Environmental impact report (EIR-plan) for the draft Marine Spatial Plan

PART 1 Non-technical summary

1 Context and objective

Rapid technological progress, changing social priorities and new economic opportunities are gradually increasing the pressure on free space at sea and the space that is available is becoming more and more limited. Over the past few years, this has become clear in relation to the creation of protected marine areas, the zone for offshore wind and new concession zones for sand extraction etc. In addition, a changing climate, a rising sea level, acidification, an increase in sea temperature, and the frequency of extreme weather conditions may also contribute to a shift of economic activities in the marine waters. This requires our government to have a future-focussed and proactive North Sea policy that is reconciled with the needs of the diverse stakeholders and the adjoining, heavily populated coastal areas, the Western Scheldt and the maritime areas of our neighbouring countries.

Integrated marine spatial planning is one of the cornerstones in order to implement this policy effectively. This connects into the European policy in this context to embed marine spatial planning within European regulations.

The Marine Spatial Plan (MSP) outlines a long-term vision for the spatial use of the Belgian part of the North Sea (BPNS), principally on the basis of an analysis of the existing activities and spatial state of the BPNS, with one eye on spatial and temporary conflicts between users and activities and the marine environment, and on the potential for multiple spatial use and combined activities. The MSP therefore further builds on previous spatial planning initiatives such as the North Sea Master plan (2003) and other zoning plans anchored in legislation.

2 Proposed alternatives MSP

The vision for the Belgian part of the North Sea (BPNS) assumes a clean, healthy, safe, productive and biologically diverse sea. This vision will be translated, in the long term, into concrete environmental, safety, economic, cultural, social and scientific targets for the BPNS for the plan horizon 2019.

These targets will be further elaborated into a graphic plan. The resulting Marine Spatial Plan (MSP) forms the proposed Alternative 1. On the basis of additional justification (including alternatives not considered) stated in the MSP at hand, an additional alternative (Alternative 2) will also be defined.

Both alternatives will be weighed up in comparison to the zero alternative (the reference situation) and further investigated in the plan EIA (Environmental Impact Assessment).

For a detailed description of the alternatives, you are referred to Table 1.

3 Expected effects of alternatives

In order to assess the consequences for the environment as a result of the MSP at hand (plan horizon 2013-2019), a strategic environmental assessment (or plan EIA) must be carried out. The plan EIA will set out the positive and negative impact of the alternatives. Within this, a scale and detail level is applied as is relevant for the developed alternatives, reconciled with the level of certainty with which the intended conditions have been formulated. In an environmental report the relative importance of the effects of the various alternatives are assessed by the situation that arises when the plan-alternatives and variations are implemented compared to the situation arising as the plan is not implemented (zero alternative). This zero alternative (reference scenario) constitutes the basis for comparison for the other plan alternatives. References made to alternative 2 deals with the not considered variant on the draft MSP at hand which has not been approved by the government. In other words, alternative 2 is used to put the draft MSP at hand (hereafter alternative 1) into perspective

On the one hand, the check takes place on a more strategic level, whereby the spatial policy options for the various alternatives are measured against the proposed targets of the MSP for the plan horizon 2019 and in relation to environmental, safety, social, cultural and scientific aspects. On the other hand, the alternatives are considered in relation to the reference situation (zero alternative).

In total, 11 effects have been defined as possibly significant: ground disruption (including turbidity), changing physical processes (including erosion, hydrodynamics), impact on climate, changing noise climate, production of electromagnetic fields, impact on biodiversity, disruption to sea birds, impact on shipping (including oil pollution), risks as a consequence of climate change, changing sea - view and pressure on available space. The study area is delineated per effect, the current and future situation is defined, an impact assessment is provided and proposals are put forward for mitigating measures and monitoring.

The following summary provides an overview of the most important conclusions, departing from the point of the proposed targets of the MSP (plan horizon 2019).

3.1 Environmental targets

TARGET: For the complete BPNS, in accordance with the Marine Strategy Framework Directive and the Water Framework Directive, efforts will focus on achieving a ‘good environmental status’ (GES) and the ‘good surface water status’ by 2020. Also achievement of the favourable conservation status, (Habitat and Bird Directive) and the implementation of the biodiversity strategy are pursued.

- On the basis of the defined effects for the plan EIA, the relevant defining elements are D1 ‘Biodiversity’, D2 ‘Non-indigenous species introduced as a result of human activity', D4 ‘Food chains’, D6 ‘Integrity of the seabed’, D7 ‘Hydrographical properties’, D8 ‘Pollution’ and D11 ‘Energy (incl. underwater noise)'.
- Various activities in the BPNS threaten the good environmental status. Ground disrupting activities, such as land reclamation, dredging and depositing, construction of wind farms and other renewable energy facilities, the installation of cables and pipelines, fishery and seawalls, lead to direct damage or loss of the seabed (D6). The modified morphology of the seabed can, in turn, bring about a change in the hydrodynamics and the erosion of the sedimentation pattern (D7). Indirectly, these effects have consequences for biodiversity (D1) and food chains in general (D4).
- Both alternatives provide the necessary space for the economic development of these activities (see also ‘economic targets'). Besides this, an expansion of sand and gravel extraction activities, dredging locations and the wind turbine zone are considered in alternative 2 (i.e. the not considered variant on the draft MSP at hand). It must be noted in this context that the cumulative effect of ground disruption as a result, for example, of multiple wind farms can be estimated to a lesser extent than the sum of the effects of individual wind farms. On the other hand, as a result of the increasing construction of wind farms, the surface area within which other ground disrupting activities, such as trawler fisheries, is forbidden also increases.
- The expansion of dredging locations, the provision of new dredging deposit locations, port enlargement and the construction of two energy atolls are the most important factors that could potentially jeopardise the realisation of a good environmental status in the context of hydrographical conditions. Given that there are currently no concrete plans for all these activities and facilities, the possible impact cannot be sufficiently estimated at this time. As and when such plans become available, the impact thereof must be investigated in-depth on a project level (project EIA), preferably on the basis of models. In so doing, particular attention must be paid to possible cumulative effects, such as the cumulative impact of the construction of an energy atoll in combination with a new dredging disposal location.
- In addition to the aforementioned pressure on the environment, both the MSP at hand (alternative 1) and the variant on the MSP at hand (alternative 2, i.e. the not considered variant on the MSP at hand) also offer very specific measures for better protection of the seabed and the valuable habitats compared to the current situation. In terms of sand and gravel extraction activities, there will be a redefinition of the sectors in control zone 2, whereby the valuable gravel beds between the sand banks will be excluded. There will also be a ban on extracting gravel in zone 2 (alternatives 1 & 2) and a gradual reduction in the permitted extraction volumes in this zone (alternative 1). The aim to achieve maximum bundling of cables (alternatives 1 & 2) and the choice of the option to make the landing point exclusively at Zeebrugge (alternative 2, i.e. the not considered variant on the MSP at hand; in alternative 1 landing of cables and pipelines is also possible in Ostend) also results in the retention of a larger zone with more limited seabed disruption. The permanent monitoring of both extraction

activities and wind farms will provide an improved insight into possible environmental effects that could lead to well-founded decisions (e.g. whether or not to close certain zones to extraction). In both alternatives, diverse limitations are also imposed on both the 'traditional' professional fishery and sport fishing compared to the existing situation, with the aim of limiting seabed disruption. More specifically, this concerns limiting the measures that must be taken in the four zones of the 'Vlaamse Banken' Habitats Directive area (alternative 1) or a total ban on both professional and sport fishing (alternative 2, i.e. the not considered variant on MSP at hand).

- It can thus be assumed that both the MSP at hand (alternative 1) and the variant on the MSP at hand (alternative 2, i.e. the not considered variant on MSP at hand) contribute towards the aim to achieve a good environmental status by 2020 for these relevant, defined elements (D1, D4, D6 & D7), and to achieve the other environmental targets.

- Shipping and the development of renewable energy also play an important role with respect to the other relevant defined elements D2 'Non-indigenous species introduced as a result of human activity', D8 'Pollution' and D11 'Energy (incl. underwater noise)', and their consequences for flora and fauna.
- The process of bringing the wind turbine zone to an operational state (alternatives 1 & 2) leads to <u>inconvenience for specific sea birds</u> (D1). On the one hand, there is direct mortality as a result of the birds colliding with the turbines (i.e. collision aspect) and, on the other, there are indirect effects such as the consequence of physical changes to the habitat and the barrier effect. The discussion of effects and the appropriate assessment has shown that there are no significant effects expected for sea birds compared to the reference situation. As a result, in the first instance, no threats are expected to the GES (defined elements D1 & D4). However, there is a significant gap in knowledge with respect to the collision aspect, i.e. the possible impact of all wind farms within the wind turbine zone on the population level. The most significant concerns involve the species in Appendix 1, the large tern, common tern and the little gull, which appear in concentrated numbers in the area during migration. Given the possible significant effects, the recommendation is to continue existing monitoring.
- The construction of wind farms and, more specifically, the pile driving activities involved in pile foundations, lead to a very clear <u>increase in noise levels</u> and this could, in turn, lead to significant effects for fish, sea birds and possibly other components within the ecosystem. Cumulative effects could occur if pile-driving activities take place in multiple wind farms within a radius of a couple of dozen kilometres at the same time. Despite their temporary nature, the activities are only acceptable if mitigating measures have been taken to reduce the detrimental impact of impulse noise on wildlife. Only then can the relevant environmental targets for underwater noise (D11) be achieved.
- Thirdly, an increase in the number of wind farms also involves the introduction of hard substrate. These new and artificial hard substrates are of huge significance for intertidal hard substrate species, for which there is little or no natural offshore habitat in the southern North

Sea. The wind farms will facilitate the introduction in the southern North Sea of a variety of species (including non-native species); this is known as the ‘stepping stone’ effect. This could form a possible threat for achieving the GES with respect to the defined element D2 (‘Non-indigenous species introduced as a result of human activity’).

- Finally, the presence of more wind farms also raises the chance of collisions with ships and, as a result, also the chance of possible oil pollution (D8). Shipping traffic will only change slightly compared to the reference situation; a shift has already taken place in the reference situation with respect to shipping traffic moving from the Thornton route to the Westpit (primarily as a result of the construction of the Rentel wind farm). The creation of a safe zone of 500 m around the complete wind turbine zone within which there will be a ban on all shipping traffic (with the exception of research and maintenance vessels), will mean little change in comparison to current practices.
- Both the MSP at hand (alternative 1) and the variant (alternative 2, i.e. the not considered variant on MSP at hand) prioritise getting the existing wind turbine zone fully operational. The discussed effects and relevance with respect to the achievement of the environmental targets are thus valid for both alternatives. Alternative 2 is perhaps less favourable for the defined elements D1, D2, D8 and D11 than alternative 1 given that alternative 2 (i.e. the not considered variant on MSP at hand) provides for research into a new wind turbine zone and the chance of negative effects on flora and fauna thus increases.
- Alongside the construction of offshore wind farms, other new developments could also cause collision risks for shipping with the corresponding environmental damage. Given the fact that the document at hand concerns a plan EIA, a detailed environmental assessment will be conducted at project level (project EIA) for the projects related to the construction of the energy atoll (energy storage structure), the ‘power outlet at sea’ (i.e. high voltage station) and possible sea port expansion.
- The prevention and precautionary measures proposed for both the MSP at hand (alternative 1) and alternative 2, such as a tug station, temporary emergency patrol locations... will fundamentally contribute towards the reduction of possible oil pollution and thus the achievement of a GES and thus to achieve the environmental targets for the Belgian marine waters.

TARGET: In the context of renewable energy and sustainable energy production, the target is to provide a capacity at sea of at least 2,000 MW.

Furthermore, the target of this Marine Spatial Plan is that all current projects for the generation of wind energy will be operational in the zone for renewable energy in 2019.

- Once the complete legal zone for the production of electricity from renewable sources is fully constructed and operational (alternatives 1 & 2), there will be a capacity of 2,200 – 2,400 MW from wind and wave energy at sea and this will fulfil the minimum requirement. The (further) construction of wind farms within the legal zone will have a clear, additional and positive impact on the reduction of greenhouse gas compared to the reference scenario. Given that the above alternative 2 provides for research into a new wind turbine zone, this alternative encompasses an even greater effect and alternative 2 is therefore the preferred choice in terms of this aspect.

TARGET: By 2019, additional insights must have been gained into the feasibility of various techniques for alternative forms of renewable energy in the BPNS. In the first instance, this would involve techniques in the context of wave energy.

- The legal zone for the production of electricity from renewable sources is indicated in alternatives 1 and 2 as the priority zone for testing alternative forms of sustainable energy generation. The availability of space for testing is the first step in the process of gathering knowledge.

TARGET: Finally, there is a target for testing active environmental measures in the zone for renewable energy. These measures for encouraging biodiversity must be sufficiently tested by 2019 in order for them to be deployed at other locations.

- Getting the current wind turbine zone fully operational (alternatives 1 & 2) and the delineation of a new wind turbine zone (alternative 2, i.e. the not considered variant on MSP at hand will signify an increase in hard substrate (artificial reef) compared to the reference situation. This new biotope introduced in a predominantly sandy environment will be colonised by flora and fauna typical of hard substrates and thus lead to increased biodiversity. The growth on the foundations and the richer macrobenthic communities of the sandy sediment will, in turn, provide more food for diverse predators, including fish and sea birds. The introduction of hard substrates may well also create a ‘stepping stone’ effect for non-indigenous species that could be detrimental for the North Sea ecosystem. Permanent monitoring of the environmental effect must provide further insights into the importance (or not) of these artificial reefs that encourage biodiversity and the achievement of a GES with respect to the defined element D2 ‘Non-indigenous species introduced as a result of human activity'. Given that the introduction of non-native (invasive) species could potentially lead to a significant loss of biodiversity, alternative 1 is preferred over alternative 2 (i.e. the not considered variant on MSP at hand).

3.2 Safety targets

TARGET: In the context of shipping, the target is to be able to continue to guarantee safe passage at sea and safe access to all Belgian ports, not only for the current generation of ships but also for ships in coming generations (larger dimensions, increased draught). This means, among other things, that sufficient space is continuously provided, throughout the planning period, for discharging dredging spoil in optimum conditions.

- Both alternatives fulfil this safety target via building in the necessary flexibility in the current dredging strategy on the basis of safe nautical access and evolution in ships (alternative 1) or the unconditional expansion of dredging locations (alternative 2 i.e. the not considered variant on MSP at hand).

TARGET: In the context of protection from the sea and flooding, we refer to the measure and targets from the Coastal Safety Master Plan.

- In terms of a safety target for the BPNS, there is intended protection against flooding of the entire coast in the long term. Both alternative 1 and alternative 2 provide for the execution of the Coastal Safety Plan. Given that the execution of the chosen measures for the Coastal Safety Plan will reduce the flooding risk compared to the situation without any additional measures by 81 to 100%, this safety target is met.

TARGET: Finally, another target relates to ensuring that the BPNS continues to provide sufficient space for retaining military exercises, which are reconciled with other activities and uses within the BPNS.

- The MSP at hand (alternative 1) does not provide for any modifications compared to the existing scenario. The total area for military use in the BPNS is relatively large but is only used on a temporary basis. In addition, consultations will be held with other users about delineation, the number of exercise days and the exercise periods (on the basis of breeding periods among other things). In alternative 2 (i.e. the not considered variant on MSP at hand), the location for military exercises is gradually reduced within the BPNS. Scrapping room for military use could hinder the organisation of military exercises and lead to Belgium being unable to fulfil its international military obligations. Space for military exercises is also important in terms of the country's defence.

3.3 Economic targets

The economic target of the MSP is to guarantee sufficient space within the planning period (2013-2019) for all economic activities at sea and is further specified as follows:

TARGET: All existing fishing grounds remain accessible, except for the delineated zone for renewable energy and subject to infrastructural constructions for coastal safety and energy storage and transport.

- Within the sub-zones of the ‘Vlaamse Banken’ Habitat Directive Area, there will be a limitation (alternative 1) or ban (alternative 2, i.e. the not considered variant on MSP at hand) with respect to fishing. Alternative 1 provides for a gradual transition to passive and alternative seabed disrupting techniques (multiple usage), but with possible, temporary negative effects on the Habitat Directive Area. Alternative 1 thus largely fulfils the target whereas this is not the case for alternative 2.

TARGET: Space is created for integrated aquaculture as a complementary activity for 'traditional’ fishing activities;

- Both alternatives fulfil this target. In the MSP at hand (alternative 1), integrated forms of marine aquaculture are limited to the concession zones Belwind I and C-Power. In alternative

2, these are expanded to the full zone for renewable energy. The concessions are provided under conditions and subject to agreement by the owner of the wind farm so that this will not result in any additional user-conflict.

TARGET: Corridors for cables and pipelines will be provided, reconciled to other activities around and uses of the BPNS and while keeping an eye on efficiency;

- Both alternatives provide for delineated corridors. Alternative 1 provides the necessary flexibility for installation *preferably* within these corridors, whereas this is a requirement of alternative 2.

TARGET: Sufficient sand and gravel extraction on the basis of the demand for building sand and gravel and work in the context of coastal defence;

- Alternative 1 retains the maximum permitted extraction volumes whereas alternative 2 (i.e. the not considered variant on MSP at hand) raises them. No limitations are therefore provided; the demand for building sand and gravel will therefore continue to be met. Alternative 2 also indicates an additional extraction area. Both alternatives may redefine control zone 2 on the basis of nature and shipping.

TARGET: The current zone for renewable energy must provide sufficient space for the generation of sustainable forms of energy.

- By making the zone for renewable energy fully operational, both alternatives fulfil this target.

TARGET: The Marine Spatial Plan provides spatial options for the growth of the Belgian ports;

- The MSP at hand (alternative 1), provides for a reserved zone for seaward expansion for the ports of Zeebrugge and Ostend in order to realise further economic development. There are currently no concrete needs or plans. Alternative 2 (i.e. the not considered variant on MSP at hand) proposes the retention of the current port areas and provides for the construction of an offshore port (logistics hub at sea).

TARGET: The existing space at sea for recreational activities will be retained as far as possible.

- Alternative 1 provides for retention of tourist/recreational options as far as is possible. Alternative 2 (i.e. the not considered variant on MSP at hand), in contrast, will limit these activities to specific zones. There is, however, no further information about this limitation.

TARGET: By the end of the plan horizon (2019), work on the realisation of the Belgian Offshore Grid must have started and there will be an electricity connection with Great Britain.

- Alternative 1 provides for a concession zone for an electricity connection with Great Britain (Nemo project) within the expansion of the European energy grid. Alternative 2 (i.e. the not considered variant on MSP at hand) does not make a specific consideration and therefore does not fulfil this target.

3.4 Cultural, social and scientific targets

TARGET: A social target for the BPNS is the maximum retention of the sea landscape (seascape) and the underwater legacy in the BPNS. The seascape is the landscape of the sea's surface up to the horizon; its integrity has significant perceived value for both the coastal resident and the tourist or recreational individual. The coast and the BPNS must therefore continue to form an appealing area for tourism and recreation in 2019.

- The construction of wind farms, energy atolls and port expansion result in disruption to the original seascape in many cases within both alternatives. Despite the fact that the modification in perceived value as a result of this damage to the landscape is a subjective given, there is no expectation that the perceived value will be reduced to such an extent that the coast and the BPNS will lose its appeal for tourism and recreation.

TARGET: The BPNS must also function as a space for research, education and monitoring. The existing accessibility to the BPNS for these activities must also be retained as far as possible in 2019.

- Alternative 1 is preferable in this context as it imposes no limitations on research, whereas alternative 2 (i.e. the not considered variant on MSP at hand) limits this to specific zones.

3.5 Conclusion

As a result of the variety of activities and potential environmental effects, it is not yet possible to make a clear choice between the alternatives at hand. Either alternative could be preferable, depending on the effect under consideration. Even though alternative 2 (i.e. the not considered variant on MSP at hand), for example, offers more guarantees for nature conservation via the complete exclusion of seabed disrupting fishing in the ‘Vlaamse Banken’ Habitats Directive Area, and provides a greater contribution to the reduction of greenhouse gases via the provision of an additional wind turbine zone, the option to expand certain activities within alternative 2 (new wind turbine zone, expansion of dredging locations, new zone for sand extraction, the construction of an offshore port, concession zone for energy atoll far off the coast) could lead to a heavier environmental burden (greater chance of disruption to fauna, collisions, oil pollution, etc).

Given the fact that the document at hand concerns a plan EIA, a detailed discussion of environmental effects and an environmental assessment will be conducted on project level (project EIA) for the diverse, newly proposed developments. As a result of the policy choices and on the basis of the precautionary principle, the MSP at hand (alternative 1) is more often preferable then alternative 2 (i.e. the not considered variant on MSP at hand).

On a strategic level, a clear consideration can be made in relation to the proposed targets. In general, an adequate guarantee can be provided that both alternatives are sufficient in terms of the environment and safety. A larger problem presents itself within the context of guarantees of the necessary space for all economic activities at sea. There is a question as to whether the ban, provided in alternative 2, on all fishing in the entire ‘Vlaamse Banken’ Habitat Directive Area may impose excessive limitations on the sector and that its viability will thus be jeopardised. On the other hand, this form of limitation on seabed disrupting fishery techniques may be the only way to guarantee the viability of the North Sea's ecosystem. Further research is recommended in this context. [Alternative 2 also limits tourism/recreational activities to specific zones. More information about the zones, however, has not yet been provided (given the fact that alternative 2 is the not considered variant on MSP at hand and consequently not further elaborated). Finally, alternative 2 does not explicitly support the expansion of the European energy grid. From an economic point of view, alternative 1 is therefore preferable.

In the context of scientific targets, the MSP at hand (alternative 1) is preferable as it imposes no restrictions in this regard and allows research to be carried out across the entire BPNS.

4. Alternatives and variants

An environmental impact report (EIR) estimates the relative importance of the impact of various alternatives by comparing the situation that will be created if plan alternatives and variants are implemented with the situation that is created if the plan is not implemented (zero alternative). This zero alternative thus forms the comparable basis for the other plan alternatives.

4.1 Proposed alternatives

The targets that Belgium has set itself for the plan horizon 2019 have been further elaborated into a more definitive representation of the spatial accents in the policy for each user and activity. This then provided a graphic plan that forms a summary of the binding options that the policy must adopt in the period 2013-2019 with respect to the spatial organisation in the BPNS. This Draft Marine Spatial Plan (MSP) forms the proposed alternative that will be considered in comparison to the zero alternative (the reference situation) and that will be studied in further detail in the plan EIA.

For a detailed description of spatial policy options, you are referred to the draft Marine Spatial Plan (Federal Public Service Health, Food Chain Safety and Environment – DG Environment, Marine and Environmental Services, 2012). A coordinated, graphic plan of these spatial policy options for the plan horizon 2019 is provided in Appendix 1.

Appendix 1: Maps of spatial policy options for the draft Marine Spatial Plan for the planning period 2013 - 2019

A number of important modifications compared to the existing situation (the zero alternative) can be summarised as follows:

- Maximise potential for multiple usage:

- More attention paid to nature by, for example, stimulating multiple use of space outside the current nature conservation zones and the partial limitation of ground disrupting activities;
- Stimulating sustainable energy by facilitating full operation of the zone that is delineated for wind energy, favouring the expansion of the European energy grid, and providing concession areas for an energy atoll and a zone for a 'power outlet at sea' (i.e. high voltage station);
- Do not expose possible port expansions and transport over the sea to future risk or constraint;
- Stimulating alternatives, sustainable fisheries in certain parts of the BPNS;
- Redefining sectors of sand and gravel extraction zone 2 on the basis of shipping safety and nature conservation, and a gradual reduction of extraction in this zone.

For a detailed description of alternative 1 (the MSP at hand), you are referred to Table 1.

4.2 Suggestions for additional alternatives

On the basis of additional justifications stated in the MSP at hand, a suggestion is made for an additional alternative (Alternative 2). Alternatives that have not been considered, as set out in the MSP at hand, form the departure point in this context.

The most important points of difference with respect to alternative 2 compared to the MSP at hand (alternative 1) can be summarised as follows:

- More intensive form of nature conservation:
- More prerequisites in relation to the location of cables and pipelines;
- Choice to provide concession zones for an energy atoll and a zone for a 'power outlet at sea' (i.e. high voltage station) at other locations and for an offshore port further out to sea;
- The reduction of the fishery sector and the decrease of the zones for military activities;
- (Further) limitation of research and recreational activities.

For a detailed description of alternative 2, you are referred to Table 1.

4.3 Summary of alternatives

Table 1 sets out the various alternatives compared to one another and provides the measures per user/activity for each alternative. This table also provides an overview of the reference scenario (zero alternative). The reference scenario ought to simulate the repercussions of the implemented and approved policy in Belgium up to 2019 on the BPNS.

The reference scenario contains current expertise on marine policy in the context of nature, energy, exploitation of natural sources, shipping, tourism, climate change,… working on the basis of the current targets and legal framework.

The reference scenario within this study is inspired by the first integrated plan, the so-called Master plan North Sea 2005, but has been updated according to legal provisions. The reference scenario is based on the legally established zones.

Table 1: Summary of various alternatives for strategic environmental assessment MSP

	ZERO ALTERNATIVE (reference scenario)	ALTERNATIVE 1 (MSP at hand)	ALTERNATIVE 2 (not considered variant on MSP at hand)
Nature conservation	Retention of contours and number of current nature conservation areas	Ditto zero alternative	Natura 2000 area 'Vlakte van de Raan' once again designated as a Habitat Directive Area in Belgian legislation
	Further elaboration and implementation of general nature conservation measures	Further elaborate and implement general and specific nature conservation measures. A specific measures for the SAC 'Vlaamse Banken' includes the designated zones for seabed protection (with restrictions for sport fishing and professional fishing).	Further elaborate and implement general and specific nature conservation measures. A specific measure for the 'Vlaamse Banken' includes the designation of zones for seabed protection (with complete ban on sport and professional fishing).
	Further reconciliation of measures with nearby nature conservation areas in France and on land	Ditto zero alternative	Further reconciliation with measures with nearby nature conservation areas in France and on land and with Dutch Natura2000 area 'Vlakte van de Raan' (when Belgian area is recognised once again)
	No intention for multiple spatial use on basis of nature conservation or compensation (outside nature conservations zones)	Stimulate multiple spatial use (outside nature conservation zones: integrated aquaculture, breeding locations Lesser Black-backed Gull, Terns island, artificial reefs…)	Stimulate exclusive spatial usage for nature conservation (outside nature conservation zones)
Energy (cables, pipelines, renewable energy)	Installation of cables and pipelines preferably bundled: no cables and pipeline corridors delineated.	Install cables and pipelines preferably bundled within delineated cable and pipeline corridors	Install cables and pipelines where possible within delineated cable and pipelines
	No further expansion of European energy grid	Additional cables and high voltage stations in relation to expansion of European energy grid and concession zone for electricity cable to Great Britain	Additional cables and high voltage stations on ad hoc basis, not therefore on basis of not yet elaborated (national or European) plans
	Zone for 'power outlet at sea' (i.e. high voltage station) at sea not provided	Zone for a 'power outlet at sea' (i.e. high voltage station) to the west of the wind turbine zone	Zone for a 'power outlet at sea' (i.e. high voltage station) nearshore
	Landing points for new cables and pipelines possible (in principle) within every municipality	Landing point for new cables and pipelines: Ostend (Slijkens) and Zeebrugge	Landing point for new cables and pipelines: only Zeebrugge
	Wind turbine zone retained/not expanded + permitted projects will be carried out (assumption: C-Power and Belwind 100% operational) + Northwind, Norther and Rentel 50-75% operational)	Wind turbine zone retained/not expanded + zone is fully operational	Wind turbine zone retained + zone fully operational + new zone sought (e.g. partial multiple use with sand and gravel extraction activities in exploration zone 'Hinderbanken')
	Concession zone for energy atoll (energy storage) not provided	Concession zones energy atoll (energy storage) nearshore	Concession zones energy atoll (energy storage) far from the shore
	Retention of safety perimeters	Ditto zero alternative	Expansion of safety perimeters
Shipping, port development and dredging work	Retention of current port areas	Not constraining the further expansion of the ports of Zeebrugge, Ostend, Nieuwpoort and Blankenberge: - equipped with reservation zone for port expansion (at Zeebrugge and Ostend) - possible relocation of Terns island	Retention of current port areas + construction of offshore port
	Retention of current dredging locations without flexibility	Retention of current dredging locations with flexibility in relation to safe nautical access and evolution of vessels	Expansion of dredging locations, without conditions
	Retention of dredging locations + no expansion with reservation zone	Retention of dredging locations + expansion with reservation zone for discharging dredged material	Designation of specific additional dredging deposit locations on basis of best available information
	No additional ship routing systems	Research into possible additional ship routing systems and start of procedure for announcing this to the IMO	Westpit route and connections between Belgian coast and UK via IMO statute to be upgraded
	No temporary emergency patrol stations in reservation area in the deep sea	Not constraining the possibility of emergency patrol stations in reservation area in the deep sea	Explicit space is provide for a temporary emergency patrol station
	No fixed tug station to serve Westpit, Ferry and rest of BPNS	Fixed tug boat station for Westpit, Ferry and rest of BPNS (multiple use)	Fixed tug boat station at location other than location of 'power outlet at sea' (i.e. high voltage station)
Fishing and marine aquaculture	Retention of current fishing grounds except for wind turbine zone and infrastructural constructions for coastal safety	Retention of current fishing grounds except for wind turbine zone and infrastructural constructions for coastal safety, energy storage and transport	Retention of current fishing grounds except for wind turbine zone and infrastructural constructions for coastal safety, energy storage and transport + ban in zones for seabed protection at SAC 'Vlaamse Banken'
	Retention of accessibility to Belgian fishing ports	Ditto zero alternative	Reduction of accessibility to fishing ports due to diminishing sector
	Alternative, sustainable fishing is not specifically stimulated + no zones for seabed protection provided	Stimulate alternative, sustainable fishing in parts of SAC 'Vlaamse Banken' + provide zones for seabed protection	Stimulate alternative, sustainable fishing in parts of SAC 'Vlaamse Banken'+ provide zones for seabed protection with full ban on fishing
	No marine aquaculture possible (concession zones and concessions suspended)	Marine aquaculture only possible in integrated forms + only in wind turbine zone (at Belwind I and C-Power) (multiple use)	Marine aquaculture only possible in integrated forms + only in wind turbine zone (in full wind turbine zone) (multiple use)
Sand and gravel extraction	Retention of four existing extraction areas	Redefinition of the sectors in zone 2 on basis of shipping safety and nature conservation	Redefinition of sectors in zone 1 on basis of shipping safety and nature conservation + designation of additional extraction areas
	Evaluation of closure of parts of the 'Kwintebank' on the basis of existing Royal Decree procedure for extraction	Evaluation of closure of parts of 'Kwintebank 'on basis of existing Royal Decree procedure for sand extraction without inclusion in the Royal Decree Marine Spatial Planning	Evaluation of closure of parts of 'Kwintebank' on basis of existence of Royal Decree procedure for sand extraction + inclusion of closure of parts of' Kwintebank' in the Royal Decree Marine Spatial Planning
	No ban on sand and gravel extraction in SAC ' Vlaamse Banken'	No ban on sand and gravel extraction in SAC ' Vlaamse Banken'	Ban on sand and gravel extraction in SAC 'Vlaamse Banken'
	Current maximum permitted existing extraction volumes	Retention of maximum permitted extraction volumes with gradual decrease of extraction in the habitat area	Increase of maximum permitted extraction volumes
Coastal defence	Retention of sufficient sand and gravel extraction areas for soft coastal defence	Ditto zero alternative	Restriction of sand extraction for soft coastal defence
	Implement Coastal Safety Master Plan	Implement Coastal Safety Master Plan + exploration of new options for coastal defence	Implementation of Coastal Safety Master Plan + exploration of new options for coastal defence (including raising existing sandbank systems)
	No concrete location for experiments provided	Concrete location for experiments in 'Broersbank'	Concrete location for experiments on other sand bank
Scientific research, beaconing, radars and masts	Possible anywhere unless otherwise specified	Ditto zero alternative	Limited to specific zones
Military usage	The BPNS provides sufficient space for military exercises and other military usage	Ditto zero alternative	The BPNS reduces the space for military exercises
	Sufficient consultation about contours and the use of various legally established zones on basis of good harmonisation with other activities and users	Ditto zero alternative	Ditto MSP
Tourism and recreation	Retain options for tourism/recreational option as far as possible	Ditto zero alternative	Tourism and recreational activities limited to specific zones
	No additional limitations	Ban on use of seabed disrupting techniques in whole SAC 'Vlaamse Banken'	Ban on use of seabed disrupting techniques for whole of BPNS

5. Link from the MSP to other relevant plans, programmes or projects (PPP)

Other PPP	Target or requirements of other PPP	Relation PPP - Marine Spatial Plan
Marine Strategy Framework Directive	Efforts for 'good environmental status' by 2020 for the marine waters.	Environmental measures for achieving Good environmental status 2020.
European Climate/Energy package (horizon 2013-2020)	EU commitment to cover 20% of energy needs by 2020 with renewable energy sources, to increase energy efficiency by 20% by 2020 and to reduce the emissions of greenhouse gases by 20% by 2020 all compared to the reference year of 1990.	Provision of zones for renewable and sustainable energy production.
Master Plan Coastal Safety (Masterplan Kustveiligheid)	Guaranteeing the protection of the coast against flooding during very a heavy storm, at least until 2050.	Need for retention of sufficient sand and gravel extraction areas on basis of soft coastal defence. Implement Coastal safety plan.
Flemish Bays (Vlaamse Baaien)	Spatial vision exercise with focus on coastal defence. Firstly, the added value of islands for coastal defence will be studied. Other functionality will also be examined.	Need for retention of sufficient sand and gravel extraction areas on basis of soft coastal defence.
North Seas Countries' Offshore Grid Initiative (NSCOGI)	Collaboration concerning the creation and expansion of an offshore energy grid in the North Sea (connection between the various offshore energy generation installations via cables and high voltage stations/'power outlets at sea').	Provision of options for realisation of a Belgian Offshore Grid, connection with UK (Nemo-project) and connection with the electricity network on land (Stevin-project), such as a zone for a power outlet-at-sea, concession zone for connection with the UK.
Fluxys projects	At the moment, additional offshore pipelines between Norway and Belgium are being investigated.	Provision of sufficiently spacious cable and pipeline corridors along the existing routes.

Study of dredging discharge locations	Study which evaluates the current dredging discharge locations on the basis of efficiency. A number of alternative search zones for a new disposal points are also being proposed. The investigation is ongoing.	Provision of reservation zones for alternative disposal locations.
Flan-Sea-research project	Research into the options of generating electricity from waves.	Provision of a zone for testing alternative forms of sustainable energy generation.
Research into opportunities for aquaculture in BPNS.	The Government of Flanders is starting a number of projects focussing on marine aquaculture in the BPNS.	Provision of zones for marine aquaculture.
Action plan 'Zeehond' (Seal Action Plan)	The objective is to transfer to a more 'offensive' (active) policy for more diversity in the North Sea. An investigation into whether it is possible to strengthen the presence of seals, porpoises and European oysters.	Provision of zones for research into offensive nature conservation measures.

6. Link with existing legislation/policy relating to targets for protecting the environment

Fout! Verwijzingsbron niet gevonden. provides an overview of the legal and policy framework that is relevant for the creation of the Marine Spatial Plan (MSP) at hand. The table indicates the relevance of legal or policy based prerequisites and the extent to which the MSP at hand is already taking these into account ('yes'/'no' respectively stands for 'the MSP is already/is not already taking into account these prerequisites').

The table mainly includes European legislation and, if available, there are also references to federal legislation and the judicial framework. A reference to the regional framework is provided for legislation that applies at a regional level. (INT = international; EU = European; FED = federal and FL = Flemish level).

Table 2: Legal and policy framework

Prerequisites	Level	Relation MSP
United Nations Convention on the Law of the Sea (UNCLOS 1982, in force since 1994)	INT	Yes
ESPOO, Convention on Environmental Impact Assessment in a Transboundary Context (1991)	INT	Yes
Plan horizon 2030	INT	Yes
Communication from the Commission to the Council and the European Parliament on Integrated Coastal Zone Management: a Strategy for Europe (COM/2000/547).	EU	Yes
Strategic Environmental Assessment Directive (SEA, 2001/42/EC) and Environmental Impact Assessment Directive (EIA, 97/11/EC and 03/35/EC)	EU	Yes
Integrated Maritime Policy (IMP) – Communication from the European Commission 10/10/2007 and Regulation 1255/2011, 30/11/2011 for establishing a programme of support for the further development of an Integrated Maritime Policy.	EU	Yes
Marine Strategy Framework Directive (2008/56/EC)	EU	Yes
Act concerning the assessment of the impact of certain plans and programmes on the environment and the public participation in developing plans and programmes in relation to the environment (13/02/2006)	FED	Yes
Royal Decree Marine Strategy for Belgian maritime areas (23/06/2010)	FED	Yes
Act concerning exploration and exploitation of non-living resources in the territorial sea and the continental shelf (13/06/1969) (amended by act of 20/01/1999, 22/04/1999 and 22/12/2008)	FED	Yes

Prerequisites	Level	Relation MSP
Act concerning the Belgium's exclusive economic zone in the North Sea (22/04/1999)	FED	Yes
Act protecting marine environment in maritime areas under the jurisdiction of Belgium of 20/01/1999 (amended by act of 17/09/2005, 21/04/2007 and 20/07/2012)	FED	Yes
Royal Decree concerning procedure for permitting and authorising certain activities (07/09/2003)	FED	Yes
Royal Decree concerning rules for the environmental impact assessment (09/09/2003)	FED	Yes
Water Framework Directive (2000/60/EC)	EU	Yes
Royal Decree concerning the establishment of a framework for achieving a good surface water status (23/06/2010) (amended by Royal Decree 17/05/2012)	FED	Yes
RAMSAR (1971-1975)	INT	Yes
Bonn Treaty (1979)	INT	Yes
ASCOBANS agreement (1992)	INT	Yes
Bern Treaty (1979)	INT	Yes
OSPAR (1992, 1998)	INT	Yes
Treaty concerning Biodiversity from Rio de Janeiro (signed in 1995, published 02/04/1997)	INT	Yes
Habitat and Bird Directive (92/43/EC and 79/409/EC)	EU	Yes
Marine Environment Act (20/01/1999) (amended by act 03/05/1999, 17/09/2005, 21/04/2007 and 20/07/2012)	FED	Yes

Prerequisites	Level	Relation MSP
Royal Decree concerning the protection of species (21/12/2001)	FED	Yes
Royal Decree concerning the establishment of special protection zones and special zones for nature conservation (14/10/2005, amended by Royal Decree 16/10/2012)	FED	Yes
Royal Decree concerning the conditions, connections, execution and termination of user agreements and the creation of policy plans for protected marine areas (14/10/2005) (amended by Royal Decree 05/03/2006 and 16/10/2012)	FED	Yes
Royal Decree concerning establishment of a marine reservation, the 'Baai van Heist' (05/03/2006)	FED	Yes
UNESCO Convention on the protection of underwater cultural heritage (2001)	INT	Yes
International Council on Monuments and Sites (ICOMOS) Charter on the protection and management of underwater cultural heritage	INT	Yes
Act concerning the discovery and protection of wrecks (09/04/2007)	FED	Yes
Dune decree (Duinendecreet) (1993)	FL	Yes
Reviewed Air Quality Framework Directive (2008/50/EC)	EU	No
Directive 1999/32/EC relating to a reduction in the sulphur content of certain liquid fuels, amended by Directive 2012/33/EC	EU	No
Kyoto Protocol	INT	Yes
European Climate/Energy package (horizon 2013-2020)	EU	Yes
United Nations Convention on the Law of the Sea (UNCLOS 1982, in force since 1994)	INT	Yes

Prerequisites	Level	Relation MSP
NSCOGI (North Seas Countries' Offshore Grid Initiative) – Start up of European energy grid (memorandum of understanding, 03/12/2010)	INT	Yes
European Climate/Energy package (horizon 2013-2020) and EU directive on renewable energy sources 2009/28/EC and Action plan from the EU for energy security and solidarity (Energy Roadmap)	EU	Yes
Act concerning exploration and exploitation of non-living resources in the territorial sea and the continental shelf (13/06/1969) (amended by act of 20/01/1999, 22/04/1999 and 22/12/2008)	FED	Yes
Marine Environment Act (20/01/1999) (amended by act 03/05/1999, 17/09/2005, 21/04/2007 and 20/07/2012)	FED	Yes
Act concerning Belgium's exclusive economic zone in the North Sea (22/04/1999)	FED	Yes
Royal Decree concerning conditions and procedures for obtaining a domain concession for the construction and exploitation of installations for the production of electricity from water, flows or winds (20/12/2000, amended by Royal Decree 17/05/2004, 28/09/2008 and 3/02/2011)	FED	Yes
Belgian Action Plan for renewable energy (2010)	FED	Yes
Royal Decree electricity cables (12/03/2002) (amended by 19/12/2010)	FED	Yes
Royal Decree for establishing a safety zone around the artificial islands, installations and facilities for generating energy from water, flows and winds (11/04/2012)	FED	Yes
Act concerning the organisation of the electricity market (29/04/1999) (amended on numerous occasions; last amendment dates to 27/12/2012)	FED	Yes

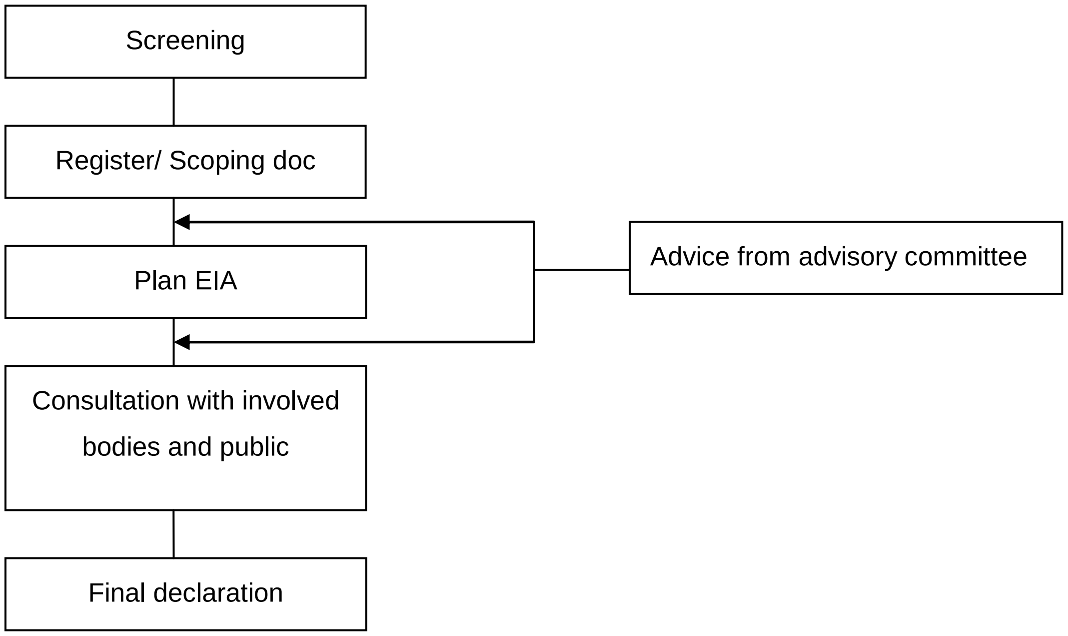
Prerequisites	Level	Relation MSP
Royal Decree concerning the conditions, geographical borders and allocation procedure for concessions for the exploration and exploitation of mineral and other non-living resources (01/09/2004)	FED	Yes
United Nations Convention on the Law of the Sea (UNCLOS 1982, in force since 1994)	INT	Yes
GNA (Joint Nautical Authority) in the Scheldt area (2005)	INT	Yes
COLREG (1972)	INT	Yes
IMO (International Maritime Organisation)	INT	Yes
MARPOL (International Convention on the Prevention of Pollution from Ships,1973-1978)	INT	Yes
Bonn Accord (1983)	INT	Yes
Marine Environment Act (20/01/1999) (amended by act 03/05/1999, 17/09/2005, 21/04/2007 and 20/07/2012)	FED	Yes
Royal Decree concerning the procedure for authorising disposal in the North Sea of particular substances and materials (12/03/2000)	FED	Yes
Act concerning exploration and exploitation of non-living resources in the territorial sea and the continental shelf (13/06/1969) (amended by act of 20/01/1999, 22/04/1999 and 22/12/2008)	FED	Yes
Marine Environment Act (20/01/1999) (amended by act 03/05/1999, 17/09/2005, 21/04/2007 and 20/07/2012)	FED	Yes
Act concerning Belgium’s exclusive economic zone in the North Sea (22/04/1999)	FED	Yes

Prerequisites	Level	Relation MSP
Royal Decree concerning the conditions, geographical borders and allocation procedure for concessions for the exploration and exploitation of mineral and other non-living resources (01/09/2004)	FED	Yes
Decree concerning the delineation of sectors in exploration zone 4 for the exploration and exploitation of non-living resources (24/12/2010)	FED	Yes
Common Fisheries Policy and revision of the Common Fisheries Policy (2012)	EU	Yes
National Strategy and Operational Programme 2007-2013	FED	Yes
Royal Decree concerning the establishment of supplementary measures for the maintenance and management of fish stocks and for control of fishery activities (14/08/1989, amended by Royal Decree 12/04/2000)	FED	Yes
SOLAS (1974/1978)	INT	Yes
OSPAR (1992, 1998)	INT	Yes
COLREG (1972)	INT	Yes
IMO (International Maritime Organisation)	INT	Yes
MARPOL (International Convention on the Prevention of Pollution from Ships,1973-1978)	INT	Yes
Bonn Accord (1983)	INT	Yes
Master Plan Coastal Safety/Integrated Coastal Safety Plan (10/06/2011)/Public Works plan Ostend and Zwin project	FL	Yes

Prerequisites	Level	Relation MSP
Roadmap for Maritime Spatial Planning: Achieving Common Principle in the EU (Communicationfrom the European Commission, 25/11/2008)	EU	Yes
Master Plan North Sea, 2005	FED	Yes
Marine Environment Act (20/01/1999) (amended by act 03/05/1999, 17/09/2005, 21/04/2007 and 20/07/2012)	FED	Yes
Royal Decree concerning the establishment of an advisory committee and the procedure for acceptance of a Marine Spatial Plan in the Belgian maritime areas (13/11/2012)	FED	Yes
“Spatial management in Flanders” Policy plan (Ruimte Vlaanderen)	FL	Yes
Spatial Structure Plan for Flanders (RSV) and Provincial Structure Plan West - Flanders (PRS-WV)	FL	Yes
Spatial management in Flanders Policy plan (Ruimte Vlaanderen)	FL	Yes
Provincial Spatial Implementation Plan (PRUP) Beach and Dike (2005, ongoing review)	FL	Yes
Regional Spatial Implementation Plans (GRUPs) for the delineation of areas for natural and agricultural structure (2009)	FL	Yes

After the final amendments, a final declaration will be drawn up. This final declaration will provide clarity in terms of which environmental arguments have been considered within the Marine Spatial Plan and how this took place. In addition, an overview will be provided of how the various consultations (involved bodies, cross-border discussion, public consultation) took place. Finally, an overview will be provided regarding the primary recommendations for monitoring during the implementation of the Marine Spatial Plan.

Figure 1: Summary of the process for the plan EIA



PART 2 Methodology applied

1 Methodological approach for the plan EIA

The aim of a plan EIA is to supply the necessary basis with respect to the choice of the best alternative. The plan EIA looks at the effects on a macro level. This means determining whether a spatial policy option may or may not be permitted. In a later EIA project, the effects will be further elaborated at a micro level where necessary.

Based on the spatial policy options, the primary potential effects that can be reasonably expected as a consequence of the spatial plan are defined and evaluated. The evaluation takes place in a qualitative to semi-quantitative manner. The determining factors within an environmental evaluation are the severity and scope of the effect and the vulnerability of the environment which will bear these effects.

Given the fact that the subject of the plan EIA is the spatial vision of the BPNS for the plan period 2019, including all users and activities at sea, the defined effects will be mainly cumulative in nature. The plan area covers the entire Belgian maritime zone and, as a result, potential cross-border effects with the adjoining countries cannot be avoided.

PART 3 Discussion and evaluation of effects

In the plan EIA, the positive and negative impact of the alternatives will be set out. Within this, a scale and detail level is applied as is relevant for the developed alternatives, reconciled with the level of certainty with which the intended conditions have been formulated.

On the one hand, the check takes place on a more strategic level, whereby the spatial policy options for the various alternatives are measured against the proposed targets of the MSP for the plan horizon 2019 in relation to environmental, safety, social, cultural and scientific aspects. On the other hand, the alternatives are considered in relation to the reference situation/scenario (zero alternative).

The 'study plan area' encompasses the Belgian Part of the North Sea (BPNS). Certain environmental effects that relate to this study, however, will also have consequences outside the plan area (cross-border effects). The delineation of the 'study area' (area within which the effects are considered relevant and thus studied) will take place in relation to each, individual environmental effect. Alongside the delineation of the study area, the current and future situation relevant for the environmental effect will be defined separately. In this way, the environmental effects can be read as individual files.

The proposed alternatives could also have significant effects for the delineated NATURA 2000 areas. The appropriate assessment will be conducted for the MSP at hand according to the requirements of Directive 92/43/EC, whereby the various alternatives will be checked to the maintenance targets (both for habitat types and for relevant species).

1 Seabed disruption (incl. turbidity)

1.1 Delineation of the study area

The seabed will be influenced by diverse activities. Given that the seabed is of fundamental importance for the ecosystem in the North Sea, every single activity – even along the edges – can have significant and sometimes persistent consequences for the marine environment, resulting in the seabed undergoing (what may or may not be tiny) changes. The study area for seabed disruption subsequently covers the entire BPNS.

1.2 Defining and evaluating the effects

1.2.1 Estimating the effects

When carrying out or creating the above activities and facilities, the seabed will be disrupted. Within this, there is also the issue of damage to the seabed, such as the permanent loss of the original seabed. Generally, the extent of the impact depends on the surface area that is disrupted. Seabed disruption goes hand in hand with an increase in the turbidity of the seawater and the loss of seabed organisms (benthos).

Sand and gravel extraction

Sand extraction is the primary activity in the BPNS. The principal effect of sand extraction is a lowering of the seabed as a result of removing the original substrate. A few possible secondary effects from a change in seabed topography include changes to the hydrodynamic processes and effects related to the sediment balance that is disrupted (see chapter 'Changing physical process'). Depending on the dynamics of the areas, extraction tracks of up to 0.5 m deep (wells or trenches) remain visible for 1 to 4 years. Four years must be considered necessary for complete (ecological) recovery (Seys, 2003). When material is removed, it is not expected to be replaced as a result of a supply from elsewhere but rather will be compensated by material that is available locally, e.g. in the channels (IMDC, 2010).

Alongside the creation of trenches or wells, intensive extraction can cause the depression of an entire area, such as is the case at two areas on the 'Kwintebank' (KBMA and KBMB, closed since 2003 and 2010 respectively). After intensive extraction, recovery will take longer. The exact duration, however, cannot be estimated. The question is rather whether recovery will take place at all after intensive extraction (Pichot, 2006). Both the extraction activities and the consequences for the environment are currently being monitored. An area is definitively closed if the area has been exploited to a depth of 5 metres under the reference level.

During extraction, a large plume develops that can stretch over several kilometres, as a result of transferral and the removal of mud/sludge and sand with undesirable granular dimensions. It is expected that the temporary increase in turbidity when extracting sand will be less significant than the concentrations that occur naturally during storms (IMDC, 2010).

Dredging and discharging dredging spoil

Dredging work that is necessary in order to maintain accessibility to Belgian ports encompasses the movement of sediment. During deep dredging work, the original seabed in the channel is removed, while maintenance dredging work only removes sediment from the already disrupted seabed (i.e. where earlier dredging work has been undone as a result of sedimentation).

The dredged sediment is discharged once again elsewhere in the sea. The discharging process creates significant, temporary turbidity. The fine material is separated from the coarse sediment and continues to shift. After sinking, both the fine and the coarse fractions create seabed coverage and change the bed composition.

Constructing wind farms

Depending on the type of foundation used for the wind turbines and the local dynamic of the seabed, the naturally soft seabed can be destroyed. If using monopile or jacket foundations, that are driven, the seabed will only undergo limited and temporary disruption during the construction phase. The surface area of original seabed that is permanently lost will also be limited (ARCADIS Belgium, 2011; Rumes et al., 2011a).

If using gravitational foundations, a substantial quantity of material must be dredged in order to prepare the seabed and then 'stored' elsewhere temporarily in the relevant concession zone. Additionally, more sand must be dredged to backfill and infill the gravitational foundations than is available in 'stock' in the concession zone. This additional demand for sand cannot be extracted from the concession zone but will have to be extracted in the sand extraction zones provided (Rumes et al., 2011a). After installation of the wind turbines, a large area of original seabed around the gravitational foundations will be permanently modified in light of the large scope of the foundations (including erosion protection).

Turbidity will temporary increase while the monopiles are being driven, during excavation of the gravitational foundation wells, when installing erosion protection or as a result of forming the erosion wells. This increase in turbidity is generally expected to remain limited in terms of both time and space. At locations where the Quaternary is thin to non-existent and where, as a result, tertiary clay layers (can) occur, there may well be a clear and long-term increase in turbidity (Rumes et al., 2011b).

For further details about the possible environmental impact as a consequence of wind farms, you are referred to the various EIA projects drawn up as part of the permits for existing wind farms (Ecolas, 2003; ARCADIS Belgium, 2003, 2007, 2008, 2011; IMDC, 2012).

Laying cables and pipelines

When digging in cables and pipelines, the bed material that is present will be removed and/or moved via ploughing, jetting, using a mechanical machine or dredging (or a combination hereof). This concerns damage to the original seabed that is limited both in area and depth. After installation, recovery will be swift given the substantial natural dynamic of the seabed. The effect of seabed disruption is thus very temporary in nature (ARCADIS Belgium, 2013).

The extent of the increase in turbidity in the seawater during the installation of cables and pipelines depends on the excavation technique used. This effect is also limited in scope and will be of a temporary nature.

Fisheries

In the context of fisheries, it is primarily trawler fishing that has a negative impact on the seabed, principally as a result of the high intensity of the interaction and not as a result of the fished area (Polet et al., 2010). Trawler fishing involves the upper layer of the seabed being constantly churned. Measurements have shown that the flatfish trawler, as a result of its pressure on the seabed, penetrates between 1 and 8 cm deep and changes the morphology (Depestele et al., 2008). Trawler fishing leaves detectible tracks that are visible for up to several days (Van Lancker et al., 2011). In general, the fishery activities are concentrated in the channels between the sand banks and have the highest impact along the inclines of the sand banks.

In terms of catch and value, trawler fishing makes up 85% of the industry in Belgium.

Coastal defence

The implementation of various types of coastal defence can lead to a range of effects on the environment. For a full discussion and evaluation of the various, options for coastal defence that have been studied and their possible impact on the environment, you are referred to the plan EIA in the Integrated Coastal Safety Plan (Resource Analysis, 2010).

Effects that can be linked to beach replenishment can be related to the area of the ‘disrupted’ beach bed, the volume of supplementary material (including the volumes required for maintenance) and the granular dimensions (sediment characteristics) The high dynamic in coastal zones means that seabed disruption is not considered to be anything like a permanent effect. In terms of seabed disrupting effects, front bank supplements are similar to beach supplements with the only difference being that more sand will be required for a front bank supplement than for classic beach replenishment and the seabed disruption will thus be greater.

Beach replenishment can also be combined with the creation of a groyne, for example. The effect of a groyne is twofold in terms of the bed. On the one hand, the creation of a groyne leads to the disruption (hardening) of a particular area on the beach bed. On the other, the groyne is capable of more effectively ‘fixing’ the supplements. This means that, over a long period, less maintenance will be required and that, as a result, less earth will have to be moved.

When installing storm flood defences, parts of the seabed will be excavated and hardened. This disruption is considered to be negligible given the fact that this involves the channel in the port where the seabed is disrupted by regular dredging work, the seabed in the port is largely separated from the natural coastal dynamic and that this covers a relatively small surface area.

The creation of an energy atoll

The creation of an energy atoll means the permanent loss of the original seabed. There are no current, concrete plans for this type of energy atoll. Several draft plans, however, have been elaborated (including Ecorem, 2013). A feasible plan is a pumped storage hydro-electric power station which creates a deep basin. The construction involves building dikes and dredging the atoll to create the basin. The excavated sediments from the power station facility can then be used as material for the dikes. The dikes can be partially built using natural materials (sand and gravel), alongside other synthetic materials (concrete crown blocks).

A possible plan for the energy atoll at Zeebrugge links into the port expansion and covers an area of ca. 265 ha. For the energy atoll in front of the coast of Blankenberge-De Haan, an elliptical island is planned, with dimensions of ca. 2,250 m by 3,500 m.

In addition to the permanent loss of seabed, during the construction phase there will be increased turbidity as a result of dredging work.

Port expansion

The port expansion at Ostend and Zeebrugge and the construction of an offshore port will lead to permanent loss of the original seabed. New port land will probably also have to be created via land reclamation. There is no way to estimate the scope of the effects for the moment.

Impact on the benthos communities

Disruption of the seabed results in intrinsic disruption of the benthos (seabed organisms). Disruption can involve coverage (with hard structures or sediment), movement or the removal of benthos altogether. The discharge of dredging spoil, for example, leads to the benthos organisms suffocating as a result of being covered. It is known that benthic communities can put up partial resistance to sediment coverage but that they struggle with chronic discharging activities (Federal Public Service Health, Food Chain Safety and Environment - DG Environment, 2010).

Dredging work in the broadest sense, i.e. for maintenance and deepening of channels, the construction of wind farms, energy atolls or sand extraction, causes a direct loss of benthic species and organisms as a result of the removal or suction of sediment. The extent of disruption depends on the quantity of sediment that is removed and the area covered by and depth of the dredging work. The removal of the substrate leads to the loss of or changes to the biotope which corresponds to the benthos. A change in the sediment composition can bring about a shift to other benthic communities (IMDC, 2010). Long term research into the biological impact of sand extraction has not shown any significant negative effects on the macrobenthos (De Backer et al., 2011). This conclusion is based on results from sampling in areas where intensive extraction has led to seabed depressions. Recolonisation of macrobenthos takes just 1 to 2 years; recovery of the biomass takes 2 to 5 years.

In terms of the short term effects of trawler fishing on benthos, Depestele *et al.* (2008) formulated the following conclusions: there is a reduction in the abundance of less-productive and slowly reproducing species and increasing dominance of highly productive opportunists and scavengers. There is also a reducing diversity of species. These effects are habitat dependent.

The increase in the turbidity of the seawater can have a negative impact on certain filter-feeder organisms. The filter mechanisms which the organisms use to sieve food particles from the water can become blocked. Raised turbidity also influences the local light climate and thus the phytoplankton (algae). The fact that phytoplankton forms the base of the food chain means that the raised turbidity can have an impact on organisms that are located higher in the food chain, such as birds, fish and sea mammals.

In many cases, the increased turbidity that is created as a result of seabed disrupting activities can have a similar scope as the increased turbidity that is caused by natural storms. It can be assumed that most organisms are resistant to this type of natural dynamic. The duration and frequency of the increased turbidity, however, is the determining factor for survival chances, certainly when it comes to cumulative effects (increased turbidity caused by multiple activities in the same area simultaneously or on a consecutive basis). This cumulative effect corresponds to a gap in knowledge.

1.2.2 Comparing the effects of the various alternatives

Sand and gravel extraction

Both alternatives provide for a redefinition of the sectors in zone 2 for sand and gravel extraction. As a result, the valuable gravel areas between the banks are excluded. There is also a ban on gravel extraction in zone 2 (alternatives 1 & 2) and a gradual reduction of the extractable volume in this zone (alternative 1, i.e. MSP at hand). Compared to the reference situation, this means an improvement in terms of seabed disruption within the Habitat Directive Area 'Vlaamse Banken'.

In contrast to the zero scenario and the MSP at hand (alternative 1), in alternative 2 in alternative 2 the closure of certain parts of the Kwintebank is legislatively anchored in the Royal Decree MSP and this offers exra protection against further seabed disruption.

On the other hand, in alternative 1, the maximum extraction volumes are maintained while alternative 2 reduces them. Alternative 2 also designates an additional extraction area. This means that (more intensive) extraction will take place at other locations and will cause the corresponding seabed disruption. Given that the other control zones (1, 3 and 4), lie outside the 'Vlaamse Banken' Habitat Directive Area, the impact on the ecosystem in alternative 1 is more limited than in the reference situation. For alternative 2, the additional pressure will depend on new maximum volumes and the location of the extra zone which is so far unknown.

Dredging and discharging dredging spoil

Both alternatives provide for the option of expanding dredging locations. This means, as a result, that there will be an increase in seabed disruption compared to the reference scenario.

The provision of new dredging locations (alternative 2) or a reservation zone for an alternative discharging location (alternative 1) could lead to less intensive use of the existing discharging locations and could thus be regarded as an improvement in relation to the reference scenario. On the other hand, there will then be new seabed disruption within an area that has not previously been disrupted by dredging discharge activities. Given that the research into the most suitable new dredging locations is currently ongoing, the designation of a more spacious reservation zone is currently the preferred option.

Constructing wind farms

Seabed disruption increases with the accelerated construction of wind farms. In this respect, alternatives 1 (the MSP at hand) and 2 (not considered variant of the MSP at hand) offer a deterioration in the environment (seabed disruption) compared to the reference situation. Alternative 2 is, however, more negative than alternative 1 given that alternative 2 provides for a new wind turbine zone which will lead to increased seabed disruption. It must, however, be noted that the cumulative effect of seabed disruption as a result of multiple wind farms can be less accurately estimated than the sum of the effects of the individual wind farms (ARCADIS Belgium, 2011). The cumulative effect of seabed disruption only becomes negligible if gravitational foundations are used, and this is not very likely with wind farms. Current wind farms tend to use pile foundations.

On the other hand, the increasing construction of wind farms also increases the area within which shipping, including trawler fishing, is banned. Once all wind farms have been built, a total area of ca. 240 km² will no longer be available for fishing activities.

Laying cables and pipelines

The work on realising maximum bundling of cables (alternatives 1 & 2) and the choice of the option of making a landing point at Zeebrugge (alternative 2) result in the retention of a larger zone with more limited seabed disruption as a result of the installation of cables and pipelines. In this context, both alternatives offer an improvement compared to the reference scenario.

The extent of disruption increases as a result of an increasing number and increasing lengths of electricity cables. Both the MSP at hand (alternative 1) and the variant on this (alternative 2) provide for the installation of various new electricity cables in the context of the expansion of a Belgian and European energy grid (including the Nemo-project) and the connection of one or more energy atolls to the electricity grid on the mainland. On the other hand, the creation of a power outlet at sea (i.e. high voltage station) corresponds to a significant reduction in the number of export cables for wind farms. The option to install the power outlet at sea (i.e. high voltage station) to the west of the existing wind turbine zone (alternative 1, with a short distance for many cables from various wind farms to the power outlet and a long distance for a limited number of cables from the power outlet to land) will probably require a more limited total cable length than is the case for a power outlet at sea nearshore (alternative 2, with a long distance for many cables from various wind farms to the power outlet (i.e. high voltage station), and a short distance for a limited number of cables from the power outlet to land).
The location of an energy atoll close to the coast (alternative 1, MSP at hand) also requires limited cable length to the mainland compared to a situation in which the atoll lies far out to sea (alternative 2, not considered variant on MSP at hand).

Alternative 2 also involves the installation of new cables for wind farm cabling and connecting the new wind turbine zone to the electricity grid on the mainland; this may or may not take the form of a connection to the Belgian offshore energy grid. The length of the export cable depends on the distance from this new wind turbine zone to the coast or the proximity of the power outlet at sea (i.e. high voltage station).

Given that the MSP at hand (alternative 1) involves more limited lengths of cabling compared to alternative 2 and, as a result, less seabed disruption, alternative 1 is the preferred option.

Fisheries

Both the MSP at hand (alternative 1) and alternative 2 impose certain limitations on both ‘traditional’ professional fishing and sport fishing compared to the existing situation. Both alternatives stimulate alternative, sustainable fishing in parts of the 'Vlaamse Banken’ Habitat Directive Area. In alternative 1, four zones are provided in order to test and facilitate the transition to passive and alternative seabed disrupting techniques. These seabed protection zones are designated within the sub-areas A and C of the Habitat Directive Area ‘Vlaamse Banken’. Scientific reports have shown that sub-areas A and C encompass habitat types that are most sensitive to seabed disruption.

Alternative 2 imposes a full ban on fishing in the seabed protection zones. In alternative 1, the use of seabed disrupting techniques in the context of sport fishing is banned throughout the ‘Vlaamse Banken’ Habitat Directive Area, while this ban is expanded within alternative 2 to include the entire BPNS.

Given the size of the area in alternative 2 that is exempted from seabed disrupting fishing, this alternative is the preferred option. Both alternatives are an improvement regarding to the zero alternative (reference situation).

Coastal defence

Both the MSP at hand (alternative 1) and the not considered variant on the MSP at hand (alternative 2), provide for the (further) implementation of the Coastal Safety Plan. In light of the fact that alternative 2 proposes restrictions on sand extraction for soft coastal defence, this could result in more limited seabed disruption and disruption to the corresponding benthos communities (as long as the limitation on sand extraction for soft coastal defence is not offset by an increase in sand extraction for commercial purposes).

Both alternatives stimulate the exploration of new options for coastal defence by providing for an experimental location. Alternative 1 designates a location at Broersbank (within the Habitat Directive Area 'Vlaamse Banken’), while alternative 2 offers a location outside the Habitat Directive Area ‘Vlaamse Banken’. In light of the presence of valuable habitats within the Habitat Directive Area ‘Vlaamse Banken’ that could be affected by the experiments, a location for experiments outside this Habitat Directive Area is preferred.

The creation of an energy atoll

With respect to the creation of an energy atoll, there is no preference for either alternative 1 or 2. Both would mean a permanent loss of seabed compared to the reference situation, which equates to the surface area of the concession zone (similar for both alternatives). Both alternatives result in a restricted loss of seabed surface.

Port expansion

Given that there are no concrete plans for port expansion during the planning period 2013-2019, no distinction can be made between alternatives 1 and 2.

1.3 Proposal for mitigating measures and monitoring

- Technical amendments to dredging vessels to limit the quantity of air in the dredging spoil, thus reducing the dispersion in the churned water ('anti-turbidity' systems).
- Use of alternative fishing methods instead of classic trawling.
- With reference to coastal defence, all measures that could contribute towards less supplementary sand having to be applied are positive, given that the effects of seabed disruption are closely related to the quantities of supplementary material used. Possible measures include choosing hard measures (possibly in combination with supplements), opting for sand with a coarser granular diameter and selecting maintenance-limiting measures (e.g. groynes, front bank supplements).
- Monitoring special habitat types (including gravel beds, areas of special ecological value).
- Monitoring the impact of seabed disrupting fishing, extraction activities, dredging (discharging) activities, construction of wind farms… on seabed integrity.
- Monitoring the increase of turbidity as a result of these activities.
- Monitoring and research on the impact of non-seabed-disrupting and alternative fishing techniques

2. Modifying physical processes (including disrupted erosion sedimentation pattern, hydrodynamics)

2.1 Delineation of the study area

Diverse activities and new infrastructure have an impact on the original morphology of the seabed. The modified morphology of the seabed can, in turn, cause changes in the hydrodynamics and the erosion/sedimentation pattern (or vice versa). Such changes can lead to large scale damage to marine ecosystems. That is why the entire southern section of the North Sea has been included as a study area.

2.2 Definition and evaluation of the effects

2.2.1 Estimating the effects

Sand and gravel extraction

Results from monitoring have shown that morphological depressions can be created in the seabed in intensively extracted areas. Nevertheless, the physical impact remains local. Years after extraction is halted, it has been discovered that the morphological changes, observed during the extraction process, have come to an end but that no significant regeneration has taken place (Degrendele *et al.* 2010 *in Belgische Staat, 2012a*). The lengthy depressions are, on the one hand, flow trenches that channel the tidal flow while, on the other, they capture sediment and allow fine sediments to be deposited when the tide is turning (Garel, 2010; Bellec et al., 2010 in *Belgische Staat*, 2012a). *Far field* effects and an impact on coastal safety and the stability of the sand bank could not be demonstrated (Verwaest 2008; Van den Eynde et al., 2010a; Van Lancker et al., 2011 in *Belgische Staat*, 2012a).

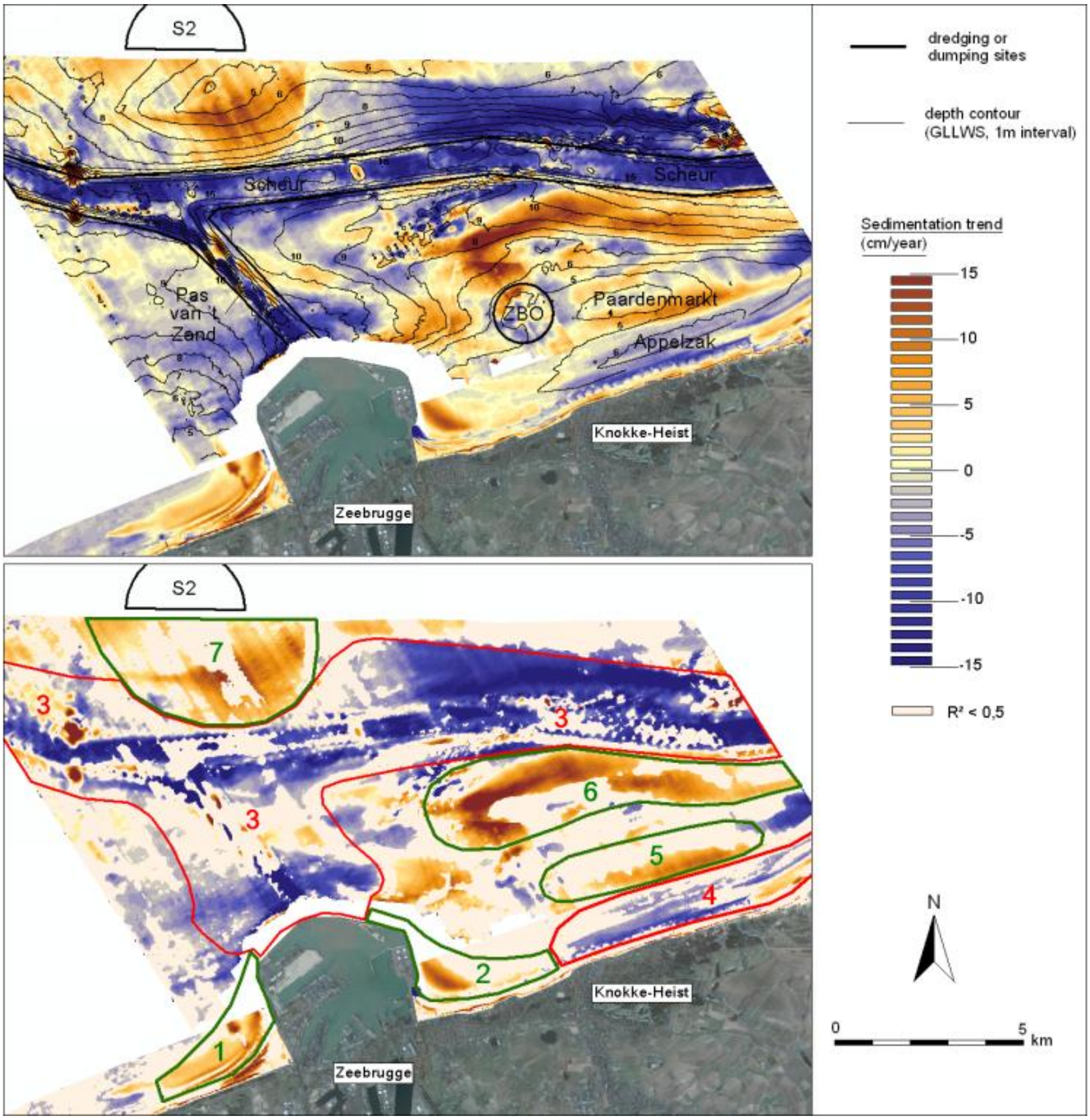
Dredging and discharging dredging spoil + Port expansion

Morphological changes in the eastern coastal zone that came about during the last few decades are a direct (deepening work, port construction, discharging operations) or indirect (changes in erosion/sedimentation pattern via disruption of the hydrodynamics) consequence of human intervention. These changes to beaches, the front bank and coastal zone have been investigated on the basis of bathymetric contrast mapping and trend analyses (Van Lancker *et al.* 2011 *in Belgische Staat, 2012a*). Figure 3 indicates erosion and sedimentation patterns around the port of Zeebrugge. The upper figure shows all trends; the figure below only shows the trends with an $R^2>0.5$. The sedimentation trend in zones 1, 2, 3 and 7 is associated with port infrastructure works, as well as dredging and discharging for the purposes of maintaining accessibility and deepening the navigation channels. The trends in zone 4 (erosion in the ebb tide channel Appelzak), 5 and 6 (Paardenmarkt sand bank and Wielingen) have no clear link to human interventions.

The construction of the outer harbour at Zeebrugge initiated significant morphological changes. Erosion is prominent along the seaward section of the western longitudinal embankment. These longitudinal embankments have resulted in an interruption in littoral sediment transportation which has led to sedimentation along both port embankments. As a consequence, the beach has been extended by several hundred metres (Van Lancker *et al.* 2011 *in Belgische Staat, 2012a*). The port has disrupted local hydrodynamics and this has led to the creation of a sand bank to the east of the port that is visible at low water (Van den Eynde et al., 2010a in *Belgische Staat*, 2012a).

The research of Van Lancker *et al.* (2011) also demonstrated that the impact of discharging activities is not limited to the disposal zone itself but can extend to a larger area around the zone. 60-70% of the discharged material is therefore transported elsewhere and does not remain at the disposal site. A large quantity of this material is made up of mud/sludge that can constitute a suspension and increase the turbidity of local waters. Another element is made up of fine sand that is shifted, changing the bathymetry and sediment composition around the disposal zone. The location of disposal zone S1 was thus moved to the north west in 2003 in light of the fact that an artificial dune had been created due to regular disposals of dredging spoil and, as a result, the disposal site had become inaccessible to dredging vessels. After the termination of discharging activities, a gradual physical recovery of the seabed was observed (Du Four & Van Lancker, 2008 in *Belgische Staat*, 2012a).

Figure 3: Erosion and sediment patterns around the Port of Zeebrugge (Van Lancker et al., 2011 in *Belgische Staat*, 2012a).



Presence of wind farms

Wind turbines (including any erosion protection that is introduced) correspond to a local change in seabed morphology. Even though there will be local disruption of the natural sediment transport around the wind turbines, this is not expected to have a significant impact on the general, natural processes in the greater environment. The impact of each construction is too limited and the distance between the wind turbines is also too great (ARCADIS Belgium, 2011).

On the basis of the discussion and evaluation of effects for the C-Power wind farm (Ecolas NV, 2003), one wind turbine construction is not expected to have any significant impact on the flow. A wind turbine in the sea causes a limited change to the flow speed on both sides of the mast and turbulence on the mast's leeside. The effect of waves will also not undergo a significant change as a result of the presence of foundation constructions and/or the wind turbine itself. In addition, the impact zone for such an obstruction to the flow is so limited that there will be no interference between the impact of the various masts and the flow itself.

In summary, therefore, it can be concluded that, in terms of hydrodynamics, sediment dynamics and morphology, there will be no important effects as a consequence of the presence of wind farms (Rumes et al., 2011a, 2011b).

Coastal defence

The installation of various types of soft and hard coastal defence has an impact on the morphology of the seabed. For a full discussion and evaluation of the various, options for coastal defence that have been studied and their possible impact on the environment, you are referred to the plan EIA in the Integrated Coastal Safety Plan (Resource Analysis, 2010). The paragraphs below will set out the most significant relevant effects on seabed morphology and hydrodynamics.

Under the influence of daily conditions, beach replenishment will transform the newly created beach profile and ensure it evolves in a balanced manner. It is not only the transverse profile that will evolve, the protruding edges of the replenishment will also be subject to erosion. Erosion must be offset by maintenance. Changes in the beach profile could lead to changes in the hydrodynamic; an increase in the angle of gradient causes a general increase in wave energy on the beach. In relation to the high energy of natural wave movement, however, the effect is very limited.

Groynes reduce the transport of sand along the coast and, in this way, can contribute towards limiting the beach maintenance required. Groynes are hard, infrastructural elements that lie across the coastline between the high and low water line and are combined with beach replenishment. The flow pattern in the seawater is modified by the groynes; the flow speed in highly dynamic situations will change significantly. The effect however will only be very slightly negative in relation to the flow speed of the natural wave movements that occur in this dynamic zone. As a consequence of the interruption of the longshore current, the linear transport of sediment near a groyne gradually reduces and sedimentation will occur on the upstream side.

Front bank replenishment is also regarded as a maintenance-limiting measure. This means that front bank replenishment over a long period will lead to lower net volumes of supplementary material being required. Changes to the beach profile (coupled with the granulometry of the supplementary sand) can lead to changes in the hydrodynamics of the intertidal zone: an increase in the angle of gradient will lead to an increase in the wave energy on the beach. Higher wave energy creates a more stressful hydrodynamic environment.

An immersible breakwater is a hard infrastructure element that is installed parallel to the coastline. An immersible breakwater facilitates a reduction in wave energy in relation to the coast. In the lee of the breakwater, there will be sedimentation; further downstream there may be local erosion over a length of several hundred metres. The flow pattern in the seawater is modified by the breakwaters; the flow speed in indicative and highly dynamic situations will change significantly. This also goes hand in hand with a reduction in the flow speed behind the constructions and changes to the natural wave movement.

A flood barrier would only be closed during very heavy, stormy conditions. This would only occur a few times per year. This periodical closure would not have a significant effect on the coastal dynamic or morphology characteristics.

The creation of an energy atoll

It is clear that the construction of an island at sea would have a significant impact on the tides and sedimentation dynamic. There are no current, concrete plans for an energy atoll. Several draft plans, however, have already been elaborated (including Ecorem, 2013, see chapter 'Seabed disruption').

In order to construct an energy atoll in front of the coast of Blankenberge-De Haan, there would be an assumption that the sand dike from the energy atoll would be incorporated into and connect with the existing sand bank of the Wenduinebank. This would enable a connection to the natural coastal dynamic as far as possible. An elliptical base shape could also contribute towards ensuring that disruption to the natural (tidal) flow process is kept to a minimum. A new dynamic balance of erosion and sedimentation is expected to develop, with consequences for the morphological structure of the seabed in the surrounding area. At first sight, the locations have a limited environmental impact at plan – level. It goes without saying that before the start of concrete projects, a detailed environmental assessment will be conducted at project level (project EIA) to estimate the potential impact on the morphology of the seabed and the hydrodynamics. The same goes for the possible effects of the energy atoll further off the shore (as proposed in alternative 2, i.e. the not considered variant on the MSP at hand).

Another possible location for an energy atoll is to the north east of the current port area at Zeebrugge. The construction of the energy atoll could thus be combined with a port expansion, on the one hand, and the possible creation of a 'beach lake' off the coast of Knokke-Heist, on the other ('visie Vlaamse Baaien 2100'; THV Noordzee en Kust, 2009). Figure 4**Fout! Verwijzingsbron niet gevonden.**

provides an overview of the possible elaboration of the port expansion at Zeebrugge and the ’beach lake’ off the coast of Knokke-Heist. The energy atoll could be fitted between the sprayed sand zone and the expansion of the eastern port dam.

The energy atoll would have a substantial impact on the tides and sedimentation dynamic in the surrounding area at this location too. This impact depends on a combination of factors: the energy atoll, possible port expansion and the possible creation of the 'beach lake'. If these plans come to fruition, the erosion/sedimentation process and the flows off the coast of Knokke-Heist would undergo a complete change. The creation of a beach lake, however, does not form part of the Marine Spatial Plan at hand and, given the huge uncertainties and very limited knowledge regarding the method of execution for the energy atoll, the port expansion and the creation of a ‘beach lake', a detailed discussion and evaluation of the environmental effects will be conducted on a project level (project EIA).

Figure 4: A possible elaboration of the port expansion at Zeebrugge and the ’beach lake’ off the coast of Knokke-Heist (THV Noordzee en Kust, 2009)

2.2.2 Comparing the effects of the various alternatives

Sand and gravel extraction

The effects of sand and gravel extraction on the morphology of the seabed and hydrodynamics are very clearly related to seabed disruption as a consequence of these activities (chapter 13). It is clear that the policy options provided in the MSP at hand (alternative 1) or in the variant on the MSP at hand (alternative 2) that contribute towards a reduction in seabed disruption will also contribute towards a lower disruption to seabed morphology and the hydrodynamic processes. For a comparison of the effects of the various alternatives, you are subsequently referred to the ‘Seabed disruption’ chapter.

Dredging and discharging dredging spoil

Both alternatives provide for the option of expanding dredging locations. As a result, erosion sedimentation trends that have already been set in motion by previous and current deepening and maintenance dredging work in the channels are expected to continue and could become more pronounced. Depending on the location of the dredging locations that are to be expanded, completely new erosion/sedimentation processes could also be initiated. It is hard to estimate whether this would relate to an improvement, a deterioration or a *stand still* for the physical processes in relation to the reference scenario, given the lack of concrete plans.

The provision of new dredging discharge locations (alternative 2) or a reservation zone for an alternative discharging location (alternative 1) would have a substantial impact on the prevailing erosion/sedimentation pattern. Given the possible significant impact of a new discharging location (and the corresponding, potentially reduced impact at the existing discharging points), it is important that the position of a new discharging point is investigated thoroughly. Given that the research into the most suitable new dredging discharge locations is currently ongoing, the designation of a more spacious reservation zone is currently the preferred option.

Port expansion

It has already been demonstrated that port expansions in the sea in the past have brought about significant changes in the physical processes (both direct and indirect effects). Further expansion of the port at Zeebrugge or Ostend would undoubtedly have an important impact on the prevailing tidal and sedimentation processes in the coastal zone.

The construction of an offshore port in deeper waters could also cause (local?) changes.

Given the fact that there are no concrete plans in relation to port expansion in the current planning period 2013-2019, the environmental and safety related impact of both the alternatives are not compared.

Presence of wind farms

The discussion of effects concludes that, in terms of hydrodynamics, sediment dynamics and morphology, there will be no important effects as a consequence of the presence of wind farms. As a result, in this context, there is no change compared to the reference scenario as a result of the (further) construction of the wind farms in the current wind turbine zone (alternatives 1 & 2) or in a new wind turbine zone (alternative 2).

Coastal defence

Both the MSP at hand (alternative 1) and the variant on the MSP at hand (alternative 2), provide for the (further) implementation of the Coastal Safety Plan. In light of the fact that alternative 2 proposes a limitation for sand extraction for soft coastal defence, this could result in a more limited impact on the physical processes. This more limited impact, however, is only valid if the limitation on sand extraction for soft coastal defence is not offset by an increase in sand extraction for commercial purposes; this is a genuine scenario given that alternative 2 also raises the maximum permitted extraction volumes. Consequently, there is no specific preference for either of the alternatives.

The creation of an energy atoll

The creation of an energy atoll, connected to possible port expansion at Zeebrugge and the possible creation of a beach lake, will have a substantial impact on the tides and sedimentation dynamic in the surrounding area. The impact of an energy atoll in front of the coast of Blankenberge-De Haan (option within alternative 1) or further out to sea (alternative 2) will probably be more limited.

The creation of an energy atoll will certainly, however, have some form of impact on the physical processes. The scope of this is difficult to estimate at the moment and must be examined in the context of an EIA project.

2.3 Proposal for mitigating measures and monitoring

- Modelling the planning process in order to gain an insight into the impact of possible intervention on the physical processes.
- Location choice for new structures and interventions on basis of prevailing erosion/sedimentation pattern
- Smart plan for new structures such as an elliptical energy atoll
- Following up bathymetry of the seabed at and nearby the location of the intervention.

3. Impact on climate

3.1 Delineation of the study area

With climate change, there is talk of changing characteristics and processes on a worldwide level. As a result, the study area for the climate discipline extends past the borders of the BPNS.

3.2 Definition and evaluation of the effects

3.2.1 Estimating the effects

The most important impact is the prevention of CO2 emissions on land as a result of the fact that the net electricity production from wind farms and wave energy convertors does not need to be generated via classic production, whether or not in combination with nuclear power. In practice, these emissions will not be prevented in the strictest sense, but the increase of total emissions will be inhibited.

The scope of these prevented emissions on land depends on whether exclusively classic or a combination of classic and nuclear production is considered for generating the net electricity production from wind farms and wave energy convertors. As a result of the uncertainty with respect to the method and moment of the planned departure from nuclear energy, both will be considered. The CO2 emission factor for electricity production changes each year as a result of the continuing evolution in the fuel mix used for the production of electricity. An average emission factor for electricity production can be calculated by dividing total emissions as a result of electricity production in Flanders (Flemish Environment Agency , 2012a) by net electricity production in Flanders (Flemish Institute for Technological Research, 2012) (REF _Ref354741147 \h). Considering the share of classic electricity power stations in the total net production, an emission factor is also calculated for electricity production exclusively on the basis of fossil fuels.

Table 4: Emission factors for electricity production in Belgium

	100% classic electricity power stations	average fuel mix
CO_2 (ton/GWh per year)	660	320

The net electricity production from wind farms and wave energy convertors in the legal zone for the production of electricity from renewable sources in the BPNS is given in Tabel 1

Tabel 1 : Net electricity production of wind farms and wave energy convertors within the offshore renewable energy zone.

Concessie Area	Capacity (MW)	Net electricity production referencence scenario (GWh/j)	Net elektricity production alternative 1 and 2 (GWh/j)
C-Power II	325	1.000	1.000
Belwind	330	1.050	1.050
Northwind	216	*50-75 % operational:* 330 – 530	670
Norther	300 – 450	*50-75 % operational:*	1.000 – 1.500

			470 – 1.100	
Rentel		288	*50-75 % operational:* 450 – 700	900
Seastar		246	*Not yet operational*	800
Mermaid	Wind energy	449 – 490	*Not yet operational*	1.400 – 1.600
	Wave energy	20 – 61	*Not yet operational*	175 – 540
TOTAL		**2.200 – 2.400**	**3.300 – 4.380**	**7.000 – 8.000**

The CO2 emissions that can be prevented on an annual basis are calculated on the basis of the above emission factors and the net electricity production by wind farms and wave energy convertors (Table 2). The total CO2 emissions as a result of classic production in Flanders for 2010 (Flemish Environment Agency, 2012a) amounts to 15,882 kton/j.

Table 2 : Prevented emissions (min. & max. scenario) as a result of the operational wind farms and wave energy convertors van de for the different alternatives

	Prevented CO_2 (kton/j)			
	Reference scenario		*Alternative 1 and 2*	
	3.300 GWh/j	*4.380 GWh/j*	*7.000 GWh/j*	*8.000 GWh/j*
100% classical power installation	2.180	2.890	4.620	5.280
Average energy mix	1.060	1.400	2.240	2.560

Given the fact that the location and the scope of the wind turbine zone is not yet known in alternative 2, the net electricity production for this zone is also as yet unknown and, consequently, prevented emissions cannot be calculated for this new area. The share of prevented emissions in alternative 2 could well be greater than the emissions calculated and indicated in Table 6.

In the reference scenario, the annually prevented CO2 emissions for the wind farms in the legal zone for the production of electricity from renewable sources, calculated on the basis of emission factors for classic production, are between 14% (3,300 GWh/j) and 18% (4,380 GWh) of the emissions via classic production in Flanders. The annually prevented emissions, calculated on the basis of the emission factors for the average fuel mix, amount to between 7% and 9% of the emissions via classic production in Flanders.

In alternatives 1 and 2, the annually prevented CO2 emissions for the wind farms and wave convertors in the legal zone for the production of electricity from renewable sources, calculated on the basis of emission factors for classic production, amount to between 29% (7,000 GWh/j) and 33% (8,000 GWh) of the emissions via classic production in Flanders. The annually prevented emissions, calculated on the basis of the emission factors for the average fuel mix, amount to between 14% and 16% of the emissions via classic production in Flanders.

The wind farms and wave convertors only contribute in a small way towards reducing the emissions of greenhouse gases on a worldwide scale but are not insignificant within the context of the European reduction targets and the aim to achieve a 20% reduction in CO2 emissions by 2020.

The effects that could correspond to this reduction in greenhouse gases, such as the temperature of the earth and the sea level, are too small to estimate accurately. Effects in terms of preventing extreme situations (storms, hard winters, hot summers…) are much harder to estimate but are just as minor.

3.2.2 Comparing the effects of the various alternatives

All alternatives contribute towards the reduction of greenhouse gases and consequently have a positive effect on the climate. The (further) construction of wind farms within the legal zone for the production of electricity from renewable sources will have a clear, additional and positive impact on the reduction of greenhouse gas compared to the reference scenario. Given that alternative 2 provides for research into a new wind turbine zone, this alternative encompasses an even greater effect and alternative 2 is therefore the preferred choice in terms of this aspect.

3.3 Proposal for mitigating measures and monitoring

- Follow up in terms of air quality and climate change is proposed in the context of monitoring.

4 Changing noise climate (including noise pollution for fauna)

4.1 Delineation of the study area

Noise behaves differently underwater to how it does in air: its speed is four times higher and noise can be heard over a much greater distance. When impulse noises are produced, noise levels higher than the background sound level can be observed at a distance of at least 20 km. It is calculated that the underwater impulse noise from driving piles can be distinguished from the background noise at a distance of 79 km (Degraer et al., 2010a). That is precisely why the study area for the noise discipline extends to past the borders of the BPNS, to a distance of ca. 80 km from the potential source.

4.2 Definition and evaluation of the effects

4.2.1 Estimating the effects

4.2.1.1 Pile driving activity

The pile driving activity during the construction phase of the six wind turbines with GBF on the Thornton bank was documented in Haelters *et al.* (2009) and in Norro *et al*. (2010, 2012) in relation to driving monopile foundations on the Bligh bank and Thornton bank. The installation of GBF is not regarded as an activity that causes a large increase in the noise pressure level (Haelters *et al*., 2009).

During the driving of monopiles (with a diameter of 5 metres) on the Bligh bank, a noise pressure level (zero to peak[1] sound pressure level) of between 179 and 194 dB re 1 µPa normalised at a 750 m distance from the source was measured. In addition, the peak level at 14 km distance from the source still measured 160 dB re 1 µPa; it can thus be deduced that the background noise level of around 100 dB re 1 µPa will only be attained at around 70 km from the source (Far field linear model; Norro et al., 2010). When driving pin piles (with a diameter of 1.8 metres) for the jacket foundations on the Thornton bank, a noise pressure of between 172 and 189 dB re 1 µPa was measured 750 metres from the source (Norro et al., 2012). The average time required for driving a jacket foundation (with four pin piles) was ~2.5 times longer than for a monopile foundation. In reference to the unweighted noise pressure level (sound exposure level of SEL), values between 145 and 168 dB re 1 µPa were observed without statistically significant differences being clear between monopile and jacket foundations.

When the monopiles are being driven, there is expected to be a clear increase in the noise pressure level. An increase of the maximum noise pressure level can be expected as the diameter of the piles increases. Nehls *et al.* (2007) propose a linear model for calculating the maximum noise pressure level at 500m from the driving site. This model expects around 205 dB re 1 µPa for a monopile with a diameter of 7.2 metres; this corresponds to a noise source between 272 and 294 dB re 1 µPa (on basis of the propagation model in Norro *et al.,* 2010). This increase only occurs during the construction phase but the consequences of this on the fauna can be felt many years later if, for example, annual recruitment or migration is disrupted (see later).

During phase 1 of the Belwind project, an average of 2 hours driving time was required per monopile and the installation encompassed 56 piles over a period of 5 months.

The jacket foundations involved four pin piles with a diameter of 2.25 to 3 metres per foundation which were driven 25 to 40 metres into the seabed. Driving these thinner piles also led to an increase in the underwater noise (source noise level higher than 250 dB re 1 µPa) and the total driving time per

[1] $dB_{p\text{-}p}$: peak to peak: pressure P1 is from the highest to the lowest point of the pressure wave
$dB_{0\text{-}p}$: zero to peak: pressure P1 is from 0 to the highest point of the pressure wave (amplitude)
dB_{rms}: Root mean square of the pressure divided by the time of the signal
dB_{SEL}:Sound exposure level: average noise level over 1 s
generally, it follows that for a sinus wave: $dB_{SEL} < dB_{rms} < dB_{0\text{-}P} < dB_{p\text{-}p}$ met $dB_{rms} = dB_{0\text{-}p} - 3dB = dB_{p\text{-}p} - 9$ dB

foundation is slightly longer than with monopile foundations. During phases II and III of the C-power project, an average of 5 hours driving was required per foundation and the installation of the pin piles for the 49 foundations was realised over a period of 4.5 months.

Given the significantly lower noise pressure created by jacket foundations, the use of this jacket foundation is expected to have a significantly lower impact on the underwater noise levels, even if the driving time per foundation is longer for jacket than for monopile foundations.

It can be concluded that the underwater noise from driving is of such a level as to have significant effects on fish and marine mammals and possibly other components of the ecosystem too. In light of the location of the wind farms in the current wind turbine zone, near Dutch waters, it is clear that these effects will cross borders. The use of monopile and jacket foundations is only acceptable therefore alongside the use of mitigating measures and monitoring (see later).

4.2.1.2 Seismic research

The source noise level (0-p, @1 m) from seismic research as conducted for oil and gas exploration amounts to 211-256 dB re 1µPa (OSPAR, 2009). The peak levels for these sources usually lie at frequencies lower than 250 Hz, with peaks in energy between 10 and 120 Hz (OSPAR, 2009). Sparkers, boomers and pingers are used to characterise soft sediments in shallow water. They usually work at higher frequencies (0.8 to 10 kHz), as a high resolution is required instead of deep penetration, and are characterised by source levels (@1 m) of 204-220 dB (rms) re 1µPa (OSPAR, 2009).

Seismic research is local and very limited in terms of time. This is why, provided that there is compliance with existing legislation and that mitigating measures are applied, seismic research is recommended.

4.2.1.3 Explosions

Underwater explosions are one of the strongest anthropogenic sources of underwater noise. The noise of an explosion can propagate across a huge distance. The propagation of the underwater noise of explosions is very complex with an initial shock pulse followed by a sequence of oscillating air-bubble pulses. The noise capacity level depends on the type and quantity of explosives used and the water depth at which the explosion has taken place and can vary between 272 and 287 dB (zero to peak re 1 µPa @ 1 m with 0.5 – 45 kg TNT[2]). The frequencies are quite low (range 2 - ~1000 Hz) with most energy between 6-21 Hz and a duration of <1 – 10 ms (OSPAR, 2009).

[2] 2,4,6-trinitrotoluene or TNT explosive is one of the most commonly used explosives for military and industrial purposes

The environmental target that has been set for the maximum level of anthropogenic impulse noises (*Belgische Staat*, 2012b) does not apply in emergencies involving the destruction of munitions at sea. An explosion is local and temporally limited. That is why controlled explosions are permitted.

4.2.1.4 Noise disruption to fauna

Impulse noises can have serious consequences for the local fauna. Studies that focus on marine mammals but also fish refer to behavioural disturbances and physiological stress (see Mueller-Blenkle *et al.*, 2010 for sole and cod, among others). Even though more and more research is being conducted into the effects of noise on fish, there is still insufficient knowledge to accurately quantify the impact of driving and other sources of anthropogenic noise on fish (see Popper and Hasting, 2009). Some studies report issues ranging from stunted growth and reduced viability to direct mortality of fish and fish larvae (see Popper en Hastings, 2009). This has consequences for the transport of fish larvae from spawning grounds to areas with a nursery function. The effect of noise on organisms is, however, context dependent; the intensity, frequency and continuity of the noise, the resistance of the environment, the wind direction and species-specific properties are the determining factors in this context. A Dutch study (Bolle et al., 2011) which encompassed experiments that involved various stages of development being exposed to different levels and durations of driving noise could not find any significant effects on the larvae of sole *Solea solea.* Further research into species that (in contrast to sole) maintain their swim bladder permanently, must reveal whether this is also the case for this type of fish species (Rumes et al., 2011a).

Further data is available for marine mammals regarding the disruptive impact of noise. The most important effects will present themselves in relation to the porpoise as this is the most common marine mammal in Belgian waters by some margin (Rumes et al., 2011a). Porpoises can suffer permanent hearing damage if they are exposed to driving noise at a distance of 2 km or less (Rumes et al., 2011b). Theoretic modelling of the impact zone for disruption to porpoises via noise measurements at existing parks resulted in an impact radius of 30 km and 19 km for monopile or jacket foundations respectively (Norro et al., 2012); no consideration was made of the duration of the driving or the repeated sequences of driving operations. Porpoises will return to the area but this could take some time and the returning (or newly arriving) porpoises will soon be disrupted by subsequent driving operations. Even though jacket foundations require piles of a smaller diameter and, as a result, the noise levels will be lower than is the case with monopiles, the disruption will last longer. On the basis of the knowledge that is currently available, it is not possible to assess whether driving a jacket foundation would have a more positive or negative effect than driving with a monopile foundation (Rumes et al., 2011a).

The passive acoustic monitoring carried out in the C-Power area and in reference areas during the driving operations in 2011 demonstrated that no porpoises were detected during driving or for many hours/days thereafter. After a sequence of driving activity, practically no further porpoises were detected in the project area (Haelters et al., 2012).

The direct effects as a result of pile driving on individual porpoises remain limited to disruption as long as certain measures for avoiding direct exposure at very high noise levels are taken (see later). Long exposure to excess underwater noise can lead to stress, with effects on hormonal levels and possible negative effects on the immune system, reduced reproductive potential, accelerated ageing and inhibited growth (summary in Tasker *et al.*, 2010). There is a gap in knowledge when it comes to the effects on population levels as a result of a large, temporary exclusion zone for porpoises (> 1,000 km² as a result of driving activities in a separate park).

Similar effects will probably occur in relation to other marine mammals, including seals and white beaked dolphins. These species, however, occur in much lower numbers than porpoises in the BPNS and they may be less sensitive to excessive underwater noise (Rumes et al., 2011a en 2011b). Seals, however, are capable of hearing low frequency noise better than porpoises. Seals may suffer permanent hearing damage if they are exposed to driving noise within 4 km of a driving location (Prins et al., 2008). No marine mammals are expected to be within this area, however, upon commencement of driving. Disruption of seals could occur at up to 40 km from a driving location (Rumes et al., 2011b). When the seals in Zeeland were monitored (not specifically focussing on possible effects of driving piles on the Thornton bank), no notable observations were made between April and August 2011 (Strucker et al., 2012), the period during which the foundations for the C-Power phase II and III project were being driven (Rumes et al., 2011a). The seal colonies continue to expand in 2011, with the highest numbers on the sand plateaus in March and April.

Cumulative effects could occur if pile-driving activities take place in multiple wind farms within a radius of a couple of dozen kilometres simultaneously. Seals that flee one park due to excessive noise levels under water could end up within the noise field of a second park under construction. This would mean that the cumulative effect is more significant than the sum of the effects of the construction of each individual park (Murphy et al., 2012). In light of such possible effects, the simultaneous construction of multiple parks in the Netherlands is not permitted however, this does not take wind farms that are being constructed in neighbouring countries into account. In contrast, the areas where disruption could occur during simultaneous construction of two parks within a distance of a few dozen kilometres could partially overlap. If this is the case, the total disrupted area multiplied by the duration of disruption would be lower than would be the case for individual constructions (Rumes et al., 2011a).

Seismic research could potentially cause noise levels that could be damaging to fauna (OSPAR, 2009). The effects depend on species, area and seismic source. Explosions could also have potentially damaging consequences for the fauna concerned. Exposure to intense noise can damage the hearing system of organisms but can also lead to other physical damage such as stress and organ damage.

The effects of impulse noises are of a temporary nature. However, given the possible damage (both direct and indirect) that impulse noise can cause to biota, it has been decided that activities in the

BPNS that produce impulse noises under water will only be acceptable if mitigating measures have been applied (see later).

4.2.2 Comparing the effects of the various alternatives

In alternatives 1 and 2, the number of turbines and wind farms increases compared to the reference scenario. Monopile or jacket foundations could potentially be used for these wind farms. The impact of underwater pile-driving in alternatives 1 and 2 is similar to the current situation as a result of the fact that the underwater impulse noise from pile driving is only temporary (during the construction phase) and it is not likely that 2 wind farms will be constructed at the same time. It must be noted, however, that there will be a longer period of pile driving in alternatives 1 and 2 and, as a result, the fauna will be subjected to a longer period of disruption. The chance of effects having repercussions on population levels is thus increased. In this respect, alternatives 1 (the MSP at hand) and 2 (the not considered variant of the MSP at hand) offer a deterioration in the environment compared to the reference situation. Alternative 2 is perhaps less favourable than alternative 1 given that alternative 2 provides for research into a new wind turbine zone and the chance of negative effects on fauna thus increases.

4.3 Proposal for mitigating measures and monitoring

4.3.1 Mitigating measures with respect to the production of noise

Pile driving activity:

- If, as a result of pile-driving activities, the underwater noise level (zero to peak SPL) 750 m from the source is higher than 185 dB re 1 µPa[3], techniques must be employed to limit the level of the underwater noise (e.g. the use of bubble curtains, noise-absorbing covers or alternative pile-driving hammers or ensuring there is longer contact between hammer and pile), or driving must be replaced by alternative techniques that cause less underwater noise (e.g. vibro-piling).
- It is recommended that technical alternatives for driving are investigated and their use considered in advance. If the monitoring programme delivers convincing results with respect to environmental damage that is caused by noise of vibrations, structural modifications could be applied in order to reduce the level of vibrations and noise or the frequency spectrum could be amended.
- The period during which the piles are being driven should be kept as short as possible.

[3] Environmental target stated in "*Belgische Staat*, 2012. Omschrijving van Goede Milieutoestand en vaststelling van Milieudoelen voor de Belgische mariene wateren. Kaderrichtlijn Mariene Strategie – Art 9 & 10. BMM, Federale Overheidsdienst Volksgezondheid, Veiligheid van de Voedselketen en Leefmilieu, Brussels, Belgium, 34 pp." (Description of Good environmental status and establishment of Environmental targets for Belgian Marine Waters. Marine Strategy Framework Directive – Art. 9 & 10. BMM, Federal Government Division Public Health, Food Chain Safety and Environment).

Seismic research:

- The research will be conducted using a 'ramp-up' procedure whereby the survey will commence with an energy-output that is then gradually built up, with the maximum energy-output only being reached after 20'.
- The research will be conducted with the lowest possible output-energy and the lowest possible source noise level required in order to achieve the research objective.

4.3.2 Monitoring noise

If pile-driving takes place, the noise of the driving process must be measured via one or more autonomously moored stations and possibly in combination with a drifting hydrophone. This must be carried out in the direct vicinity of the workplace as well as at a distance from the source (up to where noise muffling reaches the level of the background noise). For safety reasons, a minimum distance to the work (the driving platform) will be maintained at 500 m. In light of the fact that this relates to a "far field" measurement and taking the muffling of the underwater noise that is different for different frequencies into account, a decision has been made to conduct measurements within the spectrum 10 Hz to 10 kHz. The position of the various measurements will be registered in order to obtain information about the propagation of underwater noise in the complex environment that forms the BPNS. Noise measurements must be conducted during the installation of at least two foundations. The measurements are taken in order to determine the increase in the noise level as a result of the work and the spectrum of the noise level.

No monitoring is planned in terms of production of underwater noise during seismic research and explosions.

4.3.3 Mitigating measures in relation to the impact of impulse noise on fauna

In addition to the aforementioned mitigating measures for reducing changes to the noise climate, specific measures for mitigating the impact of impulse noises on fauna are also proposed. In the context of the EIRs and EIAs (Environmental Impact Report/Assessment) for wind farms and international obligations (including those for European Habitat Directive and Marine Strategy Framework Directive (MSFD), OSPAR, ASCOBANS), various conditions and recommendations have been formulated. Even though these measures focus on mitigating the effects of driving activities, some of them are also applicable to mitigating the effects of other activities that produce impulse noises. A few of the conditions and recommendations are as follows (Rumes et al., 2011a):

- In order to temporarily prevent disruption to marine mammals in Belgian and adjoining waters, pile driving for wind turbines, measurement masts and transformer platforms (both jacket and monopile foundations) may not take place between 1 January and 30 April (blocked period). The highest concentrations of porpoises can be found in the BPNS during this period.

- In order to prevent as much physiological damage to marine mammals in Belgian and adjoining waters as possible, the following preventative measures must be taken during pile-driving operations:
  - At least one acoustic device for deterring/alarming marine mammals must be used for half an hour before commencement of the driving activities up to the start of driving activities. If an acoustic deterrent is used (AHD), with a source noise level from 170 to 195 $dB_{p\ p}$ re 1μPa, a similar device must be used either on or in the immediate vicinity of the driving location (at a maximum distance of 200 m).
  - The pile driving operations must commence with a 'ramp-up' (or 'soft-start') procedure whereby the energy used to drive the pile into the seabed slowly increases and the maximum capacity of the driving device is only achieved 10 minutes after the first strike, at the earliest. The period of 10 minutes must potentially allow marine mammals to leave the zone within which acute physical damage could occur as a result of driving (if they have not been driven sufficiently far away by the acoustic deterrents), and forms a compromise between an overly short ramp-up procedure (with marine mammals still in the vicinity) and a more extended period (during which excess underwater noise is produced in the area).
  - Pile-driving may not commence and must be interrupted if marine mammals are observed at a distance of less than 500 m from the driving location. Special watches must be maintained from half an hour before driving work begins. If marine mammals are observed from the construction site or in the vicinity thereof from other vessels, the driving work must temporarily halt until the animals have left the area.

4.3.4 Monitoring fauna

- The idea that fish are sensitive to underwater noise depending on the stage of life they are at should ideally be explored. Various experimental methods could be considered; within these, it is important to distinguish between *in situ* and *ex situ* experiments. In the first instance, the impact could be measured in a direct and realistic manner 'in the field'; in the second instance (accurately measured) noise pressure can be reproduced in a laboratory and the effect of this is measured (Rumes et al., 2011a).
- The following, standardised techniques can be used to monitor marine mammals (Rumes et al., 2011a):
  - Surveys from the air in order to determine the density and spatial distribution of marine mammals (distance sampling; see Haelters, 2009).
  - Passive acoustic monitoring (PAM): PAM systems detect the absence and presence of small whale type mammals and have autonomy of at least 3 months. Comparing the detections made by PAM systems anchored in or near the project area, a PAM system in the reference areas or a comparison of PAM systems anchored in a gradient against an impact site, could provide information about the occurrence (or lack thereof) of effects and the scope thereof.

5 Production of Electromagnetic Fields

5.1 Delineation of the study area

The Belgian part of the North Sea is crossed by cables that provide electricity on land. Electric cables generate electromagnetic fields (EMF) when transporting electricity. The study area for this effect encompasses the Belgian Part of the North Sea.

5.2 Definition and evaluation of the effects

5.2.1 Estimating the effects

The issue of possible effects is only relevant during the exploitation phase, given the fact that EMF only occur when power runs through the cables.

Specific species (including marine mammals, fish, molluscs and shellfish) can detect E and/or B fields and use them for orientation, migration and tracking prey (Poléo *et al*., 2001; Gill *et al*., 2005, OSPAR, 2008). Artificial sources of EMF, as generated by cables that are used to operate offshore wind farms or cables that connect the North Sea islands (European energy grid), could disrupt these organisms. There is very little certainty, however, with respect to the occurrence of such effects and the significance of these potential effects on an individual as well as population level (Tasker et al., 2010).

The largest group of organisms that can detect E fields is the Chondrichthyes or the elasmobranchs (sharks and rays). Alongside the chondrichthyes, there are also other bony fish that can detect E-fields. This has been demonstrated by cod *Gadus morhua,* plaice *Pleuronectus platessa* and Atlantic salmon *Salmo salar (*Gill et al., 2005).

There is a huge variety of species that can detect geomagnetic fields. Several species relevant for the BPNS can detect B-fields, including porpoise *Phocaena phocaena,* white-beaked dolphin *Lagenorhynchus albirostris,* Atlantic salmon, plaice, all chondrichthyes, all jawless fish and the grey prawn *Crangon crangon (*Gill et al., 2005). Many of these species use the geomagnetic field for orientation and during periods of migration.

Submarine electricity cables are insulated so that the primary (direct) electric field is largely protected. Magnetic fields, in contrast, can pass through most materials.

In terms of AC cables, the often symmetric construction with three wires leads to a significant reduction of B and iE fields as a result of the individual fields largely counterbalancing one another due to the phase difference in the voltage and the current (OSPAR, 2008). If, when using DC cables, a bipolar system is being used, the B and iE fields around the individual cables can be largely neutralised by installing both cables involved in the bipolar system (with opposing current directions) close to one another.

It has been shown that burying a cable has no effect on the strength of the B field. Nevertheless, burying the cables is of huge importance in terms of reducing exposure, which is strongest at the surface of the cable, for the species that are sensitive to EMF by creating a physical barrier (CMACS, 2003).

The CMACS model situation and the measured values at the wind farms Nysted, C-Power and Belwind suggest that the increase in EMF in the vicinity of AC cables is very limited. The strength of the generated EMF reduces rapidly with increased distance from the cables (CMACS, 2003). In light of the fact that the cables are also buried and that many of the species that can pick up on EMF do not generally swim near the seabed, the chance of exposure to EMF is very limited. The effect is not therefore considered to be significant.

The presence of multiple electricity cables spread throughout the BPNS could possibly result in significant cumulative effects on sensitive species via the multiple and highly dispersed nature of EMF and the deviance of the respective orientations, strengths and physical forms (static or pulsating). This cannot currently be accurately estimated.

Initial cross-border effects are not expected. The occurrence of effects, however, forms a significant gap in knowledge. If significant effects occur, such as large changes in migration patterns, there could well be an issue with a cross-border effect. In this context, electricity pipelines in other areas of the North Sea also play a role.

5.2.2 Comparing the effects of the various alternatives

The work on realising maximum bundling of cables (alternatives 1 & 2) and the choice of the option of making landfall at Zeebrugge (alternative 2) result in the retention of a larger zone without the presence of EMF. The presence of multiple electricity cables spread throughout the BPNS could possibly result in significant cumulative effects on sensitive species via the multiple and highly dispersed nature of EMF. Bundling electricity cables in this respect can thus be regarded as a positive measure. On the other hand, such bundling could lead to increased disruption to migration as a result of the collected electromagnetic forces along single-track routes, with stronger, cumulative effects as a result. This, however, corresponds to a gap in knowledge.

It is clear that an increasing number and length of electricity cables will lead to the occurrence of (cumulative) effects as the result of EMF also increases. Both the MSP at hand (alternative 1) and the not considered variant on this (alternative 2) provide for the installation of various new electricity cables in the context of the expansion of a Belgian and European energy grid and for the connection of one or more energy atolls to the mainland electricity grid. On the other hand, the creation of a power outlet at sea (i.e. high voltage station) corresponds to a significant reduction in the number of export cables for wind farms. The option to install the power outlet at sea (i.e. high voltage station) to the west of the existing wind turbine zone (alternative 1) will probably require a more limited total cable length than is the case for a power outlet at sea (i.e. high voltage station) near the shore (alternative 2).

The location of an energy atoll close to the shore (alternative 1, i.e. the MSP at hand) also requires limited cable length to the mainland compared to a situation in which the atoll lies far out to sea (alternative 2, i.e. the not considered variant on the MSP at hand).

Alternative 2 also involves the installation of new cables for wind farm cabling and connecting the new wind turbine zone to the electricity grid on the mainland; this may or may not take the form of a connection to the Belgian offshore energy grid. The length of the export cable depends on the distance from this new wind turbine zone to the coast or the proximity of the power outlet at sea (i.e. high voltage station).

In light of the fact that the MSP at hand (alternative 1) offers a more limited total cable length compared to alternative 2 and the subsequent possibility that the occurrence of (cumulative) effects as a result of EMF is probably also more limited, alternative 1 is the preferred choice.

5.3 Proposal for mitigating measures and monitoring

- Sufficiently deep burial of cables reduces the potential exposure of sensitive organisms to EMF.
- When using DC technology, and if a bipolar system is potentially used (two cables with opposing polarity), the B and iE fields around the individual cables can be largely neutralised by installing both cables near to one another.
- Monitoring will take the form of in situ measurements of the EMF.

6 Impact on biodiversity

6.1 Delineation of the study area

Biodiversity has a very broad biological and geographical scope. The term biological diversity refers to the variety of living organisms of any origin as well as the variety within species and between species and ecosystems. Given the fact that the ecosystems extend across national borders, the study area for the impact on biodiversity will include the southern sector of the North Sea.

6.2 Definition and evaluation of the effects

6.2.1 Estimating the effects

Many activities and facilities in the BPNS give rise to direct effects on biodiversity, such as the destruction of certain biotopes (including benthos communities), disruption to the behaviour, capture of organisms, etc. On the other hand, these activities and facilities could also have indirect effects due to changing the range of food available, damaging the quality of habitats, etc. The result is a loss of or change to biodiversity.

As already mentioned, within the context of impact on biodiversity, the plan EIA at hand focuses on the effects of seabed disrupting activities, the impact of the introduction of hard substrates and the impact of the designation of nature conservation areas (within which management measures are taken).

Seabed activities

All seabed disrupting activities have a direct (as a result of destruction or damage) or indirect (as a result of raising turbidity) impact on seabed organisms. This impact is discussed in the chapter ‘Seabed disruption'. Interventions with a negative or positive effect on the benthos would have reverberations throughout the whole ecosystem. The macrobenthos communities are also considered to be an important indicator for the health of the marine ecosystem (*Belgische Staat*, 2012a).

Introduction of hard substrates

The construction of wind turbines at sea, within an overwhelmingly sandy environment, creates a new habitat as a result of the introduction or hard substrates (foundations). Rapid colonisation by various flora and fauna was observed in relation to previously installed turbines in the BPNS. After 3.5 months, a rich range of species was observed, with a dense covering of the Hairy Seamat (*Electra pilosa*), which creates a habitat for numerous other species such as small shellfish (Crustacea), annelid worms (Polychaeta), mussels (Mytilus edulis) and Queen Scallops (Aequipecten opercularis) (*Belgische Staat*, 2012a; Kerckhof et al., 2010).

These new and artificial hard substrates are of huge significance for intertidal hard substrate species, for which there is little or no natural offshore habitat in the southern North Sea. The construction of wind farms in the southern North Sea will facilitate the introduction of various species. This possible 'stepping stone’ effect, which enables species to spread out over huge distances via a series of closely located colonisation islands is primarily relevant for species that have no planktonic larval stage (*Belgische Staat*, 2012a). There are indications that the community on the wind turbines are different to those on natural hard substrates. The proportion of non-indigenous species – introductions from other oceans and species from the southern rocky coasts into which the area expands to the north – seems to be high (Kerckhof et al., 2011); this is particularly so in the intertidal zone. Non-indigenous species are often associated with negative effects for local biodiversity and ecosystem functions. However, not all non-indigenous species have a demonstrable impact on other species or habitats in their new environment. The invasive character of a minority, however, is such that it presents a problem for local biodiversity objectives, the economy or public health or jeopardises ecosystem services (EuroMarine, 2013). These invasive, non-indigenous species (Invasive Alien Species or IAS) are regarded around the world as the second most significant cause of the loss of biodiversity (after the direct destruction of habitats) (EC, 2008).

The growth of artificial hard substrates leads to a significant local increase in the production and concentration of organic matter (Kerckhof et al., 2010). After settling, this increased concentration of matter (e.g. after death and faecal pellets) leads to local organic enrichment of the naturally soft substrate which leads to finer sediments with a richer macrobenthic fauna being found near the hard substrates (Coates et al., 2011, 2012). The scope (quantity of organic matter and affected surface area) of this impact is expected to depend on the total surface area of hard substrate and, consequently, the biggest impact will occur if large, gravitational foundations are used (Rumes et al., 2011a).

The growth on the foundations and the richer macrobenthic communities of the sandy sediment will, in turn, provide more food for diverse predators, including fish such as cod *Gadus morhua* and pouting *Trisopterus luscus* (Reubens *et al*., 2009a, 2011a). The increased availability of food around the sandy sediments could also encourage fish and epibenthos. The swimming crab and grey prawns in the wind farms, for example, tend to be larger on average than those found outside the farms (Schaeck, 2011).

The extent to which the productivity of the fish, attracted to the artificial structures, is increased by raised food availability or decreased as a result of fiercer competition for food is still unclear. It has been further demonstrated abroad that an increase in numbers of fish around drilling platforms in the North Sea goes hand in hand with a reduction in the wider area surrounding these installations (Rumes et al., 2011a).

Since the installation of the first wind turbines on the Thornton bank, increased numbers of sandwich terns and common tern have been observed in the area. The same goes for the common gull and the European herring gull on the Bligh bank (Vanermen et al., 2011). The increased numbers of seabirds could be caused by an attraction to artificial structures as resting places or as a point of reference in the open sea (see later chapter ‘Disruption for seabirds’). The higher density of seabirds could, however, also be the consequence of organic enrichment and the domino-effect throughout the entire marine food chain.

Nature conservation areas

The designation of nature conservation areas, the creation of conservation targets and the provision of nature management measures within these areas all aim to upgrade biodiversity in the BPNS or, at least, work towards retaining the current natural resources. These interventions therefore have an intrinsically positive impact on biodiversity. Possible positive effects include an increase in habitat quality (primarily a larger habitat complex), coupled with better growth and improved survival chances for some juvenile fish. These types of effect, however, are not guaranteed to occur (Sweeting & Polunin, 2005).

The extent to which the chosen measures, such as the provision of seabed disrupting zones in the Habitat Directive Area 'Vlaamse Banken' where certain conditions and restrictions apply to the sand and gravel extraction sector and fishing, will contribute towards the retention of or improvements to natural resources will become clear as a result of monitoring.

It must be noted here that the stimulus for the use of alternative, sustainable fishing methods could also lead to secondary effects. There is therefore an increased risk of by-catch involving diving seabirds and porpoises with trammel net fishing (alternative fishing method) than is the case with trawler fishing where there is very little risk of this occurring (Depestele *et al*., 2008). Such secondary effects must also be followed up.

6.2.2 Comparing the effects of the various alternatives

Seabed activities

A comparison of the effects of the various alternatives is provided in the 'Seabed disruption' chapter.

Introduction of hard substrates

Increasing construction of wind farms leads to the surface area of hard substrate at sea also increasing. This, in turn, raises the 'stepping stone' effect for non-native species. In this respect, alternatives 1 (the MSP at hand) and 2 (variant of the MSP at hand) offer a deterioration in the environment compared to the reference situation. Alternative 2 is, however, more negative than alternative 1 given that alternative 2 provides for a new wind turbine zone.

On the other hand, organisms that are native to the original soft substrate also find advantages as a result of the introduction of hard substrates which could expand as a result of increasing numbers of turbines. In this respect, a preference could be formulated for alternative 2.

Given the fact that the introduction of non-native species, however, could potentially lead to a significant loss of biodiversity, if there is the possibility of invasive, non-indigenous species (EuroMarine, 2013), the preference remains for the alternative which introduces the least surface area of hard substrate (alternative 1).

Nature conservation areas

It is clear that increasing numbers of nature conservation areas and increasing nature conservation measures will raise the positive impact on biodiversity. Alternatives 1 and 2, whereby specific measures are provided within the Habitat Directive Area 'Vlaamse Banken', subsequently constitute an improvement compared to the current situation.

The not considered variant on the MSP at hand (Alternative 2) also includes the 'Vlakte van de Raan' as a Habitat Directive Area in Belgian legislation and, within certain areas, there will be *exclusive* spatial use for nature conservation. Alternative 2 is therefore the preferred choice.

6.3 Proposal for mitigating measures and monitoring

- Mitigating measures with respect to seabed disruption: see chapter 'Seabed disruption'.
- The introduction of hard substrates in the BPNS is to be kept to a minimum (with the construction of wind farms and with the installation of coastal defence, an energy atoll...)
- International data-sharing and cooperation.
- Monitoring of colonisation of non-native species.
- Monitoring of the effects of the chosen nature conservation measures.
- Monitoring the (secondary) effects of alternative fishing techniques.

7 Disruption to seabirds

7.1 Delineation of the study area

Marine organisms and, more specifically, seabirds could encounter problems as a result of the construction and presence of infrastructures at sea. Wind farms can be regarded as the primary source of physical disruption as a result of the permanent nature and the space that they take up above the water's surface. In the first instance, the study area will be located in the legal zone for the production of electricity from renewable sources (in short: the wind turbine zone). There could be a possible impact on local species but also on migrating bird species. As a result, the study area extends across a large section of the BPNS, plus the area in Dutch waters that connects with the north eastern border between Belgium and the Netherlands.

7.2 Definition and evaluation of the effects

7.2.1 Estimating the effects

The effects of wind farms on birds during the operational phase can be split into two components: direct and indirect effects. On the one hand, there is direct <u>mortality as a result of the collisions</u> of birds with the turbines, leading to increased mortality within the population (i.e. collision aspect), on the other hand, there are indirect effects such as the consequence of <u>physical changes to the habitat</u>. The presence, movement and noise of the turbines lead to a change in the original habitat and could also lead to changes in the dispersal and density of birds (i.e. 'displacement' effect). A second, indirect effect is the barrier-effect, i.e. disruption of flying birds as a result of the presence of the wind farm (Desholm et al., 2005; Fox et al., 2006; Drewitt & Langston, 2006).

Collision aspect

The collision risk depends on a high number of factors such as the species in the area, the numbers of birds and their behaviour, weather conditions, rotor height and speed of the turbines, the configuration of the wind farm and the available lighting (Drewitt & Langston, 2006). Changing weather conditions could also impact upon the risk of collisions. It is clear that more collisions occur during bad visibility as a result of mist and rain and during the night (Erickson et al., 2001; Stienen et al., 2002). Migrating birds also fly lower when there is low cloud or during strong headwinds and are thus more susceptible to collisions (Winkelman, 1992; Richardson, 2000).

Initial calculations regarding collisions show that the risk is highest for large gulls, common gulls *Larus canus,* northern gannets and great skuas (Vanermen & Stienen, 2009). On the basis of monitoring data from Belgium, the Netherlands and the UK, the number of collisions involving birds and wind turbines in an individual park is estimated to be low (Vanermen & Stienen, 2009; Krijgsveld *et al.*, 2011; Plonczkier & Simms, 2012). It is, however, possible that the number of collision victims from all wind farms within the wind turbine zone could have a significant effect on the population level. The fact that seabirds live for a long time and raise relatively few young each year could mean that a slightly raised mortality rate could have a significantly negative effect on the population in the long term (Drewitt & Langston, 2006). A model study by Pool *et al.* (2011) estimated the number of collision victims from 11 wind farms in the Dutch sector of the North Sea. This was achieved by extrapolating the data that had been gathered in the OWEZ park. According to this extrapolation, the number of collision victims among all species (except the European herring gull) would not lead to a negative trend in population growth.

Further reliable data is required in order to evaluate the impact properly. The most significant concerns involve the species in Appendix 1, the large tern, common tern and the little gull, which appear in concentrated numbers in the area during migration.

Physical changes to the habitat

The habitat is physically changed as a result of building wind farms. At the locations where turbines are built, there is an issue with 'physical' habitat loss. The area that will be avoided by specific species as resting or foraging areas as a response to the presence of turbines is referred to as 'effective' habitat loss (Fox et al., 2006). If certain species avoid the entire legal zone for the production of electricity from renewable sources, this would constitute a loss of habitat for these species of ca. 240 km² or 7 % of the BPNS. This could be even greater for other species. Petersen *et al.* (2006) noted a reduction of 80% in numbers of northern gannets in an area two to four kilometres around the Horns Rev wind farm.

The avoidance behaviour of particular species during the operational phases of wind farms at sea, as observed by Petersen *et al.* (2006), Leopold *et al.* (2010) and Vanermen *et al.* (2011) would seem to have been site-specific. In the BPNS, it is assumed that specific species, such as the great cormorant *Phalacrocorax carbo,* gulls and terns are attracted by wind farms and that other species (e.g. northern gannets, auks) will avoid the farms.

An explanation for the attraction behaviour is the possibility that the wind farms offer resting places or that they function as a point of reference in the open sea. The appeal to species such as terns suggests an increase in the available food in the wind farms. The growth of epifauna on the new hard substrates (i.e. wind turbine foundations) and the fishing ban also cause a change in terms of food availability. Reubens *et al. (2010 and 2011b)* demonstrated that there is an increase in fish around the turbines on the Thornton bank.

On the one hand, the appeal of wind farms for specific species is positive in the context of habitat loss but, on the other, species that are neither disrupted by nor drawn to the wind farms become more susceptible to collisions.

Barrier effect

Every year it is estimated that around 1 to 1.3 million seabirds migrate via the Southern North Sea and, consequently, also pass through the ‘bottleneck’ that is formed by the channel (Stienen *et al.*, 2007). This is therefore an important corridor for migrating seabirds and non-seabirds (Vanermen et al., 2006).

It has been shown that the majority of birds alter their flight direction and/or flight height when approaching a wind farm; there is therefore a clear barrier effect at play (Petersen et al., 2006; Krijgsveld et al., 2010, Krijgsveld et al., 2011; Plonczkier & Simms, 2012). In light of the fact that this involves a possible disruption to birds that are migrating through the Southern North Sea, there is a clear cross-border effect.

The orientation of the full legal wind turbine zone in the BPNS (perpendicular to the migration direction) is not favourable in terms of the barrier effect. The various wind farms will probably form a continuous barrier of ca. 35 km wide and this will be located where the channel between the mainland and Great Britain is ca. 140 km wide. If birds have to fly around the entire zone and also avoid wind farms in Dutch and principally English waters, this will lead to an increased use of energy for the departing birds (Drewitt & Langston, 2006). This is particularly so when you consider that, for some species, this goes hand in hand with panic responses as have been defined for geese by Krijgsveld *et al.* (2010). During spring and autumn migrations, however, the migrating birds cover such huge distances that the additional distance around the wind turbine zone is not expected to constitute a significantly negative effect (Masden et al., 2009, 2010; Poot et al., 2011). This avoidance behaviour also ensures that the chance of collisions with the turbines will reduce during migration.

7.2.2 Comparing the effects of the various alternatives

The negative disruption effects on birds increases in line with an increase in the number of turbines and wind farms. The increasing number of wind farms also increases the chance of synergetic effects too. The chance of effects having repercussions on population levels is thus increased. In this respect, alternatives 1 (the MSP at hand) and 2 (variant of the MSP at hand) offer a deterioration in the environment compared to the reference situation. Alternative 2 is perhaps less favourable than alternative 1 given that alternative 2 provides for research into a new wind turbine zone and the chance of negative effects on birds thus increases.

A possible positive effect from greater food availability for some species is not considered in this context as this appealing aspect of wind farms is counterbalanced by a higher risk of collisions.

7.3 Proposal for mitigating measures and monitoring

In terms of the wind farms that are yet to be built, it is recommended that the following factors are taken into account (both for planned wind farms in the current wind farm zone and for new parks in any new wind turbine zone provided for in alternative 2):

- Number of turbines: the lower the number of turbines in a park, the lower the collision risk;
- Turbine density: this is the number of turbines per unit of surface area and determines the openness of the park. The lower this density, the better for birds entering the park;
- The rotor height of the turbine: it has been shown that the majority of birds fly between 0 and 30 metres above the water. The higher the lower limit of the rotor, the lower the chance of collisions.

Given the possible significant cumulative effects on the avifauna (primarily with respect to the collision aspect), customised monitoring must take place. Current monitoring focuses on possible effects on the density and dispersal of seabirds, effects on migrating birds, collisions and the cumulative effects as a result of creating more wind farms in the same area. Initial findings are preliminary and must be further investigated.

As a result of their scope and flight height, large gulls are most susceptible to collisions. That is why it is important that detailed data is collected about the behaviour of these species in the wind farms. In order to answer these research questions accurately, transmitters[4] have been attached to various breeding individuals from colonies of lesser black-backed gulls and European herring gulls in Zeebrugge and Ostend.

In order to study the flight movements of birds in the wind farm zone, an automatic radar system has been purchased. This will permit the avoidance behaviour (horizontal and vertical) of migrating birds to be recorded and will also determine the flux of birds through the parks. The radar system was installed on the offshore transformer platform of C-Power at the beginning of 2012.

[4] There is currently collaboration between INBO, University Amsterdam (who make the transmitters) and Imares in order to track gulls (Rumes *et al.*, 2011a).

8 Impact on shipping safety and the chance of oil pollution

8.1 Delineation of the study area

This environmental effect looks at shipping safety and, more specially, the chance of oil pollution occurring at sea. The Belgian part of the North Sea will form the study area, including the entire Belgian coast and Dutch coastal zone of Zeeland (at the mouth of the Western Scheldt).

8.2 Definition and evaluation of the effects

As a result of new developments at sea in the context of renewable energy or port expansion, certain traffic flows at sea will change. The creation of wind farms at sea will mean that ships which now follow a route through the legal wind farm zone will, in the future, alter their route and pass the wind turbine zone at a distance of at least 500 m, in line with the Royal Decree of 11 April 2012 (Belgian Bulletin of Acts, Orders and Decrees 1 June 2012). Alongside the direct inconvenience that the ship will suffer as a result, there are also other consequences. The fact that the ship has to take another route will lead to shipping routes outside the wind turbine zone becoming busier. As a result of this additional traffic on these routes, the number of collisions is expected to increase, as is the number of accidents.

The effects for shipping as a result of these consequences can be divided as follows:

- Direct effects for shipping: changed traffic flows and an increased chance of collision/running aground involving another ship or a wind turbine;
- Subsequent damage:
  - Damage to the wind farm and damage to the ship as a result of collision/running aground;
  - Pollution as a result of a shipping disaster (including the environmental effects in terms of spillages of bunker oil and cargo oil as a result of a collisions with a turbine);
  - Personal injury;
  - Impact on the rest of shipping traffic.

The plan EIA specifically focuses on the direct effects for shipping traffic and the chance of oil pollution occurring.

8.2.1 Estimating the effects

8.2.1.1 Effects during construction

During the construction phase, the chance of a collision between ships is increased as a result of the additional presence of the ships moving to and from the zone for renewable energy, the zones for energy storage and the zones for port expansion. As a result, the effect will be most significant during the creation of wind farms at which time several frequently used shipping lanes such as the Westpit and those used by the ferries, to the west of the legal wind farm zone, must be crossed.

In recent EIA studies, it has been calculated that the chance of a collision between ships during the construction phase of a wind farm is around 2% higher than is usually the case (the number of collisions between ships increases quadratically in line with intensity) (Marin, 2011b). This increased risk, however, is of a very temporary nature.

8.2.1.2 Effects during operation

Direct effects for shipping

Analogously, it could be suggested that the most significant consequences for shipping traffic will be the result of getting the full current wind turbine zone operational because, and as far as is known, developments around energy storage (including the energy atoll) and port expansion will be situated more favourably in relation to the most important traffic flows.

Once all the wind farms have been created, the zone for renewable energy (including a safety perimeter of 500 m around the zone) will form a ‘forbidden’ zone for all shipping (with the exception of repair/maintenance vessels. As a result, the traffic pattern around this zone will change. After the closure of the area concerned, the traffic that now passes between the wind farms (i.e. the Thornton route) will have to take routes to the south east (via Westpit) and north west around the Belgian wind turbine zone (Marin, 2011b). In 2012, around 1,500 deep-lying vessels will move to and from the Belgian coastal ports and Scheldt ports (Public Federal Service public health - DG Environment, Marine and Environmental Services, 2012). These ships will also have to use the Westpit, one of the most important shipping traffic lanes for vessels moving to and from the Belgian coastal ports and Scheldt port (economic importance).

The increase in the number of shipping miles (compared to the situation with the currently permitted wind farms C-Power, Belwind, Northwind & Norther) as a result of the changed routes in the Belgian North Sea is estimated to be under 500 nautical miles per year (Marin, 2011b).

The presence of wind farms has created a new risk at the specific location at sea, i.e. the chance that a ship could run aground on or collide with a wind turbine. In the past, many safety studies have been conducted into the consequences of creating offshore wind farms in the Belgian Part of the North Sea. They have shown that wind turbines on the periphery of the Belgian wind turbine zone have a relatively high risk of collision compared to other turbines. These turbines lie closest to the Westpit route (south east) or Noordhinder.

The most recent study by Marin (2011b) calculated the cumulative collision/running aground risk if the entire Belgian wind turbine zone was used (with the exception of the Mermaid concession). The overall likelihood of colliding/running aground for the entire Belgian wind turbine zone was estimated to be once every 4 years. The accidents encompass those with minimal consequences and those with severe consequences for the environment.

The effects of the operation of the offshore wind farms on collisions involving multiple ships, outside the wind turbine zone in the Belgian North Sea, as a result of changes to shipping routes was also calculated in Marin (2011b). This demonstrated that the additional presence of Norther, Rentel and Seastar would only correspond to a slight increase (ca. 0.1%) in the number of ship/ship collisions compared to the reference situation with three permitted parks (Belwind, C-Power and Northwind).

Risk of oil pollution

As already indicated in the scoping document, the plan EIA is limited to the most significant threats to shipping and, more specifically, to the chance of pollution from oil as a result of accidents. The last paragraph already pointed out that the developments in the current wind turbine zone will determine the increase in the risk of accidents at sea, with possible consequences for the environment.

Marin (2011b) calculated the additional risk of spillage and the corresponding quantities of cargo and bunker oil that could be expected after construction of the wind farms in the current wind turbine zone in the BPNS. Without mitigating measures being taken, the general chance of a spillage of bunker oil and cargo oil in the BPNS as a result of the risk of collision with a wind turbine in a scenario which includes the realisation of the Norther, C-Power, Rentel, Northwind, Seastar and Belwind wind farms increases by ~8.3%. As a reference, Marin (2011b) calculated that if no wind farms were present in the BPNS, the total chance of a spill would be once in 31 years.

Simulations (accidental oil pollution of 100 tons HFO under various conditions) by Dulière and Legrand (2011, in: Rumes *et al.,* 2011a) showed that the oil could reach the Dutch waters in around 3h and could reach the French coast around 18h after discharge during heavy weather conditions (wind from 17 m/s). The Belgian vulnerable areas (Bird Directive Area, Habitat Directive Area and the Zwin) could be impacted within 6h (Zeebrugge area) and elsewhere along the Belgian coast could be affected within 12h. There is therefore a relatively short period for intervention in the event of an oil spill.

These modelled spills of oil constitute a ‘worst case’ scenario approach. The fact that the percentage of tankers with a double hull is increasing means that the risk of an oil spill after a collision with a wind turbine has reduced.

Primarily, the avifauna and possibly also seabirds will suffer the most significant short term effects as a result of an oil spill. The impact of a spill on bird life depends, on the one hand, on the species in the affected area, their density and vulnerability and, on the other, the polluted area. Alongside the direct victims that suffer as a result of a disaster, there are also possible negative consequences for the population (long term effect). It is, however, not always easy to distinguish the impact of a disaster from natural fluctuations in a population.

An oil spill can therefore form a large area of pollution and, depending on the weather conditions, the spill location and the moment of spillage, oil type, etc… could reach both Belgian and Dutch marine conservation areas. Particular activities, including the already permitted wind farms, will only become acceptable if the necessary preventative and precautionary measures are taken in order to further increase safety and keep the subsequent risk of environmental damage to a minimum (Rumes et al., 2011a).

Measures for limiting effects

Safety is extremely important for shipping and shipping routes must therefore be free from obstacles. The most important criteria are depth and manoeuvrability. If the depth is insufficient, the channel must be dredged. All possible obstacles must also be removed. Wrecks that form obstacles must also be secured or moved.

Possible preventative and precautionary measures that have been proposed for the already permitted wind farms are:

- Intensive management of Westpit route and ETV (prevention of collisions/running aground): In order to increase safety in the Belgian wind turbine zone, additional management measures must be taken in the zone above the Westpit. This zone is not actively monitored at the moment and there is no VTS (Vessel traffic service). The installation of an extra radar for the purposes of the wind turbine zone could help towards improved, customised shipping management. In addition, there is the option to mobilise a station tug or ETV and this could significantly reduce the chance of collision/running aground (Marin, 2011a). Certain simulations of scenarios with ETV show an expected reduction in the number of collisions by around 68% compared to scenarios without ETV (Marin, 2010).
- Customised foundation types (prevention of subsequent damage): The safety study of the Anholt wind farm (Ramboll, 2009) showed that the least significant consequences can be expected from a collision with monopile foundations. The chance that the ship's hull is penetrated is higher with jacket and tripod foundations (Dalhoff & Biehl, 2005). The consequences of a collision with a GBF (gravity based foundation) depend on the height at which the ship collides with the GBF itself.
- Emergency plan/SAR (measures to be taken after an incident): The existence of the wind farm corresponds to specific limitations for the people that must manage the risk and consequences of any incident. In particular, this concerns emergency services provided by helicopter and the efforts to contain the pollution. The wind turbine activity can also hinder these operations, leading to more significant consequences as a result of an incident. A specific emergency plan, which corresponds to legal and technical definitions, could well limit restrictions to a certain extent.
- Better prevention of pollution (management measures post incident): The permanent, automatic inclusion of meteorological data in the wind turbine zone can provide a substantial

contribution towards better local weather forecasts and also greater accuracy in models regarding the dispersal of pollution that are routinely used by the government. As a result, the collection of meteorological data forms part of preventative measures in terms of increased safety. Visibility is very important, given that most accidents seem to occur in misty weather conditions rather than in stormy seas. If an infrared meter could be positioned to measure visibility at sea within the concession and then send the data in (near) real-time to the shore (e.g. via the permit holder to the Maritime Rescue and Coordination Centre), the state of readiness to respond to problems could be raised on the coast and, if the option of a station tub boat was used, this vessel could be put at stand-by near the zone to monitor the safety of shipping as a preventative measure.

- Complying with safety and technical requirements: every wind turbine and transformer must be equipped with a drip-tray in order to avoid fluids escaping into the environment.
- Discussions with authorised bodies, under coordination of coastguard structure.
- Provision of emergency response points.

Finally, the use of a routing system, as defined under IMO, could also contribute towards shipping safety. In principle, these routing systems offer no more than recommendations however they can also be ascribed a binding status as a result of an express regulation. Such a binding status must, however, be limited to what is deemed to be explicitly in the interests of shipping safety or the protection of the marine environment.

In relation to several frequently used traffic flows in the BPNS, shipping routing systems are used by the International Maritime Organisation (IMO) which, in turn, influence the choice of particular routes. None of the routing systems used oblige the ships to follow their recommendations. Around some fixed installations, there are currently safety zones where shipping is restricted, including a safety zone of 500 m around all of the installed wind turbines and work zones that are delineated by cardinal buoys while work is taking place. These IMO regulations also have an impact on certain other users. Fishing is only permitted under certain conditions in the first category IMO routes. This means that, in practice, little fishing takes place in these traffic lanes. The fishermen avoid this zone as a result of the risk of collisions. Fishing is permitted under less stringent conditions in anchor locations in precautionary areas.

8.2.2 Comparing the effects of the various alternatives

The negative effects for shipping safety and possible oil pollution increase in line with increases in the number of and surface area covered by new developments (including hard infrastructure). More specifically, the following developments are determining factors for a comparison of effects:

Development	Reference situation	Alternative 1 (MSP at hand)	Alternative 2 (not considered variant on MSP at hand)
Wind farms	100% C-Power/ Belwind 50- 75% Northwind, Norther, Rentel	Ca. 100% already indicated wind farm energy operational	Ca. 100% wind farms energy zone operational + new zone
Energy-atol	Not provided	Nearshore	Offshore
Power outlet at sea (i.e. high voltage station)	Not provided	Westwards from wind farm energy	Nearshore
Port Expansion	Remaining of the current situation	Reservation area for port expansion	Remaining of the current situation + offshore port

The previous paragraphs primarily focussed on the construction of offshore wind farms in the planning period 2019 due to the scope and feasibility of operation within this planning period. Besides the construction of offshore wind farms, other new developments could also cause collision risks for shipping with the corresponding environmental damage. Given the fact that the document at hand concerns a plan EIA, a detailed environmental assessment will be conducted at project level (project EIA) for the projects related to the construction of the energy atoll (energy storage structure), the power outlet (i.e. high voltage station) and possible sea port expansion.

Getting the wind turbine zone fully operation (alternatives 1 & 2) will only make a slight contribution towards a change in shipping traffic compared to the reference situation as the reference situation already takes account of a shift of shipping traffic from the Thornton route to the Westpit (primarily as a result of the construction of the Rentel wind farm). In this respect, alternatives 1 (the MSP at hand) and 2 (variant of the MSP at hand) offer no change compared to the reference situation. Both alternatives, however, involve the creation of a safety zone of 500 m around the entire wind turbine zone (as long as this does not breach the border with the Dutch EEZ), within which there will be a ban on all shipping traffic (with the exception of research and maintenance vessels). It can be assumed, however, that this will not lead to a change to current practices either.

Alternative 2 is perhaps less favourable than alternative 1 given that alternative 2 provides for research into a new wind turbine zone and the chance of negative effects on shipping traffic thus increases.

This latter argument could be extrapolated for developments around the power outlet at sea (i.e. high voltage station) and the energy atoll. The MSP at hand (alternative 1) places the power outlet at sea (i.e. high voltage station) immediately to the west of the wind turbine zone and will probably not add to a deterioration of the traffic situation as a result of possible integration with the wind turbine zone. In alternative 2, however, the power outlet at sea (i.e. high voltage station) is situated in a new zone, closer to the coast. Despite the fact that no further information is available regarding the precise location in alternative 2, it could possibly lead to new movements within shipping traffic which could potentially be restrictive due to the fact that the highest volumes of traffic are found near the traffic separation systems and the Westpit (Figure 5) and given the more limited scope.

The choice of the energy atoll option allows the assumption to be made that the effects of both alternative 1 (atoll close to coast) and alternative 2 (offshore atoll) would only lead to a limited deterioration for shipping traffic compared to the reference situation.

Within the context of prevention and precautionary measures, it can be presumed that both alternatives are clearly better than the reference situation. Both alternative 1 (power outlet at sea) and 2 (other location) provide for a tug station. Both alternatives also provide for the option of a temporary emergency response point and guarantee optimisation of maximum, safe accessibility as a result of dredging (alternative 1) or maximisation (alternative 2). Alternative 1 also investigates the option of additional shipping routing systems. Alternative 2 goes one step further in this regard by immediately proposing an IMO statute for the Westpit route and the UK connection with Belgium.

Assuming that the correct decisions are made on the basis of the research into additional shipping routing systems in alternative 1, both alternatives can be regarded as equal in terms of safety, and preferable compared to the reference scenario.

8.3 Proposal for mitigating measures and monitoring

- Mitigating measures that have already been imposed and/or proposed for the permitted wind farms.
- Monitoring should involve in situ measurements of meteorological data as well as the further elaboration of air patrols in order to track any oil spills (existing practice).

9 Risks relating to climate change

9.1 Delineation of the study area

Among other things, climate change causes an increased risk of flooding along the coast which directly jeopardises the safety of man. The study area for these safety risks encompass the Belgian coastal zone, including both land and sea areas.

9.2 Definition and evaluation of the effects

9.2.1 Estimating the effects

Climate change could lead to physical and biogeochemical disruptions that would influence the ecosystem of the southern North Sea. The consequences of climate change on the BPNS include a rise in sea level, an increase in water temperature, increasing frequency of storms, an increase of flow and significant wave height, the acidification of the sea water, and so on. These, in turn, give rise to changes in available food and the environment for the various marine organisms. In addition, climate change will lead to an increased risk of flooding.

The implementation of the Coastal Safety Plan will contribute towards protecting the coast against flooding. The Coastal Safety Master Plan aims to guarantee a protected level with respect to a 1,000 year storm in the dune areas, coastal towns and ports. The execution of the chosen measures will reduce the flooding risk compared to the situation without any additional measures by 81 to 100%.

The implementation of various types of coastal defence can lead to a range of effects on the environment. The following paragraphs will outline a few examples of possible effects. For a full discussion and evaluation of the various, options for coastal defence that have been studied and their possible impact on the environment, you are referred to the plan EIA in the Integrated Coastal Safety Plan (Resource Analysis, 2010).

- Examples of effects as a result of beach replenishment:
  - As a result of the high dynamic in the coastal zones, the coastal bed, beach bed, dunes, mud flats and salt marshes are regarded as not very susceptible/vulnerable to bed disruption. Moreover, the disruption corresponds to the introduction of an even bed like the existing one (sea and beach bed).
  - Changes in the beach profile could lead to changes in the hydrodynamic; an increase in the angle of gradient causes a general increase in wave energy on the beach. In relation to the high energy of natural wave movement, however, the effect is very limited.
  - Beach replenishment or replenishment of the underwater bank with a covering of supplementary sand on the seabed will lead to most of the (less mobile) organisms that live on the seabed dying. The recovery of the beach ecosystem will depend on recruitment options and migrations.
- Examples of effects as a consequence of the introduction of groynes:
  - The flow pattern in the seawater is modified by the groynes; the flow speed in highly dynamic situations will change significantly. The effect however will only be very slightly negative in relation to the flow speed of the natural wave movements that occur in this dynamic zone.
  - Alongside mortality and changes to the biodiversity (species availability) of the seabed fauna as a result of coverage and changing substrate, leading to a negative effect on food availability for foraging avifauna species or seabed organisms, the introduction of groynes has a positive effect on the biodiversity of the macrofauna.
  - A negative effect is formed by the barrier effect of groynes which hinders migration or disrupts certain seabed inhabiting organisms.
- Examples of effects from locks and dams:

  - The use of locks and dams has a negative impact on the avifauna groups that are present. The important foraging and high-water refuge areas for avifauna do not undergo any significant changes and will therefore not be affected.
  - In a closed state, the locks and dams do impact upon fish migration. The dam forms an unbridgeable barrier. As a result, the search for suitable spawning grounds and the exchange of inland waters becomes impossible. In order to create optimum reproduction and exchange possibilities, the barrier lock/dam effect must be removed.
- During the construction phase, a range of measures can lead to disruption of the breeding avifauna. This disruption could be both visual and auditory. Foraging birds could also be disrupted during construction.

Various effects as a result of creating coastal defence structures, such as those due to sand extraction for beach replenishment on the seabed and benthos communities, or effects on hydrodynamics as a result of raising existing sand banks, will be discussed in the chapter 'Seabed disruption' and the chapter 'Changing physical processes'.

9.2.2 Comparing the effects of the various alternatives

Both the MSP at hand (alternative 1) and the variant on the MSP at hand (alternative 2), provide for the (further) implementation of the Coastal Safety Plan. Both alternatives contribute towards the protection of the coast against flooding. In light of the fact that alternative 2 provides for a limitation of sand extraction for soft coastal defence, it could be vital to opt for alternative measures for coastal defence that could be less effective or have a more significant impact on the environment. It is in this context that there is a preference for alternative 1. On the other hand, sand extraction restrictions would mean that there would be less seabed disruption and disruption to the benthos communities in the area (see chapter 'Seabed disruption').

Both alternatives stimulate the exploration of new options for coastal defence by providing for an experimental location. Alternative 1 designates a location at Broersbank (within the Habitat Directive Area 'Vlaamse Banken'), while alternative 2 offers a location outside the Habitat Directive Area 'Vlaamse Banken'. In light of the presence of valuable habitats within the Habitat Directive Area 'Vlaamse Banken' that could be affected by the experiments, a location for experiments outside this Habitat Directive Area is preferred.

The MSP at hand designates two concession zones for an energy atoll; both are close to the coast and provide for a reservation zone for seaward expansion for the ports of Zeebrugge and Ostend. These structures could also signify reinforcement of the coastal defence in these zones. The energy atolls could therefore form part of the natural coastal protective dynamic on the Vlaamse Banken.

In alternative 2, within which concession zones for an energy atoll are provided far off the coast and an offshore port is also located some distance from the coast, these structures are not able to contribute to reinforcing coastal defence.

9.3 Proposal for mitigating measures and monitoring

- No mitigating measures are taken with reference to risks as a result of climate change.
- Climate change and the consequences thereof must be monitored.
- The erosion of beaches, specific risk zones, must be monitored.

10 Changing sea - view

10.1 Delineation of the study area

This environmental effect considers the view of the sea from the perspective of the beach. The full Belgian part of the North Sea will form the study area, including the entire Belgian coast and Dutch coastal zone of Zeeland (at the mouth of the Western Scheldt).

10.2 Definition and evaluation of the effects

10.2.1 Estimating the effects

During the construction phase, there is only talk of a slightly increased shipping intensity as a result of the vessels that transport materials, machinery and workers to the construction site. This effect is limited and temporary. In terms of the sea - view , only the effects during the operational phase are relevant.

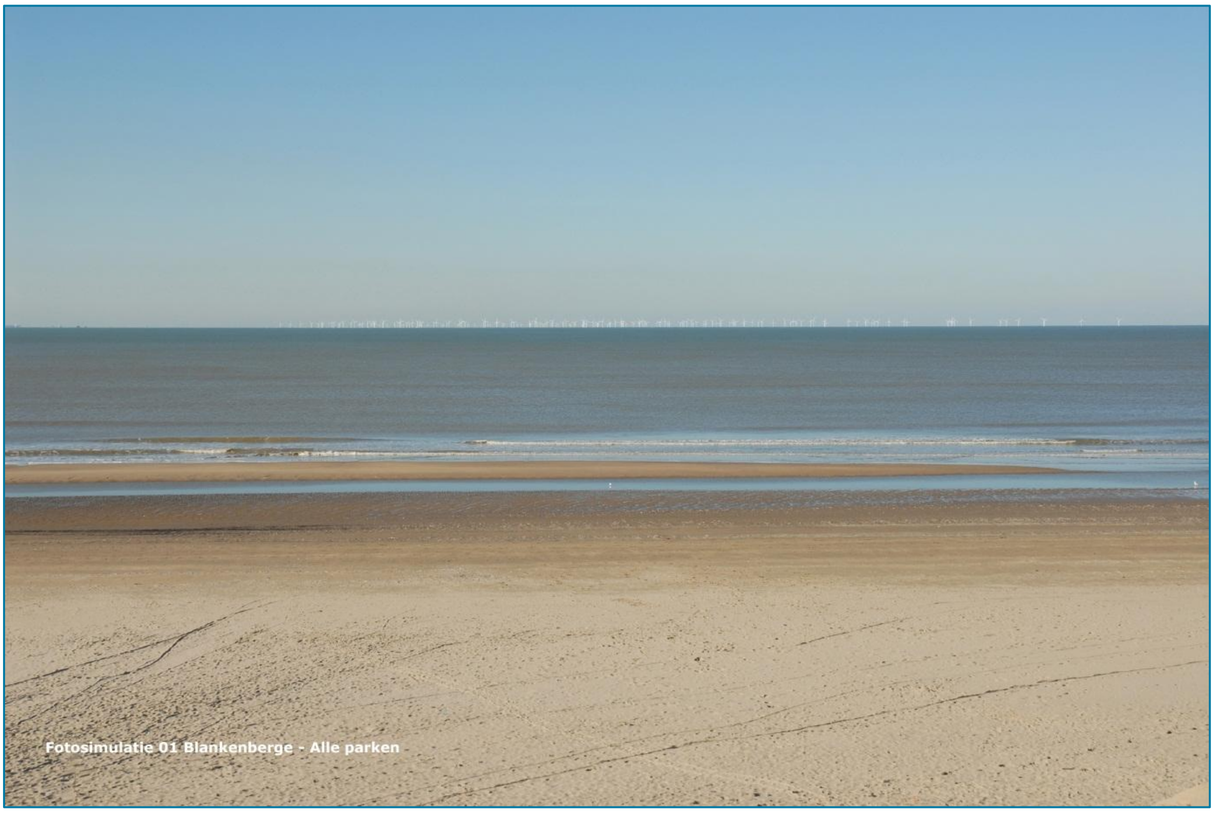
The visible presence of wind farms at sea influence the perception of the seascape. A wind farm also forms a strong contrast to the existing seascape and does not connect into the existing landscape elements that characterise the sea - view . The construction of an energy atoll and port expansion could also affect the existing sea - view .

Changes to the sea - view as a result of the construction of wind farms

The visibility of a wind farm is determined by a combination of parameters: the distance from the wind farm to the observer, the scale and configuration of the wind farm (number of turbines, distance between the turbines, pattern of turbine locations…), the layout of the turbines (colour, size...), weather conditions and contrast, etc. Distance in combination with the natural curve of the earth results in the ‘disappearance’ of the wind turbines fully or entirely behind the horizon. During clear weather and good visibility, the wind farms located close to the coast within the current wind turbine zone will be easy to see from various coastal cities.

Figure 7 provides a visual representation of the sea - view from the sea dike in Blankenberge; the full legally delineated zone for wind turbines at sea has been included. This simulation indicates the state of play with alternative 1 (MSP at hand).

Figure 7: Simulation of the full use of the zone for wind farms (as delineated by the Royal Decree of 17 May 2004, unmodified), viewpoint from sea dike in Blankenberge (Grontmij, 2010).



Within the context of monitoring the effects of offshore wind farms on the landscape, a 1,000 person survey was conducted in 2009 (Grontmij, 2010). Questions included whether the distance from the turbines to the beach was acceptable in the above situation. Over 62% of the respondents found the distance acceptable and over 13% were more or less willing to accept this distance. Almost 20% found the distance unacceptable. The same survey found that 58% or respondents agreed with the notion: “I am happy for there to be a wind farm at sea". 69% disagreed with the notion: “a wind farm at sea is too damaging in terms of the perception of the sea”.

In initial studies of the landscape aspects of wind farms (Vlakte van de Raan and Wenduine bank), conducted by BMM, certain norms for viewing angles were elaborated specifically for use with projects in the territorial sea. In summary, a horizon deployment ratio of a maximum of 1/9 (horizon = 180° view) and thus 20° was proposed for a park and 1/5 (or 36°) cumulative (BMM, 2002).

In the EIAs for the Norther wind farm (Rumes et al., 2011b), viewing angles were calculated for a full use of the zone for wind farms. The viewing angle was 30° for Blankenberge (Belgian coastal municipality with largest possible use of horizon (Figure 8). In Westkapelle (the Netherlands), the viewing angle was 38° (Figure 9). The viewing angle for Blankenberge therefore remains under the 36° proposed in the past; this value is slightly exceeded by Westkapelle. In terms of the situation for Westkapelle, it must be noted that full use of the Dutch Borssele wind turbine zone corresponds to an already high horizon deployment level by the Borssele wind turbine zone alone (viewing angle 40°) and that a large part of the Belgian wind farm zone will 'disappear' behind the Borssele wind turbine zone.

Figure 8: Viewing angle of the entire wind turbine zone from Blankenberge with designation of the distance to the coast (Rumes et al., 2011b)

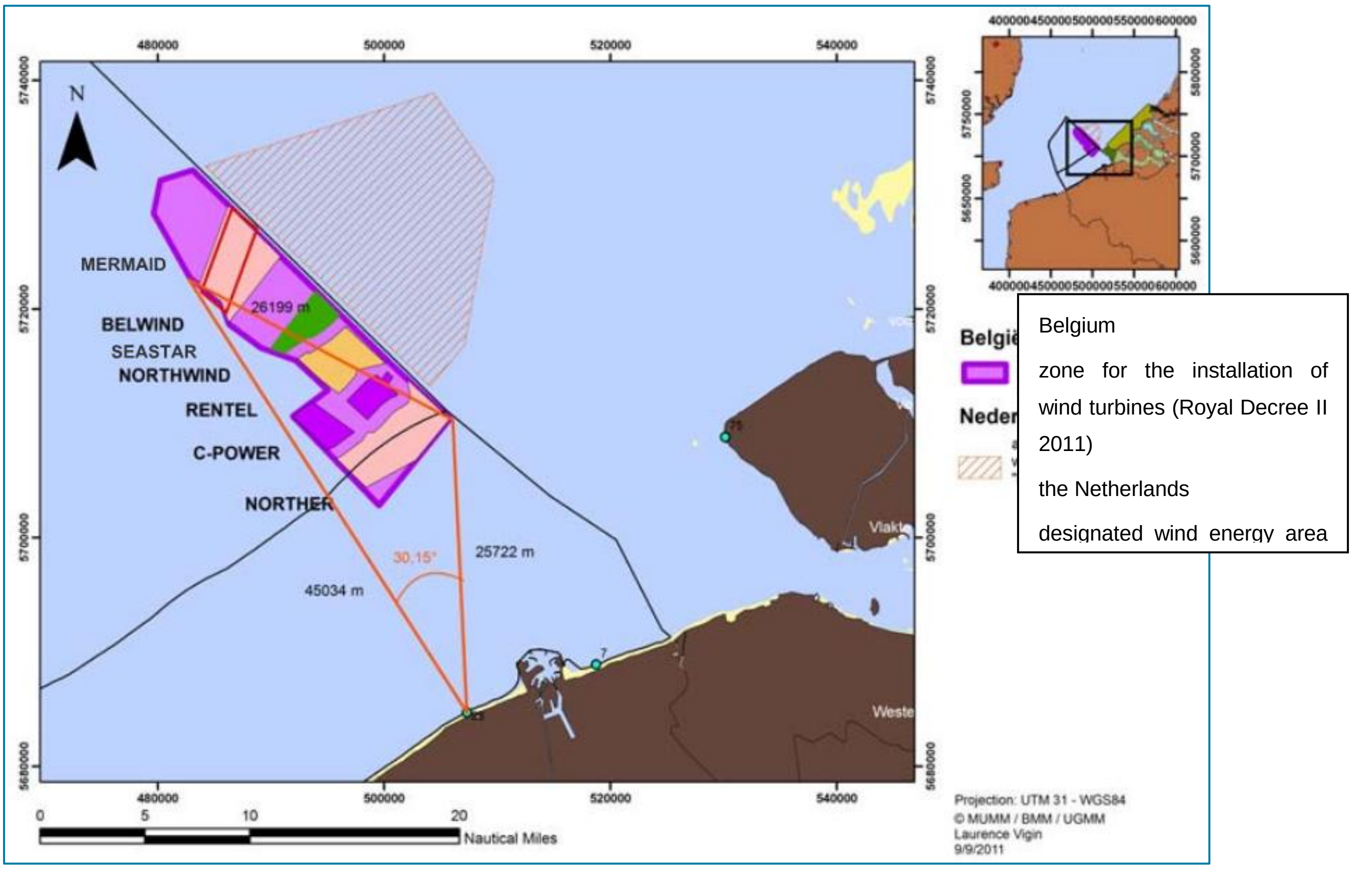
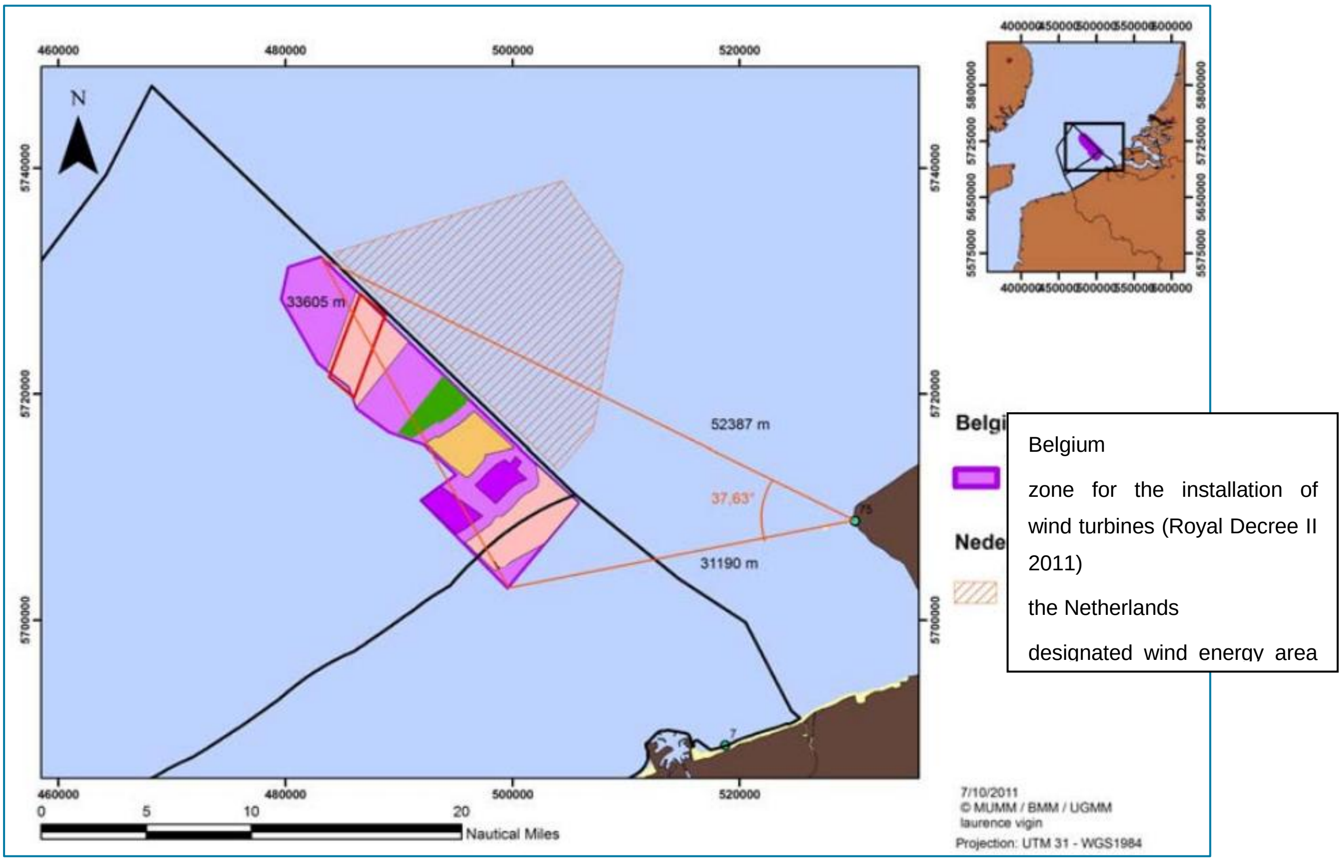


Figure 9: Viewing angle of the entire wind turbine zone from Westkapelle with designation of the distance to the coast (Rumes *et al.*, 2011b)



As already mentioned, during clear weather and good visibility, the wind farms located close to the coast within the current wind turbine zone will be easy to see from various coastal cities. This means that the sea - view will not really change in terms of the situation in alternative 1 (with a quest for getting as much of the full, current wind farm zone operational) compared to the reference scenario (with the assumption that C-Power and Belwind will be 100% operational within the planning period and Northwind, Norther and Rentel will be 50-75% operational). The wind farms located nearest to the coast (C-Power, Norther, Rentel and possible also Northwind) are also constructed to at least a halfway point. The impact on the sea - view is therefore limited with alternative 1.

Alternative 2 provides for research into a new (extra) wind turbine zone. Given that the location of such a zone is not yet known, it is not possible to determine the viewing angle for the moment. If a decision is made to opt for partial multiple spatial use with sand and gravel extraction activities at the Hinderbanken location (between the subzones of sector 4), the visual impact from the coast will be negligible as a result of the huge distance from this wind turbine zone to the coast. If the location is nearer to the coast, this could have a significant impact on the sea - view. In light of the fact that data in relation to shape, surface area and location is not yet available, it is impossible to formulate further judgements regarding the significance and acceptability of such a new wind turbine zone. On the basis of the existing situation (reference situation), the chance of such a (close) location is very small.

Changes to the sea - view as a result of the construction of an energy atoll

In the MSP at hand (alternative 1), two concrete zones for concession applications for energy storage (energy atoll) are designated:

- one in front of the coast of Blankenberge-De Haan: in this zone, a concession can be obtained for an energy atoll for maximum 1/3 of the designated zone;
- the other to the north east of the port of Zeebrugge, adjoining the reservation zone for port expansion.

A sketched design of how an energy atoll off the coast could appear is provided in Figure 10**Fout! Verwijzingsbron niet gevonden.**. On the basis of the current, civil/technical plan at hand, the top of the protective ring dike is located at +10 m LAT (possible maximum +15 m LAT). The atoll could be located at a distance of 3 to 6 km from the coast. As a result of this short distance, the island will be very prominent from the coast. A representation of the energy atoll as seen from the coast is provided in Figure 11. Given, however, the flat shape of the atoll, without high, individual constructions, it can be assumed that the energy atoll will not form a significantly disruptive or contrasting element in the sea.

Figure 10: Sketch of an energy atoll – transverse view

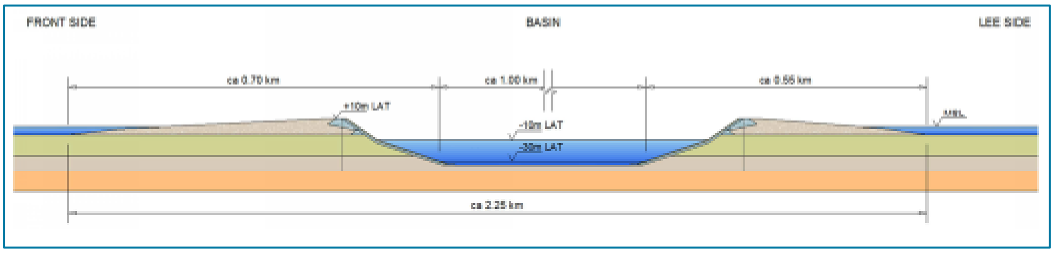


Figure 11: Representation of the energy atoll at ca. 4 km from the coast, viewed from the beach

The second concession zone for an energy atoll provided in the MSP at hand (alternative 1) is located to the north east of the current port area of Zeebrugge. The construction of the energy atoll could thus potentially be combined with a port expansion, on the one hand, and the possible creation of a 'beach lake' off the coast of Knokke-Heist, on the other ('visie Vlaamse Baaien 2100'; THV Noordzee en Kust, 2009). Figure 4 in chapter 'Changing physical processes' provides an overview of the possible elaboration of the port expansion at Zeebrugge and the 'beach lake' off the coast of Knokke-Heist. The energy atoll could be fitted between the sprayed sand zone and the expansion of the eastern port dam.

The energy atoll will also be clearly visible from the coast at this location. This significance of the impact depends on a combination of factors: the energy atoll, possible port expansion and the possible creation of the 'beach lake'. If these plans are implemented, the view of the sea from the coast of Knokke-Heist will undergo a complete change. The creation of a beach lake, however, does not form part of the Marine Spatial Plan at hand and, given the huge uncertainties and very limited knowledge regarding the method of execution for the energy atoll, the port expansion and the creation of a 'beach lake', a detailed discussion and evaluation of the effects is only possible on a project level (project EIA).

Alternative 2 provides for concession zones for an energy atoll far off the coast. In general, an increased distance from the coast corresponds to a decrease in the impact for the sea - view from the coast. In light of the limited height and flat shape of the energy atoll, it can be assumed that there will be only slight or no impact on the sea - view from this alternative.

Changes of the sea - view as a result of port expansion

The MSP at hand (alternative 1), provides for a reserved zone for seaward expansion of the ports of Zeebrugge and Ostend in order to realise further economic development. There are no current concrete plans. Such seaward expansion will have a more localised impact on the sea - view from the beach, i.e. only in the areas in the vicinity of Ostend and Zeebrugge. At Ostend, only part of the viewing field to the sea will be restricted. At Zeebrugge there could be further expansion of the already largely existing industrial landscape. There is also no disruption of the extended view of the sea, given that the interventions take place close to the coast. Given the lack of concrete plans in the planning period 2013-2019, the possible impact on the sea - view is difficult to estimate at the moment and must be further investigated on a project level (project EIA).

Alternative 2 provides for no seaward expansion of the ports of Ostend and Zeebrugge but it does include the construction of an offshore port. A location for such an offshore port is as yet unknown. As a result of the fact that the construction of a logistical interchange at sea can only be of relevance on a European level, it can be assumed that a location near the Belgian coast will not be chosen. The visibility from the coast will therefore be limited as a result of the significant distance. On the other hand, it can be assumed that such an offshore port will be equipped with port cranes that will tower high above the water and, in this way, will interrupt the even view over the sea.

10.2.2 Comparing the effects of the various alternatives

With reference to the changes in the sea - view as a result of the construction of wind farms, the MSP at hand (alternative 1) is the slightly preferred choice. The additional wind turbine zone in alternative 2 could cause an extra visual impact, although this is theoretically considered to be very limited as the new zone will probably not be located near the coast. In this case, both alternatives involve a slight change in the sea - view compared to the reference scenario.

The creation of one or more energy atolls far from the coast (alternative 2) has a more limited impact on the sea - view than the creation of one or more energy atolls at a short distance from the coast (MSP at hand). In this context, alternative 2 is also preferable over the MSP at hand.

In view of the fact that there are no concrete plans for port expansion in the planning period 2013-2019, the impact of both alternatives is difficult to estimate. This is why there is no preference for either of the alternatives in relation to this aspect.

10.3 Proposal for mitigating measures and monitoring

- During the creation of new wind farms, attention must be paid to layout (geometric design, colour of turbines, dimensions,…). Different sizes of turbines will not be recommended as this is not beneficial in terms of the uniformity of the park. A uniform and even view of the wind farm leads to better acceptability.

- With the construction of an energy atoll, efforts must be made to use natural materials and avoid high structures.
- During the creation of an energy atoll to the north east of the port of Zeebrugge, attention must be paid to the type of installation compared to the possible port expansion structure and possible creation of a ‘beach lake’ off the coast of Knokke-Heist. It is important, in this instance, that all of the structures have overall unity.
- Monitoring of the perception of offshore wind farms and other structures at sea (surveys).

11 Pressure on available free space

11.1 Delineation of the study area

In the context of this environmental effect, we consider the pressure on available free space and, more specifically, the risk of creating conflicts between various users. The entire southern section of the North Sea has therefore been included as a study area.

11.2 Definition and evaluation of the effects

11.2.1 Estimating the effects

Rapid technological progress, changing social priorities and new economic opportunities are gradually increasing the pressure on free space at sea and the space that is available is becoming more and more limited. There is therefore a need to optimise the use of the available space by, for example, allowing multiple uses in certain zones. The various users of a particular zone must try to harmonise their activities both spatially and temporally in order to avoid conflicts and keep the burden on the environment to a minimum wherever possible.

Within this discussion of effects, the emphasis lies on operational events, allowing possible conflicts to be discussed for the two most important conflict areas (subzones). In so doing, a comparison is made between the alternatives (compared to the reference situation) on the basis of the potential multiple use and related pressure on the environment. The plan EIA does not aim to estimate all possible conflicts and pressures on the environment. Possible pressure and conflict during the construction period will not be further elaborated. Detailed estimates must be sought out on project level.

Subzone 1: western zone of the BPNS at Habitat Directive Area ‘Vlaamse Banken’

So far, this subzone has been used for nature conservation, military activities, shipping, fishing and sand and gravel extraction. The legislative basis as a special zone for nature conservation and the scope of the nature conservation area (up to ca. 1/3 of the BPNS) increases the chance of conflicts as specific conditions are linked to the use of this zone.

The 'Vlaamse Banken’ were designated as a new Habitat Directive Area as a result of their exceptional natural value, particularly in relation to the ‘permanent seawater covered sand banks’ (habitat type 1110) and *Lanice conchilega* aggregations (habitat type ‘Reefs’ (1170)). Maintenance objectives are currently being set for the area and will focus on protecting these natural resources. In this context, seabed disrupting activities such as sand and gravel extraction and seabed disrupting fishing practices (e.g. traditional trawler fishing) must be avoided as they can have a negative impact on these ecosystems and their benthic communities.

Depending on the maintenance objectives, certain limitations can be imposed on extraction, such as temporary measures related to breeding or spawning seasons or the temporary closure of a concession zone as a result of excessive environmental impact. At the moment, two areas within control zone 2a are closed (KBMA & KBMB, respectively since 2003 and 2010) for further extraction as a result of the creation of depressions (up to 5 m) and no immediate signs of natural recovery.

BMM inspection flights and ILVO data demonstrate the 'Vlaamse Banken’ are used for prawn fishing (in the coastal zone around Ostend and the Kustbanken – coastal banks), trawler fishing (Vlaamse Banken), larger trawler vessels (more uniformly divided over the BPNS but intensity is lower) and, to a limited extent, trammel net and gill net fishing (within 12-mile zone). While prawn fishing takes place principally on the sand banks, other species of fish tend to be fished in the channels between and on the flanks of the sand banks. Traditional trawler fishing tends to take place in line with the new nature conservation measures. The closure of particular areas for seabed disrupting fishing will be positive in terms of the natural value of the area. For further details, you are referred to the chapter ‘Seabed disruption and biodiversity’.

The ‘Vlaamse Banken’ are crossed by the Westhinder traffic separation system which provides access to the Belgian ports and the Scheldt (see ‘Shipping’ chapter). This route does not change compared to the reference scenario. The pressure on the environment could, however, increase as a result of modifications to shipping traffic and the type of vessels that enter the Belgian ports. A temporary conflict could be created during the installation of the electricity connection with the UK (NEMO-project). Environmental effects and potential conflicts with shipping as a result of this will be investigated at project level.

The military exercise zone at Lombardsijde could potentially lead to multiple conflict situations (fishing, sand and gravel extraction, shipping, nature conservation). The exercises, however, are very limited. The K-sector is currently used for 60 days, the M-sector for 30 days and the G-sector for 2 days (in principle, available for 150 days per year, depending on the operational needs of the Belgian

Defence). In addition, sufficient discussions have taken place regarding the contours and use of the various legally defined zones to ensure there is effective harmonisation with the other activities and users in the BPNS. The munitions used and left on the seabed, however, are not cleared up; the munitions cases that fall on the beach are cleared away.

There are no spatial conflicts within this subzone with other uses, including researches, existing operational cables and pipelines, other infrastructures, nets left in situ…

Subzone 2: eastern zone of BPNS at site of potential area for generation of renewable energy

Getting the full zone for renewable energy operational will primarily lead to possible conflicts with shipping. Once all of the wind farms are installed, all shipping (with the exception of maintenance, research, rescue) will be banned from the zone for renewable energy (including a safety zone of 500 m around this zone). There is currently only a sailing ban in place within the safety zone of 500 metres around each installed wind turbine and in the working zone which is marked by cardinal buoys when work is taking place. The consequences of a modified traffic policy, however, would be limited (see 'shipping' chapter). Further limitations for shipping will be implemented with the creation of a new wind turbine zone.

The wind farms would also correspond to an increased risk of collisions (with other ships or wind turbines) with possible oil pollution as a result. For a discussion of the effects, you are referred to the 'shipping' chapter. One of the proposed mitigating measures is the installation of a permanent tug boat station that could be combined with the power outlet at sea (multiple use).

The power outlet at sea (i.e. high voltage station) could also be combined with the 'bundling cables and pipelines' concept. Bundling cables is positive in terms of the pressure on the available space. On the other hand, the option to make the installation of cables and pipes *only* possible within the delineated cable and pipeline corridors could limit the options for new energy storage (such as the possible location of the energy atoll) and the possible location of a new wind turbine zone (and also jeopardise the further exploitation of renewables) as a result of these facilities having to connect very closely into the delineated cable and pipeline corridor.

Even though there is no strict ban on fishing within the wind turbine zone (there is a ban on shipping in these zones), the two activities are difficult to combine. On the other hand, wind farms could have a positive impact on fishing. Even though wind farms are not natural systems, they do have a certain ecological value as a result of the fact that they limit seabed disrupting activities and function as a rocky habitat (artificial reefs) and thus contribute towards increased biodiversity and have a positive effect on particular fish species. The potential of the zone for renewable energy within the context of nature conservation and ecology as multiple spatial uses will also be recognised and supported.

Alongside the stimulation of sustainable non-seabed disrupting fishing techniques (see subzone 1), integrated aquaculture in the BPNS will also be encouraged in subzone 2. Monoculture projects will not be permitted. Only projects where environmental objectives, food production and the (existing) renewable energy production work in harmony will be eligible. In concrete terms, this means that various trophic levels will be cultivated simultaneously in order to limit the natural ecosystems as far as possible. In so doing, algae and shellfish production will be used in order to use up excess food that comes from fish farming.

11.2.2 Comparing the effects of the various alternatives

As indicated, specific nature conservation measures that place particular restrictions on the sand and gravel sector and fishing industry have been defined at the location of the 'Vlaamse Banken'.

Both alternatives provide for a redefinition of the sectors in zone 2 for sand and gravel extraction on the basis of shipping safety and nature conservation. Compared to the reference situation, the chance of possible conflicts decreases (multiple usage) and the use of the BPNS is optimised with particular attention paid to natural values. As a result of the designation of the 'Vlaamse Banken' as a Habitat Directive Area, the European Directive which requires an appropriate assessment of certain plans or programmes with possible significant consequences for the environment also comes into effect (this applies to the reference scenario and both alternatives). Permanent monitoring also takes place of the possible environmental effects of sand and gravel extraction and this serves as the basis for a possible closure of certain areas. In contrast to the zero scenario and the MSP at hand (alternative 1), in alternative 2 the closure of certain parts of the Kwintebank is legislatively anchored in the Royal Decree MSP (within the current plan period) and this offers extra protection against further seabed disruption. In contrast, alternative 2 designates an additional extraction area and this could compensate for the closure of the Kwintebank but could also lead to additional negative effects on the environment. It can therefore be suggested that both alternatives build in further guarantees for protecting the natural values of the 'Vlaamse Banken' and that there will be a quest to find the most efficient harmonisation between activities.

Both the MSP at hand (alternative 1) and alternative 2 impose certain limitations on both 'traditional' professional fishing and sport fishing compared to the existing situation. Both alternatives stimulate alternative, sustainable fishing in parts of the 'Vlaamse Banken' Habitat Directive Area. In alternative 1, four zones are provided in order to test and facilitate the transition to passive and alternative seabed disrupting techniques. Here, the preference is given to multiple uses of the zone, but with possible, temporary negative effects on the Habitat Directive Area. Alternative 2 imposes a full ban on fishing in these zones. In alternative 1, the use of seabed disrupting techniques in the context of sport fishing is banned throughout the 'Vlaamse Banken' Habitat Directive Area, while this ban is expanded within alternative 2 to include the entire BPNS.

Alternative 1 is therefore the preferred option in terms of providing the necessary economic guarantees for existing activities as long as they permit multiple uses under certain conditions within the ‘Vlaamse Banken’. Both alternatives 1 and 2 provide for an expansion of the zone for coastal fishing from 3 to 4.5 nautical miles (only in zones outside the limitations of the 'Vlaamse Banken’) in order to offer coastal fishing the necessary opportunities.

The closure of particular areas for seabed disrupting fishing encompassed within both alternatives will be positive in terms of the natural value of the area. Given the size of the area in alternative 2 that is exempted from seabed disrupting fishing, this alternative is the preferred option in terms of nature considerations. The closure of these areas will not only contribute towards the recovery of habitats and their respective benthic communities, but will also help in terms of improving the fish population. This will therefore, have an indirectly positive impact on fishing. The scope of this impact must be further investigated.

The restrictions imposed on fishing as a result of the designation of the Habitat Directive Area 'Vlaamse Banken’ must go hand in hand with the stimulation of integrated aquaculture in the existing wind turbine zone. In the MSP at hand (alternative 1), integrated forms of marine aquaculture are limited to the concession zones Belwind I and C-Power. In alternative 2, these are expanded to the full zone for renewable energy.

On the basis of minimum impact of this form of aquaculture on the natural ecosystem (indicated in the pre-draft MSP) and the strict conditions under which these concessions will be delivered, alternative 2 would be preferable as it permits multiple usage of the entire wind turbine zone. Given, however, this concerns a new activity within the BPNS, a test period, as given in the MSP at hand (alternative 1), is thought to more effectively take the precautionary principle into account. Possible environmental effects could thus be initially investigated further on a project level.

Getting the full zone for renewable energy operational will primarily lead to possible conflicts with shipping. The consequences of a modified traffic policy for both alternatives, however, would be limited compared to the reference situation (see ‘shipping’ chapter). Further limitations for shipping will come into play with the provision of a new wind turbine zone (alternative 2). The location and scope of such a zone is not yet known but the options include multiple spatial use with sand and gravel extraction activities in the exploration zone ‘Hinderbanken’.

The wind farms would also correspond to an increased risk of collisions (with other ships or wind turbines) with possible oil pollution as a result. For a discussion of the effects, you are referred to the ‘shipping’ chapter. One of the proposed mitigating measures is the installation of a permanent tug station. In alternative 1, this concerns a combination with the power outlet at sea (multiple use) and this therefore is the preferred option over a new location (alternative 2).

The power outlet at sea could also be combined with the ‘bundling cables and pipelines’ concept (more pronounced for alternative 1). Bundling cables is positive in terms of the pressure on the available space. Alternative 1 provides the necessary flexibility for installation preferably within these corridors, whereas this is a requirement of alternative 2. In this way, alternative 1 does not jeopardise certain developments for new energy storage (such as the possible location of an energy atoll) and the possible location of a new wind turbine zone (forming a possible threat to further exploration of renewable); it is therefore the preferred option.

Finally, multiple use is stimulated so that marine protection or recovery can be encouraged. In both alternatives, options are elaborated via a combination of energy storage (energy atoll) with a nature (compensation) role or via a combination of a power outlet at sea (i.e. high voltage station) with seal platforms (the seal action plan).

11.3 Proposal for mitigating measures and monitoring

- Spatial or temporal user conditions
- Further use of existing monitoring: wind farms, sand and gravel extraction
- Monitoring effects of integrated aquaculture
- Attention paid to cumulative effects

PART 4 Summary and conclusions

As a result of the variety of activities and possible environmental effects, it is not yet possible to make a clear choice between the alternatives at hand. Either alternative could be preferable, depending on the effect under consideration. In an environmental report the relative importance of the effects of the various alternatives are assessed by the situation that arises when the plan- alternatives and variations are implemented compared to the situation arising as the plan is not implemented (zero alternative). This zero alternative (reference scenario) constitutes the basis for comparison for the other plan alternatives. References made to alternative 2 deals with the not considered variant on the draft MSP at hand which has not been approved by the government. In other words, alternative 2 is used to put the draft MSP at hand into perspective.

Even though alternative 2 (i.e. the not considered variant on MSP at hand), for example, offers more guarantees for nature conservation via the complete exclusion of seabed disrupting fishing in the 'Vlaamse Banken' Habitats Directive Area, and provides a greater contribution to the reduction of greenhouse gases via the provision of an additional wind turbine zone, the option to expand certain activities within alternative 2 (new wind turbine zone, expansion of dredging locations, new zone for sand extraction, the construction of an offshore port, concession zone for energy atoll far off the coast) could lead to a heavier environmental burden (greater chance of disruption to fauna, collisions, oil pollution, etc).

Given the fact that the document at hand concerns a plan EIA, a detailed discussion of environmental effects and an environmental assessment will be conducted on project level (project EIA) for the diverse, newly proposed developments. As a result of the policy choices and on the basis of the precautionary principle, the MSP at hand (alternative 1) is more often preferable then alternative 2 (i.e. the not considered variant on MSP at hand).

On a strategic level, a clear consideration can be made in relation to the proposed targets. In general, an adequate guarantee can be provided that both alternatives are sufficient in terms of both the environment and safety. A larger problem presents itself within the context of guarantees of the necessary space for all economic activities at sea. There is a question as to whether the ban, provided in alternative 2(i.e. the not considered variant on the MSP), of all fishing in the entire 'Vlaamse Banken' Habitat Directive Area may impose excessive limitations for the sector and that its viability will thus be jeopardised. On the other hand, this form of limitation on seabed disrupting fishery techniques may be a better way to guarantee the viability of the North Sea's ecosystem. Further research is recommended in this context. Alternative 2 also limits tourism/recreational activities to specific zones. More information about the zones, however, has not yet been provided. Finally, alternative 2 does not explicitly support the expansion of the European energy grid. From an economic point of view, alternative 1 is therefore preferable.

In the context of scientific targets, the MSP at hand (alternative 1) is preferable as it imposes no restrictions in this regard and allows research to be carried out across the entire BPNS.

PART 5 Glossary

Active management measures	Applying modifications (e.g. installing constructions) in the marine environment with the aim of increasing natural value.
AIS	Automatic Information System, a data communication system for shipping which uses one of the mariphone channels to relay digital information regarding the identity of vessels and the cargo onboard a ship. For the data to be received correctly, the coded digital information must fulfil certain timing requirements, in this case the 'delay spread'.
Alternative	An alternative is defined as another, equal option (another method) of achieving the goal or finding a solution to a problem. Considering useful alternatives is important for various reasons: - alternatives can, in principle, reduce or prevent environmental effects; - alternatives offer an opportunity to evaluate environmental effects more fully.
Alternative to seabed disrupting fishing technique	Active seabed disrupting fishing techniques that have been modified in order to reduce the impact on the seabed.
Anchor area	A zone in which to anchor.
Base line	The low water line along the coast that is determined by the lowest astronomical tide (LAT).
Benthos	Seabed organisms
Seabed disrupting fishing technique	Active fishing technique that disrupts the seabed habitat as a result of dragging fishing gear along the seabed.
Deep water route	A route within certain boundaries that has been accurately researched

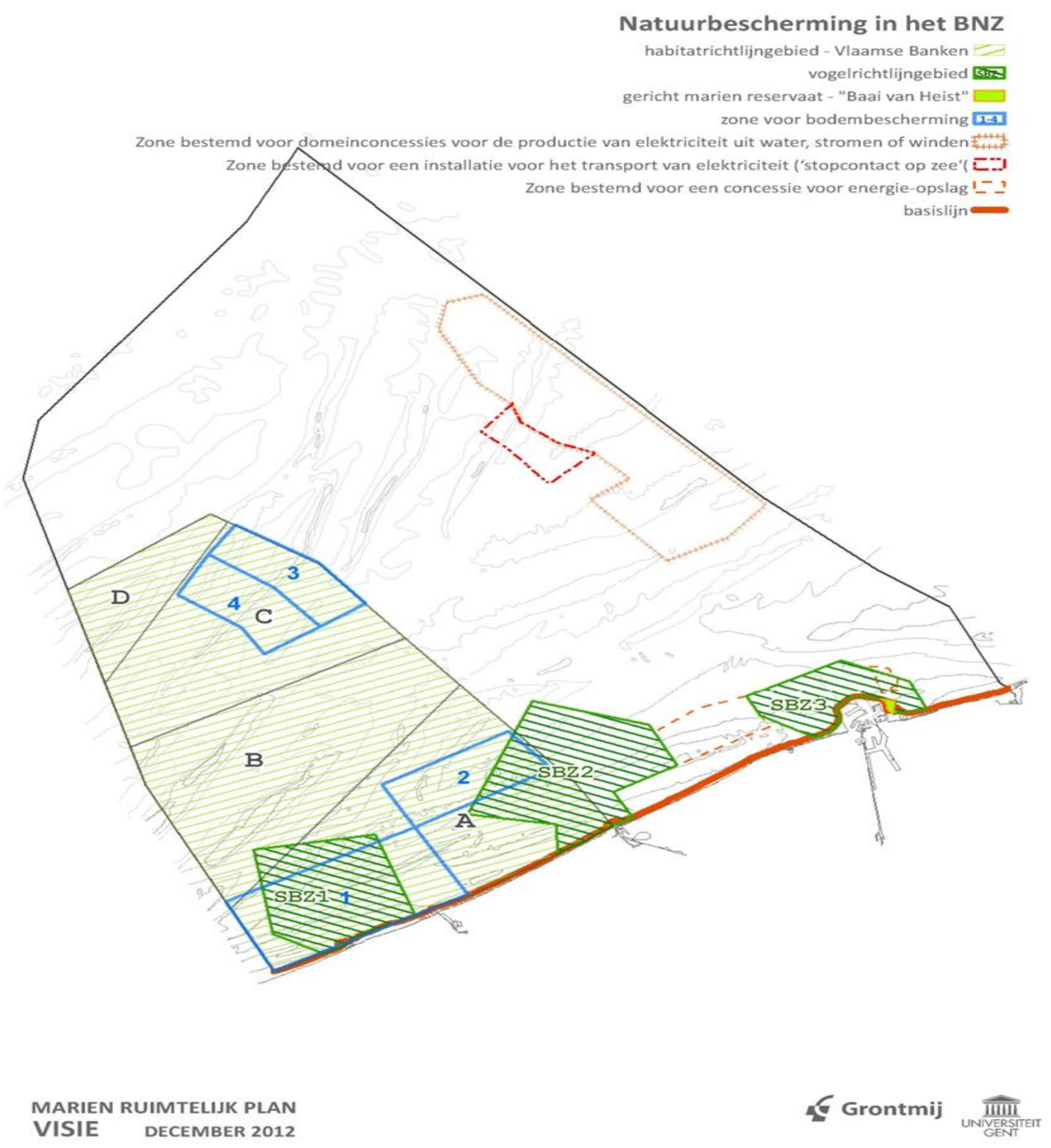
	in terms of free space to the seabed or submerged obstacles as indicated on the chart (IMO resolution A.572(14))
Epibenthos	Organisms that live on the seabed which can be efficiently sampled via trawling, such as starfish, crabs, lobsters
Epifauna	Organisms that live on the seabed
The Oostgat	Access channel in the mouth of the Scheldt on the eastern side, near Vlissingen. Only accessible for smaller vessels as a result of the restricted depth.
Intertidal area	The intertidal area is the area that is submerged at high tide and dries out at low tide.
Intertidal	The term intertidal refers to the intertidal area.
Classic seabed disrupting fishing technique	Active seabed disrupting fishing techniques that have not been modified in order to reduce the impact on the seabed.
Macrobenthos	Organisms that live in the sediment which are larger than 1 mm; such as Polychaetes, crustaceans, bivalves. Synonyms include macro-infauna, macro-endobenthos.
Mariculture	The cultivation of commercial fish, shellfish or crustaceans in salt water.
Mitigating measures	Mitigating measures are measures that help reduce, cancel out, offset or ease environmental effects (e.g. reduce duration or intensity). Mitigating measures are measures that are proposed by experts and are not included in the project definition. They can also include technical variants.
Non-seabed-disrupting fishing technique	Passive fishing techniques that do not disrupt the seabed habitat; the technique only employs static fishing gear in the water.

Reference situation	The reference situation can be defined as 'the condition of the study area which is referred to on the basis of effect forecasts'. It is the 'control' situation which is compared to the execution of a project in order to clarify environmental effects.
Shipping routing system	A system of one or more routes or routing measures for reducing the risk of shipping accidents that comprises traffic separation systems, shipping channels for two-way traffic, recommended courses, areas that must be avoided, zones for coastal traffic, roundabouts, precautionary areas and deep water routes.
Areas to be avoided	A routing measure that encompasses an area with certain boundaries where either it is very dangerous for shipping or it is extremely important that accidents are avoided and which must be avoided by all ships or particular categories of ship (IMO resolution A.572(14))
Turbidity	The turbidity of a liquid is the extent of clarity in the liquid.
Safety zone	The coastal state, according to UNCLOS (article 60, § 4 and 5), can where necessary set safety zones around artificial islands, installations and facilities, within which appropriate measures can be taken to ensure safety of both shipping and the artificial islands, installations and facilities.
Traffic separation system	A routing measure that aims to separate opposing traffic flows using specific resources and the creation of traffic areas (IMO resolution A.572(14))
Traffic flow	"Traffic flow" used by the IMO in order to designate a traffic pattern
Precautionary area	A routing measure that encompasses an area within certain boundaries where ships must sail with exceptional care and where the

	direction of the traffic flows can be recommended (IMO resolution A.572(14))

Appendix 1: Maps of spatial policy options for the draft Marine Spatial Plan for the planning period 2013 - 2019

Map 1: Nature Conservation



Translation of the map legend: Nature Conservation

Natuurbescherming in het BNZ - Nature Conservation

Habitatrichtlijngebied – Vlaamse Banken – Designated Habitat Directive Area

Vogelrichtlijngebied – Designated Bird Directive Area

Gericht marien reservaat « Baai van Heist » - National nature reserve « Baai van Heist »

Zone voor bodembescherming – Zone for seabed protection

Zone bestemd voor domeinconcessies voor de productie van elektriciteit uit water, stromen of winden – Zone for the production of electricity generated by water, current and wind.

Zone bestemd voor een installatie voor het transport van elektriciteit ('stopcontact op zee') - Zone designated for a high -voltage station ('a power outlet' at sea)

Zone bestemd voor een concessie voor energie-opslag – Zone designated for a concession for energy storage

Basislijn – Baseline

Map 2 Energy, Cables and pipelines

Translation of the map legend: Energy, Cables and pipelines in the BPNS

Energie, kabels & pijpleidingen in het BNZ - Energy, Cables and pipelines in the BPNS

Zone bestemd voor domeinconcessies voor de productie van elektriciteit uit water, stromen of winden – Zone for the production of electricity generated by water, current and wind.

Zone bestemd voor een installatie voor het transport van elektriciteit (‘stopcontact op zee’) – Zone designated for a high -voltage station (‘a power outlet’ at sea)

Aanlandingspunt voor offshore energie – Landing points for offshore energy

Preferentiële zone bestemd voor concessies voor kabels en pijpleidingen – Preference zone for a concession for cables and pipelines (i.e. cable and pipeline corridors)

Concessiezone elektriciteitskabel naar Groot-Brittannië – Zone for a concession application for a new electricity cable connection with Great Britain

Zone bestemd voor een concessie voor energie-opslag – Zone designated for a concession for energy storage

Voorzorgsgebied – Precautionary area

Basislijn – Baseline

Map 3 Shipping, port development and dredging

Translation of the map legend: Shipping, port development and dredging

Scheepvaart, baggerstorten en havenontwikkeling in het BNZ – Shipping, port development and dredging in the BPNS

Voorzorgsgebied – Precautionary area

Ankergebied – Anchor area

Te vermijden gebied – Area to be avoided

Schuiloorden – Places of refuge

Gekende verkeersstromen – Known maritime traffic flows

Vrijwaren bocht Westpitroute – Safeguarding the bend of the Westpit route

Reservatiezone voor havenuitbreiding –Reservation area for port expansion

Zone voor hernieuwbare energie – vaarverbod – Zone for the offshore renewable energy – closed area for shipping

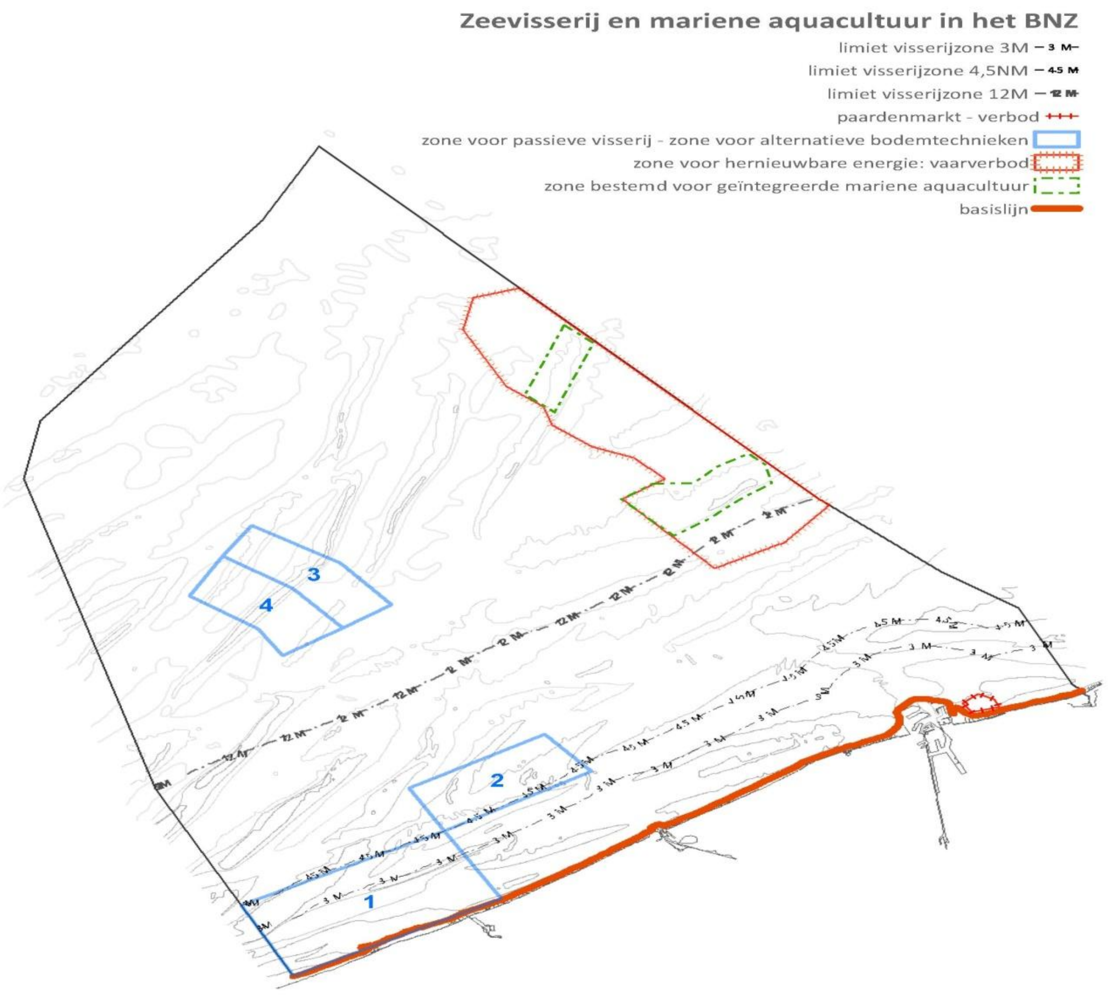
Concessiezone voor stopcontact op zee – Zone designated for a high -voltage station ('a power outlet' at sea)

Machtigingszone voor storten van baggerspecie – zone for the deposit of dredged material

Reservatiezone voor storten van baggerspecie – Reservation area for the deposit of dredged material

Basislijn – Baseline

Map 4 Fisheries and marine aquaculture



Translation of the map legend: fisheries and aquaculture

Limiet visserijzone 3M – 3NM limit of the fishing zone

Limiet visserijzone 4,5 NM - 4,5 NM limit of the fishing zone

Limiet visserijzone 12M –12NM limit of the fishing zone

Paardenmarkt ‘verbod’ – Paardenmarkt ‘prohibition’

Zone voor passieve visserij – zone voor alternatieve bodemtechnieken – Zone for passive fishing techniques – zone for alternative seabed fishing techniques

Zone bestemd voor geïntegreerde aquacultuur – Zone for integrated aquaculture

Basislijn – Baseline

Map 5 Sand and gravel extraction

Translation of the map legend: Sand and gravel extraction
Zand- en grindontginning - Sand and gravel extraction in the BPNS

Controle en exploitatiezones – Zone for control and exploitation

Monitoringgebied – Zone for monitoring

Basislijn – Baseline

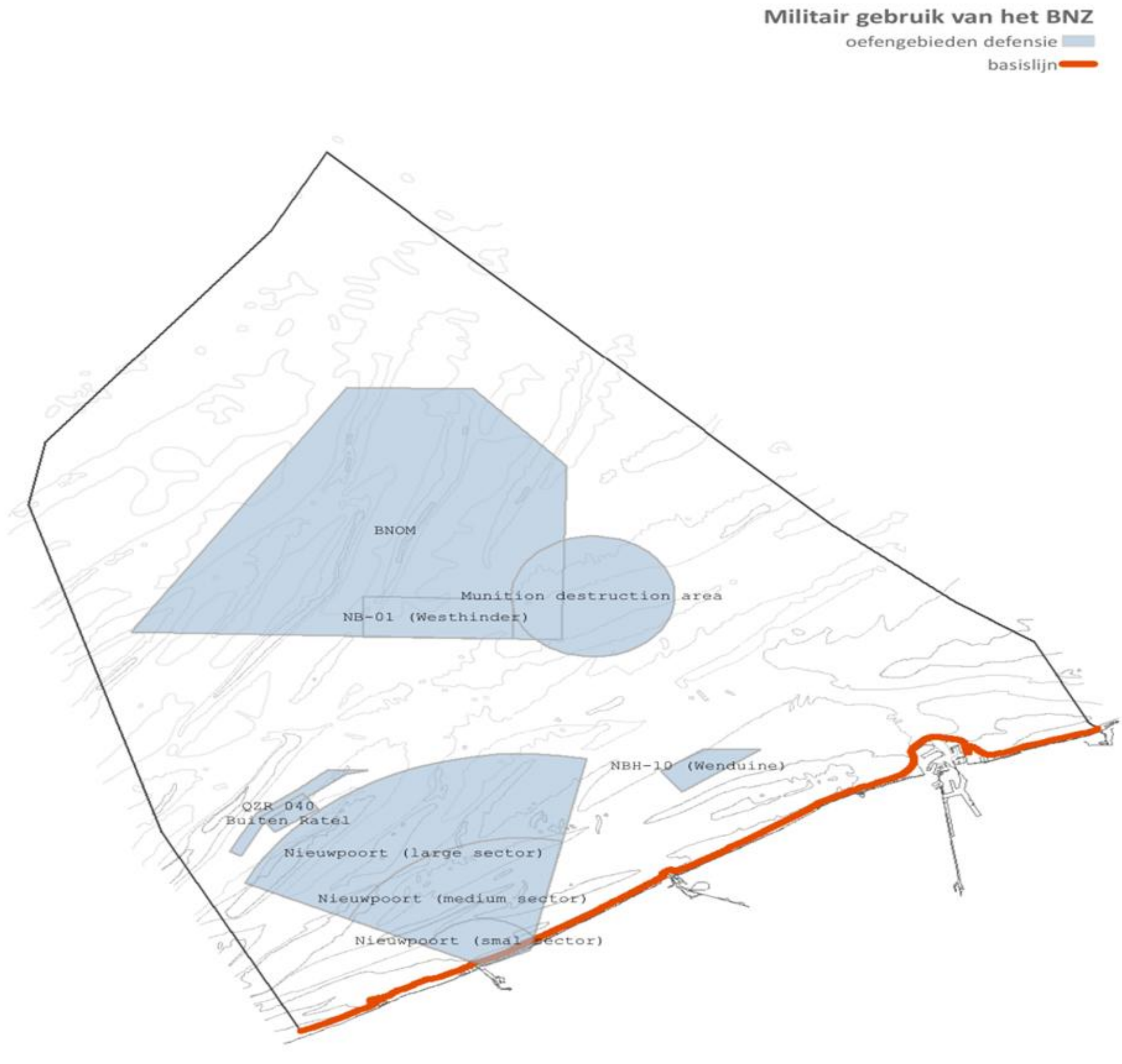
Map 6 Coastal Defence

Translation of the map legend: Coastal Defence

Kustverdediging in het BNZ – Coastal Defence in the BPNS

Testzone voor kustverdediging – Zone for experiments in function of coastal defence

Map 7 Military use



Translation of the map legend: Military use

Militair gebruik van het BNZ – Military use in the BPNS

Basislijn – Baseline