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Environmental report
for the suitability examination of site N-3.5*

Hamburg, February 2022

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List of abbreviations

TFEU	Treaty on the Functioning of the European Union
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas
EEZ	Exclusive Economic Zone
BBergG	Federal Mining Act
BfN	Federal Agency for Nature Conservation
BFO	Federal Offshore Grid Plan
BFO-N	Spatial Offshore Grid Plan - North Sea
BFO-O	Spatial Offshore Grid Plan - Baltic Sea
BGBI	Federal Law Gazette
BMU	Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit (Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety)
BNatSchG	Act on Nature Conservation and Landscape Management (Federal Nature Conservation Act)
BNetzA	Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway
BSH	Federal Maritime and Hydrographic Agency
CMS	Convention on the Conservation of Migratory Species of Wild Animals
EMSON	Survey of marine mammals and seabirds in the German EEZ of the North Sea and Baltic Seas
EnWG	Act concerning electricity and gas supply (German Energy Act)
EUNIS	European Nature Information System
EUROBATS	Agreement on the conservation of European bat populations
R&D	Research and development
SDP	Site development plan
FFH	Flora Fauna Habitat
SAC DIRECTIVE	Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive)
FFH-IA	Impact assessment in accordance with Article 6, paragraph 3 FFH Directive and Section 34 BNatSchG
FPN	North Sea Research Platform
PIS	Site preliminary investigation
HELCOM	Helsinki Convention
IBA	Important bird area
ICES	International Council for the Exploration of the Sea
IfAÖ	Institute for Applied Ecosystem Research
IOW	Leibniz Institute for Baltic Sea Research Warnemünde
IUCN	International Union for Conservation of Nature and Natural Resources (World Conservation Union)
K	Kelvin
LRT	Habitat type according to FFH Directive
MARPOL	International Convention for the Prevention of Pollution from Ships

MINOS	Marine warm-blooded animals in the North Sea and Baltic Sea: Basic principles for the assessment of offshore wind turbines
MRO	Maritime spatial planning
MSFD	Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)
NAO	North Atlantic Oscillation
NSG	Nature conservation area
Sea level	Normal zero
OSPAR	Oslo-Paris Agreement
OWF	Offshore wind farm
PAH	Polycyclic aromatic hydrocarbons
POD	Porpoise Click Detector
PSU	Practical Salinity Units
SCANS	Small Cetacean Abundance in the North Sea and Adjacent Waters
SeeAnlV	Ordinance on Installations on the seaward side of the German territorial sea (Offshore Installations Ordinance)
SEL	Sound event level
SPA	Special Protected Area
SPEC	Species of European Conservation Concern (Important Species for Bird Conservation in Europe)
StUK4	Standard "Investigation of effects of offshore wind turbines".
StUKplus	“Accompanying ecological research on the alpha ventus offshore test site project”
SEA	Strategic Environmental Assessment
SEA DIRECTIVE	Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the impacts of certain plans and programmes on the environment (SEA Directive)
UBA	Federal Environment Agency
Environmental Impact Assessment Act	Law on environmental impact assessment
EIA	Environmental Impact Assessment
EIS	Environmental impact study
EII	Environmental impact investigation
COLREGs	International Regulations for Preventing Collisions at Sea 1972
Birds Directive	Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (Birds Directive)
WTG	Wind turbine
WindSeeG	Act on the development and promotion of offshore wind energy (Offshore Wind Energy Act - WindSeeG)

1 Introduction

1.1 Legal basis and tasks of environmental assessment

Pursuant to section 12 (4) in conjunction with section 10 (2) of the Act on the development and promotion of offshore wind energy of 13 October 2016 (BGBl. I p. 2258, 2310, last amended by Article 19 of the Act of 21 December 2020 (BGBl. I p. 3138) (Wind Energy at Sea Act - WindSeeG), the BSH examines the suitability of a site for the construction and operation of wind turbines at sea as the basis for the separate assessment of suitability. As per section 12 (5) WindSeeG, the results of the suitability examination and the output that will be installed must be assessed if the result of the suitability examination is that the site is suitable for tendering pursuant to Part 3 Section 2. Within the scope of the suitability examination an environmental examination is carried out in accordance with the Environmental Impact Assessment Act in the version promulgated on 24 February 2010 (BGBl. I p. 94, last amended by Article 4 of the Act of 3 December 2020 (BGBl. I p. 2694) (Environmental Impact Assessment Act - UVPG), known as the strategic environmental assessment (SEA).

The obligation to conduct a strategic environmental assessment by drawing up an environmental report results from section 35 (1) 1 of the UVPG in conjunction with 1.18 of Appendix 5, according to which findings on the suitability of a site and the output that can be installed on the site pursuant to section12 (5) of the WindSeeG are plans or programmes in accordance with the UVPG and are subject to the SEA obligation. As per section 33 of the UVPG the SEA is a “dependent part of the official procedure to issue or amend plans and programmes”. The official procedure to issue the plan, in this case, to establish suitability, is the suitability examination, because any danger to the marine environment must be investigated within this scope.

The suitability and work examination themselves are the “plan” in accordance with the UVPG, meaning the formal confirmatory act on the basis of the results of the suitability examination.

According to Article 1 of the SEA Directive 2001/42/EC, the objective of strategic environmental assessment is to ensure a high level of environmental protection in order to promote sustainable development, and thereby to contribute to ensuring that environmental considerations are taken into account in an appropriate manner well in advance of concrete project planning, when the plans are compiled and adopted. The Strategic Environmental Assessment has the task of identifying, describing and evaluating the likely significant environmental effects of the implementation of the plan. It serves as an effective environmental precaution in accordance with the applicable laws and is implemented according to consistent principles, and with public participation. All factors in accordance with Section 2 subsection (1) of the Environmental Impact Assessment Act must be considered:

- People, in particular human health,
- fauna, flora, and biodiversity,
- site, soil, water, air, climate and landscape,
- cultural heritage and other material assets, and
- the interrelationships between the above-mentioned protected assets.

The Strategic Environmental Assessment was completed in December 2021. The main document of the Strategic Environmental Assessment is this environmental report for site N-3.5. It identifies, describes and assesses the likely significant environmental effects that the implementation of the plan for this site will have and possible alternative planning options, taking into account the essential purposes of the plan.

1.2 Brief description of the content and main objectives of the suitability and work examination

On the introduction of the central model, the support system for wind energy at sea was converted to a tendering model. The object of tenders for offshore wind energy is sites in the German North Sea and Baltic Sea upon which it is intended to build wind turbines. The site development plan (SDP) on which this determination of suitability is based sets areas, and sites within these areas, and determines the timetable in which the sites will be tendered by the BNetzA. For this purpose, the sites are set in accordance with the applicable expansion targets of central German government. The condition for a site to be tendered by the Federal Network Agency is that this specific site is suitable for the construction of offshore wind turbines.

The suitability of the site and the output that will be installed will be determined by an ordinance as per section 12 (5) of the WindSeeG. Suitability is determined provided the result of the prior suitability examination is that the site is generally suitable for the construction of a wind farm.

The determination of suitability also creates tiers for later planning approval procedures. As a result of this advance examination of the concerns and criteria of the planning approval procedure, if it is possible without any knowledge of the concrete design of the project, a rejection during the planning approval procedure will be avoided. This is because such a late rejection, and thus the loss of the site, would endanger the primary aim of the WindSeeG, which is continuously increasing the installed output of offshore wind turbines until the target is met in 2030.

As a result of this early examination, approval-relevant questions can be tiered, this accelerating subsequent planning approval procedures. This primarily simplifies administration and also directly benefits the later body responsible for the project.

The main contents of the ordinance to determine suitability will be:

- Determination of the suitability of the concrete sites at the time of their tendering pursuant to Part 3 Section 2 of the Wind Energy at Sea Act, as well as
- setting the output that will be installed.

Pursuant to section 10 (2) of the WindSeeG, a site is suitable for the construction of wind turbines, if

- the requirements of spatial planning are complied with,
- there is no threat to the marine environment,
- in particular, there are no concerns about pollution of the marine environment in accordance with Article 1 (1) 4 of the United Nations Convention on the Law of the Sea (UNCLOS) and
- it does not endanger migrating birds,
- it does not oppose the safety and efficiency of shipping or air transport as well as
- that the safety of state and national defence is guaranteed,
- other preponderant public or private concerns are not opposed,
- any development would be compatible with existing and planned cables, offshore connections, pipelines and any other cables or pipelines and
- it would be compatible with existing and planned locations of converter platforms or transformers, as well as
- other requirements pursuant to the WindSeeG and other provisions of public law are complied with.

A strategic environmental assessment will be conducted with regard to the question of whether there is a danger to the marine environment.

The ordinance to determine suitability can set requirements for later projects. This would be the case if the construction and operation of offshore wind turbines on the site would otherwise cause adverse effects on the specified criteria and concerns. The planned projects are in the determination of suitability and are summarised with regard to the marine environment under Chapter 9 (Planned measures envisaged to prevent, reduce and offset any significant adverse effects of the site development plan on the environment) and Chapter **11** (Measures envisaged for monitoring the environmental impacts).

1.3 Tiered planning procedures – relationship with other relevant plans, programmes and projects

1.3.1 Introduction

The determination of suitability is part of the scaled planning procedure for offshore wind energy, which provides tiering and begins with regional planning as strategic spatial planning for the entire Exclusive Economic Zone. A strategic environmental assessment must be carried out when the spatial plan is drawn up. Subsequently, the site development plan follows. This is a control planning instrument designed to plan the use of offshore wind energy to be as targeted and as optimal as possible. This is achieved by defining areas and sites, as well as locations, routes and route corridors for grid connections, or for transboundary submarine cable systems under the given general conditions. In principle, a strategic environmental assessment is carried out to accompany the SDP.

This follows the determination of suitability. In turn, this provides the basis for the later planning approval procedure. If the suitability of a site for the use of offshore wind energy is determined, the site will be put out to tender and the winning bidder can submit an application for approval (planning approval or planning permission) for the construction and operation of wind turbines on the site. As part of the planning approval procedure, an environmental impact assessment is carried out if the prerequisites are met.

In the event of multi-stage planning and approval processes, it follows from the relevant legislation (e.g. Federal Regional Planning Act, WindSeeG and the Federal Mining Act (BBergG) or, more generally, from Section 39 subsection (3) of the UVPG that, for plans, it should be determined at the stage of defining the scope of the investigation at which stages of the process certain environmental impacts will be assessed in particular. This will prevent multiple assessments from being carried out. The type and extent of the environmental impacts, technical requirements, and the content and subject matter of the plan must be taken into account.

In the case of subsequent plans and subsequent approvals of projects for which the plan sets a framework, the environmental assessment pursuant to Section 39 (3) Sentence 3 of the UVPG will be limited to additional or other significant environmental impacts as well as to necessary updates and more detailed investigations.

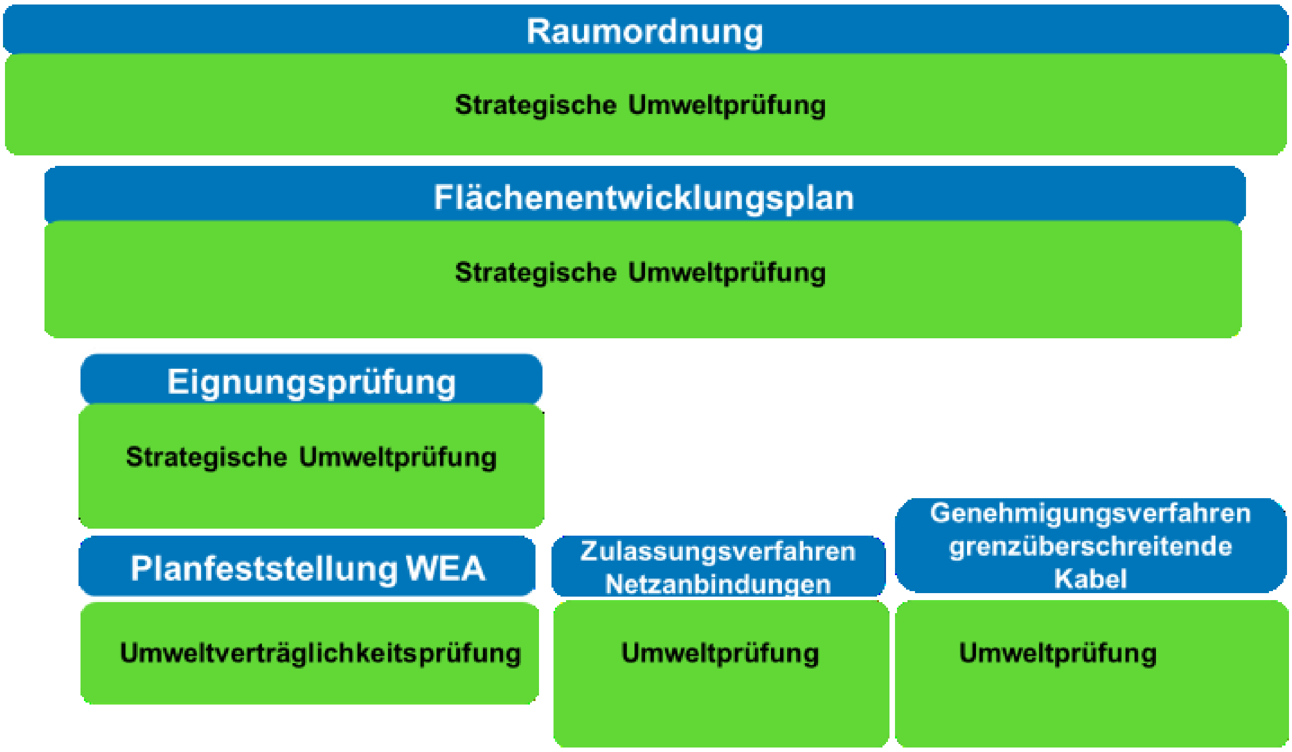

Figure 1: Overview of the environmental examinations carried out at all stages of the procedure.

Within the scope of the staged planning and approval process, all reviews consider environmental impacts on the protected assets listed in Section 2 subsection (1) of the UVPG, including their interactions with each other.

According to the definition under Section 2 subsection (2) of the UVPG, environmental impacts within the meaning of the UVPG are direct and indirect effects of a project, or the implementation of a plan or programme, on the protected assets.

According to Section 3 of the UVPG, environmental impact assessments comprise the identification, description and assessment of the significant impacts of a project or a plan or programme on the protected assets. They serve to ensure effective environmental protection in accordance with the applicable laws and are carried out according to uniform principles and with public participation.

In the offshore area, the following special protected assets have emerged as subcategories of the legally-specified protected assets of animals, plants and biological diversity:

- Avifauna: Seabirds, resting birds and migrating birds
- Benthos
- Plankton
- Marine mammals
- Fish
- Bats

In detail, the staged planning process is as follows:

1.3.2 Maritime spatial planning (EEZ)

At the highest and superordinate level this is the instrument of maritime spatial planning. For sustainable spatial planning in the EEZ, the BSH prepares spatial plans on behalf of the competent Federal Ministry, which come into force in the form of ordinances. The Ordinance of the (then) Federal Ministry of Transport, Building and Urban Development (BMVBS) on Spatial Planning in the German EEZ in the North Sea of 21 September 2009 BGBl. I p. 3107, came into force on 26

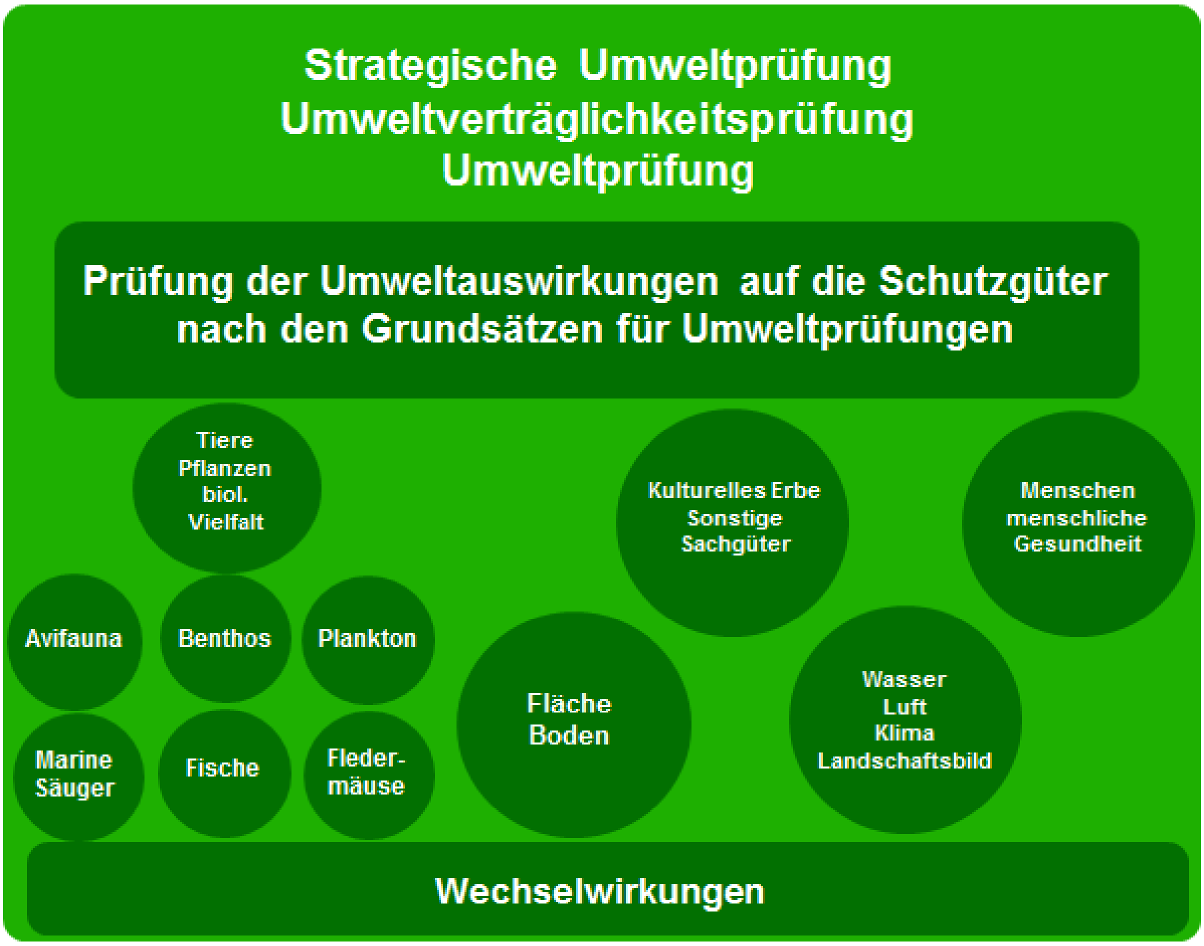

Figure 2: Overview of the protected assets in environmental assessments.

September 2009, and the Ordinance for the Area of the German EEZ in the Baltic Sea of 10 December 2009 BGBI I p. 3861 came into force on 19 December 2009. The spatial plans are currently being updated. The draft spatial plans and environmental reports for the German EEZ in the North Sea and Baltic Sea were subject to national and international consultation. The current status can be called up on the BSH website.[1]

The updated plan should come into force as an ordinance in September 2021. This will also include conditional or temporary spatial assessments.

The spatial plans will define provisions, taking into account any interactions between land and sea as well as safety aspects,

- to ensure the safety and efficiency of shipping,
- for further economic uses,

[1] https://www.bsh.de/DE/THEMEN/Offshore/Meeresraumplanung/Fortschreibung/fortschreibung-raumplanung_node.html.

- for scientific uses and
- to protect and improve the marine environment.

Within the scope of spatial planning, definitions are mainly specified in the form of priority and reservation areas and objectives and principles. According to Section 8, paragraph 1 ROG, a strategic environmental assessment must be carried out by the competent authority for the spatial plan when drawing up spatial plans. This must identify, describe and assess the likely significant impacts of the relevant spatial plan on the protected assets, including interrelationships between these.

The objective of the spatial planning instrument is to optimise overall planning solutions. A wider range of uses and functions are considered. Fundamental strategic questions should be clarified at the beginning of a planning process.

Thus, the instrument functions primarily as, and as a steering planning instrument of, the planning administrative authorities in order to create a spatially and, as far as possible, environmentally-compatible framework for all uses.

The depth of examination of thresholds in spatial planning is generally characterised by a greater scope of investigation, i.e. a fundamentally greater number of planning options, and a lesser depth of investigation in terms of detailed analyses. Above all, regional, national and global impacts, as well as secondary, cumulative and synergy effects, are taken into account.

The focus of the strategic environmental assessment is therefore on possible cumulative effects, strategic and large-scale planning options and possible transboundary impacts.

1.3.3 Site development plan

The next level is the SDP. The findings made by the SDP that are examined within the scope of the SEA result from Section 5 (1) of the WindSeeG. The plan mainly designates areas and sites for wind turbines as well as the expected output to be installed on the sites. In addition, the SDP also specifies routes, route corridors and sites. Planning and technical principles are also laid down. Although these also include a reduction in environmental impacts, they may in turn lead to impacts, so that an assessment is required as part of the SEA.

With regard to the objectives of the SDP, this deals with the fundamental questions of the use of offshore wind energy and grid connections on the basis of the legal requirements, especially with regard to the need, purpose, technology, and identification of locations and routes or route corridors. Therefore, the primary function of the plan is as a management planning instrument in order to create a spatially and, as far as possible, environmentally compatible framework for the implementation of individual projects, i.e. the construction and operation of offshore wind turbines, their grid connections, interconnectors and cross-connections between converter/transformer platforms.

The depth of the assessment of the likely significant environmental effects is characterised by a wider scope of investigation, i.e. a larger number of alternatives and, in principle, a lower depth of investigation. At the level of sectoral planning, detailed analyses are generally not yet carried out. Above all, local, national and global impacts, as well as secondary, cumulative and synergy impacts in the sense of an overall view, are taken into account.

As with the instrument of maritime spatial planning, the focus of the assessment is on possible cumulative effects, as well as on possible transboundary impacts. In addition, the SDP focuses on strategic, technical and spatial alternatives, especially for the use of wind energy and power lines.

1.3.4 Preliminary investigation including suitability examination

The next step in the staged planning process is the suitability assessment of sites for offshore wind turbines. In addition, the power to be installed is determined on the site in question.

In accordance with Section 10 (2) of the WindSeeG, the suitability examination assesses whether the construction and operation of offshore wind energy installations on the site conflicts with the criteria for the inadmissibility of defining a site in the site development plan, in accordance with Section 5 (3) of the WindSeeG or, insofar as they can be assessed independently of the later design of the project, with the interests relevant for the plan approval in accordance with Section 48 (4) Sentence 1 of the WindSeeG.

Both the criteria of Section 5 (3) of the WindSeeG and the matters of Section 48 (4) Sentence 1 of the WindSeeG require an assessment of whether the marine environment will be endangered. With regard to the latter concerns, there must be an assessment of whether pollution of the marine environment in accordance with Section 1 (1) No. 4 of the United Nations Convention on the Law of the Sea is at risk and whether bird migration is endangered.

Consequently, the suitability examination is the instrument interposed between the SDP and the planning approval procedure for offshore wind turbines. It refers to a specific site designated in the SDP and is thus set at a much smaller level than the SDP. It is distinguished from the plan approval procedure by the fact that an inspection approach independent of the later specific type of plant and layout is to be applied. Consequently, the impact prognosis model parameters are based on two scenarios, according to the range of the SDP 2020, which are intended to represent possible realistic developments (see Table 3).

Compared with the SDP, the SEA of the suitability examination is thus characterised by a smaller area of investigation and a greater depth of investigation. In principle, fewer and more spatially limited alternatives can be seriously considered. The two primary alternatives are the determination of the suitability of a site on the one hand and the determination of its (possibly also partial) unsuitability, see Section 12, paragraph 6 WindSeeG) on the other. Restrictions on the type and extent of development, which are included as specifications in the determination of suitability, are not alternatives in this sense (see also Chapter **10**).

The environmental assessment within the scope of the suitability examination focuses on considering the local impacts caused by a development with wind turbines in relation to the site and the location of the development on the site.

1.3.5 Approval procedure for offshore wind turbines

The next stage after the suitability examination is the approval procedure for the construction and operation of offshore wind turbines. After the suitability of the site has been determined and the site has been put out to tender by the BNetzA, the winning bidder can submit an application for planning approval or - if the requirements are met - for planning approval for the construction and operation of offshore wind turbines, including the necessary ancillary facilities on the pre-investigated site, to the BNetzA in accordance with Section 46 para. 1 WindSeeG.

In addition to the legal requirements of Section 73, paragraph 1, sentence 2 VwVfG, the plan must include the information contained in Section 47, paragraph 1 WindSeeG. The plan may be adopted only under certain conditions listed in Section 48, paragraph 4 WindSeeG and, including only if the marine environment is not threatened. This applies in particular if there are no concerns about any pollution of the marine environment within the scope of Article 1, paragraph 1, Number 4 of the Convention on the Law of the Sea and bird migration is not threatened.

According to Section 24 UVPG, the competent authority will prepare a summary presentation

- of the environmental impacts of the project,

- the characteristics of the project and the site, which are intended to prevent, reduce or offset significant adverse environmental impacts,
- measures to prevent, reduce or offset significant negative environmental impacts, and
- the replacement measures in case of interventions in nature and landscape.

In accordance with Section 16 (1) of the UVPG, the project developer must submit a report to the competent authority about the expected environmental impacts of the project (EIA report), which must contain at least the following information:

- a description of the project, including the location, nature, scope, design, size, and other essential characteristics of the project,
- a description of the environment and its components within the project's sphere of influence,
- a description of the characteristics of the project and of the location of the project to exclude, reduce or offset the occurrence of significant adverse environmental effects of the project,
- a description of the measures planned to prevent, reduce or offset any significant adverse effects of the project on the environment and a description of planned replacement measures,
- a description of the expected significant environmental effects of the project,
- a description of the reasonable alternatives, relevant to the project and its specific characteristics, that have been considered by the developer and the main reasons for the choice made, taking into account the specific environmental effects of the project and
- a generally understandable, non-technical summary of the EIA report.

Pilot wind turbines are dealt with exclusively within the framework of the environmental assessment in the approval procedure and not at upstream stages.

1.3.6 Summary overviews of environmental assessments

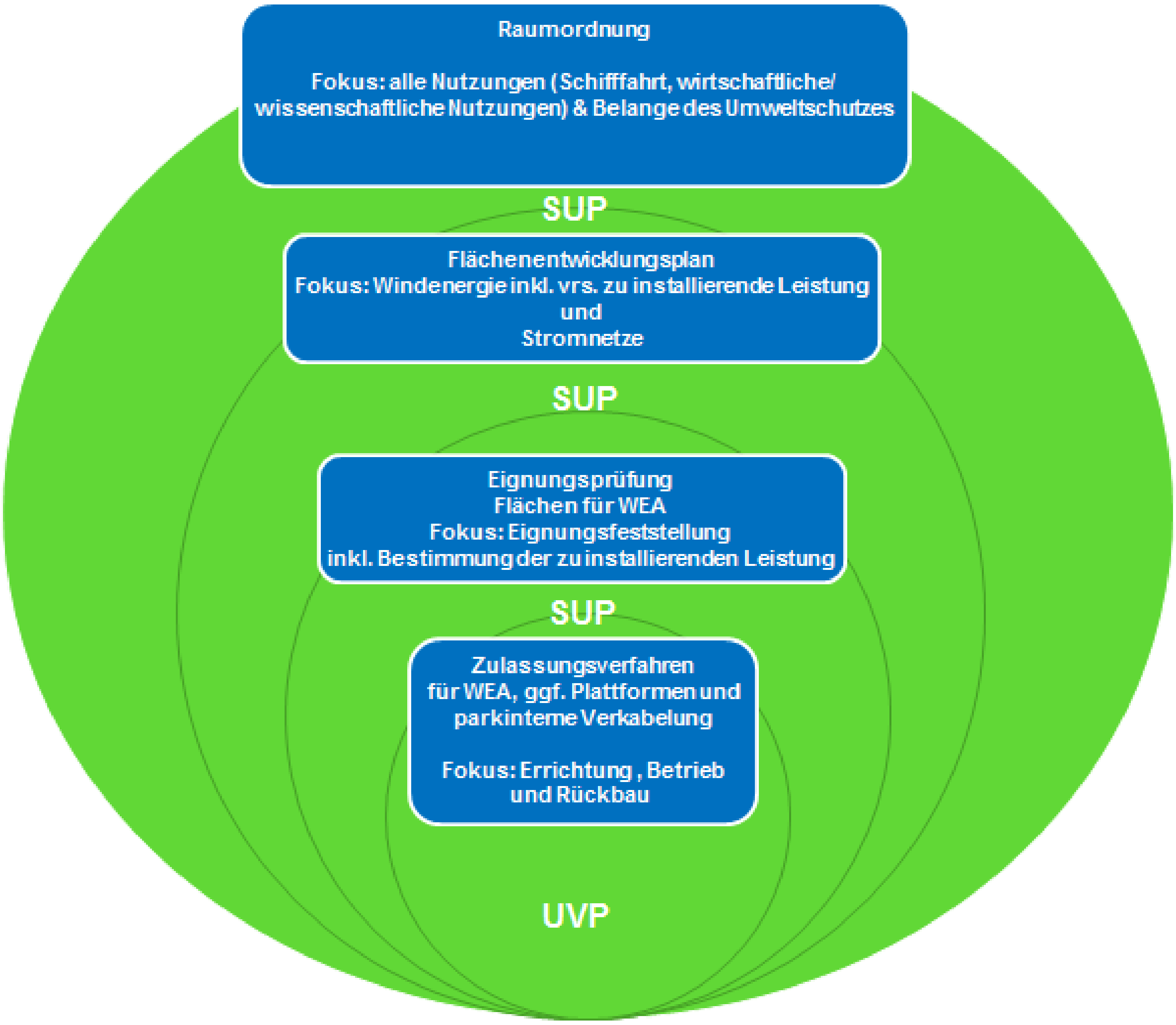

Figure 3: Object of the planning and approval procedures, with emphasis on environmental assessment.

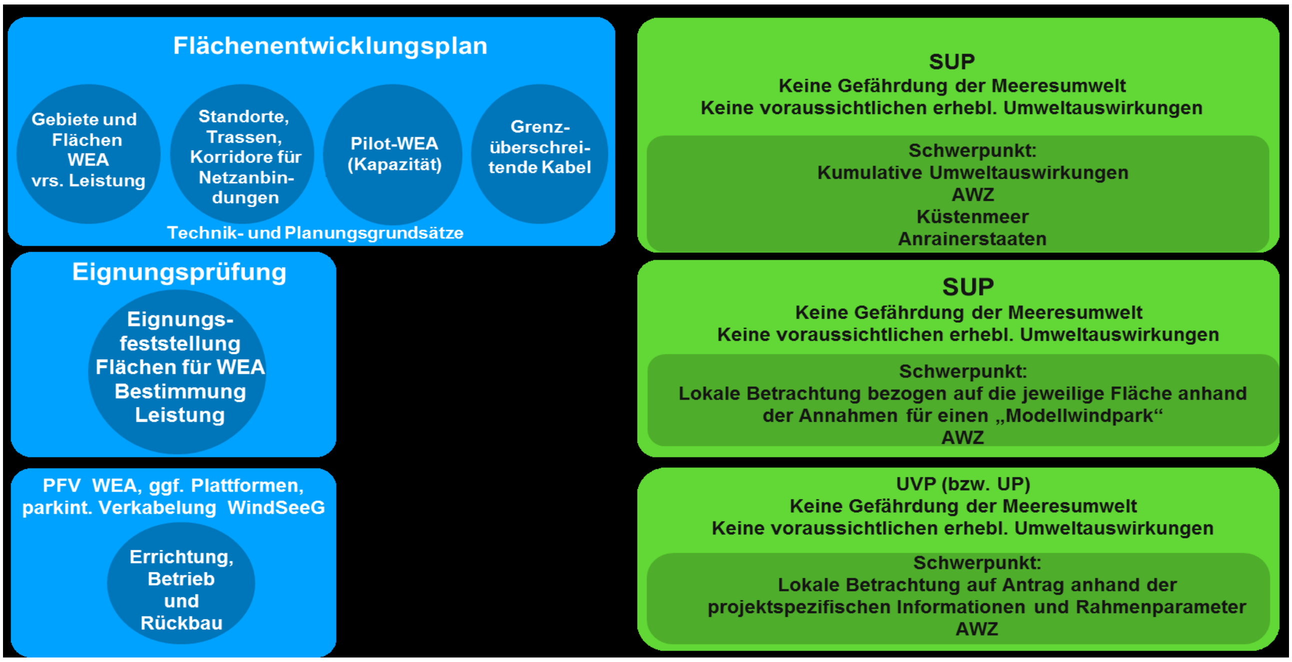

Figure 4: Object of the planning and approval procedures, with emphasis on environmental assessment for site development plan, suitability examination and EIA.

Table 1: Overview of the priorities of environmental assessments in the planning and approval process.

Maritime spatial plan-	**SDP**	**Suitability examination**
	SEA	
Strategic planning for the findings		**Strategic Environmental Assessment for sites with wind turbines**
	Findings and object of the examination	
- Priority and reservation areas • to guarantee the safety and efficiency of shipping, • to further economic uses, especially offshore wind energy and pipelines • for scientific uses and • to protect and enhance the marine environment - Objectives and principles - Application of the ecosystem approach	• Areas for offshore wind turbines • Sites for offshore wind turbines, including the expected capacity to be installed • Platform locations • Routing and route corridors for submarine cable systems • Technical and planning principles	• Review/Verification of the suitability of the site for the construction and operation of wind turbines, including the capacity to be installed • On the basis of the available and collected data (STUK) as well as other information that can be determined with reasonable effort • Specifications in particular on the type, extent and location of the development
	Environmental impact analysis	

Analyses (identifies, describes and assesses) the likely significant effects of the plan on the marine environment.	Analyses (identifies, describes and assesses) the likely significant effects of the plan on the marine environment.	Analyses (determines, describes and evaluates) the likely significant environmental impacts caused by the construction and operation of wind turbines, which can be assessed independently of the later design of the project, on the basis of model assumptions
Objective		
This aims at the optimisation of overall planning solutions (comprehensive packages of measures). Consideration of a wider range of uses. This takes place at the beginning of the planning process to clarify strategic issues of principle, i.e. at an early stage when there is even greater scope for action.	For the use of offshore wind energy, addresses the fundamental questions of • Demand or legal targets • Purpose • Technology • Capacities • Finding locations for platforms and routes Searches for packages of measures without absolutely assessing the environmental compatibility of the planning.	Deals with the fundamental issues for the use of offshore wind energy according to • Capacity • Suitability of the concrete site Assesses the suitability of the site, particularly regarding • type of development • Dimensions of development • Location of the development on the site
Essentially functions as a controlling planning instrument of the planning administrative authorities to create a spatially and environmentally-compatible framework for all uses.	Acts mainly as a steering planning instrument for a spatially and environmentally-compatible framework for the realisation of individual projects (wind turbines and grid connections, transboundary submarine cables).	Acts as an instrument between the SDP and approval procedure for wind turbines on a specific site.
Assessment depth		
Characterised by a wider scope of study, i.e. a larger number of alternatives to be assessed, and less depth of study (no detailed analyses). Considers spatial, national and global impacts as well as secondary, cumulative and synergy impacts in the sense of an overall view.	Characterised by a wider scope of study, i.e. a larger number of alternatives to be assessed, and less depth of study (no detailed analyses). Considers local, national and global impacts as well as secondary, cumulative and synergy impacts in the sense of an overall view.	Characterised by a smaller assessment area, greater depth of study (detailed analyses). Primarily considers local and national impacts on neighbouring states as well as additional/new secondary, cumulative and synergy impacts.
Focus of the assessment		
Cumulative effects • Overall planning view • Strategic and large-scale alternatives • Possible transboundary impacts	**Cumulative effects** • Overall planning view • Strategic, technical and spatial alternatives • Possible transboundary impacts	**Local impacts of any development** • Consideration of the concrete site • Technical and small-scale alternatives
Approval procedure (planning approval or permission) for wind turbines (EIA)		
Assessment subject		

Environmental impact assessment on request for • the installation and operation of wind turbines • on the site identified, pre-investigated and reviewed for suitability in the SDP • According to the findings of the SDP and the specifications of the determination of suitability
Environmental impact assessment
Analyses (determines, describes and evaluates) the environmental impacts of the specific project (wind turbines, platforms and internal cabling of the wind farm, if applicable) According to Section 24 UVPG, the competent authority will prepare a summary presentation • of the environmental impacts of the project, • the characteristics of the project and the site, which are intended to prevent, reduce or offset significant adverse environmental impacts, • measures to prevent, reduce or offset significant negative environmental impacts, and • the replacement measures in case of interventions in nature and landscape (Note: Exception according to Section 56 para. 3 BNatSchG
Objective
Addressing the questions of the specific design ("how") of a project (technical equipment, construction) on application by the winning bidder/project developer
Assessment depth
Characterised by a narrower scope of study, i.e. a limited number of alternatives, and greater depth of study (detailed analyses). Assesses the environmental compatibility of the project on the site subject to study and formulates conditions for this. Considers mainly local effects in the vicinity of the project.
Focus of the assessment
The main focus of the assessment is formed by: • Environmental impacts from construction and operation • Review with regard to the specific plant design • Plant dismantling

1.4 Presentation and consideration of environmental protection objectives

Reviewing and determining the suitability of the output that will be installed in consideration of the environmental protection targets relevant to the plan. These will provide information about the environmental status that is to be achieved in the future with regard to the relevant protected assets (environmental quality objectives). The objectives of environmental protection can be seen in the following international, Community and national conventions and regulations, administrative regulations and strategies which deal with marine environmental protection and on the basis of which the Federal Republic of Germany has committed itself to certain principles and objectives:

1.4.1 International conventions on the protection of the marine environment

The Federal Republic of Germany is a contracting party to all relevant international conventions on marine environmental protection.

1.4.1.1 Globally applicable conventions that are wholly or partly aimed at protecting the marine environment

The 1973 Convention for the Prevention of Pollution from Ships, as amended by the 1978 Protocol (MARPOL 73/78)

The convention developed under the lead of the International Maritime Organization to prevent marine pollution by ships of 1973 (International Convention for the Prevention of Pollution from Ships 1973, promulgated by the Act on the International Convention of 1973 to prevent marine pollution by ships and on the Protocol of 1978 on this Convention of 23 December 1981, BGBl 1982 II p. 2.) provides the legal basis for environmental protection in shipping. It is primarily aimed at shipowners in order to desist from operationally-induced discharges into the sea, however, pursuant to Article 2 (4) MARPOL also applies to offshore platforms. The targets of the regulation of Annexes IV and V with regard to the prevention and reduction of the discharge of waste water and ship waste are primarily relevant to the suitability examination. These targets with regard to the permissibility of waste water treatment plants and ship waste are implemented in the requirements of the determination of suitability in order to prevent and reduce particulate emissions.

Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London, 29 December 1972) and its 1996 Protocol

The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter of 29 December 1972 (promulgation through the coming into force of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, of 21 December 1977, BGBl II 1977, p. 1492) encompasses the dumping of waste and other materials from ships, aircraft and offshore platforms. While the London Convention of 1972 merely prohibits the dumping of certain matter (black list), a general dumping prohibition is incorporated in the Protocol of 1996 (promulgation through the coming into force of the Protocol of 1996 to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, of 9 December 2010, BGBl II No. 35). Exceptions from this prohibition are only permissible for certain categories of waste, such as dredging spoil and inert, inorganic, geological substances. These requirements are implemented through the requirements set within the scope of the determination of suitability.

United Nations Convention on the Law of the Sea 1982

Article 208 of the United Nations Convention on the Law of the Sea of 10 December 1982 must be taken into account in the construction of offshore plant used to mine and generate energy. This obliges coastal states to enact and implement legal regulations to prevent and reduce pollution caused by activities on the sea bed or that originate from artificial islands, plant and structures. Otherwise, coastal states are generally obliged to protect the marine environment as far as possible (see Article 194 (1) UNCLOS). Pollution must not cause any damage to other states and their environment. With regard to technologies, the convention regulates that all necessary actions to prevent and reduce the resulting marine pollution must be taken (Article 196 UNCLOS). The strategic environmental assessment identifies, describes and evaluates the likely significant environmental impacts. The suitability of a site for the construction of a wind farm is reviewed with regard to the danger to the marine environment and conflicts of use. Actions to prevent and reduce the impact are drawn up and requirements proposed that also include protection against pollution.

1.4.1.2 Regional conventions on marine environmental protection

Trilateral Wadden Sea Cooperation (1978) and Trilateral Monitoring and Assessment Programme of 1997 (TMAP)

The aim of the Trilateral Wadden Sea Cooperation and Trilateral Monitoring and Assessment Programme of 1997 between Denmark, the Netherlands and Germany is the retention of biodiversity in the Wadden Sea ecosystem. It follows the principle of achieving an ecosystem that is as natural as possible and self-sustaining, in which natural processes can proceed undisturbed. For this purpose, a Wadden Sea plan, with common key points, was adopted (COMMON WADDEN SEA SECRETARIAT 2010). The aims of the Wadden Sea plan relate to aspects such as the protected assets of the landscape, water, sediment, birds, marine mammals and fish. These overlap with the key points of the FFH and protection of birds directive, the water framework directive and the marine mammals framework strategy directive. Requirements, such as those for sediments and cable junctions, have also been included in the determination of suitability. The impacts on nature conservation areas have also been reviewed and placed in the evaluation and consideration of the plan.

Convention for the Protection of the Marine Environment of the North-East Atlantic, 1992 (OSPAR Convention)

The aim of the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention) is the protection of the marine environment of the North-East Atlantic against risks caused by anthropogenic pollution from all sources. The use of the best available emissions-reduction technology is required for this purpose (Article 2 (2) and (3) OSPAR Convention). The requirements for the reduction of emissions caused by the operation of wind farms, platforms and cables are met in the requirements included in the determination of suitability.

UNECE Convention on Environmental Impact Assessment (EIA) in a Transboundary Context (Espoo Convention) and UNECE Protocol on Strategic Environmental Assessment (SEA Protocol)

The Convention of the United Nations Economic Commission for Europe (Convention of 25 February 1991 on Environmental Impact Assessment in a Transboundary Context, implemented by the Espoo Convention of 7 June 2002, BGBl. 2002 II, p. 1406 et seqq. as well as the Second Espoo Convention of 17 March 2006, BGBl. 2006 II, p. 224 f - UNECE) obliges the contracting parties in the event of planned projects that may have significant adverse environmental impacts to carry out an EIA and to notify the affected parties. Such notification encompasses disclosures about the planned project, including information about its transboundary environmental impacts and indicates the type of possible decision. The party in whose jurisdiction a project is planned must ensure that EIA documentation is drawn up within the scope of the EIA procedure and must transmit this to the affected party. EIA documentation provides the basis for the consultations that must be held with the affected party, including on the possible transboundary impacts of the project and preventing and reducing these impacts. The contracting parties must ensure that the public affected in the state affected are informed about the project and are given an opportunity to make statements.

The EIA Protocol is an additional protocol to the Espoo Convention. The Protocol on Strategic Environmental Assessment - EIA Protocol – of the UNECE requires the contracting parties comprehensively to consider environmental aspects when drawing up plans and programmes.

The aims of the Protocol encompass the integration of environmental aspects (including health-related aspects) when drawing up plans and programmes, the voluntary consideration of environmental aspects (including health-related aspects) in policies and legal regulations, the creation of clear conditions for an EIA procedure and ensuring public participation in EIA procedures. Neighbouring states are informed within the scope of the determination of suitability and given the opportunity to make a statement.

1.4.1.3 Agreements specific to protected assets

1979 Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention)

The Convention on the Conservation of European Wildlife and Natural Habitats (see Act on the Convention of 19 September 1979 on the Conservation of European Wildlife and Natural Habitats, of 17 July 1984, BGBI II 1984 p. 618, last amended by Article 416 of the Ordinance of 31 August 2015 (BGBl. I p. 1474), - Bern Convention) of 1979 regulates the protection of species by setting quotas and restrictions on use, and the obligation to protect their habitats. Appendix II protects strictly protected fauna species, such as porpoises, loons, little gulls etc. The contents of this convention are also included in the review of environmental impacts through species protection law.

Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) of 1979

The Convention on the Conservation of Migratory Species of Wild Animals of 1979 (see Act on the Convention of 23 June 1979 on the Conservation of Migratory Species of Wild Animals of 29 June 1984 (BGBl. 1984 II p. 569, last amended by Article 417 of the Ordinance of 31 August 2015 (BGBl. I p. 1474) obliges the contracting states to take action to protect wild, migrating species of animals and on their adverse use. The so-called range states, in which the endangered species are distributed, must conserve their habitats, if these are significant, in order to safeguard the species from the danger of extinction (Art. 3 (4) a of the Bonn Convention). In addition, they must eliminate, compensate for or reduce to a minimum adverse impacts of activities or barriers that seriously impair the migration of the species (Art. 3 (4) b of the Bonn Convention) and prevent or reduce influences that endanger the species, provided this is practicable. The conditions are reviewed using species and habitat protection law and are presented in the environmental report.

Within the scope of the Bonn Convention, regional agreements for the conservation of the species listed in Appendix II were concluded pursuant to Article 4, No. 3 of the Bonn Convention.

Agreement on the Conservation of African-Eurasian Migratory Waterbirds, 1995 (AEWA)

The Agreement on the Conservation of African-Eurasian Migratory Waterbirds of 1995 (see Act on the Agreement of 16 June 1995 on the Conservation of African-Eurasian Migratory Waterbirds of 18 September 1998 (BGBl. 1998 II p. 2498, last amended by Article 29 of the Ordinance of 31 August 2015 (BGBl. I p. 1474) also encompasses species of birds that migrate over the North Sea. The migration routes of migrating birds must either be left in a favourable condition or restored. The environmental report reviews the impacts of the determination of suitability with regard to the movements of migrating birds in the EEZ.

Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas, 1991 (ASCOBANS)

The Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas of 1991 (see Act on the Agreement of 31 March 1992 on the Conservation of Small Cetaceans of the Baltic and North Seas of 21 July 1993 (BGBl. 1993 II p. 1113, last amended by Article 419 of the Ordinance of 31 August 2015 (BGBl. I p. 1474) codifies the conservation of toothed whales, with the exception of sperm whales, especially for the areas of the North Sea and Baltic Sea. Primarily, a conservation plan was worked out that is intended to reduce the rate of by-catch. The environmental report reviews the impacts of the determinations on mammals, and as a result of the suitability examination, can stipulate noise reduction and noise prevention measures, coordinate ramming work etc. in order to protect small whales.

Agreement on the Conservation of Seals in the Wadden Sea, 1991

The Agreement on the Conservation of Seals in the Wadden Sea of 1991 (see promulgation of the Agreement on the Conservation of Seals in the Wadden Sea, of 19 November 1991, BGBl II No. 32 p. 1307) is intended to create and conserve the favourable conservation situation for the seal population in the Wadden Sea. It includes regulations to monitor, sample and protect habitats. The environmental report will review the likely significant impacts on marine mammals, and thus also on seals, and place these in the evaluation and later considerations.

Agreement on the Conservation of Populations of European Bats, 1991 (EUROBATS)

The Agreement on the Conservation of European Bat Populations of 1991 (EUROBATS see Act on the Agreement of 4 December 1991 on the Conservation of European Bat Populations, BGBl II 1993 p. 1106) is intended to ensure the protection of all 53 species of European Bats through suitable actions. The Agreement is not open only to European states, but to all range states that belong to the distribution range of at least one European bat population. The Agreement provides regulations to sample animals, specify important conservation areas and to promote research, monitoring and public relations work as the most important instruments. As bats are protected as especially and strictly protected species pursuant to Section 7 (2) 13 and 14 of the BNatSchG, they are subjects of the species protection review and also protected under area protection law, which is depicted in the appropriate assessment.

Convention on Biological Diversity, 1993

The Convention on Biological Diversity (see act on the Convention of 5 June 1992 on Biological Diversity of 30 August 1993, BGBl II No. 72, p. 1741) with the purpose of conserving biological diversity as well as the balanced and appropriate distribution of the benefits resulting from the use of genetic resources. Furthermore, sustainable use of natural resources for conservation for future generations is also incorporated as an aim. Pursuant to Article 4b, the Convention also applies to procedures and activities outside the coastal waters in the EEZ. Biological diversity is a protected asset within the scope of the strategic environmental assessment. For this reason, likely significant environmental impacts are also identified and evaluated with regard to this protected asset.

1.4.2 Environmental and nature conservation requirements at EU level

The material scope of the TFEU (Treaty on the Functioning of the European Union, ABl. EC No. C 115 of 9 May 2008, p. 47), and thus in principle also secondary law, extends if the Member States increase rights in an area outside their territory that they have transferred to the EU (EuGH, Kommission./.Vereinigtes Königreich, 2005). Consequently, the Union law requirements also apply in the EEZ with regard to marine environment protection, nature conservation and the protection of water quality.

The relevant EU legislation is to be taken into account:

Council Directive of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment (85/337/EEC) (environmental impact assessment directive, EIA directive) and DIRECTIVE 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment (strategic environmental assessment directive, SEA directive).

Council Directive of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment (85/337/EEC) ((ABl. 175 p. 40) (codified in Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment; Directive 2011/92/EU of 28 November 2011, ABl. 26/11) were implemented in national law in the Environmental Impact Assessment Act. Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment (strategic environmental assessment directive, SEA directive ABl. L 197, of 21 July 2001) was also implemented in national law through the environmental impact assessment, which is why the targets as per the UVPG take precedence here.

Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Flora and Fauna Habitats Directive, FFH directive, ABl 206, of 22 July 1992.)

If it is intended to build plant in designated FFH areas and for projects in their environment, the conduct of an FFH impact assessment is required pursuant to Article 6 (3) FFH directive within the scope of approval procedures. If there are compelling reasons of public interest, construction can also be justified in the event of incompatibility. The FFH areas in the North Sea have since been designated as nature conservation areas pursuant to the national conservation area categories. Accordingly, the impact assessment is aligned on the conservation purposes in the nature conservation areas. The Directive was implemented in Germany through the Federal Nature Conservation Act, and there in the regulation on the Natura 2000 sites and on species protection.

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive, WFD)

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (WFD, ABl. L 327, of 22 December 2000) is intended to achieve a good ecological condition in surface water. Monitoring, evaluation, targets and implementing the measures are linked as steps here. It also applies to transitional waters and coastal waters, but not to the EEZ. Accordingly, when drawing up environmental reports the regulations of the Marine Strategy Framework Directive are primarily relevant.

Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for Community action in the field of marine environmental policy (Marine Strategy Framework Directive, MSFD)

The target of Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for Community action in the field of marine environmental policy (MSFD, ABl. L 164, of 25 June 2008) as the environment policy pillar of an integrated European marine policy, is “achieving or maintaining good environmental status in the Community’s marine environment by the year 2020 at the latest” (Article 1 (1) MSFD). The ultimate aim is maintaining biodiversity and providing or restoring diverse and dynamic oceans and seas which are clean, healthy and productive (see recital 3 of the MSFD). As a result, it is intended to achieve a balance between anthropogenic uses and the ecological equilibrium.

The environmental targets defined in the MSFD were developed applying an ecosystemic approach for controlling human activity and according to the precautionary principle and polluter pays principle:

- Marine environments free of impairment by human-induced eutrophication

- Marine environments free of pollution from contaminants
- Marine environments free of damage to the marine species and habitats induced by the impacts of human activity
- Marine environments containing sustainably used and conserved resources
- Marine environments free of impairment due to waste
- Marine environments free of impairment from anthropogenic introduction of energy
- Marine environments exhibiting natural hydromorphological characteristics (cf. BMU 2012).

The environmental report serves to systematically identify, describe and assess the impacts of planned specifications and provisions on the marine environment.

It is aimed primarily at assessing impacts on marine species and habitats, and to mitigate environmental impacts, requirements governing waste management, contaminants, and the use of resources are included in the determination of suitability.

Directive 2009/147/EC of the European Parliament and of the Council on the conservation of wild birds (Birds Directive)

Directive 2009/147/EC of the European Parliament and of the Council on the conservation of wild birds of 30 November 2009 (V-RL ABl. L 20/7 of 26 January 2010) is intended to conserve the long-term existence of all naturally-occurring species of birds, including migrating birds, and in addition to protection, also regulate the management and use of birds. All European species of birds in accordance with Article 1 of Directive 2009/147/EC are protected pursuant to Section 7 (2) 13 b) bb) of the Act on nature conservation and landscape conservation. Research into the requirements of the Directive will be carried out within the scope of the species protection law review.

Regulations on sustainable fisheries within the scope of the Common Fisheries Policy

The EU has exclusive competence in fisheries policy (see Article 3 (1)d of the Treaty on the Functioning of the European Union). These regulations include catch quotas, for example, which relate to the maximum sustainable yield (MSY), multi-year management plans, a landing obligation for by-catch as well as support for aquaculture facilities. The use of the EEZ for fisheries must be reviewed as a concern of the determination of suitability.

1.4.3 Environmental and nature conservation requirements at national level

There are various legal provisions at a national level too, and their specifications must be taken into account in the environmental report.

Water Resources Management Act (WHG)

The Water Resources Management Act of 31 July 2009 (BGBl. I p. 2585, last amended by Article 1 of the Act of 18 July 2017 BGBl. (Water Resources Management Act, WHG, BGBl. I p. 2771) implements the MSFD in national law in Sections 45a to 45l. Section 45a of the WHG implements the aim of guaranteeing good environmental status in marine environments by 2020. It is intended to prevent a deterioration in this status and prevent or reduce human inputs. However, regulations on uses, such as permit reservations, are not linked here. Instead, Sections 45a et seqq. must be interpreted to mean that the state is authorised to develop implementation strategies. In this context, Section 45a WHG provides the benchmark of which environmental status will be aimed at with regard to the relevant protected assets in the future (environmental quality targets). In turn, this benchmark will be used to interpret the legislative requirements. Sections 45a et seqq. WHG implement the requirements of the MSFD.

The environmental report serves to systematically identify, describe and assess the impacts of planned specifications and provisions on the marine environment.

Federal Nature Conservation Act (Bundesnaturschutzgesetz - BNatSchG)

The Federal Nature Conservation Act (Bundesnaturschutzgesetz - BNatSchG, last amended by Article 8 of the Act of 13 May 2019, (BGBI. I p. 706)) is, pursuant to Section 56 (1) BNatSchG, also applicable in the EEZ up to the requirements for landscape planning. In accordance with Section 1 of the BNatSchG, the aims of the BNatSchG include securing biodiversity, the performance and function of the ecosystem, as well as the diversity, character and beauty, and the recreational value of nature and landscapes. Sections 56 et seqq. BNatSchG contain requirements for marine nature conservation, which require reviews that are depicted in the environmental report. This relates to the protection of legally protected biotopes pursuant to Section 30 of the BNatSchG, whose destruction or other significant adverse effects are prohibited. Furthermore, an impact assessment pursuant to Section 34 (2) of the BNatSchG must be carried out for plans in nature conservation areas or if there will be impacts on the protective purpose of nature conservation areas. With regard to species protection law, pursuant to Section 44 (1) of the BNatSchG it is prohibited to injure or kill animals living in the wild of especially protected species, or significantly to disturb European bird species during reproduction, rearing, moulting, hibernation and migration periods.

In order to evaluate the suitability of the site, a review of whether there is any danger to the marine environment is carried out in particular. Requirements for the later project can be set as a result of the suitability examination in order to prevent any adverse effects to the marine environment.

Environmental Impact Assessment Act (UVPG)

The Environmental Impact Assessment Act (UVPG) stipulates that a strategic environmental assessment is carried out for certain plans or programmes. A determination of suitability is detailed in Appendix 5.1 of the UVPG, so that pursuant to Section 35 (1) 1 of the UVPG there is generally an obligation to carry out an SEA. Within this scope, this environmental report is drawn up in accordance with the requirements of the UVPG as well as the national and international transboundary public participation.

Act on the development and promotion of offshore wind energy (Offshore Wind Energy Act - WindSeeG)

As per Section 1 (1) of the WindSeeG, the aim of the Act on the development and promotion of offshore wind energy (Offshore Wind Energy Act - WindSeeG) is to expand the use of offshore wind energy in the interests of climate and environmental protection. As per paragraph 2, this will be achieved by continuous and cost-effective expansion of the installed output of offshore wind turbines to a total of 20 gigawatts between 2021 and 2030. Important elements in guaranteeing continuous expansion are the site development plan, which identifies potential sites for the construction of wind turbines, and the review of the suitability of this site preceding the planning approval procedure. However, this expansion, which is being driven forward in the interests of climate and environmental protection, should itself be carried out taking into consideration environmental protection concerns: Section 10 (2) WindSeeG standardised that in order to determine whether a site is suitable it must be reviewed whether the criteria for the inadmissibility of determinations made in the SDP, or for a later planning approval, do not contradict important criteria. As per Section 5 subsection 3 of the WindSeeG, determinations are inadmissible if there are overriding, opposing public or private interests. The following itemisation of inadmissible determinations specifies endangering the marine environment as an example rule (see Section 5 (3) 1 (2) WindSeeG). Furthermore, as per Section 48 (4) 1 of the WindSeeG, a plan for building and operating a wind farm can only be set if the marine environment will not be endangered. An efficient development can only be carried out if the potential output of a site will be used optimally. At the same time, this development must not endanger the marine environment. For this reason, requirements that protect this environment are included in the determination of suitability. These two important environmental protection targets from the WindSeeG provide guidelines for setting up the plan and planning considerations.

Regulations and ordinances governing protected regions

In accordance with Article 57 of the Federal Nature Conservation Act (BNatSchG), the ordinances of 22 September 2017 included the existing conservation and FFH areas in the German EEZ in the national area categories and declared these to be nature conservation areas. Within this framework, they were partially regrouped. For example, the ordinance on the designation of the “Sylt Outer Reef – Eastern German Bight” nature conservation area (NSGSylV of 22 September 2017, BGBl. I p. 3423) the ordinance on the designation of the “Borkum Riffgrund” nature conservation area (NSGBRgV of 22 September 2017, BGBl. I p, 3395) and the ordinance on the designation of the “Dogger Bank” nature conservation area (NSGDgbV of 22 September 2017, BGBl. I p. 3400) have now created the nature conservations areas “Sylt Outer Reef – Eastern German Bight”, “Borkum Riffgrund” and “Dogger Bank”. This results in no differences with regard to the spatial extent. In individual cases this resulted in the protection of some species for the first time (skua and pomarine jaeger). Within the scope of the SIA some impacts on the conservation areas or the compatibility of sites developed with wind turbines with the conservation areas is reviewed in order to check whether these places could suffer considerable adverse effects in the constituents relevant to the conservation purpose. The impact assessment pursuant to Section 34 (2) BNatSchG refers to the conservation purpose resulting from the ordinances. The requirements from the suitability examination for the dismantlement of the plant, noise reduction, emissions reduction, careful laying procedures etc. help avoid adverse effects on the conservation areas.

1.4.4 The Federal Government's energy and climate conservation aims

Offshore wind energy was already of particular importance to the German government's strategy for the expansion of offshore wind energy use in 2002. It was intended to raise the proportion of wind energy in electricity consumption to at least 25% within the next three decades. According to resolutions taken by the climate cabinet on 20 September 2019 and by the federal cabinet on 9 October 2019, the proportion of renewable energies in electricity consumption will now rise to 65 per cent by 2030. Consequently, the target for expanding offshore wind energy will be increased to 20 gigawatts in 2030. The Federal Government’s climate targets form the planning horizon for setting the plan.

1.5 Methodology of the Strategic Environmental Assessment

1.5.1 Introduction

The scope and extent of the environmental impacts of the plan will be identified through the strategic environmental assessment, taking into account the contents and issues to be decided. The central contextual document of the strategic environmental assessment is the environmental report drawn up as per Section 40 of the UVPG: “The environmental report identifies, describes and evaluates the likely considerable impacts on the environment, as well as sensible alternatives.

The environmental report is drawn up before the involvement of the public and the authorities and contributes to these steps of the procedure. The additional information that emerges in the course of the procedure is used as per Section 43 of the UVPG in order to update the disclosures of the environmental report. As per Section 40 (3) of the UVPG, a provisional assessment of the impacts on the environment is already made in the environmental report. As with the EIA, this must be carried out in a precautionary manner in accordance with legal requirements." (PETERS/BALLA/HESSELBARTH, UVPG comment Section 40, recital 1.)

In this case, the impacts on the environment of the determination of suitability for site N-3.5 are under review. An investigation is made into which impacts on the environment would result from developing the site with an offshore wind farm, including all the necessary facilities. The impacts on the environment are evaluated with regard to effective environmental precautions in accordance with Section 3 in conjunction with Section 2 (1) and (2) of the UVPG. Accordingly, as per Section 10 (2) in conjunction with Sections 5 (3) and 48 (4) 1 of the WindSeeG it must be ensured that the plan will not endanger the marine environment.

1.5.2 Investigation area

In accordance with Section 2 (11) of the UVPG, the investigation area is the geographic area in which the impacts on the environment relevant to the assumptions of the plan will probably occur. The designation depends on factors such as the relevant protected asset and is partly limited to site N-3.5. However, when considering mobile species, for example, it can extend beyond its boundaries.

1.5.3 Carrying out the environmental assessment

The likely considerable impacts on the environment of the plan must be identified and described as per Section 40 (1) of the UVPG, and their significance must be assessed.

The description and assessment of the environmental status, taking into account the function and importance of the site for the individual protected assets, as well as the development of the status if the plan is not carried out, form the reference status. This status forms the basis on which the changes caused by the plan or programme will be evaluated.

The description and assessment of the probable significant impacts of the implementation of the plan on the marine environment also refers to the protected assets described (see Chapter **4**).

The following protected assets are considered:

- Site
- Soil
- Water
- Biotope types
- Benthos
- Fish
- Marine mammals
- Avifauna
- Bats
- Biological diversity
- Air
- Climate
- Landscape
- Cultural heritage and other tangible assets
- People, in particular human health

A forecast is made of the project-related impacts depending on the criteria intensity, reach and duration of the effects (see Figure 5). All plan contents which may potentially have significant environmental impacts are examined.

The impacts caused by construction and dismantlement, as well as by plant and that are operations-related, including those within the scope of maintenance and repair work, are considered. The likely impacts on the environment to be identified here are both direct and indirect impacts caused by the implementation of the plan (KMENT UVPG, Section 40, recital 51.), including secondary, cumulative, synergy, short, medium and long-term, permanent and temporary, positive and negative impacts. Secondary or indirect effects are those that are not immediate and therefore may only become effective after some time and/or at other locations (WOLFGANG & APPOLD 2007, SCHOMERUS ET AL. 2006).

This is followed by a description of possible interactions, a consideration of possible cumulative effects and potential transboundary impacts.

In general, the following methodological approaches are used in the environmental assessment:

- Qualitative descriptions and assessments
- Quantitative descriptions and assessments
- Evaluations of the results of the preliminary investigation
- Evaluation of studies and technical literature
- Visualisations
- Worst-case assumptions
- Statistical evaluations, models and trend estimates (e.g. whether plant is state-of-the-art)
- Assessments by experts / the professional public

Subsequently, pursuant to Section 40 (3) of the UVPG the significance of the impacts on the environment of the plan as per Section 3 (2) of the UVPG is provisionally evaluated with regard to effective environmental precautions in accordance with applicable laws.

There is no common definition of "significance" as this involves "individually identified significance" that cannot be considered independently of the "specific characteristics of plans or programmes" (SOMMER, 2005 25 et seqq.). The question of significance in this connection is closely coupled to the question of later influences on the decision on the assumptions of the plan or programme pursuant to Section 44 of the UVPG (Kment in Hoppe/Beckmann/ Kment, UVPG - Environmental Impact Assessment Act Environmental Legal Remedies Act, comment, 5.A, Section 40, recital 54.). A threat to the marine environment caused by the designations of the plan must be ruled out or there would be a significant threat to the marine environment for the suitability examination and for Section 10 (2) in conjunction with Sections 5 (3), 48 (4) 1 of the WindSeeG that are applicable here. In general, significant impacts can be defined as effects that are serious and considerable in the context under consideration.

Based on the criteria as per Appendix 6 of the UVPG for the assessment within the scope of the preliminary review of whether there are likely to be significant impacts on the environment, the following attributes will be drawn on for the evaluation:

- the probability, duration, frequency and irreversibility of the impacts;
- cumulation with other impacts on the environment;
- the transboundary nature of the impacts;
- the risks to human health or the environment (e.g. in the event of accidents);
- the magnitude and spatial extent of the impacts;
- the importance and sensitivity of the area likely to be affected due to its specific natural characteristics or cultural heritage, the exceeding of environmental quality standards or thresholds and intensive land use;
- the impacts on areas or landscapes of which the protected status is recognised at national, community or international level.

Also relevant are the characteristics of plans, particularly with regard to:

- the extent to which the plan sets a framework for projects and other activities in terms of location, type, size and operating conditions, or through the use of resources;
- the extent to which the plan influences other plans and programmes, including those in a planning hierarchy;
- the importance of the plan for the integration of environmental considerations, in particular with a view to promoting sustainable development;

- the environmental issues relevant to the plan;
- the relevance of the plan for the implementation of Community environmental legislation (e.g. plans and programmes relating to waste management or water protection).

The specific legislation provides specifications as to when an impact reaches the materiality (significance) threshold. Sub-statutory thresholds have also been developed in order to be able to make a delimitation.

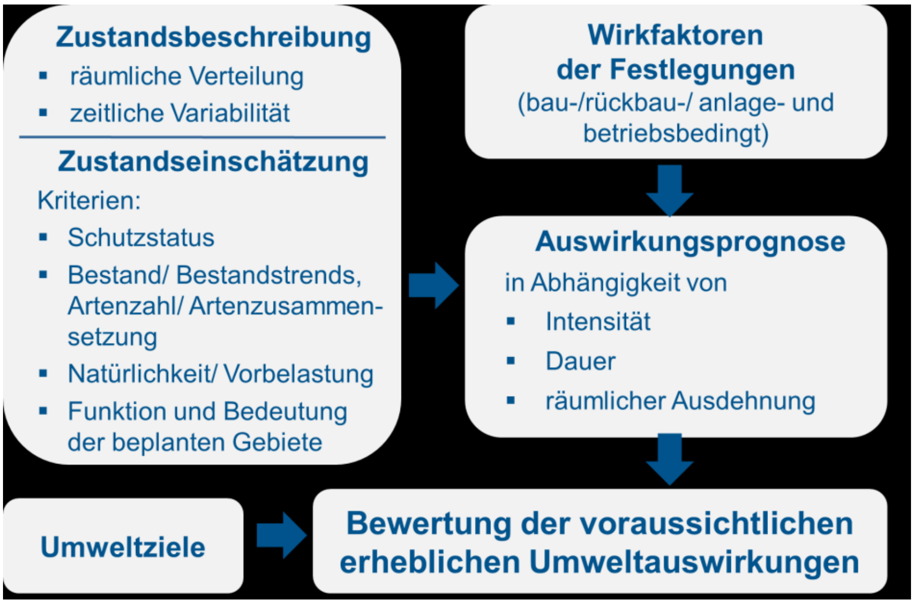

Figure 5: General methodology for assessing the likely significant environmental impacts.

With regard to the consideration of the environmental targets within the scope of the evaluation of the likely significant impacts on the environment caused by the implementation of the plan, reference is made to Chapter 4.

1.5.4 Criteria for the status description and assessment

The status assessment of the individual protected assets in chapter 2 is based on various criteria. The assessment for the protected assets of the site/soil, benthos and fish, is based on the aspects of rarity and vulnerability, diversity and peculiarity, and existing impacts. The description and assessment of the protected assets marine mammals, seabirds and resting birds as well as migrating birds is aligned on aspects for the status assessment of the protected assets site/soil, benthos and fish. As these are highly mobile species, it is not expedient to adopt a similar approach to these protected assets. Therefore, the criteria of protection status, assessment of occurrence, assessment of territorial units and existing impacts are applied to seabirds, resting birds and marine mammals. The aspects of assessment of the occurrence and large-scale significance of the area for bird migration are considered, as well as rarity and vulnerability.

The following is a summary of the criteria used for the status assessment of the respective protected asset. This overview addresses the protected assets that are the focus of the environmental assessment.

Water

Aspect: Naturalness
Criterion: Hydrographic circumstances and water quality
Aspect: Existing impacts
Criterion: Extent of existing anthropogenic impact on the body of water

Site/soil

Aspect: Rarity and threat
Criterion: Percentage of sediment on the seabed and distribution of the morphological inventory of forms.
Aspect: Diversity and uniqueness
Criterion: Heterogeneity of the sediments on the sea floor and development of the morphological inventory of forms.
Aspect: Existing impacts
Criterion: Extent of the existing anthropogenic impact on the sediment on the seabed and the morphological inventory of forms.

Benthos

Aspect: Rarity and threat
Criterion: Number of rare or endangered species based on the Red List species identified (Red List by RACHOR et al. 2013).
Aspect: Diversity and uniqueness
Criterion: Number of species and composition of the species communities. It assesses the extent to which species or biotic communities characteristic of the habitat occur and how regularly they occur.
Aspect: Existing impacts
For this criterion, the intensity of fishing exploitation, which is the most effective disturbance variable, will be used as a benchmark. Eutrophication can also affect benthic biocoenoses. For other disturbance variables, such as shipping, pollutants, etc., there is currently a lack of suitable measurement and detection methods to be able to include them in the assessment.

Biotope types

Aspect: Rarity and threat
Criterion: national conservation status and threat to biotopes according to the Red List of Endangered Biotopes in Germany (FINCK et al., 2017).
Aspect: Existing impacts
Criterion: Threat due to anthropogenic influences.

Fish

Aspect: Rarity and threat
Criterion: Proportion of species considered endangered according to the current Red List of Marine Fish (THIEL et al. 2013) and for the diadromous species on the Red List of Freshwater Fish (FREYHOF 2009) and assigned to Red List categories.
Aspect: Diversity and uniqueness
Criterion: The diversity of a fish community can be described by the number of species (α-Diversity, 'Species richness'). The species composition can be used to assess the specific nature of a fish community, i.e. how regularly habitat-typical species occur. Diversity and specificity are compared and assessed between the German EEZ in the North Sea and the individual site.
Aspect: Existing impacts
Criterion: The existing impact on a fish community is defined by anthropogenic influences. By sampling the target species and by-catch, as well as the impact on the seabed in the case of bottom-trawling fishing methods, fisheries are considered to be the most effective disturbance to the fish community and therefore, serve as a measure of the existing impacts on fish communities in the North Sea and Baltic Sea. There is no assessment of stocks on a smaller spatial scale. The input of nutrients into natural waters is another pathway through which human activities can affect fish communities, for example, due to algal blooms and oxygen depletion as a result of microbial decomposition of organic substances. For this reason, eutrophication is used to assess existing impacts.

Marine mammals

Aspect: Conservation status
Criterion: Status as per Appendix II and Appendix IV of the Habitats Directive and the following international protection agreements: Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention, CMS), ASCOBANS (Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas), Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention)
Aspect: Assessment of the population
Criteria: Population, population changes/trends based on large-scale surveys, distribution patterns and density distributions
Aspect: Assessment of spatial units
Criteria: Function and importance of the German EEZ as well as the concrete site and its nearby environment to marine mammals as a migration area, feeding or breeding ground
Aspect: Existing impacts
Criterion: Threats due to anthropogenic influences and climate change.

Seabirds and resting birds

Aspect: Conversation status
Criterion: Status according to Appendix I of the Birds Directive, European Red List from BirdLife Inter-

Aspect: Assessment of the population
Criteria: Distribution pattern, abundance, variability
Aspect: Assessment of spatial units
Criteria: Function of the concrete site and its environment for nesting birds, migratory birds, as rest areas, distances from protected areas
Aspect: Existing impacts
Criterion: Existing impacts/threats due to anthropogenic influences and climate change.

Migratory birds

Aspect: The importance of bird migration over a large area
Criterion: Guidelines and areas of concentration
Aspect: Assessment of the population
Criterion: Migration activity and its intensity
Aspect: Rarity and threat
Criterion: Number of species and threat status of the species involved as per Appendix I of the Birds Directive, AEWA (Agreement on the Conservation of African-Eurasian Migratory Waterbirds) and SPEC (Species of European Conservation Concern).
Aspect: Existing impacts
Criterion: Existing impacts/threat due to anthropogenic influences and climate change.

1.5.5 Specific assumptions for the assessment of the likely significant environmental impacts

The description and assessment of the likely significant effects of the impacts caused by implementation of the plan on the marine environment are made related to protection, including the status assessment described above.

1.5.5.1 Effect factors and potential impacts

The following table (Table 2) sets out the potential environmental effects, based on significant factors that form the basis for the assessment of the likely significant environmental effects. The effects are differentiated according to whether they are due to construction, dismantling or operations, or are caused by the installation itself.

Table 2: Project-related impacts of implementing the plan.

Protected asset	Effect	Potential impact	(De)Con-struction	Turbine	Commis-
Wind turbines					
Water	Resuspension of sediment	Modification of habitats	X		
	Modification of currents and swell	Modification of habitats		X	
	Particulate emissions	Modification of habitats			X
Soil	Placement of hard substrate (foundations)	Modification of habitats		X	
	Permanent land use	Modification of habitats		X	
	Scouring/sediment relocation	Modification of habitats		X	
Benthos	Formation of turbidity plumes	Impact on benthic species	X		
	Resuspension of sediment and sedimentation	Impairment or damage to benthic species or communities	X		
	Placement of hard substrate	Change of habitats, habitat loss		X	
Fish	Sediment swirls and turbidity plumes	Physiological effects and deterrence	X		
	Noise emissions during pile driving	Averting	X		
	Site use	Local loss of habitat for demersal species of fish		X	
	Placement of hard substrate	Attraction effects, increase in species diversity, change in species composition		X	
Seabirds and resting birds	Visual unrest due to construction activity	Local deterrence and barrier effects	X		
	Obstacle in airspace	Deterrence ⇨ Habitat loss Collisions		X	
	Light emissions	Attraction effects	X		X
Migratory birds	Obstacle in airspace	Collisions, barrier effect		X	
	Light emissions	Attraction effects ⇨ Collisions	X		X

Protected asset	Effect	Potential impact	(De)Con-struction	Turbine	Commis-
Marine mammals	Noise emission during pile driving	Danger if no prevention and reduction measures are taken	X		
Internal farm cabling					
Water	Resuspension of sediment	Modification of habitats	X		
Soil	Placement of hard substrate (stone pile)	Modification of habitats		X	
Benthos	Heat emissions	Impairment/displacement of cold-water loving species			X
	Magnetic fields	Impact on benthic species			X
	Turbidity plumes	Impact on benthic species	X		
	Placement of hard substrate (stone packing)	Habitat change, local loss of habitat		X	
Fish	Turbidity plumes	Physiological effects and deterrence	X		
	Magnetic fields	Impairment of the orientation behaviour of individual migratory species			X

Cumulative effects and interactions between factors are also assessed in addition to the effects on the individual protected assets.

1.5.5.2 Cumulative assessment

According to Article 5 subsection 1 of the SEA Directive, the environmental report also includes an assessment of cumulative and secondary impacts. Cumulative impacts result from the interaction of various independent individual effects which either add up as a result of their interaction (cumulative effects) or reinforce each other and thus generate more than the sum of their individual effects (synergy effects) (e.g. SCHOMERUS et al., 2006). Cumulative and synergy impacts can be caused both by temporal and spatial coincidence of impacts of the same or different projects. Individual impacts in this context are the construction-related and plant and operations-related impacts, where the impacts during the construction phase are mainly of a more short-term and temporary nature, while plant and operations-related impacts can occur permanently.

The assessment of cumulative impacts derives from a number of legal obligations:

- WindSeeG, Part 2, Section 1: Section 5, paragraph. 3, No. 2 WindSeeG:

"Designations pursuant to paragraph 1 (1) and (2), as well as (6) to (11), are inadmissible, if overriding public or private concerns oppose these. These designations are inadmissible in particular, if … 2. these endanger the marine environment […]"

- WindSeeG, Part 4, Section 1: Section 48, paragraph. 4 (1) WindSeeG:

"The plan may only be determined if the marine environment will not be endangered."

- UVPG: Section 2, paragraph 2 UVPG:

"Impacts on the environment in accordance with this Act are direct and indirect impacts of a project or the implementation of a plan or programme on the protected assets and from Section 3 of the UVPG environmental assessment […] provide effective environmental precautions pursuant to the applicable laws, […]"

- BNatSchG and ordinances for the designation of nature conservation areas in the German EEZ, inter alia Section 34, paragraph 1 BNatSchG (impact assessment):

"Prior to their approval or implementation, projects shall be examined for their compatibility with the conservation objectives of a Natura 2000 area if, either individually or in combination with other projects or plans, they are likely to have a significant impact on the area, and are not directly used to administer the area."

- Section 44 (1) (2) of the Federal Nature Conservation Act (BNatSchG): (Disturbance prohibition)

"[…] … Significant disturbance exists if the disturbance worsens the conservation status of the local population of a species."

Concrete concepts, such as the position paper on the cumulative assessment of the loss of loon habitat in the German North Sea (BMU 2009), can be used in part for the cumulative assessment, as well as the noise protection concept of the BMUB (2013).

The cumulative effects are reviewed related to protected assets under Chapter **4.12**.

1.5.5.3 Interrelationships

In general, impacts on any one protected asset lead to various consequences and interrelationships between the protected assets. The essential interdependence of the biotic protected assets exists via the food chains. As a result of the variability of the habitat and the complexity of the food chain and the material cycles, interrelationships can only be described with very little precision overall.

Statements on interrelationships can be found in Chapter **4.12.5**.

1.5.5.4 Assumptions on wind turbines, including the output that will be installed

According to Section 12, paragraph 5 WindSeeG, the expected installed capacity of offshore wind turbines for the site must be specified. Within the scope of the suitability examination a description is given of how the output that will be installed per site will be identified and set. Essentially, a review will be made of whether the output likely to be installed within the scope of drawing up the SDP will have to be adjusted. For the calculations within the SDP, the sites within the areas are assigned to two categories within the framework of the legal requirements on the basis of criteria such as site geometry, wind speed, the state-of-the-art offshore wind turbines and grid connection capacity. On the basis of these parameters and assumptions, the power density to be applied is determined in megawatt/km² per site. As a result of the details, reference is made to the statements within the scope of the suitability examination.

The model parameters already used within the scope of the environmental assessments for the SDP are assumed with any wind turbines that might be available in the future for the protection-related consideration in this SEA. In order to depict the range of possible developments, the assessment is largely conducted on the basis of two scenarios. In a first scenario, many small turbines are assumed, and in contrast, in a second scenario, a few large turbines. Scenarios 1 and 2 correspond to the range on which the 2020 SDP is based. The range thus covered enables a protection-related description and evaluation of the planning to be carried out that is as comprehensive as possible. Consequently, the assessment of the two scenarios encompasses all possible parameters within the range of the 2020 SDP.

The Strategic Environmental Assessment takes particular account of these factors:

- Turbines already in operation (as reference and existing impact)
- - Forecast of certain technical developments.

Table 3 offers an overview of the parameters used. It should be noted here that these are only estimation-based assumptions, because project-specific parameters are not known at SEA level for the suitability examination.

Table 3: Model Parameters for the consideration of the site.

Parameters	Scenario 1	Scenario 2
Output per turbine [MW]	10	20
Hub height [m]	approx. 125	approx. 200
Height lower rotor tip [m]	approx. 25	approx. 50
Rotor diameter [m]	approx. 200	approx. 300
Total height [m]	approx. 225	approx. 350
Diameter foundation [m]*	approx. 10	approx. 15
Foundation site excl. scour protection [m2]	approx. 79	approx. 177
Diameter of scour protection [m]	approx. 50	approx. 75
Foundation site incl. scour protection [m]	approx. 1,963	approx. 4,418

* The calculation of the site use is based on the assumption of a monopile foundation. However, it is assumed that monopile and jacket together have about the same total site use on the sea bed.

With regard to the disclosures on the hub height it must be taken into account that the aim of Section 3.5.1 (8) of the spatial plan for the North Sea stipulates a height limit of 125 m for wind turbines within view of the coast and islands. Accordingly, Scenario 1 was based on this requirement. Because Sections 19, 6 of the spatial plan generally provide for the possibility of proceedings for obtaining permission to deviate from a planning objective in order to deviate from targets of the maritime spatial plan, and that the height limit is not relevant to non-visible turbines, a hub height of 200 m was set for Scenario 2.

1.5.5.5 Assumptions of other developments

Model assumptions have been made with regard to other facilities, which are presented in Table 4.

1.5.5.6 Principles of the assessment of alternatives

In accordance with Article 5 (1) first sentence of the SEA Directive in conjunction with the criteria in Appendix I of the SEA Directive and Section 40 subsection (2) 8 of the UVPG, the environmental report contains a brief description of the reasons for the choice of the reasonable alternatives examined.

The assessment of alternatives does not explicitly require the development and assessment of particularly environmentally-friendly alternatives. Instead, the “reasonable” alternatives in the above sense should be presented in a comparative manner with regard to their environmental impacts. This will mean a consideration of environmental concerns becomes transparent when deciding on the alternative to be pursued (Balla et al, 2009). At the same time, the effort required to identify and assess the alternatives under consideration must be reasonable. The following applies: The greater the expected impacts on the environment, and thus

Table 4: Parameters for considerations of other developments on site N-3.5.

Parameters	Value
Length internal farm cabling (= 0.12 km/MW*) [km]	50
Voltage level internal farm cabling	66kV
Number of wind turbines – Scenario 1	42
Number of wind turbines – Scenario 2	21
Number of transformer platforms	0
Number of accommodation platforms	1
Site sealing foundations incl. scour protection [m^2] – Scenario 1	82,446
Site sealing foundations incl. scour protection [m^2] – Scenario 2	92,778
Site sealing accommodation platform incl. scour protection [m^2]	1,963

* The calculation of the length of the internal farm cabling is made in correlation with the output that will be installed on the relevant site. The figure of 0.12 km/MW was set by calculating the rough mean of wind farms already built and of this planning.

** The calculation of the site use is based on the assumption of a monopile foundation. It is assumed that monopile and Jacket each have approximately the same total site use on the sea bed.

and thus the need for planning conflict resolution, the more extensive or detailed investigations are required.

Within the scope of the preceding SEA on SDP 2020 (BSH 2020a) alternatives have already been reviewed. At this planning level this primarily involves the conceptual/strategic design, the spatial location and technical alternatives.
Therefore, within the scope of the suitability examination, in the sense of the tiering between the instruments the alternatives to be considered are those that specifically relate to the determinations of the SDP on the site reviewed, here N-3.5. These can primarily be alternative procedures, i.e. the (technical) design of the turbines in detail (BALLA ET AL. 2009). At the same time, the precise design of the turbines that will be built on the site have not yet been set at the point in time of the suitability examination. Therefore, within the scope of the SEA on the suitability examination, the only alternatives to be reviewed are those that relate to the relevant sites and can already be carried out without detailed knowledge of the concrete construction project.

1.6 Data sources and indications of difficulties in compiling the documents

A description and assessment of the state of the environment in the investigation area form the basis for the SEA. All protected assets must be included. The data source is the basis for the assessment of the likely significant environmental effects, the area and species protection assessment and the assessment of alternatives.

In accordance with Section 39 subsection 2 second sentence of the Environmental Impact Assessment Act, the environmental report contains the information that can be obtained with reasonable effort, taking into account the current state of knowledge and public statements known to the authority, generally accepted assessment methods, the content and level of detail of the plan and its position in the decision-making process.

This environmental report builds on the environmental assessment within the scope of drawing up the SDP for the EEZ of the North Sea.

According to the requirements of Section 10 (2) 2 of the WindSeeG, the main bases of this SEA are the investigation results and documents from the preliminary investigation, as well as data acquired during this process.

Pursuant to Section 40 (4) of the UVPG, information available to the competent authority from other procedures or activities may be included in the environmental report if suitable for the intended purpose and sufficiently up-to-date.

On this basis, additional relevant data is drawn on from the planning approval and implementation procedure carried out at the BSH. The data and knowledge situation has improved considerably in recent years, particularly as a result of the extensive data collection within the framework of environmental compatibility studies and the construction and operation monitoring for the offshore wind farm projects and the accompanying ecological research.

In summary, the following data is used as a basis for the environmental report:

- Data from the preliminary investigation for site N-3.5
- Data from the construction and operations monitoring of existing offshore wind farms in the site and in the vicinity of site N-3.5
- Data from the approval procedure for offshore wind farms in the site and in the vicinity of site N-3.5
- Scientific studies
- Findings and results from research projects and accompanying ecological research
- Results from projects
- Statements from the technical authorities
- Statements from the (specialist) public
- Literature

Since the data basis may vary depending on the protected property, the data basis is discussed at the beginning of Chapter 2.

Indications of difficulties arising when compiling the data, such as technical gaps or lack of knowledge, must be presented in accordance with Section 40 subsection 2 number 7 of the UVPG. The description and evaluation of the individual protected assets (Chapter 2) make it clear that in certain places there are still gaps in knowledge. Information gaps exist in particular with regard to the following points:

- Long-term effects from the operation of offshore wind farms and associated systems, such as converter platforms
- Data for assessment of the state of the environment of the various protected assets in the area of the outer EEZ.

In principle, forecasts on the development of the living marine environment after implementation of the plan are subject to uncertainties. Long-term data series or analytical methods are often lacking, e.g. for intersection of extensive information on biotic and abiotic factors so as to provide a better understanding of complex interrelationships in the marine ecosystem.

In particular, there is a lack of detailed site-wide sediment and biotope mapping outside the nature conservation areas of the EEZ. As a result, there is a lack of a scientific basis on which to assess the effects of the possible use of strictly protected biotope structures.

Furthermore, there are no scientific assessment criteria for some protected assets, both with regard to the assessment of their status and with regard to the effects of anthropogenic activities on the development of the living marine environment, to allow cumulative effects to be considered in both temporal and spatial terms.

Chapter 2 separately goes into each protected asset.

2 Description and assessment of the environmental status

2.1 Introduction

In accordance with Section 40 subsection 2 number 3 of the UVPG, the environmental report includes a description of the characteristics of the environment and the current state of the environment in the SEA investigation area. The description of the current state of the environment is necessary in order to predict its change when the plan is implemented. The survey considers the factors listed in Section 2 subsection 1 numbers 1 to 4 of the UVPG and the interactions between those factors. The information is presented in a problem-oriented fashion. The focus is thus on possible existing impacts, environmental elements requiring special protection and on the protected assets that will be most affected by the implementation of the plan. In spatial terms, the description of the environment is based on the respective environmental impacts of the plan. Depending on the type of impact and the factor in question, these will have differing extents and may go beyond the limits of the plan (LANDMANN & ROHMER 2018). Please refer to the statements under 1.5.2.

The following description and assessment of the state of the environment also characterises and evaluates the stock and presents the existing impacts on the basis of the information detailed above in accordance with Section 10 (1) 1 of the WindSeeG.

2.2 Soil/Site

The protected asset soil encompasses the upper layer of the seabed. In the following, this will be described with regard to its morphology, surface sediments and the subsoil close to the surface. The focus for the protected asset site is on use of the site. The aim of economical site use has already been pursued in the determination made in the SDP (BSH 2020b) on the spatially arranged and site-saving development of offshore wind turbines, and of the offshore connection cables required for these.

Subsequently, the protected assets of the site and soil are considered together. Where it makes sense or is necessary, the protected asset site is considered in more detail.

2.2.1 Data situation

The basis of the description of the surface and the subsoil close to the surface of site N-3.5 is formed by the preliminary investigations conducted on this topic. These encompass inter alia grab samples and hydrographic investigations made by means of multibeam echo sounder, side scan sonar and sediment echo sounder echolot made in 2018 (VBW WEIGT GMBH, 2020). In addition, object investigations were carried out by the VWFS Wega of the BSH (BSH, 2020).

An additional database is provided by a map of sediment distribution in the German North Sea (LAURER ET. AL, 2014; Project GPDN - Geopotential German North Sea).

The data and information used to describe the distribution of pollutants in the sediment are collected during the annual monitoring cruises of the BSH.

2.2.2 Status description

2.2.2.1 Geomorphology

The site under consideration, N-3.5, is in the western part of the EEZ of the German North Sea. This is an area with largely even seabed relief.

The entire site has been comprehensively investigated by means of multibeam echo sounder. The seabed falls off from south to north. The seabed is uniformly even and does not have any abrupt changes in depth. In the south of the area investigated there are small ripples on the seabed.

The water depths related to the Lowest Astronomical Tide (LAT) are between 27.4 and 32.5 metres. The Figure 6 shows the bathymetry of the site.

2.2.2.2 Sediment distribution on the seabed

Comprehensive investigations have been carried out on site N-3.5 with side scan sonar and soil samples have been taken. In the process, the sediment samples were classified in accordance with DIN17892-4 and in accordance with Figge 1981 and Folk 1954/1974. The determination of the key grain figures from the grain size distributions of the soil samples taken from site N-3.5 show fine sand with differing contents of medium sand. All samples have a silt proportion of less than 5%. The content of organic material is mostly below one per cent (IfAÖ, 2021a). No changes to the signal intensities are visible in the back scatter mosaic, which indicates a change in sediment.

The mapping of the sediments was conducted in accordance with instructions for mapping the seabed (BSH, 2016) and shows exclusively fine sand in site N-3.5 (Figure 7).

In addition to this very homogeneous sediment composition, four objects were verified in site N-3.5. These are presumably anthropogenic objects. Due to the poor weather at the point in time of the investigations, no diver or ROV video investigations could be carried out. Therefore, the occurrence of marine boulders in accordance with the reef mapping instructions of the BfN (2018) cannot currently be ruled out. No residual or relict sediments, or large sand and gravel is expected in the area.

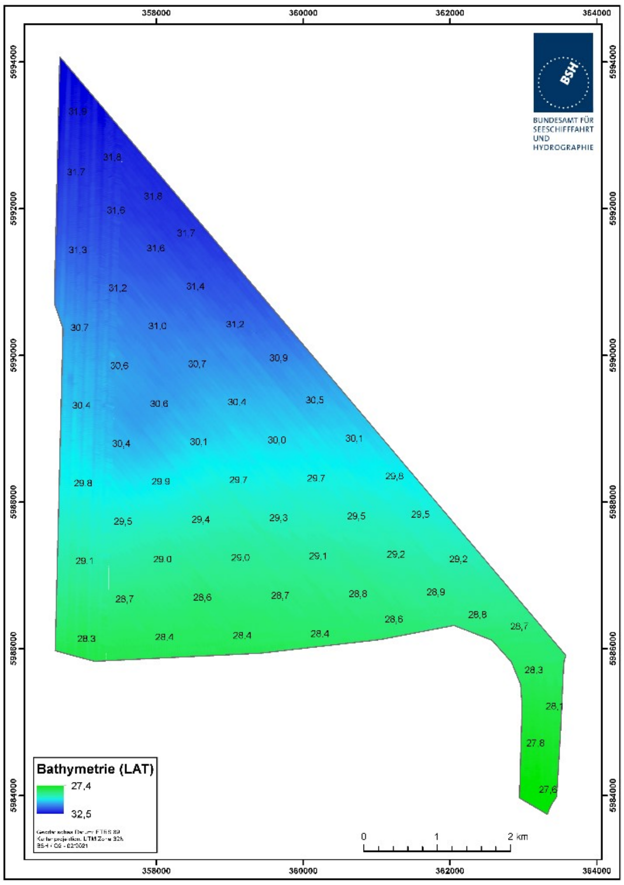

Figure 6: Bathymetry of site N-3.5 related to the Lowest Astronomical Tide (LAT).

2.2.2.3 Geological structure of the near-surface subsoil

The sediment echo sounding investigations were carried out within the scope of the preliminary investigation with an average profile interval of approx. 75 m.

On site N-3.5, below a sand layer with a thickness of approx. 0.25 to > 2 m (marine top layer, fine to medium sand) this is other sand that was only partly imaged. No base is recognisable anywhere in the measurements. On the base of the marine top layer there are extensive channel structures and hollowed, uneven depressions, which are filled with sediment. Softer sediments also occasionally fill the channels.

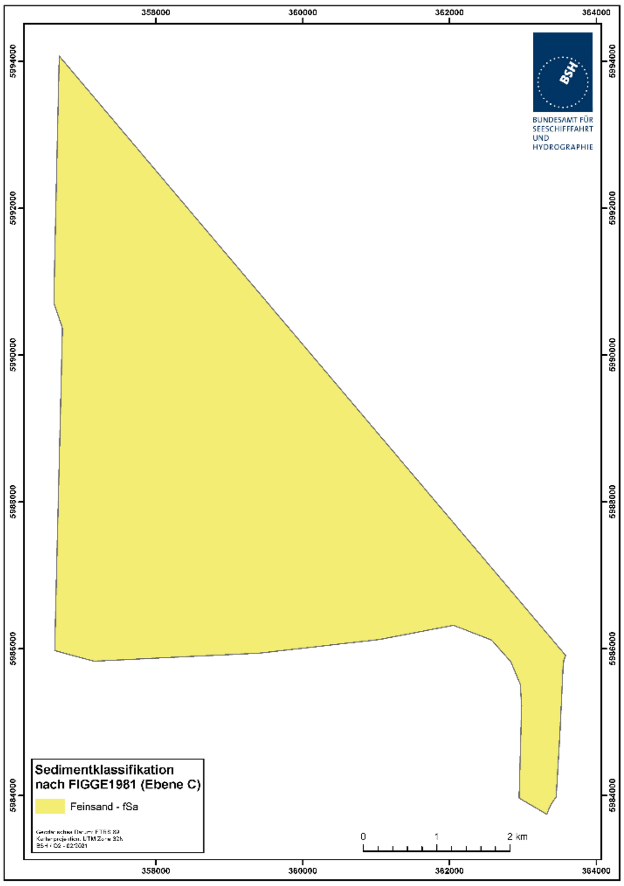

Figure 7: Sediment classification in accordance with the instructions for mapping the seabed (BSH) for site N-3.5.

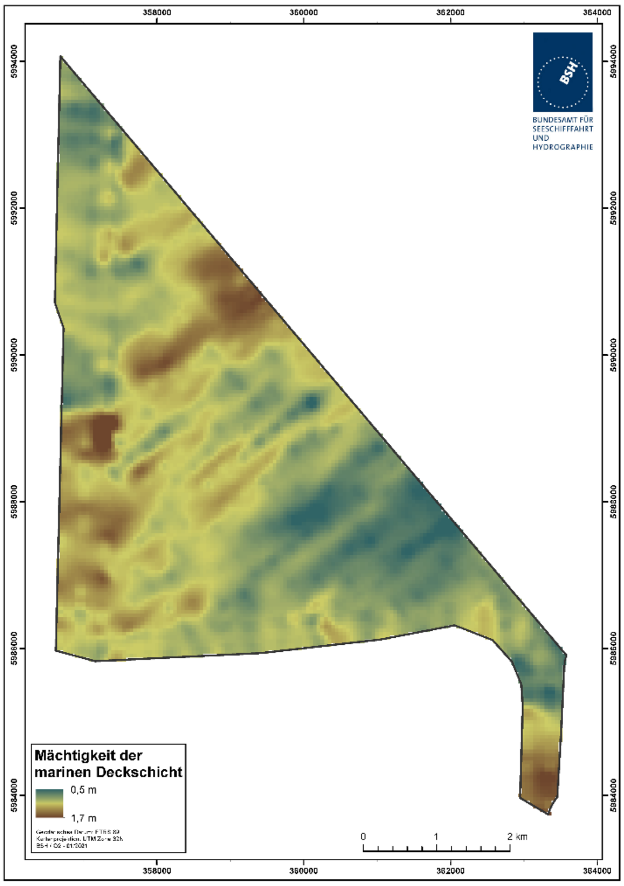

Figure 8: Thickness of the marine top layer of site N-3.5.

Where this was recognisable, it was recorded as a separate layer. Local channel structures with a depth of > 10 m are recognisable. There are occasional and very irregular, very strong, internally parallel reflectors on the base of the marine top layer. This may be peat. This was also recorded as a discrete layer. The Figure 8 shows the thickness of the marine top layer.

2.2.2.4 Pollutant distribution in the sediment

2.2.2.5 Metals

The seabed is the most important sink for trace metals in the marine ecosystem. However, it can also act as a regional source of pollution by re-suspension of historically deposited more polluted material. The absolute metal content in the sediment is strongly dominated by the regional grain size distribution. In regions with a high proportion of mud, higher contents are observed than in sandy regions. The reason is the higher affinity of the proportion of fine sediment proportion to adsorb metals. Metals accumulate mainly in the fine grain fraction.

Primarily the elements copper (Cu), cadmium (Cd) and nickel (Ni) are found in most regions of the German EEZ at low levels or in the range of background concentrations. All heavy metals show elevated levels near the coast, and less pronounced levels along the East Frisian islands than along the North Frisian coast. These very distinct gradients, with increased contents near the coast and very low contents in the central North Sea, indicate a dominant role of freshwater inflows as a source of metal pollution. In contrast, lead in the central North Sea in particular also shows significantly increased contents in the fine grain fraction. These are even higher than the values measured at stations near the coast. In contrast, the spatial distribution of the nickel contents in the fine grain fraction of the surface sediment is only characterised by very weakly pronounced gradients. The spatial structure does not allow any conclusions to be drawn about the main areas of stress. Suspended heavy metal pollution in the surface sediment of the EEZ has tended to decline overall in the past 30 years (Cd, Cu, Hg) or shows no clear trend (Ni, Pb, Zn).

2.2.2.6 Organic substances

Most of the organic pollutants are of anthropogenic origin. Some 2,000 mainly industrially-produced substances are currently considered environmentally relevant (pollutants) because they are hazardous (toxic) or persistent in the environment (persistent) and/or may accumulate in the food web (bioaccumulative). Since their properties can vary greatly, their distribution in the marine environment depends on a wide range of factors. In addition to input sources, input quantities and input pathways (directly via rivers, or diffusely via the atmosphere), the physical and chemical properties of the pollutants and the dynamic-thermodynamic state of the ocean are relevant for dispersion, mixing and distribution processes. For these reasons, the various organic pollutants in the sea show an uneven and varying distribution and occur in very different concentrations.

During its monitoring cruises, the BSH determines up to 120 different pollutants in the seawater, suspended solids and sediments. The River Elbe is the main input source of most pollutants in the German Bight. For this reason, the highest pollutant concentrations are generally found in the Elbe plume off the North Frisian coast, which generally decreases from the coast to the open sea. The gradients are particularly strong for non-polar substances, as these substances are predominantly adsorbed on suspended matter and are removed from the water phase by sedimentation. Outside the coastal regions rich in suspended matter, the concentrations of non-polar pollutants are therefore usually very low. However, many of these substances are also introduced into the sea by atmospheric deposition or have direct sources in the sea (such as PAHs (polycyclic aromatic hydrocarbons), discharged by the oil and gas industry and by shipping. Therefore, land-based sources must also be taken into account in the distribution of these substances.

According to current knowledge, the observed concentrations of most pollutants in seawater do not pose any immediate threat to the marine ecosystem. One exception is the pollution caused by tributyltin hydride (TBT), which was formerly used in marine paints and whose concentration near the coast partly reaches the biological threshold. Further, acute oil pollution (shipping, offshore oil production) can cause great harm to seabirds and seals.

2.2.2.7 Radioactive substances (radionuclides)

For decades, the radioactive contamination of the North Sea was determined by discharges from nuclear fuel reprocessing plants. As these discharges are very low today, the radioactive contamination of the North Sea does not pose any danger to people or nature according to current knowledge.

2.2.2.8 Inherited waste

Possible contamination in the North Sea EEZ includes munition remnants. In 2011, a federal and federal states working group published a basic report on the munition contamination of German marine waters, which is updated annually. According to official estimates, the seabed of the North and Baltic Seas holds 1.6 million tonnes of old ammunition and explosive ordnance of various types. A significant proportion of these ammunition dumps are from the Second World War. Even after the end of the war, large quantities of ammunition were dumped in the North and Baltic Seas to disarm Germany. The explosive ordnance load in the German North Sea is currently estimated at up to 1.3 million tonnes. The overall data availability is insufficient, so that it can be assumed that explosive ordnance can also be expected in the area of the German EEZ (e.g. remnants of mines and from combat operations). The location of the known ammunition dump area can be found on the official nautical charts and in the 2011 report (which also includes suspected sites for ammunition-contaminated areas).

The reports of the Federal-State Working Group are available at www.munition-im-meer.de.

2.2.3 Assessment of status

The status assessment of the seabed with regard to sedimentology and geomorphology is limited to site N-3.5, which is considered within the scope of the suitability examination.

2.2.3.1 Rarity and threat

The aspect "rarity and endangerment" takes into account the portion of the sediments on the seabed and the distribution of the morphological form inventory throughout the North Sea. The find sand that predominates in site N-3.5 is distributed throughout the entire North Sea. The seabed is uniformly even. Thus, the aspect "rarity and vulnerability" is rated as "low".

2.2.3.2 Diversity and uniqueness

The aspect "diversity and uniqueness" considers the heterogeneity of the described surface sediments and the characteristics of the morphological form inventory.

The sediment composition of the surface sediments in site N-3.5 is very homogeneous. No special morphological forms are known in this find sand area. Therefore, the aspect "diversity and uniqueness" is rated “low”.

2.2.3.3 Existing impacts

2.2.3.3.1 Natural factors

Climate change and sea level rise: The North Sea region has experienced dramatic climate change over the last 11,800 years, which has been associated with a profound change in the land/sea distribution due to the global sea level rise of 130 m. The sea level of the North Sea reached its present level about 2,000 years ago. Off the German North Sea coast, the sea level rose by 10 to 20 cm in the 20th century. Storms cause changes to the seabed. All sedimentary-dynamic processes can be traced back to meteorological and climatic processes, which are largely controlled by the weather patterns in the North Atlantic.

2.2.3.3.2 Anthropogenic factors

Fisheries: In the North Sea, bottom trawling uses otter trawls and beam trawls. Otter trawls are used mainly in the northern North Sea and are pulled diagonally across the seabed. In contrast, beam trawls have primarily been used in the south of the North Sea since the 1930s. Since the 1960s, there has been a sharp increase in beam trawl fishing, which has declined slightly over the last decade due to catch regulations and the decline in fish stocks. The skids of the beam trawlers leave tracks of 30 to 50 cm in width. In particular, their skids or chain nets have a greater impact on the bottom than otter trawls. The bottom trawls create specific furrows in the sediment that can range from a few millimetres to 8 cm deep on boulder clay and sandy seabed and up to 30 cm deep in soft silt. The results of the EU project TRAPESE show that at a maximum the upper 10 cm of the seabed is regularly disturbed and stirred up (PASCHEN et al. 2000). According to an IFAÖ report (2021a), fishing traces can be expected in site N-3.5 from the trawler fishing that predominates there.

Submarine cables (telecommunications, power transmission): Previously laid submarine cables in site N-3.5 (non-operational) are also existing impacts and are associated with potential effects. On the one hand, the seabed in these areas has already been locally disturbed and influenced. However, dynamic sediment processes usually lead to a complete levelling of the laying tracks. On the other hand, old submarine cables may have to be removed when building a wind farm (resuspending sediment) or junction structures may be necessary (local placement of hard substrate).

Anthropogenic factors affect the seabed through degradation, bioturbation, resuspension and material sorting. In this way, the natural sediment dynamics (sedimentation/erosion) and substance exchanges between sediment and water are influenced.

For the assessment of the aspect “existing impacts”, the extent of the pre-existing anthropogenic pollution of the sediments and the morphological form inventory is decisive. The general determination that must be made with regard to pollution is that the sediment in the site under consideration is only subject to low levels of pollution by metals and organic contaminants. As a result of the trawler fishing that takes place, the protected asset soil/site is allocated medium significance with regard to the criterion “existing impact” in site N-3.5. Consequently, this is characterised as an anthropogenically influenced area, in which the aforementioned existing impacts are present, but do not cause a loss of the ecological function.

2.3 Water

The North Sea is a relatively shallow shelf sea with a wide opening to the North Atlantic Ocean in the north. The oceanic climate of the North Sea - characterised by salinity and temperature - is largely determined by this northern opening to the Atlantic. In the south-west, the Atlantic has less influence on the North Sea because of the shallow English Channel and the narrow Dover Strait. The Baltic Sea is connected via the Great Belt and Little Belt, as well as via the Sound, with the Kattegat/Skagerrak and the North Sea.

2.3.1 Data situation

In addition to data and information from the literature, the description and assessment of the status of the protected asset water is primarily based on the evaluation of a variety of measurement series over many years carried out by the BSH, partly over several decades, as well as BSH monitoring cruises.

2.3.2 Status description

2.3.2.1 Nutrients

Nutrients such as phosphate and inorganic nitrogen compounds (nitrate, nitrite, ammonium) and silicate are essential for marine life. An excess of these nutrients, which occurred in the 1970s and 1980s due to extremely high nutrient inputs caused by industry, transport and agriculture, leads to a high accumulation of nutrients in seawater and thus to eutrophication. The eutrophication problem continues (BMEL and BMU 2020). As a result, there may be an increased occurrence of algal blooms (phytoplankton and green algae), reduced visibility depths, a decline in seagrass beds, shifts in the species spectrum and oxygen deficiency near the seabed (BMU 2018a).

The nutrient concentrations in the German Bight show a typical annual cycle, with high concentrations in winter and low concentrations in the summer months. All nutrients show similar distribution structures with a gradual decline in concentration from the area of the river mouth, across the coastal area and out to the open sea (BMU 2018a).

2.3.2.2 Contaminants

Organic contaminants and metals reach North Sea waters via direct discharges, rivers and the air, as well as via direct sources in the sea, such as offshore activities, raw material production and dumping dredging spoil. Contaminants can also accumulate in sediments and marine organisms.

The highest concentrations of organic contaminants are generally measured in the Elbe river plume off the North Frisian coast, and generally decline towards the open sea. The gradients are particularly strong for non-polar substances, as these substances are predominantly adsorbed on suspended matter and are removed from the water phase by sedimentation. Outside the coastal regions rich in suspended matter, the concentrations of non-polar pollutants are therefore usually very low. Water pollution caused by petroleum hydrocarbons is low. However isolated acute oil spills from shipping can be detected on the basis of visible oil films. In recent years, new analytical methods have been used to detect a large number of "new" contaminants (contaminants of emerging concern) with polar properties in the environment (BMU 2018a). Many of these substances (e.g. perfluorinated and polyfluorinated alkyl compounds, as well as some pesticides) occur in much higher concentrations than classic contaminants.

Metals occur naturally in the marine environment. Therefore, the detection of metals in the marine environment does not necessarily have to be regarded as pollution. Metals are dissolved and suspended in the water body. With increasing distance from the coast the suspended matter content in the water column decreases. Thus, the proportion of surfaces available for adsorption processes decreases and a proportionally increasing part of the metal content remains in solution. The concentration of mercury, cadmium, copper and zinc generally falls from the coast towards the open sea. As a result of natural background concentration of lead in sediments in the open North Sea, similar concentrations of lead in the water phase can be found in the open sea as on the coast (BMU 2018a). Similarly to nutrients, some metals (e.g. zinc or cadmium) in the dissolved fraction show periodic seasonal variations in concentration. This seasonal profile broadly corresponds to the biologic growth and remineralisation cycle.

2.3.2.3 Currents

The currents in the North Sea consist of a superposition of the half-day tidal currents with the wind- and density-driven currents. In general, the North Sea is characterised by large-scale cyclonic, i.e. anti-clockwise, circulation, with a strong inflow of Atlantic water at the north western edge and an outflow into the Atlantic Ocean via the Norwegian trench. The strength of North Sea circulation depends on the predominating air pressure distribution over the North Atlantic, which is parameterised by the North Atlantic Oscillation Index (NAO), the standardised air pressure difference between Iceland and the Azores. Based on an analysis of all current measurements carried out between 1957 and 2001 by the BSH and the German Hydrographic Institute (DHI) (KLEIN 2002), the mean amounts of current velocity (scalar mean including tidal current) and the residual current velocities (vector mean) near the surface (3–12 m water depth) and near the bottom (0–5 m distance from the bottom) were determined for various areas in the German Bight (Figure 9).

Table 5: Mean current velocities, residual and tidal currents in the German Bight.

	Oberflächennähe (3–12 m)	**Bodennähe (0–5 m Bodenabstand)**
Mittlerer Betrag	25 – 56 cm/s	16 – 42 cm/s
Vektormittel (Reststrom)	1 – 6 cm/s	1 – 3 cm/s
Gezeitenstrom	36 – 86 cm/s	26 – 73 cm/s

All time series with a length of at least 10 days and a water depth of more than 10 m were taken into consideration in this analysis. The objective of the analysis was to estimate the conditions in the open sea. The mean values are shown in Table 5. The tidal currents were determined by connecting to the Helgoland tide gauge (i.e. the measured currents are related to the tidal ranges and high tide times observed there (KLEIN & MITTELSTAEDT 2001).

Figure 9 shows the flow conditions in the near-surface layer (3–12 m measurement depth) for various areas in the German Bight. In the illustration, the values in area GB3 correspond to the (geological) sub-area "Borkum and Norderney Reef Grounds", GB2 corresponds to the sub-area "North of Helgoland" and GB1 corresponds to the sub-area "Elbe Glacial Valley and western plains".

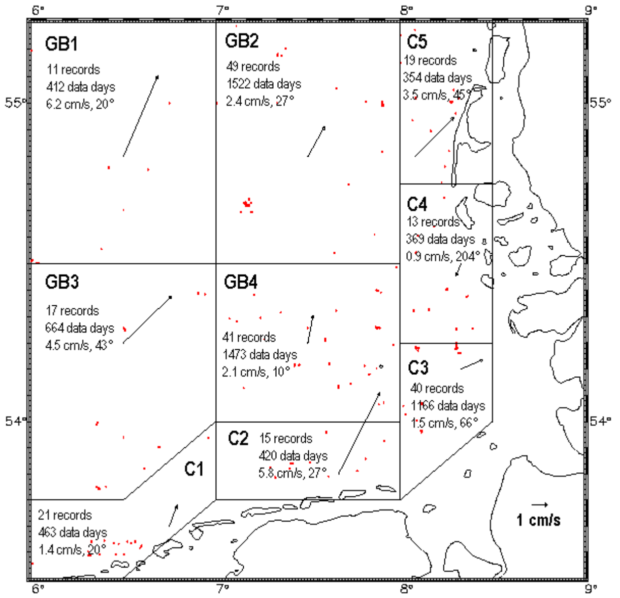

Figure 9: Vector mean of the flow in the near-surface layer (measuring depth 3 to 12 m). The measuring positions are marked with a red dot (BSH 2002).

2.3.2.4 Swell

In the case of swell*, a distinction is made between the waves generated by the local wind (the wind sea) and the swell*. Swells are waves that have left their area of origin and enter the sea area under consideration. The swell entering the southern North Sea is generated by storms in the North Atlantic or the northern North Sea. The swell has a longer period than the wind sea. The height of the wind sea depends on the wind speed and the time over which the wind acts on the water surface (duration of action) and on the length of the swell (fetch), i.e. the distance over which the wind acts. For example, the strike length in the German Bight is significantly smaller for easterly and southerly winds than for northerly and westerly winds. The significant or characteristic wave height, i.e. the mean wave height of the upper third of the wave height distribution, is given as a measure of the wind sea.

During the climatological year (1950-1986), the highest wind speeds in the inner German Bight occur in November with about 9 m/s and then drop to 7 m/s by February. In March, the speed reaches a local maximum of 8 m/s, after which it drops rapidly and remains at a flat level of around 6 m/s between May and August, before rising just as rapidly from mid-August to the maximum in late autumn (BSH, 1994). This annual trend, based on monthly averages, is transferable to the height of the sea state. For the inner German Bight, the directional distribution of the swell for the unmanned lightship UFS German Bight (formerly UFS Deutsche Bucht) shows – analogous to the distribution of the wind direction – a distribution with a maximum for swell from the west/south west and a second maximum from the east/south east (LOEWE et al. 2003).

2.3.2.5 Temperature, salinity and seasonal stratification

Water temperature and salinity in the German EEZ are determined by large-scale atmospheric and oceanographic circulation patterns, freshwater inputs from the Weser and Elbe rivers and energy exchange with the atmosphere. The latter applies in particular to sea surface temperature (LOEWE et al. 2003). The seasonal minimum temperature in the German Bight usually occurs at the end of February/beginning of March, seasonal warming begins between the end of March and the beginning of May, and the temperature maximum is reached in August. Based on spatial mean temperatures for the German Bight, SCHMELZER ET AL. (2015) find extreme values of 3.5°C in February and 17.8°C in August for the period 1968–2015. This corresponds to an average amplitude of 14.3 K, with the annual difference between maximum and minimum varying between 10 and 20 K. With the onset of seasonal warming and increased irradiation, thermal stratification sets in between the end of March and the beginning of May in the north-western German Bight at water depths of over 25-30 m. With pronounced stratification, vertical gradients of up to 3 K/m are measured in the temperature jump layer (thermocline) between the warm surface layer and the colder seabed layer; the temperature difference between the layers can be up to 10 K (LOEWE ET AL. 2013). Flatter areas are generally mixed, even in summer, due to turbulent tidal currents and wind-induced turbulence. With the beginning of the first autumn storms, the German Bight is again thermally vertically mixed.

The time series of the annual mean spatial temperatures of the entire North Sea based on the temperature maps published weekly by the BSH since 1968 show that the course of the sea surface temperature (SST) is not characterised by a linear trend, but by regime changes between warmer and colder phases (see also Fig. 3-28 in BSH 2005). The extreme warm regime of the first decade of the new millennium – in which the annual mean North Sea SST fluctuated around a mean level of 10.8°C – ended with the cold winter of 2010 (Figure 10). After four significantly cooler years, the North Sea SST reached its highest annual mean of 11.4 °C in 2014.

With regard to climate-related changes, QUANTE ET AL. (2016) expect an increase in SST of 1–3 K by the end of the century. Despite considerable differences in the model simulations with regard to set-up, forcing from the global climate model, and bias corrections, the different projections arrive at consistent results (KLEIN ET AL. 2018).

In contrast to the temperature, the salt content does not have a clearly pronounced annual cycle. Stable salinity layers in the North Sea occur in the areas of the mouths of the large

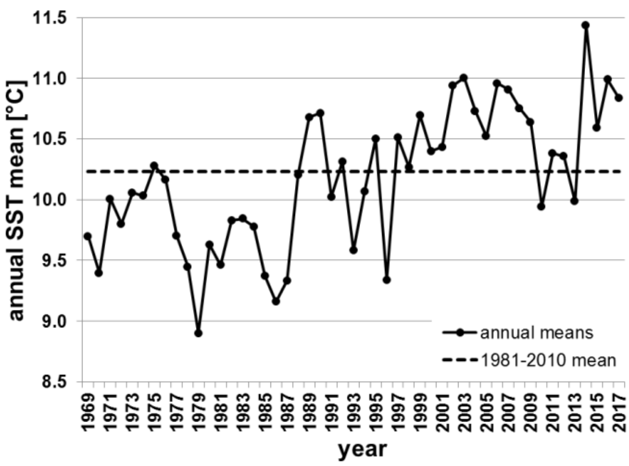

Figure 10: Annual average North Sea surface temperature for the years 1969– 2017.

rivers and in the area of the Baltic efflux. Due to tidal turbulence, the fresh water discharge of the major rivers within the estuaries mixes with the coastal water at shallow depths, but at greater depths it stratifies over the North Sea water in the German Bight. The intensity of stratification varies depending on the annual course of river discharges, which in turn exhibit considerable inter-annual variability, e.g. due to high meltwater run-off in spring after heavy snow winters. For example, the salinity at Helgoland Reede is negatively correlated with the discharge volumes of the Elbe. This shows that freshwater inputs cause a significantly reduced salinity near the surface near the coast (LOEWE et al. 2013), whereby the Elbe, with a discharge of 21.9 km³/year, has the strongest influence on salinity in the German Bight.

Since 1873 the salinity measurements of Helgoland Reede have been available, since about 1980 also the data at the positions of the former lightships, which were at least partly replaced by automated measuring systems later. The relocation of lightship positions and methodological problems, also in the measurements at Helgoland, led to breaks and uncertainties in the long time series and made reliable trend estimates difficult (HEYEN & DIPPNER 1998). No long-term trend in the annual mean surface salinity at Helgoland is apparent for the years 1950-2014. This also applies to the annual discharge rates of the Elbe. Projections of the future development of salinity in the German EEZ currently differ widely in terms of temporal development and spatial patterns. Recent projections indicate a decrease in salinity of between 0.2 and 0.7 PSU by the end of the century (KLEIN et al. 2018).

2.3.2.6 Ice conditions

In the open German Bight, the heat reserve of the relatively salty North Sea water in early winter is often so large that ice can only form very rarely. The open sea area off the North and East Frisian islands is ice-free in two thirds of all winters. On average over many years, the ice edge extends right behind the islands and into the outer estuaries of the Elbe and Weser. In normal winters, ice occurs on 17 to 23 days in the protected inner channels in the North Frisian Wadden area, and only on 2 to 5 days in the open channels - similar to the East Frisian Wadden area.

In ice-rich and very ice-rich winters, on the other hand, ice occurs on average on 54 to 64 days in the protected inner channels in the North Frisian Wadden area, and on 31 to 42 days in the open channels similar to the East Frisian Wadden area. In the inner tidal flats, mainly solid ice forms. In the outer tidal flats, mainly floe ice and ice slurry form, which are kept in motion by wind and tidal effects. Further information can be found in the Climatological Ice Atlas 1991–2010 for the German Bight (SCHMELZER et al. 2015).

2.3.2.7 Fronts

Fronts in the sea are high-energy mesoscale structures (of the order of a few tens of kilometres to a few hundred kilometres) which have a major impact on the local movement dynamics of the water, on biology and ecology and – due to their ability to bring CO_2 to greater depths – also on the climate. In the coastal areas of the North Sea, especially off the German, Dutch and English coasts, the so-called river plume fronts with strong horizontal salinity and suspended matter gradients are located between the freshwater input area of the major continental rivers and the continental coastal waters of the North Sea. These fronts are not static formations but consist of a system of smaller fronts and eddies with typical spatial scales between 5 and 20 km. This system is subject to great temporal variability with time scales from 1 to about 10 days. Depending on the meteorological conditions, the discharge rates of the Elbe and Weser rivers and the circulation conditions in the German Bight, frontal structures continuously dissolve and form. Only under extremely calm weather conditions can discrete frontal structures be observed over longer periods of time. During the period of seasonal stratification (approx. from the end of March to September), the tidal mixing fronts, which mark the transition area between the thermally stratified deep water of the open North Sea and the shallower, vertically mixed area due to wind and tidal friction, are located approximately in the area of the 30 m depth line. Due to the dependency on topography, these fronts are relatively stationary (OTTO ET AL. 1990). KIRCHES ET AL. (2013a–c) analysed satellite-based remote sensing data from 1990 – 2011 and drew up a climatology for SST, chlorophyll, gelbstoff and suspended matter fronts in the North Sea. This shows that fronts occur year-round in the North Sea. The strength of the spatial gradient generally increases towards the coast.

Fronts are characterised by significantly increased biological activity; and adjacent areas play a key role in the marine ecosystem. They influence ecosystem components at all stages – either directly or as a cascading process through the food web (ICES 2006). Vertical transport on fronts brings nutrients into the euphotic zone, thereby increasing biological productivity. The increased biological activity on fronts, due to the high availability and effective use of nutrients, results in increased atmospheric CO_2 binding and transport to deeper layers. The outflow of these $Co2_2$ enriched water masses into the open ocean is referred to as “shelf sea pumping” and is an essential process for the uptake of atmospheric CO_2 by the world ocean. The North Sea is a CO_2 sink in large parts all year round, with the exception of the southern areas in the summer months. Over 90% of the CO_2 absorbed from the atmosphere is exported to the North Atlantic.

2.3.2.8 Suspended solids and turbidity

The term "suspended matter" refers to all particles suspended in seawater with a diameter >0.4 µm. Suspended matter consists of mineral and/or organic material. The proportion of organic suspended matter is strongly dependent on the season. The highest values occur during plankton blooms in early summer. During stormy weather conditions and the resulting high waves, the suspended matter content in the entire water column increases strongly due to the swirling up of silty-sandy bottom sediments. This is where the swell has the greatest effect. When storm lows pass through the German Bight, increases in the suspended matter content of up to ten times the normal values are easily possible. As water samples cannot be taken during extreme storm conditions, corresponding estimates are derived from the records of anchored turbidimeters. If the temporal variability of the suspended sediment content at a fixed position is considered, there is always a distinct half-day tidal signal. Ebb and flood currents transport the water in the German Bight on average about 10 nautical miles from or towards the coast. Accordingly, the high suspended matter content near the coast (SPM = Suspended Particular Matter) is also transported back and forth and causes the strong local fluctuations. Further variability in SPM is caused by material transport (advection) from rivers such as the Elbe and Weser and from the south east coast of England. In Figure 11, a mean suspended sediment distribution for the German Bight is shown. The graph is based on all SPM figures stored in the Marine Environmental Database (MUDAB) as of 15 October 2005.

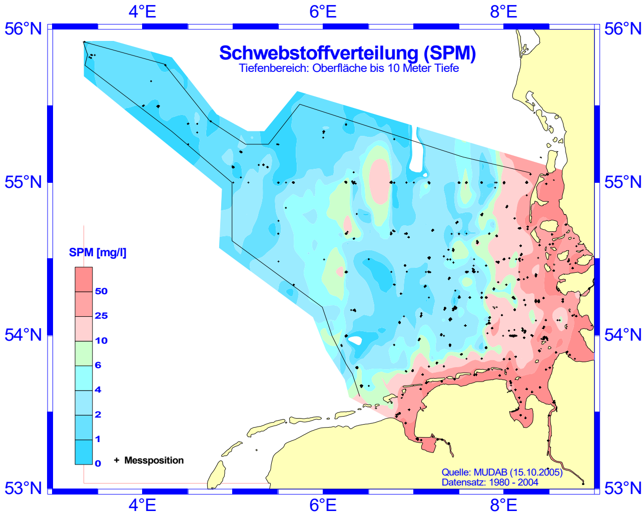

Figure 11: Mean suspended matter distribution (SPM) for the German North Sea.

The data set was reduced to the range "surface to 10 metres depth" and to values ≤150 mg/l. The underlying values measured were only obtained in weather conditions in which research vessels are still operational. Difficult weather conditions are therefore not reflected in the average figures shown here. In Figure 11, mean figures of around 50 mg/l and extreme figures of > 150 mg/l are measured in the mudflat areas landward of the East and North Frisian Islands and in the large estuaries. Further seawards, the figures quickly decrease to a range between 1 and 4 mg/l. Slightly east of 6° E, there is an area of increased suspended sediment. The lowest SPM mean values around 1.5 mg/l are found in the north-western fringe of the EEZ and over the sandy areas between Borkum Riffgrund and the Elbe-Urstromtal.

2.3.3 Assessment of status

The following parameters are used to evaluate the protected asset water:

- Thermohaline stratification

- Salinity
- Water depth and geomorphology,
- Turbidity,
- Tides,
- Circulation, currents,
- Water temperature,
- Water quality, nutrient and oxygen concentration,
- Swell as well as
- Ice conditions.

2.3.3.1 Hydrography

Hydrographic conditions result from the complex interaction of the individual parameters, which in turn are largely influenced and controlled by large-scale processes in the North Atlantic.

2.3.3.2 Nutrients

Due to measures such as the well-advanced expansion of waste water treatment technologies and the introduction of phosphate-free detergents, nutrient discharges into the North Sea have been reduced by around 50% since 1983, and phosphorus discharges by as much as 65% (BMEL and BMU 2020). Nevertheless, according to an MSRL assessment in 2018 (BMU 2018), 55% of German North Sea waters continue to be eutrophicated. As a result, eutrophication continues to be one of the largest ecological problems for the marine environment of German North Sea waters. The accumulation of nutrients and organic material via direct discharges, rivers and the air leads to undesirable biological effects, such as the development of algae mass or a changed spectrum of species, as well as other effects, such as oxygen deficits (OSPAR 2017). Contaminants

As before, organic contaminants are proven in raised concentrations in the North Sea (BMU 2018a). Many of the persistent, bio-accumulative and toxic substances will still be found in considerable concentrations in the marine environment decades after they are prohibited. However, according to current knowledge the observed concentrations of most contaminants in seawater do not pose any immediate threat to the marine ecosystem. A declining trend can be observed for the vast majority of contaminants (OSPAR 2017). One exception is the impact caused by perfluorooctane sulphonic acid PFOS, the concentration of which near the coast partly exceeds the toxicological threshold (BMU 2018a). Furthermore, seabirds and seals can be damaged by oil films floating on the water surface as a result of acute oil spills. On the basis of current knowledge, the above-mentioned metal pollution of seawater does not pose an immediate threat to the marine ecosystem.

The discharge of contaminants has a negative influence on the capacity of the marine ecosystem of the North Sea and can cause this to deteriorate significantly. The continuous renewal of water dilutes the concentrations of contaminants, resulting in a medium sensitivity with regard to the effects specified. However, excessive impacts over many years can cause serious damage to the North Sea ecosystem.

2.3.4 Conclusion

Due to the complex natural interactions and the unknown interplay between the large number of contaminants - even if these largely occur in low concentrations - an evaluation of the water also plays a role when evaluating the stocks of fish, macrozoobenthos and the soil.

The protected asset water is of medium naturalness due to eutrophication caused by existing impacts.

The existing impact on water as a protected asset is assessed to be “high”.

2.4 Biotope types

According to VON NORDHEIM & MERCK (1995), a marine biotope is a characteristic, typified marine habitat. With its ecological conditions, a marine biotope offers largely uniform conditions for biotic communities in the sea that differ from other types. Typification includes abiotic (e.g. moisture, nutrient content) and biotic features (occurrence of certain vegetation types and structures, plant communities, animal species).

The current biotope type classification of the North Sea and Baltic Sea was published by the Federal Agency for Nature Conservation (BfN) in the Red List of endangered biotope types in Germany (FINCK et al. 2017).

2.4.1 Data situation

The data basis for the description and assessment of the status of biotopes in the North Sea EEZ is detailed in the environmental report on the SDP 2020 (BSH 2020a).

A current description of the biotope types in site N-3.5 is initially made on the data basis of the 2019 autumn campaign and the 2020 spring campaign (interim report). After the completion of the 2020 autumn campaign, this data will also be included in the analyses and assessments, which confirm the results of the first two investigations (IFAÖ, 2021a).

There is no detailed mapping to date of the biotopes, including the legally protected biotopes according to Article 30 of the Federal Nature Conservation Act (BNatSchG), in the EEZ outside the nature conservation areas. A detailed and area-wide mapping of marine biotopes in the EEZ is currently being developed within the framework of ongoing R&D projects of the BfN with a spatial focus on nature conservation areas.

2.4.2 Assessment of status

The stock assessment of the biotopes occurring in the German marine area is based on the national protection status as well as the endangerment of these biotopes according to the Red List of Threat Biotopes of Germany FINCK et al. 2017).

Site N-3.5 is primarily allocated to the biotope type "Sub-littoral, even sandy bottom of the North Sea with *Tellina-fabula* community but with no dominance of specific endobenthic taxa" (Code 02.02.10.02.03.06, FINCK et al. 2017) (see details about the protected asset benthos). In the investigations of site N-3.5 in autumn 2019 and spring 2020, all the species typical for this biotope type were proven (*Bathyporeia guilliamsoniana, Magelona johnstoni, Fabulina fabula, Scoloplos armiger, Spiophanes bombyx* and *Urothoe poseidonis*).

The biotope type "Sub-littoral, even sandy bottom of the North Sea with *Tellina-fabula* community but with no dominance of specific endobenthic taxa" is included in the Red List in Category 3-V (acute warning list). There is a threat not only due to a negative development of the distribution of the biotope type, but exclusively due to commercial fishing with active fishing gear and eutrophication of non-utilised sites. The biotope type is classified as "partly reclaimable" (Category B) with a regeneration time of up to 15 years and is not detailed as a protected biotope as per section 30 of the BNatSchG.

The elements of the *Nucula-nitidosa* community also proven in site N-3.5 can be allocated to the biotope type "Sub-littoral, even sandy bottom of the North Sea with *Nucula-nitidosa* community – only open North Sea" (Code 02.02.10.02.05; FINCK et al. 2017). With the exception of the secondary species *Eudorella truncatula,* all the species typical for this biotope (*Abra alba, Abra nitida, Amphictene auricoma, Amphiura filiformis, Nephtys hombergii, Phaxas pellucidus, Scalibregma inflatum, Tellimya ferruginosa, Magelona alleni, Notomastus latericeus* and *Thyasira flexuosa*) were recorded in site N-3.5.

The biotope type is also classified as "partly reclaimable" and is not one of the biotope types protected in accordance with section 30 of the BNatSchG. As per FINCK et al. (2017) the data for this biotope type is deficient and for this reason, a further classification is not possible.

Within the scope of the SEA on the SDP (BSH 2020a) no indications of legally protected biotopes were found. This assessment is generally supported by the prior results of the preliminary investigations. However, in addition to this very homogeneous sediment composition, four objects with dimensions > 2m edge length were verified in site N-3.5. These are presumably anthropogenic objects. However, because no diver or ROV video investigations could be carried out, the occurrence of marine boulders in accordance with the reef mapping instructions of the BfN (2018) cannot currently be ruled out.

2.5 Benthos

Benthos is the term used to describe all biological communities bound to substrate surfaces or living in soft substrates at the bottom of water bodies. Benthic organisms are an important component of the North Sea ecosystem. They are the main food source for many fish species and play a crucial role in the conversion and remineralisation of sedimented organic material (KRÖNCKE 1995). The zoobenthos of the North Sea is composed of a large number of systematic groups and shows a wide variety of behaviour. Overall, this fauna is quite well investigated and therefore allows comparisons with conditions a few decades ago.

2.5.1 Data situation

The data basis for the description and assessment of the status of macrozoobenthos in the North Sea EEZ is detailed in the environmental report on the SDP 2020 (BSH 2020a).

A current description of the macrozoobenthos in site N-3.5 is initially made on the data basis of the 2019 autumn campaign and the 2020 spring campaign (interim report). After the completion of the 2020 autumn campaign, this data will also be included in the analyses and assessments, which confirm the results of the first two investigations (IFAÖ, 2021a).

As a comparison, the data from site N-3.6 sampled at the same point in time and in the same scope, as well as the preliminary investigation of sites N-3.7 and N-3.8 from autumn 2018, spring 2019 and autumn 2019, can be drawn on to provide support (IFAÖ 2021b, IFAÖ 2020a, IFAÖ 2020b).

It is not currently possible to reliably predict the likely effects of the introduction of hard substrate on the development of benthic communities.

2.5.2 Status description

Within the scope of the site preliminary investigation of N-3.5 investigations were conducted of the benthos communities (infauna and epifauna) as per the requirements of the investigation scope for the preliminary investigation and the StUK4 (BSH, 2013). In total, 20 infauna stations were sampled with one van Veen grabber and 10 epifauna stations were sampled with a 2 m beam trawl in autumn 2019 and spring 2020.

2.5.2.1 Infauna

In site N-3.5, during the 1st investigation year 195 taxa of infauna were proven in total, of which 139 could be determined up to the species. In total, 148 of the taxa were recorded in autumn 2019, while 155 taxa were proven in spring 2020. On average per station a significantly higher number of taxa were proven in autumn (64 taxa) than in spring (57 taxa).

Species that occurred constantly at all stations in autumn 2019 were*Leucothoe incisa*, *Abra alba*, *Fabulina fabula*, *Phaxas pellucidus*, *Tubulanus polymorphus*, *Phoronis muelleri*, *Loimia ramzega*, *Magelona johnstoni*, *Poecilochaetus serpens* and *Spiophanes bombyx*. In spring 2020, the species *Electra pilosa*, *Lovenella clausa*, *Bathyporeia guilliamsoniana*, *Bathyporeia tenuipes*, *Perioculodes longimanus*, *Fabulina fabula*, *Magelona johnstoni*, *Nephtys hombergii* and *Spiophanes bombyx* were proven at all stations.

The average total abundance in autumn 2019 (2,089 Ind./m²) was significantly higher than in spring 2020 (1,270 Ind./m²). No eudominant species appeared in autumn. The highest proportion of abundance in autumn 2019 was that of the polychaete *Magelona johnstoni* (12.7%) and the bean-like tellin *Fabulina fabula* (12.6 %), followed by the species complex *Chaetozone christiei* agg. (11.5%). The marine horseshoe worm *Phoronis muelleri* (8.8%) and the polychaeta *Spiophanes bombyx* (4.9%) and *Poecilochaetus serpens* (3.9%) were sub-dominant species. The secondary species made up 45.6% of total abundance.

In spring 2020, there was also no eudominant main species. As in the autumn campaign, *Magelona johnstoni* (18.1%) and *Fabulina fabula* (17.8%) made up the greatest share of abundance. The species complex *Chaetozone christiei* agg. was classified as a sub-dominant species. Furthermore, the two amphipods *Bathyporeia tenuipes* and *Bathyporeia guilliamsoniana* were sub-dominant species. The secondary species had a share of 44.7% of abundance.

At a figure of 4.50, the average diversity in autumn 2019 was significantly higher than in spring 2020, at 4.29. No significant difference was identified for the average evenness between autumn (0.77) and spring (0.76).

At a figure of 319 g/m², the average total biomass in spring 2020 was significantly higher than in autumn 2019 (205 g/m²).

In both seasons the common heart urchin *Echinocardium cordatum* was the only eudominant main species with regard to biomass (56.2% in autumn, 82.6% in spring).

The macrozoobenthos in site N-3.5 is a transition community of the *Tellina-fabula* community and of the *Nucula-nitidosa* community according to RACHOR & NEHMER (2003) and PEHLKE (2005). The *Tellina-fabula* community prefers the fine-sand areas of the 20 to 30 m depth contour, but also populates medium-sand areas (RACHOR & NEHMER 2003). As a character species, the eponymous mussel *Fabulina fabula* (formerly *Tellina fabula*), polychaeta *Goniada maculata* and *Magelona johnstoni* as well as the amphipods *Bathyporeia guilliamsoniana* und *Urothoe poseidonis* occur. The mud area of the inner German Bight, which is largely delineated by the 30-m depth contour, is populated by the *Nucula-nitidosa* community (RACHOR & NEHMER 2003). *Nucula nitidosa*, *Abra alba* and *Scalibregma inflatum* are proven here as character species.

All the character species of the *Tellina-fabula* community detailed above occurred in site N-3.5 both in autumn 2019 and spring 2020. The eponymous character species *Fabulina fabula* was recorded in both campaign at every station and occurred as the sub-dominant main species in autumn 2019. The character species *Goniada maculata* and *Spiophanes bombyx* occurred in both campaigns with a presence of 100% and were also dominant main species of the infauna community.

In addition to the fauna elements of the *Tellina-fabula* community, species of the adjacent *Nucula-nitidosa* community were also proven. These included, at high abundance proportions, the character species *Abra alba, Nucula nitidosa* and *Scalibregma inflatum* in autumn, as well as the character species *Abra alba* and *Nucula nitidosa* in spring.

The community figures identified in site N-3.5 for abundance, biomass, diversity, evenness and the taxa number of infauna fit well with the results described by DANNHEIM et al. (2014) for the Dogger Bank/ *Tellina fabula* community and the geo-cluster “OF/ NF coast”.

2.5.2.2 Epifauna

90 epifauna taxa in total were proven in site N-3.6 in autumn 2019 and spring 2020, of which 68 could be identified up to species level. During both investigation campaigns the bryozoan *Electra pilosa*, the hermit crab *Pagurus bernhardus* and the echinodermata *Asterias rubens, Astropecten irregularis* and *Ophiura ophiura* were

recorded at every station. The average taxa number per station in autumn 2019 (29 taxa) was significantly higher than in spring 2020 (24 taxa).

No significant difference was identified for the average total abundance between autumn 2019 (0.22 Ind./m²) and spring 2020 (0.25 Ind./m²). In autumn 2019, the epibenthos was characterised by two eudominant main species, the serpent star *Ophiura ophiura* and the common starfish *Asterias rubens* (32.6%). In spring 2020, the epibenthos community was also characterised by the group of echinodermata. These included the serpent star *Ophiura ophiura* (29.3%) and representatives of the ophiuridae gen. sp. that could not be identified in more detail (18.6%), as well as the two starfish *Asterias rubens* (23.0%) and *Astropecten irregularis* (20.0%).

The average diversity of epifauna did not differ significantly between the sampling in autumn 2019 (2.22) and spring 2020 (2.30). No statistically significant difference was identified for the medium evenness between autumn (0.67) and spring (0.72) either.

No statistically significant difference was identified for the average biomass between autumn 2019 (1.16 g/m²) and spring 2020 (0.95 g/m²). The starfish *Asterias rubens* was eudominant in both autumn and spring (46.4% and 47.8% respectively). Furthermore, in spring 2020 the echinodermata *Ophiura ophiura* and *Astropecten irregularis*, and additionally in autumn 2019 the swimming crab *Liocarcinus holsatus* occurred in raised biomasses.

The figures identified in site N-3.5 for abundance, biomass, diversity, evenness and the taxa number of epifauna fit well with the results described by DANNHEIM et al. (2014) for the communities “Coast II” and “Transition I, as well as the geo “SW- O DB”.

2.5.2.3 Red List species

Of the 237 taxa in total of the infauna and epifauna recorded in site N-3.5 in autumn 2019 and spring 2020, it was possible to identify 169 taxa up to species level. In total, 22 of these species are classified as endangered or rare on the Red List for Germany due to their stock situation or development (RACHOR et al. 2013). This corresponds to a proportion of Red List species of 13.0% of the total number of species.

None of the species deemed to be lost (RL category 0) and threatened with extinction (RL category 1) were recorded. The only critically endangered (RL category 2) species was the polychaeta species *Sabellaria spinulosa*, which was proven in both investigation campaigns. In total, the species was proven with a relatively low presence in the epifauna investigation (10% in autumn 2019, 30% in spring 2020).

Four of the species proven in site N-3.5 are classified as endangered (category 3): the dead man’s fingers *Alcyonium digitatum*, the razor shell *Ensis magnus*, the sea anemone *Sagartiogeton undatus* and the polychaeta species *Sigalion mathildae.* The four species were proven in both campaigns, where only *Sigalion mathildae* was recorded relatively constantly (60-85% presence).

Thirteen of the species found are listed with a threat of not evaluated (RL category G). Four additional species are deemed to be extremely rare (RL category R). In addition, four species are on the pre-warning list, but are not deemed to be endangered or rare.

Overall, it can be identified that none of the proven macrozoobenthos species in site N-3.5 have protected status in accordance with the BArtSchV or are detailed in Appendices II and IV of the FFH Directive.

2.5.3 Status assessment of the protected asset benthos

The benthos of the North Sea EEZ is subject to changes due to both natural and anthropogenic influences. In addition to natural and weather-related variability (severe winters), the main influencing factors are demersal fishing, sand and gravel extraction, the introduction of alien species and eutrophication of the water body, and climate change. The results of the investigations carried out in site N-3.5 and the surrounding area confirm a relatively strong, natural variability of the benthos communities. The results identified for site N-3.5 correspond well with the findings of the nearby sites N-3.6, N-3.7 and N-3.8 (IFAÖ 2021b, IFAÖ 2020a, IFAÖ 2020b)

2.5.3.1 Rarity and threat

The number of rare or vulnerable species is taken into account. The rarity/endangerment of the stock can be assessed on the basis of the confirmed species on the Red List.

In site N-3.5, 22 species on the Red List of RACHOR et al. (2013) were recorded that are deemed to be endangered or rare. None of the species deemed to be lost (RL category 0) or threatened with extinction (RL category 1) were proven. The species *Sabellaria spinulosa*, which is critically endangered (RL category 2), was proven with relatively low presence and in very low abundance in site N-3.5. The four species classified as endangered (RL category 3) were also proven with low abundance and low presence apart from one exception. Only the polychaete *Sigalion mathildae* occurred frequently in the samples, however, in very low abundance. On the basis of the Red List species found, and their abundance, the benthos communities of site N-3.5 have been allocated average importance with regard to the criterion rareness and threat. Consequently, the assessment of the environmental report on SDP 2020 (BSH 2020a) is confirmed, according to which the benthic communities proven in area N-3 are deemed to be neither rare nor endangered.

2.5.3.2 Diversity and uniqueness

This criterion refers to the number of species and the composition of the species communities. It assesses the extent to which species or biotic communities characteristic of the habitat occur and how regularly they occur.

The benthos coenosis identified in site N-3.5 can be described as *Tellina-fabula* communities according to RACHOR & NEHMER (2003), with some elements of *Nucula-nitidosa* coenosis. Almost all typical representatives of this community were proven in the first year of the preliminary investigations. Of the roughly 750 known species in total in the German EEZ, 237 taxa of the epifauna and infauna (169 taxa identified up to species level) were recorded in site N-3.5. Only three alien species (*Austrominius modestus*, *Tricellaria inopinata* and *Loimia ramzega*) were proven. On the basis of these results, the benthos coenosis of site N-3.5 has been allocated average importance with regard to the criterion diversity and uniqueness. Consequently, the assessments of the environmental report on SDP 2020 (BSH 2020a) are confirmed, according to which the environment of site N-3.5 is a stable transition form between the *Tellina fabula* community and the *Nucula nitidosa* community, with average species diversity incidence.

2.5.3.3 Existing impacts

For this criterion, the intensity of fishing exploitation, which is the most effective direct disturbance variable for the benthos (inter alia HIDDINK et al. 2019, EIGAARD et al. 2016, BUHL-MORTENSEN et al. 2015 and literature cited therein), is used as an assessment criterion. Eutrophication can also affect benthic biocoenoses. For other disturbance variables, such as shipping, pollutants, etc., there is currently a lack of suitable measurement and detection methods to be able to include them in the assessment.

As a result of the trawler fishing that touches the seabed that takes place in site N-3.5, it must be assumed that the dominance structures found within the epibenthos community in particular result from anthropogenic influence. According to PEDERSEN et al. (2009), in the investigation area fishing with small and large beam trawls takes place in particular. Although fishing in the North Sea has declined since the beginning of the 2000s due to EU regulations (ICES 2018a), the benthos communities in this area of the North Sea continue to have a significant influence. Since the 1980s, the discharge of nutrients into the North Sea has been reduced by 50% (BSH, 2020a). Large parts of the German EEZ in the North Sea were classified as eutrophic during the period 2006 to 2014 (BROCKMANN et al., 2017). However, despite these disclosures, there have not been suitable measurement and evidence methods to date to quantify the effects of eutrophication.

Long-lived mussel species such as *Mya arenaria* and *Arctica islandica* were not found in site N-3.5 during the investigations in autumn 2019 and spring 2020.

With regard to the criterion “existing impacts” the benthos coenosis of site N-3.5 has been allocated medium significance.

2.5.3.4 Significance of site N-3.5 for benthos

The individual criteria classified as “medium” result in an overall medium total assessment of the benthos coenosis of site N-3.5. This assessment confirms the low to medium overall assessment of the environmental report on SDP 2020 (BSH 2020a) for sites around area N-3.

2.6 Fish

As the most species-rich of all vertebrate groups living today, fish are equally important in marine ecosystems as predators and prey. The most important influences on fish populations, fishing and climate changes (HOLLOWED et al. 2013, HEESSEN et al. 2015), interact and can barely be differentiated in their relative effect (DAAN et al. 1990, VAN BEUSEKOM et al. 2018).

2.6.1 Data situation

As data is available almost exclusively from bottom trawling and not from pelagic sampling, the following assessment can be made for demersal fish only. For pelagic fish, there is no data that represents the species spectrum or which was collected in connection with offshore wind farms. A reliable assessment of the pelagic fish community is therefore not possible. A current description of the (demersal) fish in site N-3.5 was initially made on the data basis of the 2019 autumn campaign and the 2020 spring campaign 2020 (interim report). After the completion of the 2020 autumn campaign, this data will also be included in the analyses and assessments, which confirm the results of the first two investigations (IFAÖ, 2021a). In addition, current results were taken from environmental impact assessments of individual projects and cluster investigations in close proximity to N-3.5 (N-3.6: autumn 2019, spring and autumn 2020 IFAÖ 2021b; N-3.7 and N-3.8: autumn 2018, spring and autumn 2019 IFAÖ 2020a, IFAÖ 2020b, 2019; Gode Wind 01 and Gode Wind 02: autumn 2014, 2016, 2018 as well as Gode Wind 03: autumn 2009 to spring 2011 BIOCONSULT 2020), as well as the 2020 environmental report on the site development plan for the German North Sea (BSH 2020a).

Site N-3.5 is presented in detail below. Further, the area North of Borkum is considered, under which the entire data basis is summarised (project and reference site N-3.5 and the aforementioned neighbouring projects).

2.6.2 Status description

In order to be able to demarcate possible influences of OWFs on fish in Chapter **4.5**, the species are initially differentiated according to their way of life and life cycle. Further, knowledge of the diet, reproduction and habitat use can provide important information about the significance of an area or site for fish.

2.6.2.1 Lifestyles

At almost 60%, predominantly bottom-dwelling (demersal) species form the largest proportion of the fish community of the North Sea, followed by species living in open water (pelagic; 20%) and bentho pelagic (15%), which mainly live close to the seabed. Only about 5% cannot be assigned to any of the three lifestyles because of a close habitat connection (FROESE & PAULY 2019). This categorisation relates to the adult stages of the fish. However, the individual development stages of each species often differ more in form and behaviour than the same stages of different species. The majority of fish species recorded in the North Sea complete their entire life cycle, from egg to mature adult, there – for example, herring, plaice and whiting – and are therefore described as PERMANENT RESIDENTS (Lozan 1990). Other marine species, such as red and grey gurnard, predominantly occur in summer as "summer guests" in the North Sea. However, there are no clear signs of reproduction, while the so-called "accidental migrants" occur irregularly regardless of the season, and mostly only as single specimens in the North Sea, including Ray's bream and halibut.

The life cycle of diadromous species encompasses sea and fresh water, either with marine spawning grounds and limnic nursery areas (catadromous, e.g. eel) or the other way around (anadromous, e.g. smelt, twait shad or salmon).

Finally, fish can be classified functionally on the basis of their diet, reproduction or use of habitat, which in contrast to the taxonomic classification make it easier to describe the functions of fish in the ecosystem (ELLIOTT et al. 2007).

2.6.2.2 Spatial and temporal distribution

The spatial and temporal distribution of fish is determined first and foremost by their life cycle and associated migrations of the various developmental stages (HARDEN-JONES 1968, WOOTTON 2012, KING 2013). The framework for this is set by many different factors that take effect on different spatial and temporal scales. Hydrographic and climatic factors, such as swell, tides and wind-induced currents, as well as the large-scale circulation of the North Sea, have an impact over a large area. The medium (regional) to small (local) space-time scale is affected by water temperature and other hydrophysical and hydrochemical parameters, as well as food availability, intra- and inter-species competition and predation, which also includes fisheries. Another crucial factor for the distribution of fish in time and space is habitat. In a broader sense, this means not only physical structures but also hydrographic phenomena such as fronts (MUNK et al. 2009) and upwelling areas (GUTIERREZ et al. 2007), where prey can aggregate and thus initiate and maintain entire trophic cascades.

The diverse human activities and influences are further factors that can influence fish distribution. These range from nutrient and contaminant discharges, the obstruction of the migration routes of migrating species and fishing, up to building in the sea that some species of fish use as spawning substrate (sheet piles for herring spawn) or sources of nutrition (growth of artificial structures) (EEA 2015). In addition, species of fish have been able to aggregate on newly-built structures. Further information topic can be found in Chapter 4.5.

2.6.2.3 Characterisation of the fish community

KLOPPMANN et al. (2003) detected a total of 39 fish species during a one-off investigation to survey fish species of Appendix II Habitats Directive in the German EEZ in the areas of Borkum-Riffgrund, Amrum-Außengrund, Osthang Elbe-Urstromtal, and Dogger Bank in May 2002. This study showed a gradual change in the species composition of the fish communities from the inshore to the offshore areas due to hydrographic conditions. These changes were confirmed by DANNHEIM et al. (2014a), who were able to geographically distinguish four fish communities in the German EEZ using effort-corrected catch figures: The largest formed the central community (ZG), which were demarcated in the north by the two communities of the duckbill (ES I and ES II) and along the coast by a coastal community (KG). These four fish communities had a similar species composition in principle, but with different species-specific abundances. Dab were generally dominant and very common, while plaice and American plaice dominated in the offshore community ES II. Plaice were also regularly found in the central transitional community. Dragonets, solenette and hooknoses were characteristic of the coastal community of demersal fish. Solenettes and dragonets were also regularly found in the central transitional community. The species composition and distribution of demersal fish showed gradual changes from the offshore community, via the central community and up to the nearshore areas.

According to this classification (Dannheim et al. 2014a), site N-3.5 is on the transition between the central and coastal communities.

RAMBO et al. (2017) identified diversity hotspots of the demersal fish community in the northern mud ground and Borkum reef ground. Less diverse areas can be found on the Dogger Bank and the southern “Duck’s Bill” area (RAMBO et al. 2017). Site N-3.5 is outside the hotspot areas but offers raised species diversity within the German Bight nevertheless.

2.6.3 Assessment of status

The status of the demersal fish community is assessed on the basis of

- rarity and threat,
- diversity and uniqueness as well as
- existing impacts.

These three criteria are defined below and applied to site N-3.5. Subsequently, the importance of the area is considered with regard to the life cycle of the fish community.

2.6.3.1 Rarity and threat

The rarity of and threat to the fish community are assessed on the basis of the proportion of species in the relevant survey (see 2.6.1) that according to the current Red List and total species list of marine fish (Thiel et al. 2013) or Red List of freshwater fish for diadromous species (FREYHOF 2009), have been assigned to one of the following Red List categories:

0: Extinct or lost,
1: Threatened with extinction
2: Critically endangered
3: Endangered
G: Endangered to an unknown degree
R: Extremely rare
V: Warning list
D: Data insufficient
*: Not endangered

The relative proportions of the species assessed in the Red List to these assessment classes are placed in relation to the relative proportions of the species from the data sources specified in 2.6.1. An overview can be taken from table 6. In addition, particular attention is paid to the risk situation of species listed in Appendix II of the Habitats Directive. They are the focus of Europe-wide conservation efforts and require special protection measures.

33 species from 20 families in total were recorded on site N-3.5 during the preliminary investigation in autumn 2019 and spring 2020. Of these, according to THIEL et al. (2013) no species is deemed to be extinct or lost (0). One individual species proven, the thornback ray, was threatened with extinction (1). None of the species proven on site N-3.5 are classified as critically

endangered (2) or endangered (3). No species classified as extremely rare (R) were recorded either. The species snake pipefish and greater pipefish species are endangered to an unknown degree (G). Three species were registered on the warning list (V): common sole, pouting and turbot. The data situation for the lesser sand eel, the great sand eel, the reticulated dragonet and the sand goby is regarded as insufficient. Out of the 33 species recorded during the site preliminary investigation in site N-3.5, 23 are deemed not to be endangered (*).

In the surrounding sea area, North of Borkum, 61 species of fish in total were registered during the environmental impact assessments (see 2.6.1). In addition to the species proven in site N-3.5, other species potentially occur that are adapted to local geological and hydrographic conditions. In this section the species are also presented that have not yet been proven in the project site N-3.5, but have been proven in the reference area or in neighbouring sites (see 2.6.1).
According to Thiel et al. (2013), the greater weever and the European eel recorded in the area are deemed to be critically endangered (2). The thorny skate and the poor cod are both classified as endangered (3). The sea lamprey is assumed to be endangered to an unknown degree (G). The sea lamprey is detailed in Appendix II of the FFH Directive (Thiel & Winkler 2007), as is the twait shad, which was also registered in the sea area North of Borkum. Four other species were recorded on the warning list (V): the twait shad, the Atlantic mackerel, the cod and the smelt. The data situation was considered to be insufficient (D) for seven additional species (spotted dragonet, the painted and Lozano's goby, the tadpole fish, longspined bullhead, lesser sand eel and greater sand eel.

In the Red List of marine fish, 27.1% of the species assessed were assigned to a risk category (0, 1, 2, 3, G or R), 6.5% are on the early warning list and for 22.4% no assessment is possible due to lack of data. In total, 43.9% of the species are deemed not be endangered (Thiel et al. 2013, table 6).

3% of the fish species proven during the preliminary investigation in site N-3.5 are endangered (Category 1: 3%). 6.1% of species are endangered to an unknown degree and 9.1% are on the warning list. No endangerment can be identified for a further 12.1% of proven species due to an insufficient data situation. The largest proportion (69.7%) is formed by non-endangered species (table 6).

Table 6: Absolute numbers of species and the relative proportion of Red List Categories of fish proven during the site preliminary investigation (API) in site N-3.5, during environmental impact assessments (EIA) in the sea area North of Borkum and in the North Sea as a whole (Red List and total species list, THIEL et al. 2013).

Red List Category	**API N-3.5**		**EIA Area North of Borkum**		**German North Sea (THIEL et al. 2013)**	
	Absolute number of species	Relative proportion [%]	Absolute number of species	Relative proportion [%]	Absolute number of species	Relative proportion [%]
0: Extinct or lost	0	0	0	0	3	2,8
1: Threatened with extinction	1	3,0	1	1,6	8	7,5
2: Critically endangered	0	0	2	3,3	7	6,5
3: Endangered	0	0	2	3,3	2	1,9
G: Endangered to an unknown degree	2	6,1	3	4,9	5	4,7
R: Extremely rare	0	0	0	0	4	3,7
V: Warning list	3	9,1	7	11,5	7	6,5
D: Data insufficient	4	12,1	11	18,0	24	22,4
***:** Not endangered	23	69,7	35	57,4	47	43,9
Total number of species	33		61		107	

In the consideration of the North of Borkum area as a whole, the number of species with an endangered status (categories 1, 2, 3: 13.1%, G: 4.9%). 11.5% of the species registered in North of Borkum are assigned to the warning list. The data basis is not sufficient for an evaluation for 18%. In total, as in site N-3.5 more than half of all the species recorded here are classified as non-endangered (57.4%; table 6).

Extinct or lost species (0) were not identified either in site N-3.5 or in the surrounding sea areas North of Borkum. The relative proportion of species threatened with extinction (1) and critically endangered (2) species is lower than in the North Sea as a whole. Consequently, site N-3.5 tends to be of below-average importance for species in endangered categories 0–2. However, relative to the North Sea the area is of above-average importance for endangered species (3). The proportion of fish species with an unknown endangered status (G) is above that of the North Sea. N-3.5 is of below-average importance for extremely rare species (R), while the relative proportion of species in category V is well above that of the North Sea. The highest proportion of species that can occur in site N-3.5 is not endangered (*). The proportion of species that could not be assessed because of a lack of data (D) in N-3.5 and in the North of Borkum area was below the proportion of this category in the Red List for the German North Sea as a whole (Table 6).

Species in endangered categories (1, 2, 3 and G) were proven as single specimens in site N-3.5. The thornback ray, which is threatened with extinction, prefers sandy, muddy seabeds (ZIDOWITZ et al. 2017). Since 2018, some individuals have been recorded during several campaigns in the sea area North of Borkum.

The FFH species twait shad has been repeatedly proven with a bottom trawl net as a pelagic migrating species, which indicates incidence. However, the focal point of its distribution is in the areas of river mouths, so that regular incidence in site N-3.5 is not expected. The sea lamprey lives as a parasite from the body tissue of larger fish and mammals in the North Sea. The bottom trawl nets used are not quantitatively suitable evidence methods for this species and as a result, no statement about incidence can be made on the basis of isolated items of evidence.

In the overall consideration, the fish fauna in site N-3.5 are assessed to be above-average with regard to the criterion rarity and endangerment.

2.6.3.2 Diversity and uniqueness

The diversity of a fish community can be described by the number of species (α-Diversity, “species richness”). The species composition can be used to assess the specific nature of a fish community, i.e. how regularly habitat-typical species occur. The following section compares and assesses the diversity and individual characteristics of the entire North Sea and N-3.5 as well as the sea area North of Borkum.

Over 200 species of fish have been recorded in the North Sea so far (YANG 1982, DAAN 1990: 224, LOZAN 1990: > 200, FRICKE et al. 1994, 1995, 1996: 216, WWW.FISHBASE.ORG: 209; as at: 24 February 2017), where most species involve rare single specimens. Less than half of them reproduce regularly in the German Exclusive Economic Zone (EEZ) or are found as larvae, young or adult specimens. According to these criteria, only 107 species are considered to be established in the North Sea (THIEL et al. 2013). The International Bottom Trawl Survey (IBTS) identified 99 fish species in the entire North Sea between 2014 and 2018. The fish community of the sandy seabed in the southern North Sea is characterised by the species common dab, plaice, solenette, scaldfish, whiting, sand goby, common dragonet, hooknose and lesser sand eel (DAAN et al. 1990, REISS et al. 2009).

33 species in total were proven in site N-3.5, including all typical flatfish and roundfish species. The species common dab, scaldfish and solenette dominated catches in autumn and spring, while in autumn 2019 the sand goby and the striped red mullet were among the characteristic species. Taken together, these species made up more than 90% of the total specimen density during the site preliminary investigation campaign. Furthermore, the species common dragonet, sand goby, hooknose, striped red mullet, whiting, grey gurnard, lesser pipefish, red gurnard, fourbeard rockling and common sole were typical representatives of the fish fauna in site N-3.5. Although the ground trawl nets used are unsuitable for recording pelagic fish, species such as Atlantic horse mackerel were quantitatively proven.

The diversity and uniqueness in the sea area North of Borkum largely corresponds to that in site N-3.5. The composition of species differs with regard to some rare species, which is attributable to the greater scope of the sampling. With regard to the incidence of species typical for the habitat, biodiversity and dominance circumstances the results for site N-3.5 and the sea areas North of Borkum correspond. Overall, 61 fish species could be proven in the sea area North of Borkum during the various campaigns (see 2.6.1). Consequently, the variety of fish fauna species is higher than in other areas of the German EEZ (see RAMBO et al. 2017).

In their biodiversity, species of the central fish community (DANNHEIM et al. 2014a) form the largest proportion by quantity. Due to individual species of the coast community the fish fauna in N-3.5 are diversified. Accordingly, the diversity and uniqueness in site N-3.5 is characterised by a typical species and dominance structure of the fish fauna. Due to the diversity of species in the sea areas North of Borkum, the diversity and uniqueness in site N-3.5 is assessed to range from average to above-average.

Table 7: The total species list of the proven fish species in the project site N-3.5 and in the surrounding sea area North of Borkum with its Red List Status of the North Sea Region (RLS) according to Thiel et al. 2013 and their lifestyles (LW; p=pelagic, d=demersal).

Fish species	English name	LW	RLS	N-3.5	North of Borkum
Zoarces viviparus	Viviparous eelpout	d	*		x
Scomber scombrus	Atlantic mackerel	p	V		x
Pholis gunnellus	Rock gunnel	d	*	x	x
Hippoglossoides platessoides	American plaice	d	*		x
Gasterosteus aculeatus	Three-spined stickleback	d	*		x
Anguilla anguilla	European eel	d	2		x
Alosa fallax	Twait shad	p	V		x
Pomatoschistus pictus	Painted goby	d	D		x
Platichthys flesus	European flounder	d	*	x	x
Trisopterus luscus	Pouting	d	V	x	x
Raniceps raninus	Tadpole fish	d	D		x
Ciliata mustela	Fivebeard rockling	d	*	x	x
Hyperoplus lanceolatus	Great sand eel	d	D	x	x
Callionymus maculatus	Spotted dragonet	d	D		x
Callionymus lyra	Common dragonet	d	*	x	x
Scophthalmus rhombus	Brill	d	*	x	x
Syngnathus thyphle	Broadnosed pipefish	d	*		x
Eutrigla gurnardus	Grey gurnard	d	*	x	x
Entelurus aequoreus	Snake pipefish	d	G	x	x
Syngnathus acus	Greater pipefish	d	G	x	x
Liparis liparis	Common seasnail	d	*		x
Trachinus draco	Greater weever	d	2		x
Clupea harengus	Atlantic herring	p	*	x	x
Trachurus trachurus	Atlantic horse mackerel	p	*	x	x
Belone belone	Garfish	p	*	x	x
Gadus morhua	Atlantic cod	d	V		x
Syngnathus rostellatus	Lesser pipefish	d	*	x	x
Ammodytes marinus	Lesser sand eel	d	D	x	x
Scyliorhinus canicula	Small-spotted catshark	d	*		x
Limanda limanda	Common dab	d	*	x	x
Ctenolabrus rupestris	Goldsinny wrasse	d	*		x
Arnoglossus laterna	Scaldfish	d	*	x	x

Fish species	English name	LW	RLS	N-3.5	North of Borkum
Pomatoschistus lozanoi	Lozano's goby	d	D		x
Petromyzon marinus	Sea lamprey		G		x
Raja clavata	Thornback ray	d	1	x	x
Callionymus reticulatus	Reticulated dragonet	d	D	x	x
Mullus barbatus	Red mullet	d	*		x
Chelidonichthys lucerna	Tub gurnard	d	*	x	x
Microstomus kitt	Lemon sole	d	*	x	x
Pomatoschistus minutus	Sand goby	d	D	x	x
Engraulis encrasicolus	European anchovy	p	*	x	x
Pleuronectes platessa	Plaice	d	*	x	x
Gobius niger	Black goby	d	*		x
Taurulus bubalis	Longspined bullhead	d	D		x
Cyclopterus lumpus	Lumpsucker	d	*		x
Myoxocephalus scorpius	Shorthorn sculpin	d	*	x	x
Solea solea	Common sole	d	V	x	x
Sprattus sprattus	European sprat	p	*	x	x
Scophthalmus maximus	Turbot	d	V	x	x
Agonus cataphractus	Hooknose	d	*	x	x
Amblyraja radiata	Thorny skate	d	3		x
Osmerus eperlanus	European smelt	p	V		x
Mullus surmuletus	Striped red mullet	d	*	x	x
Ammodytes tobianus	Lesser sand eel	d	D		x
Hyperoplus immaculatus	Corbin's sand eel	d	D		x
Enchelyopus cimbrius	Fourbeard rockling	d	*	x	x
Echiichthys vipera	Lesser weever	d	*		x
Merlangius merlangus	Whiting	d	*	x	x
Phrynorhombus norvegicus	Norwegian topknot	d	*		x
Trisopterus minutus	Poor cod	d	3		x
Buglossidium luteum	Solenette	d	*	x	x
Total number of species				33	61

2.6.3.3 Existing impacts

The southern North Sea has been intensively used for centuries. In this context, fishery nutrient impacts have adverse effects on the natural habitat and fish community. In addition, fish fauna are subject to other direct or indirect human influences such as shipping, contaminants, sand and gravel extraction. However, these indirect influences and their effects on the fish fauna are difficult to prove. In principle, it is not possible to reliably separate the relative effects of individual anthropogenic factors on the fish community and their interactions with natural biotic (predators, prey, competitors, reproduction) and abiotic (hydrography, meteorology, sediment dynamics) parameters of the German EEZ.

However, due to the removal of target species and by-catch and the impact on the seabed in the case of bottom fishing methods, fishing is considered to be the most effective disruption on the fish community. There is no assessment of stocks on a smaller spatial scale such as the German Bight. Consequently, the assessment of this criterion cannot be carried out in detail for site N-3.5, but only for the entire North Sea.

Of the 107 species considered established in the North Sea, 21 are fished commercially (Thiel et al. 2013). The assessment of the impact of fishing is based on the "Fisheries overview - Greater North Sea Ecoregion" of the International Council for the Exploration of the Sea (ICES 2018a). Fisheries have two main effects on the ecosystem: the disturbance or destruction of benthic habitats by bottom-set nets and the taking of target species and by-catch species. The latter often include protected, endangered or threatened species, including not only fish but also birds and mammals (ICES 2018c). Some 6600 fishing vessels from 9 nations fish in the North Sea. The largest quantities were landed in the early 1970s and catches have been declining since then. However, a reduction in fishing effort has only been observed since 2003.

The intensity of bottom trawling is concentrated in the southern North Sea and is also by far the predominant form of fishing in the German EEZ (ICES 2018a). Flatfish trawling in the German EEZ targets plaice and sole, using not only heavy bottom gears but also relatively small meshes. Consequently, by-catch rates of small fish and other marine organisms can be very high.

Commercial fishing and spawning stock sizes are assessed against maximum sustainable yield (MSY), taking into consideration the precautionary approach. A total of 119 stocks have been considered in terms of fishing intensity, 43 of which have been scientifically assessed (Figure 12: Fishing intensity and reproduction capacity of 119 fish stocks in the entire North Sea. Number of stocks (top) and biomass share of catch (bottom). Fishing intensity reference level: sustainable yield (FMSY; red: above FMSY, green: below FMSY, grey: not defined); reproductive capacity reference level: Spawning biomass (MSY Btrigger; red: below MSY, green: above MSY, grey: not defined). Amended in accordance with ICES (2018a).; ICES 2018a). Of the 43 stocks assessed, 25 are managed sustainably. 38 of the 119 stocks were assessed for their reproductive capacity (spawning biomass); 29 stocks are able to use their full reproductive capacity.

The biomass proportion of the total catch (5,350,000 t in 2017) managed at too high a fishing intensity outweighs the proportions of sustainably caught and unassessed fish stocks in the North Sea (Figure 1). Fish from stocks for which the reproductive capacity is above the reference level account for the majority of biomass in the catch (3,709,000 t, Figure 12).

Overall, fishing mortality of demersal and pelagic fish has decreased significantly since the late 1990s. For most of these stocks, spawning biomass has been increasing since 2000 and is now above or close to individually set reference points. Nevertheless, fishing mortality for many stocks is also above the established reference measures (e.g. for cod, whiting, or mackerel). Moreover, for the vast majority of the stocks exploited, no reference levels are defined, which makes it impossible to carry out scientific stock assessments.

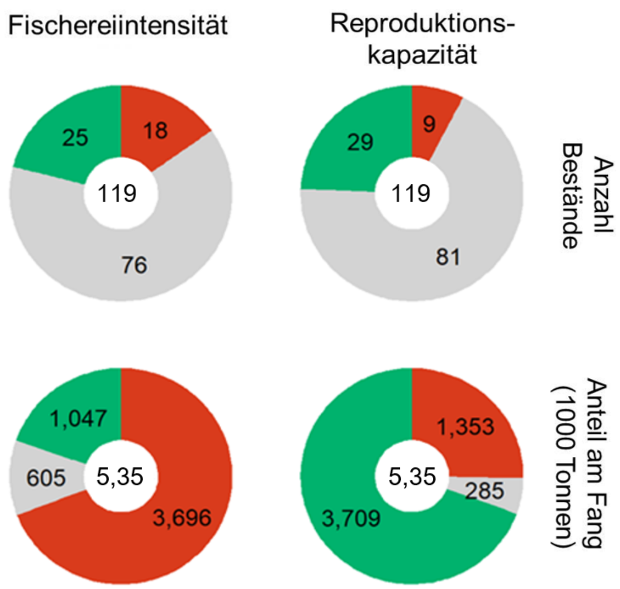

Figure 12: Fishing intensity and reproduction capacity of 119 fish stocks in the entire North Sea. Number of stocks (top) and biomass share of catch (bottom). Fishing intensity reference level: sustainable yield (FMSY; red: above FMSY, green: below FMSY, grey: not defined); reproductive capacity reference level: Spawning biomass (MSY Btrigger; red: below MSY, green: above MSY, grey: not defined). Amended in accordance with ICES (2018a).

Alongside fisheries, eutrophication is one of the greatest ecological problems for the marine environment in the North Sea (BMU 2018). Despite reduced nutrient inputs and lower nutrient concentrations, the southern North Sea is subject to a high eutrophication load in the period 2006 - 2014. Nitrates and phosphates are predominantly discharged via rivers, resulting in a pronounced gradient of nutrient concentrations from the coast to the open sea (BROCKMANN ET AL. 2017). Significant direct effects of eutrophication are increased chlorophyll-a concentrations, reduced visibility depths, local decline in seagrass areas and seagrass density with associated mass proliferation of green algae, and increased cell numbers of disruptive species of phytoplankton (in particular phaeocystis). Above all the seagrass meadows of the Wadden Sea play an important role in protecting fish spawn and offer numerous young fish, such as the common goby *Pomatoschistus microps,* a protective and feeding area between the stalks (POLTE ET AL. 2005, POLTE & ASMUS 2006). With the increasing decline of the seagrass beds due to eutrophication, there are fewer retreat areas and potentially higher predation rates. The indirect effects of nutrient enrichment, such as oxygen deficiency and a changed species composition of macrozoobenthos, may also have an impact on the fish fauna. For many species, the survival and development of fish eggs and larvae depends on oxygen concentration (DAVENPORT & LÖNNING 1987). Depending on how much oxygen is needed, lack of oxygen can lead to the death of the fish spawn and larvae. In addition, the altered species composition of benthic organisms can also affect the biodiversity of the fish community, especially that of food specialists.

Due to the fact that despite these anthropogenic factors, according to ICES, the abundance of fish species in the North Sea has not decreased for 40 years (number of species per 300 hauls; catch data from the International Bottom Trawl Survey, IBTS), and that the commercially exploited stocks are also subject to strong natural fluctuations, the existing impact on fish fauna in the German EEZ was assessed as average. This assessment is supported by the summary of fishing metrics and the ecosystem effects of bottom-disturbing fishing (WATLING & NORSE 1998, HIDDINK et al. 2006).

2.6.3.4 Significance of site N-3.5 for fish

The overriding criterion for the importance of site N-3.5 for fish is the relation to the life cycle, within which different stations are associated with stadium-specific habitat requirements through more or less extensive migrations between them.

During the current site preliminary investigation of N-3.5 catches primarily proved juvenile individuals of the character species plaice, common dab and striped red mullet. Investigations of the neighbouring areas N-3.7 and N-3.8 and the associated reference area confirm these findings.

Accordingly, site N-3.5 could aid juvenile stages as a nursery and feeding area. In addition, there are indications from investigations of the North of Borkum areas that the species scaldfish, solenette and sand goby could use the area as a spawning habitat. However, no specific spawning grounds for these species have been proven to date. Instead, the spawning areas coincide with the distribution of the adult stages (HEESSEN et al. 2015). The character species affected occur in the entire German Bight. They are feed generalists and r-strategists with extremely high reproduction outputs. There are not currently any indications of any particular significance of site N-3.5 for endangered species (see Chapter 2.6.3.1). Accordingly, the locally delineated site N-3.5 is attributed average importance as a habitat.

2.7 Marine mammals

Three species of marine mammals regularly occur in the German North Sea EEZ: Harbour porpoises (*Phocoena phocoena*), grey seals (*Halichoerus grypus*), and harbour seals (*Phoca vitulina*). All three species are characterised by high mobility. Migrations, especially in search of food, are not limited to the EEZ, but also include the territorial sea and large areas of the North Sea across borders.

The two seal species have their resting and littering places on islands and sandbanks in the area of the territorial waters. To search for food, they undertake extensive migrations in the open sea from their resting spots. Due to the high mobility of the marine mammals and the use of very extensive areas, it is necessary to consider their occurrence not only in the German EEZ, but in the entire area of the southern North Sea.

Occasionally, other marine mammals are also observed in the German North Sea EEZ, such as white-sided dolphins (*Lagenorhynchus acutus*), white-beaked dolphins (*Lagenorhynchus albirostris*), bottlenose dolphins (*Tursiops truncatus*) and minke whales (*Balaenoptera acutorostrata*), sperm whales (*Physeter macrocephalus*) and orcas (*Orcinus orca*).

Marine mammals are among the apex predators of marine food webs. As a result, they are dependent on the lower components of the marine ecosystem: On the one hand from their direct food organisms (predominantly fish and zooplankton) and on the other hand indirectly from phytoplankton. As consumers at the upper areas of marine food webs, marine mammals also influence the occurrence of food organisms.

2.7.1 Data situation

The current data situation on the incidence of marine mammals is good. The majority of the data is collected according to standardised recording methods according to the Standard for the Investigation of the Effects of Offshore Wind Turbines on the Marine Environment (StUK4, BSH 2013), subjected to systematic quality assurance and used for studies. This means the current state of knowledge on the incidence of marine mammals in German waters is classified as good. Consequently, the good data situation allows a reliable description and evaluation of incidence as well as an assessment of the status. Within this context it must be noted that when describing and evaluating the incidence of highly-mobile species, such as porpoises, data on incidence over a large area is important as well as data that provides insights into the temporal and spatial use of selected habitats.

Harbour porpoises occur all year round in the German North Sea EEZ, but their abundance and spatial distribution varies with the seasons.

The most important of these are the three so-called SCANS (Small Cetacean Abundance in the North Sea and adjacent waters) studies, which cover the entire North Sea, Skagerrak, Kattegat, Western Baltic/Beltsea, Celtic Sea, and other parts of the North East Atlantic.

The German waters currently belong to the areas of the North Sea which have been systematically and very intensively investigated for the presence of marine mammals since 2000. The bulk of the data is provided by the investigations carried out in accordance with StUK4 (BSH, 2013), as part of environmental impact studies, as well as construction and operational monitoring for offshore wind farms. Since 2009, there has been a measurement network in the German EEZ in the North Sea consisting of more than 20 stations for the acoustic recording of the habitat use of harbour porpoises in the German EEZ of the North Sea by means of so-called C-PODs, on behalf of wind farm operators. The station network provides the most comprehensive and valuable data on harbour porpoise habitat use in the areas of the German North Sea EEZ to date. In addition, the acoustic data is collected by CPODs within the scope of construction and operational monitoring for individual projects.

Since the conversion of recording methods with the StUK4 (BSH, 2013) in 2013 from observer-based recording from aircraft to digital recording using video technology or photography, large clusters have been investigated within the scope of monitoring offshore wind farms. These so-called cluster investigations cover a large part of the German EEZ, in particular also valuable harbour porpoise habitats as well as all areas with offshore wind energy use.

In addition, since 2008 regular investigations monitoring the Natura 2000 sites have been conducted on behalf of the BfN (monitoring reports on behalf of BfN 2008, 2009, 2011, 2012, 2013, 2016). Data is also collected within the framework of research projects that investigate specific issues.

The current findings relate to different spatial levels:

- Entire North Sea and adjacent bodies of water: large-scale studies carried out under SCANS I, II and III in 1994, 2005 and 2016,
- Natura 2000 sites in the German EEZ: Monitoring on behalf of the BfN since 2008 and continuously,
- Sub-areas of the German EEZ and the coastal sea: Research projects with different focal points (inter alia MINOS, MINOSplus (2002 – 2006), StUKplus (2008 – 2012), submarine cluster (on behalf of the BfN).
- Investigations into compliance with the requirements of the UVPG within the scope of licensing and planning approval procedures of the BSH and within the scope of monitoring the construction and operational phase of offshore wind farms since 2001 and continuously, as well as from the preliminary investigation. During the baseline surveys from 2001 to 2013, the majority of concrete areas with planned offshore wind farms were investigated highly precisely in temporal terms. Since 2014, these areas have been enlarged and adjusted so that there is current highly-precise temporal data for large areas of the German EEZ.

In order to identify the suitability of site N-3.5 with regard to marine mammals, for the purposes of taking into account cumulative effects and classifying the significance of the site for the relevant local population, the BSH also has more extensive current data from monitoring already built and operating offshore wind farms in the German EEZ of the North Sea. In concrete terms, data is available from the investigations of cluster 6 of the wind farm “Bard Offshore 1”, “Veja Mate”, “German Bight” of the cluster “Eastern Austerngrund” with the wind farms “Global tech 1”, “EnBWHoheSee”, “Albatros”, of the cluster “North of Borkum” with the wind farms “alpha ventus”, “Borkum Riffgrund 1”, “Borkum Riffgrund 2”, “Gode Wind 1”, “Gode Wind 2”, “Trianel Windpark Borkum Phase 1 and 2”, “Merkur Offshore”, “NordseeOne”, of the cluster “Northern Helgoland” with the wind farms “MeerwindSüdOst”, “NordseeOst”, “AmrumbankWest”, of the wind farm “Butendiek” and of the cluster “West of Sylt” with the wind farms “DanTysk” and “Sandbank”.

All data from the preliminary investigation – from data purchases or on behalf of the BSH – as well as data from monitoring wind farms that was drawn on to identify the suitability of the site, is highly-precise in temporal and spatial terms, subjected to quality assurance and comparable due to the standardised methods applied.

There are currently still gaps in knowledge in connection with researching the biological relevance of the effects of offshore wind farms on marine mammals in the German EEZ and in particular, on the key species of harbour porpoises. There is also a need for further monitoring and knowledge generation with regard to evaluating interactions as well as possible cumulative effects.

2.7.2 Spatial distribution and temporal variability

The high mobility of marine mammals depending on specific conditions of the marine environment leads to a high spatial and temporal variability of their occurrence. In addition to natural variability, climate-related changes to the marine ecosystem, as well as anthropogenic uses, are also influencing the incidence of marine mammals. Both the distribution and abundance of the animals vary over the course of the seasons. In order to be able to draw conclusions about seasonal distribution patterns and the use of areas and sites, the effects of seasonal and interannual variability, as well as the influence of anthropogenic uses, large-scale long-term studies are particularly necessary in the German EEZ.

2.7.2.1 Harbour porpoises

The harbour porpoise (*Phocoena phocoena*) is the most common and widespread whale species in the temperate waters of the North Atlantic and North Pacific as well as in some secondary seas such as the North Sea (Evans, 2020). The distribution of harbour porpoises is restricted to continental shelf seas with water depths predominantly between 20 m and 200 m because of their hunting and diving behaviour (Read 1999, Evans, 2020). The animals are extremely mobile and can cover long distances in a short time. Satellite telemetry has shown that harbour porpoises can travel up to 58 km in one day. The marked animals have behaved very individually in their migration. There were migrations of a few hours to a few days between the individually chosen places of stay* (Read & Westgate 1997).

In the North Sea, the harbour porpoise is the most widespread species of cetacean. In general, harbour porpoises occurring in German and neighbouring waters of the southern North Sea are assigned to a single population (ASCOBANS 2005, Fontaine et al., 2007, 2010).

The best overview of the occurrence of harbour porpoises throughout the North Sea is provided by the large-scale surveys of small cetaceans in northern European waters conducted in 1994, 2005 and 2016 as part of the SCANS surveys (Hammond et al. 2002, Hammond & Macleod 2006, Hammond et al. 2017). The large-scale SCANS surveys make it possible to estimate stock size and population trends in the entire area of the North Sea, which is part of the habitat of highly mobile animals, without the need for detailed mapping of marine mammals in sub-areas (seasonal, regional, small-scale). The abundance of harbour porpoises in the North Sea in 1994 was estimated at 341,366 animals based on the SCANS-I survey. In 2005, a larger area was covered by the SCANS II survey and, as a result, a larger number of 385,617 animals was estimated. However, the abundance calculated on a site of the same size as in 1994 was approximately 335,000 animals. The latest survey in 2016 showed a mean abundance of 345,373 (minimum abundance: 246,526; maximum abundance: 495,752) animals in the North Sea. As part of the statistical evaluation of the data from SCANS-III, the data from SCANS I and II was recalculated. Results from SCANS I, II, and III indicate no decreasing trend in harbour porpoise abundance between 1994, 2005, and 2016(HAMMOND et al., 2017). However, the regional distribution in 2005 and 2016 differs from the distribution in 1994 in that more animals were counted in the south-west than in the north-west in 2005 (LIFE04NAT/GB/000245, Final Report, 2006) and in 2016 high abundances were recorded throughout the English Channel. The results of the latest SCANS survey (SCANS III) can be summarised as follows: The calculated abundance of harbour porpoises in the North Sea in 2016 is 345,000 (variance coefficient CV = 0.18) individuals; this is comparable to the abundance of 355,000 in 2005 (CV = 0.22) and in 1994 with 289,000 (CV = 0.14). However, in 2016 a further shift of stocks towards the south-eastern coast of the UK and the English Channel was identified. This shift led to a decline in stocks in the German waters of the North Sea (HAMMOND et al. 2017). The statistical modelling of the results from the SCANS-III is still pending.

The abundance calculated in SCANS I, II, and III is also comparable to the statistical figure of 361,000 (CV = 0.20) from the modelling data of a study conducted from 2005 to 2013 inclusive (GILLES et al. 2016). The study by GILLES et al. (2016) provides a very good overview of the seasonal distribution patterns of harbour porpoise in the North Sea. Data from the UK, Belgium, the Netherlands, Germany and Denmark for the years 2005 to 2013 inclusive was considered together in the study. Data from large-scale and transboundary visual surveys, such as those collected in the SCANS-II and Doggerbank projects, as well as extensive data from smaller-scale national surveys (monitoring, EIS), was validated, and seasonal and habitat distribution patterns were predicted (GILLES et al. 2016). The results of the habitat modelling were verified and confirmed in the course of the study using data from acoustic surveys. This study is one of the first to take into account dynamic hydrographic variables such as surface temperature, salinity and chlorophyll as well as food availability, especially of sand eels. Food availability was modelled by the distance of the animals to known sand eel habitats in the North Sea. Habitat modelling showed significantly high densities in the area west of Dogger Bank, especially in spring and summer. The study concludes that the distribution patterns of harbour porpoise in the North Sea indicate the high spatial and temporal variability of hydrographic conditions, the formation of fronts, and the associated food availability.

Within the framework of the large-scale survey of 2016, SCANS III showed a further shift of the stock from the south-eastern area of the North Sea more towards the south-western area in the direction of the English Channel (Hammond et al., 2017). An initial analysis of research data and data from the national monitoring of nature conservation areas also suggests a shift in the population; the authors considered several factors as possible reasons for the observed change (NACHTSHEIM ET AL., 2021, GILLES ET AL., 2019).

2.7.2.2 Occurrence of the harbour porpoise in the German North Sea

Site N-3.5 of the area N-3 (SDP, 2019, 2020) is in the south of the German EEZ and is part of the habitat of the harbour porpoise in the North Sea. Especially in the summer months, the area of the coastal sea and the German EEZ off the North Frisian Islands, especially north of Amrum and near the Danish border, are intensively used by harbour porpoises (SIEBERT et al. 2006). In addition, the presence of calves is always confirmed there during the summer months.

The large-scale investigations into the distribution and abundance of harbour porpoises and other marine mammals carried out in the framework of the MINOS and MINOSplus projects from 2002 to 2006 (SCHEIDAT et al. 2004, GILLES et al. 2006) have provided an initial overview for the German waters of the North Sea. Based on the results of the MINOS surveys (SCHEIDAT et al. 2004), the abundance of harbour porpoises in German North Sea waters was estimated at 34,381 individuals in 2002 and 39,115 individuals in 2003. In addition to the pronounced temporal variability, a strong spatial variability was also observed. The seasonal analysis of the data has shown that temporarily (e.g. in May/June 2006), up to 51,551 animals may have been present in the German EEZ of the North Sea (GILLES et al. 2006). Since 2008, the abundance of harbour porpoises has been determined as part of the monitoring of Natura 2000 sites. Although abundance varies from year to year, it remains at high levels, especially in the summer and spring months. In May 2012, the highest abundance recorded to date in the German North Sea was 68,739 animals (GILLES et al. 2012).

A current evaluation of the data from the monitoring of the Natura 2000 areas and from research projects has confirmed the indication from the SCANS-III study and has shown that the stock of harbour porpoises in the German EEZ of the North Sea has changed over the past few years. These changes to the stock have been more pronounced in the nature conservation area "Sylter Außenriff – Östliche Deutsche Bucht" than in the south of the German EEZ (NACHTSHEIM et al., 2021, GILLES et al., 2019).

2.7.2.3 Occurrence in nature conservation areas

On the basis of the results of the MINOS and EMSON investigations (recording of marine mammals and seabirds in the German North Sea and Baltic Sea EEZs) three areas in the German EEZ were defined that are particularly important to harbour porpoises. These were notified to the EU as offshore protected areas in accordance with the Habitats Directive and recognised by the EU as Sites of Community Importance (SCI) in November 2007: Dogger Bank (DE 1003-301), Borkum Riffgrund (DE 2104-301), and especially the Sylter Außenriff (DE 1209-301). Since 2017, the three FFH areas in the German EEZ of the North Sea have been given the status of nature conservation areas:

- Ordinance on the Establishment of the Nature Conservation Area "Borkum Riffgrund" (NSGBRgV), Federal Law Gazette I, I p. 3395 dated 22 September 2017,
- Ordinance on the Establishment of the "Doggerbank" Nature Conservation Area (NSGDgbV), Federal Law Gazette I, I p. 3400 dated 22 September 2017,
- Ordinance on the Establishment of the Nature Conservation Area "Sylter Außenriff – Östliche Deutsche Bucht" (NSGSylV), Federal Law Gazette I, I p. 3423 dated 22 September 2017.

The "Sylter Außenriff – Östliche Deutsche Bucht" nature conservation area is the main distribution area for harbour porpoises in the EEZ. The highest densities are often found here in the summer months. The nature conservation area "Sylter Außenriff – Östliche Deutsche Bucht" has the function of a nursery area*. In the period from 1 May and until the end of August, large numbers of calves are recorded in the conservation area "Sylter Außenriff – Östliche Deutsche Bucht".

The "Borkum Riffgrund" nature conservation area is of great importance for harbour porpoises in spring and partially in the early summer months.

Results from the monitoring of Natura2000 areas as well as from the monitoring of offshore wind farms have shown a high occurrence of harbour porpoise in protected areas until 2013, especially in the area of the Sylter Außenfiff (GILLES ET AL., 2013). However, current findings from the monitoring of Natura2000 areas show a change in populations in the German EEZ, which also particularly affects the nature conservation area "Sylter Außenriff – Östliche Deutsche Bucht" (NACHTSHEIM ET AL., 2021, GILLES ET AL. 2019).

The BMU has highlighted the importance of the nature conservation area "Sylter Außenriff –

Östliche Deutsche Bucht” in a noise prevention concept for the harbour porpoise on the basis of these findings and has defined a main concentration area of the harbour porpoise in the summer months (BMU 2013).

2.7.2.4 Incidence in site N-3.5

Information with regard to the incidence of marine mammals in area N-3, in which the relevant site N-3.5 can be found, is provided for the period 2008 to 2012 inclusive in the investigations made within the scope of the third investigation year, the construction and operations monitoring for the test field “alpha ventus” as well as the accompanying ecological research within the scope of the project “StUKplus”. For this purpose, extensive aircraft and ship-supported surveys of marine mammals according to the StUK were carried out in the entire area of the German EEZ between the traffic separation areas TGB and GBWA, in which the project site N-3.5 is also located. In parallel to the visual surveys, acoustic surveys of harbour porpoises using underwater acoustic detectors also took place during the investigations (ROSE et al. 2014, GILLES et al. 2014). These investigations covered all three areas N-1, N-2 and N-3. The highest densities were always found to the west of areas N-2 and N-3 in the "Borkum Riffgrund" nature conservation area. The highest density, at 2.58 Ind./km^2, within the scope of the investigations specified was identified in summer 2010.

Since 2013 and continuously, large-scale so-called cluster investigations as per StUK4 have been carried out north of the East Frisian islands. The entire N-1, N-2 and N-3 areas, including site N-3.5, are included in the large area under review of the cluster North of Borkum, in which nine wind farms were built between 2009 and 2019 and six of which are already in regular operation. This provides up-to-date data on the occurrence of marine mammals and on possible impacts from the construction and operation phases of the wind farms already implemented in the entire area North of Borkum.

The most recent data on the incidence of marine mammals in site N-3.5 and the surrounding area was collected in 2019 (IFAÖ et al., 2020c). During the eight video-supported surveys carried out during the period from 29 January 2019 to 30 October 2019 a transect route of 9,996 km in total was flown. This corresponds to a site investigated of 5,297 km² in total. The digital video-supported recording technology thus allows an average site coverage of 17.4% of the area investigated. In the year of the investigation, 2019, 692 marine mammals in total were recorded during the eight video-supported investigations. In the process, 481 harbour porpoises, 188 seals (4 grey seals, 71 harbour seals, 113 undefined seals), 1 undefined whale and 22 other marine mammals that could not be clearly allocated to either of the categories small cetacean or seal were identified. Harbour porpoises were recorded during all eight flights, where the number of animals recorded varied between the individual flights between a minimum of 6 individuals (July) and a maximum of 180 individuals (October). The highest density was identified in October at 0.59 Ind./km². The lowest density was identified in June with only 0.02 Ind./km². In the other months the density fluctuated between 0.06 and 0.21 Ind./km². During the eight flights, 26 harbour porpoise calves in total were sighted, of which 19 calves were sighted between mid-May and mid-September. At 17 individuals, the most calves were sighted on 15 August 2019. In spring, summer and autumn 2019, there was also a high incidence of harbour porpoises in the west of the investigation area and in particular in the nature conservation area “Borkum Riffgrund” and its vicinity. The east of the investigation area also had some higher densities (IFAÖ et al., 2020c).

The acoustic recording by means of CPODs from eight long-term measurement stations and other individual CPOD measurements demonstrated that harbour porpoises were present every day in the area of the cluster ‘North of

Borkum" in 2019. All eight POD stations demonstrated an almost continuous daily presence of 98.8% to 100% of detection-positive days/DPD (total average 99.5% DPD) during the entire recording period. The acoustic recording also confirmed higher presence rates in the nature conservation area "Borkum Riffgrund" (IFAÖ et al., 2020c).

The results from all investigations for the cluster "North of Borkum" or areas N-1, N-2 and N-3, show that harbour porpoises occur in varying numbers all year round in this area of the German EEZ. The highest densities were always recorded in spring and in the first months of summer. The highest density of harbour porpoises was also identified in the summer months at 2.9 Ind./ km^2 until 2013. The area North of Borkum, and thus also site N-3.5, were traversed by mother-calf pairs in the summer months.

The results of the cluster studies "North of Borkum" have shown a change in the occurrence of harbour porpoises since 2014, with a tendency towards lower densities (IFAÖ et al., 2017a, IFAÖ et al., 2018a, IFAÖ et al., 2019a, IFAÖ et al., 2020c). The results of the cluster studies north of the traffic separation areas, north of Helgoland and north of Amrumbank also indicate a trend towards lower harbour porpoise densities since 2013. The results of the cluster studies "North of Borkum" thus fit into the overall picture of changes in the occurrence of harbour porpoises in the German North Sea EEZ and in the southern North Sea. Compared to the occurrence of harbour porpoises in other areas of the German North Sea EEZ, however, the changes are smallest in the area north of Borkum. The entire area north of Borkum with the "Borkum Riffgrund" nature conservation area and the three areas for offshore wind energy utilisation N-1, N-2 and N-3 also show a high and stable occurrence of harbour porpoises in the years 2013 to 2019.

The data from the acoustic survey of harbour porpoises in the "North of Borkum" cluster studies also show continuous use of the area by harbour porpoises, which is also more intensive in spring and summer. The results from visual and acoustic surveys of the cluster studies also confirm a higher abundance and use by harbour porpoises in the western part of the study area, in particular the FFH area "Borkum Riffgrund". The abundance of harbour porpoises and habitat use decreases in the area North of Borkum towards the east, with occasional high densities being found in various sub-areas. Distribution patterns appear to be related to food availability (IFAÖ et al., 2017a, IFAÖ et al., 2018a, IFAÖ et al., 2019a, IFAÖ et al., 2020c, GILLES et al., 2019).

Within the framework of the large-scale survey of 2016, SCANS III showed a further shift of the stock from the south-eastern area of the North Sea more towards the south-western area in the direction of the English Channel (HAMMOND et al., 2017). An initial analysis of research data and data from the national monitoring of nature conservation areas also suggests a shift in the population; the authors considered several factors as possible reasons for the observed change (NACHTSHEIM ET AL., 2021, GILLES ET AL., 2019).

2.7.2.5 Harbour seals and grey seals

The harbour seal is the most widespread seal species in the North Atlantic and is found along the coastal regions throughout the North Sea. Throughout the Wadden Sea, regular aerial surveys are carried out at the height of moulting in August. In 2005, 14,275 seals were counted throughout the Wadden Sea (ABT et al. 2005). As some animals are in the water and not also counted, this is the minimum population.

Suitable undisturbed resting places are crucial for the occurrence of seals. In the German North Sea, sandbanks in particular are used for this purpose(SCHWARZ & HEIDEMANN, 1994). Telemetric studies show that adult harbour seals in particular rarely move more than 50 km from their original resting sites (TOLLIT et al. 1998). On foraging trips*, the action radius is usually about 50 to 70 km from the resting places to the hunting grounds (z. B. THOMPSON & MILLER 1990), although in the Wadden Sea area, it can be as much as 100 km (ORTHMANN 2000).

Censuses of grey seals at the time of moulting have so far only been carried out occasionally in the German North Sea. In 2005, 303 grey seals were counted in Schleswig-Holstein at the time of moulting. For Lower Saxony, 100 animals are estimated (AK SEEHUNDE 2005). These figures are only a snapshot.

Strong seasonal fluctuations are reported (ABT et al. 2002, ABT 2004). The numbers observed in German waters must be seen in a broader geographical context because grey seals can sometimes undertake very long migrations between different resting sites throughout the North Sea region (MCCONNELL et al. 1999). The grey seals observed in the resting places in coastal waters probably have their feeding grounds at least partly in the EEZ.

The cluster investigations "North of Borkum" have shown that grey seals and harbour seals use the entire area irregularly and in small numbers. A comparison of the monthly densities from 2018 with those of the previous years (2014-2017) shows that the densities in individual months can fluctuate greatly from year to year (IFAÖ et al., 2019a).

Site N-3.5 is also used by seals irregularly and in small numbers.

2.7.3 Status assessment of the protected asset - marine mammals

The good data situation that has developed since 2002 up to today has allowed a good assessment to be made of the significance and status of the vicinity of site N-3.5 as a habitat for marine mammals.

2.7.3.1 Conservation status

Harbour porpoises are protected under several international conservation agreements. They come under the conservation mandate of the European Habitats Directive (Directive 92/43/EEC) on the conservation of natural habitats and of wild fauna and flora, according to which special areas are designated to conserve the species. The harbour porpoise is listed in both Appendix II and Appendix IV of the Habitats Directive. As a species listed in Appendix IV, it enjoys strict general protection under Articles 12 and 16 of the Habitats Directive.

The porpoise is also listed in Appendix II to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention, CMS). The Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS) was also adopted under the auspices of CMS. In addition, the Convention on the Conservation of European Wildlife and Natural Habitats (BERN Convention), which lists the harbour porpoise in Appendix II, should also be mentioned.

In Germany, the harbour porpoise is included in the Red List of Threatened Species (MEINIG et al., 2020). It is classified in threat category 2 here (endangered). The authors point out that the threat classification for Germany results from the joint consideration of threats in the North Sea and the Baltic Sea. The occurrence in the North Sea is surveyed by ship- and aircraft-supported investigations and is described as stable. In the Borkum-Riffgrund nature conservation area, there has been a slight increase in abundance (PESCHKO et al. 2016, cited in MEINING et al., 2020). However, because of an ongoing threat from by-catch in gillnets, environmental toxins, and noise, the authors have come to the conclusion that the status should be classified as "Endangered" despite the overall stable short-term population trend (MEINIG et al., 2020). Investigations in the Danish Baltic Sea and adjacent areas also indicate stable population sizes of around

30,000 individuals (Sveegaard et al. 2013, Viquerat et al. 2014 cited in Meinig et al., 2020). In contrast, the results from the EU research project SAMBAH have shown that the stock of the separate sub-population of harbour porpoises in the central Baltic Sea is only approximately 500 animals (SAMBAH 2016). For this reason, this sub-population is classified as “critically endangered”.

Grey seals and harbour seals are also listed in Appendix II of the Habitats Directive.

In the current Red List of Mammals of Germany, the grey seal has been reclassified from endangerment category 2 (critically endangered) to category 3 (endangered) (Meinig et al., 2020).

The harbour seal is classified in category G (indeterminate). The authors confirm that there are two separate populations in the German North Sea and Baltic Sea. The German North Sea population has seen an increase in juveniles since 2013 and after the two distemper virus epidemics, and would be classified as "not endangered" on its own, unlike the German Baltic Sea population (Meinig et al., 2020).

Based on the results of the research projects MINOS and EMSON, three areas that are of particular importance for harbour porpoises were defined in the German EEZ. These were notified to the EU as offshore protected areas in accordance with the Habitats Directive and recognised by the EU as Sites of Community Importance (SCI) in November 2007: Doggerbank (DE 1003-301), Borkum Riffgrund (DE 2104-301), and especially Sylter Außenriff (DE 1209-301). Since 2017, the three FFH areas in the German EEZ of the North Sea have been given the status of nature conservation areas:

- Ordinance on the Establishment of the Nature Conservation Area “Borkum Riffgrund” (NSGBRgV), Federal Law Gazette I, I p. 3395 dated 22 September 2017,
- Ordinance on the Establishment of the “Doggerbank” Nature Conservation Area (NSGDgbV), Federal Law Gazette I, I p. 3400 dated 22 September 2017,
- Ordinance on the Establishment of the Nature Conservation Area “Sylter Außenriff – Östliche Deutsche Bucht” (NSGSylV), Federal Law Gazette I, I p. 3423 dated 22 September 2017.

The conservation objectives of the nature conservation areas in the German EEZ of the North Sea include the maintenance and restoration of a favourable conservation status of the species from Appendix II of the Habitats Directive, in particular the harbour porpoise, grey seal, and seal as well as the conservation of their habitats (NSGBRgV, 2017. Federal Law Gazette, Part I, No. 63, 3395)

2.7.3.2 Assessment of the population

The harbour porpoise is the key species in the German waters of the North Sea that is used in the BMU's noise abatement concept (2013) to assess the potential impacts of impulsive noise inputs. Furthermore, within the framework of the implementation of the MSFD, the harbour porpoise is the indicator species for assessing cumulative impacts of uses and, finally, for assessing good environmental status in the OSPAR area.

The population of harbour porpoises in the North Sea has decreased over the last few centuries. The general situation of the harbour porpoise had already deteriorated in earlier times. In the North Sea, the population has declined mainly due to by-catch, pollution, noise, over-fishing and food restrictions (ASCOBANS 2005, Evans 2020). However, there is a lack of concrete data to calculate or forecast trends. The best overview of the distribution of harbour porpoises in the North Sea is provided by the compilation from the “Atlas of the Cetacean Distribution in North-West European Waters”(Reid et al. 2003).

However, when making abundance or population calculations based on aerial surveys or even field trips, the authors caution that the occasional sighting of a large aggregation (group) of animals within an area recorded in a short period of time can lead to the assumption of unrealistically high relative densities (REID et al. 2003). The recognition of distribution patterns or the calculation of populations is made more difficult in particular by the high mobility of the animals.

The population of harbour porpoises throughout the North Sea has not changed significantly since 1994, or no significant differences were found between data from SCANS I, II, and III (HAMMOND & MACLEOD 2006, HAMMOND et al. 2017, Evans, 2020).

The statistical evaluation of data from the large-scale surveys carried out as part of research projects and, since 2008, as part of the monitoring of Natura 2000 sites on behalf of the Federal Agency for Nature Conservation (BfN) indicates a significant increase in harbour porpoise densities in the southern German North Sea between 2002 and 2012. In the area of Sylter Außenriff, the trend analysis also indicates stable populations in summer over the years 2002 to 2012 (GILLES et al. 2013). The western area in particular shows a positive trend for spring and summer, while no clear trend can be detected in autumn. Harbour porpoise densities in the eastern area have remained largely constant over the years and significant differences between the hotspots in the west and lower density in the south-eastern German Bight have been found.

Current findings from the large-scale cluster studies of offshore wind farms do not provide any indication of a decreasing trend in the abundance of the harbour porpoise or of changes in seasonal distribution patterns in the German North Sea EEZ from 2001 to the present. The multi-annual data from the CPOD station network confirms a continuous use of the habitats by harbour porpoises (ROSE et al. 2019).

In general, there is still a north-south density gradient of harbour porpoise occurrence from the North Frisian to the East Frisian area.

A current assessment of the stock trend in German waters in the North Sea based on data from monitoring nature conservation areas and research projects for the years 2012 to 2018 has shown a stock shift. Declining trends were observed in the "Sylter Außenriff –Östliche Deutsche Bucht" and "Dogger Bank" nature conservation areas as well as in the central area of the German Bight. A positive trend has developed in the conservation area “Borkum Riffgrund” and towards areas N-1, N-2 and N-3. The causes of the stock shift are not yet known and could be related to both the impacts of human activities and shifts in the fish stocks (NACHTSHEIM ET AL., 2021, GILLES ET AL., 2019).

2.7.3.3 Significance of site N-3.5 for marine mammals

According to the current state of knowledge, it can be assumed that the German EEZ is used by harbour porpoises for traversing, staying and also as a food and area-specific breeding ground. Based on the knowledge available, it can be concluded that the EEZ is of medium to high importance for harbour porpoises in certain areas. Habitat use varies in different areas of the EEZ. Marine mammals and, of course, harbour porpoises are highly mobile species that use large areas variably in search of food, depending on hydrographic conditions and food supply. It is therefore not very useful to consider the importance of individual sites such as the sites covered by the plan or individual wind farm sites. In the following, the importance of areas that belong to a natural area unit and that were additionally covered by intensive project-related studies will be assessed separately.

According to current knowledge, site N-3.5 is of medium to - seasonal in spring - high importance for harbour porpoises. The investigations carried out as part of the monitoring of the Natura 2000 sites and as part of the cluster investigations “North of Borkum” always confirm a significantly higher occurrence in the "Borkum Riffgrund" conservation area with decreasing densities in an easterly direction, which is also where site N-3.5 is located.

- Site N-3.5 is used by harbour porpoises all year round for crossing and staying and probably for feeding.
- However, the use of the site by harbour porpoises is significantly higher in spring.
- The use of the sites by harbour porpoises in summer is mostly average compared to the use of the waters west of Sylt.
- The sightings of calves in area N-3 are rather sporadic and irregular and therefore most likely exclude the use of the area as a rearing area.
- There is no evidence of a continuous specific function of area N-3 and thus also for site N-3.5 for harbour porpoises.

Area N-3 and site N-3.5 have a low to (in the south) medium significance for grey seals and harbour seals.

2.7.3.4 Existing impacts

Existing impacts on the North Sea harbour porpoise population include a variety of anthropogenic activities, changes in the marine ecosystem, diseases and climate change.

Existing impacts on marine mammals result from fishing, attacks by dolphin-like creatures, physiological effects on reproduction, diseases possibly related to high levels of pollution and underwater noise. The main endangerment for harbour porpoise stocks in the North Sea results from fishing, through by-catch in bottom trawls and bottom-set gillnets, depletion of prey fish stocks through over-fishing and the resulting reduction in food availability (Evans, 2020). An analysis of dead and stranded fish from the British Isles between 1991 and 2010 has identified the causes as follows: 23% infectious diseases, 19% attacks by dolphins, 17% by-catch, 15% starvation and 4% were stranded alive (EVANS, 2020).

Current anthropogenic uses in the areas' vicinity with noise pollution include shipping, seismic exploration, military use and the detonation of non-transportable ammunition. The endangerment of marine mammals can be caused during the construction of wind turbines and converter platforms with deep foundations, in particular by noise emissions during the installation of the foundations by means of pile driving, if no mitigation or preventive measures are taken.

In addition to impacts caused by the discharge of organic and inorganic pollutants or oil spills, the stock is also endangered by diseases (of bacterial or viral origin) and climate change (especially impacts on the marine food web).

Current anthropogenic uses in the vicinity if site N-3.5 with high noise pollution include shipping, seismic exploration, military use and the detonation of non-transportable ammunition. The endangerment of marine mammals can be caused during the construction of wind farms and converter platforms with deep foundations, in particular by noise emissions during the installation of the foundations, if no mitigating or preventive measures are taken.

2.8 Seabirds and resting birds

According to the “Quality standards for the use of ornithological data in spatially-relevant planning” (DEUTSCHE ORNITHOLOGEN-GESELLSCHAFT 1995), resting birds are “birds that stay in an area outside the breeding territory, usually for a longer period of time (e.g. for moulting, feeding, resting, wintering)”. Feeding birds are defined as birds "which regularly seek food in the investigated area, do not breed there, but breed or might breed in the wider region".

Seabirds are species of birds that are mainly bound to the sea with their way of life and only come ashore for breeding for a short time. These include, for example, fulmars, gannets and auks (guillemots, razorbills). Terns and gulls, on the other hand, usually have a distribution closer to the coast than seabirds.

2.8.1 Data situation

The BSH has a comprehensive data basis for the suitability examination of site N-3.5 with regard to the protected asset “Seabirds and resting birds”. This largely consists of the results and findings from mandatory operator monitoring during the construction and operations phase of an offshore wind farm as per the standard investigation concept (StUK 4). Within the scope of the monitoring, since 2013 the seabirds and resting birds incidence for the areas N-1, N-2 and N-3 has been subject to large-scale investigations by means of ship and aircraft-supported (digital) surveys for the investigation cluster “North of Borkum” (UMBO). The findings from the monitoring are thus suitable for describing and evaluating the seabirds and resting birds in the vicinity of site N-3.5 (IFAÖ et al. 2015a, IFAÖ et al. 2015b, IFAÖ et al. 2016, IFAÖ et al. 2017, IFAÖ et al. 2018, IFAÖ et al. 2019, IFAÖ et al. 2020).

Furthermore, within the scope of the StUKplus research project “TESTBIRD” additional surveys were made of the test field “alpha ventus” and a large-scale reference area between 2009 and 2013, which focussed on possible behaviour reactions of seabirds towards wind turbines (MENDEL et al. 2015).
Important information on large-scale seabird volumes in the German EEZ of the North Sea is provided by the investigations of the NATURA2000 areas carried out in the past few years on behalf of the German Federal Agency for Nature Conservation (e.g. MARKONES et al. 2015). In addition, reference is made to extensive specialist scientific literature and evaluations of different specific questions.

Data availability can therefore be regarded as very good overall. Nevertheless, the following points must be taken into account:

- The species-specific risk of seabirds colliding with offshore wind turbines can only be partially predicted and is currently being recorded with the investigations according to StUK4 in the operating phase, but also in ongoing research projects.
- Behavioural changes and habituation effects among disturbance-sensitive species in the German EEZ have only been investigated since the commissioning of the first large, commercial wind farms, including the converter platforms. Operational monitoring is still ongoing.
- There is still insufficient knowledge of the effects of disturbances or habitat loss at species population level, and these will only be investigated on the basis of the data currently being collected.

2.8.2 Spatial distribution, temporal variability and abundance of seabirds and resting birds in the German North Sea

Seabirds are highly mobile and therefore able to cross large areas during their search for food or to track species-specific prey organisms such as fish over long distances. This high mobility - depending on the specific conditions of the marine environment - leads to a high degree of spatial and temporal variability in the occurrence of seabirds. The distribution and abundance of birds vary over the course of the seasons.

The distribution of seabirds in the German Bight is determined in particular by the distance from the coast or breeding grounds, hydrographic conditions, water depth, the composition of the bottom and the food supply. In addition, the occurrence of seabirds is influenced by strong natural events (e.g. storms) and anthropogenic factors such as nutrient and pollutant inputs, shipping and fisheries. Seabirds, as consumers at the top of the food web, feed on species-specific fish, macrozooplankton and benthic organisms.

They are thus directly dependent on the occurrence and quality of benthos, zooplankton and fish.

Some areas of the German territorial waters and parts of the EEZ of the North Sea are of great importance for seabirds and waterbirds (not only nationally but also internationally as a number of studies have shown) and were identified as areas of special importance for seabirds, "Important Bird Areas - IBA" early on(Skov et al. 1995, Heath & Evans 2000). Particular mention should be made here of sub-area II of the "Sylter Außenriff – Östliche Deutsche Bucht" nature conservation area established by an ordinance of 22 September 2017, which was already designated as a Special Protected Area (SPA) by an ordinance of 15 September 2005: Special Protected Area (SPA)) in accordance with V-RL (79/409/EEC).

With regard to the group of loons, a main concentration area was identified in spring in the German Bight, west of Sylt, as part of a comprehensive evaluation and assessment of existing data sets. The delimitation of the main concentration area was chosen to include all important and known regular occurrences (BMU 2009).

There are 19 species of seabirds in the German North Sea EEZ, which are regularly recorded as resting birds in larger populations. The following table 8 contains population estimates for the most important seabird species in the EEZ and the entire German North Sea in the seasons with the highest occurrence. Detailed descriptions of the seasonal and spatial occurrences of the most common seabird and resting bird species, as well as particularly important species for the nature conservation area "Sylter Außenriff – Östliche Deutsche Bucht" in the North Sea EEZ, can be taken from the corresponding chapters of the environmental report on the site development plan 2020 for the German North Sea (BSH 2020a).

Table 8: Populations of the most important resting bird species in the German North Sea and EEZ in the seasons with the highest occurrence according to Mendel et al. (2008). Spring populations of red-throated divers according to Schwemmer et al. (2019); spring populations of black-throated divers according to Garthe et al. (2015).

Common name (*scientific Name*)	**Season**	**Stock German North Sea**	**Stock German EEZ**
Red-throated diver (*Gavia stella*)	Winter	3,600	1,900
	Spring	22,000	16,500
Black-throated diver (*Gavia arctica*)	Winter	300	170
	Spring	1,600	1,200
Northern gannet (*Morus bassanus*)	Summer	1,400	1,200
Great black-backed gull (*Larus marinus*)	Winter	15,500	9,000
	Autumn	16,500	9,500
Lesser black-backed gull (*Larus fuscus*)	Summer	76,000	29,000
	Autumn	33,000	14,500
Common gull (*Larus canus*)	Winter	50,000	10,000

Little gull (*Hydrocoloeus minutus*)	Winter	1,100	450
Kittiwake (*Rissa tridactyla)*	Winter	14,000	11,000
	Summer	20,000	8,500
Sandwich tern (*Thalasseus sandvicensis*)	Summer	21,000	130
	Autumn	3,500	110
Common tern (*Sterna hirundo*)	Summer	19,500	0
	Autumn	5,800	800
Arctic tern (*Sterna paradisaea*)	Summer	15,500	210
	Autumn	3,100	1,700
Razorbill (*Alca torda*)	Winter	7,500	4,500
	Spring	850	800
Guillemot (*Uria aalge*)	Winter	33,000	27,000
	Spring	18,500	15,500

2.8.3 Occurrence of seabirds and resting birds in the vicinity of site N-3.5

The extensive investigations of seabirds within the scope of the environmental impact studies and during the construction and operations phases of offshore wind farms in the investigation cluster “North of Borkum” consistently show for site N-3.5 that a seabird community can be found here that would be expected for the predominant water depths and hydrographic conditions, the distance from the coast and for the specific local influences.

The seabird incidence is dominated by seagulls, which occur all-year round in the vicinity of site N-3.5. The most common species in the past investigation years have included the lesser black-backed gull (*Larus fuscus*) and black-legged kittiwake (*Rissa tridactyla*).

<u>Lesser black-backed gulls</u> occur in large scale in the vicinity of site N-3.5, and the volume of their occurrence differs seasonally. In the investigation years 2013 – 2019 the highest densities were identified in the summer months, when the species can be found extensively in the investigation areas of the cluster “North of Borkum”. The maximum density identified to date was 5.95 Ind./km^2 in July 2017 according to ship transverse investigations and 3.86 Ind./km^2 in July 2016 according to aircraft transverse investigations. The spatial distribution of the lesser black-backed gull, which prominently follows ships, is frequently influenced by fishing activity and consequently does not demonstrate any specific distribution pattern. In the past few years the focus of distribution was consequently variable throughout the investigation areas and thus occasionally also in close proximity to site N-3.5. Lesser black-backed gulls are also regularly sighted in wind farms (BioConsult SH et al. 2015, IfAÖ et al. 2018, IfAÖ et al. 2019, IfAÖ et al. 2020).

Black-legged kittiwakes are the second most-common species of gull according to both investigation methods in the investigation areas of the cluster “North of Borkum”. In the investigation years 2013 – 2019, in addition to increased densities in the winter months the highest densities were identified in spring. According to ship investigations the highest densities to date were identified in March 2019 at 1.23 Ind./km^2, and according to digital flight transverse investigations in April 2016 at 1.38 Ind./km^2 (IfAÖ et al. 2020). The spatial incidence extends incompletely across the entire investigation area of the cluster “North of Borkum”. In the past few years, however, there has been a tendency towards higher incidences in the west of the investigation area and thus not in direct proximity to site N-3.5 (IFAÖ et al. 2018, IFAÖ et al. 2019 IFAÖ et al. 2020).

Common gulls (*Larus canus*), European herring gulls (*Larus argentatus*) and great black-backed gulls (*Larus marinus*) occur all year round, however, only rarely in the investigation areas of the cluster “North of Borkum”. The highest monthly densities for all three species were identified in the winter months. The maximum density of the common gull was unusually high at 2.06 Ind./km^2 according to a ship transverse investigation in December 2018. In the previous investigation years maximum monthly densities of 0.42 Ind./km^2 were identified. The highest densities for all three species were, according to flight transverse investigations in November 2014, 1.44 Ind./km^2 for common gulls, 1.26 Ind./km^2 for European herring gulls and 0.17 Ind./km^2 for great black-backed gulls (IFAÖ et al. 2019). The spatial distribution for all three species in the investigation areas of the cluster “North of Borkum” showed no focal points in the investigations to date (IFAÖ et al. 2018, IFAÖ et al. 2019, IFAÖ et al. 2020). Accordingly, no preference for the direct proximity of site N-3.5 can be recognised.

Little gulls (*Hydrocoloeus minutus*) can mainly be encountered in the German Bight as migrants during their home migration to their breeding grounds in eastern Europe from the end of March, as well as during their outward migration to their wintering areas in western Europe from the end of September (MENDEL et al. 2008). Accordingly, the highest monthly densities in the past investigation years were also identified in the spring months, mainly in April. The highest monthly densities identified to date was 1.20 Ind./km^2 in April 2017 according to ship transverse investigations and 1.92 Ind./km2 according to digital aircraft investigations (IFAÖ et al. 2020). The spatial distribution in the investigation area has not identified any focal point of incidence to date.

Loons can be encountered in the German Bight from autumn to spring. They are mostly completely absent in summer. Due to the similarity of red-throated divers (*Gavia stellata*) and black-throated divers (*Gavia arctica)* both these species are frequently summarised as loons in further considerations. However, from the proportion of the individuals identified from actual up to species level, a dominant frequency of the red-throated diver can be recognised, which often makes up more than 90% in comparison with the black-throated diver (MENDEL et al. 2008). In the previous investigations of the cluster “North of Borkum” (2013 – 2019) the highest average seasonal densities of 0.17 – 0.36 Ind./km^2 both in ship and aircraft transverse investigations occurred in spring (IFAÖ et al. 2020).

In all previous investigation years, the highest monthly densities according to aircraft and ship transverse investigations on the cluster “North of Borkum” were identified in April and were mostly at 0.20 – 0.44 Ind./km^2 (IFAÖ et al. 2020). The aircraft transverse investigations in February 2017 were an exception with a highest monthly density of 0.36 Ind./km^2. It should be noted here that the large-scale digital aircraft investigation area also covers the area close to the coast within the 12-nautical mile zone, thus recording incidences of loons developing near the coast in winter (IFAÖ et al. 2018). No clear focal points of distribution were recognised in the past investigations. However, particularly in the species-specific spring in some years there is a tendency towards the west of the "North of Borkum" investigation area as well as to the south near the coast. According to the investigations of the cluster "North of Borkum", the vicinity of site N-3.5 does not seem to have any particular significance for loons (IFAÖ et al. 2015a, IFAÖ et al. 2015b, IFAÖ et al. 2018, IFAÖ et al. 2019, IFAÖ et al. 2020).

Terns primarily occur in the vicinity of site N-3.5 during their migration home in spring. In summer, their occurrences concentrate in coastal areas near their breeding colonies in the Wadden Sea. While terns can be observed rarely in the offshore area on their outward migration, they are mostly not encountered at all during winter in the entire German North Sea (MENDEL et al. 2008). The highest monthly densities, and thus also the highest average seasonal densities of the sandwich tern (*Thalasseus sandvicensis*) in previous investigations were always identified in spring during the home migration periods to the breeding grounds. In past investigation years the highest monthly density was 0.70 Ind./km^2 according to ship transverse investigations in April 2017. According to aircraft transverse recording, the highest monthly density identified to date was in May 2018 at 0.73 Ind./km^2. (IFAÖ et al. 2020). In some years higher densities were identified in the proximity of site N-3.5, which, however, were not observed in all years (IFAÖ et al. 2018, IFAÖ et al. 2019, IFAÖ et al. 2020).

The previous highest monthly densities for the common tern and Arctic tern (*Sterna hirundo, Sterna paradisaea*), which are frequently difficult to differentiate and thus often recorded together, were 0.59 Ind./km^2 in May 2019 (ship transverse investigation) and 0.97 Ind./km^2 in April 2014 (aircraft transverse investigation). No clear distribution focal points could be identified in surveys made to date (IFAÖ et al. 2015a, IFAÖ et al. 2015b, IFAÖ et al. 2018, IFAÖ et al. 2019, IFAÖ et al. 2020).

According to previous surveys of seabirds and resting birds in the investigation cluster "North of Borkum", the species groups of auks is the second most-common group of seabirds. The common guillemot (*Uria aalge*) and razorbill *Alca torda*) are particularly apparent. Due to the relative similarity of both of the species detailed above from increasing distance, as well as their heavily overlapping habitat requirements and feeding areas, an often relatively large proportion of auks is not determined at species level. Consequently, data evaluations are frequently carried out for both species together. However, based on the individuals actually determined up to species level, a dominance of the common guillemot in this group is clear. In past investigations, alongside lesser black-backed gulls, common guillemots were among the two most common species in the investigation cluster "North of Borkum".

The highest seasonal densities of auks according to ship transverse investigations were mostly identified in winter (3.63 Ind./km^2 in winter 2017, maximum monthly density 6.83 Ind./km^2 in January 2017). According to aircraft transverse investigations, the highest densities to date were 6.54 Ind./km^2 in spring 2016 (IFAÖ et al. 2020). The spatial distribution of auks, particularly for common guillemots, has to date shown large-scale incidence in the investigation areas for the cluster "North of Borkum". However, a slight tendency towards the west of the cluster was primarily recognised in 2017 and 2018. Incidence in 2019 was once again characterised by large-scale, almost comprehensive distribution in the investigation areas. In total, no focal point of distribution can be recognised for the proximity of site N-3.5 (IFAÖ et al. 2018, IFAÖ et al. 2019, IFAÖ et al. 2020).

Northern gannets (*Sula bassana*) occur in the investigation area, as well as in the entire German Bight, all year round. The highest monthly densities to date were identified in April 2018 at 1.85 Ind./km² (ship investigations) and April 2016 at 0.55 Ind./km² (aircraft investigations). Inter-annual differences are not unusual for a highly mobile species like the northern gannet. The focal points of distribution to date were most abundant in spring, mostly in the west of the cluster "North of Borkum" (IFAÖ et al. 2017, IFAÖ et al. 2018, IFAÖ et al. 2019, IFAÖ et al. 2020). In other seasons northern gannets showed a large-scale, if incomplete distribution. Consequently, there is no preference for the proximity of site N-3.5 from the investigations to date (IFAÖ et al. 2018, IFAÖ et al. 2019, IFAÖ et al. 2020).

Northern fulmars (*Fulmarus glacialis*) are a typical high seas bird species and primarily occur away from the coast in the EEZ beyond the 30m-depth contour. However, their distribution focal points are strongly aligned on the hydrographic properties of North Sea waters and the availability of nutrition. They are accordingly variable (CAMPHUYSEN & GARTHE 1997, MENDEL et al. 2008, MARKONES et al. 2015). The investigations carried out over the past few years only rarely observed individual northern fulmars in the investigation area. Neither temporal nor spatial focal points could be identified (IFAÖ et al. 2017, IFAÖ et al. 2018, IFAÖ et al. 2019, IFAÖ et al. 2020).

Due to the water depth of 23 - 29 m, sea ducks only occur rarely as resting birds in this area of the German Bight. Their distribution is concentrated on areas close to the coast or flatter offshore areas (MENDEL et al. 2008). This is made clear because of the densities identified for common scooters (*Melanitta nigra*) on the basis of ship transverse investigations in comparison with the densities on the basis of aircraft transverse investigation, whose area extends into the coastal sea. The highest monthly density identified to date in a ship transverse investigation was made in July 2017 at 0.33 Ind./km². The highest monthly density identified to date in an aircraft transverse investigation was made in March 2017, at 9.94 Ind./km² (IfAÖ et al. 2019). The strong incidence of common scooters is concentrated in the flatter areas of the investigation area near the coast, to the south of site N-3.5. No focal points of distribution in deeper areas in the vicinity of site N-3.5 have been recognised to date for diving sea ducks, and for common scooters in particular (IFAÖ et al. 2017, IFAÖ et al. 2018, IFAÖ et al. 2019, IFAÖ et al. 2020).

Skuas, primarily the species pomarine jaeger (*Stercorarius pomarinus*) and great skuas (*Stercorarius skua*), were only rarely sighted in the investigation areas in past investigation years (2013 – 2019). According to ship transverse investigations, annually 7 (2015, 2016, 2018) up to a maximum of 17 (2013) skuas, great skuas and undetermined skuas were sighted. According to aircraft transverse investigations these were two (2013, 2015, 2016, 2018) to 12 individuals of the species detailed or undetermined species groups (IFAÖ et al. 2015a, IFAÖ et al. 2015b, IFAÖ et al. 2016, IFAÖ et al. 2017, IFAÖ et al. 2018, IFAÖ et al. 2019, IFAÖ et al. 2020).

Black-headed gulls (*Larus ridibundus*) are not typical offshore species and have only been observed in correspondingly low densities without a spatial focal point to date. Great crested grebes (*Podiceps cristatus*) have only been recorded rarely in investigations to date. (IFAÖ et al. 2015a, IFAÖ et al. 2015b, IFAÖ et al. 2016, IFAÖ et al. 2017, IFAÖ et al. 2018, IFAÖ et al. 2019, IFAÖ et al. 2020).

2.8.4 Assessment of the status of the habitat for seabirds and resting birds

The great amount of research carried out in recent years allows a good assessment of the importance and status of the area surrounding site N-3.5 as a habitat for seabirds.

2.8.4.1 Conservation status

Of the seabird species regularly observed in the vicinity of site N-3.5, albeit in low densities in some cases, the red-throated diver, black-throated diver, little gull and the three species of tern - sandwich tern, common tern and Arctic tern - are listed in annexe I of the EU Birds Directive, as already mentioned. Red-throated diver, black-throated diver and little gull are also classified in SPEC category 3 (not restricted to Europe but with negative population trends and unfavourable conservation status). Common gull and sandwich tern are considered "concentrated in Europe with negative population trends and low conservation status" (SPEC category 2). Northern fulmars are considered "endangered" (EN) according to the pan-European endangerment status (EUR-Gef.). Kittiwakes are classified as "vulnerable" (VU) according to the current pan-European endangerment status, little gull, herring gull, guillemot and razorbill are classified as "near threatened" (NT) (BirdLife International 2015). The endangerment status in the 27 EU states (EU27-Gef.) is considered to be "endangered" (EN) for Thirteen Gulls and "vulnerable" (VU) for Northern fulmar and herring gull (BirdLife International 2015). For the assessment aspect of protection status, the seabird community found in the vicinity of site N-3.5 is therefore of medium to high importance.

2.8.4.2 Assessment of the occurrence of resting birds and seabirds

In the wider surroundings of site N-3.5, seagulls dominate the seabird population, as described in the chapter **2.8.3**. Lesser black-backed gulls, guillemots and kittiwakes are the most frequently observed species. Species of annexe I of the V-RL (Birds Directive), such as divers, terns and little gulls, use the area around site N-3.5 as a feeding ground only on average and mainly during migration periods. For them, this area does not count among the valuable resting habitats or preferred staging areas on the Northern German coast. The main resting area for divers on the Northern German coast is west of Sylt.

Due to a water depth of 23 - 29 m, feeding diving species such as sea ducks occur only sporadically in the site N.3-5. Furthermore, distinctly deep-sea bird species such as the fulmar prefer greater depths between 40 - 50 m, which is why only isolated observations were made in this site. For the gannets, guillemots and razorbills breeding on Helgoland, site N-3.5, with a distance of < 40 km from the island, is outside their action radius during the breeding season. Outside the breeding season, gannets were observed only sporadically, while guillemots were among the three most frequent seabird species.

According to current knowledge, the occurrence of seabirds and resting birds in the site N-3.5 and its surroundings can be assessed as average.

2.8.4.3 Assessment of spatial units

In the vicinity of site N-3.5, typical seabird species of the North Sea EEZ were recorded (BSH 2020a), although often only in low densities. This is mainly due to the fact that the area characteristics do not correspond to the species-specific preferred conditions of some seabird species. Seabird species such as fulmars and gannets occur only sporadically during migration periods. For breeding birds, the surroundings of site N-3.5 are of no particular importance due to the distance to the breeding colonies on the coasts or on Helgoland. Furthermore, site N-3.5 is located at a distance of more than 40 km from the bird sanctuary area "Eastern German Bight" (subarea II of the nature reserve "Sylt Outer Reef - Eastern German Bight"). Overall, the function of site N-3.5 and its surroundings is assessed as medium.

2.8.4.4 Legacy impacts

Site N-3.5 is located between the two traffic separation routes Terschelling German Bight and German Bight Western Approach. Due to its proximity to the two busy shipping routes, the surroundings of site N-3.5 are affected by the increased volume of traffic. In addition, fishing in the North Sea affects the availability of food resources, damages the seabed through bottom trawling and poses a direct threat through the setting of gillnets in which seabird species diving for food become entangled and die. The pressures from shipping and fishing in the vicinity of site N-3.5 are of medium to species-specific high intensity for seabirds. In addition, wind farm projects have already been implemented in the immediate vicinity of site N-3.5. As part of the marine ecosystem, seabirds are also exposed to threats. Changes in the ecosystem may be associated with threats to seabird populations. The following factors can cause changes in the marine ecosystem and thus also in seabirds:

- Climate change: Changes in water temperature are accompanied by changes in water circulation, plankton distribution and the composition of the fish fauna. Plankton and fish fauna serve as a food source for seabirds. However, because of the uncertainty regarding the effects of climate change on the individual ecosystem components, it is hardly possible to predict the impacts of climate change on seabirds.
- Fisheries: It can be assumed that fishing has a considerable influence on the composition of the seabird community in the EEZ, and thus also in the vicinity of site N-3.5. Fisheries can lead to a reduction in the food supply and even to food limitation. Selective fishing of fish species or fish sizes may lead to changes in the food supply for seabirds. Fishing discards provide additional food sources for some seabird species. The resulting trend towards more birds (lesser black-backed gull, herring gull and common gull) has been established by targeted surveys (GARTHE et al. 2006).
- Navigation: Shipping traffic has a scaring effect on species sensitive to disturbance, such as divers (MENDEL et al. 2019, FLIESSBACH et al. 2019, BURGER et al. 2019) and also includes the risk of oil spills
- Technical structures (offshore wind turbines, platforms): Technical structures can have similar impacts on disturbance-sensitive species as shipping traffic. In addition, there is an increase in the volume of shipping, e.g. due to supply trips. There is also a risk of collision with such structures.

In addition, seabirds may be threatened by eutrophication, the accumulation of pollutants in marine food network and rubbish floating in the water, e.g. parts of fishing nets and plastic parts. Epidemics of viral or bacterial origin also pose a threat to populations of resting birds and seabirds.

Due to the impacts described above, the existing pressures on site N-3.5 and its surroundings are rated as "medium".

2.8.4.5 Conclusion

According to current knowledge, the surroundings of site N-3.5 are of medium importance for resting and foraging seabirds.

2.9 Migratory birds

Bird migration is usually defined as periodic migrations between the breeding area and a separate non-breeding area, which in the case of birds at higher latitudes normally contains the wintering grounds. Since bird migration takes place annually, it is also called annual migration - and is spread throughout the world. In this context, one also speaks of two-way migratory birds, which make a return journey, or annual migratory birds, which migrate every year. Often, in addition to a resting place, one or more stopovers are made, be it for moulting, to find favourable feeding areas or for other reasons. A distinction is made between long-distance and short-distance migrants according to the distance travelled and physiological criteria (ALERSTAM 1990, BERTHOLD 2000, NEWTON 2008, NEWTON 2010).

2.9.1 Data situation

The BSH has a comprehensive data base for the suitability assessment of site N-3.5 with regard to migratory birds. This is mainly composed of the results and findings of the operator's mandatory monitoring during the construction and operation phases of offshore wind farm projects in accordance with the standard study concept (StUK 4). As part of the monitoring, the FINO 1 research platform has been investigating bird migration for areas N-1, N-2 and N-3 since 2013 by means of radar surveys, visual observations and night migration interrogations for the "Nördlich Borkum" (North of Borkum) study cluster (UMBO). The findings from the monitoring are therefore also suitable for describing and assessing bird migration in the vicinity of site N-3.5 (AVITEC RESEARCH GBR 2015a, AVITEC RESEARCH GBR 2015b, AVITEC RESEARCH GBR 2016, AVITEC RESEARCH GBR 2017, AVITEC RESEARCH GBR 2018, AVITEC RESEARCH GBR 2019, AVITEC RESEARCH GBR 2020).

In general, it should be noted that the methods required in the StUK can only capture sections of a complex migration event. Visual observations provide information on the type, number and migration direction of birds during the day; however, the migration height is difficult to determine. Nocturnal interrogations only provide information on calling species, with the number of individuals remaining undetermined. Radar surveys can provide reliable indications of migratory activity, but do not allow species-specific recording, no determination of the number of individuals and only record migratory activity up to an altitude of 1,000 m, maximum 1,500 m.

In the period before 2013, extensive research projects and further studies were carried out, e.g. in the context of environmental impact studies, which form a comprehensive basis for the description of bird migration before the expansion of offshore wind energy in the area north of Borkum (e.g. OREJAS et al. 2005, HÜPPOP et al. 2009).

In order to classify the bird migration in the area of site N-3.5 in relation to the overall bird migration, long-term data series from various offshore and coastal sites are available (MÜLLER 1981, DIERSCHKE 2001, HÜPPOP & HÜPPOP 2002, HÜPPOP & HÜPPOP 2004, HÜPPOP et al. 2004, HÜPPOP et al. 2005).

Overall, the available data form a very good basis for the suitability assessment of the site in question, N-3.5. Due to the methodological limitations mentioned above and the general difficulties in recording a dynamic phenomenon such as bird migration, there are still gaps in knowledge with regard to the following points:

- There is currently a lack of sufficient knowledge of the effects of offshore construction in some areas. Findings from the coastal sea and on land are only transferable to a very limited extent due to the different conditions.
- The species-specific risk of migratory birds colliding with offshore wind turbines is largely unknown.
- Possible barrier impacts of offshore wind turbines on species-specific sea migration routes are largely unexplored.

2.9.2 Bird migration over the German Bight - Spatial distribution and temporal variability of migratory birds

According to previous estimates, several 10-100 million birds migrate across the German Bight every year (EXO et al. 2003, HÜPPOP et al. 2005). The largest proportion is made up of songbirds, the majority of which cross the North Sea at night (HÜPPOP et al. 2005, HÜPPOP et al. 2006). The majority of birds come from Norway, Sweden and Denmark. For waterfowl and waders, however, breeding grounds extend far northeast into the Palaearctic and in the north and northwest to Spitsbergen, Iceland and Greenland.

The German Bight is on the migration route of numerous bird species. For example, between

226 and 257 (on average 242) species per year were recorded on Helgoland from 1990 to 2003 (according to DIERSCHKE et al. 1991-2004, cited in OREJAS et al. 2005). Other species that migrate at night but do not or rarely call, (such as the Pied Flycatcher*) (HÜPPOP et al. 2005) should also be included. If rarities are included, a total of more than 425 migratory bird species have been recorded on Helgoland over the course of several years (HÜPPOP et al. 2006). At greater distances from the coast, the average migration intensity and possibly the number of migrating species seems to decrease (DIERSCHKE 2001).

According to current knowledge, migratory bird events can be roughly divided into two phenomena: broad-front migration and migration along migration routes. It is known that most migratory bird species fly across at least large parts of their transit areas on a broad front.

According to KNUST et al. (2003), this also applies to the North Sea and Baltic Sea. Species that migrate at night in particular, which cannot be guided by geographical structures due to darkness, migrate across the sea in a broad frontal migration.

Broad-front migration is typical for the nocturnal, but also for the diurnal migration of songbirds. A current cross-project evaluation of all data from large-scale bird migration monitoring for offshore wind farm projects showed a clear gradient of decreasing migration intensities with greater distance from the coast for nocturnal bird migration over the North Sea, which is dominated by songbirds (WELCKER 2019). For several songbirds primarily migrating during the day, a lower migration intensity can be observed on Helgoland than on Sylt or Wangerooge (HÜPPOP et al. 2009). Radar observations confirm that the intensity of the migration of the limousines decreases towards the offshore area (DAVIDSE et al. 2000, LEOPOLD et al. 2004, HÜPPOP et al. 2006). Also the comparative investigations of the visible diurnal migration of waders and waterbirds between Helgoland and the (former) Research Platform North Sea (FPN), 72 km west of Sylt of DIERSCHKE (2001) indicate a gradient between the coast and the open North Sea. This assumption is confirmed in the BeoFINO final report, as the results of the visual observations presented show a clear concentration of waterfowl near the coast. Only a few bird species are found in the offshore area in equal or larger numbers of individuals (e.g. red-throated diver, pink-footed goose).

Figure 13 shows a detailed section of the broad front over the south-eastern North Sea.

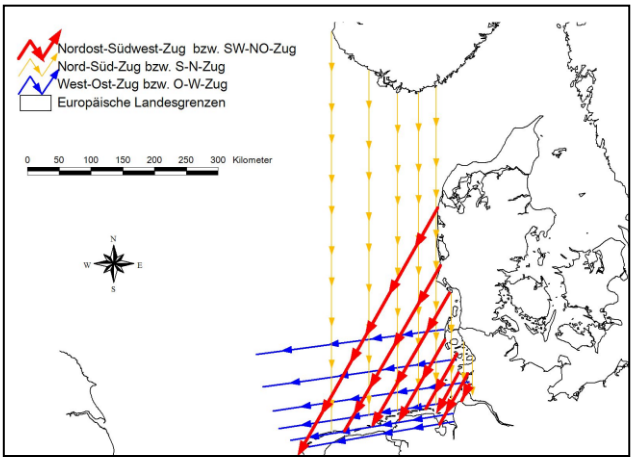

Figure 13: Scheme of main migration routes over the south-eastern North Sea (shown for autumn from HÜPPOP et al. 2005a).

It should be emphasised that the distances between the lines of individual migration flows merely indicate the direction of a gradient. Therefore, conclusions about the magnitude of the spatial trends must not be drawn from the figure. The thickness of the lines also only qualitatively illustrates differences in intensity between the migration flows.

The seasonal north-east-south-west or south-west-north-east migration dominates over a wide area according to the current state of knowledge (see Figure 13), although there may be some differences in the direction of migration and the degree of coastal orientation. HÜPPOP et al. (2009) and AVITEC RESEARCH GBR (2015b) also found a clear main direction of migration to the south-southwest during their surveys using radar on the FINO1 research platform in autumn (departure). In spring, a clear direction (northeast) was also discernible, but only at night when no foraging birds were active.

Seasonal migration intensity is closely linked to species- or population-specific life cycles (e.g. BERTHOLD 2000). In addition to these largely endogenously controlled annual rhythms in migratory activity, the concrete course of migration is primarily determined by weather conditions. Weather factors also influence the height and speed at which the animals migrate. In general, birds wait for favourable weather conditions (e.g. tailwind, no precipitation, good visibility) for their migration in order to optimise it in terms of energy. As a result, bird migration is concentrated on individual days or nights in autumn and spring. According to the results of an R&D project, half of all birds migrate in only 5 to 10% of all days (KNUST et al. 2003).

More detailed descriptions of large-scale bird migration over the German Bight can be found in the Environmental Report on the Area Development Plan 2020 for the German North Sea (BSH 2020a).

2.9.3 Bird migration in the vicinity of site N-3.5

2.9.3.1 Species spectrum

Within the framework of current surveys of the cluster "North of Borkum", in which the site N-3.5 is located, a total of 74 species were detected in 2019 by means of visual observations during the light phase and nocturnal migratory call surveys. In previous years, 53 (2017) to 87 species (2013) were recorded (AVITEC RESEARCH GBR 2020).

In the overall view of the study years 2013 to 2019, gulls dominated the migratory activity in the light phase and formed relative shares of 41 % in spring to 43 % in autumn of all recorded migratory birds (spring n = 11,948 individuals; autumn 12,386 individuals). Among the gulls, the lesser black-backed gull was the most frequent species over the entire period, followed by little gull, common gull, kittiwake and black-headed gull in varying frequencies (AVITEC RESEARCH GBR 2020).

Other species groups or families regularly observed in the vicinity of site N-3.5 include ducks (Anatidae), terns and songbirds. However, the occurrence is very variable interannually and seasonally.

Sandwich terns were the second most common species in spring 2017 (71 ind. out of a total of 758 birds observed), but there were no sightings in autumn 2017. Overall, the species group of terns accounted for 10% of the birds observed in spring and 13% of the birds observed in autumn in the total period 2013 - 2019 (AVITEC RESEARCH GBR 2020).

The duck family showed a high variability in its occurrence over the years. Across all home migration periods considered, more than one in four birds was a duck bird (28 %). However, observations of ducks were almost completely absent in spring 2013 (AVITEC RESEARCH GBR 2015a), and only a few ducks were observed in the home migration periods 2017 and 2018. In autumn, only one in ten birds was a duck from 2013 to 2019. The more common species include greylag goose, brent goose, short-billed goose and, among ducks, common scoter (AVITEC RESEARCH GBR 2020).

Songbirds were observed more frequently in the light phase in autumn than in spring. This species group showed very pronounced inter-annual fluctuations. Their relative abundance varied from year to year between 10 5 (autumn 2015, 2017) to 37 % (autumn 2014). The most frequent species included starling and meadow pipit (AVITEC RESEARCH GBR 2020).

Frequencies > 2% of the total number of individuals were also reached by gannets, cormorants and alcids (AVITEC RESEARCH GBR 2020).

In the dark phase, five to 17 species in spring, and 12 to 26 species in autumn were identified annually in 2013 - 2019 by migratory call recording. The nocturnal autumn migration was dominated by songbirds: 98 % of the bird-positive files (n= 11,261) contained songbird calls. Thrushes dominated the recorded songbird occurrence over the entire period. The most common species were the redwing, blackbird and song thrush. Skylark, meadow pipit, starling and robin were also recorded regularly and in higher numbers. Non-singing birds were only rarely detected in autumn (2.6 %). In spring, there were more frequent detections of non-singing birds in the period 2013 - 2019. This was dominated by the common gull (AVITEC RESEARCH GBR 2020).

2.9.3.2 Migration intensities, migration heights, migration direction

The bird migration surveys conducted by FINO 1 as part of the investigations on the cluster "North of Borkum" for the whole period from 2013 to 2019 showed that bird migration was detected almost continuously during the migration periods on the basis of entire migration nights or days. The main bird migration events were in spring in the second half of April and in autumn in October. Seasonal and interannual differences can be seen when looking at the individual years of recording. Over all years, bird migration events of varying intensity occurred, up to mass migration or strong migration according to the definition of the long-term site-specific scale (AVITEC RESEARCH GBR 2020). Due to equipment damage, no vertical radar recording took place in autumn 2019. The following is therefore mainly based on the surveys from 2017 and 2018 and supplemented with findings from 2019 where possible.

Migration intensities

In 2018, extrapolated to the entire spring season, 119,812 bird movements or 104 echoes/h*km were recorded during the day. At night, 229,680 bird movements or 323 echoes/h*km were extrapolated for the spring. During the autumn migration, 126,122 bird movements or 93 echoes/h*km were recorded during the day and 177,043 bird movements or 158 echoes/h*km during the night (AVITEC RESEARCH GBR 2019). Compared to the previous year 2017, the extrapolated bird movements in spring were thus higher (2017 spring day: 94,333 bird movements or 94 echoes/h*km; 2017 spring night: 204,228 bird movements; 309 echoes/h*km), while in autumn the values ranked well compared to the previous year (2017 autumn day: 142,875 bird movements or 111 echoes/h*km; 2017 autumn night: 193,417 bird movements; 187 echoes/h*km) (AVITEC RESEARCH GBR 2018).

Migration intensities of more than 1,000 echoes/h*km on average were not exceeded in spring 2018 on seven nights and not at all during the day. The situation was similar in autumn 2018, with migration events of 1,000 echoes/h*km on three nights (AVITEC RESEARCH GBR 2019). In 2017, migration intensities of 1,000 echoes/h*km were recorded on four nights, in autumn 2017 on only one night (AVITEC RESEARCH GBR 2018). In spring 2019, migration intensities of 1,000 echoes/h*km were determined on a total of 12 nights, while daytime migration intensities did not exceed 500 echoes/h*km (AVITEC RESEARCH GBR 2020).

An examination of the diurnal occurrence of bird migration in the vicinity of site N-3.5 in the period 2013 - 2019 shows that bird migration was recorded at all times of day, but that nocturnal bird migration predominated. Bird migration activity was highest in the second and third quarters of the night. During the light phase, the highest activity was recorded in the first quarter of the day. In view of the temporal pattern with often fluent transitions to previous night migration, it can be assumed that the migratory activity in the first daylight quarter is particularly due to birds that have not yet reached the mainland again at sunrise (AVITEC RESEARCH GBR 2020).

Migration heights

An examination of flight altitudes based on vertical radar surveys during the migration periods of 2013 - 2019 reveals that migratory birds, within the detection range up to 1,000 m, predominantly choose low migration altitudes up to a few hundred metres in height (AVITEC RESEARCH GBR 2020).

In the individual observation, 20 % of all calculated migratory movements in spring (n = 349,452) and 31 % of all migratory movements in autumn (n = 303,165) were recorded at altitudes of up to 100 m during the 2018 migration periods (AVITEC RESEARCH GBR 2019). In spring, there were diurnal differences in the altitude distribution. During the day, about 54 % of all flight movements registered and calculated during the day were at altitudes of up to 300 m. In the dark phase, the proportion was only about 50 %. In the dark phase, the proportion was only 40 %, with only 15 % of all flight movements registered at altitudes up to 100 m (AVITEC RESEARCH GBR 2019). In spring 2019, the height distribution according to vertical radar detection was very similar to the previous year (AVITEC RESEARCH GBR 2020). Contrasting diurnal differences were found for autumn migration in 2018. Overall, the stronger concentration of bird migration on lower altitudinal ranges in the light phase was evident across all years (2013-2019) (AVITEC RESEARCH GBR 2020).

In general, deviations from the altitudinal profile described above on migration days or on migration nights with particularly strong bird migration activity can be seen for home and departure migration periods, as well as for light and dark phases.

In its expert reports, Avitec Research assumes that at least 2/3 of the total bird migration is registered on average by means of vertical radar detection in a detection range of up to 1,000 m altitude. This means that it can be assumed that about 1/3 of the bird migration takes place above the detection range of standard vertical radars (AVITEC RESEARCH GBR 2019). In a cross-project analysis of bird migration monitoring data, WELCKER (2019) found that on nights of higher bird migration intensity, migration occurs at higher altitudes.

On strong nights, bimodal flight altitude distributions can also be observed. For example, on the night of 07/08/11 2017, 38.3% of migratory movements were recorded at altitudes up to 100 m and 39.3% between 600 - 800 m (AVITEC RESEARCH GBR 2018).

Migration plan observations provide information on the distribution of migration heights in the lower 200 m during the light phase, with reference to the species. Based on these observations, it appears that the majority of bird migration in the vicinity of site N-3.5 takes place in the lower 20 -50 m during the day. In the period 2013 - 2019, more than 80 % of all recorded birds flew at altitudes of up to 50 m during the departure period (AVITEC RESEARCH GBR 2019). In spring 2019, 77 % (n = 1,067) of all recorded birds were recorded at altitudinal ranges up to 50 m, compared to 79 % at altitudinal ranges up to 20 m in 2018. In autumn 2018 and 2019, 75 % and 72 % of all recorded birds flew to heights up to 20 m, respectively (2018 n = 854; 2019 n= 1,087) (AVITEC RESEARCH GBR 2019, AVITEC RESEARCH GBR 2020).

Direction of pull

The migratory directions according to horizontal radar records from 2014-2019 corresponded to a clear north-east directed home migration and a south-west directed departure migration in spring. The variability between the individual years was very low, but deviations could occur when comparing individual nights. Differences may result from adjustments of the flight direction to the prevailing wind conditions in order to either profit from the locally prevailing wind conditions or at least to minimise energetically cost-intensive effects. Furthermore, deviating main orientations may result from the origin of the migrants involved from different departure regions (AVITEC RESEARCH GBR 2020).

2.9.4 Status assessment and importance of site N-3.5 and its surroundings for bird migration

The assessment of the status of migratory birds and the importance of site N-3.5 and its surroundings for bird migration is based on the following evaluation criteria:

- The importance of bird migration over a large area
- Assessment of occurrence
- Rarity and endangerment
- Legacy impacts

Unless otherwise stated, the following comments refer to bird migration as a whole.

2.9.4.1 The importance of bird migration over a large area

Special migratory corridors are not recognisable for any migratory bird species in the North Sea EEZ area. Bird migration takes place in an unspecified broad-fronted migration across the North Sea with a tendency towards coastal orientation. Site N-3.5 and its surroundings north of the East Frisian Islands are therefore of medium importance.

2.9.4.2 Assessment of occurrence

Bird migration occurs continuously in the vicinity of site N-3.5 during migration periods. Occasionally, very strong bird migration ("mass migration") occurs on a site-specific scale. However, the temporarily high migration rates are part of the overall bird migration over the German Bight (see detailed information in BSH 2020a). The migratory activity and its intensity in the vicinity of site N-3.5 is therefore considered to be of medium importance.

2.9.4.3 Rarity and endangerment

In the study years 2013 - 2019, 53 (2017) to 87 (2013) species were recorded annually by means of migration plan observations and nocturnal migratory call recording. Between 5 (autumn 2015 and 2016) and 12 (spring 2013) species of annexe I of the Birds Directive were recorded per migration period. The most frequently recorded species were red-throated diver, little gull, common, Arctic and sandwich tern. More rarely and only in the form of single individuals, black-throated diver, red kite, barnacle goose, osprey, salmon tern, short-eared owl, merlin, Mediterranean gull, whooper swan, black kite, peregrine falcon, western marsh harrier, golden plover, bar-tailed godwit, great northern diver, Balearic shearwater, storm petrel, Leach's petrel and woodlark were observed or recorded acoustically during the monitoring according to the standard survey concept (StUK). In view of the number of species recorded in the vicinity of site N-3.5 in relation to the species spectrum of bird migration over the entire German Bight (see chapter 2.9.2), the number of species is assessed as medium and the endangerment status as high.

2.9.4.4 Legacy impacts

Anthropogenic factors contribute to the mortality of migratory birds in a variety of ways and, in a complex interaction, can influence population size and determine current migration patterns.

Major anthropogenic factors that increase mortality of migratory birds are active hunting, collisions with anthropogenic structures and, for waterbirds and seabirds, pollution by oil or chemicals (CAMPHUYSEN et al. 1999). The various factors have a cumulative effect; the detached significance is therefore usually difficult to determine. Especially in Mediterranean countries, a statistically insufficient amount of hunting still takes place (HÜPPOP & HÜPPOP 2002). TUCKER & HEATH (1994) conclude that more than 30% of

European species marked by population declines are also threatened by hunting.

The proportion of birds ringed on Helgoland and indirectly killed by humans has increased in the past in all species groups and finding regions; building and vehicle approaches were the main causes (HÜPPOP & HÜPPOP 2002). Surveys of collision victims at four lighthouses in the German Bight show that songbirds are strongly dominant. Starlings, thrushes (song thrush, red thrush, juniper thrush) and blackbirds are particularly prominent among the birds being found dead. Similar findings are available for FINO1 (HÜPPOP et al. 2009), the FPN (MÜLLER 1981) or former lighthouses on the Danish west coast (HANSEN 1954). During 36 of 159 visits to the research platform FINO1 with bird monitoring between October 2003 and December 2007, a total of 770 dead birds (35 species) were found. Thrushes and starlings were the most common, accounting for 85% of the total. The species concerned are characterised by nocturnal migration and relatively large populations. It is striking that almost 50% of the collisions registered on FINO1 occurred in only two nights. On both nights, there were south-easterly winds (which may have encouraged migration over sea) and poor visibility (which may have led to a reduction in flight height and increased attraction by the illuminated platform) (HÜPPOP et al. 2009). The area around site N-3.5 is already partly covered with wind farms.

Global warming and climate change also have measurable impacts on bird migration (e.g. through changes in phenology or altered arrival and departure times) However, these are species-specific and vary from region to region (cf BAIRLEIN & HÜPPOP 2004, CRICK 2004, BAIRLEIN & WINKEL 2001). For example, clear relationships between large-scale climate cycles such as the North Atlantic Oscillation (NAO) and the condition of songbirds on their spring migration have been demonstrated (HÜPPOP & HÜPPOP 2003). Climate change can influence conditions in breeding, resting and wintering areas or the ressources of these sub-habitats.

Overall, the existing pressures are assessed as medium to occasionally high.

2.9.4.5 Conclusion

On the basis of the above criteria and their respective evaluation, the overall significance of site N-3.5 and its surroundings for bird migration is medium.

2.10 Bats and bat migration

Bats are characterised by a very high mobility. While bats can travel up to 60 km per day in search of food, nesting or summer resting places and wintering areas are several hundred kilometres apart. Migration movements of bats in search of extensive food sources and suitable resting places are very often observed on land, but predominantly aperiodically. However, migratory movements of bats over the North Sea are still poorly documented and largely unexplored.

2.10.1 Data situation

The data base on bat migration over the North Sea is insufficient for a detailed description of the occurrence and intensity of bat migration in the offshore area in general and in the vicinity of site N-3.5 in particular. In the following, reference is made to general literature on bats, findings from systematic recordings on Helgoland as well as acoustic recordings on the research platform FINO1 and other sources of knowledge in order to reflect the current state of knowledge. In view of the need for further knowledge about bat migration over the North Sea, the following can be stated:

- There is a lack of knowledge about the quality and quantity of migratory bat populations in the North Sea area.

- There is currently a lack of sufficient knowledge of the effects of offshore construction. Findings from the coastal sea and on land are only transferable to a very limited extent due to the different conditions.
- The species-specific risk of bats colliding with offshore wind turbines is largely unknown.

2.10.2 Spatial distribution and status assessment

Bats are characterised by a very high mobility. Migration movements of bats in search of extensive food sources and suitable resting places are very often observed on land, but predominantly aperiodically. In contrast to irregular movements, migrations take place periodically or seasonally. Both the sedentary and migratory behaviour of bats is highly variable. On the one hand, differences can occur depending on species and sex. On the other hand, sedentary or migratory movements can vary greatly even within the populations of a species. Based on their sedentary behaviour, bats are divided into short-distance, medium-distance and long-distance migratory species.

Bats go on short- and medium-distance migrations in search of nesting, feeding, and resting places. Corridors along flowing waters, around lakes and Bodden waters are known for medium distances (BACH & MEYER-CORDS 2005). However, long-distance migrations are still largely unexplored. Bats migratory routes are scarcely described. This particularly applies to migratory movements across the open sea. In contrast to bird migration, which has been confirmed by extensive studies, the migration of bats remains largely unexplored due to the lack of suitable methods or large-scale special monitoring programmes.

The long-distance migratory species include the mountain noctule bat (*Nyctalus noctula*), Nathusius's pipistrelle (*Pipistrellus nathusii*), parti-coloured bat (*Verspertilia murinus*), and Leisler's bat (*Nyctalus leisleri*). For these four species, migrations over a distance of 1,500 to 2,000 km are regularly recorded (TRESS et al. 2004, HUTTERER et al. 2005).

Long-distance migratory movements are also observed in the mosquito bat species (*Pipistrellus pygmaeus*) and common pipistrelle (*Pipistrellus pipistrellus*) (BACH & MEYER-CORDS 2005). Some long-distance migratory species occur in Germany and countries bordering the North Sea and have occasionally been encountered on islands, ships and platforms in the North Sea.

However, based on observations of bats on Helgoland, the number of bats migrating from the Danish coast across the German North Sea in autumn is estimated at about 1,200 individuals (SKIBA 2007). An evaluation of observations of bats migrating from south-west Jutland to the North Sea leads to the same conclusion (SKIBA 2011).

Visual observations such as on the coast or on ships and offshore platforms, provide initial indications but are hardly suitable for fully recording the migration behaviour of nocturnal and nocturnally migrating bats over the sea. The recording of ultrasonic calls of bats by suitable detectors (bat detectors) provides good results on land about the occurrence and migration movements of bats (SKIBA 2003). However, the results obtained so far from the use of bat detectors in the North Sea only provide initial indications. Acoustic surveys of bat migration over the North Sea on the FINO1 research platform resulted in detections of only at least 28 individuals between August 2004 and December 2015 (HÜPPOP & HILL 2016).

When recording bat migration over the open sea, the general occurrence, species composition and migration routes as well as the heights at which bats migrate must be considered in order to assess the potential risk of collision with offshore wind farms. Depending on location and method, the individuals surveyed by HÜPPOP &

HILL (2016) were surveyed between 15 and 26 m at mean sea level, which includes the area between the lower rotor blade tip and the water surface of the majority of wind farms. BRABANT et al. (2018) investigated bat occurrence at Thornton Bank wind farm using bat detectors at 17 m and 94 m above ground. Only 10 % of the total of 98 bat recordings, and thus significantly fewer than at 17 m, were taken at a greater height.

Some species such as the rough-skinned bat and the greater evening bat are listed in Appendix II of the 1979 Convention on Migratory Species (CMS), “Bonn Convention”. A total of 25 bat species are native to Germany. In the current Red List of mammals (MEINIG et al. 2008), two of these species are classified as "endangered to an unknown extent", four species are classified as "critically endangered" and three species as "threatened with extinction". The common bent-wing bat (*Miniopterus schreibersii)* is considered “extinct or lost”. Of the species that have so far been recorded more frequently in marine or coastal areas of Germany, the noctule is on the early warning list, while the common pipistrelle and the Nathusius' pipistrelle are considered "safe". For an assessment of the endangerment status of the common swift data availability is considered insufficient.

The data available for the North Sea EEZ and the area of site N-3.5 are fragmentary and insufficient to draw conclusions on bat migration movements. It is not possible to draw concrete conclusions on migratory species, migration directions, migration heights, migration corridors and possible concentration ranges on the basis of the available data. What we have seen so far only confirms that bats, especially long-distance migratory species, fly over the North Sea. Against this background, there is currently no scientific basis for describing and assessing the occurrence of bats in the vicinity of site N-3.5 and, accordingly, the status of bats as an object of conservation.

2.11 Biological diversity

Biological diversity (or in short: Biodiversity) comprises the diversity of habitats and biotic communities, the diversity of species and the genetic diversity within species (Art. 2 Convention on Biological Diversity, 1992). The spotlight is on biodiversity in the eyes of the public. Species diversity is the result of an evolutionary process that has been going on for over 3.5 billion years, a dynamic process of extinction and species formation. Of the approximately 1.7 million species described by science to date, some 250,000 occur in the sea, and although there are considerably more species on land than in the sea, the sea is more comprehensive and phylogenetically more highly developed than the land in terms of its tribal biodiversity. Of the 33 known animal phyla, 32 are found in the sea; 15 of these are exclusively marine. (VON WESTERNHAGEN & DETHLEFSEN 2003).

Marine diversity cannot be directly observed and is therefore difficult to assess. For their assessment, tools such as nets, weirs, grabs, traps or optical registration methods must be used. However, the use of such devices can only ever provide a section of the actual species spectrum – precisely that which is specific to the device question. Since the North Sea, as a relatively shallow marginal sea, is more easily accessible than, for example, the deep sea, intensive marine and fisheries research has been carried out for about 150 years, which has led to an increase in knowledge about its flora and fauna. This makes it possible to refer to inventory lists and species catalogues in order to document possible changes (VON WESTERNHAGEN & DETHLEFSEN 2003). According to the results of the Continuous Plankton Recorder (CPR), about 450 different plankton taxa (phyto- and zooplankton) have been identified in the North Sea. About 1,500 marine species of macrozoobenthos are known. Of these, an estimated 800 are found in the German North Sea area (RACHOR et al. 1995). According to YANG (1982), the fish fauna of the North Sea is composed of 224 species of fish and lamprey. For the German North Sea, 189 species are reported (FRICKE et al. 1995). In the North Sea EEZ, 19 seabirds and resting birds occur regularly in larger populations. Three of these species are listed in annexe I of the V-RL.

With regard to the current state of biodiversity in the North Sea, it should be noted that there is countless evidence of changes in biodiversity and species assemblages at all systematic and trophic levels in the North Sea. The changes in biodiversity are mainly due to human activities, such as fishing and marine pollution, or due to climate change.

Red lists of endangered animal and plant species fulfil an important monitoring and warning function in this context, as they show the status of the populations of species and biotopes in a region. Based on the Red Lists, it can be stated that 32.2% of all currently assessed macrozoobenthos species in the North Sea and Baltic Sea (RACHOR et al. 2013) and 27.1% of the fish and lampreys established in the North Sea (THIEL et al. 2013, FREYHOF 2009) are assigned to a Red List category. The marine mammals form a species group in which all representatives are currently vulnerable, whereby the bottlenose dolphin has even disappeared from the area of the German North Sea (VON NORDHEIM et al. 2003). Of the 19 regularly occurring seabirds and resting birds, three species are listed in annexe I of the V-RL. In general, according to the V-RL, all wild native bird species are to be conserved and thus protected.

2.12 Air

Shipping causes emissions of nitrogen oxides, sulphur dioxides, carbon dioxide and soot particles. These can have a negative impact on air quality and are largely discharged into the sea as atmospheric deposition. Since 1 January 2015, shipping in the North Sea has been subject to stricter rules as an emission control area, the so-called Sulphur Emission Control Area (SECA). Under Annex VI, Regulation 14 of MARPOL, ships may only use heavy fuel oil with a maximum sulphur content of 0.10%. Worldwide, a limit of 3.50% is currently still in force. According to a resolution of the International Maritime Organization (IMO) in 2016, this limit value is to be reduced to 0.50% worldwide from 2020.

Emissions of nitrogen oxides are particularly relevant for the North Sea as an additional nutrient load. To this end, the IMO decided in 2017 that the North Sea will be declared a "Nitrogen Emission Control Area" (NECA) from 2021. The reduction of nitrogen oxides in the Baltic Sea region through the North Sea and Baltic Sea ECA is estimated at 22,000 t (European Monitoring and Evaluation Programme (EMEP 2016).

2.13 Climate

The German North Sea is located in the temperate climate zone. An important influencing factor is warm Atlantic water from the North Atlantic Current. Icing can occur in coastal areas, but is rare and only occurs at intervals of several years. There is broad agreement among climate researchers that the global climate system is being noticeably affected by the increasing release of greenhouse gases and pollutants, and that the first effects are already being felt.

According to reports of the Intergovernmental Panel on Climate Change (IPCC 2001, 2007), large-scale impacts of climate change on the oceans are expected to be increases in sea surface temperature and average global sea level. Many marine ecosystems are sensitive to climate change. Global warming is also expected to have a significant impact on the North Sea, both through a rise in sea level and through changes in the ecosystem. In recent years, for example, species that were previously only found further south have increasingly spread, and the habits of long-established species have changed, sometimes considerably.

2.14 Landscape

The marine seascape scenery is characterised by large-scale open space structures surrounded by offshore wind turbines. In the German Bight, for example, there are wind turbines that are visible on the horizon when viewed from the coast.

Tall structures are platforms and measuring masts for research purposes, which are located within or in the immediate vicinity of the wind farms. In the future, the seascape scenery will continue to change due to the expansion of offshore wind energy utilisation, and the necessary lighting can also have a negative impact on the appearance of the landscape.

The extent to which the seascape scenery is impaired by vertical structures depends strongly on the visibility conditions. The space in which a building becomes visible in the landscape is the visual impact space. It is defined by the visual relationship between the structure and its surroundings, whereby the intensity of an effect decreases with increasing distance (Gassner et al. 2005).

In the case of platforms and offshore wind farms or sites planned at a distance of at least 30 km from the coastline, the impact on the seascape scenery as perceived from land is not very high. At such a distance the platforms and wind farms will not be massively visible even in good visibility conditions. This also applies with regard to night-time security lighting.

The as yet undeveloped site N-3.5 is located between already existing wind farms at a corresponding distance from the coast.

2.15 Material assets, cultural heritage (archaeology)

Indications of possible material assets or cultural heritage are available insofar as the spatial location of a large number of wrecks is known on the basis of the evaluation of existing hydroacoustic recordings and the BSH wreck database and is recorded in the BSH nautical charts.

Furthermore, the sonograms (side-scan sonar recordings) recorded during the preliminary investigation of the site are evaluated with regard to possible objects and bottom structures. Objects and bottom structures recognisable in the sonograms are mapped out (either directly in the so-called waterfall mode of the recording software or from side scan sonar mosaics with a max. resolution of 25x25 cm) and classified using visual methods (video).

There are no entries for site N-3.5 in the BSH wreck database. The evaluations of the side-scan sonar recordings did not yield any indications. The preliminary investigation did not include a separate examination of the site for cultural assets.

2.16 Protected property human beings including human health

Site N-3.5 has a low significance for the human resource. In a broader sense, the maritime space represents the working environment for people employed on ships. Exact numbers of people regularly present in the area are not available. However, the numerous existing and planned wind farm projects are increasing activities in the vicinity of site N-3.5.

Overall, the North Sea EEZ is of little importance for active recreational use. Direct use for recreation and leisure by recreational boats and tourist watercraft is only sporadic. No special significance of the planning areas for human health and well-being can be inferred.

2.17 Interactions between the factors

The components of the marine ecosystem, from bacteria and plankton to marine mammals and birds, influence each other through complex processes. The plankton described conclusively in the North Sea Environmental Report on the FEP (BSH, 2020a) and the biological protected goods plankton, benthos, fish, marine mammals and birds described individually in chapter 2 are interdependent within the marine food network.

Phytoplankton serves as the food base for organisms that specialise in filtering water for food. The main primary consumers of phytoplankton include zooplanktonic organisms such as copepods and water fleas. Zooplankton has a central role in the marine ecosystem as a primary consumer of phytoplankton on the one hand and as the lowest secondary producer within the marine food network on the other. Zooplankton serve as food for the secondary consumers of the marine food network, from carnivorous zooplankton species to benthos, fish to marine mammals and seabirds. Among the top components of marine food network are the so-called predators. Upper-level predators within marine food network include aquatic and seabirds and marine mammals. In food network, producers and consumers are interdependent and influence each other in many ways.

In general, food availability regulates the growth and distribution of species. Exhaustion of the producer results in the decline of the consumer. Consumers in turn control the growth of producers by eating away. Food limitation affects the individual level by impairing the physical condition of each individual. At the population level, food restriction leads to changes in the abundance and distribution of species. Food competition within a species or between species has similar effects.

The timing of succession or sequencing of growth between the different components of marine food network is critical. For example, the growth of fish larvae is directly dependent on the available biomass of plankton. For seabirds, breeding success is also directly related to the availability of suitable fish (species, length, biomass, energy value). Temporally or spatially offset occurrence of succession and abundance of species from different trophic levels leads to disruption of food network. Temporal offset, the so-called trophic "mismatch", causes malnutrition or even starvation, particularly in early developmental stages of organisms. Disruption of marine food network can affect not only individuals but also populations. Predator-prey relationships or trophic relationships between size or age groups of a species or between species also regulate the balance of the marine ecosystem. For example, the decline of cod stocks in the Baltic Sea had a positive effect on the development of sprat stocks (ÖSTERBLOM et al. 2006).

Trophic relationships and interrelationships between plankton, benthos, fish, marine mammals, and seabirds are controlled by multiple mechanisms. Such mechanisms operate from the bottom of the food network, starting with nutrient, oxygen or light availability, upwards to the upper predators. Such bottom-up control mechanisms can act by increasing or decreasing primary production. Effects emanating from the upper predators downwards, via “top-down” mechanisms, can also control food availability.

The interactions within the components of marine food network are influenced by abiotic and biotic factors. For example, dynamic hydrographic structures, frontal formation, water stratification and currents play a decisive role in food availability (increase in primary production) and use by upper predators. Exceptional events such as storms and ice winters also influence trophic relationships within marine food network. Biotic factors, such as toxic algal blooms, parasite infestation and epidemics, also affect the entire food chain.

Anthropogenic activities also have a decisive influence on the interrelationship within the components of the marine ecosystem. Humans affect the marine food network both directly through the capture of marine animals and indirectly through activities that can affect food network components.

Overfishing of fish stocks, for example, confronts upper predators such as seabirds and marine mammals with food limitations or forces them to develop new food resources. Overfishing can also cause changes in the lower reaches of food network. This can lead to the extreme spread of jellyfish when their fish predators are fished away*. Furthermore, shipping and mariculture are additional factors that can lead to positive or negative changes in marine food network through the introduction of non-native species. Discharges of nutrients and pollutants via rivers and the atmosphere also affect marine organisms and can lead to changes in trophic conditions.

Natural or anthropogenic impacts on one of the components of the marine food network, e.g. the species spectrum or the biomass of the plankton, can influence the entire food network and shift and possibly endanger the balance of the marine ecosystem. Examples of the very complex interactions and control mechanisms within the marine food network have been presented in detail in the description of the individual protected goods.

The complex interrelationships of the various components to each other ultimately lead to changes in the entire marine ecosystem of the North Sea. The changes in the marine ecosystem of the North Sea described in Chapter 2 can be summarised:

- Since the early 1980s, there have been slow changes in the living marine environment.
- Since 1987/88, rapid changes in the living marine environment have been observed.

The following aspects or changes can influence the interrelationships between the different components of the living marine environment: Changes in species composition (phyto- and zooplankton, benthos, fish), introduction and partial establishment of non-native species (phyto- and zooplankton, benthos, fish), changes in abundance and dominance ratios (phyto- and zooplankton), changes in available biomass (phytoplankton), extension of the growth phase (phytoplankton, copepods), Delay in the growth phase after a warm winter (spring diatom bloom), food organisms of fish larvae have brought forward the start of growth (copepods), decline of many species typical of the area (plankton, benthos, fish), decline in the food base for upper predators (seabirds), shift of stocks from southern to northern latitudes (cod), shift of stocks from northern to southern latitudes (harbour porpoises).

3 Expected development in the event of non-implementation of the plan

Pursuant to § 40 (2) (3) of UVPG (Environmental Impact Assessment Act), in addition to the presentation of the current state of the environment, its development in the event of non-implementation of the plan must be predicted. This representation "forms a reference state against which the changes caused by the plan or programme can be measured". (WULFHORST 2011). It is to be examined which developments the state of the environment would undergo during the forecast period if the plan or programme were not implemented (KMENT in UVPG, § 40, marginal no. 46), i.e. if no offshore wind turbines were erected and operated on the site. In this context, possible environmental impacts that already exist in the area and that could possibly become more widespread if planning is not carried out must also be cosidered (KMENT in UVPG, § 40, marginal no. 46).

3.1 Soil/ site

The protected goods soil and site would be affected by various uses in the area of site N-3.5, both in the case of implementation and non-implementation of the construction projects. Anthropogenic factors affect the seabed through erosion, mixing, swirling, material sorting, displacement and compaction. In this way, the natural sediment dynamics (sedimentation/erosion) and the exchange of matter between sediment and groundwater are influenced. If the plan is not implemented, the soil as a protected resource would continue to be unrestrictedly affected by the impacts of fishing. This is associated with direct disturbance of near-surface sediments, resuspension of sediment, sediment redistribution and potential pollutant inputs. These are also potential impacts on the soil during the construction phase of the wind turbines, platforms and submarine cable systems, which would be eliminated by non-implementation, as would permanent, locally confined seabed sealing.

3.2 Water

If the construction project on site N-3.5 is not carried out, water as a protected resource would continue to be affected to a minor extent, in particular by general land-based nutrient and pollutant inputs into German North Sea waters.

Construction, installation and operational impacts (see Chapter 4) would not occur if the plan were not implemented. However, as these would occur with low intensity and would not cause any structural or functional impairments to the water as a protected resource, the development of the water as a protected resource will not differ significantly if the construction project is carried out or not carried out on site N-3.5.

3.3 Biotope types

If the plan is not implemented, the biotope types would be affected in particular by the unrestricted effects of fishing, including disturbance of the seabed and increased turbidity development. If the plan is implemented, fishing intensity on the site is expected to decrease based on the legal framework and past practice.

The form and extent of fisheries use will depend on the future GDWS navigation regulations pursuant to Article 53 of the WindSeeG (Law on the development and promotion of offshore wind energy) in conjunction with § 7 (2) and (3) of the VO-KVR, which will be issued for the safety zone regularly established around offshore wind farms.

Up to now, fishing or the use of certain fishing gear (such as angling, bottom, trawl and drift nets or similar gear) as well as anchoring within the safety zone has been regularly prohibited after weighing up the significant concerns. In part, passive fishing with baskets and fish traps in the safety zone outside the built-up wind farm sites is exempted, provided that the passive fishing gear is on the seabed.

In order to ensure the safety of installations and shipping and to fulfil the conditions of the suitability of the sites for the shipping police, similar prohibitions on fishing can also be expected in the future in similar circumstances. It is conceivable that passive fishing with fish traps and baskets will be permitted outside the area of the safety zone in which the facilities themselves are located. If the plan were not implemented, the biotopes would no longer be able to recover to the same extent due to the expected significant restriction of fishing.

3.4 Benthos

The benthic community would be particularly affected by the unrestricted impacts of fishing, including seabed disturbance and increased turbidity development, if the plan is not implemented. The function of the wind farm site as a refuge for benthic communities, which is to be expected for the implementation of the plan on the basis of the legal framework and the previous practice of fishing restrictions (see 3.3), would no longer exist if the plan is not implemented. On the other hand, the localised limited impact of the introduction of hard substrate through the foundations would be eliminated.

3.5 Fish

In analogy to the benthic ecosystem, other uses, in particular the unrestricted impacts of fishing, would partially affect fish as a protected resource if the plan were not implemented.

The potential function of the wind farm site as a refuge for fish, which can be expected for the implementation of the plan on the basis of the legal framework and previous practice of fishing restrictions (see 3.3), would no longer exist if the plan were not implemented.

Overall, similar impacts on fish fauna as on benthic fauna can be expected both if the plan is implemented and if it is not implemented. The staged planning procedure and the standardised technical and planning principles allow potential environmental impacts to be identified at an early stage. This can ensure better protection of the fish fauna.

3.6 Marine mammals

Marine mammals would continue to be affected by the impacts of various uses, such as shipping and fishing, even if offshore wind turbines were not implemented in site N-3.5.

Marine mammals, particularly the sound-sensitive harbour porpoise, could be affected by the sound input from the installation of offshore wind turbines through the installation of driven foundations for offshore wind turbines, substations, residential platforms and converter platforms if no sound mitigation measures are taken. Alternative foundation methods are currently being developed or have even been partially realised, such as jacket suction buckets at suitable sites. The installation of so-called Suction Bucket monopiles is currently being tested.

Power transmission from the N-3.5 site towards the land is realised by means of direct current cables. The operation of DC cables is state of the art for the distances that will be required to connect the offshore wind farms in site N-3.5.

The determination of suitability also includes a number of requirements that relate to the most compatible design of offshore wind energy production, in particular requirements for noise abatement and the coordination of noise-intensive work in order to avoid and reduce significant disturbance of the harbour porpoise and to exclude significant impairment of the conservation purposes and conservation objectives of the nature conservation areas. Overall, however, the effects of the realisation of offshore wind turbines in site N-3.5 on marine mammals will be comparable to the effects of the zero option, as project- and site-specific noise abatement measures are generally ordered in the concrete individual approval procedure. In addition, a trend is emerging with regard to power and the associated reduction in the number of turbines. If offshore wind turbines were not realised, site N-3.5 might not be used for renewable energy production in an economic and at the same time environmentally sound way.

The effects of natural variability as a result of climate change on marine mammals are complex and difficult to predict. All species will be indirectly affected by possible climate change impacts on the marine food web. The possible shift in harbour porpoise stocks already mentioned could also be related to climate change. Overall, however, this development is independent of the construction and operation of offshore wind turbines in site N-3.5.

3.7 Seabirds and resting birds

Even if the Plan were not implemented, the protected species of seabirds and resting birds would be affected by the impacts of various uses, such as shipping and fishing, in parts as shown. The impacts of climate change on the affected species are complex and difficult to predict. All species will be indirectly affected by possible impacts of climate change on their food organisms, especially fish. Overall, however, this development is independent of the non-implementation or implementation of the plan.

If the plan were not implemented, the suitability of the site in question, N-3.5, would not be established and it would consequently not be built on. As a result, potential project-related impacts on seabirds and resting birds from a wind farm on site N-3.5 would not occur. However, pre-existing impacts from existing projects and other uses in the vicinity of site N-3.5 would continue to exist. In view of this, the impacts on the protected species of seabirds and resting birds would not differ significantly if the plan were implemented or not implemented. However, if the plan were not implemented, site N-3.5 would not be available to meet the expansion targets for offshore wind energy.

3.8 Migratory birds

Migratory birds would still be affected by the impacts of various uses, such as shipping and fishing, in parts as described in the chapter 2.9.4.4, even if the Plan is not implemented. The impacts of climate change on the affected species are complex and difficult to predict. All species will be indirectly affected by possible impacts of climate change on their food organisms, especially fish. Overall, however, this development is independent of the non-implementation or implementation of the plan.

If the plan were not implemented, the suitability of the site in question, N-3.5, would not be established and it would consequently not be built on. As a result, potential pre-existing impacts on migratory birds from a wind farm on site N-3.5 would not occur. However, pre-existing impacts from existing projects and other uses in the vicinity of site N-3.5 would continue to exist.

3.9 Bats and bat migration

Migratory movements of bats across the North Sea are still poorly documented and largely unexplored. There is a lack of concrete information on migrating species, migration corridors, migration heights, and migration concentrations. Previous knowledge merely confirms that bats, especially long-distance migratory species, fly over the North Sea. However, based on previous findings, e.g. on the distribution and habitat preferences of bats, some effects of climate change can be predicted. For example, the loss of roosting sites along migration routes, the decimation of breeding habitats and changes in food supply are to be expected. Time-delayed food availability may have consequences for the reproductive success of bats in particular (AHLEN 2002, RICHARDSON 2004). The observed insect die-off will have an increasingly negative impact on bats.

If the plan is not implemented, the impact on bats is likely to be the same as if the plan were implemented. It can also be assumed that any adverse effects on bats can be avoided by the same prevention and mitigation measures used to protect bird migration.

3.10 Biological diversity

Large-scale impacts of climate change can also be expected in the oceans. As many marine ecosystems are sensitive to climate change, this has implications for biodiversity. There may be a shift in the species spectrum. For example, a strong influence on the population density and dynamics of fish would be conceivable, which in turn would have significant consequences for food network. Overall, however, this development is independent of the implementation of the plan.

Local impacts on habitat diversity and biodiversity, e.g. through the introduction of hard substrate by the foundations and scour protection of the wind turbines, would not occur if the plan were not implemented. On the other hand, however, recovery of the benthos and fish communities with corresponding impacts on biodiversity would also no longer occur due to the suspension of fishing if the plan were not implemented. Large-scale impacts on biodiversity are not expected even if the Plan is not implemented.

3.11 Air

With increasing intensity of use, shipping traffic in the North Sea also increases, which can have a negative impact on air quality. However, this development is largely independent of the construction of a wind farm on site N-3.5, as the construction and operation of the turbines and the cabling within the wind farm would have no measurable impact on air quality in this area. Therefore, the development of the air quality as a protected resource is the same if the construction project is implemented as it is if the construction project is not implemented.

3.12 Climate

No impacts on the climate are expected from the construction and operation of wind turbines and the cabling within the park, as no measurable climate-relevant emissions occur either during construction or operation. Thus, the development of the climate as a protected good is independent of the non-implementation or implementation of the construction project on site N-3.5.

Negative impacts on the climate from the construction of wind energy plants are not expected, as no measurable climate-relevant emissions occur either during construction or operation. On the contrary, the CO_2 savings associated with the expansion of offshore wind energy can be expected to have a positive impact on the climate in the long term.

3.13 Landscape

The realisation of offshore wind farms has impacts on the seascape scenery because it is altered by the installation of vertical structures and security lights. The extent of these visual impairments to the seascape scenery caused by the planned offshore installations will depend to a large extent on the respective visibility conditions. Area N-3 is more than 30 km from the North Sea coast, which means that the existing and planned offshore installations are/will only be visible from land to a very limited extent (HASLØV & KJÆRSGAARD 2000), and only under good visibility conditions. The development of the seascape scenery in the absence of the development on site N-3.5 is not expected to differ significantly from the development in the presence of the development, as site N-3.5 is enclosed by other wind farms already constructed and planned.

3.14 Material assets, cultural heritage (archaeology)

According to current knowledge and on the basis of the preliminary investigations, no material assets or cultural heritage (e.g. wrecks or settlement remains) are known to exist in the area of site N-3.5. Nevertheless, the occurrence of cultural or material goods cannot be completely ruled out at this point in time. The preliminary investigation did not include a separate examination of the site for cultural assets.

The determination of suitability includes a requirement to identify and report cultural assets on the site and to take any resulting protective measures (§ 38 (1)). In addition, according to § 38 (3), an evaluation of the data obtained in the preliminary investigation on suspected cases of cultural property in the respective site must be submitted to the plan approval authority upon request.

Under these conditions, no significant impacts on the object of protection "cultural heritage and other material goods" are to be expected either in the case of implementation or non-implementation of the construction project on site N-3.5.

3.15 Protected property human beings including human health

Overall, the site has a low significance for human health and well-being. People are not directly affected by the plan, but at most indirectly through their perception of the landscape as an object of protection and possible influences on the recreational function of the landscape for water sports enthusiasts and tourists (cf. Chap. 2.16). If the construction project were not carried out, the site would theoretically be available for these uses. However, due to the considerable distance of more than 30 km to the coast, the site would in fact be used little or not at all for these purposes. In addition, the undeveloped site would be surrounded by other offshore wind farms and their safety zones with navigation regulations, so that use by recreational boats would only be possible to a limited extent even if the construction project were not carried out. Site N-3.5 is already used as a working environment due to the operation of the surrounding wind farms. This use would remain if the construction project were not carried out. Development would increase the importance of site N-3.5 as a working environment compared to no development.

3.16 Interactions between the factors

It is assumed that the interrelationships between the protected goods will develop in the same way regardless of whether the plan is implemented. At this point, please refer to the chapter 2.17.

4 Description and assessment of the likely significant effects of implementation of the plan on the marine environment

Pursuant to § 40 (1) UVPG, the likely significant environmental effects of implementing the plan must be described and assessed. The general procedure is already described in Chapter **1.5.3**.

The protected interests for which a significant adverse effect could already be ruled out in the previous chapter 2 are not considered. This applies to the protected goods air, climate, landscape, cultural heritage and other material goods, as well as to the protected good human beings, including human health. Possible impacts on biodiversity are dealt with in the individual biological assets. All the protected assets listed in § (2) (1) of the UVPG are examined before the species protection and area protection assessments are presented. Statements on the general protection of nature and landscape in accordance with § 13 of the Federal Nature Conservation Act are also covered in the assessment of the individual protected assets.

4.1 Soil/ site

4.1.1 Wind turbines and platforms

Wind turbines and platforms are currently installed almost exclusively as deep foundations. In deep foundations, the foundation of a wind turbine or platform is anchored in the seabed using one or more steel piles. The foundation piles are generally driven into the seabed.

To protect against scouring, scour protection in the form of riprap is primarily installed around the foundation elements or the foundation piles are installed correspondingly deeper into the ground.

The wind turbines and platforms have a locally limited environmental impact with regard to the seabed, which is the subject of the protection. The sediment is only permanently affected in the immediate vicinity by the introduction of the foundation elements (including scour protection, if necessary) and the resulting site use.

4.1.1.1 Construction-related

When the foundations of the wind turbines and platforms are being installed, sediment is briefly churned up and turbidity plumes are formed.

The extent of resuspension depends essentially on the fine grain content in the seabed. As the surface sediments in the area of site N-3.5 are mainly medium sandy fine sands, which have low silt contents of less than 5 %, the released sediment will quickly settle directly at the construction site or in its immediate vicinity. The anticipated impairments caused by increased turbidity will be limited to a small area.

Pollutants and nutrients can be released from the sediment into the groundwater in the short term. The potential introduction of pollutants into the water column by churned up sediment is negligible due to the relatively low fine-grain content (silt and clay) and the low pollutant load, and also the relatively rapid resedimentation of the sand. This also applies against the background that the sandy sediments are naturally (e.g. during storms) churned up and moved by sea waves touching the ground and appropriate currents.

Impacts in the form of mechanical stress on the seabed as a result of displacement, compaction, and vibrations that are to be expected in the course of the construction phase are assessed as low because of their small-scale nature. As part of the construction preparation measures for gravity foundations, it may be necessary to excavate construction pits. The movement of the excavated soil will result in the encroachment of additional sites.

4.1.1.2 Installation-related

Due to the type of installation, the seabed is only permanently sealed locally to a very limited extent by the insertion of the foundation elements of deep-foundation wind turbines or platforms. The sites that are affected essentially consist of the diameter of the foundation piles, plus any scour protection that may be required. By far the most common type of foundation in this case is the monopile. A monopile with a diameter of 8.5 m, including scour protection, requires a surface area of around 1400 m^2.

4.1.1.3 Operation-related

Because of the interrelationship between the foundation and the hydrodynamics in the immediate vicinity of the installation, the sandy sediments may be permanently stirred up and rearranged. Scouring may also occur in the immediate vicinity of the installations. Based on experience to date, permanent sediment shifting due to currents is only to be expected in the immediate vicinity of the facilities and platforms. These will arise locally around the individual foundation piles (local scour) according to the findings from the accompanying geological investigations in the “alpha ventus” offshore test site (LAMBERS-HUESMANN & ZEILER 2011) as well as on the FINO1 and FINO3 research platforms. Due to the prevailing properties of the seabed within site N-3.5 and the predicted spatially narrow scope of the scouring, no significant substrate changes are to be expected.

On the basis of the above statements and considering the assessment of the condition that the seabed in the study area is predominantly poorly structured with a homogeneous sediment distribution of medium sandy fine sands, the SEA concludes that no significant impacts on the protected resource soil are to be expected as a result of the determination of the turbine or platform locations.

4.1.2 In-park cabling

4.1.2.1 Construction-related

Due to construction, the turbidity of the water column increases as a result of the sediment swirl during the cable laying work, which is distributed over a larger site due to the influence of the tidal currents. The extent of the resuspension mainly depends on the laying method and the consistency of the seabed. Due to the prevailing sediment characteristics within the considered site N-3.5, most of the released sediment will settle directly at the construction site or in its immediate vicinity. The suspension content decreases to the natural background values due to dilution effects and sedimentation of the stirred up sediment particles. The impairment that is anticipated because of increased turbidity remains locally limited. The results of investigations of different methods in the North Sea reveal that the seabed levels off relatively quickly in some cases due to the natural sediment dynamics along the affected routes.

Pollutants and nutrients can be released from the sediment into the groundwater in the short term. The possible release of pollutants from the sandy sediment is negligible due to the low proportion of fine grains and the low concentrations of heavy metals in the sediment.

Impacts in the form of mechanical stress on the seabed as a result of displacement, compaction, and vibrations that are to be expected in the course of the construction phase are assessed as low because of their small-scale nature.

4.1.2.2 Operation-related

Operation-related B oth direct current and three-phase undersea cable systems heat up the surrounding sediment radially around the cable systems. The heat emission results from the thermal losses of the cable system during energy transmission.

With regard to possible negative impacts of heat emission from cable systems, the 2 K criterion represents a precautionary value which, according to the BfN's assessment based on the current state of knowledge, ensures with sufficient probability that significant negative impacts of cable heating on nature or the benthic community are avoided. In order to ensure compliance with the "2 K criterion", i.e. a maximum temperature increase of 2 degrees in 20 cm below the seabed surface, a corresponding principle on sediment heating has already been included in the BFO-N and continued in the FEP. The determination of suitability contains the requirement that the planning principle of the site development plan on sediment heating must be observed when dimensioning and laying the submarine cable systems within the park (§ 5).

Energy losses from cable systems depend on a number of factors. The following output parameters have a significant influence:

- Transmission technology: Basically, greater heat emission due to thermal losses can be assumed with three-phase submarine cable systems than with direct current submarine cable systems with the same transmission capacity (OSPAR Commission 2010).
- Ambient temperature in the vicinity of the cable systems: Depending on the water depth and the time of year, fluctuation of the natural sediment temperature can be assumed, which influences heat dissipation.
- Thermal resistance of the sediment: In the EEZ, and thus also on site N-3.5, predominantly water-saturated sands occur, for whose specific thermal resistance a size range of 0.4 to 0.7 KmW-1 is valid, taking into account various sources (Smolczyk 2001, Bartnikas & Srivastava 1999, VDI 1991, Barnes 1977). According to this, more efficient heat removal can be assumed for water-saturated coarse sands than for finer-grained sands.

For the temperature development in the sediment layer near the surface, the installation depth of the cable systems is also decisive. According to the current state of knowledge, no significant impacts from cable-induced sediment warming are to be expected if sufficient installation depth is maintained and state-of-the-art cable configurations are used. Temperature measurements on a park-internal rotary current cable system in the Danish offshore wind farm “Nysted” showed a sediment warming directly above the cable (transmission power of 166 MW) 20 cm below the seabed of max. 1.4 K (MEISSNER et al. 2007). The intensive water movement near the bottom of the North Sea also leads to the rapid removal of local heat.

Taking into account the above-mentioned results and forecasts, compliance with the so-called "2 K criterion" can be assumed for a laying depth of at least 1.50 m.

Table 9: Thermal properties of water-saturated soils (according to SMOLCZYK 2001)..

Soil type	**Thermal conductivity minimum**	**Thermal conductivity maximum**	**Specific thermal resistance maximum**	**Specific thermal resistance minimum**
	W / (K*m)	W / (K*m)	K*m/ W	K*m/ W
Gravel	2.00	3.30	0.50	0.30
Sand	1.50	2.50	0.67	0.40
Clay	0.90	1.80	1.11	0.56
Boulder clay	2.60	3.10	0.38	0.32

Soil type	Thermal conductivity minimum	Thermal conductivity maximum	Specific thermal resistance maximum	Specific thermal resistance minimum
Silt/ slick	1.40	2.00	0.71	0.50

Since the concrete impact of a cable system also depends on its cross-section and other properties, it does not appear to be expedient to determine a uniformly applicable value for the cover to be produced without knowledge of the concrete project parameters. The concrete coverage to be produced is determined in the individual approval procedure on the basis of a comprehensive study to be submitted by the developer. The interests of marine environmental protection must also be explicitly taken into account.

If the 2 K criterion according to the planning principle of the FEP and the requirement for sediment heating in § 5 of the determination of suitability are complied with, it can currently be assumed that no significant effects, such as structural and functional changes, are to be expected on the soil as a protected resource due to the cable-induced sediment heating. Due to the low proportion of organic material in the sediments of site N-3.5, the sediment heating is not expected to result in any significant release of pollutants.

4.2 Water

4.2.1 Wind turbines and platforms

4.2.1.1 Construction-related impacts - Resuspension of sediment

The installation of the foundation elements leads to a resuspension of sediment in the immediate vicinity. Depending on the fine grain content in the sediment, turbidity plumes may form in the lower water column, further reducing the already low visibility depths in these water depths. In this context, the content of organic material in the sediment can lead to higher oxygen depletion and release of nutrients and pollutants in the short term. However, due to the low organic content in the surface sediments of site N-3.5, this is not to be expected.

Overall, small-scale impacts of short duration and low intensity are expected. The structural and functional impairments are minor.

4.2.1.2 Impacts caused by the installation - Changes in currents and sea states

The support structures of offshore wind turbines represent obstacles in the body of water, which lead to a change in the flow conditions on both a small and medium scale. Numerical modelling of current conditions in offshore wind farms has already been carried out within the framework of the GIGAWIND project (ZIELKE et al. 2001, MITTENDORF & ZIELKE 2002, GIGAWIND / UNI HANNOVER 2003 and 2004).

From the modelling results it can be deduced that the flow velocity will increase in the immediate construction areas. The influence of a single structure on the flow extends laterally to a very small area. This can lead to a change in the dynamics of the stratification conditions in the water body in the immediate vicinity of the supporting structures. Due to the mixing within the water column, stratified water bodies may experience an increased oxygen input in greater water depths.

Furthermore, the swell changes due to the supporting structures, as they cause additional friction in the wave field. This leads to a slight decrease in wave height on the side facing away from the swell and to a slight increase in wave height on the side facing the current (HOFFMANNS & VERHEIJ 1997, CHAKRABARI 1987). According to the results of the Gigawind project, the influence of a single structure on the sea state, similar to that of the current, is limited to distances of about one to two structure diameters laterally and a few diameters behind. Wave dissipation is expected to result in minor attenuation, although the effect of large offshore wind farms on the wake of the wind field and thus on the wave field is the subject of current research.

The changes in the flow regime and sea state due to offshore wind turbines or offshore wind farms are long-term and medium-scale. The intensity of the effects is low. Based on this intensity assessment, the structural and functional changes are minor.

4.2.1.3 Operational impacts

To ensure the operation of offshore installations (wind turbines and platforms), techniques are used which may be associated with material inputs into the marine environment. In particular, the protection of structural installations against corrosion is associated with permanent emissions into the marine environment. At the same time, corrosion protection is essential for the structural integrity of the installations. Galvanic anodes (sacrificial anodes) can be used on the foundation structures as a common corrosion protection variant in the underwater area. Gradual dissolution of these anodes releases the components into the marine environment. The mass of anode required for a service life of 25 years varies depending on the foundation structure, type of structure and local environmental conditions. According to current experience in the offshore industry, emissions from wind turbines, for example, are around 150-700 kg per turbine per year. Galvanic anodes in the field of offshore wind energy typically consist of aluminium-zinc-indium alloys (approx. 95% aluminium, 2.5-5.75% zinc, 0.015-0.04% indium; DNV GL 2010 2010). In principle, the galvanic anodes may also contain small quantities of particularly environmentally critical heavy metals (e.g. cadmium, lead, copper) due to the production process (Reese et al. 2020), which are also released into the marine environment during operation. When assessing this impact, it must also be taken into account that inputs from corrosion protection are distributed throughout the North Sea system by distribution and dilution processes and do not necessarily accumulate locally and lead to harmful concentrations.

As an alternative to galvanic anodes, impressed current anodes have now established themselves on the market and are increasingly being used. These external current anodes are inert and only associated with minimal emissions (e.g. due to material removal).

With regard to the effects of corrosion protection-related emissions in the area of offshore wind farms, the BSH is conducting the research project "OffCHEm" (https://www.bsh.de/DE/THEMEN/Forschung_und_Entwicklung/Aktuelle-Projekte/OffChEm/OffChEm_node.html) in cooperation with the Helmholtz Centre Geesthacht. Initial results indicate that the metal contents in water and sediment samples from the wind farms investigated are within the range of North Sea variability. Therefore, according to the current state of investigation and knowledge, the existing environmental quality standards (insofar as they exist for the substances in question) are not currently exceeded in these areas due to corrosion-related inputs.

Nevertheless, in accordance with the precautionary principle, state of the art techniques for the protection of the marine environment must be used to avoid substance inputs. In particular, the use of external power systems is to be preferred. Furthermore, the use of galvanic anodes is only permitted in combination with coatings, which significantly reduces emissions from galvanic anodes into the body of water. Subsequently, only galvanic anodes whose production-related content of environmentally critical heavy metals is reduced to a minimum may be used.

For this reason, the effects from corrosion protection are assessed as long-term, small-scale and of low intensity according to current knowledge. The structural and functional changes are minor.

In addition to the material emissions from corrosion protection, there may also be other selective inputs into the water during the regular operation of platforms. Rainwater and drainage water can contain oil due to the operating materials contained in the platform equipment (e.g. operating materials released through leakages). Light liquid separators (oil separators) are therefore used to reduce the oil content of this wastewater. According to technical availability and the current state of implementation, the oil content is to be reduced procedurally to 5 ppm, so that the MARPOL directive for maritime shipping (limit value 15 ppm for bilge water) is undercut. On manned platforms, in exceptional cases, sewage water from sanitary facilities, laundry and canteen operations can be treated by certified sewage water treatment plants and reduced in view of the possible environmental impact of inadequate sewage water treatment. On platforms with low manning levels, this sewage water should always be collected and disposed of ashore. For the purpose of plant cooling, closed cooling systems without material discharges have generally been established on the platforms. Only in atypical exceptional cases can "open" state-of-the-art seawater cooling systems be approved. To ensure the permanent operational readiness of these system-relevant cooling systems, biocides (usually sodium hypochlorite) are added to protect pipelines and pumps from marine fouling. The sea cooling water is then discharged back into the sea; the components are then subject to local distribution and dilution processes.

The effects of the above-mentioned platform-side emissions into the water are also assessed as long-term, small-scale and of low intensity, assuming implementation of the state of the art and compliance with the minimisation requirement according to current knowledge. The structural and functional changes are minor.

For the operation of the wind turbines and platforms, high volumes of operating materials hazardous to water are inevitably required in some cases (including hydraulic oils, lubricating greases, transformer oils and diesel for emergency generators, extinguishing agents). Due to their material properties, these substances have a fundamental hazard potential for the marine environment. Risks resulting from spills or accidents can be prevented by taking precautionary and safety measures (e.g. enclosures, double-walled tanks, catch basins, management concepts). The same applies to fuel changes and refuelling measures. If environmentally compatible and, as far as possible, biodegradable substances are used, the overall impact on the marine environment resulting from accidental discharges is assessed as low, taking into account the probability of occurrence.

4.2.2 In-park cabling

Construction-related impacts - Resuspension of sediment

The installation of the in-park cabling will result in the resuspension of sediment in the immediate vicinity. Depending on the fine grain content in the sediment, turbidity plumes may form in the lower water column, further reducing the already low visibility depths in these water depths. Depending on the organic content, this can result in higher oxygen consumption and the release of nutrients and pollutants in the short term. However, due to the low content of organic material in the surface sediments of site N-3.5, this is not to be expected.

Overall, small-scale impacts of short duration and low intensity are expected. The structural and functional impairments are minor.

4.3 Biotope types

4.3.1 Wind turbines and residential platform

Possible impacts on the biotope types may result from a direct claim on protected biotopes, a possible cover by sedimentation of material released due to construction, as well as potential habitat changes.

In addition to a very homogeneous sediment composition, four objects with dimensions >2 m edge length were verified in the area of site N-3.5. Presumably, these are anthropogenic objects. However, as no diver or ROV video survey could be carried out, the presence of marine boulders as defined in the reef mapping guidance of the BFN (2018) cannot be excluded at this stage.

Due to the relatively small number of potential marine boulders, direct encroachment of protected biotopes by the turbines and the residential platform can probably be avoided as part of the project planning. Impacts due to sedimentation and habitat alteration are small-scale and short-term, respectively. Thus, significant construction-related, installation-related and operational impacts of the facilities on protected biotopes can probably be excluded.

Should indications of the presence of legally protected biotopes emerge after final evaluation of the preliminary investigations, these will be taken into account accordingly in the suitability assessment.

4.3.2 In-park cabling

Due to the relatively small number of potential marine boulders, direct encroachment of protected biotopes by the turbines and the residential platform can probably be avoided as part of the project planning. Impacts due to sedimentation and habitat alteration are small-scale and short-term, respectively. Thus, significant construction-related, installation-related and operational impacts of the facilities on protected biotopes can probably be excluded.

Should indications of the presence of legally protected biotopes emerge after final evaluation of the preliminary investigations, these will be taken into account accordingly in the suitability assessment.

4.4 Benthos

The construction of the residential platform and the wind turbines, as well as the turbines themselves, may have an impact on the macrozoobenthos.

Site N-3.5 has an average significance in terms of the species inventory of benthic organisms. The identified *Tellina-fabula*-community with elements of the *Nucula-nitidosa*- community also has no special features, as it is typical for the German North Sea due to the predominant sediments. The species inventory found and the number of Red List species indicate an average importance of site N-3.5 for benthic organisms.

The construction-related, installation-related and operational impacts of the plan are listed in detail in the Environmental Report on the FEP 2020 (BSH, 2020a) and are summarised below.

4.4.1 Wind turbines and residential platform

4.4.1.1 Construction-related

The deep foundation of the wind turbines and the residential platform will cause disturbance of the seabed, sediment turbulence and the formation of turbidity plumes. This can lead to the impairment or damage of benthic organisms or communities in the immediate vicinity of the installations for the duration of construction activities.

Due to the predominant sedimentary composition, the sediment released will settle quickly. The sand fraction is deposited again after small-scale drifting and can lead to impairments of the macrozoobenthos due to overtopping.

According to current knowledge, the construction-related impacts due to turbidity plumes and sedimentation are to be classified as short-term and small-scale.

4.4.1.2 Installation-related

Depending on the installation, changes in the benthic community may occur as a result of the sealing of the surface, the introduction of hard substrates and the alteration of the flow conditions around the facilities and the platform. In the area of the facilities and the associated scour protection, there will be site sealing/land use to the extent mentioned under **1.5.5.4** for the two scenarios and thus a complete loss of soft bottom macrozoobenthos habitats.

The recruitment of additional species will most likely come from the natural hard substrate habitats, such as superficial boulder clay and stones. This means that the risk of negative impacts on the benthic sandy seabed community by non-native species is low.

In the immediate vicinity of the structures, the benthic communities are influenced by a change from formerly sedentary and sessile species to mobile species due to sediment erosion and an increase in predators.

Therefore, according to the corresponding specification in the determination of suitability (§ 16), only fill made of natural stones or biologically inert and natural materials are to be used for scour protection, so that installation-related emissions of pollutants are not to be expected.

The restriction of fishing on site N-3.5 (see 3.3), which is to be expected on the basis of the legal framework and previous practice, could have a positive effect on the benthos. Associated negative fishing effects, such as disturbance of the seabed, would be eliminated or would not occur to the same extent. Due to the lack of or reduced fishing pressure, a more natural community structure of the benthos could develop within the project site.

Irrespective of the design of the future wind farm, the prohibition or significant restriction of fishing is likely to occur throughout site N-3.5, so that fishing disturbance would be eliminated or would occur to a lesser extent.

4.4.1.3 Operation-related

According to current knowledge, operational impacts of the wind turbines and the residential platform on the macrozoobenthos are not to be expected.

Sewage water is to be collected professionally as a matter of priority, transported ashore and disposed of properly there. Thus, according to current knowledge, taking into account the above-mentioned requirements of the determination of suitability, no significant impacts are to be expected from the discharge of wastewater and the use of corrosion protection systems.

Based on the above statements and representations, the SEA concludes that, according to the current state of knowledge, the construction and operation of the wind turbines and the residential platform are not expected to have any significant impacts on the benthos in site N-3.5. Overall, the impacts are estimated to be short-term and small-scale. Only small-scale areas outside protected areas are used and, due to the usually rapid regeneration capacity of the existing populations of benthic organisms with short generation cycles and their widespread distribution in the German Bight, rapid recolonisation is very likely.

Overall, the impacts are estimated to be short-term and small-scale. Only very small areas outside protected areas are taken up, and due to the mostly fast regenerative capacity of the occurring populations of benthic organisms with short generation cycles and their widespread distribution in the German Bight, rapid recolonisation is very likely.

4.4.2 In-park cabling

4.4.2.1 Construction-related

Possible effects on benthic organisms depend on the installation methods used. Local sediment swirling and turbidity plumes are to be expected for the duration of the installation of the cabling within the park. This may result in a small-scale and short-term loss of habitat for benthic species or impairment or damage to benthic organisms or communities during construction activities in the vicinity of the cable systems. The linear character of submarine cable systems favours repopulation from undisturbed peripheral areas.

Benthic organisms may also be affected in the short term and on a small scale by the release of nutrients and pollutants associated with the resuspension of sediment particles. The impacts are generally considered to be minor, as the flushing in of the cable systems is limited in time and space and the pollutant load in the EEZ area is comparatively low and nutrients or pollutants are quickly diluted.

4.4.2.2 Installation-related

In the area of any cable crossings, the disturbances are permanent but also small-scale. Required cable crossings are secured with stone fill which permanently represents a hard substrate unfamiliar to the site. The hard substrate that is foreign to the location provides new habitats for benthic organisms.

According to the specifications of the determination of suitability, only fills made of natural stones or biologically inert and natural materials are to be used in the area of cable crossings. The use of cable protection systems containing plastic is only permitted in exceptional cases and must be kept to a minimum. Thus, according to current knowledge, installation-related emissions of pollutants are not to be expected.

4.4.2.3 Operation-related

In terms of operation, warming of the uppermost sediment layer of the seabed can occur directly above the cable system, which can cause a reduction in the winter mortality of the infauna and lead to a change in the species communities in the area of the cable routes. According to current knowledge, if sufficient installation depth is maintained and state of the art cable configurations are used, the 2K criterion can be met and no significant impacts on benthos are expected due to cable-induced sediment heating. The determination of suitability includes the requirement to observe the corresponding FEP planning principle on sediment heating when dimensioning and laying the park-internal submarine cable systems.

The same assumptions apply to electric and electromagnetic fields. These are also not expected to have a significant impact on the macrozoobenthos.

According to current knowledge, no significant effects on the benthic communities are expected from the laying and operation of the submarine cable systems, assuming a sufficient laying depth and considering that the effects will occur on a small scale, i.e. only a few metres on either side of the cable. According to current knowledge, the ecological effects are small-scale and mostly short-term.

4.5 Fish

The fish fauna in area N-3.5 shows a typical species composition of the German Bight. The demersal fish community is also dominated by flatfish species in the North of Borkum sea area.

According to current knowledge, the planned site does not represent a preferred habitat for any of the fish species protected under the Red List and the Habitats Directive. Consequently, the fish population in planning area N-3.5 is not of outstanding ecological importance (see explanations in chapter **2.6**).

4.5.1 Wind turbines and residential platform

For the assessment of the construction- and dismantling-related impacts as well as the installation- and operation-related effects of a wind farm on the fish community, two project-specific scenarios are used as a basis at the current planning stage (cf. chapter **1.5.5.4**). The parameters relevant for the fish fauna are shown in Table 10. In scenario 1, the planning is based on 42 wind turbines, in scenario 2 the installation of 21 larger turbines is considered.

Possible effects of the different wind farm phases on the fish fauna are presented below and transferred to the impact criteria of the two model wind farm scenarios.

Table 10: Relevant wind farm parameters for assessing the impacts of the model wind farm scenarios on fish fauna.

Parameters	Scenario 1	Scenario 2
Number of installations	42	21
Diameter of foundation [m]	10	15
Site of foundation excl. scour protection [m²]	79	177
Diameter of scour protection [m]	50	75
Site of foundation incl. scour protection [m²]	1963	4418

4.5.1.1 Construction-related

- Noise emissions due to pile driving of the foundations
- Sedimentation and turbidity plumes

<u>Noise emissions</u>

All of the fish species which have been investigated so far and their stages of life can perceive sound as particle movement and pressure changes (KNUST et al. 2003, KUNC et al. 2016, WEILGART 2018, POPPER & HAWKINS 2019). Depending on the intensity, frequency and duration of sound events, sound can have a direct negative impact on fish development, growth and behaviour, or override environmental acoustic signals that are sometimes crucial for fish survival (KUNC et al. 2016, WEILGART 2018). However, most of the evidence to date on the effects of sound on fish comes from laboratory studies (WEILGART 2018). There have been few studies of the range of perception and possible species-specific behavioural reactions in the marine habitat to date. The construction and decommissioning impacts of wind farms on fish fauna are spatially and temporally limited. It is likely that during the construction phase, short, intense sound events - especially during the installation of the established fundaments - will displace fish. In the Belgian EEZ, DE BACKER et al. (2017) showed that the sound pressure generated during pile driving was sufficient to cause internal bleeding and barotrauma of the swim bladder in cod. This effect was observed at a distance of 1,400 m or closer from a pile-driving sound source without any sound protection (DE BACKER et al. 2017). Investigations such as this indicate that significant disturbances or even the killing of individual fish in the vicinity of the ramming points are possible. The risk to fish posed by the noise from pile driving is likely to be reduced by the noise mitigation measures that have been ordered. Some aspects of the marine mammal deterrence measures are likely to be applicable to fish. In accordance with the planning principle for sound reduction during pile driving, an emitted sound event level of less than 160 dB re 1µPa²s outside a circle with a radius of 750 m around the pile driving or insertion site is to be maintained as a noise protection value.
After temporary displacement, the fish are likely to return after completion of the sound-intensive construction measures.

For the consideration of the wind farm scenarios, the specifications on mitigation measures for noise input included in the suitability assessment are used as a basis, which were originally introduced to protect marine mammals, so that the emitted sound level is below 160 dB outside a circle with a radius of 750 m around the pile driving site. The duration of construction activities and the associated noise emissions are comparable in both scenarios. In scenario 1, the pile-driving duration of the individual wind turbines is shorter than in scenario 2 due to the smaller foundations. However, the installation of 42 smaller turbines takes longer in total, so that overall a similar pile driving time is assumed for both scenarios. The risk of injury to fish in the vicinity of the pile driving sites could be increased in the first scenario due to the larger number of sites with sudden levels of noise. However, the prior deterrence should induce a flight reaction of the animals. A significant impairment of fish as a protected resource is therefore not to be expected from the construction of the wind farm, provided that deterrence and mitigation measures are applied.

<u>Sedimentation and turbidity plumes</u>

The construction activities of the foundations of the wind turbines as well as the residential platform and the cabling within the park cause sedimentation and turbidity plumes, which - albeit temporary and species-specific - can cause physiological impairments and scaring effects. Predators that hunt in open water (e.g. mackerel and horse mackerel) avoid areas with high sediment loads and thus avoid the danger of gill adhesion (Ehrich & Stransky 1999). An endangerment of these species as a result of sediment turbulence does not seem likely due to their high mobility. Neither is any impairment of bottom-dwelling fish to be expected due to their good swimming properties and the associated evasion possibilities. In the case of plaice and sole, even increased foraging activity was observed after storm-induced sediment disturbance (Ehrich et al. 1998). In principle, however, fish can avoid disturbances due to their distinct sensory abilities (lateral line) and their high mobility, so that impairments are unlikely for adult fish. Eggs and larvae whose reception, processing and implementation of sensory stimuli are not yet or only slightly developed are generally more sensitive than adults of the same species. However, the spawning areas of most fish species are located outside the wind farm site of N-3.5 to be developed. After fertilisation, fish eggs form a dermis which makes them robust against mechanical stimuli, e.g. sediments that have been churned up. Although the concentration of suspended particles can reach values that are harmful to certain organisms, the effects on fish are to be regarded as relatively low, since such concentrations occur only spatially and temporally in a limited manner and are quickly degraded again by dilution and distribution effects (Herrmann & Krause 2000). This also applies to possible increases in concentrations of nutrients and pollutants due to the resuspension of sediment particles (ICES 1992, ICES WGEXT 1998). In the case of sedimentation of the released substrate, the main risk is coverage of fish spawn deposited on the bottom. This can result in a lack of oxygen supply to the eggs and, depending on the efficiency and duration of the sedimentation process, can lead to damage or even death of the spawn. For most fish species present in the EEZ, no damage to the spawning stock is expected, since they either have pelagic eggs and/or their spawning grounds are in shallow water outside the EEZ. The early life stages may also be adapted to turbulence, which regularly occurs in the North Sea due to natural phenomena such as storms or currents.

The more construction activities take place in site N-3.5, the higher the sedimentation and turbidity plumes. Accordingly, increased sediment suspension is to be expected in the immediate vicinity of the 42 foundation structures of the first scenario, compared to the construction of 21 wind turbines of the second scenario. In scenario 1, more wind turbines have to be connected by internal cabling, so that the sediment suspension is greater than in scenario 2, especially when the submarine cables are flushed in. As a result, a possible impact on fish fauna is more likely in Scenario 1 than in Scenario 2. Sediment resuspension is limited in time and space, so that impairments are only temporary. In addition, fish are adapted to sediment resuspension in the North Sea in a variety of ways. A significant impact on fish fauna due to construction activities is not expected for either Scenario 1 or Scenario 2.

4.5.1.2 Installation-related

- Land use
- Introduction of hard substrate
- Probable restriction of fishing

Land use

After completion of the foundations, part of the site will no longer be available for the demersal fish community. There will be a loss of habitat for benthic fish species and their food base, the macrozoobenthic, due to the local overbuilding.

With a total area of 45,149 m² in scenario 1, the habitat loss is significantly lower than the site loss of 53,016 m² in scenario 2 (area of foundation incl. scour protection). For the demersal fish fauna, the implementation of the first model wind farm scenario would preserve a larger site of their habitat.

Introduction of hard substrate

The construction of wind farms alters the habitat structure of site N-3.5 through the introduction of hard substrate (foundations, scour protection). An attraction effect of artificial reefs on fish has been observed in the majority of cases (METHRATTA & DARDICK 2019). GLAROU et al (2020) evaluated 89 scientific studies on artificial reefs, 94% of which showed that artificial reefs have positive or no effect on the abundance and biodiversity of the fish population. In 49% of the studies, a local increase in the abundance of fish was recorded after the construction of artificial reefs. Reasons for increased fish abundance on artificial reefs could be the locally more abundant food availability and protection from currents and predators (GLAROU et al. 2020).

The attractiveness of artificial substrates for fish depends on the size of the hard substrate introduced (OGAWA et al. 1977). The effective radius is assumed to be 200 to 300 m for pelagic fish and up to 100 m for benthic fish. (GROVE et al. 1989). STANLEY & WILSON (1997) both found increased fish densities within 16 m of an oil rig in the Gulf of Mexico. When this is transferred to the foundations of the wind turbines, due to the distance between the individual turbines it can be assumed that each individual foundation, regardless of the type of foundation, acts as a separate, relatively unstructured substrate and the effect does not cover the entire site of the wind farm.

COUPERUS et al. (2010) found a concentration of pelagic fish that was up to 37 times greater in the vicinity (0-20 m) of wind turbine foundations using hydroacoustic methods in comparison to the areas between the individual wind turbines. REUBENS et al. (2013) found significantly higher concentrations of Franzosendorschen at wind turbine foundations than over the surrounding soft substrate, feeding predominantly on the fouling on the foundations.

OWPs could not only provide an aggregation site for various fish species, but also increase the productivity of some species in the site. Recent biological studies have shown that cod reproduce in the wind farms of the "Nördlich Helgoland" cluster (GIMPEL et al. in prep.). This evidence serves as an indication of the impact of OWPs on productivity and would need to be further investigated.
With potentially increased species diversity, biomass and productivity of the fish community in OWPs, the dominance relationships within the fish community could lead to increased feeding pressure on one or more prey fish species as a result of the increase in large predators.

In terms of the model wind farm scenarios, the presence and abundance of fish species could increase in Scenario 1 due to the higher number of turbines, potentially increasing biodiversity on site N-3.5 more than in Scenario 2. As a result of colonisation by benthic invertebrates, more fish individuals could accumulate in the vicinity of the 42 wind turbines than at 21 wind turbines. Consequential effects would then be, as mentioned above, an improved food basis, higher biodiversity, but also increased feeding pressure or a change in dominance ratios.

Probable restriction of fishing

The restriction of fishing on site N-3.5 (see 3.3), which is to be expected on the basis of the legal framework and previous practice, could have a further positive effect on the fish fauna. Associated negative fishing effects, such as disturbance of the seabed and catch and bycatch of many species, would be eliminated or would not occur to the same extent. Due to the lack of or reduced fishing pressure, the age structure of the fish fauna within the project site could develop into a more natural distribution again, so that the number of older individuals increases. In particular, site-faithful fish species would benefit from the restricted use. To date, the effects on fish fauna that could result from the restriction or elimination of fishing in the area of offshore wind farms have not been quantitatively investigated. Therefore, there is currently a need for research to transfer such effects to the population level of fish.

Irrespective of the design of the future wind farm, the prohibition or significant restriction of fishing is likely to occur throughout site N-3.5, so that fishing disturbance would be eliminated or would occur to a lesser extent.

4.5.2 In-park cabling

4.5.2.1 Construction-related

- Noise emissions
- Sedimentation and turbidity plumes

During the construction phase of submarine cable systems, fish fauna may be temporarily disturbed by noise and vibrations caused by the use of ships and cranes as well as by the installation of the cable systems. Furthermore, construction-related turbidity plumes can occur close to the bottom and local sediment shifting can take place, which can damage fish spawn and larvae in particular. The ecological effects of turbidity plumes on fish are described in detail in the chapter 4.5.1.1. The effects on fish in areas with sediment redistribution are short-term and geographically limited.

The more construction activities take place in site N-3.5, the higher the noise emissions and sedimentation. In Scenario 1, more WTGs have to be connected by cabling within the park, so that sediment turbulence is greater than in Scenario 2, especially when the submarine cables are flushed in. As a result, a possible impact on fish fauna is more likely in Scenario 1 than in Scenario 2. Sediment resuspension is limited in time and space, so that impairments are only temporary. In addition, fish are adapted to sediment resuspension in the North Sea in a variety of ways. A significant impact on fish fauna due to construction activities is not expected for either Scenario 1 or Scenario 2.

4.5.2.2 Installation-related

- Habitat alteration due to cable crossings

The rock fills in the vicinity of the planned pipeline crossings are expected to cause a local change in the fish community. A change in the fish community may lead to a change in dominance ratios and the food network. However, due to the small-scale nature of the cable crossing structures, these effects are to be considered minor.

4.5.2.3 Operation-related

- Heating of the sediment
- Electric / electromagnetic fields

Heating of the sediment

The determination of suitability contains a requirement (§ 5) for sediment heating in the immediate vicinity of the cables, with which reference is made to the planning principle of the FEP. Experience shows that it will not exceed the precautionary value of 2K at 20 cm sediment depth. Therefore, no significant impacts on fish fauna are expected.

Electric / electromagnetic fields

The generation of magnetic fields cannot be ruled out during the operation of submarine cables. Direct electric fields do not occur in a significantly measurable way in either the direct current or the three-phase submarine cable systems. Magnetic fields of the individual cable systems largely cancel each other out in the planned bipolar (forward and return conductors) or three-wire cable configurations. Modelling for direct current submarine cable systems resulted in values of 11 to max. 15 µT at the seabed surface (PGU 2012a, PGU 2012b). In comparison, the natural magnetic field of the earth is 30 to 60 µT, depending on the location. Due to the lower load current and the three-wire technology, a weaker magnetic field can be assumed for three-phase cable systems than for DC cable systems. Values of less than 10 µT can be expected for three-phase cable systems. The strongest magnetic fields occur directly above the cable system. The strength of the fields decreases relatively quickly with increasing distance from the cable system. Orientation to the geomagnetic field has been documented for a number of fish species, especially migratory species such as salmon and river eel. These species can perceive electric fields, which in some cases can lead to behavioural changes (MARHOLD & KULLINK 2000). According to KULLINK & MARHOLD (1999), a possible impairment of the orientation behaviour of adult specimens of species that use electric or magnetic fields for orientation (such as eels, sharks, salmon) is at most short-term, as shown by experiments on Baltic Sea eels. Fish rely on different environmental parameters, which in interaction are responsible for orientation performance.

4.6 Marine mammals

According to current knowledge, it can be assumed that the German EEZ is used by harbour porpoises for transiting, staying and also food- and area-specific breeding. Based on the available findings, particularly from the current studies for offshore wind farms and the monitoring of Natura2000 areas, a medium to seasonally high importance of the area in which site N-3.5 is located for harbour porpoises can be deduced. Site N-3.5 is of medium importance for harbour seals and grey seals.

4.6.1 Wind turbines and residential platform

4.6.1.1 Construction-related

Harbour porpoises, grey seals and seals can be at risk from noise emissions during the construction of offshore wind turbines and the residential platform unless avoidance and reduction measures are taken. Depending on the foundation method, impulse sound or continuous sound can be introduced. The introduction of impulse noise, which is generated when piles are being driven with hydraulic hammers, for example, has been thoroughly investigated. The current state of knowledge about impulse noise makes a significant contribution to the development of technical noise reduction systems. On the other hand, little knowledge is available about the introduction of continuous sound resulting from the driving of foundation piles using alternative methods.

The Federal Environment Agency (UBA) recommends compliance with noise protection values during the installation of foundations for offshore wind turbines. The sound event level (SEL) outside of a circle with a radius of 750 m around the pile-driving or insertion point must not exceed 160 dB (re 1 µPa). The maximum peak sound pressure level must not exceed 190 dB if possible. The UBA recommendation does not include any further concretisation of the SEL noise protection value (http://www.umweltdaten.de/publikationen/fpdf-l/4118.pdf, as of: May 2011).

The noise protection value recommended by UBA has already been worked out by means of preliminary work in various projects (UNIVERSITY OF HANNOVER, ITAP, FTZ 2003). For precautionary reasons, "safety margins" have been taken into consideration, e.g. for the inter-individual distribution of hearing sensitivity which has been documented to date, and particularly because of the problem of repeated exposure to loud sound impulses such as the ones that will occur when foundations are being rammed (ELMER et al., 2007). At present, only a small amount of reliable data is available for evaluating the effect duration of exposure to pile-driving sounds. However, pile-driving operations, which can last several hours, are much more potentially damaging than a single pile driving operation. It currently remains unclear what kind of deduction should be applied to the above-mentioned limit value should be applied to a series of individual events. A deduction of 3 dB to 5 dB for each tenfold increase in the number of pile-driving impulses is being discussed among experts. Because of the uncertainties shown here in the evaluation of the effect duration, the limit value that is used in licensing practice is less than the limit value proposed by SOUTHALL et al (2007).

As part of the development of a measurement specification for recording and evaluating underwater noise from offshore wind farms, the BSH has concretised the specifications from the UBA recommendation (UBA 2011) and the findings of the research projects with regard to noise protection values and standardised them as much as possible. In the BSH's measurement regulations for underwater sound measurements, the SEL_5 value is defined as the assessment level, i.e. 95% of the measured individual sound event levels must be below the statistically determined SEL_5 value (BSH 2011). The extensive measurements within the scope of the efficiency control show that the SEL_5 is up to 3 dB higher than the SEL_{50}. Therefore, by defining the SEL_5 value as an assessment level, a further tightening of the noise protection value was made in order to take the precautionary principle into consideration.

In its overall assessment of the available expert information, the BSH therefore assumes that the sound event level (SEL_5) outside of a circle with a radius of 750 m around the pile-driving or introduction site must not exceed 160 dB (re 1 µPa) in order to be able to rule out adverse effects on harbour porpoises with the required certainty.

Initial results concerning the acoustic resilience of harbour porpoises have been obtained as part of the MINOSplus project. After sonication with a maximum reception level of 200 pk-pk dB re 1 µPa and an energy flux density of 164 dB re 1 µPa2/Hz, a temporary hearing threshold shift (TTS) was detected for the first time in a captive animal at 4 kHz. It was also shown that the hearing threshold shift lasted for more than 24 hours. Behavioural changes were already registered in the animal at a reception level of 174 pk-pk dB re 1 µPa (LUCKE et al. 2009). However, in addition to the absolute volume, the duration of the signal also determines the effects on the exposure limit. The exposure limit decreases as the duration of the signal increases, i.e. damage to the hearing of the animals can occur in the event of prolonged exposure, even at lower volumes. Based on these latest findings, it is clear that harbour porpoises suffer a hearing threshold shift above 200 decibels (dB) at the latest, which may also lead to damage to vital sensory organs.

The scientific findings that have led to the recommendation or setting of so-called noise limits are mainly based on observations of other cetacean species (SOUTHALL et al. 2007) or on experiments on harbour porpoises in captivity using so-called airguns or air pulsers (LUCKE et al. 2009).

Without the use of noise-reducing measures, considerable impairment to marine mammals during the pile driving of the foundations cannot be ruled out. The pile driving for the wind turbines and the residential platform will therefore only be permitted in the specific approval procedure with the use of effective noise reduction measures. Principles will be included for this purpose. These state that the pile driving work during the installation of the foundations of offshore wind turbines and platforms is only to be carried out in compliance with strict noise reduction measures. In the specific approval procedure, extensive noise reduction measures and monitoring measures will be arranged in order to ensure that the applicable noise protection values (noise event level (SEL) of 160 dB re 1µPa and maximum peak level of 190 dB re 1µPa at a distance of 750 m around the pile-driving or introduction point) are complied with. Suitable measures must be taken to ensure that no marine mammals are present in the vicinity of the pile-driving site.

Current technical developments in the field of reducing underwater noise show that the use of suitable systems can significantly reduce or even completely prevent the effects of noise input on marine mammals (BELLMANN 2020).

Taking the current state of knowledge into consideration, the licensing procedure will contain conditions as part of the specification of the types of foundation to be constructed with the goal of avoiding effects on harbour porpoises caused by noise to as great an extent as possible. The extent of the necessary conditions will result from the checking of the structural design in a location and project-specific way at approval level on the basis of the species protection law and area protection law requirements.

The noise abatement concept of BMU has also been in force since 2013. The approach of the BMU noise abatement concept is habitat-related. According to the noise abatement concept, pile driving work must be temporally coordinated in such a way that sufficiently large areas, especially within the German EEZ in the North Sea and especially within the protected areas and the main concentration area of the harbour porpoise during the summer months are kept free from effects caused by impact noise.

The approval notices of the BSH include two orders for the protection of the marine environment from noise emissions caused by pile driving work:

- Noise reduction at source: Mandatory use of low-noise working methods in accordance with the state of the art for driving foundation piles, and mandatory limitation of noise emissions during pile driving. The ordinance is primarily intended to protect marine species from pulsating noise input by avoiding deaths and injuries.
- Avoidance of significant cumulative effects: The spread of noise emissions must not exceed a defined site percentage of the German EEZ and the nature conservation areas. This ensures that sufficient high-quality habitats are available to the animals at all times for their avoidance. The primary purpose of the ordinance is to protect marine habitats by preventing and minimising disturbances caused by impulsive noise.

The order under a) specifies the noise protection values to be complied with and the maximum duration of the pulsating sound input, the use of technical noise reduction systems and deterrence and the extent of the monitoring of the protective measures.

Under order b), provisions are made for avoiding and reducing significant cumulative effects or disturbances to the harbour porpoise population which may be caused by pulsating sound impacts, among other things. The provisions are derived from the BMU concept for the protection of harbour porpoises in the German North Sea EEZ (BMU, 2013).

- It shall be ensured with the necessary certainty that at any time no more than 10% of the site of the German EEZ of the North Sea and no more than 10% of a neighbouring nature conservation area is affected by noise-inducing pile driving activities.
- During the sensitive period of the harbour porpoise from 1 May to 31 August, it shall be ensured with the necessary certainty that no more than 1% of sub-area I of the nature conservation area “Sylter Außenriff – Östliche Deutsche Bucht” with its special function as a nursery area* is affected by sound-intensive pile driving work for the foundation of the piles from disturbance-triggering sound inputs.

In order to ensure that marine habitats are protected, the BMU noise abatement concept of (2013) states that, depending on the location of a project in the German EEZ or its proximity to nature conservation areas, additional measures are required during foundation work. Additional measures will be issued by the BSH within the scope of the third construction approval, taking the site-specific and project-specific characteristics into consideration.

In general, the considerations mentioned for harbour porpoises regarding noise exposure from construction and operation activities of wind turbines and platforms also apply to all other marine mammals occurring in the indirect vicinity of the structures.

Especially during pile driving, direct disturbance of marine mammals at the individual level can be expected locally around the pile driving site and for a limited time, whereby – as explained above – the duration of the work also has impacts on the exposure limit. In order to prevent a resulting threat to the marine environment, the specific approval procedure must include an order to minimise the effective pile driving time (including the entanglement). The effective pile driving time to be observed in each case (including deterrence) will be specified later in the approval procedure on a location- and installation-specific basis. As part of the enforcement procedure, the coordination of noise-intensive works with other construction projects is also reserved in order to prevent or reduce cumulative effects.

On the basis of the function-dependent importance of the areas for harbour porpoises and taking the noise abatement concept of the BMU (2013) into consideration for avoiding disturbances and cumulative effects, the provisions made in the site development plan (FEP, 2019), the specifications within the scope of the suitability assessment and the conditions imposed within the scope of individual approval procedures for reducing noise input, the potential effects of noise-intensive construction work on harbour porpoises are not considered to be significant. By protecting open space in nature conservation areas, defining the reserve area and implementing the specifications of the BMUB's noise abatement concept, the impairment of important feeding and breeding grounds for harbour porpoises is ruled out.

4.6.1.2 Operation-related

According to current knowledge, operational noise from the wind turbines and the residential platform has no impact on highly mobile animals such as marine mammals. The investigations carried out as part of the operational monitoring for offshore wind farms have so far given no indications of avoidance by wind farm-related shipping traffic. So far, avoidance has been observed only during the installation of the foundations; this may be related to the large number and varying operating conditions of vehicles on the site.

The standardised measurements of the continuous noise input from the operation of the wind farms, including the wind farm-related shipping traffic, have shown that low-frequency noise can be measured at a distance of 100 m from the respective wind turbine. However, with increasing distance from the installation, the noise from the installation is only insignificantly different from the ambient sound. At a distance of only 1 km from the wind farm, higher sound levels are always measured than in the centre of the wind farm. The investigations have clearly shown that the underwater noise emitted by the installations cannot be clearly identified from other sound sources (e.g. waves or ship noise) even at short distances. It was also hardly possible to differentiate the wind farm-related shipping traffic from the general ambient noise, which is introduced by various sound sources such as other shipping traffic, wind and waves, rain and other uses (MATUSCHEK et al. 2018).

All of the measurements showed that not only the offshore wind turbines emit sound into the water, but also various natural sound sources such as wind and waves (permanent background sound) can be detected in the water in a broadband manner and contribute to the broadband permanent background sound.

In the measurement regulation for the recording and evaluation of underwater noise (BSH, 2011), a level difference of at least 10 dB is required between pulsating and background noise for a technically unambiguous calculation of impulse noise during pile driving. On the other hand, for the calculation or evaluation of continuous sound measurements there is no minimum requirement in this respect due to a lack of experience and data. Within the airborne sound range, a level difference of at least 6 dB is required between plant and background noise in order to achieve an unambiguous assessment of installation noise and operating noise. If this level difference is not achieved, a technically unambiguous assessment of the installation noise is not possible, or the installation noise is not clearly distinguishable from the background noise level.

The results from the measurements of underwater sound that are available show that a 6 dB criterion such as this based on airborne sound can only be fulfilled in the close proximity to one of the installations at most. However, this criterion is no longer fulfilled even a short distance from the edge of the wind farm. As a result, from an acoustic point of view, the sound emitted by the operation of the wind turbines outside the project areas does not clearly differ from the existing ambient noise.

The biological relevance of continuous sound on marine species, particularly harbour porpoises, has not yet been conclusively clarified. Continuous noise is the result of emissions from various anthropogenic uses, but also from natural sources. Reactions of animals in the immediate vicinity of a source such as a moving ship are to be expected and can occasionally be observed (Wisniewska et al., 2018). Such reactions are even essential for survival to avoid collisions, for example. On the other hand, reactions that have not been observed in close proximity to sound sources can no longer be assigned to a specific source.

The vast majority of behavioural changes are the result of a wide range of effects. Noise can certainly be a possible cause of behavioural changes. However, behavioural changes are primarily controlled by the survival strategy of the animals, for preying on food, for escaping from predators and for communicating with members of the same species. For this reason, behavioural changes always occur in a situational way and in a different form.

The literature contains references to possible behavioural changes caused by ship noise, but the results are not valid for drawing conclusions about the significance of behavioural changes or even for developing and implementing suitable mitigation measures.

Scientific reviews of the existing literature on possible effects of ship noise on cetaceans but also on fish clearly point to the lack of comparability, transferability and reproducibility of results (Popper & Hawkins, 2019, Erbe et al. 2019).

The now long-standing studies according to StUK in the context of operational monitoring of offshore wind farms in the German EEZ of the North Sea have so far not provided any evidence indicating avoidance or behavioural change of harbour porpoises in the wind farms, their surroundings and along shipping lanes (BioConsultSH, 2019, IfAÖ et al., 2018 and 2019, IBL et al., 2018). In the southern area of the German EEZ of the North Sea, of all places, with the two traffic separation areas and now with nine offshore wind farms in operation, the occurrence of harbour porpoise has increased since 2012 (NACHTSHEIM et al., 2021, GILLES et al., 2019).

Previous evaluations of the service traffic of some wind farms show that there are on average three trips per day for the purpose of supply, maintenance or repair of turbines. Thus, the average number of wind farm-related vessel movements is within the range of normal vessel traffic in and around the sites of offshore wind farms, as it was before the wind farms were built. Due to the bypassing of the wind farm sites from commercial shipping and the expected exclusion or considerable restriction of the use of fishing vessels (see 3.3), wind farms are to be described as rather traffic quiet zones.

It is known from oil and gas platforms that the attraction of various fish species leads to an enrichment of the food supply (FABI et al., 2004; LOKKEBORG et al., 2002). The recording of harbour porpoise activity in close proximity to platforms has also shown an increase in harbour porpoise activity associated with foraging during the night (TODD et al., 2009). It can therefore be assumed that the potentially increased food supply in the vicinity of the wind turbines and the residential platform is very likely to be attractive to marine mammals.

As a result of the SEA, it can be stated that, according to the current state of knowledge, no significant impacts on the protected marine mammals are to be expected as a result of the construction and operation of wind turbines and the residential platform within site N-3.5.

4.6.2 In-park cabling

4.6.2.1 Construction-related

During the installation phase, which is limited in time and space, short-term scaring effects may occur due to construction-related shipping traffic. However, these effects do not go beyond the disturbances generally associated with slow ship movements. Possible changes in sediment structure and associated temporary benthic changes will not have a significant impact on marine mammals, as they forage for prey in widely extended areas in the water column.

4.6.2.2 Operation-related

Operational sediment heating has no direct impact on highly mobile animals such as marine mammals. The influence of electromagnetic fields from submarine cables on the migration behaviour of marine mammals is largely unknown (GILL et al. 2005). However, as the magnetic fields that occur are significantly below the natural magnetic field of the Earth, no significant impacts on marine mammals are to be expected.

As a result of the SEA, it can be stated that, according to current knowledge, no significant impacts on marine mammals are to be expected from the laying and operation of the cabling within the park.

As a result of the SEA, it can be stated that, according to the current state of knowledge, no significant impacts on the protected marine mammals are to be expected as a result of the laying and operation of current-carrying cables.

4.7 Seabirds and resting birds

4.7.1 Wind turbines

If the determination of suitability of site N-3.5 is determined and an offshore wind farm project is realised on this site, the following general impacts may occur:

4.7.1.1 Construction-related

During the construction of offshore wind turbines, impacts on seabirds and resting birds can be expected, although the nature and extent of these impacts will be limited in time and space.

Species sensitive to disturbance may react with avoidance behaviour to the construction site or construction site traffic. Turbidity plumes may result from the installation process. Attracting effects caused by the illumination of the construction site and the construction site vehicles cannot be ruled out.

The potential impacts during the construction phase of an OWP on site N-3.5 are to be assessed as spatially and temporally local. The construction-related shipping traffic will not exceed the level of impact that regular shipping has on seabirds in the area between the two traffic separation areas North of Borkum. Turbidity plumes will also only occur locally and for a limited time. With regard to possible attracting effects caused by the lighting, a requirement to minimise emissions was included in the determination of suitability (§ 6) in order to, among other things, reduce light emissions to a necessary minimum, and thus also possible attraction effects. In conclusion, due to the generally high mobility of birds and the specification of measures to avoid and reduce intensive disturbance by coordinating construction activities, significant impacts on all species of seabirds and resting birds during the construction phase can be excluded with the necessary certainty.

4.7.1.2 Operation-related and installation-related

Erected wind turbines can be an obstacle in the airspace and can also cause collisions with the vertical structures of seabirds and resting birds (GARTHE 2000). It is difficult to estimate the extent of such incidents to date, since it is assumed that a large proportion of the colliding birds do not collide with a fixed structure (HÜPPOP et al. 2006). The collision risk of a species is determined by factors such as manoeuvrability, flight altitude and proportion of time spent flying ((GARTHE & HÜPPOP 2004). The collision risk for seabirds and resting birds must therefore be assessed differently for each species.

During the operational phase of the wind farms, species-sensitive species can be expected to avoid the wind farm sites to a species-specific extent. As a result of the restriction of fishing on site N-3.5 (see 3.3), which is to be expected on the basis of the legal framework and previous practice, it cannot be ruled out that fish stocks will recover during the operational phase. In addition to the introduction of hard substrate, the species spectrum of the fish present could therefore increase and provide an attractive food supply for foraging seabirds.

The relevant height parameters of the turbines are an important key figure for assessing the possible risk of collision for sea birds and resting birds with wind turbines at sea. Therefore, in the suitability assessment, two scenarios are examined, analogous to the site development plan 2020, in accordance with current technical developments with regard to the dimensions of future wind turbines, which consider possible relevant turbine parameters (cf. chapter **1.5.5.4**). According to scenario 1, wind turbines with a hub height of 125 m and a rotor diameter of 200 m would be used, which would thus reach a total height of 225 m. According to scenario 2, wind turbines with a hub height of 200 m, a rotor diameter of 300 m and a total height of 350 m would be used. This means that the lower rotor-free area from the water surface to the lower rotor blade tip would be 25 m in scenario 1 and 50 m in scenario 2.

As part of StUKplus, the "TESTBIRD" project used rangefinders to determine the flight altitude distribution of a total of seven species of sea birds and resting birds. The large white-headed gull species i.e. herring gull, lesser black-backed gull and great black-backed gull species flew at heights of 30 - 150 m in the majority of the recorded flights. Species such as kittiwake, common gull, little gull and gannet, on the other hand, were mainly observed at lower altitudes up to 30 m (MENDEL et al. 2015). A recent study at the Thanet Offshore Wind Farm in England investigated the flight height distribution of Northern gannet, kittiwake, and the large white-headed gull species herring gull, great black-backed, and lesser black-backed gull, also using the rangefinder (SKOV et al. 2018). The flight altitude measurements of great large white-headed gulls and gannets were comparable to the altitudes determined by MENDEL et al. (2015). The kittiwakes, on the other hand, were mostly observed at an altitude of about 33 m.

Large and small white-headed gulls are generally very manoeuverable, and can react to wind turbines with appropriate evasive manoeuvres (GARTHE & HÜPPOP 2004). This was also shown in the study by SKOV et al. (2018), which investigated not only the flight altitude but also the immediate, small-scale, and large-scale evasive behaviour of the species considered. Furthermore, the investigations using radar and thermal imaging cameras revealed low nocturnal activity. The risk of collisions at night due to attracting effects caused by the lighting of the wind turbines can, therefore, also be rated as low.

However, the risk of collision is estimated to be very low for disturbance-sensitive species such as red-throated and black-throated divers, since they do not fly directly into or near the wind farms due to their avoidance behaviour.

For the terns, which are listed in annexe I of the V-RL, there is also no risk of collision with the turbines, as they prefer low flight altitudes and are extremely agile flyers (GARTHE & HÜPPOP 2004).

Overall, an increased collision risk for seabirds and resting bird species is not to be assumed for the realisation of the wind turbines specified in Scenarios 1 and 2 on site N-3.5. According to current knowledge, this also applies to species whose flight altitudes are within the range of the rotating rotor blades, but whose flight behaviour allows them to avoid the turbines at an early stage.

During the operational phase of the wind farms, species-sensitive species can be expected to avoid the wind farm sites to a species-specific extent.

Red-throated divers and black-throated divers show very pronounced avoidance behaviour towards offshore wind farms. A recent study by the FTZ on behalf of the BSH and the BfN, which took into consideration data from wind farm monitoring in the EEZ as well as research data and data from Natura2000 monitoring, found a statistically significant decrease in diver abundance over all built-up areas in the EEZ up to 10 km starting from the periphery of a wind farm (GARTHE et al. 2018). This was also the conclusion of a study commissioned by the BWO, which used a modified data source and different statistical analysis methods than the FTZ study (BIOCONSULT SH et al. 2020). Both studies do not show total avoidance, but partial avoidance with increasing diver densities up to 10 km from a wind farm.

In order to quantify the loss of habitat, early decisions concerning individual approval procedures were based on a scaring distance of 2 km (defined as complete avoidance of the wind farm site including a 2 km buffer zone) for divers. The assumption of a habitat loss of 2 km was based on data from the monitoring of the Danish wind farm "Horns Rev" (PETERSEN et al.2006). The recent study by GARTHE et al. (2018) shows more than a doubling of the shooing distance to an average of 5.5 km. This scaring distance, which is also known as calculated total habitat loss, is based on the purely statistical assumption that there are no divers within 5.5 km of an offshore wind farm. The study commissioned by the BWO showed a calculated total habitat loss ('theoretical habitat loss') of 5 km for wind farm projects in the entire study area under consideration and therefore provided a comparable result. In the individual consideration of a northern and a southern sub-area, a calculated total habitat loss of 2 km in the southern sub-area indicated that there were regional differences. For wind farm projects in the northern sub-area, which comprises the main concentration area, the determined overriding value of 5 km was confirmed (BIOCONSULT SH et al. 2020).

For the study cluster "North of Borkum", effects up to 2 - 4 km were detected on the basis of large-scale digital flight recording until 2016 (IFAÖ et al. 2017). The survey years 2017, 2018 and 2019, on the other hand, revealed avoidance effects up to 10 km (IFAÖ et al. 2018, IFAÖ et al. 2019, IFAÖ et al. 2020). Again, this is a partial avoidance and not a complete avoidance. According to the experts, the avoidance distances determined in the cluster studies "North of Borkum" would thus be similar to those in the studies from the area of the main concentration area of divers (cf. HEINÄNEN 2018 and GARTHE et al. 2018). At the same time, the experts point out the high dispersion of the data and the overall heterogeneous distribution pattern of the divers (IFAÖ et al. 2019). It can be assumed that further studies would provide a clearer picture of the avoidance behaviour of divers in the area North of Borkum. Detailed information on the avoidance behaviour of divers, especially in the area of the main concentration area west of Sylt, can be found in the relevant chapters of the Environmental Report on the site development plan 2020 for the German North Sea (BSH 2020a).

For site N-3.5, the results of the cluster studies "North of Borum" specifically mean that avoidance behaviour by divers will also have to be assumed in the case of a wind farm on this site. In view of the existing development to the east and south of site N-3.5 in area N-3, it is likely that there will be an overlap of avoidance effects. In addition, site N-3.5 is located more than 40 km from the main concentration area of divers, the most important resting area in the North Sea EEZ. In view of the low seasonal and spatial occurrence of divers in the vicinity of site N-3.5 (see chapter 2.8.3), significant effects can be excluded with the necessary certainty. For an overview of cumulative effects, see chapter 4.12.4.

For other species such as gannets, little gulls, terns, guillemots and razorbills, findings on small-scale avoidance behaviour towards wind farms are available. According to the evaluation of the data from the cluster "North of Borkum", these range up to a maximum distance of 2 km for little gulls and gannets, and up to 4 km for guillemots and razorbills, depending on the survey method (after ship survey). However, this is also only a case of partial avoidance. For terns, an avoidance of wind farm sites is emerging, but this does not extend beyond the boundary of a wind farm (IFAÖ et al. 2017, IFAÖ et al. 2018, IFAÖ et al. 2019, IFAÖ et al. 2020). Little gull and gannet occur only sporadically or during migration periods in the vicinity of site N-3.5. Guillemot and razorbill are widely distributed throughout the North Sea EEZ. According to the current status, no significant impacts are to be expected for these species.

4.7.2 In-park cabling and residential platform

The impacts of platforms and submarine cable systems have already been assessed and evaluated at the level of the Strategic Environmental Assessment for the site development plan (BSH 2020a). As a result, the impacts of platforms and submarine cable systems on seabirds and resting birds were assessed as not significant. This assessment is still valid.

4.8 Migratory birds

The endangerment of bird migration is a reason for refusal of offshore wind farm projects according to § 48 (4) 1b of WindSeeG.

4.8.1 Wind turbines

If the suitability of site N-3.5 is determined and an offshore wind farm project is realised on this site, the following general impacts may occur:

4.8.1.1 Construction-related

Disturbance during the construction phase is primarily caused by light emissions and visual disturbance. These can cause scaring and barrier effects on migrating birds, which vary according to the species. However, lighting for construction equipment can also have the effect of attracting migrating birds and increase the risk of collision.

4.8.1.2 System-related and operation-related

Potential impacts of an offshore wind farm at site N-3.5 during the operational phase may be that it presents a barrier to migrating birds or a collision risk. Flying around or otherwise changing flight behaviour may result in higher energy consumption, which may affect the fitness of the birds and subsequently their survival rate or breeding success. Collision events may occur at vertical structures (such as rotors and support structures of wind turbines). Poor weather conditions - especially at night and in strong winds - increase the risk of collision. In addition, there are possible dazzling or attracting effects caused by the safety lighting of the turbines, which can lead to birds becoming disoriented. Furthermore, birds caught in wake currents and air turbulence at the rotors could be affected in their manoeuvrability. For the above-mentioned impacts, it can be assumed that the sensitivities and risks are different for each species. For this reason, when considering the likely significant impacts on site N-3.5, the hazard potential is considered on a species-specific basis. A species-specific assessment is not possible in most cases due to methodological limitations in bird migration recording.

Detailed information on the general hazard potential of bird migration and the assessment criteria can be found in the corresponding chapters of the Environmental Report on the Site Development Plan for the German North Sea (BSH 2020a).

The relevant height parameters of the turbines are an important key figure for assessing the possible risk of collision for sea birds and resting birds with wind turbines at sea. Therefore, in the suitability assessment, two scenarios are examined, analogous to the site development plan

2020, in accordance with current technical developments with regard to the dimensions of future wind turbines, which consider possible relevant turbine parameters (cf. chapter 1.5.5.4). According to scenario 1, wind turbines with a hub height of 125 m and a rotor diameter of 200 m would be used, which would thus reach a total height of 225 m. According to scenario 2, wind turbines with a hub height of 200 m, a rotor diameter of 300 m and a total height of 350 m would be used. This means that the lower rotor-free area from the water surface to the lower rotor blade tip would be 25 m in scenario 1 and 50 m in scenario 2. The larger dimensions also increase the swept site of the rotor. However, this influence is reduced by the decrease in the number of turbines. However, the higher turbines can increase the collision risk.

The assessment of the conflict potential for bird migration is differentiated according to species groups due to the different way of life, navigational ability and migration behaviour (day/night migrants). The rarity, endangerment status and reproductive strategy are also to be included in the sensitivity assessment to be carried out. In the following consideration of individual species and species groups, only those species are taken into account that have been recorded in significant numbers of individuals in the vicinity of site N-3.5.

Seagulls

In the vicinity of site N-3.5, seagulls dominated the migratory activity during the light phase in the past survey years (see chapter 2.9.3.1). The populations of the most common gull species are generally large. The lesser black-backed gull was the most common gull species during all migration periods of the survey years 2013 to 2019 (AVITEC RESEARCH GBR 2020). The population of the dominant subspecies in Germany, *Larus fuscus intermedius*, is currently estimated at 325,000 - 440,000 individuals (WETLANDS INTERNATIONAL 2020). Among the gulls, the herring gull is the only species with an assignment to SPEC category 2 (Species concentrated in Europe with negative population trends and unfavourable conservation status). In the German North Sea, both the subspecies *Larus argentatus argentatus* and the subspecies *Larus argentatus argenteus* occur. The size of the two populations is estimated to comprise 1,300,000 - 3,100,000 individuals and 990,000 - 1,050,000 individuals, respectively (WETLANDS INTERNATIONAL 2020).

In the observation of the flight height distribution during the light phase in spring 2017, it was found at the FINO 1 site on days with proportionally strong large white-headed gull migration that great large white-headed gulls mostly flew in height ranges of more than 20 m (AVITEC RESEARCH GBR 2018). Within the framework of research projects, flight height measurements using rangefinders for the large white-headed gull species i.e. herring gulls, lesser black-backed gull and great black-backed gull species showed that the majority of flights were at heights of 30-150 m. Other species of small gulls such as kittiwakes and common gulls, on the other hand, were mainly observed at altitudes up to 30 m (MENDEL et al. 2015, SKOV et al. 2018).

Large and small white-headed gulls are generally very manoeuverable, and can react to wind turbines with appropriate evasive manoeuvres (GARTHE & HÜPPOP 2004). This was also shown in the study by SKOV et al. (2018), which investigated not only the flight altitude but also the immediate, small-scale, and large-scale evasive behaviour of the species considered. Gulls can also land on the water in adverse weather conditions and wait for better migration conditions. Overall, therefore, significant impacts on gulls can be ruled out with the necessary certainty by building on site N-3.5, also against the background of the installation scenarios to be considered here.

According to Article 4 (1) of the Birds Directive (Birds Directive), special protection measures (in particular the designation of protected areas) must be applied to the habitats of the species listed in annexe 1 of the Directive.

In addition, according to Article 4 (2) of the Birds Directive, Member States must take appropriate measures for the breeding, moulting, wintering and resting areas of regularly occurring migratory bird species not listed in annexe 1. However, there is no generally applicable and binding list for these migratory bird species to be protected. However, the classification of species in the European SPEC categories (Species of European Conservation Concern), the pan-European endangerment categories (EUR-Gef.), the EU25 endangerment categories (EU25-Gef.) and the status of the species according to the Action Plan of the "Agreement on the Conservation of African-Eurasian Migratory Waterbirds" (AEWA), among others, provide indications of their worthiness for protection.

In the following, the impacts on the species in need of special protection according to annexe I and other species in need of protection according to Article 4 (2) of the Bird Directive are considered and assessed in a differentiated manner.

With regard to the impacts on annexe I species of the Birds Directive, the following applies:

Tern species group

In the previous cluster studies on bird migration at the FINO 1 site (period 2013 - 2019), in the vicinity of site N.3-5, terns were among the more frequent species groups. Among them, the Sandwich Tern (*Thalasseus sandvicensis*) was the most common species, while Common and Arctic Terns (*Sterna hirundo*, *Sterna paradisaea)*) could only be clearly distinguished from each other in rare cases.

The size of the Arctic tern and Common tern biogeographical populations are estimated at 1,000,000 and 800,000 - 1,700,000 individuals, respectively. The population size of the relevant biogeographical population of Sandwich Tern is currently estimated at 166,000 - 171,000 individuals ((WETLANDS INTERNATIONAL 2020).

With the help of data collected via diurnal migration observations from 2008 - 2012, A AVITEC RESEARCH GBR (2014) carried out estimates of the amount of species (group)-specific migration for the sea area around FINO 1, and thus for the first time for an offshore site in the German Bight area, based on multi-year observations. It was found that over an imaginary line running transversely to the main migration direction with a length of 6 - 20 km in NW-SE direction with FINO 1 in the centre, approx. 10,000 migrating Sandwich Terns had to be expected per year, which corresponds to approx. 6.0 % of the biogeographical population. Furthermore, the passage of approx. 1 % of the biogeographical population of Common Terns during the autumn departure was to be expected. Consequently, the vicinity of site N-3.5 was considered to be of high importance with regard to tern migration in the past.

These projections were based on sightings of 20 (autumn 2009) to 901 Sandwich Terns (spring 2012) and 13 (autumn 2009) to 228 Common Terns (autumn 2010)AVITEC RESEARCH GBR 2014).

Sightings in recent years since the start of offshore wind energy development in the vicinity of site N-3.5 have resulted in sightings of 25 (autumn 2019) to 304 (spring 2015) Sandwich Terns or 1 (spring 2018 and 2019) to 24 (autumn 2019) Common Terns (AVITEC RESEARCH GBR 2016; AVITEC RESEARCH GBR 2018, AVITEC RESEARCH GBR 2019, AVITEC RESEARCH GBR 2020). These sightings correspond to a maximum of 0.2% of the Arctic tern biogeographical population and 0.003% of the Common tern biogeographical population.

For the Sandwich Tern, the current cluster studies show a decrease in migratory event rates in the sectors facing away from the wind farm, with a simultaneous increase in migratory event rates in the sectors facing the wind farm. This change indicates that the wind farm projects are being flown around. Common and Crested Terns were more frequently observed passing along the outer boundaries of wind farms (AVITEC RESEARCH GBR 2018). Given the sometimes extremely long total distance of migration routes, it can be assumed that flying around a wind farm only extends the migration route insignificantly. With regard to the collision risk, the risk of collision is considered low due to the extreme manoeuvrability of terns. Their preferred flight altitudes, confirmed by observations in the vicinity of site N-3.5, are in the lower 20 m altitude range and thus outside the danger zone of the rotor blades of both wind farm scenarios (AVITEC RESEARCH GBR 2019).

The hazard potential for terns is therefore assessed as low, despite the previously high importance of the area surrounding site N-3.5 for tern migration.

Diver species group

The species group of divers includes the red-throated diver (Gavia stellata) and the black-throated diver (*Gavia arctica*). The respective relevant biogeographical populations are estimated to comprise 150,000 - 450,000 individuals (red-throated diver) and 250,000 - 500,000 individuals (black-throated diver)(WETLANDS INTERNATIONAL 2020). Divers are considered to be particularly sensitive to disturbance and show marked avoidance behaviour towards offshore wind farms during resting (see chapter 4.7.1.2). According to GARTHE & HÜPPOP (2004), red-throated and black-throated divers received the highest wind farm sensitivity indices of 43 and 44, respectively. Due to their avoidance behaviour, the collision risk can be considered very low. In addition, divers have been observed regularly, but only in small numbers of individuals, in the course of bird migration surveys for the "Northern Borkum" cluster in recent years (AVITEC RESEARCH GBR 2020). Furthermore, divers mainly fly close to the water surface and at most at heights of approx. 10 m (GARTHE & HÜPPOP 2004). Significant impacts on the diver species group in terms of endangering bird migration can be excluded with the necessary certainty.

Little gull (Hydrocoloeus minutus)

The little gull is also a species listed in annexe I of the Birds Directive and is therefore considered separately from the other gull species observed in the vicinity of site N-3.5.

The biogeographical population of the little gull is currently estimated at 72,000 - 174,000 individuals (WETLANDS INTERNATIIONAL 2020). In the vicinity of site N-3.5, it was observed regularly but only in small numbers during daytime bird migration surveys. Furthermore, rangefinder surveys showed that little gulls prefer flight altitudes in the lower 30 m (MENDEL et al. 2015). Thus, the lower rotor blade tips of the turbines in Scenario 1 could in principle project into the preferred flight heights of little gulls. However, GARTHE & HÜPPOP (2004) classified the little gulls as relatively insensitive to offshore wind farms, partly due to its extreme manoeuvrability (WSI 12.8). Considering the knowledge on occurrence, population and flight behaviour, significant impacts on little gulls can be excluded with the necessary certainty.

With regard to the impacts on the species to be protected under Article 4(2) of the Directive, the following applies:

Geese and ducks species group

From the group of geese and ducks, which are protected or endangered according to at least one of the above-mentioned agreements or endangerment analyses, the common scoter (*Melanitta nig-ra*), the brent goose (*Branta bernicla*), the short-billed goose (*Anser brachyrhynchus*) and the greylag goose (*Anser anser*) have been observed in noteworthy numbers of individuals in the vicinity of site N-3.5 in the past survey years.

Common scoters have an AEWA endangerment status of B 2a (populations with an individual number of more than about 100,000, for which special attention seems necessary due to the concentration on a small number of sites in each phase of their annual cycle). The size of the biogeographic population of the Common Scoter is currently estimated at 550,000 individuals (WETLANDS INTERNATIONAL 2020).

Brent Geese are classified under AEWA as Vulnerability Status B 2b (populations with numbers of individuals greater than approximately 100,000 for which special attention is considered necessary due to reliance on a habitat type at significant risk). The size of the relevant biogeographical population is currently estimated at 200,000 - 280,000 individuals (WETLANDS INTERNATIONAL 2020).

Short-billed geese are listed in AEWA category B1 (populations with numbers of individuals of about 25,000 and 100,000 that do not meet the requirements for column A). According to current estimates, the relevant biogeographical population comprises 63,000 individuals (WETLANDS INTERNATIONAL 2020).

Greylag geese are listed in AEWA category C1 (populations with an individual number of more than about 100,000 for which international cooperation could be of significant benefit and which do not meet the requirements for column A or B). According to current estimates, the relevant biogeographical population comprises 610,000 individuals (WETLANDS INTERNATIONAL 2020).

During the visual observations of bird migration of the cluster "North of Borkum", individuals of the mentioned species were regularly recorded in the past survey years (2013 - 2019). The most sightings of common scoters were recorded in spring 2016 with 166 individuals (AVITEC RESEARCH GBR 2017). This corresponds to about 0.03 % of the biogeographical population. For brent goose, short-billed goose and greylag goose, the highest sightings were 303 individuals (spring 2014), 171 individuals (autumn 2015) and 80 individuals (spring 2016) (AVITEC RESEARCH GBR 2015b; AVITEC RESEARCH GBR 2016; AVITEC RESEARCH GBR 2017). This corresponds to 0.15% of the biogeographical population for Brent Geese, 0.3% for Short-beaked Geese and 0.01% of the respective biogeographical populations for Greylag Geese.

All species mentioned are mainly diurnal migrants. It is therefore to be expected that they can recognise and fly around the vertical obstacles in time due to their good visual abilities. The visual observations of the past years at the FINO 1 site showed that diurnal migration mainly takes place in the lower 20 - 50 metres of altitude (see chapter 0). Considering the possible scenarios of the turbines, the diurnal migration mostly takes place below the lower rotor blade tip.

Due to the low observed population proportions on migration in the vicinity of site N-3.5 and the flight behaviour of the species considered, significant impacts on duck and goose species occurring regularly and in significant numbers can be excluded with the necessary certainty.

Wader species group

In the vicinity of site N-3.5, only a few species of waders were recorded in very small numbers of individuals during bird migration surveys in previous years, both at night and during the day. It can therefore be assumed that a wind farm on site N-3.5 will not have any significant impact on wading birds.

In summary, it can be stated for diurnal migrants that they mainly fly in the lower 50 m altitude range and thus also below the lower rotor tip according to the underlying scenarios for turbines. It is generally assumed that diurnal migrants orientate themselves visually and, if diurnal species are seabirds or waterbirds, can land on the water. As a result, significant impacts on predominantly diurnal species are not expected.

Songbirds

Songbirds dominate the nocturnal bird migration. Taking into account migration behaviour, there is a particular collision risk for the nocturnal migration of small birds due to migration in the dark, high migration volume and the strong attraction effect of artificial light sources.

In general, migrating birds fly higher in good weather than in bad weather. It is also known that most birds usually start their migration in good weather and are able to choose their departure conditions such that they are likely to reach their destination in the best possible weather (BSH 2009). In a recent study, BRUST et al. (2019) found that the migratory behaviour of thrushes is not only influenced by prevailing wind conditions, but also by the condition of the individual and individual behaviour. Individuals that stayed longer at stopover sites along the coast tended more often to cross the North Sea along an offshore route rather than following the coastline.

Moreover, in the clear weather conditions preferred by birds for migration, the probability of collision with wind turbines is low because the flight altitudes of most birds are above the range of the rotor blades and the turbines are clearly visible. On the other hand, unexpected fog and rain, which lead to poor visibility and low flight altitudes, represent a potential risk situation. The coincidence of bad weather conditions with so-called mass migration events is particularly problematic. According to information from various environmental impact studies, mass migration events in which birds of different species fly over the North Sea simultaneously occur about 5 to 10 times per year. On average, two to three of these are coupled with bad weather. An analysis of all existing bird migration surveys from the mandatory monitoring of offshore wind farms in the EEZ of the North Sea and Baltic Sea (observation period 2008 - 2016) confirms that particularly intensive bird migration coincides with extremely bad weather conditions at less than 1 % of the migration times (WELCKER & VILELA 2019).

The most frequent species in the vicinity of site N-3.5, according to migratory records from previous study years, are mainly thrush species such as the redwing, song thrush and blackbird. Skylark, meadow pipit, starling and robin were also recorded regularly and in higher numbers (see chapter 2.9.3.1).

The large numbers of songbirds crossing the area originate from very individual populations. Based on the main migration direction SW or NE, the German Bight is mainly crossed by songbirds from the Fennoscandian region. The migratory birds recorded are therefore presumably mainly from the breeding populations of northern Europe. At present, there are no more up-to-date estimates of the population sizes of the northern European breeding populations. According to BIRDLIFE INTERNATIONAL (2004), the northern European breeding populations of redwings were estimated at 3,250,000 to 5,500,000, song thrushes 3,300,000 to 5,700,000, starlings 1,380,000 to 2,660,000 individuals, skylarks 2,000,000 to 3,100,000 and meadow pipits 2,230,000 to 7,245,000. According to the available studies at the FINO 1 site, the listed songbird species do not occur in the study area with significant population shares (> 1 percent of the total number of individuals of the breeding populations in Northern Europe). In view of the size of the northern European breeding populations, the study area is not of particular importance for the songbird populations during migration.

However, it cannot be ruled out that the lighting of the turbines has an attracting effect, especially on birds migrating at night, and that they fly into the turbines or are at least affected by glare. Studies of lighthouses in Denmark have shown that light sources are rarely approached by seabirds and waterfowl, but increasingly by small birds such as starlings, song thrushes and skylarks in poor visibility. In a recent study, REBKE et al. (2019) investigated the influence of different coloured and different luminous light sources on nocturnal songbird migration under different cloud cover conditions. As a result, birds were more attracted to continuous than to flashing lighting. In addition, the authors recommended the use of red light in cloudy weather to reduce attracting effects in low visibility conditions.

The risk of bird strike due to attraction effects of wind turbine lighting seems to be more likely in the above-mentioned - individually abundant - populations and therefore does not indicate a threat to nocturnal bird migration. In the determination of suitability, as in the individual approval procedures, orders are provided for the avoidance or minimisation of light emissions, among other things, insofar as these are not required and unavoidable by the safety requirements of shipping and air traffic.

Overall, the individual species- and species-group-specific assessment shows that for the migratory bird species occurring in the project area or their relevant biogeographical populations, significant impacts caused by a wind farm on site N-3.5 can be excluded with the necessary certainty. However, the possible increased collision risk due to the higher 10-20 MW turbines on which the assessment is based must be taken into account in the cumulative consideration of several wind farm projects in the vicinity of site N-3.5 and in the concrete planning of the individual project.

4.8.2 In-park cabling and residential platform

The impacts of platforms and submarine cable systems have already been assessed and evaluated at the level of the Strategic Environmental Assessment for the site development plan (BSH 2020a). As a result, the impacts of platforms and submarine cable systems on seabirds and resting birds were assessed as not significant. This assessment is still valid.

4.9 Bats and bat migration

Migratory movements of bats across the North Sea are still poorly documented and largely unexplored. There is a lack of concrete information on migrating species, migration corridors, migration heights, and migration concentrations. Previous knowledge merely confirms that bats, especially long-distance migratory species, fly over the North Sea.

At present, there is no robust data on migration corridors and migration behaviour of bats over the North Sea to realistically assess potential impacts of a wind farm on site N-3.5. It can be assumed that any negative impacts on bats can be avoided and mitigated by the same measures used to protect bird migration.

4.10 Climate

No impacts on the climate are expected from the construction and operation of wind turbines, a platform and the cabling within the park, as no measurable climate-relevant emissions occur either during construction or operation.

4.11 Landscape

The realisation of offshore wind farms has impacts on the seascape scenery because it is altered by the installation of vertical structures and security lights. The extent of these visual impairments to the seascape scenery caused by the planned offshore installations will depend to a large extent on the respective visibility conditions. Area N-3 is more than 30 km from the North Sea coast, which means that the existing and planned offshore installations are/will only be visible from land to a very limited extent (HASLØV & KJÆRSGAARD 2000), and only under good visibility conditions. The development of the seascape scenery will not be significantly altered by the implementation of the construction project on site N-3.5, as this site is completely enclosed by other offshore wind energy projects that are likely to be constructed beforehand.

4.12 Cumulative effects

In the following, it is examined in accordance with the explanations under Chap. 1.5.5.2 whether significant environmental effects on the protected goods are to be expected as a result of the cumulative effects.

4.12.1 Soil/ site, benthos and biotope types

A significant part of the environmental impacts caused by the development of the site, the construction of the residential platform and the park-internal submarine cable systems on the protected goods soil, benthos and biotopes will occur exclusively during the construction period (formation of turbidity plumes, sediment relocation, etc.) and in a spatially limited area. Possible cumulative impacts on the seabed, which could also have a direct impact on the benthos and specially protected biotopes, result from the sum of the permanent direct land use of the foundations of the wind turbines and platforms as well as the installed cable systems. As described in the chapter 4, the individual impacts are generally small-scale and local.

To estimate the direct land use, a rough calculation is made below based on the model wind farm scenarios (chapter **1.5.5.4**) and the assumptions for other installations (chapter **1.5.5.5**). The calculated land use is based on ecological aspects, i.e. the calculation is based on the direct ecological loss of function or the possible structural change in the site caused by the installation of foundations and cable systems. In the area of the cable trench, however, the impact on sediment and benthic organisms will be essentially temporary. In the case of the crossing of particularly sensitive biotope types such as reefs or species-rich gravel, coarse-sand and shell beds, permanent impairment would have to be assumed.

Based on the allocated capacity of 420 MW for site N-3.5 and an assumed capacity per turbine of 10 MW (model wind farm scenario 1) or 20 MW (model wind farm scenario 2), the calculated number of turbines for the site is between 42 turbines (scenario 1) and 21 turbines (scenario 2).

Based on the model wind farm parameters, this results in a surface sealing of 84,409 m² (Scenario 1) and 94,741 m² (Scenario 2), including an assumed scour protection and a residential platform. Compared to the total area of the N-3.5 site of approx. 28.9 km², the calculated land sealing for the model wind farm scenarios is between 0.29 % (Scenario 1) and 0.33 % (Scenario 2).

The calculation of the loss of function due to the in-farm cabling was carried out in accordance with the reported capacity, assuming a 1 m wide cable trench. On the basis of this conservative estimate, there is a temporary impact on area N-3.5 due to approx. 50 km of cabling within the park, which corresponds to a temporary land use of 0.17 % of the total site of N-3.5.

The sum of land sealing and temporary land use also results in a conservatively estimated impact of well below 1% of the total site of N-3.5 (0.47% - 0.50%). Thus, according to current knowledge, no significant adverse effects are to be expected, even in cumulation, which would lead to a threat to the marine environment with regard to the seabed and the benthos.

4.12.2 Fish

The wind farms of the southern North Sea could have an additive effect beyond their immediate location, in that the mass and measurable production of plankton could be dispersed by currents and thus influence the qualitative and quantitative composition of the zooplankton (FLOETER et al. 2017). This, in turn, could affect planktivorous fish, including pelagic schooling fish such as herring and sprat, which are the target of one of the largest fisheries in the North Sea. Species composition could also change directly; species with habitat preferences that differ from those of the established species (e.g. reef dwellers) could find more favourable living conditions and thus occur more frequently. In the

Danish wind farm Horns Rev, 7 years after its construction, a horizontal gradient in the occurrence of hartsubrate-affected species was found between the surrounding sand sites and near the turbine foundations: Clifffish, eel mother and lumpfish were found much more frequently near the wind turbine foundations than on the surrounding sand sites (LEONHARD et al. 2011). Cumulative effects resulting from a major expansion of offshore wind energy could include

- the recolonisation of previously heavily fished areas and sites,
- an increase in the number of older individuals,
- better conditions for the fish due to a larger and more diverse food base,
- further establishment and distribution of fish species adapted to reef structures,
- better living conditions for territorial species such as cod-like fish.

Besides predation, intraspecific and interspecific competition, also known as density limitation, is the natural mechanism for limiting populations. It is not possible to rule out the onset of local density limitation within individual wind farms before the positive effects of the wind farms are reproduced spatially through the migration of "surplus" individuals, for example. In this case, the effects would be local and not cumulative. What effects changes in fish fauna might have on other elements of the food network, both below and above their trophic level, cannot be predicted at this stage of knowledge.

4.12.3 Marine mammals

Cumulative effects on marine mammals, in particular harbour porpoises, may occur mainly due to noise exposure during the installation of foundations using impact pile driving. For example, marine mammals may be significantly affected if pile driving takes place simultaneously at different sites within the EEZ without equivalent alternative habitats being available.

So far, the implementation of offshore wind farms and platforms has been relatively slow and gradual. In the period from 2009 to 2018 inclusive, pile driving work was carried out on twenty wind farms and eight converter platforms in the German North Sea EEZ. Since 2011, all pile driving work has been carried out using technical noise mitigation measures. Since 2014, the sound protection values have been reliably met and even undercut by the successful use of sound reduction systems (Bellmann, 2020).

The majority of the construction sites were located at distances of 40 km to 50 km away from each other, so that there was no overlap of noise-intensive pile driving that could have led to cumulative effects. Only in the case of the two directly adjacent projects Meerwind Süd/Ost and Nordsee Ost in area N-4 was it necessary to coordinate the pile driving, including deterrent measures.

The evaluation of the noise results with regard to noise propagation and the possibly resulting accumulation has shown that the propagation of impulsive noise is strongly limited when effective noise-minimising measures are applied (DÄHNE et al., 2017).

Current findings on the possible cumulative effects of pile driving on the occurrence of harbour porpoise in the German EEZ of the North Sea are provided by two studies from 2016 and 2019 commissioned by the German Offshore Wind Energy Association (BWO). Within the framework of the two studies, the extensive data from monitoring the construction phases of offshore wind farms by means of acoustic and visual/digital recording of harbour porpoise were evaluated and assessed across projects (Brandt et al., 2016, Brandt et al., 2018, Rose et al., 2019). Within the studies, novel evaluation approaches were described and elaborate statistical analyses were robustly conducted. Already known seasonal and area-specific activity patterns were reconfirmed. However, strong interannual as well as spatial fluctuations in harbour porpoise activity were also identified. The aim of the second study (GESCHA 2) was to evaluate possible effects of the optimised technical noise protection measures from 2014 up to and including 2016 with regard to disturbance of the harbour porpoise in the form of displacement.

The study came to the conclusion that the optimised use of the technical noise abatement measures since 2014 and the resulting reliable compliance with the limit value did not lead to a reduction in the displacement effects on harbour porpoises compared to the phase from 2011 to 2013 with not yet optimised noise abatement systems. No reduction of the displacement effects could be observed from a sound level of 165 dB (SEL_{05} re 1µPa2 s at a distance of 750 m). The displacement effects were assessed analogously to the GESCHA 1 study from 2016 (period 2011 to 2013 inclusive) based on the range and duration before, during and after pile driving. The authors put forward five hypotheses to explain the results (Diederichs et al., 2019):

- The stereotypic response of harbour porpoises may cause animals to leave the area above a certain sound level and not return for a period of time, regardless of the progression of sound emissions.
- Displacement effects from the use of the seal scarer are more intense than the effectively attenuated pile driving sound.
- Shipping traffic and other construction site-related noise lead to displacement effects.
- Installations (pile driving) carried out in very short succession at intervals of less than 24 hours lead to displacement.
- Differences between habitats and in relation to food supply, but also differences in the quality of the data, have an influence on the results of the study.

After assessing the current findings, the BSH assumes that the observed avoidance effects on harbour porpoises during the installation phase are due to a variety of construction-related factors as well as natural processes. However, it can be assumed that the avoidance effects would be greater in the absence of effective technical noise mitigation and compliance with noise limits. The mitigation of pile driving noise at source is all the more important as it has become increasingly apparent since 2014 that offshore construction sites are experiencing increased activity due to the optimisation and acceleration of logistics and construction processes, which could potentially be additional sources of disturbance to harbour porpoises.

The findings from monitoring have always been taken into account in the context of enforcement. For example, the BSH and BfN authorities decided to switch from Pinger and SealScarer to the Fauna Guard system in 2018. The use of the new FaunaGuard system was intensively monitored, the data was analysed and the results are being evaluated in a study.

Cumulative impacts on harbour porpoise populations from the construction of offshore wind turbines and the residential platform within site N-3.5 and possibly sites N-3.6 and N-7.2, which are being tendered simultaneously, as well as the "EnBWHedreiht" offshore wind farm planned in the immediate vicinity, will be mitigated by the specifications included in the suitability assessment in accordance with the requirements of the BMU's 2013 noise protection concept. In accordance with the noise protection concept of the BMU (2013), all pile driving work will have to be coordinated in such a way that less than 10% of the site of the German EEZ in the North Sea is affected by pile driving noise. The aim is always to keep sufficient alternative habitats free in the protected areas, in equivalent habitats and in the entire German EEZ.

4.12.4 Seabirds and resting birds

Vertical structures such as platforms or offshore wind turbines can have differing impacts on resting birds, such as loss of habitat, an increased risk of collision or a chasing and disturbing effect. These effects have already been considered in Chapter 4.7.1.2 on a site-specific basis and taking into account the possible technical scenarios with regard to turbine parameters. A further project-specific assessment will be carried out as part of the environmental impact assessment for the individual project and monitored as part of the subsequent mandatory monitoring of the construction and operation phases of offshore wind farm projects. For resting birds, habitat loss due to cumulative effects of several structures or offshore wind farms can be particularly significant.

In order to assess the significance of cumulative effects on seabirds, any effects must be assessed on a species-specific basis. In particular, species listed in Annex I of the Birds Directive, species in sub-area II of the Sylt Outer Reef – Eastern German Bight Nature Conservation Area and species for which avoidance behaviour towards structures has already been established must be considered with regard to cumulative effects.

When assessing the cumulative effects of building offshore wind farms, special attention must be paid to the group of loons with the endangered yet disturbance-sensitive species of red-throated and black-throated divers. GARTHE & HÜPPOP (2004) certify that loons are very sensitive to structures. For the consideration of cumulative effects, both neighbouring wind farms and those located in the same coherent functional spatial unit defined by physically and biologically significant characteristics for a species should be considered. In addition to the structures themselves, impacts from shipping traffic (including for the operation and maintenance of platforms and submarine cables) must also be considered. Recent knowledge from studies confirm the scare effect on loons caused by ships. Red-throated and black-throated divers are among the bird species in the German North Sea most sensitive to shipping traffic (MENDEL et al. 2019, FLIESSBACH et al. 2019, BURGER et al. 2019).

Since 2009, the BSH has carried out the qualitative assessment of cumulative effects on loons within the framework of licensing procedures, using the main concentration area in accordance with the BMU position paper (2009).

The definition of the main concentration area of loons in the German North Sea EEZ as part of BMU's position paper (2009) is an important measure to ensure species protection of the sturgeon-sensitive species red-throated and black-throated diver. The BMU decreed that in future licensing procedures for offshore wind farms, the main concentration area should be used as a benchmark for the cumulative assessment of loon habitat loss.

The main concentration area takes into account the spring season, a period of particular importance for the species. The main concentration area was defined in 2009 on the basis of the data available at the time: the main concentration area was home to around 66% of the German North Sea diver (loon) population and around 83% of the EEZ population in spring, and is therefore, among other things, of particular importance in terms of population biology (BMU 2009) and an important functional component of the marine environment with regard to seabirds and resting birds. Against the background of current stock assessments, the importance of the main concentration area for loons in the German North Sea and within the EEZ has further increased (SCHWEMMER et al. 2019). The particular importance of the main concentration area was also confirmed by a study commissioned by the BWO on loons in the German Bight (BIOCONSULT SH ET AL. 2020). The delineation of the main concentration area for loons is based on the data situation, which is considered to be very good, and on expert analyses that have gained broad scientific acceptance. The area includes all areas of very high and most of the areas of high sea otter density in the German Bight.

Current findings from the operational monitoring of offshore wind farms and research projects consistently show that the avoidance behaviour of loons towards offshore wind farms is far more pronounced than had been anticipated in the original approval decisions for the wind farm projects (see Chapter 4.7.1.2). The adverse effect of offshore wind farms in the main concentration area (MCA) on the MCA is already greater than originally assumed (cf BSH 2020a).

The area where site N-3.5 is located is mainly used by loons as a transit area during migration periods and in winter. According to current knowledge, this site and its surroundings are located outside of the main resting areas of loons in the German North Sea.

On the basis of the available findings from research projects and monitoring of wind farm clusters, the BSH has concluded that site N-3.5 and its surroundings are not of high importance for the loon population in the German North Sea. Site N-3.5 is located at a distance of > 40 km from the main concentration area west of Sylt. The construction of an offshore wind farm on site N-3.5 can therefore exclude cumulative effects with the necessary certainty.

4.12.5 Migratory birds

The potential threat to bird migration arises not only from the effects of the individual project, in this case a project on site N-3.5, but also cumulatively in connection with other approved or already constructed wind farm projects in the vicinity of site N-3.5 or in the main direction of migration.

The surroundings of site N-3.5 in area N-3 already have a development with 153 m high wind turbines in the south of the area and a development with 187 m high wind turbines in the east, further projects/areas in the east of area N-3 are in the planning stage. It can be assumed that the dimensions of the projects still to be realised will be comparable with the scenarios of the present suitability assessment. A staircase effect may arise between the already existing wind farms and a wind farm on site N-3.5 due to the difference in height, as the visibility of the taller turbines could be limited. This is especially true for the smaller turbines of scenario 1, as here mainly the rotating rotors would be visible. In the case of the larger turbines with a hub height of 200 m, the massive nacelle would normally also be visible. The following consideration of collision risk is based on the main migration directions north-east (spring) and south-west (autumn).

The staircase effect described above would occur in spring, when the birds, coming from the south/southwest on their migration to the breeding areas, initially fly towards the smaller, already completed wind farm projects in area N-3. In autumn, they reach the larger wind farm projects on the eastern outer border of N-3 first.

Under normal migratory conditions preferred by migratory birds, no concrete threats due to collisions have been identified to date.

Unexpected fog and rain, which lead to poor visibility and low altitudes, are potential hazards. The coincidence of bad weather conditions with so-called mass migration events is particularly problematic. On the other hand, research results obtained on the FINO1 research platform could qualify this prognosis. It was found that birds migrate higher in very poor visibility (below 2 km) than in medium (3 to 10 km) or good visibility (> 10 km). However, these results were based on only three nights of measurements (HÜPPOP et al. 2005).

The risk of collision for birds migrating during the day and seabirds is generally considered to be low (see Chapter 4.8.1).

Cumulative effects could also result in a lengthening of the migration path for migrating birds. The potential adverse effect on bird migration in terms of a barrier effect depends on many factors; the orientation of the wind farms in relation to the main migration directions must be considered in particular. Assuming the main direction of migration is southwest to northeast and vice versa, the wind farms of the same or another area adjacent to each other in this orientation form a uniform barrier, so that a single avoidance movement is sufficient. It is known that birds avoid wind farms, i.e. they fly around wind farms or over them horizontally. In addition to observations on land, this behaviour has also been demonstrated in offshore areas (e.g. KAHLERT et al. 2004, AVITEC RESEARCH GBR 2015b). Lateral avoidance reactions are apparently the most common reaction (HORCH & KELLER 2005). Avoidance reactions in different directions occurred, but a reverse migration was not observed (KAHLERT et al. 2004). AVITEC RESEARCH GBR (2015) found avoidance behaviour among ducks, gannets, auks, little gulls and black-legged kittiwakes during long-term surveys.

Site N-3.5 is located to the north of a wind farm already in operation; further projects to the east of site N-3.5 are currently being planned or have already been implemented. In perspective, all these projects would represent a barrier of approx. 50 km to the main migration direction north-east or south-west, so that the potentially necessary diversions for migratory birds in the main migration direction would amount to max. 70 km if the original migration route is resumed after the avoidance movement. Assuming that migratory birds maintain their migration route in a north-easterly direction, a further avoidance reaction is possible with regard to a project located more than 50 km to the north-east in site development plan area N-5, so that in addition to the 70 km diversions already mentioned, migratory birds would have to fly an additional approx. 20 km to fly around the northern wind farm in area N-5.

The flight distance to cross the North Sea is in some cases several 100 km. According to BERTHOLD (2000), the non-stop flight performance of the majority of migratory bird species is in the order of magnitude of over 1000 km. This also applies to small birds. It is, therefore, unlikely that the additional energy demand that may be required would endanger bird migration as a result of a potentially necessary diversions of approx. 50 km.

Consideration of the existing knowledge on the migratory behaviour of the various bird species, their usual flight altitudes and the diurnal distribution of bird migration leads to the conclusion that, based on the current state of knowledge, the construction and operation of a wind farm on site N-3.5 is not likely to endanger bird migration, considering the cumulative effect of the offshore wind farm projects that have already been approved. At this stage, a possible bypassing of the projects is not expected to have any significant negative effect on the further development of the populations.

In this context, it has to be taken into consideration that, according to the present state of the art in science and technology, this prediction is made under premises that are not yet suitable to ensure the basis for bird migration in a satisfactory manner. There are gaps in the current knowledge, especially with regard to the species-specific migratory behaviour in bad weather conditions (rain, fog).

4.13 Interrelationships

In general, impacts on any one protected asset lead to various consequences and interactions between the protected assets. For example, impacts on the seabed or the water body usually also have consequences for the biotic assets in these habitats. For example, pollutant discharges may reduce water and/or sediment quality and be absorbed by benthic and pelagic organisms from the surrounding medium. The essential interdependence of the biotic protected assets exists via the food web. These interrelationships between the various objects of protection and possible impacts on biological diversity are described in detail for the respective objects of protection.

Possible interactions during the construction phase result from sediment shifting and turbidity plumes, as well as noise emissions. However, these interactions occur only very briefly and are limited to a few days or weeks.

4.13.1 Sediment shifting and turbidity plumes

Sediment shifting and turbidity plumes occur during the construction phase for wind farms and platforms or the laying of a submarine cable system. Fish are temporarily driven away. The macrozoobenthos is covered locally. As a result, the feeding conditions for benthos-eating fish and for fish-eating seabirds and harbour porpoises also change temporarily and locally (decrease in the supply of available food). However, considerable impairments to the biotic assets to be protected, and thus to the existing interactions with one another, can be excluded with the requisite degree of certainty due to the mobility of species and the temporal and spatial limitation of sediment relocation and turbidity plumes.

4.13.2 Noise input

Noise intensive work to construct and install the systems can lead to temporary escape reactions and avoidance of the area by marine mammals, some fish species and seabird species. Based on current knowledge, no significant noise emissions are to be expected from the operation of offshore wind turbines, current-carrying cables and transformer stations or residential platforms. Only operational shipping traffic can lead to a temporary and local increase in underwater noise. There is currently a lack of experience and data to assess possible interrelationships due to such indirect operational noise emissions.

4.13.3 Land use

The laying of foundations results in a local deprivation of settlement area for the benthic zone, which can lead to a potential deterioration of the food base for the fish, birds and marine mammals following within the food pyramid. However, benthos-eating seabirds in deeper water areas are not affected by the loss of foraging area due to land sealing, as the water is too deep for effective food acquisition.

4.13.4 Placement of artificial hard substrate

The introduction of artificial or non-native hard substrate (platform foundations, cable crossing structures) leads to a local change in soil composition and sediment conditions. As a result, the composition of the macrozoobenthos may change. According to KNUST et al. (2003), the introduction of artificial hard substrate into sandy seabeds leads to the settlement of additional species. These species will most likely be recruited from natural hard substrate habitats, such as superficial boulder clay and stones.

Thus, the risk of negative impacts on benthic sandy seabed communities by non-native species is low. However, settlement areas for sandy soil fauna are lost in these places. By changing the species composition of the macrozoobenthos community, the food base of the fish community at the site can be influenced (bottom-up regulation).

Certain fish species could be attracted, which in turn could increase the feeding pressure on the benthos by predation and thus shape the dominance relationships by selecting certain species (top-down regulation).

4.13.5 Prohibition of use and driving

Based on the legal framework and past practice, a prohibition or significant restriction of fishing is to be expected on site N-3.5 (see 3.3). The resulting elimination of or restrictions on fishing can lead to an increase in the stock of both target and unused fish species, and a shift in the length spectrum of these fish species is also conceivable. In the event of an increase in fish stocks, an enrichment of the food supply for marine mammals can be expected. Furthermore, it is expected that a macrozoobenthic community largely undisturbed by fishing activity will develop. This could mean that the diversity of the community of species will increase, giving sensitive and long-lived species of the current epifauna and infauna better chances of survival and developing stable stocks. The growth of wind turbines with sessile invertebrates could favour benthophagous fish species and make a larger and more diverse food source accessible to fish (LINDEBOOM et al. 2011). This could improve the condition of the fish, which in turn would have a positive effect on fitness. However, there is currently a need for research to transfer such cumulative effects to the fish population level.

Due to the variability of the habitat and the complexity of the food web and material cycles, interrelationships can only be described very imprecisely overall. In principle, the SEA concludes that, based on current knowledge, no significant effects on existing interrelationships are discernible during implementation of the plan that could result in a threat to the marine environment.

4.14 Transboundary impacts

Based on the current state of knowledge, no significant impacts on the areas of neighbouring states adjacent to the German North Sea EEZ can be identified as a result of site N-3.5.

Sec. 2 para. 3 of the Act on the Assessment of Environmental Impacts (UVPG) defines transboundary impacts on the environment as impacts on the environment in another state.

Whether the development of site N-3.5 may have an impact on the environment in neighbouring states, and whether this impact is to be classified as significant, depends on the circumstances of the individual case.

In accordance with the assumptions of the agreement on the implementation of transboundary participation between Germany and the Netherlands ("Gemeinsame Erklärung über die Zusammenarbeit bei der Durchführung grenzüberschreitender Umweltverträglichkeitsprüfungen sowie grenzüberschreitender strategischer Umweltprüfungen im deutsch-niederländischen Grenzbereich zwischen dem Ministerium für Infrastruktur und Umwelt der Niederlande und dem Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit der Bundesrepublik Deutschland" 2013), which distinguishes between projects located up to 5 km from the border and those located beyond this distance, impacts are more likely in cases of spatial proximity.

Site N-3.5 is centrally located in the German North Sea EEZ. The distance to the Dutch EEZ is at least 45 km. Denmark (or the Danish EEZ) is at least 130 km away. Thus, local impacts on benthos, soil or biotopes in the neighbouring states due to sediment plumes and soil sealing, on marine mammals or fish due to noise, or on the seascape scenery, and thus on tourism, are generally not to be expected.

Long-range transboundary impacts are also not to be expected.

According to the Guidance on the Practical Application of the Espoo Convention, prepared by the Netherlands, Sweden and Finland in 2003, projects that may have long range impacts in a transboundary context would be those that result in air or water pollution, projects that pose a potential threat to migratory species and projects related to climate change.

As shown above, no significant impacts on the protected assets air and water or climate are expected.

Possible significant transboundary impacts could only arise for the highly mobile protected assets fish, marine mammals, seabirds and resting birds, as well as migratory birds and bats, if the (local) effects of the project would have a significant impact on the respective population/migratory species. However, according to the above impact predictions for the individual protected assets, this is not the case.

With regard to fish as a protected asset, the SEA concludes that, according to the current state of knowledge, no significant impacts on the protected assets are to be expected as a result of site N-3.5, since on the one hand the site does not have a prominent function for the fish fauna and on the other hand the recognisable and predictable effects are of a small-scale and temporary nature. This also excludes transboundary impacts.

Based on current knowledge and considering impact-minimising and damage-limiting measures, significant (transboundary) impacts can also be excluded for the protected marine mammal species. For example, the installation of wind turbine foundations and the residential platform will only be permitted with the use of effective sound reduction measures.

For protected seabirds and resting birds, significant transboundary impacts can also be excluded with the requisite degree of certainty due to the distance to the Dutch and Danish boundaries.

Bird migration over the North Sea takes place in a broad-front migration that cannot be defined in more detail, with a tendency towards coastal orientation. Guidelines and fixed migration routes are not yet known. The individual species-specific assessment (Chapter 4.8.1) did not reveal any significant impacts. Consideration of the existing knowledge on the migratory behaviour of the various bird species, their usual flight altitudes and the diurnal distribution of bird migration leads to the conclusion that, based on the current state of knowledge, the construction and operation of a wind farm on site N-3.5 is not likely to endanger bird migration, taking into account the cumulative effect of the offshore wind farm projects that have already been approved, although there is still a lack of knowledge about species-specific migration behaviour. As a result, significant transboundary impacts are also not likely.

Migratory movements of bats across the North Sea are still poorly documented and largely unexplored. There is a lack of concrete information on migrating species, migration corridors, migration heights, and migration concentrations. Previous knowledge merely confirms that bats, especially long-distance migratory species, fly over the North Sea. A technically comprehensible assessment of possible impacts, including transboundary impacts, is therefore not possible at the present time. It can be assumed that any negative impacts can be avoided and mitigated by the same measures used to protect bird migration. For further information, please refer to the results of the impact predictions for the individual protected assets in Chap. **4.1** et seq.

5 Review of biotope protection law

According to Sec. 7 para. 2 no. 4 BNatSchG, a biotope is the habitat of a community of wild animals and plants. A biotc community is a community of organisms of different species in a definable habitat (SCHÜTTE/GERBIG in Schlacke, Joint Commentary on the Federal Nature Conservation Act (GK-BNatSchG), Sec. 7, marginal no. 36) For Germany, 764 biotopes are distinguished (HENDRISCHKE/ KIEß in Schlacke GK-BNatSchG, Sec. 30, marginal no. 8). Certain parts of nature and landscape that have a special significance as biotopes are protected by law, Sec. 30 para. 1 BNatSchG.

5.1 Legal basis

Sec. 30 BNatSchG provides legal protection for biotopes that require special protection because of their rarity, their endangerment or their special significance as habitats for particular animal or plant species (Hendrischke/Kieß in Schlacke, GK-BNatSchG, Sec. 30, marginal no. 8). According to Sec. 56 para.1 BNatSchG, the standards of the Federal Nature Conservation Act are also applicable in the German EEZ.

Sec. 30 para. 2 no. 6 BNatSchG names the legally protected coastal and marine biotopes. Reefs, sublittoral sandbanks, species-rich gravel, coarse sand and shell layers and sea-pen and burrowing megafauna communities are relevant for the EEZ. The latter have not yet been recorded in the EEZ due to the absence of the sea pen species characteristic of the biotope.

The legal protection of these biotopes applies with immediate effect, without the need for additional administrative designation of the area. Explanations and definitions of the individual biotopes can be found in the explanatory memorandum to the Federal Nature Conservation Act. In addition, the BfN has published mapping instructions for various marine biotopes. In addition, the "Interpretation Manual of European Habits – EUR27" can be used for biotopes that also represent FHH habitat types (e.g. reefs, sandbanks) (HENDRISCHKE/KIEß in Schlacke GK-BNatSchG, Sec. 30, marginal no.).

Within the framework of the present assessment of biotope protection law, it is being investigated whether legally protected biotopes exist on the site or in the area of investigation in accordance with Sec. 30 BNatSchG and whether, in this case, the prohibition of destruction and adverse effects will be upheld while the plan is being implemented.

According to Sec. 30 para. 2 sentence 1 BNatSchG, all actions that may cause destruction or other significant adverse effects on the marine biotopes listed in Sec. 30 para. 2 sentence 1 no. 6 BNatSchG are generally prohibited.

The direct and permanent use of a biotope protected under Sec. 30 BNatSchG generally constitutes a significant adverse effect. Following the methodology of LAMBRECHT & TRAUTNER (2007), an adverse effect can be classified as not significant in individual cases if various qualitative-functional, quantitative-absolute and relative criteria are met, taking into account all impact factors and considering them cumulatively. A central component of this assessment approach are orientation values for quantitative-absolute area losses of an affected biotope occurrence, which may not be exceeded depending on its overall size. In principle, a maximum value of 1% has been established for the relative area loss.

5.2 Legally protected marine biotopes

According to the current state of knowledge, there are no confirmed occurrences of legally protected biotopes for site N-3.5 according to Sec. 30 BNatSchG. Besides a very homogeneous sediment composition, four objects with dimensions >2 m edge length were verified in the area of site N-3.5. Presumably, these are anthropogenic objects. However, since no diver or

ROV video survey could be conducted, the presence of marine boulders as defined by the reef mapping instructions of the BFN (2018) cannot be excluded at this time.

Due to the relatively small number of potential marine boulders, direct encroachment of protected biotopes by the turbines and residential platform can likely be avoided as part of project planning. Impacts from sedimentation and habitat alteration would be small-scale and short-term. Thus, significant construction-related, facility-related, and operational impacts of the turbines on protected biotopes can likely be excluded.

If, after final analysis of the preliminary investigations, there are indications of the presence of legally protected biotopes, these will be considered accordingly in the suitability assessment.

5.3 Result of the assessment

Since, according to current knowledge, no biotopes protected under Sec. 30 BNatSchG exist in site N-3.5, significant adverse effects on legally protected biotopes as defined by Sec. 30 para. 2 BNatSchG can be excluded. Should the four verified objects in site N-3.5 prove to be Marine boulders as defined in the reef mapping instructions (BFN 2018), they should be considered accordingly during project planning.

6 Assessment of wildlife conservation regulations

The provisions of species protection law will be observed during the implementation of the plan with regard to the construction and operation of offshore wind turbines or offshore wind installations, including the ancillary facilities required for their operation.

6.1 Legal basis

Species protection is regulated in Sec. 37 et seq. BNatSchG as a tiered protection regime and is also applicable in the German EEZ due to the extension according to Sec. 56 para. 1 BNatSchG.

Sec. 39 BNatSchG contains a general basic protection for all wild species.

For specially protected species, an increased level of protection applies according to Sec. 44 para. 1 no. 1, 3 and 4 BNatSchG, and for strictly protected species including European bird species, the highest level of protection applies according to Sec. 44 para. 1 no. 2 BNatSchG.

According to Sec. 7 para. 2 no. 13 BNatSchG, specially protected species include the animal and plant species listed in Annex A or B of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (Ordinance (EC) No. 338/97), animal and plant species listed in Annex IV of the Habitats Directive (Directive 92/43/EEC), European bird species and the species listed in the Ordinance on the Protection of Wild Fauna and Flora (Federal Species Protection Ordinance - BArtSchV).

Strictly protected species according to Sec. 7 para. 2 no. 14 BNatSchG include those listed in Annex A or B of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (Ordinance (EC) No. 338/97), animal and plant species listed in Annex IV of the Habitats Directive (Directive 92/43/EEC) and strictly protected species according to the Ordinance on the Protection of Wild Fauna and Flora (Federal Species Protection Ordinance - BArtSchV).

According to Sec. 44, para. 1, no. 1 BNatSchG, wild animals of specially protected species may not be injured or killed. The access prohibition of Sec. 44 para. 1 no. 1 BNatSchG is aimed at the protection of individuals and as such is inaccessible to a population-related relativisation (Landmann/Rohmer UmweltR/Gellermann BNatSchG Sec. 44 marginal no. 9). According to Sec. 44 para. 5 sentence 2 no. 1 BNatSchG, there is no violation of the prohibition of killing and injury according to para. 1 no. 1 for the animal species listed in Annex IV of the Habitats Directive and European bird species, among others, "if the adverse effect caused by the intervention or the project does not significantly increase the risk of killing and injury for specimens of the affected species and this adverse effect cannot be avoided by applying the necessary, professionally recognised protective measures".

According to Sec. 44, paragraph 1, No. 2 BNatSchG, wild fauna of strictly protected species and European bird species must not be significantly disturbed during reproduction, rearing, moulting, hibernation, and migration periods. It does not matter whether a relevant injury or disturbance is due to reasonable grounds; nor do reasons, motives or subjective tendencies play any part in respect of compliance with the prohibitions (LANDMANN/ROHMER UMWELTR GELLERMANN BNATSCHG SEC. 44 MARGINAL NO. 10–14).

A significant disturbance does not already exist when it is experienced by individual specimens, but only when the disturbance deteriorates the conservation status of the local population of a species (BVerwGE 130, 299; BVerwGE 131, 274).

In the explanatory memorandum to the amendment of the BNatSchG 2007, the term local population is defined as follows: A local population comprises those (sub-)habitats and activity areas of individuals of a species which are sufficiently spatially and functionally interrelated so as to meet the habitat requirements of the species.

According to the Guidance Document on the Strict System of Protection for Species of Community Interest under the Habitats Directive (para. 39), disturbance within the meaning of Art. 12 of the Habitats Directive occurs if the act in question reduces the chances of survival, reproductive success or the ability to reproduce of a protected species, or if this act leads to a reduction in its range. On the other hand, occasional disturbances which are not likely to have a negative impact on the species concerned are not to be regarded as disturbance within the meaning of Article 12 of the Habitats Directive.

According to the explanatory memorandum, a deterioration of the conservation status of the local population is also to be assumed if the chances of survival, breeding success or reproductive capacity are reduced (BT-Drs. 16/5100, p. 11), whereby this must be assessed on a species-specific basis for each individual case. What is essential is whether the disturbance is associated with effects which, in view of the circumstances of the individual case and the conservation situation of the species concerned, make adverse effects on the conservation status of the local population appear likely (similarly in OVG Berlin NuR 2009, 898 (899), for example if specimens of rare or highly endangered species are disturbed, the disturbed individuals belong to small local populations or a disturbance affects all animals of the population in question (LANDMANN/ROHMER UMWELTR GELLERMANN BNATSCHG SEC. 44 MARGINAL NO. 13). In contrast, significant disturbance may be precluded, for example, by the wide distribution of a species with possibly large local populations (BVerwG NuR 2008, 633 marginal no. 258) or the existence of low-disturbance alternative habitats that can be used by the animals (LANDMANN/ROHMER UMWELTR GELLERMANN BNATSCHG SEC. 44 MARGINAL NO. 13).

Within the framework of this assessment of wildlife conservation regulations, it is being investigated whether the implementation of the plan, i.e. the realisation and operation of wind turbines and other facilities, fulfils the requirements of Sec. 44 para. 1 no. 1 and no. 2 BNatSchG for specially and strictly protected animal species. In particular, it is being examined whether the construction and operation of the turbines violate the prohibitions under species protection law.

The present assessment is conducted at the level of assessing the basic suitability of site N-3.5 for the generation of electricity from wind energy. The designation of the technical construction of the concrete project is missing at this time. In this respect, an update of the species protection assessment will be necessary within the framework of the subsequent individual approval procedure, taking into account the specific project parameters.

6.2 Marine mammals

As explained above, site N-3.5 is home to harbour porpoise species listed in Annex IV (animal and plant species of Community interest requiring strict protection) of the Habitats Directive, as well as harbour seal and grey seal species as native mammals under the Federal Species Protection Ordinance (Annex 1 BArtSchV). Harbour porpoises occur in varying numbers throughout the year. Harbour seals and grey seals are encountered in small numbers and irregularly.

Against this background, the suitability of the site must also be ensured with regard to Sec. 44 para. 1 BNatSchG.

Use by marine mammals varies considerably in the individual areas of the site development plan in the German North Sea EEZ. Area N-3, where site N-3.5 is located, is of medium to – seasonally in spring – high importance for harbour porpoises, but of low to medium importance for grey seals and harbour seals.

6.2.1 Harbour porpoise

With an average body length of 1.5 m and a weight of approx. 60 kg, the harbour porpoise (*Phocoena phocoena*) is a small, rather inconspicuous whale species that is extremely shy. This widespread whale species in the temperate waters of the North Atlantic and North Pacific is usually observed singly or as mother-calf pairs and rarely in groups.

The harbour porpoise has a lifespan of 8 to 12 years. Observations have shown that individual animals can live up to 23 years. The harbour porpoise does not reach reproductive age until it is three to four years old. Harbour porpoises give birth to one calf per year or every two years. The gestation period is 10 to 11 months and the lactation period 8 to 10 months. Calves weigh between 4.5 and 10 kg at birth with a length of 70 to 90 cm. Most calves are born in May, June and July.

Harbour porpoises use continental shelf seas up to 200 m deep due to their hunting and diving behaviour. Preferred depths seem to be between 20 and 50 m.

Preferred food organisms include fish such as sand eel, goby, herring, sardines, cod with lengths up to 30 cm. Among the whale species, the harbour porpoise shows a distinctly selective feeding behaviour with a clear preference for food prey rich in fat and energy. The occurrence of the preferred food resources largely determines the distribution patterns of the harbour porpoise.

The harbour porpoise uses the frequency range between 80 kHz and 120 kHz for communication and echolocation and thus belongs to the group of high-frequency whales.

Bycatch is a major threat to harbour porpoises, as are diseases, attacks by dolphins, the enrichment of food organisms with pollutants and microplastics, and underwater noise.

The construction and operation of the facilities in site N-3.5 will be associated with noise emissions. The impacts of the project with regard to noise emissions are to be assessed in terms of species protection law.

6.2.1.1 Sec. 44 para. 1 no. 1 BNatSchG (prohibition of killing and injury)

According to Sec. 44 para. 1 no. 1 BNatSchG, the killing or injuring of wild animals of specially protected species, i.e. including animals listed in Annex IV of the Habitats Directive, such as the harbour porpoise, is prohibited.

In its statements BfN frequently assumes that, according to current knowledge, injuries in harbour porpoises occur in the form of temporary hearing loss when animals are exposed to a single event sound pressure level (SEL) of 164 dB re 1 $\mu Pa^2/Hz$ or a peak level of 200 dB re 1 µPa.

According to the BfN, it is sufficiently certain that, if the specified limits of 160 dB for the sound event level (SEL_{05}) and 190 dB for the peak level at a distance of 750 m from the emission point are complied with, killing and injury pursuant to Sec. 44 para. 1 no. 1 BNatSchG cannot occur.

The BfN considers the current use of monopiles with a diameter of up to 8.2 m and jacket piles with a diameter of up to 4 m. The BfN assumes that suitable means, such as soft-start procedures, are used to ensure that no harbour porpoises are present within the 750 m radius around the pile driving site.

The BSH agrees with this assessment. Specifications are made in the determination of suitability, and orders are also issued later in the course of the individual approval procedures and, if necessary, in their enforcement with regard to the necessary noise abatement measures and other mitigation measures (so-called conflict-avoiding or -mitigating measures), cf. inter alia *Lau* in: Frenz/Müggenborg, BNatSchG, Commentary, Berlin 2011, Sec. 44 marginal no. 3., by means of which the occurrence of the prohibited act can be excluded or the intensity of any adverse effects can be reduced. The measures are strictly monitored using the prescribed monitoring system to ensure with the necessary certainty that the killing and injury pursuant to Sec. 44 para. 1 no. 1 BNatSchG will not occur.

As part of the determination of suitability, it is envisaged that the subsequent developer of the project will be instructed to use the quietest working method in the circumstances for the foundation and installation of the facilities. On this basis, the BSH can order suitable specifications with regard to individual work steps, such as deterrent measures as well as a slow increase in pile-driving energy, by means of so-called “soft-start” procedures. Deterrent/aversive measures and soft-starts can ensure that no harbour porpoises or other marine mammals are present in an adequate area around the pile-driving site, keeping them a minimum distance of 750 m or more from the construction site.

In summary, the implementation of the prohibition of killing can be excluded by the above-mentioned mitigation and avoidance measures. The use of appropriate deterrent measures will ensure that the animals are outside the 750-metre radius of the point of emission. In addition, the degree of noise reduction required and specified in the suitability determination must be such that it can be assumed that outside the area in which no harbour porpoises are expected to be present as a result of the deterrent measures to be implemented, there will be no lethal and no long-term adverse effects of the noise.

The measures ordered by the BSH within the framework of the individual approval procedure will prevent with sufficient certainty the fulfilment of the prohibitions of species protection under Art. 44 para. 1 no. 1 BNatSchG.

According to the current state of knowledge, neither the operation of the installations nor the laying and operation of inter-array cabling will have any significant negative impacts on marine mammals that meet the killing and injury criteria under Sec. 44 para. 1 no. 1 BNatSchG.

6.2.1.2 Sec. 44 para. 1 no. 2 BNatSchG (prohibition of disturbance)

Under Sec. 44 para. 1 no. 2 BNatSchG, it is also prohibited to cause significant disturbance to wild animals of strictly protected species during the reproduction, rearing, moulting, wintering and migration periods.

The harbour porpoise is a strictly protected species according to appendix IV of the Habitats Directive and thus within the meaning of Sec. 44 para. 1 no. 2 BNatSchG in conjunction with. Sec. 7 para. 2 no. 14 BNatSchG so that a species protection assessment must also be carried out in this regard.

The species protection assessment under Sec. 44 para. 1 no. 2 BNatSchG relates to population-relevant disturbances of the local population, the occurrence of which varies in the German North Sea EEZ.

In its statements in the context of planning approval and enforcement procedures, the Federal Agency for Nature Conservation (BfN) regularly examines the existence of disturbance under species protection law within the meaning of Sec. 44 para. 1 no. 2 BNatSchG. It comes to the conclusion that the occurrence of a significant disturbance caused by construction-related underwater noise in relation to the protected species harbour porpoise can be avoided, provided that the sound event level of 160 dB or the peak level of 190 dB is not exceeded at a distance of 750 m from the point of emission and sufficient alternative areas are available in the German North Sea. BfN demands that compliance with the latter requirement be ensured by coordinating the timing of noise-intensive activities of multiple project participants with the aim of ensuring that no more than 10% of the area of the German North Sea EEZ is affected by noise (BMU 2013).

Impacts of the construction phase

The temporary pile driving work is not expected to cause any significant disturbance to harbour porpoises within the meaning of Sec. 44 para. 1 no. 2 BNatSchG.

According to the current state of knowledge, it is not to be assumed that disturbances that may occur due to noise-intensive construction measures would deteriorate the conservation status of the “local population”.

Through effective noise abatement management, in particular through the application of suitable noise mitigation systems in the sense of the specifications from the determination of suitability as well as subsequent orders in the planning approval of the BSH and taking into consideration the specifications from the noise abatement concept of the BMU (2013), negative impacts of the pile driving work on harbour porpoises are not to be expected.

The determination of suitability includes the requirement for the developer of the project to coordinate the pile driving work required for its project with that of other projects that could potentially be constructed in the same period (§ 8). The planning approval decision of the BSH will contain concretising directives which ensure effective noise abatement management by means of suitable measures.

In accordance with the precautionary principle, measures to avoid and reduce the effects of noise during construction are specified according to the state of the art in science and technology. The measures ordered in the determination of suitability or later in the planning approval to ensure compliance with the requirements of species protection are coordinated with the BfN in the course of implementation and adapted, if necessary. The following noise-reducing and environmental protection measures are ordered regularly within the framework of the plan-approval procedures:

- Preparation of a sound prognosis under consideration of the site- and installation-specific characteristics (basic design) before the start of construction,
- Selection of the construction method producing the lowest noise level according to the state of the art and the existing conditions,
- Preparation of a specific noise prevention concept, adapted to the selected foundation structures and construction processes, for implementation of pile driving, in principle two years before the start of construction, and in any case before the conclusion of contracts concerning components affected by noise,
- Use of noise-reducing accompanying measures, individually or in combination, noise-reducing systems remote from the piles (bubble curtain system) and, if necessary, noise-reducing systems close to the piles in accordance with the state of the art in science and technology,
- Consideration of hammer characteristics and the options for controlling the pile driving process in the noise prevention concept,
- Concept for scaring animals away from the hazard area (within a radius of at least 750 m around the pile driving site),
- Concept for verifying the effectiveness of the deterrent and noise-reducing measures,
- State-of-the-art installation design to reduce operational noise.

As outlined above, deterrent measures and a soft-start procedure must be applied to ensure that animals in the vicinity of the pile-driving operations have the opportunity to move away or to avoid them in good time.

Even a measure ordered to avoid the risk of killing pursuant to Sec. 44 para. 1 no. 1 BNatSchG, such as deterring a species, can in principle comply with the prohibition of disturbance if it takes place during the periods of protection and is significant (BVerwG, judgement of 27/11/2018 – 9 A 8/17, cited in juris).

For deterrence up until 2017, a combination of pingers was used as a pre-warning system, followed by the use of the so-called Seal Scarers as a warning system. All the results of the monitoring by means of acoustic detection of harbour porpoises in the vicinity of offshore construction sites with pile driving have confirmed that the use of deterrence has always been effective. The animals have left the danger zone of the respective construction site. However, scaring deterrence using Seal Scarers is accompanied by a large loss of habitat, caused by the animals' flight reactions and therefore constitutes a disturbance (BRANDT et al., 2013, DÄHNE et al., 2017, ROSE et al., 2019).

To prevent this, a new system for deterring animals from the danger zone of the construction sites, the so-called Fauna Guard System, has been used in construction projects in the German North Sea EEZ since 2018. The development of new deterrence systems, such as the Fauna Guard System, opens up the possibility for the first time to adapt the deterrence of harbour porpoises and seals in such a way that the realisation of the killing and realisation elements within the meaning of Sec. 44 para. 1 no. 1 BNatSchG can be excluded with certainty without leading to a simultaneous realisation of the disturbance elements within the meaning of Sec. 44 para. 1 no. 2 BNatSchG.

The use of the Fauna Guard System is accompanied by monitoring measures. The effects of the Fauna Guard System are being systematically analysed as part of a research project. If necessary, adjustments in the application of the system will have to be implemented in future construction projects.

On the basis of the above-mentioned requirement, this, but also another type of deterrence can be ordered if this proves to be more suitable on the basis of the state of knowledge and the state of the art at that time.

The selection of noise abatement measures by the subsequent developer of the project must be based on the state of the art in science and technology and on experience already gained in other offshore projects. Findings based on practical experience in the application of technical noise-reducing systems and from experience with the control of the pile driving process in connection with the characteristics of the impact piling hammer were gained, in particular, during the foundation work in the projects “Butendiek”, “Borkum Riffgrund I”, “Sandbank”, Gode Wind 01/02”, “NordseeOne”, “Veja Mate”, “Arkona Basin Southeast”, “Merkur Offshore” and others. A current study commissioned by BMU (BELLMANN, 2020) provides a cross-project evaluation and presentation of the results from all technical noise abatement measures used in German projects to date.

The results of the very extensive monitoring of the construction phase of 20 offshore wind farms have confirmed that the measures to avoid and reduce disturbances to harbour porpoise arising from impact noise are effectively implemented and that the requirements of BMU's noise abatement concept (2013) are reliably met. The current state of knowledge takes into account construction sites at water depths ranging from 22 m to 41 m, in seabed soils ranging from homogeneous sandy to heterogeneous and difficult to penetrate profiles, and piles with diameters of up to 8.1 m. It has been shown that the industry has found solutions in the various procedures to effectively harmonise installation processes and noise protection.

According to the current state of knowledge and on the basis of the development of technical noise protection to date, it can be assumed that considerable disturbance to harbour porpoises can be excluded from the foundation work within site N-3.5, even assuming the use of piles with a diameter of up to 10 m.

In addition, the plan approval decision of the BSH will specify monitoring measures and noise measurements in detail in order to detect a possible hazard potential on site on the basis of the actual project parameters and, if necessary, to initiate damage mitigation measures.

New findings confirm that the reduction of noise input through the use of technical noise reduction systems clearly reduces disturbance effects that act on harbour porpoises. The minimisation of effects concerns both the spatial and temporal extent of disturbances (BRANDT et al. 2016).

As a result, significant disturbances within the meaning of Sec. 44 para. 1 no. 2 BNatSchG are not to be expected if the above-mentioned strict sound protection and sound reduction measures are applied in accordance with the requirements of the determination of suitability and the orders in the planning approvals and the limit value of 160 dB SEL_5 at a distance of 750 m is complied with. Furthermore, the BfN's demand to coordinate the timing of noise-intensive construction phases of different project developers in the German North Sea EEZ in accordance with the BMU's Noise Abatement Concept (2013) is mandated.

Impacts during operation

According to the current state of knowledge, the operationof offshore wind turbines cannot be assumed to constitute a disturbance pursuant to Sec. 44 para. 1 no. 2 BNatSchG. Based on the current state of knowledge, no negative long-term effects from wind turbine noise emissions for harbour porpoises are to be expected assuming the normal design of the plants. Any effects are limited to the immediate vicinity of the plant and depend on sound propagation in the specific area and, not least, on the presence of other sound sources and background noise, such as shipping traffic (MADSEN et al. 2006). This is confirmed by findings from experimental work on the perception of low-frequency acoustic signals by harbour porpoises using simulated operating noise from offshore wind turbines (LUCKE et al. 2007b): Masking effects were recorded at simulated operating noises of 128 dB re 1 µPa at frequencies of 0.7, 1.0 and 2.0 kHz. By contrast, no significant masking effects were detected at operating noises of 115 dB re 1 µPa. The results obtained so far from the monitoring of underwater noise in offshore wind farms and their surroundings confirm that noise emissions from the operation of the turbines are not clearly distinguishable from background noise even after a few hundred metres (Chapter 4.5.1). Monitoring of harbour porpoise during the operational phase of offshore wind farms in the German North Sea EEZ has also not revealed any evidence of avoidance or changes in behaviour. Offshore wind farms located in areas of high abundance continue to be frequented by harbour porpoises. This result applies both to wind farms in the harbour porpoise's main distribution area in the German Bight, such as “Butendiek”, and to wind farms outside this area, such as north of Borkum (BioConsultSH, 2018, 2019, IfAÖ et al., 2018, 2019).

Results of a study on the habitat use of offshore wind farms by harbour porpoises operating from the Dutch offshore wind farm “Egmont aan Zee” also confirm this observation. The acoustic survey was used to assess the use of the wind farm site or two reference sites by harbour porpoises prior to the installation of the turbines (baseline survey) and during two consecutive years of operation. The results of the study confirm a pronounced and statistically significant increase in acoustic activity in the inner area of the wind farm during the operating phase compared to the activity or use during the baseline survey (SCHEIDAT et al. 2011). The increase in harbour porpoise activity within the wind farm during operation significantly exceeded the increase in activity in both reference areas. The increase in use of the wind farm area was significantly independent of seasonality and interannual variability. The authors of the study see a direct correlation between the presence of the turbines and the increased use by harbour porpoises. They suspect the causes to be factors such as an enrichment of the food supply due to a “reef effect” or calming of the area due to the absence of fishing and shipping or possibly a positive combination of these factors.

The results of the investigations during the operational phase of the “alpha ventus” project also indicate a return to distribution patterns and abundances of harbour porpoise that are comparable – and in some cases higher – than those from the baseline survey of 2008.

The results from the monitoring of the operational phase of offshore wind farms in the EEZ have so far not yielded clear results. The investigations in accordance with StUK4 using aircraft-based survey has so far revealed fewer sightings of harbour porpoises inside the wind farm areas than outside. However, the acoustic survey of habitat use by means of special underwater measuring devices known as CPODs shows that harbour porpoises use the wind farm areas (Butendiek 2017, Nördlich Helgoland, 2019, Krumpel et al., 2017, 2018, 2019). The two methods – visual/digital detection from aircraft and acoustic detection – are complementary, i.e. the results from both methods should be used to identify and assess possible effects. The joint evaluation of the data, the development of suitable evaluation criteria and the description of the biological relevance is to be the subject of a research programme.

In order to ensure with sufficient certainty that contravening of the prohibition pursuant to Sec. 44 para. 1 no. 2 BNatSchG will not occur, an operational sound-reducing turbine design in accordance with the state of the art should be used against this background in the sense of the corresponding requirements of the determination of suitability (§ 7 para. 4).

Appropriate monitoring is also provided for in the determination of suitability for the operational phase of the individual project in site N-3.5 (§ 4), in order to be able to record and assess any site- and project-specific impacts.

As a result, the protective measures ordered are sufficient to ensure that, where harbour porpoises are concerned, operation of turbines in site N-3.5 also does not contravene the prohibitions according to Sec. 44 para. 1 no. 2 BNatSchG.

Other marine mammals

In addition to the harbour porpoise, animal species listed as such in a statutory ordinance pursuant to Sec. 54 para. 1 BNatSchG are considered to be specially protected under Sec. 7 para. 2 no. 13 lit c BNatSchG. The BartSchV (Ordinance for the Protection of Wild Fauna and Flora), which was issued on the basis of Sec. 54 para.1 no.1 BNatSchG, lists native mammals as specially protected, which thus also fall under the species protection provisions of Sec. 44 para. 1 no. 1 BNatSchG. In principle, the considerations listed in detail for harbour porpoises regarding noise pollution from the construction and operation of offshore wind turbines apply to all other marine mammals inhabiting site N-3.5 and its surroundings. However, dependent on the species, hearing thresholds, sensitivity and behavioural responses vary considerably among marine mammals. The differences in the perception and evaluation of sound events among marine mammals are based on two components: On the one hand, the sensory systems are morphoanatomically and functionally species-specific. As a result, marine mammal species hear and react differently to sound. On the other hand, both perception and reaction behaviour depend on the respective habitat (Ketten 2004).

With regard to harbour seals and grey seals, there are no indications from the monitoring of the operational phase that would indicate avoidance of the areas or changes in behaviour.

Site N-3.5 and its surroundings are of no particular importance for harbour seals and grey seals. The nearest frequently frequented breeding and resting areas are more than 80 km away from Helgoland and the East Frisian Islands.

Seals are generally considered tolerant of sonic activity, especially when they have a plentiful supply of food. However, telemetric studies have shown flight reactions during seismic activity (RICHARDSON 2004). According to all current findings, seals can still hear pile-driving sounds at a distance of more than 100 km.

Overall, it can be assumed that the operation of the facilities in site N-3.5 will not fulfil the prohibition criteria of Sec. 44 para. 1 no. 2 BNatSchG with regard to harbour seals and grey seals due to the distances from the breeding and resting areas mentioned above and the measures specified.

6.3 Avifauna (seabirds, resting and migratory birds)

The suitability of site N-3.5 for offshore wind energy use is to be assessed on the basis of species protection requirements according to Sec. 44 para. 1 BNatSchG for avifauna (resting and migratory birds).

In the vicinity of site N-3.5, protected bird species according to Annex I of the Birds Directive (in particular the red-throated diver, black-throated diver, little gull, Sandwich tern, common tern, and Arctic tern) and regularly occurring migratory bird species (in particular the common and lesser black-backed gull, northern fulmar, gannet, kittiwake, guillemot, and razorbill)) occur in varying densities. Against this background, the compatibility of the plans with Article 44 subsection (1) number 1 of the BNatSchG (prohibition of killing and injury) and Article 44 subsection (1) number 2 of the BNatSchG (prohibition of disturbance) must be examined and ensured.

All findings to date indicate a medium importance of site N-3.5 including its surroundings for seabirds, including species listed in Annex I of the Bids Directive. Site N-3.5 lies outside the concentration centres of various bird species listed in Annex I of the Birds Directive, such as loons, terns, little gulls and terns.

Site N-3.5 and its surroundings are of medium importance for migratory bird species. It is expected that significant proportions of the songbirds breeding in northern Europe migrate across the North Sea. However, guidelines and concentration areas for bird migration are not present in the EEZ. There is evidence that migration intensity decreases with distance from the coast.

6.3.1 Sec. 44 para. 1 no. 1 BNatSchG (prohibition of killing and injury)

Sec. 44 para. 1 no. 1 BNatSchG in conjunction with. Art. 5 of the Birds Directive, it is prohibited to hunt, capture, injure, or kill wild animals of specially protected species. The specially protected species include European bird species, so that species listed in Annex I of the Birds Directive, species whose habitats and haunts in nature conservation areas are protected, as well as characteristic species and regularly occurring migratory bird species (in particular the common and lesser black-backed gull, northern fulmar, gannet, kittiwake, guillemot, and razorbill). Accordingly, injuring or killing resting birds as a result of collisions with wind turbines must be excluded in principle. The risk of collision depends on the behaviour of the individual animals and is directly related to the species concerned and the environmental conditions encountered. For example, a collision of loons is not to be expected because of their pronounced avoidance behaviour towards vertical obstacles.

As already explained, according to Sec. 44 para. 5 sentence 2 no. 1 BNatSchG, a violation of the prohibition of killing and injury does not exist “if the impairment caused by the intervention or the project does not significantly increase the risk of killing and injury to specimens of the species concerned, and this impairment cannot be avoided by applying the necessary, professionally recognised protective measures”. This exception was included in the BNatSchG on the basis of pertinent Supreme Court decisions, since in the planning and approval of public infrastructure and private construction projects, it must regularly be assumed that unavoidable operational killings or injuries of single individuals (e.g. due to collision of birds with wind turbines) may occur, which, however, as the realisation of socially adequate risks, should not fall under the scope of the ban (BT-Drs. 16/5100, p. 11 and 16/12274, p. 70 f.). An attribution is only made if the risk of consequences of the project is significantly increased due to special circumstances, such as the design of the turbines, the topographical conditions or the biology of the species. In this context, measures to avoid and reduce risks are to be included in the assessment (cf. LÜTKES/EWER/HEUGEL, SEC. 44 BNATSCHG, MARGINAL NO. 8, 2011; BVERWG, JUDGEMENT OF 12 MARCH 2008; REF. 9 A3.06; BVERWG, JUDGEMENT OF 9 July 2008, ref. 9 A14.07; FRENZ/MÜGGENBORG/LAU, Sec. 44 BNATSCHG, MARGINAL NO. 14, 2011).

In its statement of 31/05/2021, the BfN states that, based on the prohibition of killing species under species protection law in accordance with Sec. 44 para. 1 no. 1 BNatSchG among other things, there is a clear need for action with regard to the necessary avoidance through shutdowns during high migratory volumes in the risk area of the OWP. Especially for birds of prey, geese, waders, gulls and terns as well as a number of songbirds, a significantly increased collision risk is to be assumed during events with a very high migration intensity over site N-3.5.

In the view of the BSH, at the time of the determination of suitability of site N-3.5, there is no changed state of knowledge regarding migration events or a significantly increased risk of killing according to Sec. 44 para. 1 no. 1 BNatSchG compared to the determination of suitability of the neighbouring site N-3.8 that justifies a different assessment under species protection law at the level of the determination of suitability of site N-3.5. The measures provided for in the determination of suitability, such as minimising light emissions, also help to ensure that collisions with offshore wind turbines are avoided as far as possible or that this risk is at least minimised. In addition, effects monitoring should be carried out during the operating phase in order to verify the current nature conservation assessment of the actual risk of bird strike posed by the installations and, if necessary, to be able to adjust it. According to the provisions of the WindSeeG, further measures can be ordered during the planning approval procedure and also later during implementation. Against this background, the BSH does not believe that there is a significant increase in the risk of killing or injuring migratory birds. The realisation of offshore wind energy installations together with ancillary facilities, such as a residential platform and inter-array cabling does not violate the prohibition of killing and injury pursuant to Sec. 44 para. 1 no. 1 BNatSchG.

According to the current state of knowledge, a site-related significantly increased risk of collision of individual resting bird species on site N-3.5 is not apparent. This is also the conclusion reached by the BfN in its statement of 31/05/2021.

6.3.2 Sec. 44 para. 1 no. 2 BNatSchG (prohibition of disturbance)

Pursuant to Sec. 44 para. 1 no. 2 BNatSchG, it is prohibited to significantly disturb wild animals of strictly protected species during the breeding, rearing, moulting, hibernation and migration periods, whereby a significant disturbance exists if the disturbance worsens the conservation status of the local population of a species.

The assessment of wildlife conservation regulations according to Sec. 44 para. 1 no. 2 BNatSchG refers to population-relevant disturbances of local populations. For this reason, it is necessary to consider possible disturbances to local populations in German waters, in particular in the German EEZ, by wind energy use on site N-3.5. A cross-area and area-wide species protection assessment with regard to the ban on disturbance in the sense of a deterioration in the conservation status of local populations of protected species was carried out as part of the SEA for the site development plan 2020 (BSH 2020a). The following is a brief summary of the results of the species protection assessment with regard to Sec. 44 para. 1 no. 2 BNatSchG for the site development plan.

Summary of the species protection assessment pursuant to Sec. 44 para. 1 no. 2 BNatSchG (prohibition of disturbance) for the site development plan

The focus of the assessment was on the loon species group, which has been shown to be particularly sensitive to wind farms based on the results of operational monitoring of offshore wind farms in the German EEZ, research projects and published literature.

The assessment showed that loons are highly sensitive in terms of population biology, that the main concentration area is of high importance for the maintenance of the local population, and that the adverse effects due to avoidance behaviour towards offshore wind farms are intense and permanent.

In order to prevent a deterioration of the conservation status of the local population because of the cumulative impacts of the wind farms, it is necessary to keep the area of the main concentration area currently available to loons outside the impact zones of already realised wind farms free of new wind farm projects.

The BSH concluded that significant disturbance within the meaning of Sec. 44, para. 1 No. 2 BNatSchG as a result of the implementation of the plan (site development plan) can be excluded with the necessary certainty if it is ensured that no additional habitat loss occurs in the main concentration area.

As a result, site N-5.4 was excluded from further planning for offshore wind turbines based on the results of the assessment of cumulative adverse effects on the conservation status of the local population of common loons, and areas N-4 and N-5 were placed under review for subsequent use.

For areas N-1 to N-3, N-6 to N-13, the assessment pursuant to Sec. 44 para. 1 no. 2 BNatSchG came to the conclusion that, according to the current state of knowledge, the disturbance requirement cannot be assumed to be fulfilled, which also applies to other species listed in Annex I of the Birds Directive and characteristic species as well as regularly occurring migratory bird species.

Species protection assessment according to Sec. 44 para. 1 no. 2 BNatSchG for site N-3.5

The results of the assessment carried out within the framework of preparing the site development plan (BSH 2020a) can be confirmed for site N-3.5 on the basis of the available data and information.

As already described, protected species can be found on site N-3.5 and in its surroundings. These include species listed in Annex I of the Birds Directive, species whose habitats are protected in the nature conservation areas, as well as characteristic species and regularly occurring migratory bird species (in particular the common and lesser black-backed gull, northern fulmar, gannet, kittiwake, guillemot, and razorbill). Against this background, the compatibility of wind energy use on site N-3.5 with Sec. 44 para. 1 no. 2 BNatSchG in conjunction with Art. 5 of the Birds Directive must be ensured.

The area where site N-3.5 is located is mainly used by loons as a transit area during migration periods and in winter. According to current knowledge, this area and its surroundings lie outside the main loon concentration area identified in the German Bight. On the basis of the available findings from research projects and monitoring of wind farm clusters, the BSH has concluded that site N-3.5 and its surroundings are not of high importance for the loon population in the

German North Sea. Site N-3.5 is located at a distance of more than 40 km from the main loon concentration area. Due to this distance, it can be assumed that there will be no significant disturbance of the local loon population in the main concentration area west of Sylt. In its statement on the draft environmental report on site N-3.5 dated 31/05/2021, the Federal Agency for Nature Conservation (BfN) shares this assessment. As a result, significant disturbance of the local population according to Sec. 44 para. 1 no. 2 BNatSchG can be excluded with the necessary certainty.

Due to the relatively low observed densities of little gulls in the vicinity of site N-3.5, as well as the temporally limited coupling to the species-specific main migration periods, a low to at most medium importance of the vicinity of N-3.5 for little gulls can be assumed. Determined maximum densities are subject to interannual fluctuations. Cumulative effects on the population are not to be expected according to current knowledge. With regard to little gulls, the realisation of the disturbance element according to Sec. 44 para. 1 no. 2 BNatSchG can be excluded with the necessary certainty for a wind farm project on site N-3.5 according to the current state of knowledge. This is also the assessment reached by the BfN in its statement of 31/05/2021.

Based on the available findings on the occurrence of terns in the vicinity of site N-3.5, the BSH does not, according to current knowledge, assume significant disturbance due to an offshore wind farm project on site N-3.5. Previous findings from the cluster survey on “North of Borkum” indicate a partial avoidance of the wind farm areas, but not beyond the boundaries of a wind farm. Furthermore, terns only use the area surrounding site N-3.5 as a migration area during migration periods. According to the current state of knowledge, the realisation of the disturbance element according to Sec. 44 para. 1 no. 2 BNatSchG for terns can therefore be excluded with the necessary certainty. This is also the assessment reached by the BfN in its statement of 31/05/2021.

Significant impacts on guillemots and razorbills due to a wind farm project on site N-3.5 are not to be expected due to the large overall population and the large-scale distribution according to current knowledge. In its statement of 31/05/2021, the BfN states that, based on the current state of knowledge, it cannot be assumed that the construction of a wind farm on site N-3.5 will have any significant adverse effects on guillemot and razorbill. Nevertheless, with regard to the avoidance behaviour of guillemots and razorbills, the BfN refers to initial indications of a higher effect strength, which prompted the BfN to initiate a research project on the potential impacts of further wind power development. The findings from this research project, as well as other related future results, will be considered in the future. For an offshore wind farm on site N-3.5, however, the realisation of the disturbance element according to Sec. 44 para. 1 no. 2 BNatSchG can be excluded with the necessary certainty according to the current state of knowledge.

Little is known so far about reactions of the northern fulmar to offshore wind farms under construction or in operation, as generally low sighting rates and insufficient data do not allow reliable conclusions to be drawn. Experts assume that offshore wind farms are not very sensitive to disturbance. In its statement of 31/05/2021, the BfN concludes that the disturbance element pursuant to Sec. 44 para. 1 no. 2 BNatSchG will not be realised by a project on site N-3.5. The BSH concurs with this assessment. Due to the only isolated sightings and very low densities observed in the vicinity of site N-3.5, significant disturbance according to Sec. 44 para. 1 no. 2 BNatSchG can be excluded with the necessary certainty.

For gannets, there are some statistically non-significant investigations suggesting a potential avoidance behaviour towards wind turbines. Unambiguous statements frequently cannot be made due to the high mobility of the species and, similar to the northern fulmar, the associated low sighting rates and small samples. In view of the low, interannually fluctuating occurrence of the gannet, site N-3.5 can be assumed to be of low importance as a resting and feeding area. In its statement of 31/05/2021, the BfN concludes that the disturbance element pursuant to Sec. 44 para. 1 no. 2 BNatSchG will not be realised by a project on site N-3.5. The BSH concurs with this assessment. A realisation of the disturbance element according to Sec. 44 para. 1 no. 2 for gannets can be excluded with the necessary certainty.

Seabirds and resting birds in the vicinity of site N-3.5 are dominated by gulls. Among them, lesser black-backed gulls and black-legged kittiwakes are the most common species. In general, offshore wind turbines seem to attract the majority of gull species. They are also known as prominent ship followers. Significant impacts on gulls from an offshore wind farm on site N-3.5 are therefore not to be expected according to current knowledge. In its statement of 31/05/2021, the BfN also states that a project on site N-3.5 would not cause significant disturbance within the meaning of Sec. 44 para. 1 no. 2. According to the current state of knowledge, the construction and operation of offshore wind turbines and ancillary facilities (residential platform, inter-array cabling) on site N-3.5 can be excluded with the necessary certainty as a disturbance element pursuant to Sec. 44 para. 1 no. 2 BNatSchG.

At the time of the determination of the suitability of site N-3.5, the designation of the technical construction of the concrete project is lacking. In this respect, it is necessary to update the examination of the realisation of the disturbance element pursuant to Sec. 44 para. 1 no. 2 BNatSchG within the framework of the individual approval procedure.

6.4 Bats

Migratory movements of bats across the North Sea are still poorly documented and largely unexplored. There is a lack of concrete information on migrating species, migration corridors, migration heights, and migration concentrations. Previous knowledge merely confirms that bats, especially long-distance migratory species, fly over the North Sea.

6.4.1 Sec. 44, para. 1, no. 1 and no. 2 BNatSchG

According to Annex IV of the Habitats Directive, bats are animal and plant species of Community interest that require strict protection and are therefore strictly protected under Sec. 7 para. 2 no.14 BNatSchG. A total of 25 bat species are native to Germany. According to expert knowledge, the risk of isolated collisions with wind turbines cannot be excluded. In terms of species protection, the same considerations apply in principle as those already mentioned in the assessment of avifauna. Collision with offshore structures does not constitute deliberate killing. Here, explicit reference can be made to the Guidance on the strict system of protection for animal species of Community interest under the Habitats Directive, which assumes in II.3.6 marginal no. 83 that the killing of bats is an incidental killing requiring continuous monitoring according to Art. 12 para. 4 Habitats Directive.

Experience and findings from research projects or from wind farms already in operation will also be adequately considered in further processes.

The data available for the EEZ of the North Sea are fragmentary and insufficient to be able to draw conclusions about bat migration. It is not possible to draw concrete conclusions on migratory species, migration directions, migration heights, migration corridors and possible concentration ranges on the basis of the available data. What we have seen so far only confirms that bats, especially long-distance migratory species, fly over the North Sea.

However, it can be assumed that any negative impacts of wind turbines on bats can be countered by the same avoidance and mitigation measures provided for the protection of bird migration.

According to the current state of knowledge, the construction and operation of offshore wind turbines and ancillary facilities (residential platform, inter-array cabling) on site N-3.5 is not likely to result in either killing or injury according to Sec. 44 para. 1 no. 1 BNatSchG or significant disturbance under species protection law according to Sec. 44 para. 1 no. 2 BNatSchG.

7 Impact assessment/area protection assessment

7.1 Legal basis

According to Sec. 36 in conjunction with Sec. 34 BNatSchG, plans or projects which, individually or in combination with other plans or projects, may have a significant adverse effect on a Natura 2000 area and which do not directly serve the management of the area, must be assessed for their compatibility with the protection and conservation objectives of the Natura 2000 site. This also applies to projects outside the site which, either individually or in combination with other projects or plans, are likely to significantly affect the site's conservation objectives. The Natura 2000 network comprises the areas of Community importance under the Habitats Directive and the bird sanctuaries. Insofar as these areas have been designated as protected areas, the assessment relates to their compatibility with the conservation objectives of these nature conservation areas, Sec. 34 para. 1 sentence 2 BNatSchG.

The impact assessment has a narrower scope than the rest of the SEA, because it is limited to checking compatibility with the conservation objectives defined for the protected area, i.e. it has a territorial reference.

Within the scope of this SEA, the compatibility of the construction and operation of wind turbines on site N-3.5 with the conservation objectives of the individual nature conservation areas is assessed separately for protected assets and protected areas.

The suitability assessment carried out here for site N-3.5 takes place at the superordinate level of the suitability assessment and does not replace the assessment at the level of the specific project in knowledge of the specific project parameters, which is carried out within the framework of planning approval procedures. In this respect, further preventative and mitigation measures are to be expected if these are deemed necessary by the impact assessment within the framework of planning approval procedures in order to exclude any adverse effect on the conservation objectives of the Natura 2000 areas or conservation purposes of the protected areas by the use within or outside a nature conservation area. In this context, the compatibility within the framework of the suitability assessment is to be examined on the basis of the previous investigations carried out for the nature conservation areas or areas under the Habitats Directive.

Prior to their designation as marine protected areas according to Sec. 20 para. 2, 57 BNatSchG, the nature conservation areas in the EEZ were included as areas under the Habitats Directive in the first updated list of sites of Community importance for the Atlantic biogeographical region in accordance with Art. 4 para. 2 of the Habitats Directive (Official Journal of the EU, 15/01/2008, L 12/1), so that an impact assessment had already been carried out as part of the Spatial Offshore Grid Plan for the German North Sea EEZ (BSH 2017). Most recently, an impact assessment according to Sec. 34 para. 1 BNatSchG was carried out as part of the SEA for the site development plan (BSH, 2020a).

Essentially, construction of artificial installations and structures in nature conservation areas is prohibited. Also according to Sec. 5 para. 3 no. 5 lit a), areas may not be located within a protected area designated according to Sec. 57 BNatSchG, which has to be checked again in the suitability assessment.

However, projects and plans located outside protected areas must also be examined for their compatibility with the protective purpose of the respective ordinance as “surrounding projects” (Landmann/Rohmer, Sec. 34 BNatSchG, marginal no. 10) (cf e.g. Sec. 5, para. 4 NSGBRgV). They are permissible if, according to Sec. 34, para. 2 BNatSchG, they cannot lead to significant adverse effects of the components of the nature conservation area that are relevant to the conservation purpose or if they fulfil the requirements according to Sec. 34 para. 3 to 5 BNatSchG (cf also Sec. 5 para. 2 and 4 NSGBRgV). The conservation objectives are derived from the Protected Area Ordinances or other designations.

The German EEZ of the North Sea contains the nature conservation areas “Sylt Outer Reef – Eastern German Bight” (Ordinance on the establishment of the nature conservation area “Sylt Outer Reef – Eastern German Bight” of 22 September 2017), “Borkum Reef Ground” (Ordinance on the establishment of the nature conservation area “Borkum Reef Ground” of 22 September 2017) and “Dogger Bank” (Ordinance on the establishment of the nature conservation area “Dogger Bank” of 22 September 2017).

Within the framework of the impact assessment, the habitat types “reef” (EU code 1170) and “sandbank” (EU code 1110) according to Appendix I of the Habitats Directive with their characteristic and endangered biotic communities and species as well as protected species, specifically fish (river lamprey, twaite shad), marine mammals according to Appendix II of the Habitats Directive (harbour porpoise, grey seal, and harbour seal) as well as protected bird species according to Appendix I of the Birds Directive (in particular red-throated diver, black-throated diver, little gull, Sandwich tern, common tern, and Arctic tern) and regularly occurring migratory bird species (in particular common and lesser black-backed gull, northern fulmar, gannet, kittiwake, guillemot, and razorbill).

The “Borkum Reef Ground” nature conservation area with an area of 625 km^2 is the closest to site N-3.5 in the German EEZ. The shortest distance between site N-3.5 and the “Borkum Reef Ground” nature conservation area is 13.3 km.

At a distance of 18.0 km from site N-3.5, there is also the area under the Habitats Directive “Lower Saxony Wadden Sea National Park” (EU code: DE 2306-301, Act on the Lower Saxony Wadden Sea National Park of 11 July 2001(NWattNPG)) in the coastal waters. The area under the Habitats Directive in the coastal waters has already been included in the list of Sites of Community Importance (SCIs) in the Atlantic biogeographical region according to Article 4 para. 2 of the Habitats Directive by decision of the EU Commission of 7 December 2004 (Official Journal of the EU, 29 December 2004, L387/1).

The nature conservation area “Sylt Outer Reef – Eastern German Bight” has an area of 5,603 km^2 and is located in the southern North Sea. The shortest distance to site N-3.5 is 53.4 km.

The “Dogger Bank” nature conservation area covers an area of 1,692 km^2 and is located in the “Duck’s bill” of the German EEZ. The shortest distance to site N-3.5 is 203.7 km.

The impact assessment also considers possible long-distance effects on these two protected areas in the German EEZ as well as protected areas in the adjacent waters of neighbouring countries.

7.2 Impact assessment Impact with regard to habitat types

The conservation or, where necessary, the restoration of a favourable conservation status of the habitat types “sandbanks with only slight permanent overtopping by seawater” and “reefs” is the conservation objective of the “Borkum Reef Ground” nature conservation area according to Sec. 3 para. 3 no. 1 NSGBRgV. “Sandbanks” are also protected in the “Dogger Bank” nature conservation area according to Sec 3 para. 3 no. 1 NSGDgbV, and habitat types of value in the “Lower Saxon Wadden Sea National Park” in the coastal waters.

Due to the shortest distance of area N-3.5 of at least 13.3 km to the “Borkum Reef Ground” nature conservation area in the German EEZ or 18.0 km to the area under the Habitats Directive “Lower Saxon Wadden Sea National Park” in the coastal waters, impacts related to construction, installation and operation on the SAC habitat types “Reef” and “Sandbank” in the nature conservation area “Borkum Reef Ground” and the SAC habitat types in the “Lower Saxon Wadden Sea National Park” with their characteristic and endangered biotic communities and species can be excluded. The distance of site N-3.5 lies far outside the drift distances discussed in the literature so that no release of turbidity, nutrients, and pollutants that could adversely affect the nature conservation areas and areas under the Habitats Directive in their components relevant to the conservation objectives or the conservation purpose is to be expected.

7.3 Impact assessment with regard to protected species

7.3.1 Protected marine mammal species

7.3.1.1 Impact assessment according to Sec. 36 in conjunction with 34 para. 1 BNatSchG in conjunction with Sec. 5 para. 6 of the ordinance on the establishment of the “Borkum Reef Ground” nature conservation area

According to Sec. 36 in conjunction with Sec. 34 para. 1 BNatSchG and Sec. 5 para. 6 NSGBRgV, the requirements of Sec. 5 para. 4 NSGBRgV must be observed when determining the suitability of site N-3.5.

The assessment of the impacts of the construction of offshore wind turbines and ancillary facilities within site N-3.5 is based on the conservation objectives of the nearest protected area in the German EEZ, “Borkum Reef Ground”. According to Sec. 3 para. 1 NSGBRgV , the protection purpose is to achieve the conservation objectives of the Natura 2000 site. According to Sec. 3 para. 2 no. 3 NSGBRgV , the conservation and restoration of the specific ecological values and functions of the area, in particular the populations of harbour porpoise and seals and their habitats, and the natural population dynamics are to be protected.

Finally, under Sec. 3, para. 5, no. 1 to no. 5 NSGBRgV, the ordinance sets out objectives to ensure the conservation and restoration of the marine mammal species listed in Sec. 3, para. 2 NSGBRgV (harbour porpoise, harbour seal, and grey seal) as well as to conserve and restore their habitats.

Conservation and restoration:

- No.1: of the natural population densities of these species with the aim of achieving a favourable conservation status, their natural spatial and temporal distribution, health status and reproductive fitness, taking into account natural population dynamics and genetic exchanges with populations outside the area
- No. 2: of the area as a largely undisturbed habitat, unaffected by local pollution, of the species of marine mammals referred to in paragraph 3, Number 2 and, in particular, as a habitat of supraregional importance for harbour porpoises in the area of the East Frisian Wadden Sea,
- No. 3: of undissected habitats and the possibility of migration of the species of marine mammals referred to in subsection 3 number 2 NSGBRgV within, in particular to neighbouring conservation areas of the Wadden Sea and off Helgoland,
- No. 4: of the essential food sources of the species of marine mammals referred to in subsection 3 number 2 NSGBRgV, in particular the natural population densities, age-group distributions and distribution patterns of the organisms serving as food sources for these marine species of marine mammals, and
- No. 5: a high vitality of individuals and species-typical age structure of fish and cyclostomes populations as well as the spatial and temporal distribution patterns and population densities of their natural food sources.

Site N-3.5 is located within area N-3 of the site development plan (2019) in the German EEZ. The shortest distance to the "Borkum Reef Ground" nature conservation area, (EU code: DE 2104-301) is 13.3 km.

The site development plan (2019) has made designations with regard to areas and sites for wind turbines and platforms. Potential impacts of the site development plan were assessed as part of the impact assessment. The assessment concluded that the construction and operation of offshore wind turbines and platforms in area N-3 will not have a significant adverse effect on marine mammals.

The assessment considered possible impacts from the construction and operation of offshore wind turbines in the specific site N-3.5 and in interaction with existing wind turbines from the neighbouring offshore wind farms "NordseeOne", "GodeWind01" and "GodeWind03" as well as with the planned wind turbines in site N-3.6 and in the offshore wind farm "GodeWind03".

The assessment had shown that noise input from pile driving during the installation of foundations for offshore wind turbines and platforms can cause significant impacts on marine mammals, in particular harbour porpoise, if no noise abatement measures are taken. The exclusion of significant impacts, in particular as a result of disturbance of the local stock and the population of the respective species, requires the implementation of strict noise abatement measures. The determination of suitability contains a number of requirements in this respect. In the course of the species protection assessment, noise abatement measures were also specified in accordance with the state of the art in science and technology, the application of which, according to current knowledge, precludes significant disturbance of the population in site N-3.5, in its vicinity and in the German North Sea EEZ. In 2008, the BSH introduced orders in its approval notices that include binding limit values for impulse noise input from pile driving. The introduction of the binding limit values is based on findings on the triggering of temporary hearing threshold shifts in harbour porpoises (Lucke et al., 2008, 2009). Compliance with the limit values (160 dB individual sound event level (SEL05) re 1μPa2s and 190 dB re 1μPa at a distance of 750 m) is monitored by the BSH by applying standardised measurement and evaluation methods. Additional noise abatement measures with regard to the coordination of parallel pile driving and to reduce the impact on nature conservation areas are also derived from the BMU's noise abatement concept (2013) and are created as part of the suitability assessment and ordered and strictly monitored by the BSH in the individual approval procedures, adapted to the site- and project-specific characteristics. Since 2011, all pile driving work in German waters of the North Sea and Baltic Sea has been carried out using noise reduction systems. Monitoring of the noise abatement-related measures has shown that they have been very effective since 2014. A significant disturbance of the stocks and an associated adverse effect on the local population in the German EEZ of the North Sea can thus be excluded.

An adverse effect on the conservation objectives of the "Borkum Reef Ground" nature conservation area due to the construction and operation of offshore wind turbines and inter-array cabling in site N-3.5 can be excluded with the necessary degree of certainty, taking into account the specifications provided for in the determination of suitability and the instructions in the planning approval.

However, at this point in time, the assessment cannot consider the constructive design of the installations and the construction process. In this respect, an update of the impact assessment is necessary within the framework of the subsequent planning approval procedure, in which additional site- and project-specific characteristics of the installations are examined and suitable protective measures are ordered as necessary.

7.3.1.2 Impact assessment according to Sec. 34 para. 1 BNatSchG in conjunction with. Art. 6, para. 3 Habitats Directive with regard to the area under the Habitats Directive "Lower Saxon Wadden Sea National Park"

The same applies to the area under the Habitats Directive "Lower Saxon Wadden Sea National Park". According to the standard data sheet, the species harbour porpoise and harbour seal are found there in addition to the habitat types "reef" (EU code 1170) and "sandbank" (EU code 1110) (Amtsblatt der Europäischen Gemeinschaften 2011, No. L 107/4, DE 2306-301, revision of 08/2011). However, the shortest distance to site N-3.5 is 18 km, so that significant adverse effects within the meaning of Sec.34 BNatSchG can be excluded here as well, provided the noise mitigation measures are complied with. Accordingly, the realisation of offshore wind turbines in site N-3.5 is not likely to have a significant adverse effect on the conservation objectives of this area under the Habitats Directive.

7.3.1.3 Requirement of an impact assessment according to Sec. 34 para. 1 BNatSchG in conjunction with. Art. 6, para. 3 Habitats Directive with regard to the areas under the Habitats Directive "Sylt Outer Reef – Eastern German Bight" and "Dogger Bank"

An impact assessment of the implementation of offshore wind energy use in site N-3.5 pursuant to Sec. 7 BNatSchG in connection with the conservation objectives of the nature conservation areas "Sylt Outer Reef – Eastern German Bight" and "Dogger Bank" with regard to marine mammals is not required due to the large distance (53.4 km to the Sylt Outer Reef and 203.7 km to Dogger Bank) of site N3.5 from the nature conservation areas.

7.3.1.4 Result

In conclusion, significant adverse effects on the conservation objectives of the nature conservation areas in the German EEZ "Borkum Reef Ground", "Sylt Outer Reef –Eastern German Bight", "Dogger Bank" and the "Lower Saxon Wadden Sea National Park" in the coastal waters due to the construction and operation of offshore wind turbines in site N-3.5 can be excluded with the necessary certainty, taking into account the requirements for noise protection.

7.3.2 Protected bird species

7.3.2.1 Assessment of compatibility with the protection purposes and conservation objectives of Area I of the Sylt Outer Reef – Eastern German Bight nature conservation area with regard to avifauna - long-distance effects

According to Sec. 5 para. 1 no. 1 NSGSylV, the conservation or, where necessary, the restoration to a favourable conservation status of bird species listed in Annex I of the Birds Directive and regularly occurring migratory bird species occurring in this area are part of the protection purposes of the nature conservation area.

The species mentioned under Sec. 5 para. 1 no. 1 SGNSylV include the species red-throated diver (*Gavia stellata*, EU code A001) and black-throated diver (*Gavia arctica*, EU code A002).

The ordinance then sets out objectives for Area II under Sec. 5 para. 2 no. 1 to no. 4 SGNSylV to ensure the conservation and restoration of the bird species listed in Sec. 5 para. 1 SGNSylV and the functions of Area II under para. 1.

Conservation and restoration:

- No.1: of the qualitative and quantitative populations of bird species with the aim of achieving a favourable conservation status, taking into account natural population dynamics and population trends; special attention must be paid to bird species with negative trends in their biogeographical population
- No.2: of the main organisms serving as food sources for bird species, in particular their natural population densities, age-group distributions and distribution patterns
- No.3: of the increased biological productivity at vertical fronts, which is characteristic of the area, and the geo- and hydromorphological characteristics with their species-specific ecological functions and effects, and
- No.4: of the natural quality of habitats with their respective species-specific ecological functions, their fragmentation and spatial interrelationships, and unimpeded access to adjacent and neighbouring marine areas.

According to current knowledge, site N-3.5 is not significant with regard to the occurrence of protected bird species in Area II of the nature conservation area "Sylt Outer Reef – Eastern German Bight" due to the distance.

A significant adverse effect on the conservation objectives of Area II of the nature conservation area "Sylt Outer Reef – Eastern German Bight" due to the implementation of offshore wind energy use on site N-3.5 can be excluded due to the distance. Please refer to the explanations in Chapters 4.7 and 6.3.

7.3.3 Other species

According to Sec. 3 para. 3 no. 2 NSGBRgV, the conservation objectives pursued in the nature conservation area include the conservation or, where necessary, the restoration of a favourable conservation status of the twaite shad (*Alosa fallax*, EU code 1103) as a species listed in Annex II of the Habitats Directive.

According to Sec. 2 para. 3 in conjunction with. Annex 5 NWattNPG, the areas of the national park also serve to preserve or restore a favourable conservation status of the twaite shad, the European river lamprey (*Lampetra fluviatilis*) and the sea lamprey (*Petromyzon marinus*).

However, due to the shortest distance of site N-3.5 of at least 13.3 km to the nature conservation area "Borkum Reef Ground" in the German EEZ and of 18.0 km to the area under the Habitats Directive "Lower Saxony Wadden Sea National Park" in the coastal waters, impacts related to construction, installation and operation on these species or their conservation status in the nature conservation area can be excluded.

7.4 Outcome of the impact assessment

As a result, significant adverse effect on the protective purposes of the nature conservation areas "Borkum Reef Ground", "Sylt Outer Reef – Eastern German Bight", and "Dogger Bank" and the protective purposes of the area under the Habitats Directive "Lower Saxon Wadden Sea National Park" can be excluded with the necessary certainty by the implementation of the plan, taking into consideration avoidance and mitigation measures for FHH habitat types, marine mammals, avifauna, and other protected animal groups.

It should be noted that the SAC impact assessment carried out here was not able to examine project-specific properties which are only specified and set out by project developers in the course of planning approval procedures. The impact assessment is therefore carried out in the context of planning approval procedures for the respective project, with the aim of deriving and defining the necessary avoidance and mitigation measures at project level.

According to the current state of knowledge, a significant adverse effect on the Habitats Directive habitat types "reefs" and "sandbanks with only slight permanent overtopping by seawater" can be excluded even when cumulatively considering the plan and already existing projects for the nature conservation areas “Borkum Reef Ground”, “Sylt Outer Reef – Eastern German Bight”, and “Dogger Bank” as well as for the “Lower Saxon Wadden Sea National Park” in the coastal waters because of the small-scale impacts as well as the distances to the areas.

8 Evaluation of the overall plan

In summary, significant impacts on the marine environment from the construction and operation of offshore wind turbines or offshore wind installations, including the necessary facilities, are not to be expected. With strict adherence to preventive and mitigation measures, in particular for noise reduction during the construction phase, avoidance of light emissions, significant impacts can be avoided by implementing a project on the site.

The laying of inter-array cabling can be designed to be as environmentally friendly as possible, among other things, by choosing the gentlest possible laying method. The stipulation, which refers to the site development plan's planning principles on sediment heating, should ensure that significant negative impacts of cable heat-up on benthic communities are avoided. Preventing to the greatest extent possible any crossings of multiple submarine cable systems also serves to prevent negative impacts on the marine environment, in particular on the factors Soil, and Benthos. Given the above descriptions and assessments, the Strategic Environmental Assessment concludes that, with regard to possible interactions, no significant effects on the marine environment within the investigation area are to be expected from construction and operation of an offshore wind farm on site N-3.5 on the basis of current knowledge and the comparatively abstract level of sectoral planning. The potential effects are frequently small-scale and mostly short-term, as they are limited to the construction phase. To date, there is a lack of sufficient scientific knowledge and consistent evaluation methods for cumulative assessment of the effects on individual factors such as bat migration. For this reason, these impacts cannot be conclusively assessed within the scope of this SEA, or are subject to uncertainties and require an expanded level of knowledge, for example through scientific research.

9 Planned measures to prevent, reduce and offset significant negative impacts on the marine environment

In accordance with Sec. 40 para. 2 UVPG, the environmental report includes a description of the planned measures to prevent, mitigate and, as far as possible, compensate for significant adverse environmental effects resulting from implementation of the plan. While individual prevention, mitigation and compensation measures may begin even at the planning level, others only come into play at the specific implementation stage.

With regard to planning prevention and mitigation measures, the site development plan already defines spatial and textual specifications which, in accordance with the environmental protection objectives set out therein, serve to prevent or mitigate significant negative effects in the marine environment due to implementation of the site development plan. The designations of the site development plan are considered in the suitability assessment. Due to the concrete reference to the area, the measures can also be specified here or additional measures can be specified. In the subsequent planning approval procedure, project-specific or site-specific measures that relate to the specific planned project are added.

Within the framework of the suitability assessment, measures in accordance with Sec. 12 para. 5 sentence 2 WindSeeG can be proposed as specifications for the subsequent project in order to determine the suitability of the site if the construction and operation of wind turbines on the site might otherwise have adverse effects on criteria and concerns pursuant to Sec. 10 para. 2 WindSeeG.

The assessment of the suitability of the site with regard to a hazard to the marine environment is based, among other things, on data from the baseline survey according to StUK.

In order to avoid hazards to the marine environment from noise emissions, measures are to be taken in particular during the construction of the turbines. These should ensure that the work is carried out as quietly and briefly as possible while complying with limits for sound pressure (SEL05) and peak sound pressure levels. This principle, in particular the observance of maximum values of 160 dB for the sound event level (SEL_{05}) and 190 dB for the peak level at a distance of 750 m from the point of emission, can already be anchored in the determination of suitability even without knowledge of the specific types of installations. The planning approval authority will later order specifications, e.g. on maximum permissible durations, in knowledge of the types of turbines and foundations used.

The developers of the offshore wind farms to be completed in parallel shall coordinate their respective pile driving activities to avoid disturbance within the meaning of Sec. 44 para. 1 no. 2 BNatSchG.

Together with the planning documents, the developer of the project shall submit documents on the determination of the adverse effects according to Sec. 15 BNatSchG and on compensation according to BKompV (compensation concept: presentation of the planned compensation measures and substantive discussion of the compensation measures) in order to provide the planning approval authority with the basis required according to Sec. 15 BNatSchG to be able to decide on the permissibility of the notified adverse effects.

The required submarine cable systems shall be designed and laid in such a way that adverse effects on the marine environment caused by cable-induced sediment heating are reduced as far as possible. It shall be ensured and demonstrated in the planning approval procedure that the sediment above the cable system is not heated by more than two degrees (Kelvin) at a depth of 20 cm below the seabed surface. The planning approval authority will later order the minimum cover to be provided, knowing the concrete parameters and, if necessary, differentiating between subsections. The procedure for laying submarine cable systems shall be selected in such a way that the minimum cover ordered is achieved with the least possible impacts on the environment.

In order to avoid pollution of the marine environment, measures must be taken during the planning and implementation of the installations to avoid or reduce material emissions during construction and operation. These measures must ensure that no emissions of pollutants, noise and light, which are avoidable according to the state of the art, enter the marine environment. Insofar as such emissions are required and unavoidable by the safety requirements of shipping and air traffic, it shall be ensured that they cause as little adverse effect as possible. The least possible adverse effect shall be ensured, for example, by the choice of operating materials used, structural safety systems, appropriate monitoring measures and organisational and technical precautions. This applies in particular to the areas of fuel change, refuelling, corrosion protection, sewage water, drainage water, the diesel generators used and scour and cable protection.

10 Investigated alternatives

In accordance with Art. 5, para. 1, sentence 1 SEA Directive in conjunction with the criteria in Appendix I SEA Directive and Sec. 40, para. 2, no. 8 UVPG, the environmental report contains a brief description of the reasons for the choice of the reasonable alternatives examined.

Essentially, different types of alternatives can be considered for an assessment of alternatives; in particular strategic, spatial or technical alternatives. The prerequisite is always that these are reasonable or can be seriously considered. Thus, not all conceivable alternatives need to be assessed. However, it is no longer sufficient to identify, describe and evaluate only those alternatives that "seriously offer" or "impose" themselves. The obligation to investigate thus extends to all alternatives that "are not obviously ... remote" (LANDMANN & ROHMER 2018). Assessment of alternatives does not explicitly require the development and assessment of particularly environmentally-friendly alternatives. Rather, the "reasonable" alternatives in the above sense should be presented in a comparative manner with regard to their environmental impacts, so that consideration of environmental concerns becomes transparent when deciding on the alternative to be pursued (BALLA et al. 2009).

At the same time, the effort required to identify and assess the alternatives under consideration must be reasonable. The following applies: The greater the expected environmental impacts and thus the need for conflict management in planning, the more likely it is that extensive or detailed investigations will be required.

By way of example, Appendix 4, no. 2 UVPG refers to the assessment of alternatives with regard to the design, technology, location, size and scope of the project, but explicitly refers only to projects. According to (HOPPE 2018), the examination of reasonable alternatives in terms of plans and programmes is likely to be reduced to conceptual alternatives and site-related alternatives and, with rare exceptions, to omit facility-specific alternatives. At the same time, attention should be paid to whether alternative plan or programme concepts have already been addressed at a higher planning level in the sense of the synergy effects of tiering (of planning levels) as set out in Sec. 39 para. 3 UVPG, or paraphrasing according to context, e.g. environmental assessment on the appropriate planning level.

Alternatives are already being examined as part of the upstream SEA for the site development plan 2020 (BSH 2020a). At this planning level, these are primarily the conceptual/strategic design, the spatial location and technical alternatives.

The focus of this assessment of the site development plan is the consideration of alternatives for the designation of the areas required to achieve the statutory expansion target for offshore wind energy: The areas are compared and designated using nature conservation criteria. The area designated in the site development plan represents the planning area for the suitability assessment following the designation in the site development plan. The scope of the subsequent project is therefore already essentially determined in the site development plan by the designation of the area and the expected generation capacity to be installed on the area.

This designation of the areas for offshore wind energy in turn forms the starting point for the further specifications of the site development plan with regard to the required grid connection systems. At the present level of the suitability assessment, it is therefore neither necessary nor reasonable to examine alternative sites to the present planning area, the area defined by the site development plan. Such an examination would inevitably run counter to the site development plan's "framework", consisting of the wind farm procedures and grid connections in operation or in concrete planning, and the synchronised designations of the site development plan for wind energy areas and grid connection systems based on these.

The examination of alternative site locations would therefore be unsuitable for achieving the objective of the plan to determine the suitability assessment for the site under review in the order for tender specified in the site development plan (§ 9 para. 1 no. 2 WindSeeG). The omission of the examination of spatial alternatives also corresponds to the "synergy effects of tiering" laid down in Sec. 39 para. 3 UVPG, through which the examination of alternatives can be decisively reduced (HOPPE 2018). The examination of reasonable alternatives in the SEA for the site development plan procedure (published on 28.06.2019) appears to be sufficiently up-to-date and detailed for this purpose.

In the suitability assessment, therefore, only alternatives that relate to the specific site to be assessed according to the designations of the site development plan, in this case N-3.5, are to be considered in the sense of tiering between the instruments. These can primarily be process alternatives, i.e. the (technical) design of the facilities in detail (BALLA et al.2009).

At the same time, the exact design of the facilities to be constructed on the site has not yet been determined at the time of the suitability assessment. The examination of alternatives with regard to the concrete design of the later project can therefore only take place in the subsequent planning approval procedure. At this point, therefore, only alternatives are to be examined that relate to the respective area and can already be undertaken without detailed knowledge of the concrete building project. This does not concern "alternatives for the entire plan, but rather variants for individual planning provisions or the type of implementation in question" (HOPPE 2018).

These must be distinguished from measures to avoid, reduce and compensate for significant adverse impacts of the plan on the marine environment. In this context, only "re-planning that leads to a significant change in the planning concept and thus to a new plan variant ... is subject to the examination of reasonable alternatives" (BALLA et al. 2009). The corresponding "re-planning" that does not lead to corresponding new plan variants is presented as avoidance and mitigation measures in Chapter 9.

The remaining conceivable alternatives that have not already been conclusively dealt with in the site development plan and do not represent mere measures and are conceivable at the present abstract level without knowledge of the concrete project therefore appear limited. As shown, they are limited to process alternatives, i.e. the (technical) design of the facilities in detail.

Against this background, one alternative that could be seriously considered appears to be the use of different facility concepts that differ in terms of their physical parameters. Due to the amount of construction to be expected on the site and its impact on the marine environment, the variation of the facility parameters appears to be of particular importance for wind turbines. In order to achieve the capacity of 420 MW on site N-3.5 determined in the suitability assessment (§ 12 para. 4 WindSeeG) and specified by legal ordinance (§ 12 para. 5 sentence 1 WindSeeG), the developer may use various facilities available on the market at the time of project planning. In the sense of "comprehensive information gathering" (Hoppe 2018), the implementation of the project can be assessed using model parameters for opposing concepts: On the one hand, for an implementation with small facilities, a correspondingly relatively low generation capacity and thus a larger number of facilities, or on the other hand, with large, powerful facilities and thus a smaller number of facilities; see Chapter **1.5.5.4**.

It also seems conceivable, even without knowledge of the specific project, to consider alternatives with regard to the foundation of the elevated structures (wind turbine and residential platform); see Chapter 10.2. Due to the principle effects of the choice of foundation type on the design and environmental impacts, the comparison of foundation variants represents an alternative, not a mere measure to reduce or avoid impacts on the marine environment. The other technical designs of the facilities, such as the design of scour protection or corrosion protection, on the other hand, are regarded as measures to avoid, reduce or offset impacts on the environment and are described accordingly in Chapter 9.

A zero alternative is only to be considered in the examination of reasonable alternatives if it considers the objectives and the geographical scope. In the present case, this zero-alternative would mean that the area is not suitable for a tender. This presupposes that the adverse effect on the relevant criteria and concerns is also to be feared if the determination of suitability includes specifications for the subsequent project. This is not the case for site N-3.5, since adverse effects can be excluded by specifications. The zero alternative therefore does not represent a reasonable alternative and is not to be examined, as it would not be "consistent with the objectives of the planning" (HOPPE 2018).

The likely developments in the state of the environment in the event of non-implementation of the plan, i.e. without offshore wind turbines or offshore wind installations being constructed and operated on the site, are described as a benchmark for assessing the impacts on the environment in Chapter **3**.

The consideration of alternatives with regard to inter-array cabling does not appear to be appropriate, as there are no reasonable alternatives with regard to their technical design (largely standardised transmission voltages and cable systems) or installation (laying on the seabed is ruled out due to the lack of cable protection).

10.1 Facility concept

Wind turbines characterised by various parameters can be used in the implementation of the project. For the comparison of alternatives and their evaluation, it seems useful to assess model-like wind farm plans that show the range of wind turbines that are available or will be available in the future.

Corresponding model-like scenarios have already been introduced in (BSH 2020b). These two scenarios are also used in the present assessment, described under Chapter **1.5.5.4** and applied to site N-3.5.

The two alternative scenarios differ in particular with regard to the number of facilities to be constructed to achieve the capacity to be installed (scenario 1: 42 facilities vs. scenario 2: 21 facilities) as well as hub height and rotor diameter, which determine the total height of the individual wind turbines (approx. 225 m vs. 350 m).

The assessment of these alternatives/scenarios is carried out in relation to the individual protected assets in Chapter **4**.

As a result, neither of the two scenarios can be rated as clearly preferable due to their lower impacts on the environment. Rather, the assessment differs depending on the protected asset. Scenario 2, for example, is more advantageous with regard to the protected assets Soil and Benthos, since the smaller number of wind turbines and the scour protection associated with each facility means that hard substrate from other sites is introduced. For avifauna, on the other hand, a slightly lower adverse effect is expected from the lower facilities in scenario 1.

10.2 Foundation

As described in Chapter **1.5.5.4**, the wind turbines and the residential platform are assumed to be founded on driven pile foundations (monopile for the offshore wind turbines and jacket for the residential platform). In principle, the use of other foundation types is conceivable. In individual cases or for test purposes, other variants have already been implemented or planned in the German EEZ.

Suction bucket, vibro-pile or gravity foundation are discussed as conceivable alternatives for the foundation of facilities. Bored piles, on the other hand, are out of the question for use in the sandy soils of the German North Sea EEZ, as the required drilling fluid cannot be kept in the borehole in the porous sandy subsoil.

Only very limited information is available for the above-mentioned foundation types under consideration. In particular, there is insufficient knowledge from monitoring comparable offshore installations. Based on the current state of knowledge with regard to the specific parameters and in particular with regard to the impacts on the various protected assets during construction and operation, the impacts on the environment of these foundation types cannot be determined, described and assessed.

For example, it is not possible to compare the different foundation types with regard to their noise emissions during construction and operation, as there is a lack of knowledge regarding both the noise emissions associated with construction and the continuous noise during operation. Therefore, the possible impacts of the foundation alternatives on the marine environment cannot be assessed. This is the case, for example, with the use of vibratory hammers but also with suction buckets. Only gravity foundations, if they can be installed without sheet piling, can possibly be described as low noise. However, further significant impacts of gravity foundations, such as the sealing of large areas and the associated change in the functions of the seabed, would then have to be examined in terms of environmental compatibility. Again, there is insufficient information available.

Consideration of these alternatives in detail is therefore consequently excluded, as the necessary information cannot be determined with reasonable effort.

Furthermore, the foundation variants mentioned are each suitable for different soil types and water depths, so that the choice of foundation would also have to consider the respective conditions of the area. However, the assessment of the soil in terms of its subsoil properties is not carried out as part of the suitability assessment; at most, the preliminary exploration can reveal a condition of the soil that is not or less suitable for certain foundation technologies (DEUTSCHER BUNDESTAG 2016).

In order to assess whether one of the above-mentioned foundation methods can be considered for the specific area, further investigations would be required, which would have to be determined and evaluated depending on the individual case.

11 Measures planned to monitor the environmental impacts of the plan

The potential significant impacts on the environment resulting from the implementation of the plan are to be monitored in accordance with Sec. 45 UVPG. This is intended to enable unforeseen negative impacts to be identified at an early stage and suitable remedial measures to be taken.

Therefore, in accordance with Sec. 40 para. 2 no. 9 UVPG, the environmental report is to specify the measures envisaged for monitoring the significant environmental effects of implementation of the plan. Monitoring is the responsibility of the BSH, which is the authority responsible for the SEA (see Sec. 45 para. 2 UVPG). As intended by Sec. 45 para. 5 UVPG, existing monitoring mechanisms may be used to prevent duplication of monitoring work.

With regard to the planned monitoring activities, it should be noted that the actual monitoring of the potential effects on the marine environment can only begin when the plan is implemented, i.e. when the project is realised on site N-3.5. Nevertheless, the natural development of the marine environment, including climate change, should not be disregarded when assessing the results of monitoring activities. However, general research cannot be carried out within the framework of monitoring. Therefore, the project-related monitoring of the effects of the project on the site and its surroundings is of particular importance.

The main task of monitoring this plan in conjunction with the site development plan and the individual planning approval procedures is to combine and evaluate the results from the various monitoring phases. The assessment will also cover the unforeseen significant effects of the implementation of the plan, the marine environment and the assessment of the predictions in the environmental report. The procedure planned for this, the measures envisaged for monitoring the potential impacts of the plans and the data required are described in the environmental report on the site development plan 2020 for the German North Sea in Chapter 10 (particularly in Chapter 10.1 for the potential impacts of the areas and sites for offshore wind turbines) (BSH 2020a).

In order to verify the predictions of the present environmental report and the subsequent EIA as part of the planning approval procedure and to enable any necessary adjustments to be made, construction and operation monitoring must be carried out with regard to the individual protected assets and any hazards, such as collisions of migratory birds with the wind turbines. This is to be designed in accordance with the requirements of the StUK.

12 Non-technical summary

12.1 Subject and occasion

Pursuant to Sec. 12 para. 4 in conjunction with Sec. 10 para. 2 WindSeeG, the BSH assesses the suitability of an area for the construction and operation of offshore wind turbines or offshore wind installations as a basis for the separate determination of suitability by means of a legal ordinance. As part of the suitability assessment, an environmental assessment within the meaning of the Act on the Assessment of Environmental Impacts in the version published on 24 February 2010 (BGBl. I p. 94), as last amended by Article 22 of the Act of 13 May 2019 (BGBl. I p. 706), the so-called Strategic Environmental Assessment (SEA), is carried out._The main document of the Strategic Environmental Assessment is the present Environmental Report. It identifies, describes and assesses the likely significant effects that the implementation of the plan, i.e. the construction and operation of an offshore wind farm on site N-3.5, will have on the environment and possible alternative planning options, considering the essential purposes of the plan.

The determination of suitability is part of a planning cascade. It is preceded by the specialist maritime spatial planning as a rough overall plan for all uses in the German EEZ and the site development plan as an important steering instrument for the orderly development of offshore wind energy. On the basis of the site development plan, which designates areas and sites as well as route and route corridors for grid connections, the areas are pre-investigated by the BSH and checked for their suitability.

The ordinance to be issued on the basis of a positive suitability assessment contains, in addition to the basic determination of suitability and the power to be installed, specifications for the project on the site if otherwise suitability would have to be denied due to adverse effects on the marine environment or other concerns to be assessed.

The determination of suitability in connection with the underlying suitability assessment is in the nature of technical planning and as such forms the basis for the subsequent planning approval procedure. If the suitability of a site for the use of offshore wind energy is established, the site is put out to tender and the winning bidder can submit an application for approval (planning approval or planning permission) for the erection and operation of wind times on the site.

The present SEA is related to the environmental assessments of the upstream and downstream planning levels. Whereas in the upstream strategic environmental assessments of maritime spatial planning and the SEA, the depth of the assessment of likely significant environmental impacts was characterised by a broader scope of investigation and, in principle, a lower depth of investigation, and the focus of the assessment was on the evaluation of cumulative effects and the examination of spatial alternatives, the SEA for the suitability assessment examines the impacts on the marine environment caused by an offshore wind farm project on the specific site. In addition, the results of the state preliminary investigation are to be used for the suitability assessment; the depth of assessment is therefore increased compared to the upstream plans.

The suitability assessment and the SEA as the basis for the determination by legal ordinance are carried out taking into account the environmental conservation objectives. These provide information on the environmental status that is to be achieved in the future (environmental quality objectives). The objectives of environmental protection can be derived from an overall view of the international, Community and national conventions and regulations which deal with marine environmental protection and on the basis of which the Federal Republic of Germany has committed itself to certain principles and objectives.

12.2 Methodology of the Strategic Environmental Assessment

In the present environmental report, the methodology already used for the SEA of the Spatial Offshore Grid Plans (BFO) and the site development plan is built upon and further developed with regard to the designations made in the suitability determination.

This SEA primarily identifies, describes and assesses whether the construction and operation of an offshore wind farm on the site may have significant impacts on the protected assets concerned. Insofar as impacts would be expected, it is further examined whether these can be compensated for by measures and whether these would not in themselves constitute a significant adverse effect. Although some measures serve, among other things, to reduce environmental impacts, they may also lead to impacts themselves, so that an assessment is required.

The assessment of the likely significant environmental effects includes secondary, cumulative, synergistic, short-, medium- and long-term, permanent and temporary, positive and negative effects in terms of the assets to be protected. A detailed description and assessment of the environmental status serves as the basis for assessing potential impacts. The SEA is carried out on the basis of the results of the SEA site development plan North Sea (BSH 2020a) for the following protected assets:

- Area
- Soil
- Water
- Biotope types
- Benthos
- Fish
- Marine mammals
- Avifauna
- Bats
- Biological diversity
- Air
- Climate
- Landscape
- Cultural heritage and other tangible assets
- People, in particular human health
- Interactions between protected assets

The description and assessment of the likely significant impacts on the environment is carried out in relation to the protected assets. All plan contents which may potentially have significant environmental impacts are examined.

The impacts from construction and dismantling as well as the impacts from the wind energy installation itself and its operating conditions are considered. In addition, effects that may arise in the course of maintenance and repair work are also considered. This is followed by a description of possible interactions, a consideration of possible cumulative effects and potential transboundary impacts.

The impacts are assessed on the basis of the status description and status assessment and the function and significance of the respective area for the individual protected assets. The prediction is based on the criteria of intensity, range and duration of the effects.

Within the framework of the impact prediction, certain parameters are assumed for the consideration of protected assets in the SEA. In order to depict the range of possible (realistic) developments, the assessment is essentially based on two scenarios. Scenario 1 assumes many small facilities, while scenario 2 assumes a few large facilities, each with different parameters, such as the number of facilities, hub height, height of the lower rotor tip, rotor diameter, overall height, diameter of foundation types and scour protection. The range of parameters thus covered allows for a comprehensive description and assessment of the current planning status.

12.3 Result of the assessment of the individual protected assets

12.3.1 Soil/Area

The surface sediments of site N-3.5 show a homogeneous sediment composition and a largely structureless seabed. It is a typical fine sand area as is found in almost the entire North Sea.

Wind energy installations have a locally limited environmental impact with regard to the seabed as a protected asset. The sediment is only permanently affected in the immediate vicinity by the insertion of foundation elements – including scour protection, if applicable – and the resulting land use.

Due to the construction of wind energy installations and the laying of inter-array cabling, sediments are briefly stirred up and turbidity plumes are formed. The extent of resuspension depends essentially on the fine grain content in the soil. In the marine areas with a relatively low proportion of fine grains – such as site N-3.5 – most of the released sediment will settle relatively quickly directly in the area of the intervention or in the immediate vicinity. Because of dilution effects and sedimentation of the stirred-up sediment particles, the suspension content quickly decreases again to the natural background values. A substantial change in sediment composition is not expected.

Due to operational conditions, the interaction of foundation and hydrodynamics in the immediate vicinity of the installations may lead to a permanent agitation and rearrangement of sediments. According to previous experience in the North Sea EEZ, current-related permanent sediment shifting can only be expected in the immediate vicinity of the wind turbines. Due to the predicted spatially limited extent of scouring, no significant changes in the substrate are to be expected.

In the short term, pollutants and nutrients may be released from the sediment into the soil water. The possible release of pollutants from the sandy sediment of site N-3.5 is negligible due to the relatively low fine-grain content (silt and clay) and the low concentrations of heavy metals.

Impacts in the form of mechanical stress on the seabed sediment due to displacement, compaction and vibrations, which are to be expected during the construction phase, are estimated to be low due to their limited extent.

12.3.2 Water

The water body of the German Bight is characterised by land-based inputs of nutrients and pollutants, although no acute negative effects on the marine ecosystem are to be expected from the concentrations of most pollutants. However, the naturalness of the protected asset Water in German North Sea waters is generally classified as medium due to existing loads from nutrient inputs (eutrophication).

The resuspension of sediment during the construction phase may affect the water body through turbidity plumes and – depending on the organic content – an increased oxygen depletion as well as a liberation of nutrients and pollutants. In this respect, small-scale impacts of short duration and low intensity are expected on site N-3.5, especially due to the low organic content in the sediment. The structural and functional impairments are minor.

The constructed facilities generally change the flow regime in the long term and in the medium term, but with very low intensity.

Operationally, the material emissions from corrosion protection and selective inputs from the regular operation of platforms are of particular importance for the protected asset Water. According to the current state of knowledge, these impacts – assuming implementation of the state of the art and compliance with the minimisation requirement – are assessed as long-term, small-scale and of low intensity. The structural and functional changes are minor.

12.3.3 Biotope types

Possible impacts of facilities and submarine cables on protected biotopes may result from direct use of these biotopes, their covering by sedimentation of material released during construction, or potential habitat changes.

Owing to the predominant sediment composition, impairments caused by overburdening are likely to be small-scale and temporary, as the released sediment will settle quickly. Permanent habitat changes are limited to the immediate area of foundations and crossing structures for cable crossings. Required cable crossings are secured with stone packing which permanently represents a hard substrate unfamiliar to the site. This provides new habitats for benthic organisms that love hard substrates and can lead to a change in the species composition. These small-scale habitat changes are not expected to have any significant impact on the protected habitat types. In addition, the risk of a negative impact on the benthic soft soil community by species untypical of the area is low, since it is highly likely that the species will be recruited from natural hard substrate habitats.

Permanent habitat changes are limited to the immediate vicinity of foundations and rock fills, which are required in the case of cable crossings. Stone rubble permanently represents a hard substrate that is foreign to the site. This provides new habitats for benthic organisms and can lead to a change in the species composition. These small-scale areas are not expected to have any significant impact on the protected biotope types. In addition, the risk of a negative impact on the benthic soft soil community by species untypical of the area is low, since it is highly likely that the species will be recruited from natural hard substrate habitats.

12.3.4 Benthos

Site N-3.5 is not of major importance in terms of the species inventory of benthic organisms. Nor do the benthic communities identified show any special features, as they are typical of the North Sea EEZ due to the predominant sediments. Investigations of the macrozoobenthos during the preliminary site investigation revealed biotic communities typical of the German North Sea. The species inventory found and the number of Red List species indicate an average importance of site N-3.5 for benthic organisms.

Deep foundations of wind turbines and platforms cause disturbances of the seabed, sediment turbulence and the formation of turbidity plumes. The resuspension of sediment and the subsequent sedimentation can lead to an impairment or damage of the benthos in the immediate vicinity of the foundations for the duration of construction activities. However, due to the prevailing sediment composition, these impairments will only have a small-scale effect and are limited in time. As a rule, the concentration of the suspended material decreases very quickly with removal. Depending on the given installations, changes in species composition may occur as a result of the local land sealing and the introduction of hard substrates in the immediate vicinity of the structures.

The laying of inter-array cabling is also expected to cause only small-scale and short-term disturbances of the benthos by sediment turbulence and turbidity plumes in the area of the cable route. Possible effects on the benthos depend on the installation methods used. With the comparatively gentle installation using the flushing method, only minor disturbances of the benthos in the area of the cable route are to be expected. Local sediment shifts and turbidity plumes are to be expected during the laying of the submarine cable systems. Due to the predominant sediment composition in the North Sea EEZ, most of the sediment released will settle directly at the construction site or in its immediate vicinity.

Benthic habitats are directly overbuilt in the area of any stone packing for cable junctions. The resulting habitat loss is permanent but small-scale. The result is a non-native hard substrate which can cause changes in the species composition on a small scale. In addition, the benthic community could benefit from the expected reduction in fishing (see 3.3) and develop into a more natural community in site N-3.5.

Due to operational conditions, a warming of the uppermost sediment layer of the seabed can occur directly above the cable system. With sufficient installation depth and taking into consideration the fact that the effects will be small-scale, no significant impacts on benthic communities are expected according to current state of knowledge. According to the current state of knowledge, the 2K criterion will be met and no significant effects on the benthos from cable-induced sediment warming are to be expected, provided that a sufficient laying depth is maintained and state-of-the-art cable configurations are used. The same assumptions apply to electric and electromagnetic fields.

The ecological impacts are small-scale and mostly short-term.

12.3.5 Fish

The fish fauna in site N-3.5 has a typical species composition. In all areas, the demersal fish community is dominated by flatfish character species, which is typical for the German Bight. According to current knowledge, the site does not represent a preferred habitat for any of the protected fish species. As a result, the fish stock in the planning area N-3.5 is not ecologically significant compared to neighbouring marine areas. According to current knowledge, the planned construction of a wind farm and associated residential platform and inter-array cabling is not expected to have a significant impact on the protected fish species. The impacts on the fish fauna from the construction of the wind farms are limited in space and time. During the construction phase of the wind turbines, the residential platform and the laying of the submarine cables, the fish fauna may be temporarily affected in small areas by sediment turbulence and the formation of turbidity plumes. Due to the prevailing sediment and current conditions, the turbidity of the water is expected to decrease again quickly. Thus, according to current knowledge, the adverse effect is spatially and temporally limited and not significant. In addition, the fish fauna is adapted to the natural sediment turbulence caused by storms that is typical for this area. Furthermore, during the construction phase, fish may temporarily flee due to noise and vibrations. Noise emissions are minimised by mitigation measures such as deterrence and bubble curtains. Further local impacts on the fish fauna may be caused by the additional hard substrates introduced as a result of changes in habitat. The fish community loses part of its habitat due to the installation of the wind farm. Benthic invertebrates settle on the introduced structures and provide food for the fish. In addition, the fish community could benefit from the expected restriction of fishing (see 3.3) and accumulate in the refuge area N-3.5. Regardless of the wind farm scenario, the installation of a wind farm does not have any significant adverse effects on fish fauna. In the long term, the first scenario could offer an advantage for the fish community due to the lower area use and the majority of wind turbines.

12.3.6 Marine mammals

According to the current state of knowledge, it can be assumed that the German EEZ is used by harbour porpoises for traversing, staying and also as a food and area-specific breeding ground. Based on the knowledge available, it can be concluded that the EEZ is of medium to high importance for harbour porpoises in certain areas. Use varies in the sub-areas of the EEZ. This also applies to seals and grey seals*. Site N-3.5 is of medium to high importance for harbour porpoises (seasonally in spring) and low to medium importance for grey seals and harbour seals.

Hazards to marine mammals can be caused by noise emissions during pile driving of the foundations of the offshore wind turbines and the residential platform. Without the use of noise abatement measures, significant disturbance to marine mammals during pile driving could not be excluded. In the specific approval procedure, therefore, the driving of piles of offshore wind turbines and the residential platform will only be permitted if effective noise-reduction measures are used. To this end, the determination of suitability for site N-3.5 contains requirements for the protection of the living marine environment from impulse noise inputs.

These state that the installation of the foundations must be carried out using effective noise reduction measures to comply with applicable noise protection values. In the specific approval procedure, extensive noise mitigation measures and monitoring measures are ordered to comply with applicable noise protection values (sound event level (SEL) of 160 dB re 1 µPa²s and maximum peak level of 190 dB re 1 µPa at a distance of 750 m around the pile driving or placement site). Suitable measures shall be taken to ensure that no marine mammals are present in the vicinity of the pile driving site.

Current technical developments in the field of reducing underwater noise show that the effects of noise input on marine mammals can be significantly reduced by the application of appropriate measures. The noise abatement concept of BMU has also been in force since 2013. According to the noise abatement concept, pile driving activities must be coordinated in such a way that sufficiently large areas, especially within the protected areas and the main concentration area of harbour porpoise in the summer months, are kept free of impacts caused by impact noise. According to current knowledge, significant effects on marine mammals caused by the operation of offshore wind turbines and the residential platform can be excluded.

The exclusion of the construction of offshore wind turbines and converter platforms in Natura 2000 areas, which has already been established in the site development plan, contributes to reducing the risk to harbour porpoises in important feeding and breeding areas.

Following implementation of the mitigation measures for compliance with applicable noise protection values, which are defined as planning principles in the site development plan (BSH 2020b) and are to be ordered as part of the determination of the suitability of site N-3.5 and in the planning approval procedure, no significant adverse impacts on marine mammals are currently expected as a result of the construction and operation of the planned offshore wind turbines and the residential platform. No significant impacts on marine mammals are expected from the laying and operation of submarine cable systems.

12.3.7 Seabirds and resting birds

According to current knowledge, the area surrounding site N-3.5 is of medium importance for resting and foraging seabirds. Overall, typical seabird species of the North Sea EEZ have been observed (BSH 2020a), although often only in low densities. This is mainly due to the fact that the area characteristics do not correspond to the species-specific preferred conditions of some seabird species.

Impacts during the construction phase because of deterrent effects are to be expected at most locally and temporarily. Due to the high mobility of birds, significant effects can be excluded with the required degree of certainty.

Wind turbines can have a permanent disturbing and chasing effect on species sensitive to disturbance such as red-throated and black-throated divers. Current findings show a more pronounced avoidance behaviour of loons towards existing wind farms than was originally anticipated. There are no findings on habituation effects to date. Given the existing development to the east and south of site N-3.5 in area N-3, it is likely that there will be an overlap of avoidance effects. In addition, site N-3.5 is located more than 40 km from the main concentration area of loons, the most important resting area in the North Sea EEZ. Given the low seasonal and spatial occurrence of loons in the vicinity of site N-3.5 (see Chapter **2.8.3**), significant effects can be excluded with the necessary certainty. Significant impacts on other species from a project on site N-3.5 can also be excluded.

12.3.8 Migratory birds

Overall, site N-3.5 and its surroundings are of medium importance for bird migration.

Possible impacts may include the wind turbines constituting a barrier or a collision risk. In the clear weather conditions preferred by birds for their migration, the probability of collision with a wind turbine or platform is low. Poor weather conditions increase the risk. Overall, the individual species-specific assessment showed that for the migratory bird species occurring in the project area or their relevant biogeographical populations, significant impacts due to a wind farm on site N-3.5 can be excluded with the necessary certainty. However, the possible increased collision risk due to the higher 10-20 MW facilities used as a basis for the assessment (cf Chapter 1.5.5.4) must be taken into account in the cumulative assessment of several wind farm projects in the vicinity of site N-3.5 and in the specific planning of the individual project.

12.3.9 Bats

Migratory movements of bats across the North Sea are still poorly documented and largely unexplored. There is a lack of concrete information on migrating species, migration corridors, migration heights, and migration concentrations. Previous knowledge merely confirms that bats, especially long-distance migratory species, fly over the North Sea.

Hazards to individual individuals from collisions with wind turbines and platforms cannot be excluded. According to the current state of knowledge, there are no findings on possible significant impairments of the bat migration over the North Sea EEZ. It can also be assumed that any adverse effects on bats can be avoided by the same prevention and mitigation measures used to protect bird migration.

12.3.10 Biological diversity

Biological diversity comprises the diversity of habitats and biotic communities, the diversity of species, and the genetic diversity within species (Article 2 Convention on Biological Diversity, 1992). Biodiversity is in the public eye.

With regard to the current state of biodiversity in the North Sea, it should be noted that there is countless evidence of changes in biodiversity and species assemblages at all systematic and trophic levels in the North Sea. These are mainly because of human activities (e.g. fishing and marine pollution) or climate change. Red lists of endangered animal and plant species have an important monitoring and warning function in this context because they show the status of the populations of species and biotopes in a region. In the environmental report, possible impacts on biodiversity are dealt with under the individual protected assets. In summary, according to current knowledge, the planned expansion of offshore wind energy and the corresponding grid connections is not expected to have a significant impact on biological diversity.

12.3.11 Air

The construction and operation of the wind turbines and the installation of inter-array cabling will not result in any measurable impacts on air quality.

12.3.12 Climate

Negative impacts on the climate from the construction and operation of wind turbines and inter-array cabling on site N-3.5 are not expected, as no measurable climate-relevant emissions occur either during construction or operation.

12.3.13 Landscape

The realisation of offshore wind farms has impacts on the landscape because it is altered by the installation of vertical structures and security lights. The extent of these visual adverse effects of the landscape caused by the planned wind turbines will strongly depend on the respective visibility conditions.

Due to the large distance to the nearest coast (> 35 km), the development of the seascape scenery will not change significantly due to the implementation of the construction project on site N-3.5, especially since the area in question is almost completely enclosed by other wind farms that are expected to have been constructed previously.

12.3.14 Material assets, cultural heritage (archaeology)

According to the current state of knowledge and on the basis of the preliminary investigations, no material or cultural assets (e.g. wrecks or settlement remains) are known to exist in the area of site N-3.5; however, their occurrence cannot be completely excluded at this point in time. Considering the specifications on cultural assets from the determination of suitability (Sec. 38), no significant impacts on the protected asset “Cultural heritage and other material assets” are to be expected on site N-3.5.

12.3.15 Protected asset Population & human health

Site N-3.5 has a low significance for human health and well-being. There is no direct use for recreation and leisure. People are not directly affected by the plan; site N-3.5 is already used solely as a working environment due to the operational activities of the surrounding wind farms. This use will be increased by the development of site N-3.5.

12.3.16 Interrelationships/ cumulative impacts

In general, impacts on any one protected asset lead to various consequences and interactions between the protected assets. The essential interdependence of the biotic protected assets exists via the food web. Possible interactions during the construction phase result from sediment shifting and turbidity plumes, as well as noise emissions. However, these interactions occur only very briefly and are limited to a few days or weeks.

Interactions relating to the facilities – due to the introduction of hard substrate, for example – are permanent, but to be expected only on a local level. This could lead to small-scale change in the food supply.

Due to the variability of the habitat, interrelationships can only be described in very imprecise terms overall. In principle, it can be stated that according to the current state of knowledge, no interactions are discernible that could result in a threat to the marine environment.

Cumulative effects arise from the interaction of various independent individual effects which either add up as a result of their interaction (cumulative effects) or reinforce each other and thus generate more than the sum of their individual effects (synergetic effects). Both cumulative and synergetic effects can be caused both by temporal and spatial coincidence of effects of the same or different projects.

12.3.16.1 Soil, benthos and biotope types

A significant part of the environmental impacts caused by the development of the site, construction of the residential platform and the inter-array submarine cable systems on the protected assets Soil, Benthos and Biotopes will occur exclusively during the construction period (formation of turbidity plumes, sediment relocation, etc.) and in a spatially narrowly limited area. Possible cumulative impacts on the seabed, which could also have a direct impact on the benthic material to be protected and on specially protected biotopes, result from sum of the permanent direct land use of the foundations of the wind energy installations and platforms and from the cable systems laid. The individual impacts are basically small-scale and local.

To estimate the direct area use, a rough calculation is made below based on the model wind farm scenarios (Chapter **1.5.5.4**) and the assumptions for other facilities (Chapter **1.5.5.5**). The calculated land use is based on ecological aspects, i.e. the calculation is based on the direct ecological loss of function or the possible structural change in the area caused by the installation of foundations and cable systems. In the area of the cable trench, however, the impact on sediment and benthic organisms will be essentially temporary. In the case of the crossing of particularly sensitive biotope types such as reefs or species-rich gravel, coarse-sand and shell beds, permanent impairment would have to be assumed.

Based on the allocated capacity of 420 MW for site N-3.5 and an assumed capacity per facility of 10 MW (model wind farm scenario 1) or 20 MW (model wind farm scenario 2), the calculated number of facilities for the site is between 42 facilities (scenario 1) and 21 facilities (scenario 2).

Based on the model wind farm parameters, this results in a soil sealing of 47,112 m² (scenario 1) and 54,979 m² (scenario 2), including an assumed scour protection and a residential platform. Compared to the total area of site N-3.5 of approx. 28.9 km², the calculated soil sealing for the model wind farm scenarios is between 0.16% (scenario 1) and 0.19% (scenario 2).

The calculation of the loss of function due to inter-array cabling was carried out in accordance with the reported capacity, assuming a 1 m wide cable trench. Based on this conservative estimate, there is a temporary adverse effect of approx. 28 km of inter-array cabling for site N-3.5, which corresponds to a temporary area use of 0.10% of the total area of N-3.5.

The sum of soil sealing and temporary land use also results in a conservatively estimated adverse effect of well below 1% of the total area of N-3.5 (0.26% - 0.29%). Thus, according to current knowledge, no significant adverse effects are to be expected, even in cumulation, that would lead to a threat to the marine environment with regard to the seabed and the benthos.

12.3.16.2 Fish

The wind farms of the southern North Sea could have an additive effect and beyond their immediate location in that the mass and measurable production of plankton could be dispersed by currents and thus influence the qualitative and quantitative composition of the zooplankton. This, in turn, could affect planktivorous fish, including pelagic schooling fish such as herring and sprat, which are the target of one of the largest fisheries in the North Sea. Species composition could also change directly; species with habitat preferences that differ from those of the established species (e.g. reef dwellers) could find more favourable living conditions and thus occur more frequently. In the Danish wind farm Horns Rev, 7 years after its construction, a horizontal gradient in the occurrence of hartsubrate-affected species was found between the surrounding sand areas and near the turbine foundations: Cliff perch (Ctenolabrus rupestris), eelpout (Zoarces viviparus), and lumpfish (Cyclopterus lumpus) were much more common near the wind turbine foundations than on the surrounding sandy areas (LEONHARD et al. 2011). Cumulative effects resulting from a major expansion of offshore wind energy could include

- an increase in the number of older individuals,
- better conditions for fish due to a larger, more diverse food resource,
- further establishment and distribution of fish species adapted to reef structures,

- the recolonisation of previously heavily fished areas and zones,
- better living conditions for territorial species such as cod-like fish.

Besides predation, intraspecific and interspecific competition, also known as density limitation, is the natural mechanism for limiting populations. It is not possible to rule out the onset of local density limitation within individual wind farms before the positive effects of the wind farms are reproduced spatially through the migration of "surplus" individuals, for example. In this case, the effects would be local and not cumulative. The effects that changes in fish fauna could have on other elements of the food web, both below and above their trophic level, cannot be predicted at this stage.

12.3.16.3 Marine mammals

Cumulative effects on marine mammals, in particular harbour porpoises, may occur mainly due to noise exposure during pile driving of the foundations. For example, these assets could be significantly affected by the fact that, if pile-driving takes place simultaneously at other sites within the EEZ, there is not enough space for avoidance.

Cumulative impacts of the plan on the population of harbour porpoise are considered in accordance with the requirements of the noise abatement concept of the BMU of 2013. Pile driving activities that have the potential to cause disturbance to harbour porpoises due to noise input in the nature conservation areas or in the entire German North Sea EEZ shall be timed in such a way that the proportion of the area affected always remains below 10% or below 1% in subarea I of the nature conservation area "Sylt Outer Reef – Eastern German Bight".

12.3.16.4 Seabirds and resting birds

Vertical structures such as platforms or offshore wind turbines can have differing impacts on resting birds, such as loss of habitat, an increased risk of collision or a chasing and disturbing effect. These effects are considered on a site and project specific basis in the environmental impact assessment and are monitored in the subsequent monitoring of the construction and operation phase of offshore wind farm projects. For resting birds, habitat loss due to cumulative effects of several structures or offshore wind farms can be particularly significant.

Since 2009, the BSH has carried out the qualitative assessment of cumulative effects on loons within the framework of licensing procedures, using the main concentration area in accordance with the BMU position paper (2009).

The definition of the main concentration area of loons in the German North Sea EEZ as part of BMU's position paper (2009) is an important measure to ensure species protection of the sturgeon-sensitive species red-throated and black-throated diver. The BMU decreed that in future licensing procedures for offshore wind farms, the main concentration area should be used as a benchmark for the cumulative assessment of loon habitat loss.

The main concentration area takes into account the spring season, a period of particular importance for the species. The main concentration area was defined in 2009 on the basis of the data available at the time: the main concentration area was home to around 66% of the German North Sea diver (loon) population and around 83% of the EEZ population in spring, and is therefore, among other things, of particular importance in terms of population biology (BMU 2009) and an important functional component of the marine environment with regard to seabirds and resting birds. Against the background of current stock assessments, the importance of the main concentration area for loons in the German North Sea and within the EEZ has further increased (Schwemmer et al. 2019). The importance of the main concentration area for loons was confirmed by the study now available that was commissioned by the BWI (BioConsult SH et al. 2020). The delineation of the main concentration area for loons is based on the data situation, which is considered to be very good, and on expert analyses that have gained broad scientific acceptance. The area includes all areas of very high and most of the areas of high sea otter density in the German Bight.

The area where site N-3.5 is located is mainly used by loons as a transit area during migration periods and in winter. According to current knowledge, this site and its surroundings are located outside of the main resting areas of loons in the German North Sea.

On the basis of the available findings from research projects and monitoring of wind farm clusters, the BSH has concluded that site N-3.5 and its surroundings are not of high importance for the loon population in the German North Sea. Site N-3.5 is located at a distance of > 40 km from the main concentration area west of Sylt. The construction of an offshore wind farm on site N-3.5 can therefore exclude cumulative effects with the necessary certainty.

12.3.16.5 Migratory birds

The potential threat to bird migration arises not only from the effects of the individual project, in this case a project on site N-3.5, but also cumulatively in connection with other approved or already constructed wind farm projects in the vicinity of site N-3.5 or in the main direction of migration.

The surroundings of site N-3.5 in area N-3 already have a development with 153 m high wind turbines in the south of the area and a development with 187 m high wind turbines in the east, further projects/areas in the east of area N-3 are in the planning stage. It can be assumed that the dimensions of the projects still to be realised will be comparable with the scenarios of the present suitability assessment. A staircase effect may arise between the already existing wind farms and a wind farm on site N-3.5 due to the difference in height, as the visibility of the taller turbines could be limited. This is especially true for the smaller turbines of scenario 1, as here mainly the rotating rotors would be visible. In the case of the larger turbines with a hub height of 200 m, the massive nacelle would normally also be visible. The following consideration of collision risk is based on the main migration directions northeast (spring) and south-west (autumn).

The staircase effect described above would occur in spring, when the birds, coming from the south/southwest on their migration to the breeding areas, initially fly towards the smaller, already completed wind farm projects in area N-3. In autumn, they reach the larger wind farm projects on the eastern outer border of N-3 first.

Under normal migratory conditions preferred by migratory birds, no concrete threats due to collisions have been identified to date.

Unexpected fog and rain, which lead to poor visibility and low altitudes, are potential hazards. The coincidence of bad weather conditions with so-called mass migration events is particularly problematic. On the other hand, research results obtained on the FINO1 research platform could qualify this prognosis. It was found that birds migrate higher in very poor visibility (below 2 km) than in medium (3 to 10 km) or good visibility (> 10 km). However, these results were based on only three nights of measurements (Hüppop et al. 2005).

The risk of collision for birds migrating during the day and seabirds is generally considered to be low (see Chapter 4.8.1).

Cumulative effects could also result in a lengthening of the migration path for migrating birds. The potential adverse effect on bird migration in terms of a barrier effect depends on many factors; the orientation of the wind farms in relation to the main migration directions must be considered in particular. Assuming the main direction of migration is southwest to northeast and vice versa, the wind farms of the same or another area adjacent to each other in this orientation form a uniform barrier, so that a single avoidance movement is sufficient. It is known that birds avoid wind farms, i.e. they fly around wind farms or over them horizontally. In addition to observations on land, this behaviour has also been demonstrated in offshore areas (e.g. KAHLERT et al. 2004, AVITEC RESEARCH GBR 2015b). Lateral avoidance reactions are apparently the most common reaction (HORCH & KELLER 2005). Avoidance reactions in different directions occurred, but a reverse migration was not observed (KAHLERT et al. 2004). AVITEC RESEARCH GBR (2015) found avoidance behaviour among ducks, gannets, auks, little gulls and black-legged kittiwakes during long-term surveys.

Site N-3.5 is located to the north of a wind farm already in operation; further projects to the east of site N-3.5 are currently being planned or have already been implemented. In perspective, all these projects would represent a barrier of approx. 50 km to the main migration direction north-east or south-west, so that the potentially necessary diversions for migratory birds in the main migration direction would amount to max. 70 km if the original migration route is resumed after the avoidance movement. Assuming that migratory birds maintain their migration route in a north-easterly direction, a further avoidance reaction is possible with regard to a project located more than 50 km to the north-east in site development plan area N-5, so that in addition to the 70 km diversions already mentioned, migratory birds would have to fly an additional approx. 20 km to fly around the northern wind farm in area N-5.

The flight distance to cross the North Sea is in some cases several 100 km. According to BERTHOLD (2000), the non-stop flight performance of the majority of migratory bird species is in the order of magnitude of over 1000 km. This also applies to small birds. It is, therefore, unlikely that the additional energy demand that may be required would endanger bird migration as a result of a potentially necessary diversions of approx. 50 km.

Consideration of the existing knowledge on the migratory behaviour of the various bird species, their usual flight altitudes and the diurnal distribution of bird migration leads to the conclusion that, based on the current state of knowledge, the construction and operation of a wind farm on site N-3.5 is not likely to endanger bird migration, considering the cumulative effect of the offshore wind farm projects that have already been approved. At this stage, a possible bypassing of the projects is not expected to have any significant negative effect on the further development of the populations.

In this context, it has to be taken into consideration that, according to the present state of the art in science and technology, this prediction is made under premises that are not yet suitable to ensure the basis for bird migration in a satisfactory manner. There are gaps in the current knowledge, especially with regard to the species-specific migratory behaviour in bad weather conditions (rain, fog).

12.4 Transboundary impacts

The SEA concludes that, as things stand at present, site N-3.5 does not have a significant impact on the areas of neighbouring countries bordering the German North Sea EEZ. Site N-3.5 is centrally located in the German North Sea EEZ. The distance to the Dutch EEZ is at least 45 km. Denmark (or the Danish EEZ) is at least 130 km away.

Significant transboundary impacts due to these distances can generally be excluded for the following protected assets: soil, water, plankton, benthos, biotope types, landscape, cultural heritage and other material assets, and the human being and human health. Possible significant transboundary impacts could only arise if all planned wind farm projects in the area of the German North Sea for the highly mobile protected assets – fish, marine mammals, seabirds and resting birds, migratory birds and bats – are considered cumulatively.

With regard to fish as a protected asset, the SEA comes to the conclusion that, according to the current state of knowledge, no significant transboundary impacts on the protected assets are to be expected as a result of site N-3.5, since on the one hand the site does not have a prominent function for the fish fauna and on the other hand the recognisable and predictable effects are of a small-scale and temporary nature.

Based on current knowledge and considering impact-minimising and damage-limiting measures, significant transboundary impacts can also be excluded for the protected marine mammal species. For example, the installation of wind turbine foundations and residential platforms will only be permitted as part of the determination of suitability if effective sound reduction measures are used and noise-intensive construction work is coordinated with neighbouring projects.

For protected seabirds and resting birds, significant transboundary impacts can also be excluded with the requisite degree of certainty due to the distance to the Dutch and Danish boundaries.

Bird migration over the North Sea takes place in a broad-front migration that cannot be defined in more detail, with a tendency towards coastal orientation. Guidelines and fixed migration routes are not yet known. The individual species-specific assessment (Chapter 4.8.1) did not reveal any significant impacts. Consideration of the existing knowledge on the migratory behaviour of the various bird species, their usual flight altitudes and the diurnal distribution of bird migration leads to the conclusion that, based on the current state of knowledge, the construction and operation of a wind farm on site N-3.5 is not likely to endanger bird migration, taking into account the cumulative effect of the offshore wind farm projects that have already been approved, although there is still a lack of knowledge about species-specific migration behaviour. As a result, significant transboundary impacts are also not likely.

Migratory movements of bats across the North Sea are still poorly documented and largely unexplored. There is a lack of concrete information on migrating species, migration corridors, migration heights, and migration concentrations. Previous knowledge merely confirms that bats, especially long-distance migratory species, fly over the North Sea. A technically comprehensible assessment of possible impacts, including transboundary impacts, is therefore not possible at the present time. It can be assumed that any negative impacts can be avoided and mitigated by the same measures used to protect bird migration. For further information, please refer to the results of the impact predictions for the individual protected assets in Chap. **4.1** et seq.

12.5 Assessment of wildlife conservation regulations

The assessment of wildlife conservation regulations according to Sec. 44 para. 1 BNatSchG concludes that, based on current knowledge, the construction of a wind farm on site N-3.5 will not have any significant negative impacts on marine mammals that would trigger the prohibition of species protection under species protection law, provided that preventive and mitigation measures are strictly adhered to and the requirements of the BMU noise protection concept are implemented. The assessment of wildlife conservation regulations also comes to the same conclusion with regard to avifauna.

12.6 Impact assessment

In the German North Sea EEZ, the nature conservation areas “Sylt Outer Reef – Eastern German Bight” are located at a distance of 53.4 km from site N-3.5, “Borkum Reef Ground” at a distance of 13.3 km, “Doggerbank” at a distance of 203.7 km, and the “Lower Saxon Wadden Sea

National Park" located in the coastal waters, which is 18.0 km away.

According to Sec. 34 BNatSchG, the compatibility of plans or projects has to be assessed and it has to be determined whether, individually or in combination with other plans or projects, they may have a significant adverse effect on the conservation objectives of a Natura 2000 site or the conservation objectives of a nature conservation area. This also applies in principle to projects outside the area.

Within the framework of the impact assessment, the habitat types "reef" and "sandbank" with their characteristic and endangered biotic communities and species as well as protected species, specifically fish, certain marine mammals according to Annex II of the Habitats Directive (harbour porpoise, grey seal and harbour seal) as well as protected bird species according to Annex I of the Birds Directive (in particular red-throated diver, black-throated diver, little gull, Sandwich tern, common tern, and Arctic tern) and regularly occurring migratory bird species (in particular common and lesser black-backed gull, northern fulmar, gannet, kittiwake, guillemot, and razorbill) are to be considered in accordance with the conservation objectives of the above-mentioned nature conservation areas.

Due to the shortest distance of area N-3.5 of at least 13.3 km to the "Borkum Reef Ground" nature conservation area in the German EEZ or 18.0 km to the area under the Habitats Directive "Lower Saxon Wadden Sea National Park" in the coastal waters, impacts related to construction, installation and operation on the SAC habitat types "Reef" and "Sandbank" with their characteristic and endangered biotic communities and species can be excluded. The distance of site N-3.5 lies far outside the drift distances discussed in the literature so that no release of turbidity, nutrients, and pollutants that could adversely affect the nature conservation areas and areas under the Habitats Directive in their components relevant to the conservation objectives or the conservation purpose is to be expected. The same applies because of the distances to the areas for fish and cyclostomes.

Significant adverse effects on the nature conservation areas in the German EEZ "Borkum Reef Ground" and the "Lower Saxon Wadden Sea National Park" in the coastal waters with regard to the harbour porpoises, grey seals and harbour seals protected there can also be excluded with the necessary degree of certainty, taking into account the requirements for noise protection. In particular, any impacts from construction-related noise emissions can be efficiently prevented by specifying sound reduction measures and coordinating them with the construction measures of other projects.

With regard to the seabird species protected in the nature conservation area "Sylt Outer Reef – Eastern German Bight", site N-3.5 and thus also an offshore wind farm on the site are, according to current knowledge, of no significance due to the distance.

12.7 Planned measures to prevent, reduce and offset significant negative impacts on the marine environment

In accordance with Sec. 40 para. 2 UVPG and the requirements of the SEA Directive, the measures planned to prevent, reduce and as far as possible compensate for significant negative impacts on the environment through the implementation of the plan are presented. While individual prevention, mitigation and compensation measures may begin even at the planning level, others only come into play at the specific implementation stage.

With regard to planning prevention and mitigation measures, the site development plan already defines spatial and textual specifications which, in accordance with the environmental protection objectives set out therein, serve to prevent or mitigate significant negative effects in the marine environment due to implementation of the site development plan. The designations of the site development plan are considered in the suitability assessment. Due to the concrete reference to the area, the measures can also be specified here or additional measures can be specified within the framework of the ordinance on the determination of suitability. In the subsequent planning approval procedure, project-specific or site-specific measures that relate to the specific planned project are added.

Within the framework of the suitability assessment, measures in accordance with Sec. 12 para. 5 sentence 2 WindSeeG may be included in the ordinance as specifications for the subsequent project in order to determine the suitability of the site if the construction and operation of wind turbines on the site might otherwise have adverse effects on criteria and concerns pursuant to Sec. 10 para. 2 WindSeeG.

Specifically, measures must be taken to avoid hazards to the marine environment from noise emissions, especially during the construction of the facilities, in order to comply with limit values for sound pressure and peak sound pressure levels and to carry out the work as quietly and briefly as possible. Emissions shall be avoided and unavoidable emissions reduced so that pollution of the marine environment is not a concern.

12.8 Examination of reasonable alternatives

In accordance with Art. 5, para. 1, sentence 1 SEA Directive in conjunction with the criteria in Appendix I SEA Directive and Sec. 40, para. 2, no. 8 UVPG, the environmental report contains a brief description of the reasons for the choice of the reasonable alternatives examined.

Essentially, different types of alternatives can be considered for an assessment of alternatives; in particular strategic, spatial or technical alternatives. The prerequisite is always that these are reasonable or can be seriously considered.

Alternatives are already being examined as part of the upstream SEA for the site development plan 2020 (BSH 2020a). At this planning level, these are primarily the conceptual/strategic design, the spatial location and technical alternatives.

In the suitability assessment, therefore, only alternatives that relate to the specific site to be assessed according to the designations of the site development plan, in this case N-3.5, are to be considered in the sense of tiering between the instruments. These can primarily be process alternatives, i.e. the (technical) design of the facilities in detail (BALLA et al. 2009). At the same time, the exact design of the facilities to be constructed on the site has not yet been determined at the time of the suitability assessment. The examination of alternatives with regard to the concrete design of the later project can therefore only take place in the subsequent planning approval procedure. At this point, therefore, only alternatives are to be examined that relate to the respective area and can already be undertaken without detailed knowledge of the concrete building project. This could be achieved by implementing the project with different facility concepts using model scenarios. The two alternative scenarios differ in particular with regard to the number of facilities to be constructed to achieve the capacity to be installed (scenario 1: 42 vs. scenario 2: 21) as well as hub height and rotor diameter, which determine the total height of the individual wind turbines (approx. 225 m vs. 350 m). As a result, neither of the two scenarios can be rated as clearly preferable due to their lower impacts on the environment. Rather, the assessment differs depending on the protected asset. Scenario 2, for example, is more advantageous with regard to the protected assets Soil and Benthos, since the smaller number of wind turbines and the scour protection associated with each facility means that hard substrate from other sites is introduced. For avifauna, on the other hand, a slightly lower adverse effect is expected from the lower facilities in scenario 1.

Another alternative is to evaluate the use of different foundation types. Suction bucket, vibropile or gravity foundation are discussed as conceivable alternatives for the foundation of facilities using driven pile foundations for the German North Sea EEZ.

Only very limited information is available for the above-mentioned foundation types under consideration. In particular, there is insufficient knowledge from monitoring comparable offshore installations. Based on the current state of knowledge with regard to the specific parameters and in particular with regard to the impacts on the various protected assets during construction and operation, the impacts on the environment of these foundation types cannot be determined, described and assessed.

Consideration of these alternatives in detail is therefore consequently excluded, as the necessary information cannot be determined with reasonable effort.

12.9 Measures planned to monitor the environmental impacts of implementing the site development plan

The potential significant impacts on the environment resulting from the implementation of the plan are to be monitored in accordance with Sec. 45 UVPG. This is intended to enable unforeseen negative impacts to be identified at an early stage and suitable remedial measures to be taken.

Therefore, in accordance with Sec. 40 para. 2 no. 9 UVPG, the environmental report is to specify the measures envisaged for monitoring the significant environmental impacts of implementation of the plan. Monitoring is the responsibility of the BSH, which is the authority responsible for the SEA (see Sec. 45 para. 2 UVPG). As intended by Sec. 45 para. 5 UVPG, existing monitoring mechanisms may be used to prevent duplication of monitoring work.

With regard to the planned monitoring activities, it should be noted that the actual monitoring of the potential effects on the marine environment can only begin when the plan is implemented, i.e. when the project is realised on site N-3.5. However, general research cannot be carried out within the framework of monitoring. Therefore, the project-related monitoring of the effects of the project on the site and its surroundings is of particular importance.

The main task of monitoring this plan in conjunction with the site development plan and the individual planning approval procedures is to combine and evaluate the results from the various monitoring phases. The assessment will also cover the unforeseen significant effects of the implementation of the plan, the marine environment and the assessment of the predictions in the environmental report. The procedure planned for this, the measures envisaged for monitoring the potential impacts of the plans and the data required are described in the environmental report on the site development plan 2020 for the German North Sea in Chapter 10 (particularly in Chapter 10.1 for the potential impacts of the areas and sites for offshore wind turbines) (BSH 2020a).

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