

EIR for the extraction of marine aggregates in the Belgian part of the North Sea

Non-technical summary

Zeegra vzw | Coastal Division | Maritime Access Division

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File record

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NON-TECHNICAL SUMMARY

1 PROJECT DESCRIPTION

This environmental impact report (EIR) was drawn up for the **sand extraction carried out in all control zones** within the Belgian part of the North Sea (BNS) (Map 1). This study assesses the joint impact of the total of exploitation activities that the initiators (Zeegra vzw, the Coastal Division and the Maritime Access Division) will conduct in control zones 1, 2, 3, 4 and 5, as well as the relevant cumulative effects of the exploitation activities in combination with other activities in the BNS.

Control zone 2 is situated within the **Habitats Directive area 'Vlaamse Banken'**. In addition, control zone 4 is situated close to this Habitats Directive area and can therefore also have an impact on protected habitats. Possible impacts on this protected area are taken into account in the appropriate evaluation which is part of the present EIR.

The mined marine aggregates are an important source of building materials where, depending on the quality and grain size, the sand is used as filling sand or as a raw material in asphalt production or in the mortar or concrete industry. On the other hand, the extracted sediments can be used for coastal protection (sand replenishment) and other maritime works.

The extraction activities are carried out with trailing suction hopper dredgers (TSHD). Depending on the scenario, the requested volume to be extracted amounts to approximately 15 or 20 million m³ per successive period of 5 years (3 or 4 million m³/year as a moving average over 5 years)¹, supplemented by the quantities for maintenance replenishment commissioned by the Flemish Government. The extraction limits (15 or 20 million m³/5 years) include all extraction carried out by the commercial sector (Zeegra vzw) as well as the volumes extracted for maintenance replenishment in SAC 'Vlaamse Banken' by the Coastal Division. The maintenance replenishments carried out by the Flemish authorities in the other control zones are not covered by the extraction limit but are taken into account additionally. Other exceptional (future) projects by the Maritime Access / Coastal division, such as the construction of the new Zeebrugge lock, infrastructure works within the North Sea ports, the Master Plan for Coastal Safety and the Complex Project Kustvisie, etc., are not considered within the present EIR, as the plans are not yet sufficiently specific (current research) and/or the effective execution period is not yet known. Moreover, such projects are themselves subject to EIR and the (cumulative) effects will be studied in project EIRs at an appropriate time.

The present EIR is an important annex to future concession applications for sand extraction, to be submitted by the members of Zeegra vzw and the Coastal Division (Maritime Access Division, where relevant). These concession applications are not submitted at once by all members of Zeegra vzw or the Coastal Division, but rather occur over a period of the next 10 years. With each (individual) concession application, new insights based on legislative changes, ongoing research and/or monitoring will be considered as annex to the concession application.

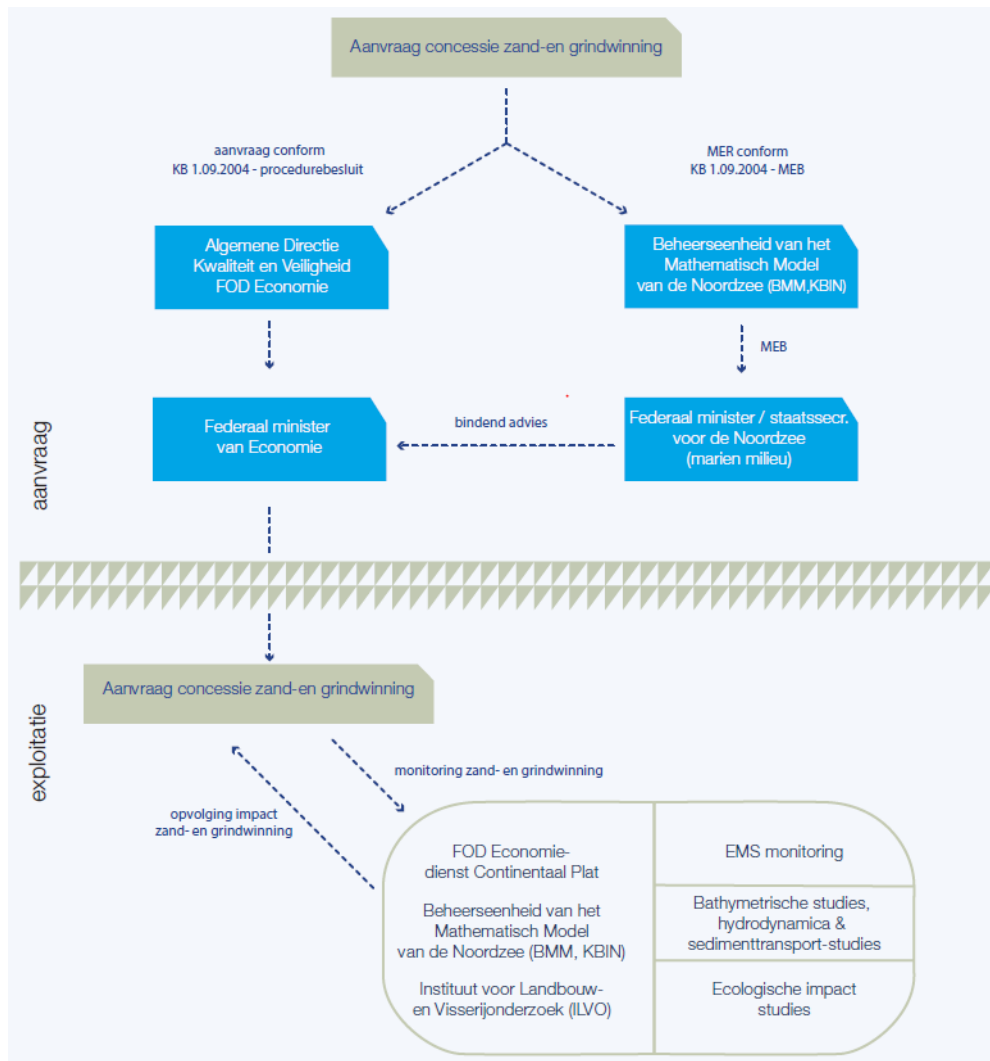
2 PROCEDURE

The extraction of sand at sea requires a **concession permit**. This can be obtained by submitting an application file to the Director-General of the General Directorate for Quality and Safety of the FPS Economy as laid down in the Royal Decree (RD) of 1 September 2004 - allocation procedure (see Figure below). In addition, the RD of 1 September 2004 - environmental impact assessment (EIA) stipulates that an environmental impact report must be submitted to the Management Unit of the Mathematical Model of the North Sea (MUMM) (the 'Administration'). The assessment of the environmental impact report by MUMM is transmitted to the Secretary of State responsible for the marine environment, who in turn submits a binding advice to the Federal Minister for the Economy. The RD of 19 April 2014 includes amendments

¹ Within the abolished extraction ceilings (15 or 20 M m³/5 years), the volumes extracted within the Habitats Directive area 'Vlaamse Banken' must be taken into account by the Flemish Government at the conference KB 19/04/2017 (Art. 19) to amend KB 01/09/2001 (Art. 25).

to previous RDs, among other things to bring it in line with the RD of 20 March 2014 establishing the marine spatial plan, replaced by the RD of 22 May 2019.

This part of the text is the non-technical summary of the EIR that the initiators will use as part of their future concession applications for control zones 1, 2, 3, 4 and 5.



3 ALTERNATIVES

For this EIR, four scenarios were worked out which were assessed for their impact. **Scenario 0 'Business as usual' (BAU)** is based on the situation as it is today as much as possible, with extraction spread over the available exploitable area within control zones 1, 2, 3 and 4 below the current extraction limit (15 M m³/5 years) for commercial activities + replenishments in SAC 'Vlaamse Banken' by the Coastal Division (within control zone 2), further supplemented by extraction on behalf of the Flemish Government. **Scenario 1** also takes the current extraction limit as its starting point, but control zone 5 is also used to spread the extraction more spatially. **Scenario 2** uses an increased extraction limit of 20 M m³/5 years for commercial activities + replenishments in SAC 'Vlaamse Banken' by the Coastal Division, divided over control zones 1, 2, 3 and 4. Finally, **scenario 3** also uses the increased extraction limit, in combination with the inclusion of control zone 5. For the scenarios with an increased extraction limit, the additional 5 M m³/5 years will be extracted within control zone 4 and/or 5. For all scenarios, a new reference level in terms of maximum depth of extraction in each control zone and in each sector is taken into account, which is scientifically substantiated and provides for a sustainable exploitation of the available sand volumes. This was taken into account when calculating the volumes to be mined within each scenario, so that the volumes do not

exceed this new reference level at any point. The new reference level was established by Ministerial Decree of 28 September 2020 and will take effect on 1 January 2021.

Below is an overview of the volumes that are to be extracted for the individual sectors for each of the 4 scenarios (per successive 5-year period).

SCENARIO 0: BUSINESS AS USUAL (BAU) IN AREAS 1, 2, 3 & 4				Commercial		Flemish Government	
Control area	Sector	Extraction volumes per 5-year period per sector (m ³)		Extraction volumes per 5-year period per sector (m ³)		Extraction volumes per 5-year period per sector (m ³)	
1	Sector 1a (Thornton Bank)	8.399.000	8.399.000	8.399.000	8.399.000	0	0
2	Sector 2kb (Kwintebank)	723.512	4.196.462	511.903	3.120.437	211.609	1.076.025
	Sector 2br (Buiten Ratel)	1.830.158		1.152.447		677.711	
	Sector 2od (Oostdijck)	1.642.792		1.456.087		186.705	
3	Sector 3a (Sierra Ventana)	2.920.055	2.920.055	1.760.639	1.760.639	1.159.416	1.159.416
	Sector 3b (Sierra Ventana)	0		0		0	
4	Sector 4a (Noordhinder)	0	3.736.428	0	213.554	0	3.522.874
	Sector 4b (Oosthinder noord)	550.874		142.555		408.319	
	Sector 4c (Oosthinder zuid)	3.089.186		44.966		3.044.219	
	Sector 4d (Westhinder)	96.369		26.033		70.336	

SCENARIO 1: AREAS 1, 2, 3, 4 & 5 with current extraction limit (15 M m ³ /5 year)				Commercial		Flemish Government	
Control area	Sector	Extraction volumes per 5-year period per sector (m ³)		Extraction volumes per 5-year period per sector (m ³)		Extraction volumes per 5-year period per sector (m ³)	
1	Sector 1a (Thornton Bank)	8.666.865	8.666.865	8.666.865	8.666.865	0	0
2	Sector 2kb (Kwintebank)	739.838	4.295.980	528.229	3.219.955	211.609	1.076.025
	Sector 2br (Buiten Ratel)	1.866.912		1.189.201		677.711	
	Sector 2od (Oostdijck)	1.689.231		1.502.526		186.705	
3	Sector 3a (Sierra Ventana)	2.976.206	2.976.206	1.816.790	1.816.790	1.159.416	1.159.416
	Sector 3b (Sierra Ventana)	0		0		0	
4	Sector 4a (Noordhinder)	0	3.676.100	0	220.365	0	3.455.735
	Sector 4b (Oosthinder noord)	529.844		147.101		382.742	
	Sector 4c (Oosthinder zuid)	3.065.043		46.400		3.018.643	
	Sector 4d (Westhinder)	81.214		26.863		54.350	
5	Sector 5 (Blighbank)	67.139	67.139	0	0	67.139	67.139

SCENARIO 2: AREAS 1, 2, 3 & 4 with increased extraction limit (20 M m ³ /5 year)				Commercial		Flemish Government	
Control area	Sector	Extraction volumes per 5-year period per sector (m ³)		Extraction volumes per 5-year period per sector (m ³)		Extraction volumes per 5-year period per sector (m ³)	
1	Sector 1a (Thorntonbank)	8.666.865	8.666.865	8.666.865	8.666.865	0	0
2	Sector 2kb (Kwintebank)	739.838	4.295.980	528.229	3.219.955	211.609	1.076.025
	Sector 2br (Buiten Ratel)	1.866.912		1.189.201		677.711	
	Sector 2od (Oostdijck)	1.689.231		1.502.526		186.705	
3	Sector 3a (Sierra Ventana)	2.976.206	2.976.206	1.816.790	1.816.790	1.159.416	1.159.416
	Sector 3b (Sierra Ventana)	0		0		0	
4	Sector 4a (Noordhinder)	0	8.743.239	0	5.220.365	0	3.522.874
	Sector 4b (Oosthinder noord)	2.575.648		2.167.329		408.319	
	Sector 4c (Oosthinder zuid)	4.977.568		1.933.349		3.044.219	
	Sector 4d (Westhinder)	1.190.022		1.119.686		70.336	

SCENARIO 3: AREAS 1, 2, 3, 4 & 5 with increased extraction limit (20 M m ³ /5 year)				Commercial		Flemish Government	
Control area	Sector	Extraction volumes per 5-year period per sector (m ³)		Extraction volumes per 5-year period per sector (m ³)		Extraction volumes per 5-year period per sector (m ³)	
1	Sector 1a (Thornton Bank)	8.666.865	8.666.865	8.666.865	8.666.865	0	0
2	Sector 2kb (Kwintebank)	739.838	4.295.980	528.229	3.219.955	211.609	1.076.025
	Sector 2br (Buiten Ratel)	1.866.912		1.189.201		677.711	
	Sector 2od (Oostdijck)	1.689.231		1.502.526		186.705	
3	Sector 3a (Sierra Ventana)	2.976.206	2.976.206	1.816.790	1.816.790	1.159.416	1.159.416
	Sector 3b (Sierra Ventana)	0		0		0	
4	Sector 4a (Noordhinder)	0	7.620.056	0	4.164.320	0	3.455.735
	Sector 4b (Oosthinder noord)	2.123.382		1.740.639		382.742	
	Sector 4c (Oosthinder zuid)	4.553.451		1.534.809		3.018.643	
	Sector 4d (Westhinder)	943.223		888.872		54.350	
5	Sector 5 (Blighbank)	1.123.183	1.123.183	1.056.044	1.056.044	67.139	67.139

4 IMPACT DESCRIPTION AND ASSESSMENT

4.1 Soil

4.1.1 Reference situation

The sandbanks in the Belgian part of the North Sea are tidal banks and coastal sand ridges created by the interaction of fluvial sand and SW-NE directed tidal currents.

Control zone 1 (sector 1a, Figure 1) covers the western part of the Thornton Bank, one of the Zeeland Banks. The THBREF area in sector 1a has been closed for exploitation since 1 October 2010 to serve as a reference area for biological monitoring. In the new Marine Spatial Plan (MSP) 2020-2026 this area will be maintained for monitoring until 1 May 2023. After that date, extraction may resume within the monitoring zone in sector 1a, in case of a positive advice of the advisory committee.

Control zone 2 covers three parts of Vlaamse Banken: Oostdyck (sector 2od), Buiten Ratel (sector 2br) and Kwintebank (sector 2kb). The sand in this zone is generally of very good quality. Two areas (KBMA and KBMB) on the Kwintebank were closed because of two depressions at a depth of 5m compared to the previous reference level. Since 2015, the central part of sector 2br (Buiten Ratel) has also been closed since a depression of a depth of 5m was observed with respect to the previous reference level.

The sectors of control zone 2 have been redefined in the MSP 2014-2020 in order, on the one hand, to respect a safety zone around a new anchorage area and, on the other hand, to exclude valuable gravel beds between the banks. These provisions were also laid down in the new MSP 2020-2026 (RD of 22 May 2019).

Control zone 3 is a small zone on the south-western spur of the Vlakte van de Raan. This spur is called Sierra Ventana. This zone is divided into a northern and a southern part (3b and 3a, respectively). The southern part of control zone 3 (sector 3a) is open for exploitation. The northern half (sector 3b) coincides with the S1 dredge dump and is closed for extraction as long as dredged material is being dumped there. Sectors 3a and 3b are alternately open for extraction, but until now extractions have only been carried out in sector 3a. For safety reasons, dumping and extraction cannot be combined. With control zone 3, the aim is to reduce the pressure on the natural sand banks, but the quality of the sand is fairly low, so the sand is not preferential for all applications.

Control zone 4 consists of 4 sectors 4a, 4b, 4c and 4d and is located near the Hinderbanken. 4a is located at the level of the Noordhinder. This sector will soon be closed for research and prospecting in function of the construction of new wind farms (from 2021 onwards). Sector 4b at Oosthinder-noord, 4c at Oosthinder-zuid and 4d at Westhinder are open for exploitation. Sectors 4c and 4d practically border the SAC 'Vlaamse Banken'. Just as in control zone 2, sandy sediments with coarser gravel characteristics are found in zone 4.

Control zone 5 is a new zone in which no extraction has taken place yet, but which is also laid down in the MSP 2020-2026. This zone is located on the Blijhbank and is characterised by sand with gravel traces.

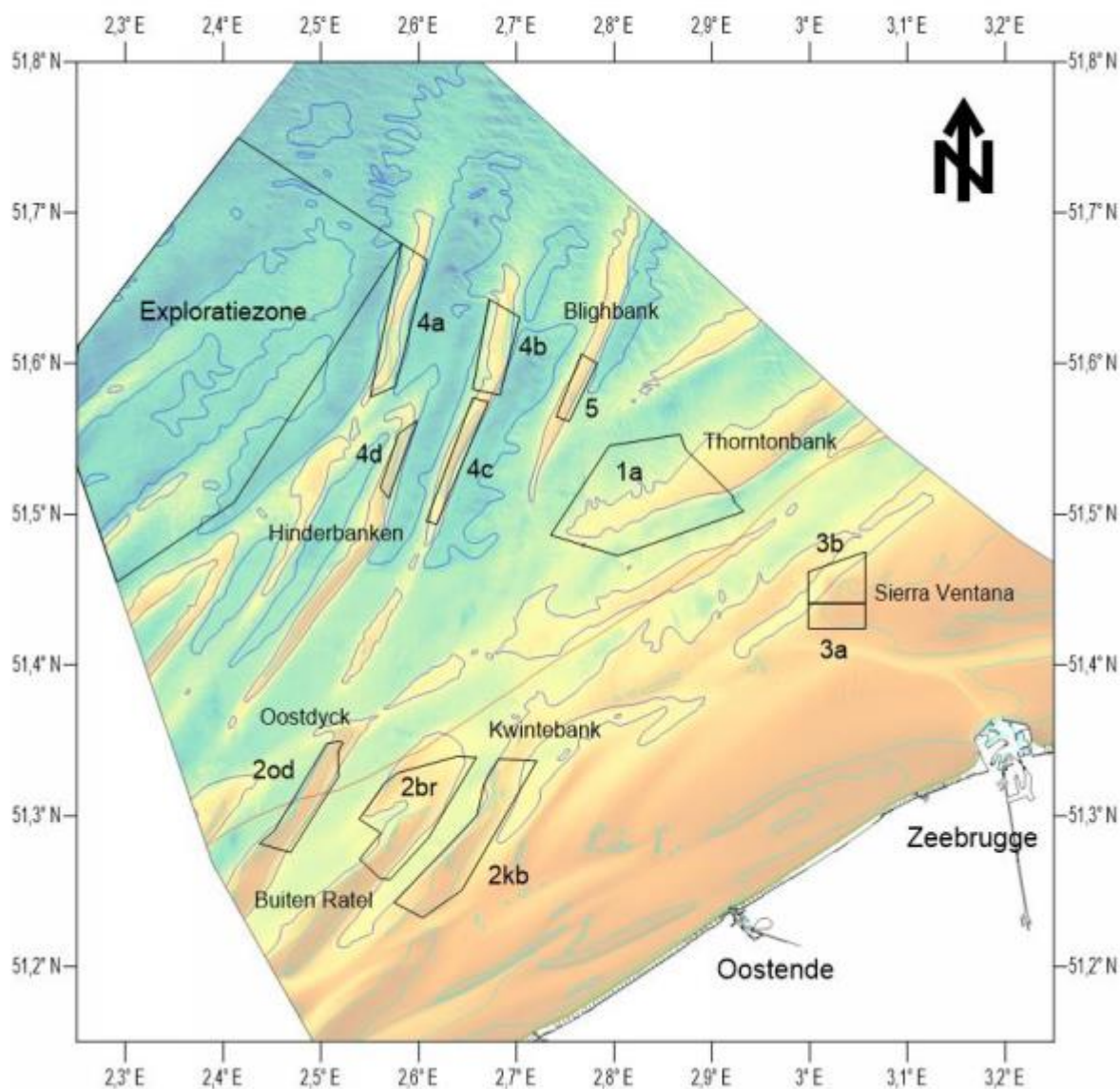


Figure 1: Borders of sand extraction areas (control zones and sectors), as laid down in the Marine Spatial Plan 2020-2026 (FPS Economy, 2019).

4.1.2 Impact description and assessment

Bathymetry - The removal of marine aggregates in the BNS has a permanent effect on the bathymetry of the seabed. However, the effect is local and non-cumulative, and largely concerns a continuation of an existing activity (scenario BAU). The effect of the removal of marine aggregates and the change in bathymetry of the seabed is assessed as moderately negative (--), for all scenarios. The difference in lowering of the seabed between the different implementation scenarios is limited, i.e. 0.15 m (BAU scenario) compared to 0.14 m (scenario 1), 0.23 m (scenario 2) and 0.21 m (scenario 3) over a consecutive period of 5 years (0.30, 0.27, 0.46 and 0.42, respectively, over a period of 10 years). In none of the scenarios the available volumes for a given sector are exceeded in relation to the new reference limits. Therefore, sustainable exploitation will not be compromised for the next concession period.

Seabed morphology - The formation of extraction tracks has a temporary and local effect on seabed morphology. The change in the height of sand dunes, on the other hand, appears to be a (semi-) permanent effect. As this is a local effect, the effect of marine aggregate extraction on seabed morphology is assessed as moderately negative (--). This assessment applies to all implementation alternatives.

Sedimentological changes – Based on the scenarios and the volumes to be extracted, the probability of sedimentological changes (shifting of grain sizes) is the same for all scenarios, i.e. negligible (almost no effect) (0). Monitoring has indicated that clear sedimentological changes are only observed in zones of intensive extraction. Within the implementation scenarios of this EIR, extraction will be spread over the available exploitable area of the different sectors within control zones. The exploitable volumes calculated over a period of 10 years for the scenarios and sectors do not exceed available volumes in relation to the new reference limits, despite the extra 5 M m³ (per 5 years) in scenario 2 and 3.

4.2 Water

4.2.1 Reference situation

The current of the North Sea water, driven by the tides and prevailing winds, in Belgian waters comes mainly from the SW to WSW.

Sediment transport on the sandbanks is clockwise: to the NE on the western bank flank (driven by flood current from the SW) and to the SW on the eastern bank flank (driven by ebb current from the NE).

The turbidity or clarity of the seawater is determined by the amount of suspended material in the water. Satellite images, which measure the amount of suspended matter in the upper water layer, show a clear spatial variation in concentrations, with a decrease from the Belgian coast further into the sea. Near the sandbanks, there is always a lower concentration than near the coast (e.g. Zeebrugge, where the highest concentrations occur) because of the sandy sediment. In addition to the onshore offshore gradient, a downward trend can also be observed from east to west.

4.2.2 Impact description and assessment

Hydrodynamics and sediment transport - It is assumed that in all implementation scenarios the marine aggregate extraction will be as spread as possible within each of the control zones 1, 2, 3, and 4 (BAU and Scenario 2) and 5 (Scenarios 1 and 3). In this way, the probability of a locally large reduction of the soil structure is reduced and thus the probability of a significant effect on water flow and the spatial erosion/deposit pattern is also minimized. Given the relatively small bathymetric differences between the 4 implementation scenarios, the effect of all scenarios is therefore considered negligible (virtually no effect) (0). The impact on coastal defence is also negligible (0).

Turbidity - The increase in turbidity due to sand extraction is temporary and limited in scope. In addition, the increased turbidity is maximally of the same order of magnitude as the natural turbidity during storms. Furthermore, the marine extraction activities in control zones 1, 2, 3, 4 and 5 are largely a continuation of an existing activity (scenario BAU). The effect on turbidity per unit of time and space will thus not vary notably between scenarios. Therefore, the effect of increased turbidity is considered to be slightly negative (-) for all implementation alternatives.

Sedimentation of the turbidity plume - Sedimentation of the turbidity plume is not negligible. Recent research has shown that there is a risk that fine material from the spill will have effects in the distant field (up to 14 km away), which entails a potential impact on seabed functions and thus seabed integrity. This enrichment with fine material is, however, not a measurable effect for all control zones, and the direct link with spill from marine aggregate extraction is not confirmed. Moreover, the considered extraction activities largely concern a continuation of a current activity (scenario BAU). The effect of sedimentation of the turbidity plume is thus assessed as slightly negative (-) for all scenarios.

Water quality - The effect of sand extraction on water quality is considered negligible (virtually no effect) (0), for all implementation alternatives.

4.3 Fauna, Flora & Biodiversity

4.3.1 Reference situation

4.3.1.1 Macrobenthos

Five common macrobenthic communities can be distinguished in the subtidal mobile substrates of the Belgian part of the North Sea, named after the most common species in this community. Each of them is characterised by certain species, diversity and density values; and they are usually observed in a specific and more or less well-defined environment. In general, three communities are found closer to the coastal zone (*Abra*, *Limecola*, and *Magelona-Ensis*), linked to the usually finer sediments, and one community further offshore (*Hesionura*) is found in coarse sand sediments, while the *Nephtys* community occurs everywhere within the BNS.

Control zone 1 (sector 1a) consists of a mix of *Nephtys* and *Hesionura* communities. Especially in the eastern region of this sector there is a dominance of the *Nephtys* community. In control zone 2 there is a transition from the *Nephtys*-dominated sector 2kb (Kwintebank) to the *Hesionura* community at the level of sector 2od (Oostdyck), with a mix of both at the level of sector 2br (Buiten Ratel). Control zone 3 has a mix of *Nephtys* and *Hesionura* communities as well but supplemented with the *Abra* community. Control zones 4 and 5 further offshore are characterised by coarser sediments and the *Hesionura* community (with here and there *Nephtys*).

The existing biological valuation map for macrobenthos (2007; update foreseen end 2020/early 2021) shows that control zone 1 (sector 1a) is mainly a complex of both valuable patches and patches of very little value. Control zone 2 is mainly valuable for macrobenthos (overlap with Habitats Directive area 'Vlaamse Banken'), with some patches of very little value. Control zone 3 is located in a wider area that has been mainly marked as valuable. Control zones 4 and 5 are in less valuable areas according to the valuation map, but recent research has shown that in the coarser sediments very valuable communities can occur as well.

4.3.1.2 Epibenthos & Fishing communities

Sampling near the Buiten Ratel (sector 2br of control zone 2), Oostdyck (sector 2od of control zone 2), Thornton Bank (control zone 1) and Hinderbanken (control zone 4) shows that the general temporal and spatial patterns, as known for the Belgian part of the North Sea, are dominant in the structuring of the epibenthos and fish communities of the exploitation areas. Within the epibenthos, the BNS is characterised by, among others, brittle stars, bivalves and shrimps. The fish fauna consists mainly of demersal communities of flatfish (e.g. sole, common dab, plaice), perciformes (e.g. lesser weever, sand eel) and gobies. It is generally noted that species abundance and densities are generally higher in autumn than in spring. On the other hand, densities and biomass are higher in the more coastal zone compared to further offshore locations.

Temporal patterns - Differences in communities were observed between spring and autumn. Some species were present in one season only, such as sprat in spring, and horse mackerel and surmullet in autumn. While others occurred in much higher numbers in either season, such as grey shrimp in spring and squid in autumn.

Spatial patterns - In addition to the dominant seasonal pattern, a clear spatial pattern within each season was observed (based on data up to 2012):

- Fewer species and lower densities were observed near the Hinderbanken (control zone 4) and the Oostdyck (sector 2od within control zone 2). Samples from autumn were dominated by lesser weever and horse mackerel; samples from spring only by lesser weever, supplemented by grey shrimp and sprat at some locations.
- Near the Buiten Ratel (sector 2br within control zone 2) and Thornton Bank (zone 1) a higher number of species was found, and mainly near the gullies in higher densities. In spring, samples were dominated by grey shrimp in both areas, supplemented mainly by hermit crab and starfish near the Buiten Ratel, and by several other species near the Thornton Bank. In autumn, the impact area of the Buiten Ratel was dominated by starfish, hermit crab, grey shrimp and swimming crab, while in the reference area

one site was dominated by lesser weever and horse mackerel and the other site by starfish and hermit crab. In the autumn samples of the Thornton Bank, other species occurred in more or less equal densities, although with a slight dominance of lesser weever at the top of the sandbank.

Finally, more recent monitoring data (oral communication ILVO; publication expected end 2020) shows that extraction regime and frequency affect epibenthos and fish communities. Mainly frequent intense extraction activities over several years may lead to changes in the number of individuals of more opportunistic species such as brittle stars, starfish, the common swimming crab, shore sea urchin and common dab. With less frequent extraction, interrupted by periods of less activity, there are no differences in epibenthos and fish fauna, apart from the natural variation inherent in the sandbank system within the BNS.

4.3.1.3 Avifauna & Marine mammals

The BNS is an important wintering and foraging area for seabirds. Especially the shallow western coastal banks are of great importance. In addition, the relationship with the land is of great importance, with seasonal migration parallel to and close to the coastal strip, both over water and on land, and forming part of the East Atlantic migratory bird route. Despite the limited size of the BNS, eight species of seabirds (listed in Annex I of the Birds Directive 79/409/EEC) are regularly identified in the BNS: red-throated diver, great crested grebe, lesser black-backed gull, great black-backed gull, little gull, little tern, sandwich tern, and common tern.

The importance of the coastal zone is clearly reflected in the existing biological assessment map (2012) for seabirds. Control Areas 1 and 3 are indicated on this map as valuable for seabirds, while Control Area 2 is partly considered valuable. However, also control zones 4 and 5 that are more offshore are marked as partially valuable.

The mammal species found in Belgian waters are the harbour porpoise, the common seal, the grey seal, the bottlenose dolphin and the white-beaked dolphin, although mainly the first three are more frequently observed. They are all protected species as they are covered by the Habitats Directive. In view of the fact that the harbour porpoise occurs in the BNS in much larger numbers than the other mammal species and also proves to be very sensitive to disturbance, the focus for the effect description within the EIR will be on this species. However, the occurrence of the harbour porpoise, both spatially and over time, is difficult to predict as it is a highly mobile species and the animals found within the BNS are part of a much larger population, which spreads over the entire southern and central North Sea. Harbour porpoises are found throughout the year in the Belgian maritime areas, but there is a clear seasonal pattern. During most of the year, less than 1 % of the North Sea population occurs in Belgian waters, but seasonally during the migration period (spring-summer) this number increases to more than 5 % of the population in the North Sea.

4.3.1.4 Appropriate assessment

Control zone 2 is situated within the Habitats Directive area 'Vlaamse Banken'. This area was selected for its high ecological value and high percentage of valuable biotopes. It covers 35 % of the area of Habitat Type 1110² in the BNS, 29 % of the *Lanice conchilega* aggregations and 38 % of the gravel beds³. On the basis of the European Habitats Directive (art. 6, § 3) and its further translation into articles 14 and 15 of the RD 27/10/2016 concerning the procedure to designation and conservation of marine protected areas, an appropriate assessment must be made for the sand extraction activities, as these activities may have an impact on protected habitats.

² Habitat type 1110 'Sandbanks' as listed in Annex I of the Habitats Directive

³ *Lanice conchilega* aggregations and gravel beds are biotopes that can be considered as Habitat Type 1170 'Reefs' (as listed in Annex I of the Habitats Directive), or as a 'special feature' under Habitat Type 1110 'Sandbanks'.

4.3.2 Impact description and assessment

4.3.2.1 Macrobenthos

Biotope loss - In all implementation scenarios, locally significant habitat loss occurs due to removal of the top layer of the seabed. Under scenarios 1 and 3, habitat loss occurs over a larger area (additional control zone 5 included), while under scenarios 2 and 3 it occurs in a larger volume. However, as the area of clearing is limited in all scenarios compared to the total surface area of BNS (approx. 4%), the impact of habitat loss is assessed as slightly negative (-) for all scenarios.

Increase in turbidity - The increase in turbidity due to sand extraction is very temporary and limited in spatial scope. In addition, the increased turbidity is maximally of the same order of magnitude as the natural turbidity during storms. As the benthos of the subtidal sandbanks is adapted to these natural dynamics, the impact of the increase in turbidity due to the extraction activities is considered negligible (virtually no effect) (0), for all implementation alternatives.

Sedimentation of the turbidity plume - Taking into account the direct and indirect (possible) effects, sedimentation of the turbidity plume is not negligible. Research has shown that there is a risk that fine material from the overflow will have effects in the distant field, although this enrichment with fine materials has not been observed for all control zones. This possible effect needs to be assessed further in ongoing monitoring initiatives. In view of the possible consequences for seabed functions and ecosystem efficiency, the effect of sedimentation of the turbidity plume is assessed as slightly negative (-) for all scenarios. In scenarios 1 and 3, extraction activities are more spatially distributed over a larger area, given the inclusion of control zone 5. Scenarios 2 and 3 involve a larger volume of sediment to be extracted. However, these differences are too small to make a distinction in assessment between the different scenarios.

Changes in structural and functional characteristics of the benthic ecosystem - As long as marine aggregate extraction takes place at low intensities (such as so far at the Oostdyck, southern central part of the Buiten Ratel) or at high but infrequent intensities (Oosthinder, control zone 4), it can be assumed that the current sandy benthic ecosystem of the BNS is resilient enough to buffer the biological impact of extractions, both structurally and functionally. If, on the other hand, the extraction pressure is high and focuses on a limited area, in which large volumes are extracted and that is frequently visited, it can be expected that changes in sediment composition will lead to biological changes. However, as these biological changes are relatively limited, and do not give rise to measurable changes in ecosystem functioning based on current knowledge, there are no significant adverse effects. In addition, a new reference level will be implemented in 2021, based on criteria consistent with the recommendations for sustainable exploitation of tidal banks. For none of the zones/sectors the proposed volumes to be exploited within the scenarios exceed the available volumes compared to the new reference level for the upcoming concession period.

In addition, there appears to be a chance that fine material from the spill will have effects in the distant field, although not observed for all control zones, with possible consequences for benthos communities. Such effects are most likely to occur during intensive extraction operations that are located within a limited area (frequently visited or not).

In all scenarios, extraction activities will be spatially distributed within control zones 1, 2, 3 and 4 (scenario BAU and 2), or supplemented by control zone 5 (scenarios 1 and 3). The increased extraction limit in scenarios 2 and 3 means a higher impact as more sediment is removed, but this difference is very small. Therefore, the impact of marine aggregate extraction on the structural and functional characteristics of the benthic ecosystem is assessed as slightly negative (-) for all scenarios.

Ecotoxicological effects - Ecotoxicological effects on benthos due to marine aggregate extraction are considered negligible (virtually no effect) (0), for all implementation alternatives.

4.3.2.2 Epibenthos & Fishing communities

As sand extraction is limited to the higher parts of the sandbanks, the ecologically more valuable gullies (and also coarser sediments) where epibenthos and fish preferably occur are preserved. Moreover, many epibenthos species and all demersal fish are mobile species that can migrate easily, and the disturbed area is relatively small compared to the total surface area of the BNS. The effect of **biotope loss** (approx.

4% of total surface BNS) **and biotope change, increased turbidity and mortality** on epibenthos and fish communities is assessed as slightly negative (-) in each case, for all implementation alternatives.

Ecotoxicological effects on epibenthos and fish communities due to marine aggregate extraction are considered negligible (virtually no effect) (0), for all implementation alternatives.

4.3.2.3 Avifauna & Marine mammals

Food availability - Reduced availability of benthos as a food source is expected to *potentially* occur only in intensively exploited areas, with potential direct and/or indirect effects on seabirds and marine mammals. However, the area of intensively exploited zones is very limited compared to the total surface area of BNS (max. ca. 4 %).

Despite the temporary and local effect of marine aggregate extraction on demersal fish communities, there is no uniformly observed effect, and variations in densities of prey species are as well caused by natural seasonal fluctuations. In addition, marine aggregate extraction may also cause temporary facilitation of food availability through sediment swirling and the release of epibenthos in the process.

Consequently, it is assumed that there will be virtually no changes in food availability for both seabirds and marine mammals as a result of marine aggregate extraction in the BNS. Impact is assessed as negligible (almost no impact) (0), for all implementation scenarios.

Increased turbidity - As the increased turbidity occurs only temporarily and is at most of the same order of magnitude as the natural turbidity during storms, the impact of the increased turbidity due to the extraction activities on seabirds and marine mammals is considered negligible (virtually no effect) (0), for all implementation alternatives.

Disturbance - Disturbance caused by marine aggregate extraction is of a temporary nature and takes place in limited zones in the BNS. The number of vessel movements remains limited compared to the shipping traffic already present in BNS, despite the increasing number of vessel movements for scenarios 2 and 3 (increased extraction limit). Seabirds and marine mammals are mobile species that, if desired, can avoid the zones of disturbance. The unloading activity in coastal ports is part of the currently prevailing port activities which common avifauna is used to and does not take place in the vicinity of seal resting areas. Consequently, the impact of disturbance (including noise) caused by marine aggregate extraction is assessed as slightly negative (-).

4.3.2.4 Appropriate assessment

Habitat type 1110 'Sandbanks permanently flooded with seawater' - The physical habitat is influenced only very locally, at the level of the exploitable zones within control zone 2. The sandbank-gully ecosystem as a whole is not affected, given the limited area (ca. 4 % of total BNS) where extractions will occur compared to the total surface area of the BNS. Moreover, all proposed volumes to be extracted have been drawn up on the basis of the recommendations for sustainable exploitation of tidal banks. The biological effects (structural and functional changes in the benthic communities associated with the sand banks and gully system) of marine aggregate extraction will remain relatively limited, for all implementation scenarios.

It is therefore concluded that no significant negative effects are expected on Habitat Type 1110 'Sandbanks permanently flooded with seawater' due to marine aggregate extraction in the BNS. Based on current knowledge, the realisation of the conservation objectives for this habitat type within SAC 'Vlaamse Banken' will not be compromised. There is no distinction in the impact assessment for the different implementation alternatives.

Habitat type 1170: 'Reefs - Gravel beds' - Due to an earlier redefinition of the sectors of control zone 2 and the introduction of a ban on gravel extraction in control zone 2, the direct impact of marine aggregate extraction on gravel beds within the Habitats Directive area 'Vlaamse Banken' was reduced to a minimum.

In addition, there appears to be a chance that fine material from the overflow has *indirect* effects on gravel beds. However, no direct relationship has yet been established between enrichment with fine material and extraction activities, although this cannot be excluded. Given the fact that enrichment with fine material has

not been measured in all control zones of the BNS (including parts of control zone 2 within SAC 'Vlaamse Banken'), that the ratio between hard and soft substrata was re-established after a period of time, and that the current EIR builds on the principle of sustainable exploitation of the sand banks (cf. new reference level), it can be concluded based on current knowledge that the conservation objectives regarding the areal spread of the habitat type and the ratio between hard and soft sediment substrata not showing a negative trend, will not be significantly compromised due to aggregate extraction in control zones 2 and 4 in and near SAC 'Vlaamse Banken'. The potentially indirect effect of enrichment with fine material and possible 'smothering' of gravel beds needs to be further assessed in monitoring initiatives. Additionally, causal relationships between enrichment with fine materials and natural and anthropogenic pressures needs to be clarified (Van Lancker *et al.*, 2017; ongoing studies regarding sediment plumes).

Based on current knowledge it is concluded that no significant negative effects are expected on Habitat Type 1170: 'Reefs - Gravel beds' as a result of marine aggregate extraction in the BNS. The realisation of the conservation objectives for this habitat type within SAC 'Vlaamse Banken' will not be compromised. There is no distinction in the impact assessment between the different implementation alternatives.

Habitat type 1170 'Reefs - *Lanice* aggregations' - As the *Lanice conchilega* aggregations within the SAC 'Vlaamse Banken' are mainly located just off the coast and control zone 2 is located further offshore, no significant negative effects are expected on habitat type 1170 'Reefs - *Lanice* aggregations' as a result of marine aggregate extraction in the BNS. Current extraction efforts in control zone 2 are relatively limited (and a few areas have been closed already), and future volumes to be extracted will not increase under the scenarios with the increased extraction limit (scenario 2 and 3), so that there will be no increase in the disturbance of habitat type 1170 – biogenic reefs. The realisation of the conservation objectives for this habitat type within SAC 'Vlaamse Banken' will not be compromised. There is no distinction in the impact assessment between the different implementation alternatives.

Harbour porpoises - No changes are expected in food availability for harbour porpoises due to marine aggregate extraction in the BNS. Noise disturbance is of a temporary nature and occurs in limited zones in the BNS. Moreover, harbour porpoises are mobile animals that can avoid the zones of disturbance if desired.

It is concluded that no significant adverse effects are expected on harbour porpoises due to marine aggregate extraction in the BNS. The realisation of the conservation objectives for harbour porpoises will not be compromised. There is no distinction in the impact assessment between the different implementation alternatives.

Conclusion - No significant negative effects are expected on the Habitats Directive area 'Vlaamse Banken' and the species harbour porpoise. Based on current knowledge, the conservation objectives for habitat types 1110 (Sandbanks permanently flooded with seawater) and 1170 (Reefs) will not be compromised, as well as those for the harbour porpoise. There is no distinction in the impact assessment between the different implementation alternatives, in part due to the fact that extractions within control zones 2 and 4, which are most relevant in light of the Appropriate assessment, are foreseen under all scenarios. Within control zone 2, current extraction efforts are already limited and will not increase in the future, even not for the scenarios with an increased extraction limit (continuation of the current activity).

The possible indirect effects on gravel beds due to enrichment of the seabed matrix with fine sediments (possibly from overflow) should be further investigated and assessed.

4.4 Atmosphere & Climate

4.4.1 Reference situation

In the coastal zone, the positive impact on air quality due to the prevailing south-west winds can clearly be observed, with purer air coming in from the sea. Near the port of Zeebrugge and to a lesser extent near the port of Ostend generally higher concentrations of pollutants are observed compared to the rest of the coastal region and West Flanders. The reason for the increased values near these port areas is the strong presence of shipping, more road traffic (freight traffic) and more industrial emissions. However, the measurement results of recent years show a decrease in pollutant concentrations in these zones due to a decrease in emissions. The air quality in the project area for all relevant components more than meets the

air quality objectives. It can be assumed that values at sea in the areas of the sand extraction will be much lower.

Ro-ro ships and container ships combined account for about half of total maritime emissions in 2018. This is not surprising given the importance of these types of goods in the traffic of the Flemish ports. Dredging accounts for the largest share of emissions from domestic shipping, about half of total emissions. Furthermore, it appears that the share of sand extraction in the total emission of nitrogen oxides $\text{NO}_x(\text{NO}_2)$ is also in the top 3 of activities (besides dredging and towage activities).

4.4.2 Impact description and assessment

The share of **emissions** from marine aggregate extraction in the control zones considered under the different scenarios compared to total emissions from domestic shipping is significant for scenario BAU and 1 (approx. 14-24 % of total emissions, depending on the parameter considered), but does not differ substantially from the current situation since extractions under the current limit are largely a continuation of the current activity. Given the increase in the amount of material to be extracted in scenarios 2 and 3 (+5 M m³ of additional volume), it can be assumed that the impact of marine aggregate extraction on air quality will increase relatively compared to the current situation (cf. scenario BAU) and scenario 1 as the number of ship movements to the extraction areas increases (by about 28 %). Emissions for scenarios 2 and 3 are therefore about 30 % higher than for scenarios BAU and 1, and their share compared to total emissions from domestic shipping is about 19-31 %, which is also higher than under scenarios BAU and 1. The impact of the increased ship movements on emissions is likely to be greater in scenarios 2 and 3 than the expected decreasing emissions of air pollutants due to systematic implementation of various standards and fleet renewal.

The impact of marine aggregate extraction on air quality is therefore assessed as moderately negative (--) for scenarios 2 and 3, versus slightly negative for scenarios BAU and 1 (-).

4.5 Noise

4.5.1 Reference situation

The natural background noise level under water is approximately between 90 and 100 dB (re 1 μPa) in the frequency range 100 Hz to a few kHz. Noise from ship engines is one of the most important sound sources of human origin. The noise and vibrations from the engine room, the propeller noise and the noise from the currents increase the underwater ambient noise level. The channel between the UK and the mainland is regarded in literature as a 'hot-spot' for underwater noise caused by the high density of shipping. Dredging work, seismic surveys of soil conditions and pile driving in the construction of wind turbines are also important anthropogenic noise sources.

Above water, in the high seas, the background noise level is estimated to be 35 ± 5 dB(A). Near the coast, due to the concentration of anthropogenic activities, it is slightly higher and average values between 50 and 65 dB(A) are recorded at 25 m from the coastline.

4.5.2 Impact description and assessment

The **underwater noise** due to marine aggregate extraction (mining as such) is significantly higher than the background noise up to a few kilometres from the source if the weather conditions are favourable. Given that the activity under consideration is largely a continuation of the already existing activity (same volumes in scenarios BAU and 1), there is no increase in the prevailing noise climate, but the situation remains virtually unchanged compared to the current situation for scenarios BAU and 1. For scenarios 2 and 3 there is an increase compared to the current situation, given the increased extraction activities. However, these are still integrated into the prevailing shipping traffic and the associated noise climate. The effect of marine

aggregate extraction (activity within the control zones) on the underwater noise climate is assessed as slightly negative (-) for all scenarios.

The sound of the TSHD(s) **above water** can be observed up to a distance of 1 to 2 km from the source. Since the activity in question is largely a continuation of existing activity in areas close to the coast (1, 2 and 3), there is no increase in the prevailing noise climate near the coastline, but the situation remains virtually unchanged compared with the present situation. Moreover, control zones 4 and 5 are further away from the coast, so that extraction activities in these zones will contribute little to the noise climate at sea and will not be perceptible at the coastline. The effect of marine aggregate extraction on the above-water noise climate is assessed as negligible (almost no effect) (0), for all scenarios.

The influence of the **moving TSHDs** on the current total environmental noise above and below water is limited compared to current shipping, for all scenarios. Indeed, the activity considered in scenario BAU and 1 is largely a continuation of the already existing activity (same volume). In scenarios 2 and 3 there is a limited increase in extracted volume (extra 5 M m³/5 years), which increases the number of ship movements. However, this will not lead to a perceptible increase in the prevailing noise climate, as the ship movements are integrated in the total shipping traffic within the BNS.

The noise emission during **unloading of the ship** is relatively low and takes place in an environment where there is already a strongly disturbed noise climate (port area). The effect on the noise climate of discharging the extracted marine aggregates is assessed as negligible (0) for the various scenarios.

4.6 Seascape & Cultural heritage

4.6.1 Reference situation

The sea and the beach are experienced as positive by the population. In fact, the coast is an important tourist attraction in Belgium, both for day tourists and for residential tourism. In contrast to the sea, the view of the coastline inland is characterised by a succession of high-rise buildings. Movement in the landscape caused by cargo ships, fishermen, recreational boats, surfers, etc. are part of the landscape experience for the people on the dike. Particularly near the seaports, there is heavy traffic of oncoming and approaching ships.

The concept of 'maritime archaeological heritage' has a very large connotation, but within this EIR the emphasis will be on the shipwrecks, which are scattered within the BNS. According to the most recent data in the wreck database, at least 3 wrecks are located near control zone 2. At the level of control zone 3, 1 wreck is located on the border with the extraction area. Within sector 1a there are 3 wrecks. In control zones 4 and 5 there are no wrecks according to the latest observations and data. However, none of the wrecks in the control zones are protected.

4.6.2 Impact description and assessment

There is no increase in the **disturbance of seascape** by the marine aggregate extraction in control zones 1, 2, 3 and 4 (BAU scenario and scenario 2) as it is a continuation of the already existing activity. However, there is an increase in the disturbance of seascape in scenarios 1 and 3, given the inclusion of control zone 5. Nevertheless, given the large distance of this zone from the coastline, this effect is also considered to be minimal. Ship movements are integrated in the prevailing busy shipping traffic, which is part of the perception of the marine landscape. As a consequence, the effect of marine aggregate extraction on seascape is considered negligible/nearly no effect (0).

Marine aggregate extraction means a possible loss or damage to **maritime cultural heritage**. Subject to maximum application of the practical recommendations and maximum use of the practical protocols resulting from the SeArch project, the impact will be assessed as slightly negative (-).

4.7 Compatibility with other activities

4.7.1 Reference situation

According to the Marine Spatial Plan 2020-2026 (RD 19/05/2019), the control zones for the extraction of marine aggregates overlap in spatial use with almost all other anthropogenic activities (depending on the control zone considered). However, not all activities are expected to be equally affected by marine aggregate extraction. The most important are: fishing, zones for energy (incl. cables and pipelines), military activities, zones for the dumping of dredged materials, shipping, and tourism and recreation.

4.7.2 Impact description and assessment

Fisheries - The direct impact (temporal incompatibility) of marine aggregate extraction on fisheries is limited given that benthic fisheries are more focused on the flanks and gullies between sandbanks, and that shrimp fisheries are mainly conducted outside the most intensively exploited areas. Moreover, there is no change from the current situation. The possible indirect effect is also limited as no clear overall impact of aggregate extraction on demersal fish communities has been observed so far in the BNS. As a consequence, the impact of marine aggregate extraction on fisheries is considered to be slightly negative (-). This applies to all implementation alternatives.

Marine aquaculture - Marine aggregate extraction could have potential ecotoxicological effects on the (potential future) reared organisms in the mariculture zones due to the potential release of toxic substances during the exploitation activity. Increased turbidity and the related sediment plume can also have an indirect effect on the culture of certain species. However, the ecotoxicological effects of extraction are considered negligible, and the impact of turbidity slightly negative (see above). Moreover, due to the strong flow of seawater, such a rapid dilution occurs that the effect of marine aggregate extraction in the BNS on mariculture is considered negligible (almost no effect) (0). This assessment applies to all implementation alternatives.

Commercial and industrial activities - Marine aggregate extraction could potentially have an (indirect) impact on the potential future activities in the CIA zones similar to the effects on mariculture (see above). As these activities are currently not yet concrete, and as there is no spatial overlap between these zones and the control zones for marine aggregate extraction, the effect is considered 'not applicable' within the present EIR.

Shipping - The control zones for sand extraction have no or only minimal overlap with the main IMO shipping lanes and traffic flows necessary for shipping to call at Belgian ports and the ports on the Scheldt. For a discussion and assessment of the risk of collisions, reference is made to the 'Safety aspects'.

There are no conflicts with the harbours. The ships used in marine aggregate extraction that come to port to unload their cargo are part of the normal port-related shipping activities and thus have to adhere to the port regulations. The effect of marine aggregate extraction and port-related activities on harbours is therefore considered negligible (almost no effect).

Dredging and dumping - No spatial conflicts are identified between marine aggregate extraction and dredging activities (including dumping of dredged material in sector 3b, which is considered as closed in the present EIR). The effect is assessed as negligible (virtually no effect) (0) for all implementation alternatives.

Energy - Current knowledge indicates only local (significant) changes in flow patterns and erosion/sedimentation patterns at very intensively exploited areas. It is therefore assumed that such significant changes in flow patterns will not extend beyond the boundaries of the control zones. Therefore, virtually no effect (0) on the stability of wind turbines and possible future wind farms is expected.

Marine aggregate extraction has a negligible (virtually no) effect (0) on cables and pipelines, provided that the applicable regulations and safety perimeters are observed. These assessments apply to all implementation scenarios.

Coastal defence - Marine aggregate extraction potentially has a direct impact (increased wave impact during storms) and indirect impact (coastal erosion) on coastal defence. Both effects are considered

negligible (almost no effect) (0), essentially due to the relatively large distance of sand extraction zones to the coast and the presence of other sandbanks dissipating wave energy, for all implementation alternatives.

Military activities - Marine aggregate extraction has a negligible (virtually no) impact (0) on military activities, subject to compliance with the ban on access to the military zones concerned during announced exercises and other military activities. This applies to all implementation alternatives.

Tourism and Recreation - The marine aggregate extraction has no impact on tourist-recreational activities in the coastal zone. Moreover, provided that the shipping regulations are observed correctly, the risk of collisions between an extraction vessel and recreational shipping at sea is considered to be very low. The impact of marine aggregate extraction is considered negligible (almost no impact) (0), for all implementation alternatives.

4.8 Security aspects

4.8.1 Reference situation

4.8.1.1 Shipping

Belgian seaports are located on some of the busiest shipping lanes in the world, with more than 150,000 ship movements per year. The number of seagoing vessels calling at Belgian seaports on an annual basis has declined over the last four decades (-19 % since 1980). However, this decline has been offset by the ever-increasing size of vessels, which has led to an increase in total gross tonnage of 338 % over the same period.

4.8.1.2 Oil pollution

As the project area is located in the North Sea, it is covered by the arrangements applicable to MARPOL 'special areas', Annex I. The discharge of oily liquids is prohibited. A loss of oil from ships can have several causes: a collision between two ships, ships colliding with a stationary or floating obstacle, cracks in the hull, sinking, fire on board, serious negligence, deliberate (criminal) discharge activities, etc. Once a (accidental) discharge has taken place, it will spread and pose a potential threat to the marine ecosystem and coastal areas.

Despite the increase in maritime transport, there is a clear downward trend in the annual number of illegal oil spills detected in Belgian waters during the period 1991-2019. In 2019, 13 operational oil spills in and near the Belgian maritime areas were observed during aerial surveillance. The reason for this general downward trend is undoubtedly due to all the policy measures taken at national, European and global level and the improved port reception facilities, in addition to the dissuasive effect of the current means of monitoring. On the other hand, the observation flights do show an upward trend in operational discharges of harmful substances other than oil in the period 1991 to 2019.

4.8.2 Impact description and assessment

Maritime safety - Building on the results of previous EIRs (Ecolas, 2006; IMDC, 2010; ARCADIS Belgium, 2016) and EIAs, it can be assumed that the probability of an accident occurring during marine aggregate extraction in control zones 1, 2, 3, 4 and 5 is low. There is a limited extension in scenario 1 and 3 to zone 5, but the additional risk remains limited.

The increase in the risk of shipwreck due to the increase in commercial sand extraction activities and the associated ship movements (+28.5 % in scenario 2 and 3, mainly in control zone 4) compared to the current situation (cf. scenario BAU and scenario 1) is negligible: the current risk in scenario BAU and 1 increases slightly, but remains small. The effect of marine aggregate extraction in control zones 1, 2, 3, 4 and 5 on maritime safety is therefore assessed as slightly negative (-) for all scenarios (scenario BAU, 1, 2, 3). It

goes without saying that careful compliance with the regulations in force with regard to shipping safety is a strict precondition for this.

Risk of oil pollution - In conclusion, the risk of oil pollution is very low. The greatest risk of an oil spill being stranded is at higher wind speeds (17 m/s) and wind friction (5 %). The precautionary principle should be applied, first and foremost to prevent an accident at sea as much as possible and, if this proves impossible, to avoid or reduce a discharge as quickly as possible.

In particular, avifauna, and possibly also marine mammals, will feel the most significant short-term effects of oil pollution. The impact of a discharge on the bird population depends on the one hand on the species present, their density and vulnerability and on the other hand on the polluted surface. In addition to the direct victims caused by a disaster, there may also be negative consequences for the population (long-term effect). However, it is often not easy to distinguish the effect of an oil spill from natural fluctuations in a population.

The effect of marine aggregate extraction on the likelihood of oil pollution is assessed as slightly negative (-).

4.9 Impact on Good Environmental Status and Environmental Targets (MSFD)

Marine aggregate extraction has a potential impact on Good Environmental Status and on the realisation of Belgium's Environmental Targets as defined in the framework of the Marine Strategy Framework Directive 2008/56/EC. The following descriptive elements (Descriptors) are relevant here: D1 (Biodiversity), D2 (Non-indigenous species), D4 (Ecosystem, food chain), D6 (Seabed integrity), D7 (Hydrographic conditions), D8 (Contaminants), and D11 (Underwater noise).

D1/D4/D6:

- Because of redefining the sectors of control zone 2 and introducing a ban on gravel extraction in control zone 2 in the MSP (2014-2020; 2020-2026), a positive trend is expected compared to the initial state (2012) - at least with regard to marine aggregate extraction - for several indicators showing the realisation of Good Environmental Status for descriptors D1, D4 and D6.
- Despite the large share of extraction activities in the physical disturbance of the seabed of the BNS, the area disturbed is relatively limited (1.9-2.7 %) compared to the whole BNS. It is therefore assumed that the actual removal of substrate and changes in topography due to aggregate extraction do not have a significant impact on the integrity of the seabed and the connectivity of habitats, also because the implementation scenarios take into account the maximum extraction depths compared to the scientifically founded reference level under sustainable exploitation. A limited impact is possible, but significant impacts are not expected.
- In the near field (near intensively exploited areas) sedimentological changes occur frequently; a more heterogeneous habitat is created, but there is no unilateral significant refinement of the sediments. For this aspect no significant impact on the Good Environmental Status of D6 is expected either.
- In the distant field, no 'smothering' (asphyxiation) of the gravel beds due to the turbidity plume has been observed so far. On the other hand, there is a risk that fine material from the overflow has effects in the distant field by capturing and buffering these fine sediments in the soil matrix, with possible consequences for seabed functions. Based on the most recent data gathered by FPS Economy, enrichment with fine material is not a commonly observed phenomenon for all control zones. On top of this observation, there is only a limited amount of fine sediment that is released during extraction operations due to the fact that it is mainly the coarser fraction that is being sieved and discarded as overflow into the sea.
- The possible indirect effects due to enrichment of the seabed matrix with fine sediments (possibly originating from overflow) are still partly a gap in knowledge and should be further assessed. Further studies and monitoring efforts over the coming years, combined with the publication of the most recent observations of multibeam and backscatter data (foreseen end of December 2020), will provide further insight on the risk of enrichment with fine fraction. If this shows that the integrity of the seabed is indeed compromised, mitigation measures should be sought.

D2 - Marine aggregate extraction does not give rise to the introduction of new non-indigenous species. Consequently, no impact is expected on the realisation of the Good Environmental Status for descriptor D2.

D7 - Based on the impact descriptions and assessments within the disciplines 'Soil' and 'Water' it is concluded that no significant impact as a result of marine aggregate extraction on the achievement of the Good Environmental Status and the environmental targets for descriptor D7 (Hydrographic conditions) is expected.

D8 - The probability of an accident occurring during marine aggregate extraction in control zones 1, 2, 3, 4 and 5 is low. There is a 28.5 % increase in shipping activity in scenarios 2 and 3 for commercial sand extraction, but the risk remains low in all scenarios. The risk of oil pollution is very low as well. Careful compliance with current regulations on maritime safety is a strict condition at all stages of the marine aggregate extraction process. In addition, the precautionary principle must be applied, the primary aim being to prevent a shipping accident as much as possible and, if this proves impossible, to avoid or reduce a discharge as quickly as possible. Taking these aspects into account, it can be concluded that the marine aggregate extraction does not affect the realisation of the environmental targets in the BNS for descriptor D8, and this for scenario BAU, 1, 2 and 3.

D11 - Overall, it can be concluded that marine aggregate extraction in the control areas will not contribute to a positive trend in annual average ambient noise levels as there is a continuation of an existing activity (same volume) for scenarios BAU and 1. For scenarios 2 and 3, there is a 33 % increase in commercial volumes extracted and thus in the number of ship movements (+ 28.5 %) compared to scenarios BAU and 1. However, in view of the small contribution of ship movements in the sector compared to total ship movements in the BNS, marine aggregate extraction (in the different scenarios) does not compromise the realisation of the environmental targets in the BNS for descriptor D11.

5 CUMULATIVE EFFECTS

Cumulative effects may occur due to a combination of marine aggregate extraction in control zones 1, 2, 3, 4 and 5 with various other human activities at sea causing (partly) similar effects. This mainly concerns fishing, in particular bottom trawling fisheries; the construction and operation of wind farms in the BNS (including the laying of cables); dredging and dumping of dredged material; and shipping. Possible future renewable energy projects (wind farms in the new 'Princess Elisabeth' zone, MOG II), future coastal defence projects (such as Complex Project Kustvisie), CIA for which the plans are not yet specific enough (ongoing research) and/or the effective implementation period is still unprecedented, are not included in the present EIR. Moreover, such projects are themselves subject to EIR and the (cumulative) effects will be studied in due course in project EIRs.

In many cases, the cumulative effect is **equal to the sum of the effects** of the individual activities. An example is the cumulative effect on soil of marine aggregate extraction and wind farms at sea.

In a single case, the cumulative effect is **smaller than the sum of the effects** of the individual activities. This is the case for marine aggregate extraction in the control zones in combination with dumping of the dredged material (cumulative impact on soil) as part of the dumped material, i.e. part dumped in landfill S1, is later reclaimed (overlap with control zone 3b). Part of the modification of the soil in this zone will therefore be removed.

Finally, there are several aspects where the cumulative effect is (possibly) **greater than the sum of the effects** of the individual activities:

- Marine aggregate extraction in control zones in combination with bottom trawling fisheries - cumulative impact on soil
- Marine aggregate extraction in the control zones in combination with all other relevant activities - cumulative impact on macrobenthos (Fauna, Flora & Biodiversity)
- Marine aggregate extraction in the control zones in combination with all other relevant activities - cumulative impact on epibenthos & fish communities (Fauna, Flora & Biodiversity)
- Marine aggregate extraction in the control zones in combination with all other relevant activities - cumulative impact on underwater noise and on marine mammals (Fauna, Flora & Biodiversity)

- Marine aggregate extraction in the control zones in combination with all other relevant activities - cumulative impact on maritime safety (safety aspects)

Cumulative effect of marine aggregate extraction in control area 1, 2, 3, 4 and 5 in combination with	Fishing	Wind farms (incl. cables)	Dredging and dumping of dredge spoil	Shipping
Soil	>S(?)	S	S <S	n/a
Water	S	S	S	n/a
Fauna, Flora & Biodiversity: macrobenthos			>S	
Fauna, Flora & Biodiversity: epibenthos & fish			>S	
Fauna, Flora & Biodiversity: marine mammals			>S	
Atmosphere			S	
Noise			>S	
Cultural heritage			S	
Maritime safety			>S	

When assessing cumulative effects, it is important to note that the activity for which the present EIR is drawn up, namely marine aggregate extraction in control zones 1, 2, 3, 4 and 5, is largely a continuation of an already existing activity (with the exception of zone 5 in scenarios 1 and 3). The discussed cumulative effects are already present today, and will not or hardly change in the future as a result of the continuation of marine aggregate extraction in control zones 1, 2, 3, 4 with a limited extension to zone 5. The implementation of a new reference level (from 2021 onwards), based on criteria consistent with the recommendations for the sustainable exploitation of tidal banks in order to conserve e.g. Fauna, Flora & Biodiversity, should also be taken into account. The proposed volumes to be extracted within the various scenarios (including those using an increased extraction limit, i.e. scenarios 2 and 3) do not exceed, for any zone/sector, the available volumes in relation to the new reference level for the coming concession period. There is thus no significant increase in the various cumulative effects compared to the current situation (taking account of autonomous development), irrespective of the fact that the cumulative effect in question is equal to, less than or greater than the sum of the effects of the individual activities.

6 MONITORING

In accordance with the law of 13 January 1969, which stipulates that exploration and exploitation must be subject to continuous review of the impact of activities, regular monitoring of exploitation activities in the BNS has been carried out since the end of 1999 by the Continental Shelf Service of the FPS Economy, the Institute for Agricultural and Fisheries Research (ILVO) and the Management Unit of the Mathematical Model of the North Sea (MUMM). Their results are presented during the sand extraction study day that takes place every three years as foreseen by law (first upcoming scheduled for the end of November 2020). New insights and results that are being presented during those study days can always be included as an annex to future concession applications.

The current monitoring programme mainly focuses on hydrodynamic processes and sediment transport near the Hinderbanken (control zone 4), with references to both modelling and field studies. Over the years, the control techniques used, mapping and statistical processing of the extracted volumes and the impact of the extraction on bathymetry, morphology and the nature of the sediments have been increasingly fine-tuned. The electronic monitoring system (black box) has already proven its importance for the quantitative monitoring of the spatial and temporal evolution of the extracted volumes. Moreover, the multibeam

echosounder remains the most suitable instrument for determining with great reliability the impact of the extractions on bathymetry and the morphology and nature of the seabed. From various disciplines (including 'Soil', 'Water', 'Fauna, Flora & Biodiversity') it is important to continue the ongoing monitoring in the same way. Analysis techniques from remote sensing on land can be applied to serial backscatter datasets and are useful in the context of before and after control impact (BACI) type monitoring of sand extraction.

The most important knowledge gaps to date concern the possible effects of sand extraction on the seabed, the water column and benthic fauna. Some issues that should be further clarified include: the possible long-term regeneration processes of depressions caused by intensive extraction; the distinction between natural variability and anthropogenic effects; the possible effects of sedimentation of the turbidity plume in the far field; and the cumulative impact of marine aggregate extraction in combination with bottom trawling fisheries. These aspects should be further investigated within the ongoing monitoring programme.

7 TRANSBOUNDARY EFFECTS

In view of the fact that no significant negative environmental effects have been identified in the present EIR for the Belgian part of the North Sea as a result of the marine aggregate extraction and that, moreover, the control zones are not located on the border with neighbouring countries, it is evident that there will also be no significant adverse transboundary environmental effects. Significant cumulative effects as a result of the marine aggregate extraction with projects abroad are not expected either.

8 SYNTHESIS AND CONCLUSIONS

The main effects of marine aggregate extraction relate to the disciplines 'Soil', 'Water', 'Atmosphere' and 'Fauna, Flora & Biodiversity' (mainly Macrobenthos).

- Because (intensive) extraction affects the volume of the sandbanks (permanent effect on bathymetry, however local and non-cumulative), this can lead to an effect on seabed integrity and disturbed morphology and global sediment dynamics. The implementation of volumes to be extracted in relation to a new reference level established within the framework of sustainable exploitation meets this need by ensuring maximum preservation of the seabed integrity and morphology of the sandbanks. The available volumes in relation to this new reference level will not be exceeded in any scenario.
- The physical disturbance of marine aggregate extraction can give rise to changes in structural and functional characteristics of the benthic ecosystem. When the extraction pressure is high and focuses on a limited area, which is frequently visited and where large volumes are extracted, it can be expected that changes in sediment composition will lead to biological changes (cf. extraction regime and frequency). However, the biological changes observed so far remain limited. Additionally, the implementation of extraction with respect to the new reference level within the different implementation scenarios will ensure that sustainable exploitation is not compromised and that ecologically valuable parts of the sandbanks are spared.
- With regard to sedimentation of the turbidity plume, there is a risk that fine material from the overflow will have effects on the ecologically valuable gravel beds in the far field. These possible indirect effects on gravel beds still partially constitute a knowledge gap and should be further investigated. To date, no 1-to-1 relationship between sand extraction and sedimentation of the passive turbidity plume has been demonstrated. In addition, the enrichment with fine sediments is not occurring in all extraction zones, so it is not a common phenomenon.
- The ship movements associated with sand extraction activities on the BNS cause an increase in emissions of, among other things, nitrogen oxides, sulphur dioxide and fine particulate matter, which have an impact on air quality and represent a significant proportion of total emissions from domestic shipping. These effects are particularly noticeable in scenarios 2 and 3.

These main effects are assessed as **slightly to moderately negative**. For scenarios 2 and 3 (increased extraction limit) only the effect on air quality is assessed more negatively compared to scenarios BAU and 1 (current extraction limit). In scenarios 2 and 3 there is an additional volume of 5 M m³ / 5 years (+ 33 %)

to be extracted, increasing the amount of ship movements and associated emissions by approx.. 30 % compared to scenario BAU and 1. However, in both scenarios 2 and 3 all effects remain acceptable (maximum moderately negative). Furthermore, the extension of extraction activities to zone 5 (as in scenarios 1 and 3) is not very distinctive, as this control zone is limited in size, located further away from the coast, and the volumes that could be extracted there contribute little in percentage terms to the total quantities.

The other effects (within these disciplines and within the other disciplines) are all considered **negligible to slightly negative**.