12

Safety against flooding

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Citation:

Verwaest, T., DeWolf, P., Mertens, T., Mostaert, F., Pirlet, H., 2013. Safety against flooding. In: Lescrauwaet, A.K., Pirlet, H., Verleye, T., Mees, J., Herman, R. (Eds.), Compendium for Coast and Sea 2013: integrating knowledge on the socio-economic, environmental and institutional aspects of the Coast and Sea in Flanders and Belgium. Oostende, Belgium, p. 219-230.

Climate change has led to a warmer climate and to an associated sea level rise caused by the melting of the ice caps and the thermal expansion of the ocean water. Between 1961 and 2003, the global sea level rose by an average of 1.8 mm per year. In the period between 1993 and 2003, this increase reached a value of 3.1 mm per year (*Climate change 2007: synthesis report 2008* [226555]), whereas the global average amounts to 3.4 mm per year (*http://www.milieurapport.be/en/home/*). In the case of Belgium, the average sea level in Ostend rose by 1.69 mm per year (1927-2006), while the average sea level rise after 1992 amounted to 4.41 mm per year (figure 1) (*Van den Eynde et al. 2009* [206438], *Van den Eynde et al. 2011* [212421], *CLIMAR project BELSPO*, *Van den Eynde 2011* [206376], more recent figures in *Van Steertegem 2012* [138542]). Moreover, the increase is more pronounced during flood tides compared to ebb tides, which enhances the tidal amplitude. Climate change and the associated sea level rise also result in the erosion of coastal areas and a higher frequency of storm surges (*EEA Technical Report 2010a* [205600], *The European environment: state and outlook 2010. Adapting to climate change 2010* [226556]), although no increase in the storm frequency in the Belgian Part of the North Sea (BNS) has been observed so far (*Van den Eynde et al. 2011* [212421], *CLIMAR project BELSPO*). These factors imply an enhanced flood risk in low-lying coastal areas. The Netherlands and Belgium belong to the most vulnerable countries of the European Union, given that the elevation of more than 85% of the Belgian and Dutch coastal area is lower than the level of a yearly storm (+5 m TAW) (*EEA Report 2006* [100281], *Eurosion*): in Flanders, 15% of the area is situated below 5 meters above the average sea level. Moreover, the Belgian coast has the most built-up area of all European coasts: in 2000, more than 30% of the coastal strip of 10 km wide was built-up area. This figure amounted to 50% of the coastal area when considering the first kilometre inland of the coastline (*http://www.milieurapport.be/en/home/*). Besides housing, intense economic activities take place in the coastal areas of the Netherlands and Belgium, *inter alia* due to the presence of harbours. Hence, the loss of life and material damage in case of a flood may be quite high (*The European environment: state and outlook 2010. Adapting to climate change 2010* [226556], *Kellens, 2011* [207941]). Moreover, more than a third of the Flemish coastline is subject to erosion and needs to be protected against the impact of super storms. Besides the natural coastal protection (beaches and dunes), additional protection is needed. In Flanders, the *Masterplan Coastal Safety* [206919] defines the measures required for a sufficient protection of the coastline and the adjacent low-lying polders against super storms. The *Masterplan Coastal Safety* [206919] also takes into account the expected sea level rise by 2050. Both 'soft' measures (beach nourishment, dune nourishment, etc.) and 'hard' coastal protection measures (seawall, flood barriers, etc.) are included in the masterplan. These measures extend as far as the locks and weirs of the rivers and canals in the hinterland. Flooding of low-lying polders due to heavy rainfall also occurs in the coastal area, but is not restricted to this zone. Nevertheless, it is important to take these kind of floods into account, especially given that by 2100, the chance of rainfall may be 10% higher in the coastal area compared to the hinterland (*Van Steertegem 2009* [142609]). However, this type of floods will not be discussed in the current text.

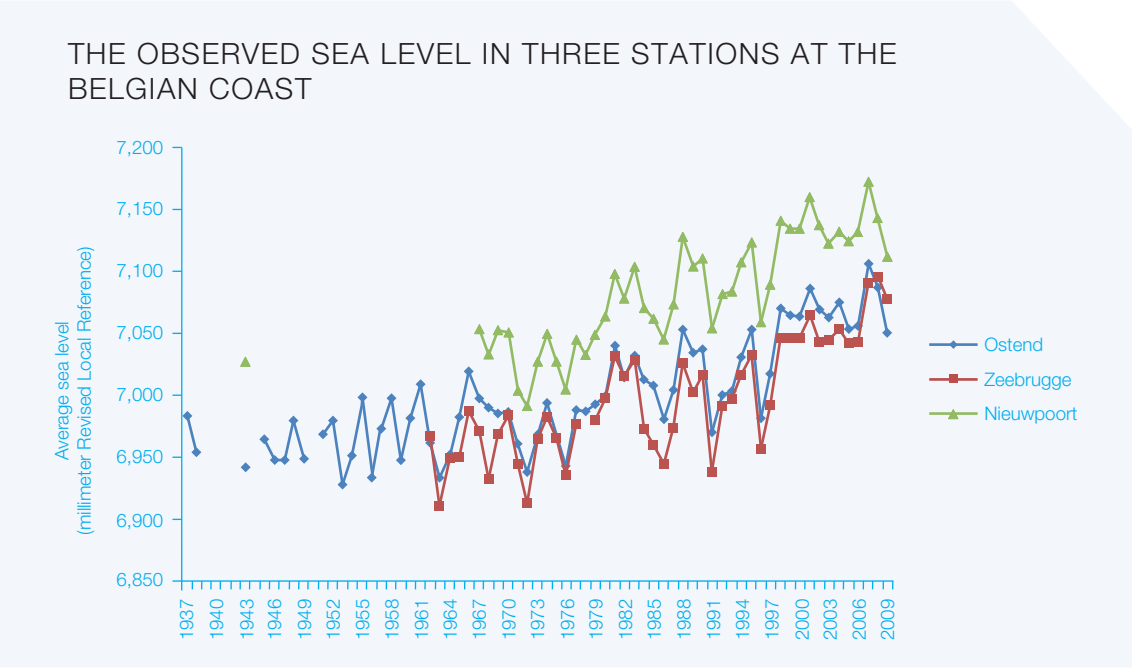

Figure 1. The observed sea level rise in three stations on the Belgian coast (1937 – 2009) (*kustbarometer*; *MD&K-Flemish Hydrography*, more information: *website milieurapport*).

12.1 Policy context

In 2007, the *Directorate-General Environment* of the European Commission issued the *Floods Directive* (*2007/60/EC*) to counter the harmful consequences of floods on humans, nature, heritage, economy, etc. and the potential increase in the number of floods in the context of climate change. The directive is valid in all European coastal and inland waters. Flanders implemented this directive in 2010, by modifying the *Decree of 18 July 2003 on Integrated Water Policy*. Comparable to other European countries, the water safety policy in Flanders does not only take into account the protection against floods, but also the control of flood risks (*Coordination Committee on Integrated Water Policy*) (see also **Sustainable use**). The Coordination Committee on Integrated Water Policy (*CIW*) effectuates an integrated approach by means of a platform to consult the different policy domains and administrative levels that are involved in the water policy, together with the water companies. *Waterwegen en Zeekanaal NV* (*W&Z*) is competent for the water management of the navigable waterways. The *Coastal Division* (part of the Agency for Maritime and Coastal Services – *MD&K* of the Flemish policy domain of Mobility and Public Works - *MOW*) is responsible for the protection of the Flemish coast against floods from the sea. Furthermore, the Flemish government approved a concept note on 1 February 2013 with the draft of the Flemish climate policy plan 2013-2020 (Mitigation plan and Adaptation plan) (*website deparement LNE*).

Every 6 years, the Flemish authorities submit the entire sea barrier to a safety test. In the context of this test, the basic safety in all coastal zones needs to be guaranteed, namely the protection against a super storm with a statistic return period of 1,000 year. On the other hand, the test examines from a cost/benefit perspective whether there is a significant residual risk in terms of damage and casualties. The current sea barrier offers protection against a 100 year flood. In order to sufficiently protect the coastal zone until 2050, the *Coastal Division* elaborated in collaboration with *Flanders Hydrologic Research*, a flood risk management plan for the coastal area, that was approved by the Flemish government on 10 June 2011: the *Masterplan Coastal Safety* [206919] (see also **Sustainable use**).

To realise all coastal protection measures, the environmental legislation needs to be respected by the elaboration of Environmental Impact Assessments (EIA's). Besides, building permits have to be requested for so-called 'hard measures'. This requires collaboration, in particular with the Agency for Nature and Forest (*ANB*) of the Flemish policy domain of Environment, Nature and Energy and with the policy domain Spatial Planning, Housing Policy and Immovable Heritage with regard to the building permits.

100% safety can never be guaranteed. Hence, emergency plans remain necessary. All coastal towns need to elaborate a municipal emergency plan against floods (so-called 'BNIP floods'). The provincial level is responsible for the coordination between the municipalities in case of super storms. Furthermore, the province of West Flanders is competent for the elaboration and coordination of a provincial BNIP floods. When cross-border problems occur in case of a super storm, the crisis centre of the FPS Home Affairs will take over the coordination, *inter alia* by the implementation of the National Emergency Plan 'Floods and High water'.

12.2 Spatial use

In the *Masterplan Coastal Safety* [206919] the demarcation of areas of particular interest along the Flemish coast is discussed, as well as the necessary protection measures for each of these areas. The status of the works in each of these zones can be found on the following website: *www.kustveiligheid.be*. A map with the hard and soft coastal protection measures is available in the *coastal atlas* (*Belpaeme et al. 2011* [207333]) and *Maes et al. (2005)* [78279] (*GAUFRE project BELSPO*) (figure 2).

The protection of the coast is also discussed in the draft of the Marine Spatial Plan (*Ontwerp van koninklijk besluit tot vaststelling van het marien ruimtelijk plan* [227527]), as proposed by the Minister competent for the North Sea. The draft plan formulates some spatial policy choices with regard to coastal safety. In the context of the implementation and support of the Masterplan Coastal Safety, sufficient sand and gravel extraction areas are demarcated with a view to the soft coastal protection (see also theme **Sand and gravel extraction**). In addition, new possibilities for coastal protection are being explored, with a location for experiments in the coastal waters in the proximity of the Broers Bank.

AN OVERVIEW OF THE CURRENT HARD AND SOFT COASTAL PROTECTION MEASURES ALONG THE COASTLINE

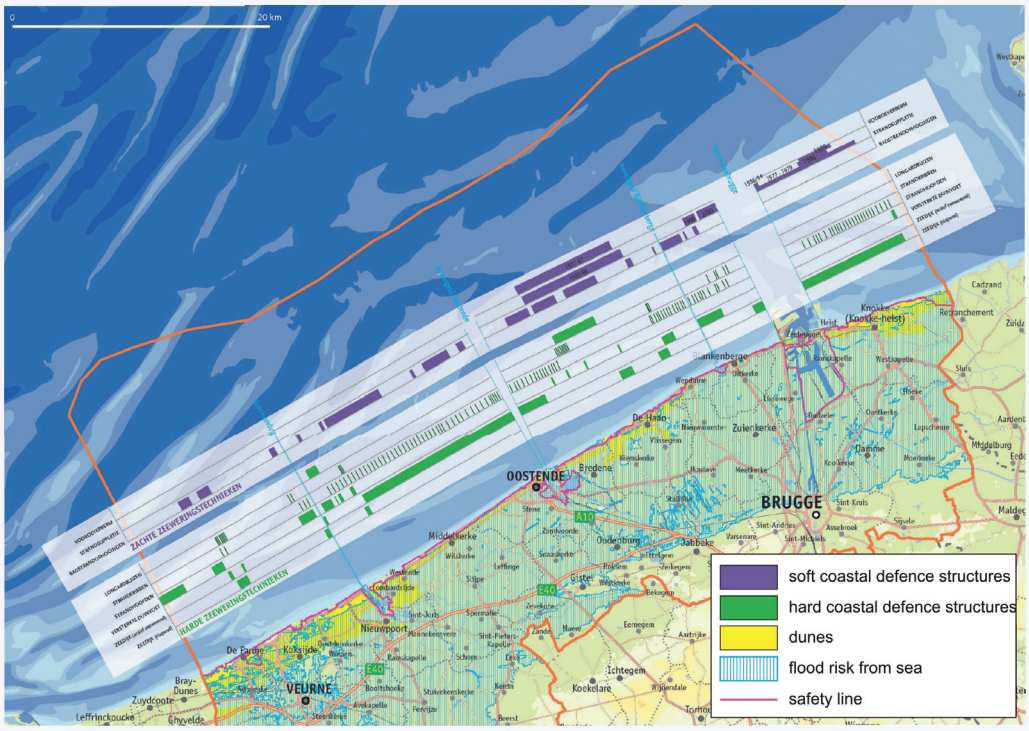

Figure 2. An overview of the current hard and soft coastal protection measures along the coastline (*Coastal Atlas*, *Belpaeme et al. 2011* [207333]).

12.3 Societal interest

12.3.1 Damage and casualties in case of floods

The study of the protective measures of the *Masterplan Coastal Safety* [206919] revealed that more than one third of the coastline was not sufficiently protected against a super storm with a return period between 100 years and 17,000 year. In addition to the safety tests of the sea barrier, flood risk calculations were executed. In these calculations, the number of casualties and economic damage was investigated for a range of super storms. Table 1 summarises the calculation results.

Table 1. An overview of the flood risks in the Belgian coastal area for different storm surge levels and return periods, with the associated deaths and the direct economic damage.

FLOOD RISKS IN THE BELGIAN COASTAL ZONE			
Storm surge level	Return period	Deaths	Direct economic damage
+ 6.5 m TAW	~100 year	41	0.67 billion euro
+ 7.0 m TAW	~1,000 year	251	2.1 billion euro
+ 7.5 m TAW	~4,000 year	885	3.9 billion euro
+ 8.0 m TAW	~17,000 year	3.297	6.5 billion euro

Moreover, the ongoing spatial developments in the coastal areas further increase the potential economic and human losses. Hence, this increases the damage a storm may cause with a certain probability of occurrence (*Plan-MER voor het Geïntegreerd Kustveiligheidsplan: kennisgeving 2009* [139531], *Kellens 2011* [207941]).

In the context of the *CLIMAR project (BELSPO)*, *Van der Biest et al. (2009)* [134413] selected three indicators quantifying the risks of climate change with regard to floods in the coastal zone: (1) the loss of beach and dune areas by erosion, (2) modelling of the economic damage and (3) the number of casualties in case of a storm surge level of + 8.00 m TAW in two long-term climate scenarios (2100). In the CLIMAR study (*CLIMAR project BELSPO*), the research focused on the coastal municipalities whereas the ports were not taken into account, despite their relative low-lying location. Hence the ports may constitute weak spots in the sea barrier. In the *Masterplan Coastal Safety* [206919], 2050 is set as the time horizon: the proposed measures thus offer protection for all coast towns and coastal ports, until at least 2050. For the storm surge barrier in Nieuwpoort, this is until 2100. Beach nourishment constitutes the most important measure of the *Masterplan Coastal Safety* [206919]. This measure allows a flexible reaction to the sea level rise, even after 2050. In the project *Flanders Bays* of the Flemish government, climate change and sea level rise are considered in the long term until 2100 (see also **Sustainable use**). The *Masterplan Coastal Safety* [206919] was approved by the Flemish government in June 2011 and subsequently the execution of the measures of the Masterplan started. Global long-term climate scenarios have been published by the Intergovernmental Panel on Climate Change (*IPCC*). These kinds of estimates allow a detailed understanding of the societal interest of coastal protection and safety against floods in general.

A map with the distribution of the flood in case of a 1,000-year storm under the conditions present in 2006 is shown in figure 3. The largest risk of damage is situated in the four ports. With regard to the coastal municipalities, special attention needs to be paid to the zones Ostend-centre, Ostend-Raversijde, Ostend-Mariakerke, Ostend-Wellington and De Haan-Wenduine. Also, the damage risk in Middelkerke is relatively high. Moreover, the expected number of casualties in these zones is not socially acceptable (*Masterplan Coastal safety* [206919]).

CALCULATION OF THE DISTRIBUTION OF THE FLOOD OF A 1,000-YEAR STORM, UNDER THE CONDITIONS PRESENT IN 2006

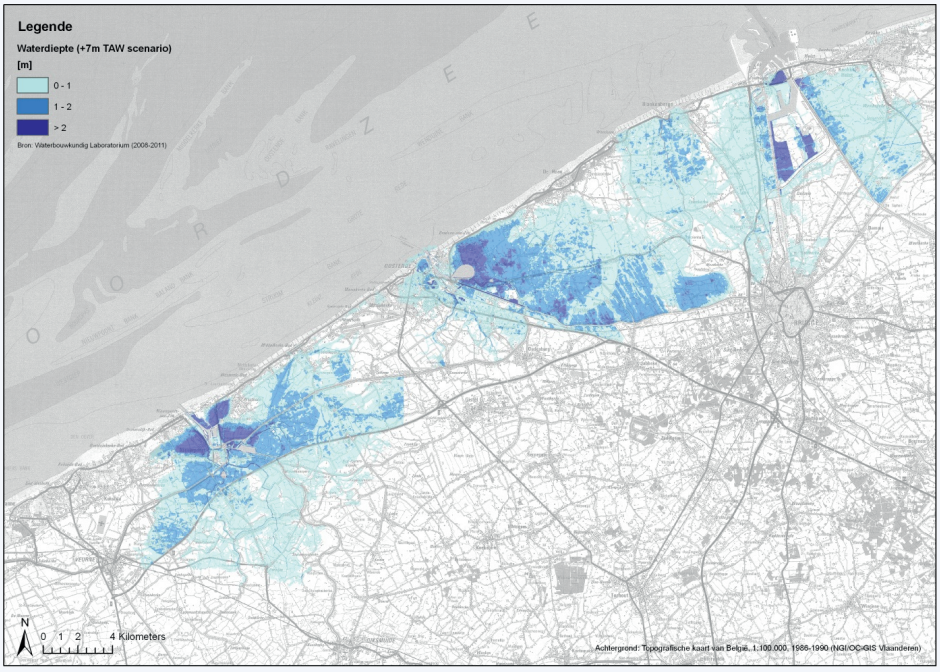

Figure 3. Calculation of the distribution of the flood of a 1,000-year storm, under the conditions present in 2006 (*Masterplan Coastal Safety* [206919]).

12.3.2 Investments in coastal safety

The total cost of investment of the *Masterplan Coastal Safety* [206919] is estimated to be more than 300 million euros. An important share of this estimate is included in the renovation and reinforcement of sea locks, weirs and other constructions in the ports. The estimated maintenance cost for the new beaches amounts to a yearly average of 8 million euros (*Masterplan Coastal Safety* [206919]). Prior to the *Masterplan Coastal Safety* [206919], the Belgian beaches were replenished with a yearly average of 550,000 m^3 of sand (both by means of pressure pipes and by trucks) (*Maelfait & Belpaeme 2007* [119667], *Vandewalle et al. 2008* [127263], *Masterplan Coastal safety* [206919]).

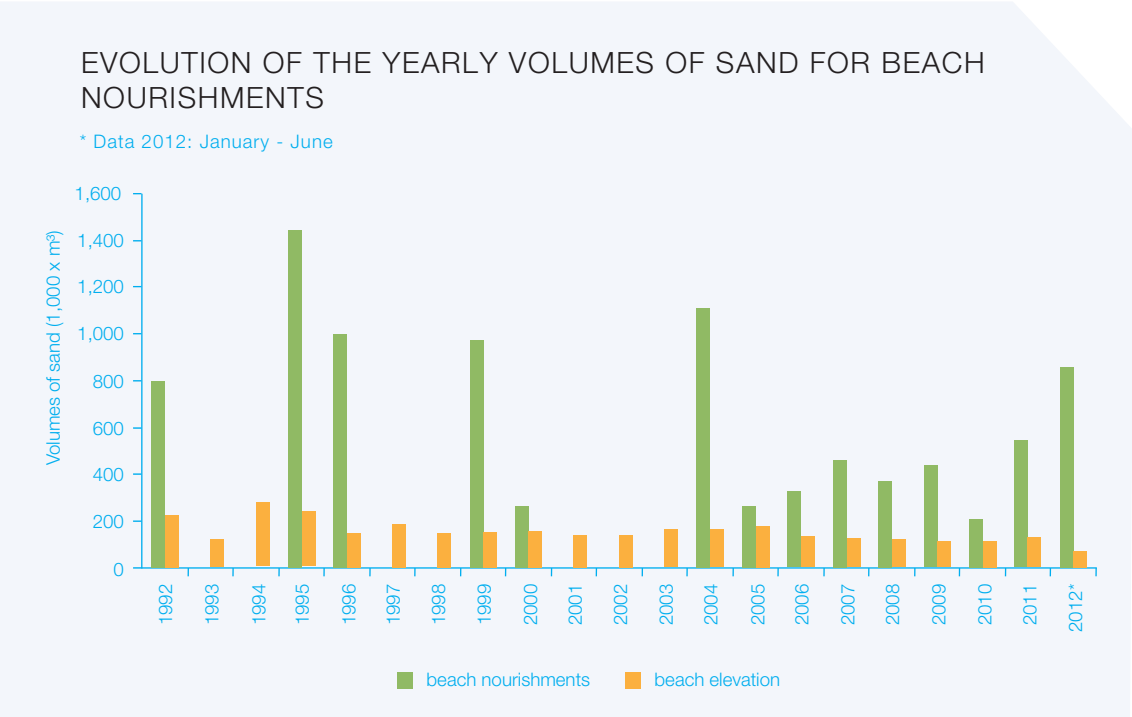

Figure 4. Evolution of the yearly volumes of sand for beach nourishments (*Van Quickelborne 2012* [221538]; MD&K, Coastal Division).

12.4 Impact

12.4.1 The impact of the sea barrier

The coastal protection works and infrastructure have an impact on some environmental aspects, depending on the technique used. The hard as well as the soft protection works are therefore governed by the European *EIA Directive* (*85/337/EEC*), implying that an EIA needs to be drafted prior to the granting of any environmental permit.

The different measures that were investigated in the context of the *Masterplan Coastal Safety* [206919], are:

For the coastal municipalities:
- Beach nourishment;
- Beach nourishment with a wave absorbing seawall;
- Beach nourishment with a water barrier on the seawall;
- Beach nourishment in combination with groynes;
- Beach nourishment in combination with breakwaters.

For the dunes:
- Beach nourishment;
- Dune nourishment.

For the ports:

- Water barriers around the port and/or seawall strengthening (depending on the location) in combination with the strengthening and/or regulation of the existing sea locks and weirs;
- Storm surge barriers at the entrance of the port.

In general, the EIA studies estimate the environmental impact that may appear during the construction, subsequent to the execution and during the maintenance works. Therefore, the effects need to be considered as potential effects. The impact of the extraction of the necessary raw materials (e.g. sand extraction at sea) has been included in separate EIAs.

Table 2 gives an overview of the potential effects which need to be considered during the assessment of coastal protection measures, as well as the associated literature which deals with these effects in detail. A more detailed description is given in the following publications: *Geïntegreerd Kustveiligheidsplan. Niet-technische samenvatting 2009* [226558], *Plan-MER – Plan voor kustverdediging en maritieme toegankelijkheid van Oostende (2007)* [214633].

Table 2. An overview of the potential effects that have to be taken into account when evaluating coastal protection measures, as well as the related literature.

DISCIPLINE	POTENTIAL EFFECTS	LITERATURE
Water	• Turbidity of the water column • Modification of the flow pattern and the currents of the sea water • Hydrological effects - changing groundwater levels in the dunes and adjacent areas • Changes in the groundwater quality (depending on the quality of the replenished sand)	*Plan-MER – Plan voor kustverdediging en maritieme toegankelijkheid van Oostende 2007* [214633], *Geïntegreerd Kustveiligheidsplan. Niet-technische samenvatting 2009* [226558], *Lebbe 2011* [206161]
Soil	• Impact on the present seabed, beach, dune and polder soils (degree of soil disturbance) and the effect on the morphology	*Plan-MER – Plan voor kustverdediging en maritieme toegankelijkheid van Oostende 2007* [214633], *Geïntegreerd Kustveiligheidsplan. Niet-technische samenvatting 2009* [226558]
Air	• Emissions into the air and their impact on human health	*Plan-MER – Plan voor kustverdediging en maritieme toegankelijkheid van Oostende 2007* [214633], *Geïntegreerd Kustveiligheidsplan. Niet-technische samenvatting 2009* [226558]
Noise and vibrations	• Noise impact on humans and animals and the effects on human health	*Plan-MER – Plan voor kustverdediging en maritieme toegankelijkheid van Oostende 2007* [214633], *Geïntegreerd Kustveiligheidsplan. Niet-technische samenvatting 2009* [226558]
Landscape, archaeology and architectural heritage	• Functional fragmentation of the spatial use • Visual-spatial effects of adding or changing landscape elements • Disappearance and disturbance of the historical geographical elements and structures • Effects on the architectural heritage and archaeology	*Plan-MER – Plan voor kustverdediging en maritieme toegankelijkheid van Oostende 2007* [214633], *Geïntegreerd Kustveiligheidsplan. Niet-technische samenvatting 2009* [226558]
Fauna and flora	• Effects on the habitat, vegetation, benthos and avifauna • Creation of habitats due to the expansion of dry beaches and dunes • Barrier function for benthos	*Engledow et al. 2001* [25266], *Speybroeck et al. 2004* [69028], *Volckaert et al. 2004* [69036], *Speybroeck et al. 2006a* [100573], *Speybroeck et al. 2006b*, *Speybroeck et al. 2007* [116938], *Plan-MER – Plan voor kustverdediging en maritieme toegankelijkheid van Oostende 2007* [214633], *Van Ginderdeuren et al. 2007* [120913], *Geïntegreerd Kustveiligheidsplan. Niet-technische samenvatting 2009* [226558], *Janssen & Rozemeijer 2009* [142372], *Braarup Cuykens et al. 2010* [197472], *Van den Eede & Vinckx 2011* [202895]

DISCIPLINE (continuation)	POTENTIAL EFFECTS	LITERATURE
Mobility	• Modifications in the accessibility	*Plan-MER – Plan voor kustverdediging en maritieme toegankelijkheid van Oostende 2007* [214633], *Geïntegreerd Kustveiligheidsplan. Niet-technische samenvatting 2009* [226558]
Spatial use (Human - Space)	• Modifications in the access possibilities • Modifications of the recreational area • Modification of functions • Nuisance	*Plan-MER – Plan voor kustverdediging en maritieme toegankelijkheid van Oostende 2007* [214633], *Geïntegreerd Kustveiligheidsplan. Niet-technische samenvatting 2009* [226558]
Human – health and safety aspects	• Possible health effects, due to the exposure to polluted air, noise emissions and vibrations • Changes in the safety of recreationists or inhabitants, due to changing sea currents, or due to the placement or removal of obstacles, or general modification of coastal safety	*Plan-MER – Plan voor kustverdediging en maritieme toegankelijkheid van Oostende 2007* [214633], *Geïntegreerd Kustveiligheidsplan. Niet-technische samenvatting 2009* [226558]

Besides a general EIA plan that maps the total environmental effects of the measures of the *Masterplan Coastal Safety* [206919], a project EIA may be elaborated when needed, in order to evaluate the local effects of the different projects. However, in most cases an exemption from the project EIA can be requested.

12.5 Sustainable use

12.5.1 Safety measures against floods

In the context of the *EU Floods Directive* (*2007/60/EC*), the Member States monitor the river basins and associated coastal areas that are vulnerable to floods. Flood risk maps for these regions have to be elaborated by 2013. Subsequently, the reporting follows a 6-year cycle. Before the end of 2015, the Member States also need to elaborate flood risk management plans at river basin level, focusing on the prevention of and protection against floods. These flood risk management plans are integrated into the river basin management plans that have to be drafted in the context of the *European Water Framework Directive* (*2000/60/EC*) (WFD; see theme **Nature and environment**) in one integrated plan (2015). The first generation of river basin management plans has already included a few measures (*CIW 2010* [132013]) concerning floods (*Vanneuville et al. 2011*). An additional challenge in the coastal area concerns the integration of flood risks from the inland waters (such as the Yser) on the one hand, and from the sea on the other hand. In Flanders, the *CIW* coordinates the procedures for the drafting of all required documents for the *WFD* and the *Floods Directive*. Furthermore, an instrument such as the *water test* also contributes to the preventive reduction of the damage caused by floods.

By means of the *Masterplan Coastal Safety* [206919], the Coastal Division wants to protect the coast from at least a 1,000-year storm surge, and wants to reduce the residual risk of serious economic damage and casualties, based on a cost/benefit approach. The Masterplan is aimed at an approach according to the principles of integrated coastal zone management (see theme **Integrated coastal zone management**). The plan has been gradually executed since 2011.

In order to protect the Flemish coast against at least a 1,000-year storm surge, and to reduce the risk of serious economic damage and casualties as much as possible, measures are necessary along certain parts of the coastline (*Plan-MER voor het Geïntegreerd Kustveiligheidsplan: kennisgeving 2009* [139531]). A separate safety test of the sea barrier along the first safety line (a solid line from the French to the Dutch border, that mostly coincides with the most seaward border of the habitation, or in unpopulated areas with the height of the surge of a 1,000-year storm) has revealed that one third of our coast, as well as the coastal ports, have a protection level which is not sufficient against a 1,000-year storm. The dikes, quays, locks and other protective constructions in the ports of Nieuwpoort, Blankenberge, Zeebrugge and Ostend cannot always resist the high water levels that are related to super storm floods (*website Masterplan Coastal Safety*, *Plan-MER voor het Geïntegreerd Kustveiligheidsplan: kennisgeving 2009* [139531]). Figure 5 provides an overview of all zones of particular attention.

ZONES OF PARTICULAR ATTENTION WITH REGARD TO COASTAL SAFETY ALONG THE EAST AND WEST COAST

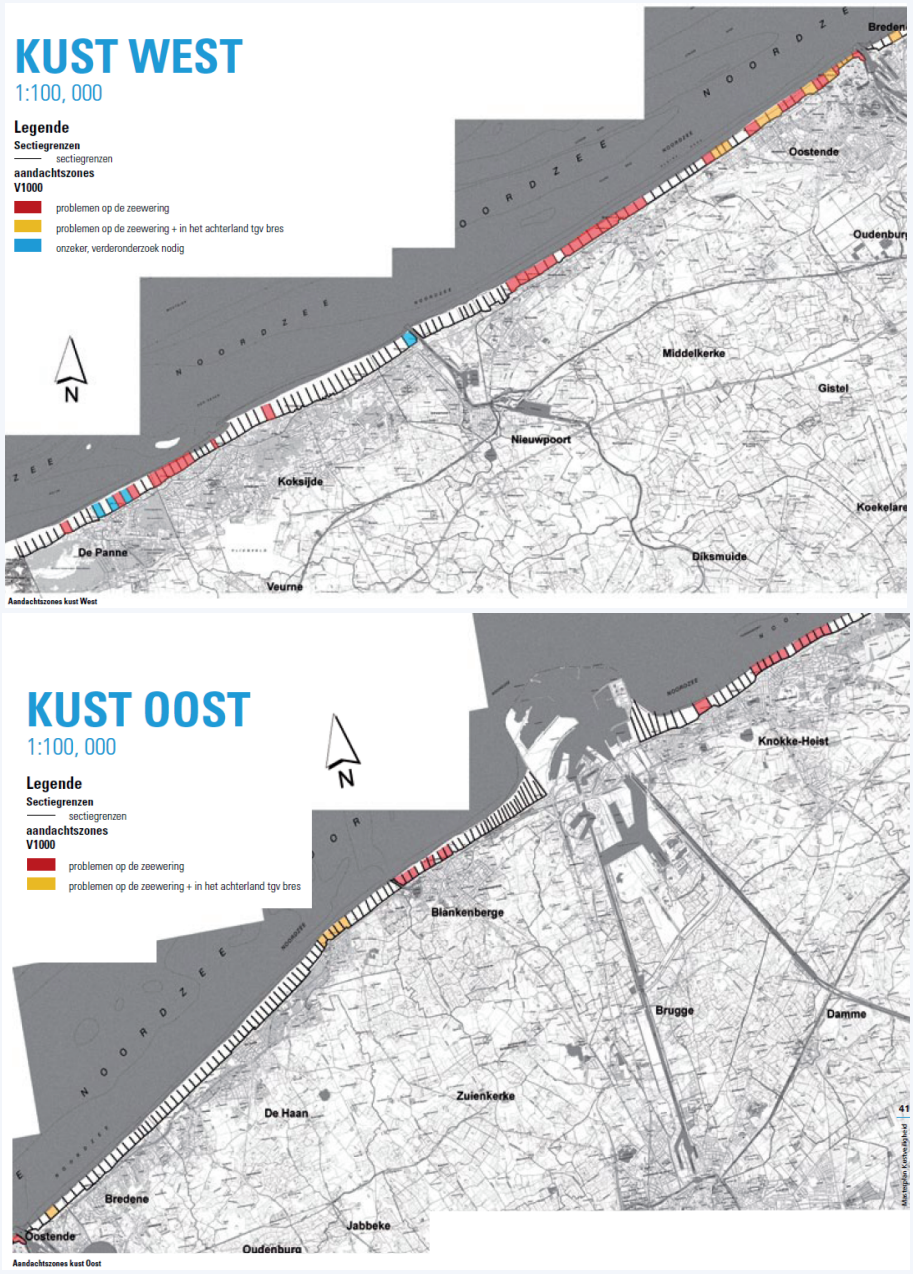

Figure 5. Zones of particular attention with regard to coastal safety along the east and west coast (*Masterplan Coastal Safety* 206919).

For each type of environment (coastal municipalities, dunes and ports) of the zones that require special attention, different measures were selected on the basis of the cost and the technical effectiveness (table 3). In the bathing areas, beach nourishment was preferred, whether or not in combination with measures to strengthen the seawall (water barriers or wave absorbing expansions of the seawall) or measures limiting the maintenance works (windscreens, brushwood, marram grass, etc.). For the dunes, beach or dune nourishments were considered. For the ports, storm walls, raising of the seawall/quay, or the construction of a storm surge barrier were investigated (*Geïntegreerd*

Table 3. Overview of the selected protection measures for each zone of particular attention (*Masterplan Coastal Safety*).

ZONE OF PARTICULAR ATTENTION	SELECTED MEASURES
De Panne - section 8	Dune nourishment
De Panne – centre (section 13 to 18)	Beach nourishment with an elevated beach
St. Idesbald - Koksijde-centre (section 21 to 31)	Beach nourishment with an elevated beach
Koksijde - section 39	Raising the road by the replenishment of the dune passage in combination with the reconstruction of the road
Port of Nieuwpoort	Construction of a storm surge barrier
Middelkerke - Westende (section 74 to 88)	Beach nourishment with a low-lying beach in combination with wave absorbing expansions and a storm wall seawards of the casino
Raversijde – Ostend Wellington (section 97 to 108)	Beach nourishment with a low-lying beach in combination with a high stormwall or adapted seawall ramp and wave absorbing expansion or widening of the seawall at Raversijde
Ostend centre (section 109 to 117) + Port of Ostend + Ostend-East (section 118 tot 120)	OW-Plan Ostend
Ostend-East (section 121)	Beach nourishment in connection with the OW-plan, subplan for integrated coastal zone management at Oosteroever (section 119 and 120)
De Haan - Wenduine (section 172 to 176)	Beach nourishment with a low-lying beach in combination with stormwalls at De rotonde and the seawall/widening of the seawall
Port of Blankenberge	Construction of a storm wall at +8m TAW in combination with anti-erosion protection around the port
Blankenberge (section 185 to 195)	Beach nourishment with a low-lying beach
Port of Zeebrugge	Construction of a storm wall at +8m TAW around the Prins Albert I dock and connected to the locks in combination with anti-erosion protection around the port
Knokke-Heist (section 225 to 243)	Beach nourishment (profile between steep and low-lying beach)
Zwin (section 250 to 255)	Zwinproject
Renovation of weirs and locks	Ports of Blankenberge, Ostend and Zeebrugge

Kustveiligheidsplan. Niet-technische samenvatting 2009 [226558]). The proposed measures were evaluated afterwards based on social, economic and environmental criteria. The required measures in order to realise the proposed level of flood protection along the entire coastline and in the coastal ports are summarised below. These measures are the most desirable alternatives. They are based on technical studies, impact assessments (EIAs, Social Cost-Benefits Analysis and residual risk calculations) and consultation with the stakeholders, in particular the municipalities.

12.5.2 Sustainable use of the coast

The ecological impact of beach nourishments has already been investigated in several studies (*Speybroeck et al. 2004* [69028], *Speybroeck et al. 2006a* [100573], *Speybroeck et al. 2006b* [225426], *Speybroeck et al. 2007* [116938], *Braarup Cuykens et al. 2010* [197472], *Van den Eede & Vinckx 2011* [202895]) executed on behalf of the *Coastal Division*.

In order to develop the sea barrier in an integrated way, the Flemish region, with the *Coastal Division* as competent authority, has signed the protocol of the Coordination Centre for Integrated Coastal Zone Management. With this protocol, the partners of the Coordination Centre (Coastal Division, Agency for Nature and Forest, Flanders Marine Institute, Province of West Flanders and FPS Health, Food Chain Safety and Environment) express their intention to collaborate in an integrated way and use the Coordination Centre as an instrument in this regard (see theme **Integrated coastal zone management**).

In the context of the future plan 'Flanders in Action', the Flemish government is developing an integrated approach with regard to the challenges of sustainable coastal management in the long term, within the concept '*Flanders Bays* [222799]'. In this project, *11 subprojects* have been further investigated to show which of these concepts and subprojects have sufficient potential to be implemented in future plans. On the basis of the research work, the Flemish authority wants to develop a series of measures in the medium term in the 'Masterplan Flanders Bays' (until 2050). The deadline for this Masterplan is 2014. The final goal of the Flanders Bays project is to develop an integrated long-term vision for the area (until 2100), that will serve as a framework for the future policy.

Finally, other initiatives and studies also look at a sustainable protection of the coastal zone. *Natuurpunt* pleads for one integrated plan that elaborates the adaptation of coastal nature to climate change: the so-called *Kappa-plan*, which develops a sustainable vision for the protection of our coast with natural climate buffers. Coastal protection is also discussed in several research projects, such as the CcASPAR (Climate change and changes in spatial structures in Flanders) project (*Allaert et al. 2012* [221516]), the BELSPO project *CLIMAR* (*Van den Eynde et al. 2009* [206438], *Van den Eynde et al. 2011* [212421]), the *SAFECOAST project*, and the European projects '*Coastal Communities 2050*' and *Theseus*. Moreover, the protection of the coast constitutes an important part in the (integrated) visions that are being generated for the development of the coastal region and the instruments for a sustainable and integrated coastal zone management (see theme **Integrated coastal zone management**).

Legislation reference list

Table with European legislation. The consolidated version of this legislation is available on *Eurlex*.

EUROPEAN LEGISLATION			
Abbreviations (if available)	Title	Year	Number
Directives			
EIA-Directive	Council Directive on the assessment of the effects of certain public and private projects on the environment	1985	337
Water Framework Directive	Directive 2000/60/EC establishing a framework for Community action in the field of water policy	2000	60
Floods Directive	Directive on the assessment and management of flood risks	2007	60
Other (Decisions, Communications, White Papers, etc.)			
	Recommendation of the European Parliament and of the Council of 30 May 2002 concerning the implementation of Integrated Coastal Zone Management in Europe	2002	413

Table with Belgian and Flemish legislation. The consolidated version of this legislation is available on *Belgisch staatsblad* and the *Justel-databases*.

BELGIAN AND FLEMISH LEGISLATION	
Date	Title
Decrees	
18 juli 2003	Decreet (betreffende het) Integraal Waterbeleid