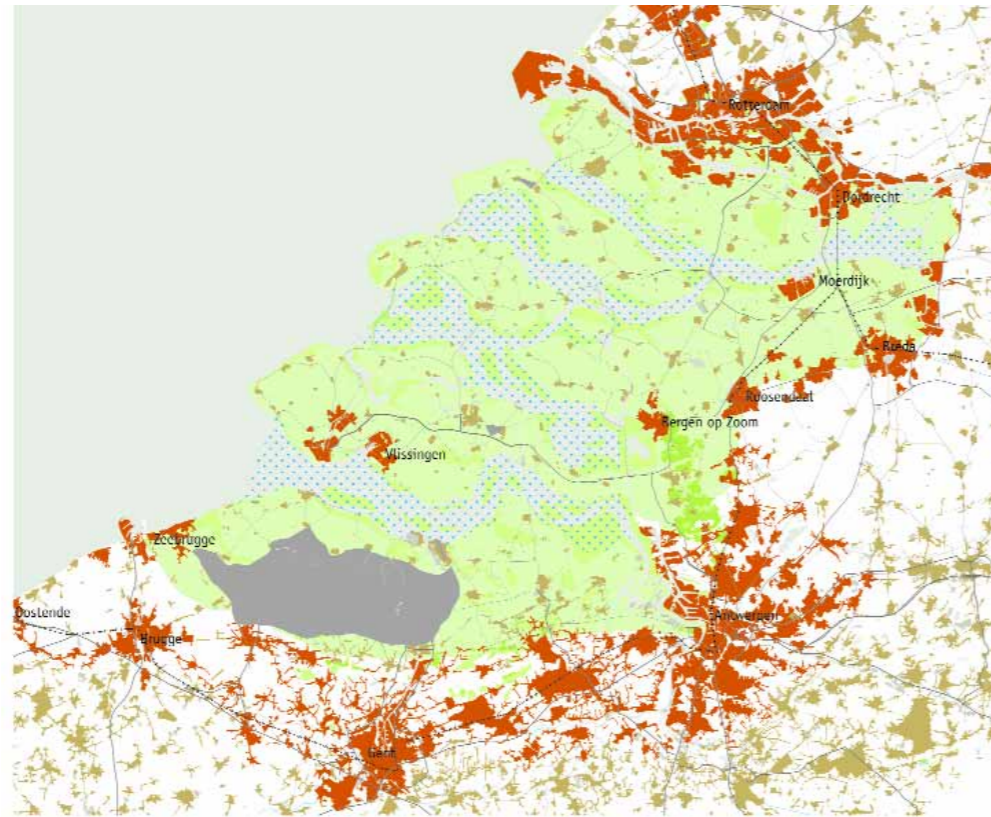
Towards a new Delta Plan

The time is ripe for a new Delta Plan, one that provides benefits in terms of safety, ecology, economy, and quality of life. The great challenge is to implement the safety measures that are necessary due to climate change in a way that eliminates water quality problems and improves opportunities for agriculture, fishing and tourism. The vision behind such an approach was formulated in 2003 with the document “De Delta in Zicht” (The Delta in Sight), which has found broad acceptance.

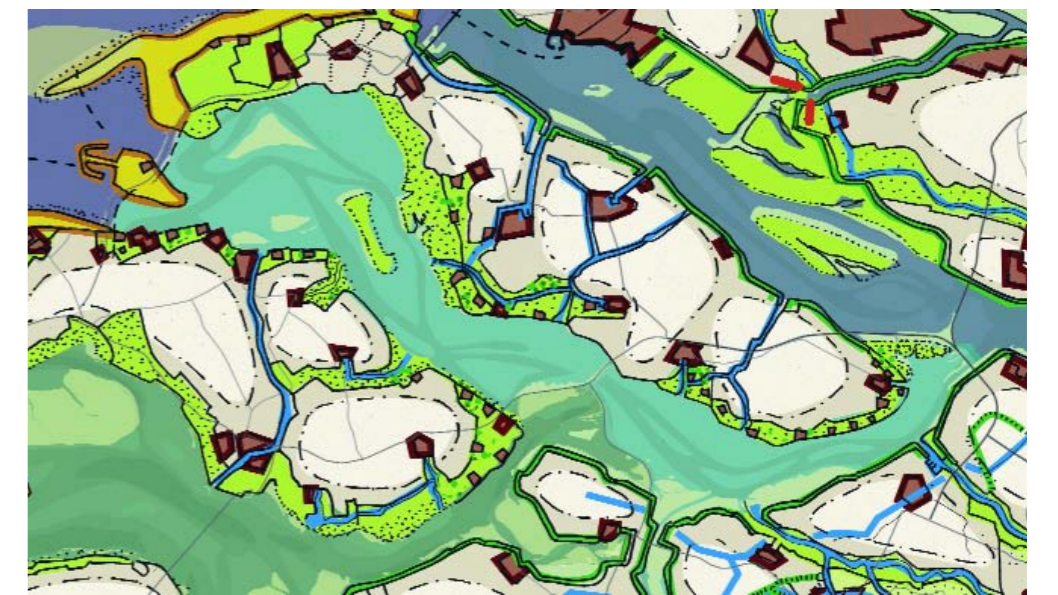
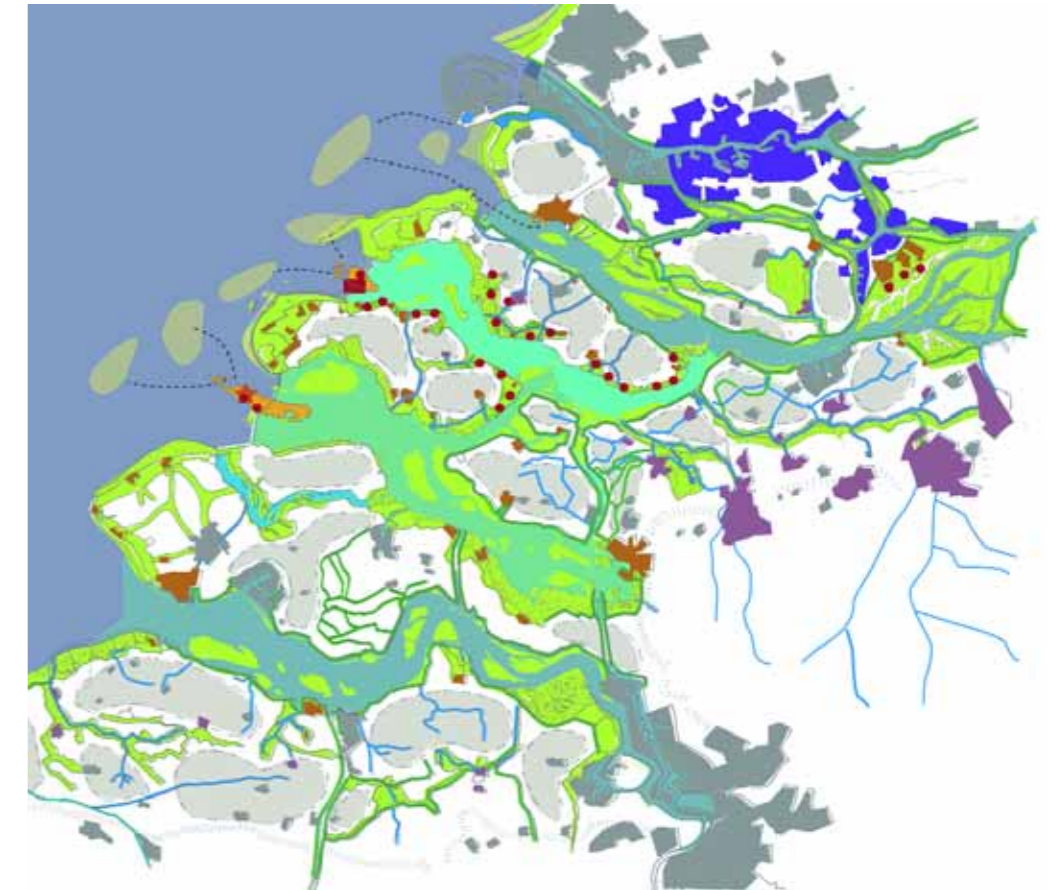
Grevelingenmeer and Volkerak-Zoommeer: the illustration shows possible landscape, nature and socio-economic development of land-water gradients and the restoration of relations with inland former tidal creeks.



The master plan for Perkpolder by Buro Lubbers and Rijnbouwt Van der Vossen Rijnbouwt uses natural forces to provide extra flood protection by encouraging sedimentation.



The Delta region has been preparing a comprehensive Delta programme creating a vital and safe area, also serving as a leisure landscape in an urbanized environment.



The perspective for the Hollands Diep – Haringvliet area highlights a possible strengthening of the relation of the city of Dordrecht with the Biesbosch area.



The possible perspective for the eastern part of the Oosterschelde reconnects the city of Bergen op Zoom with the Oosterschelde.

One of the keys of this new plan is to encourage humans to adapt to the dynamics and ecological processes that have formed the delta over time, rather than vice versa – to make better use of the water systems instead of fighting against them. The impoldering process has already been partially reversed in the Veerse Meer with the construction of the Katse Heule (2004), an opening linking it to the Oosterschelde, with promising and fantastic results. By utilizing the natural forces of tidal flows, it has been possible to greatly improve the water quality of the Veerse Meer.

There are also plans for restoring the role of dynamic estuarine processes in the other delta waters. All these plans and ideas have one thing in common: they make use of natural forces to restore the water systems to a healthier state. These natural forces can also be used to provide extra flood protection by encouraging sedimentation wherever possible, thereby encouraging the development of salt marshes, which (in combination with dikes) can provide coastal protection. This concept has been integrated into the development plan for Perkpolder, which will be executed in the coming years.

Preparing the future

Since May 2008, the Delta region has been preparing a comprehensive regional Delta programme that strives to reach a climate-proof, safe, ecologically resilient and socio-economically vital Delta area in the Southwest Netherlands. Utrecht based H+N+S Landscape Archi-

itects designed – in cooperation with Deltares, an independent Dutch research institute for water, soil and subsurface issues – a series of perspectives that trace the possible implementation of the programme until 2050. These graphics can be read as an imagination of the mutual benefit of ecological and infrastructural improvement.

There are still many challenges. The new programme must maintain safety against sea and river water, while restoring estuarine dynamics (tides, sea-to-river gradients and water-to-land gradients) for better water quality, natural productivity and natural values. It must

simultaneously accommodate shipping, accommodate agriculture, improve conditions for fisheries and shellfish cultivation, improve recreation and tourism opportunities (especially in the eastern part of the delta), and optimize the connections between the green-blue heart and the cities around it.

If the programme succeeds, the delta will experience a substantial increase in quality as a diverse ecological system and an attractive area for living, working and recreation. The relationship between land and water will again become richer and more diverse, both along the basins and along the water in the urban regions.



The master plan for the city of Bergen op Zoom, designed by Soeters Van Eldonk, links the city to the waterfront again. A body of water connects the residential areas to the harbour.