AN INTEGRATED MASTER PLAN FOR FLANDERS FUTURE COASTAL SAFETY

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Recent studies showed that one third of the Belgian coastline is not sufficiently protected against severe storm events. Therefore an Integrated Master Plan for Coastal Safety has been set up which forms the basis for the development of the seafront along the Belgian coast in the nearby and distant future (up till 2050) with safety against flooding as its main objective. The implementation phase of the Master Plan is planned between 2011 and 2015.

INTRODUCTION

The Belgian coast is situated at the southern part of the North Sea between The Netherlands and France. The coastline is 67 km long consisting mostly of sandy beaches with sea walls in front of the cities and dunes in between. There are 4 harbours at Nieuwpoort, Oostende, Blankenberge and Zeebrugge and a tidal inlet at the border with The Netherlands, called the Zwin.

This small stretch of land is intensively used by different stakeholders. Aside from housing the coastline is landmarked by nature reserves, tourism and industry. Nevertheless, the low-lying polders in the hinterland form a 15 kilometer wide flood prone area in which about 400.000 people live (Fig. 1). This area is situated about 2 meters under the level of an average storm and without appropriate coastal protection it would flood every year.

Recent studies showed that one third of the coastline is not sufficiently protected against severe storm events. Therefore coastal protection plans were set up to assure a minimum safety standard for the entire coastline.

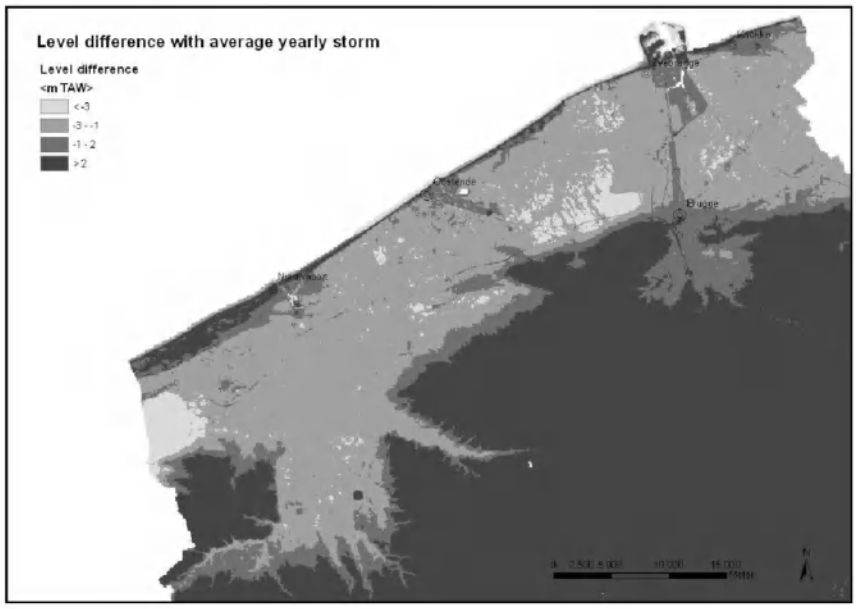

Figure 1: The low-lying polders at the Belgian coastline.

FROM SAFETY STUDIES TO THE SET UP OF A MASTER PLAN

In 2007, the Belgian Coastal Division initiated an Integrated Master Plan for Coastal Safety to provide a minimum safety standard of once in 1000 year for the entire coastline. As explained in Mertens et al (2008) this plan forms the basis for the development of the seafront along the Belgian coast in the nearby and distant future (up till 2050) with safety against flooding as its main objective.

The combined evaluation of environmental impacts, flood risk reductions and costs versus benefits supported the selection of integrated protection measures for every weak link. The implementation phase of the Master Plan for Coastal Safety is planned between 2011 and 2015.

Weak links

All weak links have been determined based on stability and breaching calculations of the sea defences. The results indicate that one third of the coastline needs to be reinforced to withstand extreme storm floods, providing a minimum safety standard of once in 1000 year (Fig. 2).

According to Van Poucke et al (2009) and Balens et al (2011) a worst credible storm can result in 3300 casualties, mainly on the sea defence itself, and € 6.5 billion economic damage. At all harbours and several coastal communities quay walls and dyke levels are too low, resulting in overflow and breaches during extreme storms, thus causing major flooding for dozens of kilometers land inwards (Fig. 3).

Locks and weirs need special attention, as structural strengthening or an adjusted operation is needed for these structures to resist the impact of water forces during storms. For these constructions a separate study has started to work out a testing procedure for extreme storm events.

The contribution of each weak link to the overall number of risks enabled to prioritize specific protection measures in the final Master Plan.

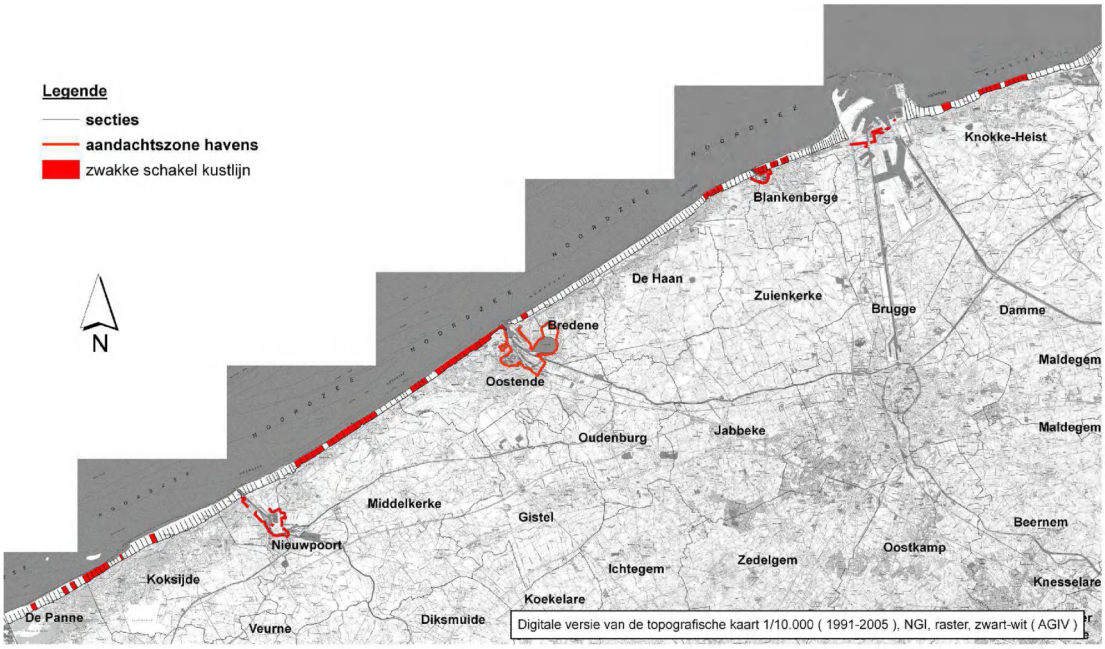

Figure 2: Weak links at the Belgian coastal zone.

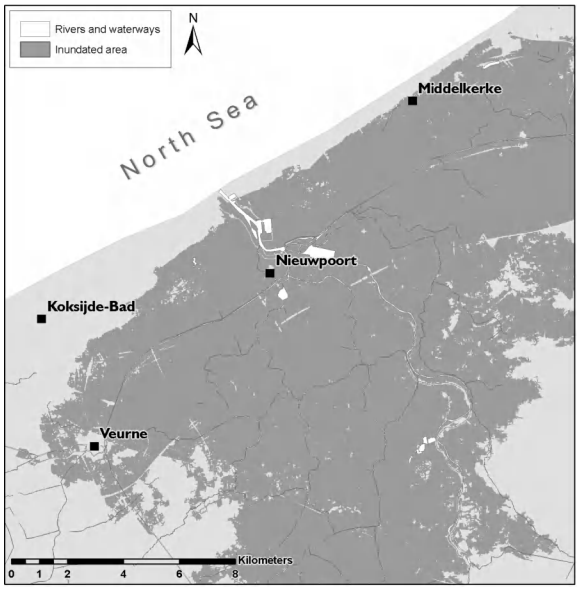

Figure 3: Flooding of the western Belgian coastal zone due to breaches in the sea defences caused by an extreme storm event (simulated with the MIKEFLOOD software package).

EVALUATION OF PROTECTION MEASURES

Potential protection measures such as beach or dune nourishments, storm return walls, stilling wave basins and storm surge barriers have been selected and studied to account for their flood risk reduction, environmental impacts, costs vs. benefits, plus expert judgement for the evaluation of non-monetary values.

COASTAL ZONE	COASTAL PROTECTION MEASURE
De Panne	dune nourishment + beach nourishment
St. Idesbald - Koksijde	beach nourishment
Koksijde	dune nourishment + reconstruction of road
Harbour of Nieuwpoort	storm surge barrier
Middelkerke - Westende	beach nourishment + storm return wall around casino
Raversijde – Mariakerke	beach nourishment + storm return wall
Oostende center	beach nourishment + stilling wave basin
Harbour of Oostende	storm return wall
East Bank of Oostende	beach nourishment
De Haan-Wenduine	beach nourishment + storm return wall
Harbour of Blankenberge	storm return wall + erosion resistant slopes
Blankenberge	beach nourishment
Harbour of Zeebrugge	storm return wall + erosion resistant slopes
Knokke-Heist	beach nourishment
Zwin	International dyke

Table 1: Overview of the planned coastal protection works in each coastal zone (west to east).

Beach nourishments were found to be cost efficient in the long term, whereas storm return walls easily earn themselves back in a short time period. Further information can be found in Mertens et al (2010).

An approved Master Plan

On the 10th of June 2011 the Flemish Parliament approved the Master Plan and its implementation. An overview of the foreseen protection works in each coastal zone is given in Table 1.

FUTURE COASTAL PROTECTION MEASURES

The implementation of the Master Plan is estimated at 300 million euros, of which two third is reserved for investment works and one third for maintenance. The works are planned between 2011 and 2015.

Soft measures

In total more than 20 million m³ sand is needed to heighten and broaden the beaches and dunes and maintain them till the year 2050. For these nourishment works sand will be extracted in exploration zone 4 of the Belgian part of the North Sea.

The beaches and dunes are monitored yearly and the management is adapted accordingly. Generally beach nourishments are maintained every 5 years in order to grow with sea level rise and to not oversize the nourishment profiles. These profiles are calculated to guarantee sufficient sand volume to withstand storm impacts, and apart from achieving an optimal safety standard grain size and profile slopes are optimised to minimise environmental disturbance of the local area.

Hard measures

In several coastal towns and harbours storm return walls need to be built in order to guarantee a sufficient safety level. An optimal design of these hard protection measures will be studied to minimise their height and to optimise their spatial integration.

Flanders Hydraulics and Ghent University carry out physical experiments in their wave flumes to estimate overtopping discharge and pressures on the structures. Different alternatives for the high sea wall are tested (e.g. different positions, the use of a parapet, ...). An example of a parapet is visualised in Figure 4. The tests will be filmed and displayed during expositions in order to show the public the enormous violence of overtopping waves and the positive effect of the new structures. Landscape architects use these elements to create a completely new sea wall and boulevard, not only for the coastal safety, but also to improve the quality for people living and walking on the sea wall and beach. For this a continuous interaction between landscape architects and engineers is going on.

For the harbour of Nieuwpoort on the other hand, it was decided to build a storm surge barrier at the harbour entrance. This measure proved to be the optimal choice of the cost-benefit analysis and for minimising the environmental impact.

For the architectural and technical design of all hard measures both the Coastal Division and the local community equally co-finance. As for the actual implementation all basal costs are paid by the Coastal Division, while all extra costs for refinement are paid by the community itself.

Figure 4. Digital simulation of a parapet (design by POLYGON Graphics).

Communication

In the course of the study special attention was given to the communication with different stakeholders and the broader public (questionnaires, presentations, brochures, digital newsletter…). A steering committee and advisory board were regularly consulted to reflect upon the proceedings of the study.

For the implementation of the Master Plan further interaction is foreseen with these two consultation bodies and a coast wide communication programme is being developed. As a starting point joint communication about the infrastructure works is organised with all coastal communities during information evenings for the broad public. Next to that a website (www.kustveiligheid.be) will become online from September 2011 onwards in which all relevant information will be gathered.

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