Nord Stream
The new gas supply route for Europe

RAMBØLL

Nord Stream Extension
EIA programme, Denmark

Nord Stream AG

April 2013

Dokument Nr. N-PE-PER-REP-705-BPDK0100-A

Table of Contents

Abbreviations and definitions

ADF	Admiral Danish Fleet (Søværnets Operative Kommando)
AG	Aktiengesellschaft
AIS	automatic identification system
ALARP	as low as reasonably practicable
bcm	billion cubic metres
BUCC	back-up control room
BSPA	Baltic Sea Protected Areas
CO_2	carbon dioxide
COMBINE	Cooperative Monitoring in the Baltic Marine Environment
CTDO	conductivity, temperature, depth and oxygen (profiler)
CWA	chemical warfare agents
CWC	concrete weight coating
DEA	Danish Energy Agency (Energistyrelsen)
DEPA	Danish Environmental Protection Agency
DEMA	Danish Emergency Management Agency (Beredskabsstyrelsen)
DMA	Danish Maritime Authority (Søfartsstyrelsen)
DNA	Danish Nature Agency (Naturstyrelsen)
DNV	Det Norske Veritas
EC	European Commission
EEZ	exclusive economic zone
EIA	environmental impact assessment
ESMS	environmental and social management system
Espoo	Convention on Environmental Impact Assessment in a Transboundary Context
EU	European Union
HAZID	hazard identification
HELCOM	The Baltic Marine Environment Protection Commission; also known as the Helsinki Commission
IBA	Important Bird Area (according to Birdlife International)
ICES	The International Council for the Exploration of the Sea
IFC	International Finance Corporation
IMO	International Maritime Organization
LFFG	landfall facilities in Germany
LFFR	landfall facilities in Russia
LNG	liquefied natural gas
MARPOL	International Convention for the Prevention of Pollution from Ships
MCC	main control room
NEGP	North European Gas Pipeline
NOAH	Friends of the Earth Denmark
NO_x	nitrogen oxides
OECD	Organisation for Economic Co-operation and Development
PID	Project Information Document

psu	practical salinity unit
ROV	remotely operated vehicle
SO_2	sulphur dioxide
TSS	traffic separation scheme
UNCLOS	United Nations Convention on the Law of the Sea
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organization
VSM	Viking Ship Museum
WWF	World Wide Fund for Nature

Nord Stream Extension
EIA programme
Denmark

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1 Purpose of the EIA programme

The purpose of this environmental impact assessment (EIA) programme, prepared by Ramboll Oil & Gas, Denmark, for Nord Stream AG in Zug, Switzerland, is to:

- describe the proposed Nord Stream Extension Project (referred to here as "the Project")
- describe the environmental baseline in the Project area and the potential environmental impacts to be assessed
- provide authorities with information about the Project to enable them to execute the national scoping procedure
- provide all stakeholders with a good overview of the Project, allowing them to determine their level of interest in the proposed Project.

On-going route corridor investigations, basic engineering, stakeholder consultation, results of the environmental impact assessment and regulatory review will influence the Project's design and planning. Therefore, specific Project details – e.g. detailed pipeline design, exact routing, landfall sites and construction methods – may change from those described in this EIA programme. There may also be changes to the overall Project based on the outcome of on-going commercial negotiations. All clarifications and changes will be included in the Project's EIA Reporting and the permit application documents.

To make allowance for any possible outcome this document describes the Project in its widest scope by assuming two pipelines of maximum diameter (48 inches).

The information in this EIA programme reflects the preliminary Project design as of April 2013. This EIA programme does not document environmental commitments to which the Project shall be bound. The Project Developer will identify such commitments during the EIA and permitting process and will then provide relevant documentation in the EIA reporting and the permit application document.

1.1 Contact details

More information may be obtained from:

Nord Stream AG
Grafenauweg 2
6304 Zug
Switzerland

Contact person:
Nicklas Andersson
Head of Permitting for Denmark and Sweden

www.nord-stream.com
info@nord-stream.com

2 Introduction to the Project

2.1 The project developer

Nord Stream AG, based in Zug, Switzerland, is an international consortium of five major companies established in December 2005 under the former name of NEGP for the purpose of the planning, construction and subsequent operation of a natural gas pipeline system through the Baltic Sea. The shareholders of the Nord Stream consortium are the Russian natural gas company OAO Gazprom (51%) and four European natural gas companies Wintershall Holding GmbH (15.5%), E.ON Ruhrgas AG (15.5%), N.V. Nederlandse Gasunie (9%), and GDF SUEZ (9%). Nord Stream AG successfully constructed the two Nord Stream pipelines, showing that subsea natural gas transportation through the Baltic Sea is a sustainable solution for meeting European natural gas demand.

In a feasibility study Nord Stream AG identified different route corridor options for the envisaged possible extension of its existing twin natural gas pipeline system through the Baltic Sea. Based upon the feasibility report findings Nord Stream AG then obtained the approval of its shareholders to further develop the Project. Depending on the business interests of Nord Stream AG's current shareholder group, the shareholder structure for the Project may change at a later stage.

2.2 The Project

The Project comprises the planning, construction and operation of up to two additional natural gas offshore pipelines through the Baltic Sea spanning from Russia to Germany, each with a transport capacity in the order of 27.5 billion cubic metres (bcm) of natural gas per year and with similar properties to that of the existing two Nord Stream pipelines: 48 inch steel pipes with internal flow coating and external corrosion protection coating and concrete weight coating, inner pipe diameter of 1,153 mm, segmented pipe wall thicknesses along the pipeline route corresponding to decreasing design pressures in the range of 220 bar, 200 bar and 177.5 bar, and total pipeline length of approximately 1,250 km. The Project's pipeline system is preliminarily scheduled to be constructed from 2016 to 2018.

Based on existing knowledge Nord Stream AG evaluated several route corridor options, including a routing through Estonian exclusive economic zone (EEZ). Subsequently Nord Stream AG applied for survey permits in the corresponding countries to commence as soon as possible with the further investigations for an optimised pipeline routing. The Estonian government decided in December 2012 not to grant Nord Stream AG a permit to perform a reconnaissance survey in Estonian EEZ waters. Thus the originally identified route corridor options had to be reduced. All remaining route corridor options follow a routing from a landfall in Russia through Finnish, Swedish and Danish waters to a landfall in Germany (Figure 2.1).

Detailed investigations will be based on new reconnaissance and detailed level surveys, environmental surveys, basic engineering, risk assessments, environmental and social impact assessments and stakeholder feedback.

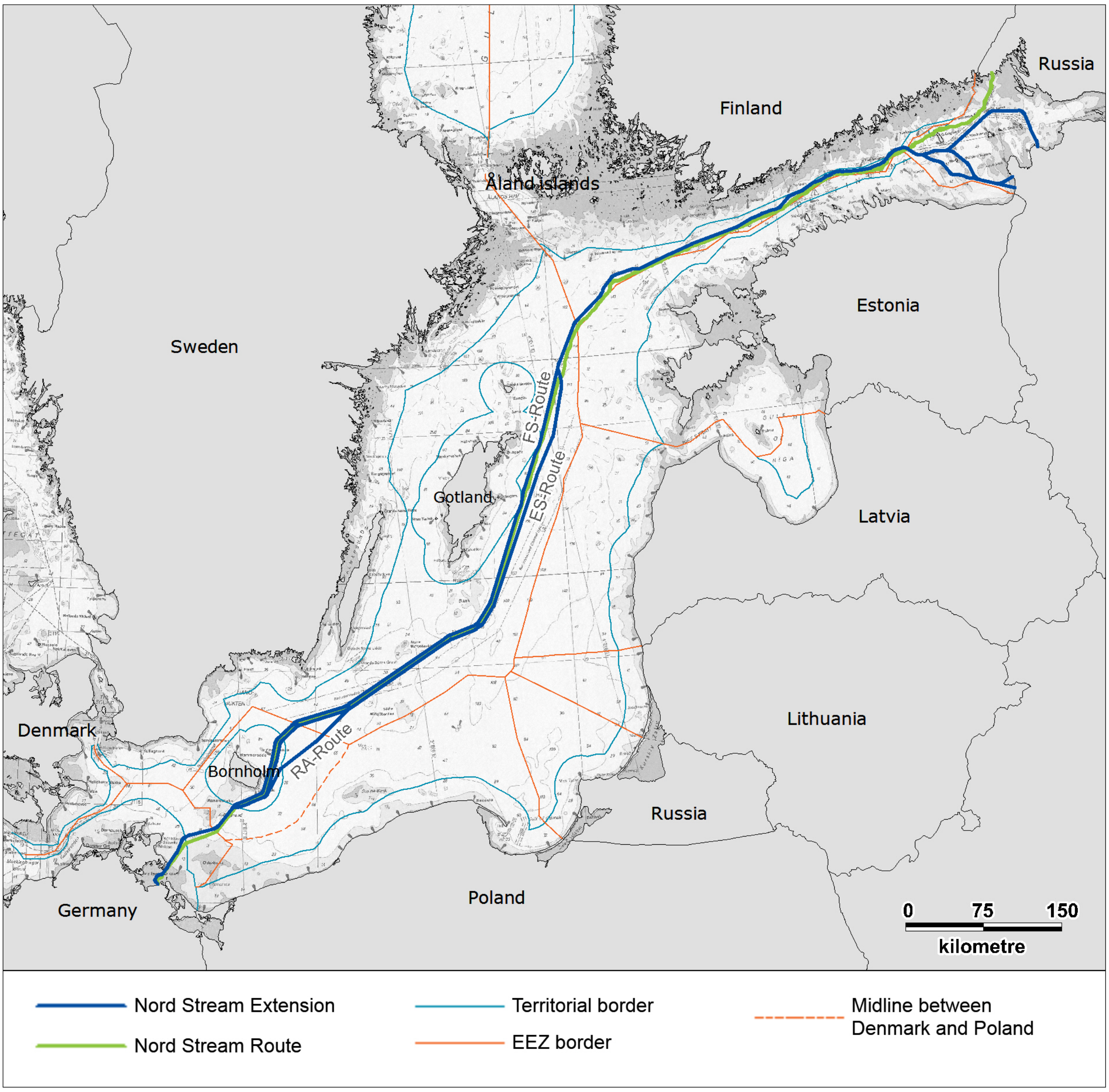

Figure 2.1 Route corridor options for the Nord Stream Extension Project.

2.3 Present status of Nord Stream Line 1 and 2

Nord Stream is a pipeline system through the Baltic Sea, transporting natural gas via a direct connection from the Russian natural gas pipeline grid to the EU markets. Currently, two offshore pipelines run from Vyborg near St. Petersburg in Russia to Lubmin near Greifswald in Germany and provide a total transport capacity of 55 bcm of natural gas a year. The pipelines were built and are now operated by Nord Stream AG based in Zug, Switzerland.

The existing twin pipelines' route, 1,224 kilometres long and entirely offshore through the Baltic Sea, passes through the EEZ of Russia, Finland, Sweden, Denmark and Germany and through the territorial waters of Russia, Denmark and Germany with landfalls in Russia and Germany. Pipe-laying of the first pipeline began in April 2010 and was completed in June 2011. Transportation of natural gas through Line 1 began in November 2011. Pipe-laying of Line 2, which runs almost parallel to Line 1, was completed in April 2012. In October 2012, gas transport through the second pipeline started. At the German landfall the natural gas is delivered into the two German pipeline systems OPAL "Ostsee-Pipeline-Anbindungs-Leitung" and NEL "Nordeuropäische Erdgasleitung" for further transport into the European natural gas grid.

The Baltic Sea, being a large body of relatively shallow brackish waters with limited water exchange with the North Sea, is a sensitive ecosystem and unique in terms of its flora, fauna and human activities. Nord Stream AG has carefully studied these factors and taken them into account in the project activities of the existing twin pipelines. Extensive route alternative surveys and EIA studies ensured that routing, design and construction activities for the first two pipelines minimised any potential adverse environmental and social impact. Nationally focused EIAs and the international consultation process governed by the Espoo Convention were key elements in the project's permitting process. Furthermore, as an essential part of the project financing, the relevant requirements of international financial institutions, such as the Equator Principles, the OECD Common Approaches and Performance Standards of the International Finance Corporation (IFC) were met, including the development and implementation of an Environmental and Social Management System (ESMS).

In addition to presenting a state-of-the-art technical design, Nord Stream AG demonstrated in a very transparent way that it is competent in the sustainable management of environmental and social aspects and risks associated with the implementation of a pipeline project in the Baltic Sea region. All construction work for the pipeline system was carried out in an environmentally responsible manner, successfully protecting the unique ecosystem of the Baltic Sea. The implementation of an Environmental and Social Management System enabled Nord Stream to monitor its contractors and closely follow up all commitments and obligations, in turn ensuring good management of construction and operations activities and transparent and comprehensive reporting to authorities and stakeholders.

After completion of construction of line 1 and line 2 the results from Nord Stream's Environmental and Social Monitoring Programmes demonstrate that Nord Stream's pipeline construction did not cause any unforeseen environmental impact in the Baltic Sea. So far, all monitoring results from the Danish section have confirmed the findings of the Danish environmental impact assessments and verified that construction-related impacts were minor, locally limited and of short duration only.

3 Purpose of and need for the Project

A robust pipeline infrastructure, which connects the Russian natural gas pipeline grid to the European energy markets and safeguards reliable and secure natural gas supply, is required to fulfil contractual agreements between Russian and European natural gas companies over the coming decades. The successful construction of the first two Nord Stream pipelines clearly indicates that from an environmental, technical and economic point of view, subsea natural gas transportation through the Baltic Sea is a sustainable solution to meet European natural gas demand. The first two Nord Stream pipelines have been completed according to schedule while adhering to high quality, safety, environmental and social criteria.

Natural gas is the only fossil fuel with expected growth in the EU's energy mix

Currently making up one quarter of the EU's primary energy consumption, natural gas accounts for a significant proportion of energy consumption within the EU member states. By 2035, the share of natural gas in the EU's primary energy mix is expected to rise from 26% to 30% (see Figure 3.1).

The share of natural gas will grow in lieu of other, less environmentally friendly fossil fuels. The share of oil is predicted to go down from 33% in 2010 to about 25% in 2035, and the share of coal to decline from 16% (2010) to 9% (2035).

The percentage of nuclear energy in the EU's primary energy mix is forecasted to remain almost unchanged at 14 % (2010) and at 13% (2035). Although nuclear power generation does not emit carbon dioxide, nuclear power plants are highly disputed regarding their safety and radioactive waste management and therefore are not regarded as a priority option to substitute fossil fuel.

The proportion of energy supplied by renewable sources in the EU is forecasted to increase from 11% in 2010 to approximately 23% in 2035, still leaving a significant share of the energy mix to other sources – with natural gas, as a low-emission fuel, being the widely preferred option.

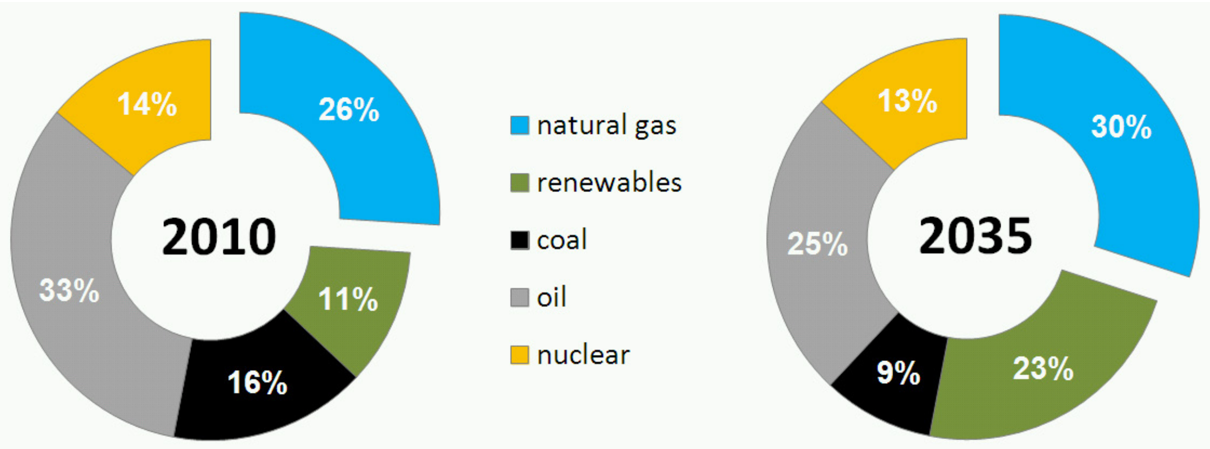

Figure 3.1 EU energy mix – the growing demand for natural gas (Sources: Eurostat 2012; IEA World Energy Outlook, 2012)

The Nord Stream Pipelines ensure reliable natural gas supplies to the EU

To provide robust, reliable and secure natural gas supplies to meet all contractual supply obligations by Russia vis à vis its EU customers for the coming decades requires supply infrastructure free from technical and non-technical risks. Direct pipeline connections have the advantage of avoiding non-technical risks so that reliability can be ensured by applying state-of-the-art construction and operation.

The existing Nord Stream pipelines and their planned extension meet that requirement. They not only ensure the fulfilment of existing long-term supply contracts between Russian and EU companies, but offer additional supply options to north-western Europe to compensate for its declining domestic gas production.

The existing Nord Stream Pipeline system and its planned extension with state-of-the-art technology offer a technically sound solution for many decades of deliveries of Russian gas to the EU. Offering a direct natural gas connection, it is free from non-technical risks and free of interference of a commercial or non-commercial nature by third parties.

The commitment of OAO Gazprom and major EU energy companies to the building of Nord Stream Lines 1 and 2 and to an extension of the Nord Stream Pipeline system, both involving major private investment, underlines the interest of the natural gas industry in strengthening the long-term supply relationship between Russia and the EU. This will be of considerable benefit to the EU by increasing reliability and security of supply and to its natural gas consumers by providing additional supply options.

The EU recognises the importance of the Nord Stream Pipeline. The Trans-European Energy Network, via EU Decision No 1364/2006/EC of 6 September 2006, acknowledges the northern European natural gas pipeline running from Russia to Germany through the Baltic Sea as a project of “European interest”.

Alternative transport means

Liquefied Natural Gas (LNG) deliveries to the EU member states are expected to almost double by 2030. However, due to global market competition, a further increase is unlikely. LNG transport, compared with offshore pipelines, tends to be less energy-efficient and involves higher carbon emissions. The LNG process is complex, and involves liquefaction of gas at the point of export, specialised shipping transport, and finally re-gasification. In July 2009, the European Commission’s Joint Research Centre released a report on the advantages and drawbacks of LNG. According to the report, “The LNG supply chain tends to be more energy and greenhouse gas intensive than the supply chain for pipeline gas, because of the extra processing steps”. To replace the annual capacity planned for the Project would require some 600 to 700 round-trips per year by LNG tankers from an LNG facility in Russia to an LNG facility in North West Europe. Over and above additional carbon emissions, ship traffic causes emissions of other air pollutants, noise in the marine environment and influences maritime safety, particularly in heavily trafficked areas.

An overland pipeline project from Russia to North West Europe, for example through the eastern or northern and western Baltic Sea bordering states, would be longer and include significant environmental and social challenges when compared with an offshore pipeline on the sea floor of the Baltic Sea. Overland pipeline challenges include human settlements, roads, railways, canals, rivers, surface landforms, agricultural land, as well as potentially sensitive eco-systems and cultural heritage sites. An overland pipeline would also require additional infrastructure sites such as compressor stations approximately every 200 km to maintain pressure for gas transport flow, which would require significant land and energy usage while emitting noise and atmospheric emissions.

4 Alternatives

4.1 Route corridor options

Based on existing knowledge Nord Stream AG evaluated several route corridor options, including a routing through Estonian EEZ waters. Subsequently Nord Stream AG applied for survey permits in the corresponding countries to commence as soon as possible with the further investigations for an optimised pipeline routing. The Estonian government decided in December 2012 not to grant Nord Stream AG a permit to perform a reconnaissance survey in Estonian EEZ waters. Thus the originally identified route corridor options had to be reduced. All remaining route corridor options follow a routing from a landfall in Russia through Finnish, Swedish and Danish waters to a landfall in Germany.

The overall length of the pipeline corridors is around 1,250 km depending on the location of landfall sites and detailed routing options.

4.2 Route corridor selection criteria

In order to plan a sustainable route corridor for the new pipelines, specific selection criteria in the categories environment, social and technical have to be considered.

Environmental criteria relate to the potential effects of the pipelines' installation and operation on the environment of the Baltic Sea, including protected or environmentally sensitive areas hosting ecologically sensitive species of animal or plant life. Furthermore, any Project-associated work that might disrupt the seabed's natural composition must be minimised.

With regard to social criteria, the key is to minimise any restrictions on marine spatial planning concepts and marine users – those working in shipping, fishing, offshore industries, the military, tourism or recreation – and paying attention to existing and planned offshore installations, such as cables, pipelines or wind farms. Analysing offshore munitions dumping sites and cultural heritage sites also falls within this category.

Technical considerations relate to pipeline design, component manufacture, installation method, operation, integrity, and risk assessment results. These include water depth for pipeline stability, installation, maintenance and repair, minimum pipeline bend radii, criteria for cable and pipeline crossings, distance to and crossing of shipping lanes and seabed roughness. Here, it is also important to consider how to reduce construction time while minimising the operation's technical complexity, minimising impacts and use of resources.

Drawing on the company's experience and available data from the existing pipelines, and taking the selection criteria described above into account, Nord Stream AG performed a thorough desk study corridor assessment that identified a number of feasible route corridor and landfall options as a basis for further planning during the next project phase.

4.3 Route corridor options through Danish waters

Three route corridor options pass through Danish EEZ and territorial waters (see Figure 4.1). The route corridor options have the following characteristics in Danish waters:

- FS route: runs parallel to the Nord Stream pipelines on the north-western side for the entire section in Danish waters. The FS route maintains a greater distance from the chemical munitions dumping site than the Nord Stream pipelines. Consequently, the distance from the FS route to Bornholm Island is correspondingly shorter.

- ES route: runs parallel to the Nord Stream pipelines on the south-eastern side for most parts in Danish waters. The ES route runs closer to the chemical munitions dumping site than the Nord Stream pipelines. The distance from the ES route to Bornholm Island is greater than for the Nord Stream pipelines. A route option allows for crossing over from the ES route to the FS route immediately after the Swedish/Danish EEZ border. If the ES route is maintained through Danish waters, crossing over to the FS route before entering the German EEZ is necessary due to the shallow depth in German waters.

- R-A route: enters Danish waters further southeast than the ES route and offers a more direct route through Danish waters than the FS and ES routes. In order to avoid the disputed area southeast of Bornholm (border issue between Denmark and Poland), it crosses the area northeast of Bornholm where bottom trawling, anchoring and seabed works are discouraged, before entering Danish territorial waters, turning southwest and joining the ES route for the remainder of the route towards the Danish/German EEZ border.

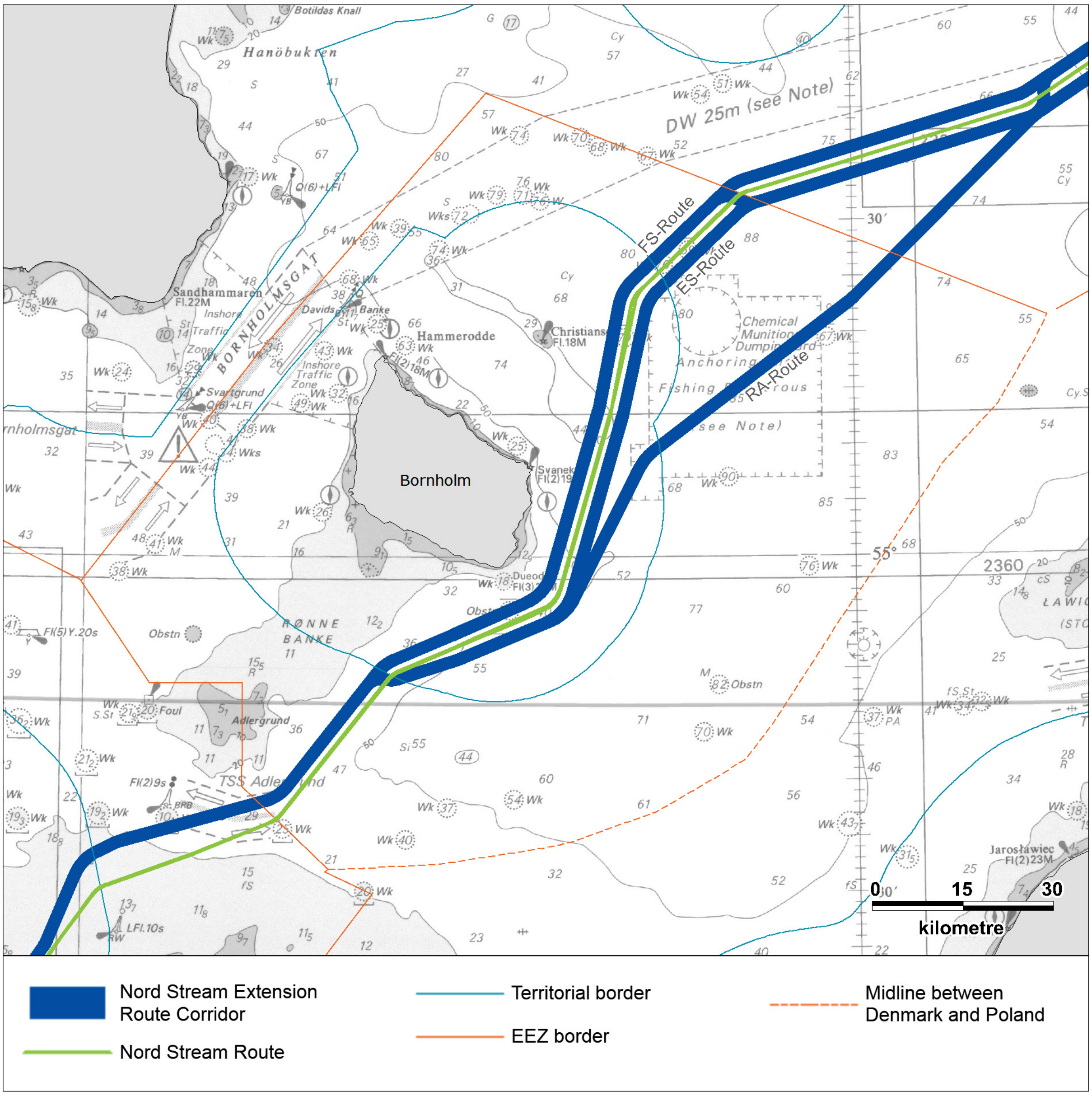

Figure 4.1 Route corridor options for the Nord Stream Extension Project through Danish waters.

4.4 No-action alternative

The description of the no-action (or zero) alternative provides the basis for enabling the comparison of the predicted impacts of Project implementation with the environmental conditions of not implementing the Project. Consequently, the no-action alternative identifies the existing environmental conditions, which will not experience any disturbance from the action taken by the Project developer.

Experience from the construction of the two Nord Stream Pipelines indicates that from an environmental, technical and economic point of view, a subsea natural gas transportation system through the Baltic Sea is an environmentally feasible solution. Environmental and social monitoring of the Nord Stream Project has so far verified that the environmental and social impact of the Nord Stream twin pipeline construction has been of minor significance.

The no-action alternative means not implementing the Project at all. All activities connected with Project implementation, i.e. constructing and operating of up to two additional subsea pipelines from Russia to Germany on the seabed of the Baltic Sea, would not take place. Consequently, there would be no environmental or social impact from the Project, neither an adverse one nor a positive one.

5 Project description

Over the past years, Nord Stream AG has acquired extensive knowledge through the design and construction of a natural gas pipeline system in the Baltic Sea. As the design and construction of the existing Nord Stream pipelines was successful, the Project can draw on its principles and maximize synergies allowing for efficient planning and re-use of gained knowledge and experience. On-going route corridor investigations, basic engineering, stakeholder consultation, results of the EIAs and regulatory review will influence the Project's design and planning. Therefore, specific details, e.g. pipeline design, routing, landfall sites and construction methods, may change from those described, but will be subject to the relevant national permitting procedures.

5.1 Project infrastructure

The Project's pipeline system will provide the linkage between an upstream operator's compressor station near the landfall in Russia and a downstream operator's receiving terminal in Germany.

The Project's pipeline system will include the Baltic Sea offshore pipelines themselves and the related facilities, which are:

- Landfall facilities in Russia (LFFR)
- Landfall facilities in Germany (LFFG)
- Main control centre in Zug, Switzerland (MCC)
- Back-up control centre in Zug, Switzerland (BUCC).

This configuration replicates that of the existing Nord Stream infrastructure but will utilise different landfall sites and different pipeline route corridors.

5.2 Technical design

Key parameters and components

The following key parameters and pipeline components are base case subject to optimization during basic engineering and have been confirmed as being viable and will be used as a basis for the extension pipelines:

- the envisaged flow rate in the order of 27.5 bcm/year can (depending on the length of the pipeline) be achieved using 48 inch pipes with a constant inner pipe diameter of 1,153 mm and design pressures in the range of 220 bar, 200 bar and 177.5 bar
- wall thicknesses of 34.6 mm, 30.9 mm and 26.8 mm (relating to the different pressure ranges)
- buckle arrestor thickness of 41.0 mm
- internal flow coating: low solvent epoxy, roughness RZ = 5 µm, thickness 90 µm to 150 µm
- external corrosion coating: three-layer polyethylene of 4.2 mm
- concrete coating thickness and density: 60 mm to 120 mm, 2,400 kg/m^3 to 3,200 kg/m^3

- corrosion protection anodes: zinc-based anodes in low-salinity water, aluminium anodes in other areas.

Again drawing on the experience gained on the first two Nord Stream pipelines, there is confidence in selecting:

- rock berms for rectifying free spans, mitigating against in-service buckling, securing on-bottom stability, establishing hyperbaric tie-in embankments
- concrete mattresses for crossing cables
- crossing of the existing Nord Stream pipelines and the possible future Baltic Connector and Baltic Pipe using rock berms (if the existing pipelines are exposed) or mattresses (if they are buried)
- post-lay trenching for stability
- pre-lay dredging for stability and protection.

Standards, verification and certification

As for the Nord Stream pipelines, the Project's pipelines will be designed, constructed and operated in accordance and in compliance with the international offshore standard DNV OS-F101, Submarine Pipeline Systems, along with its associated Recommended Practices, issued by Det Norske Veritas (DNV).

Independent third-party experts from international certification bodies will be assigned to witness, audit and participate in all aspects of the project design and implementation, and to provide final certificates according to country-specific regulations prior to commissioning and start of operations.

5.3 Materials

Line pipe

The Project's pipelines will be constructed of individual steel line pipes with a length in the order of 12 m that will be welded together in a continuous laying process.

The line pipes will be internally coated with an epoxy-based material (Figure 5.1). The purpose of the internal coating is to reduce hydraulic friction, thereby improving the natural gas flow conditions.

Figure 5.1 Internal pipeline coating will be an antifriction, epoxy-based coating.

An external three-layer polyethylene coating will be applied over the line pipes to prevent corrosion. Further corrosion protection will be achieved by incorporating sacrificial anodes of aluminium and zinc (see section below describing anodes for cathodic protection). The sacrificial anodes are a dedicated and independent protection system in addition to the anticorrosion coating.

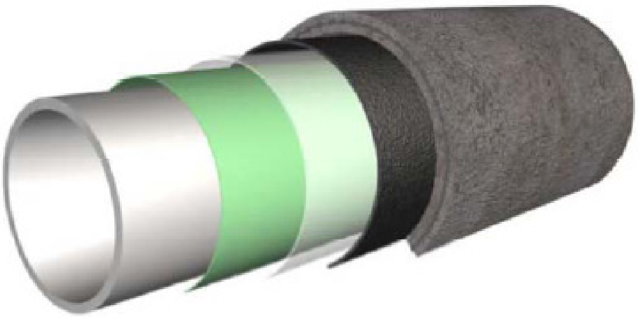

Figure 5.2 Concrete coating (grey) on top of the three-layer anticorrosion coating. The three-layered polyethylene external anticorrosion coating consists of an inner layer of fusion-bonded epoxy (dark green), a middle adhesive layer (light green) and a top layer of polyethylene (black).

A concrete weight-coating containing iron ore will be applied over the line pipe's external anticorrosion coating (Figure 5.2). While the primary purpose of the concrete coating will be to provide on-bottom stability, the coating will also provide additional external protection against foreign objects.

Buckle arrestors

To minimise the consequence of pipe collapse during installation, buckle arrestors (pipe reinforcement) will be installed at specific intervals in susceptible areas. Risk of collapse is during installation only. Buckle arrestors are full-length pipe joints with over-thickness that are installed in deep water sections, with typically 1,000 m separation. The buckle arrestors are machined at each end down to the wall thickness of the adjacent pipes to allow welding offshore. The material requirements and properties for the buckle arrestors are generally the same as for the line pipe.

Anodes for cathodic protection

To ensure the integrity of the pipelines over their design operational life, in addition to the three-layer polyethylene external anticorrosion pipe coating, a secondary anticorrosion protection will be provided by sacrificial anodes of a galvanic material. This secondary protection will be an independent system that will protect the pipelines in case of damage to the external anticorrosion coating.

The performance and durability of different sacrificial anode alloys in Baltic Sea environmental conditions has been evaluated with dedicated tests for the construction of Nord Stream Line 1 and Line 2. The tests showed that the salinity of seawater has a major effect on the electrochemical behaviour of aluminium alloys. In light of the test results, zinc alloy is foreseen for sections of the pipeline route with very low average salinity. For all other sections, indium-activated aluminium will be used.

Valves

The selection of 48 inch in-line valves for isolation and emergency shutdown service, which are located onshore at both ends of the pipelines at LFFG and LFFR, was made with special attention during the Nord Stream Line 1 and Line 2 project in order to achieve high levels of safety, reliability and availability. The functional, technical and safety requirements to 48 inch in-line valves for the Project are hence the same as they were for Line 1 and Line 2. Other, smaller valves include upstream and downstream pipe work.

5.4 Logistics concept

On 25 April 2012 Nord Stream AG announced the successful completion of its complex international logistics programme for the construction of Line 1 and Line 2. The award-winning logistics concept (2010 Logistics Award of the German Logistics Association) enabled the most efficient and environmentally sound way of supplying the around 200,000 pieces of 24 tonnes concrete weight coated steel pipes to the pipe-laying vessels in the Baltic Sea.

A key feature of Nord Stream's impact-minimised logistics concept was the creation and use of a network of five strategically located logistics sites in Germany, Sweden and Finland. The deployment of these strategically located sites reduced the maximum distance between the marshalling yards and the pipeline route to 100 nautical miles. This would enable the pipe carrier vessels to make their trips to and from the lay vessels always within one day.

In order to achieve a safe and smooth supply chain the Project plans on using two concrete weight coating (CWC) plants and five marshalling yards.

5.5 Preparatory activities

Conventional munitions clearance

A geophysical munitions screening survey will be conducted along the pipeline route corridor to identify any mines, bombs and other munitions that could be resting on or in the seabed. Mines and munitions that are a threat to the pipeline will be removed before any construction activities.

Extensive munitions screening surveys were conducted during the Nord Stream Project and no conventional munitions were identified in Danish waters; hence no munitions clearance was carried out in Danish waters. However, experience from other countries showed no significant impacts from munitions clearance.

5.6 Construction activities

Construction methods and construction philosophy will generally be similar to those of the Nord Stream Line 1 and Line 2. Project pipeline scenarios were defined and have been analysed for typical offshore pipe-laying vessels. The different route options all have a water depth of less than 200 m and the Project's pipelines can be safely laid in these water depths.

Rock placement

A total of approximately 2,500 km of pipeline (1,250 km for each of the new twin pipelines) will be laid on the seabed during the construction phase. In order to prepare the seabed for pipe-laying, the entire route will be surveyed beforehand. Rock berms will then be strategically placed in order to support the line in areas of high seabed relief, to serve as basement structures at tie-in areas and to fix the pipelines for stability purposes after pipe-laying. Rock placement activities include works in which crushed rock is placed on the seabed by a fall-pipe (see Figure 5.3). It is aimed to minimise required rock volumes by reducing the amount of rock placed before pipe-laying in order to maximise rock placement efficiency after pipe-laying based on actual pipeline survey information.

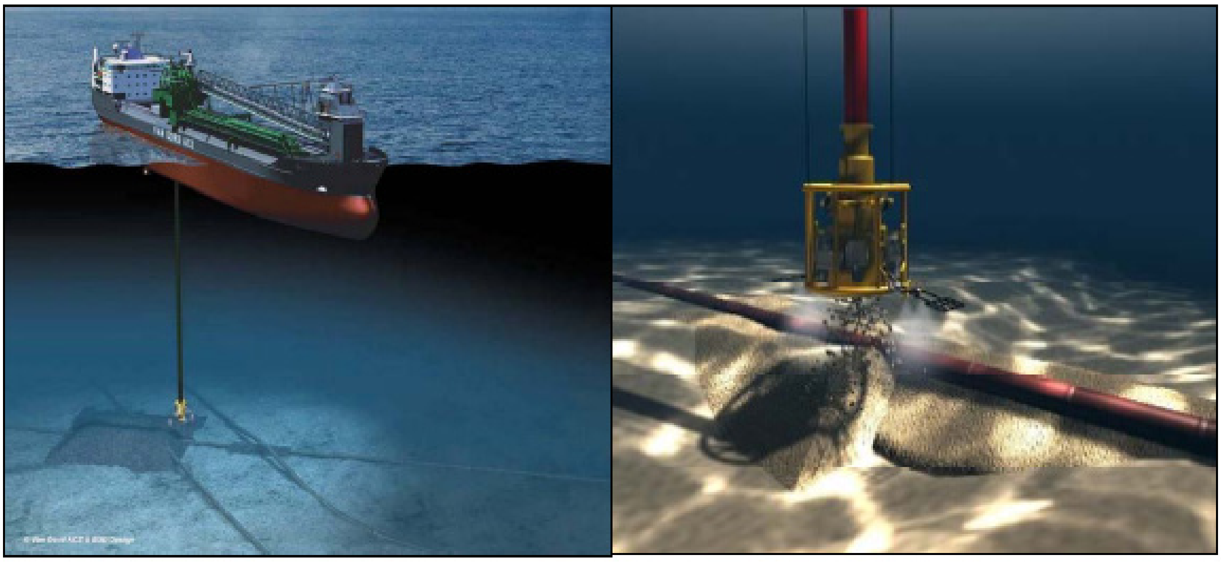

Figure 5.3 Rock placement on the seabed through a fall-pipe.

Pipe-lay

Pipeline installation will be carried out by lay vessels adopting the conventional S-laying technique. This method is named after the profile of the pipe as it moves across the bow or stern of the lay vessel and onto the sea floor, which forms an elongated ‘S’ (see Figure 5.4). The individual line pipes will be delivered to the lay vessel, where they will be assembled into a continuous pipeline and lowered to the seabed.

The process onboard the lay vessel comprises the following general steps, which take place in a continuous cycle: welding of pipe, non-destructive testing of welds, field joint protection against corrosion, laying on the sea floor.

Both pipelines will be constructed in specific sections for subsequent interconnection. Abandonment and recovery operations involve the leaving and subsequent retrieval of the pipeline somewhere along its route. Abandonment of the pipeline may also become necessary if weather conditions make positioning difficult or cause too much movement within the system.

The average lay rate is expected to be in the order of 2 km to 3 km per day, depending on weather conditions, water depth and pipe wall thickness. It is considered to install the new pipelines using two vessel types: a dynamically positioned lay vessel in areas with the highest concentration of munitions on the seabed and anchored lay vessels (shallow water and deep water vessels). Whereas the standard anchored lay vessel is positioned and moved forward by a number of anchors placed at safe positions on the seabed, the dynamically positioned lay vessel is kept in position by propellers and thrusters that constantly counteract forces acting on the vessel from the pipeline, waves, currents and wind.

Figure 5.4 The S-lay pipe-lay vessel and survey support vessels.

Trenching

In certain shallow water areas it may be required to carry out pre-lay trenching activities and/or post-lay trenching activities in order to embed sections of the pipelines into the seabed. Where pre-lay trenching is required it is planned to be carried out by dredging (underwater excavation). For dredging activities various types of dredgers (mechanical equipment) can be deployed to remove marine sediments, such as backhoe dredgers, trailing suction hopper dredgers, bucket ladder dredgers and grab dredgers. However, dredging is not likely to take place in Danish waters due to the water depth. Post-lay trenching allows the precise embedment of certain sections of the pipeline into the seabed after completion of pipe-laying. The pipelines are laid on the sea floor and subsequently trenched into the seabed to a required depth, using a plough pulled along by a tugboat and guided by the pipeline. The plough mechanically moves the material on the seabed, creating a V-shaped furrow, with the seabed sediment pushed up on either side of the trench.

Interconnecting the pipelines

Each of the Project's pipelines will be built in three sections with different wall thicknesses. Each section is designed for a different operation pressure, due to the pressure drop along the pipeline during natural gas transport, and will be laid and pressure-tested separately (see sections on pre-commissioning and commissioning, 5.7 and 5.8) before being interconnected. Apart from the possibility of deploying so-called “smart plugs”, the sections can be connected underwater, using so-called hyperbaric tie-ins (see Figure 5.5), to form the complete 1,250 km pipeline.

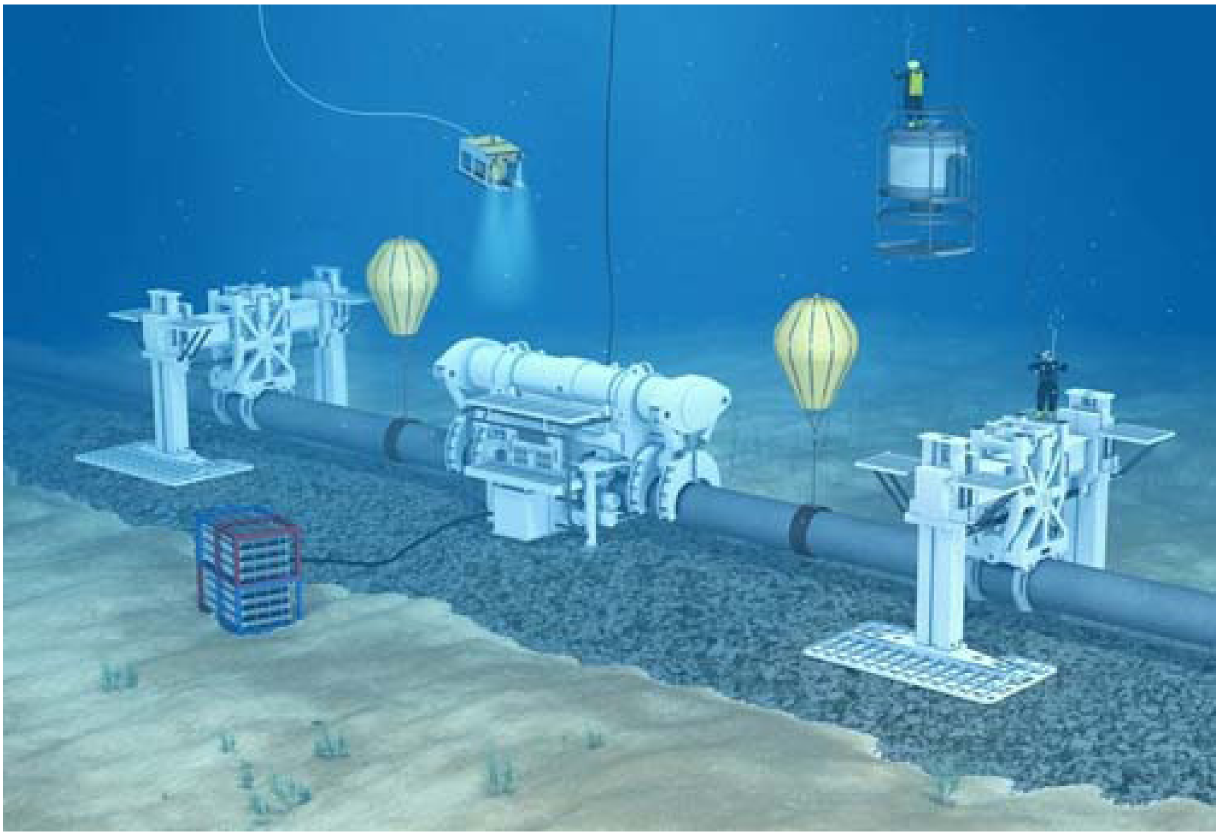

Figure 5.5 Hyperbaric tie-in set-up.

Hyperbaric tie-ins will be conducted at the two locations where the pipeline wall thicknesses change. At both locations rock berms will be installed on the seabed to provide stability for the tie-in operations. Once a section of the pipeline is finished, a lay-down head will be welded to the end of the pipeline before the pipe-laying vessel lays it down. This head provides an air- and water-tight seal. At the tie-in locations the ends of the two respective pipeline sections will overlap. Then, for hyperbaric welding they will be aligned using large H-frames and cut back. An underwater habitat, or “hyperbaric chamber”, will be placed over the pipeline ends and the pipelines will be welded together inside that habitat. The entire operation will be remotely controlled from a support vessel and assisted by divers. Once the tie-ins are finished, the habitat will be removed and a survey will confirm the correct position of the pipeline.

Crossings

The Project’s pipeline route corridor options will cross power and communication cables (existing and planned), the two existing Nord Stream pipelines and the future Baltic Pipe and Baltic Connector pipelines. It is envisaged to develop specific crossing designs for each crossing, typically consisting of concrete mattresses and/or rock, which will be agreed with the cable/pipeline owners.

5.7 Pre-commissioning

Pre-commissioning (pipeline testing) refers to the series of activities carried out before the introduction of natural gas into the pipelines. Pre-commissioning serves to confirm the mechanical integrity of the pipelines and ensures that they are ready for safe operational use with natural gas. Generally, the main pre-commissioning activities are flooding, cleaning and gauging, pressure testing, dewatering, and drying.

5.8 Commissioning

After pre-commissioning the pipelines will contain dry air. Nitrogen gas as an inert buffer will then be inserted into the pipelines immediately prior to natural gas-filling. This ensures that the inflowing natural gas will not be able to react with the atmospheric air and create unwanted mixtures inside the pipeline; the nitrogen gas acts as a buffer between the atmospheric air and the natural gas. Commissioning will then proceed by filling the pipelines with natural gas from the connected facilities.

5.9 Operation

The Project's pipelines will be designed for an operating life of at least 50 years, analogous to the existing Nord Stream Lines 1 and 2.

Operation of the new pipelines encompasses the integrated process of supervision and control of the natural gas transport infrastructure, and of inspection and maintenance of the assets and equipment. All gas transportation process activities involved to achieve reliable and safe operation will be managed and coordinated.

The Project's pipeline system will be remotely monitored and controlled from a Main Control Centre (MCC). The MCC will be equipped with video wall display and operator/engineering workstations and will be manned 24 hours per day, 365 days per year. Normal pipeline system operations will be performed via the operator consoles. Additionally, available consoles will be used to perform technical tasks such as training, gas transportation simulations, data analysis, report generation, software upgrades and database maintenance.

A Back-Up Control Centre (BUCC) will be installed in a different building than the MCC, to cope with the possibility of loss of the MCC, e.g. in case of a fire. The BUCC monitoring system and control systems are continuously updated in real time and in parallel with the MCC. This will guarantee that the BUCC can immediately take over the function of the MCC, if required.

The landfall facilities in Russia and Germany will have local emergency shutdown systems. The systems will be triggered in the case of facilities fire detection, facilities gas detection or pipeline leak detection.

5.10 Decommissioning

The service period of the Project's pipelines system is planned to end in a minimum of 50 years after start of operations. Once the pipelines are nearing the end of their design life or economic life, potential shutdown and associated activities will be agreed with the national authorities. Decommissioning will take place according to industry standards and national and international legislation at that point in time. The decommissioning programme will be developed in time, since future regulations and technical know-how gained over the lifetime of the pipelines must be taken into account.

6 EIA procedure and public participation

6.1 National and international legal framework

6.1.1 International conventions

The international UN Convention on the Law of the Sea (UNCLOS) entitles all states to lay submarine cables and pipelines on the continental shelf of other coastal states subject to the consent of such affected states. Hence, the Project is required to submit various national permit applications in order to obtain country-specific permits from the states through whose waters the Nord Stream Extension pipelines are planned to pass.

A comprehensive assessment of environmental impacts is a key element in the permitting process for the construction and operation of a major natural gas pipeline system. Countries in the EU are bound to follow the EU EIA Directive and the international Espoo Convention, if applicable. Detailed EIA procedures in the territorial waters and the EEZs of the Baltic Sea differ among the countries concerned; therefore the Project's EIAs must follow the country-specific standards, and the territorial boundaries of the countries have to be strictly met.

6.1.2 National EIA and permitting procedure

The national Danish EIA procedure and documentation needed are described in Statutory Order no. 632 of 11/06/2012 /1/. The requirements align to parts of the following directives: the EU EIA Directive 2011/92/EU, the EC Bird Protection Directive 2009/147/EC and the EC Habitat Directive 92/43/EEC.

The EIA obligation for natural gas pipelines is stated in Statutory Order no. 632 concerning 'EIA, appropriate assessment regarding international nature protected areas and protection of certain species in relation to offshore projects on exploitation and extraction of hydrocarbons, underground storage, pipelines, etc.'

The Statutory Order is valid for natural gas pipelines with a diameter exceeding 800 mm and a length greater than 40 km. Regulations regarding the EIA process and reporting are included in the Order.

The Danish Energy Agency (DEA, *Energistyrelsen*) under the Ministry of Climate, Energy and Building, acts as the permitting and EIA authority. Hence, the DEA assumes the role of coordinating authority and single point-of-contact for the Project Developer.

A construction permit and a subsequent permit to take the pipeline into operation are granted according to Consolidated Act no. 1101 of 18/11/2005 (the Continental Shelf Act), as changed by Act no. 548 of 06/06/2007 and Act no. 1400 of 27/12/2008, and Order no. 361 of 25/04/2006 about certain offshore pipelines, based on an application for permission to build, install and operate transit pipelines on the Danish continental shelf and in Danish territorial waters.

An indicative timeline for the EIA and permitting process in Denmark is presented in Table 6.1.

Table 6.1 Indicative timeline for the EIA and permitting process in Denmark.

Developer process	Estimated time schedule
Development of EIA Programme	January – March 2013
Submission of EIA Programme to DEA	April 2013
Consultation with stakeholders and preparation of EIA report and construction permit application	April 2013 – December 2014
Submission of EIA report and construction permit application	December 2014
Public hearing phase of EIA report and construction permit application	January 2015 – March 2015
Submission of final EIA report and construction permit application	June 2015
Submission of operation permit application	Prior to operation
Authority process (DEA)	**Estimated time schedule**
Submission of EIA programme to relevant authorities and announce the project on the DEA homepage	April 2013
Espoo notification of affected Parties (handled by the Danish Nature Agency)	April 2013
Information meeting (Bornholm) (developer presenting)	May 2013
Forward incoming questions and issues raised to the EIA programme to the Project developer	June 2013
Incoming EIA report and construction permit application	December 2014
Public hearing phase of EIA report and construction permit application	January 2015 – March 2015
Public hearing (Bornholm) (developer presenting)	February 2015
Forward relevant comments received from stakeholders to the Project developer	March 2015
Incoming final EIA report and construction permit application	June 2015
Permit decision	June – December 2015

Scoping phase

There is no distinct scoping procedure defined in the Danish Statutory Order no. 632 of 11/06/2012 for EIA of oil and gas projects, and a developer is only required to submit the application for a construction permit together with an EIA report and appropriate assessments. Nord Stream AG, however, would like to conduct a Danish scoping phase for the Nord Stream Extension Project, as intended with this document.

In April 2013 Nord Stream AG will submit this EIA programme together with the Project Information Document (PID), which can be used for the information of possibly affected countries. All relevant Danish authorities are consulted and have the possibility to give comments to the EIA programme. They may also comment to the PIDs which Denmark will receive from the other Parties of origin with regard to cross-border effects from project activities in other countries (see Section 6.1.3).

EIA phase

The EIA phase covers the period of the development of the EIA documentation, its submission and subsequent public hearing.

The contents of an EIA are stipulated in Statutory Order no. 632 of 11/06/2012, Annexes 2 and 3, and are aligned with the EU EIA Directive. Nord Stream will conduct the necessary baseline studies and ensure that all relevant information (as discussed in the scoping phase) is available as background for the impact assessment.

Nord Stream will submit an application for a construction permit together with the EIA report. The application will be announced on the DEA's homepage and a public hearing will take place.

Final authority evaluation and approval

Together with the relevant authorities the DEA reviews the construction application and EIA report. The DEA is the permit deciding authority.

Operation permit application

In good time prior to the planned start of operation Nord Stream will submit a permit application to take the pipeline into operation on the Danish continental shelf and in Danish territorial waters. The DEA is the permit deciding authority.

6.1.3 Transboundary EIA procedure (Espoo)

The UNECE Convention on Environmental Impact Assessment in a Transboundary Context was adopted in Espoo in Finland on 25 February 1991 and entered into force on 10 September 1997. It is commonly called the Espoo Convention. In 2001, the Parties adopted an amendment to the Convention allowing non-UNECE member States to become Parties as well.

The Espoo Convention promotes international cooperation and participation of the public when the environmental impact of a planned activity is expected to cross a border. It sets out the rights and duties of countries in assessing the likely environmental impact of a proposed activity. It applies to activities that are likely to cause a significant adverse cross-border (transboundary) environmental impact, and it is aimed at preventing, mitigating and monitoring such potential impact. The Espoo Convention defines the country in which the proposed activity takes place as the "Party of origin" and each of the countries likely to be impacted as an "affected Party".

The Espoo Convention has been incorporated into the EU EIA Directive 85/337/EEC (later Directive 2011/92/EU), which has been implemented into the national legislation of the EU Member States.

The Espoo procedure for the Project is proposed to run almost in parallel to all the national EIA procedures. A preliminary cross-check of country-specific EIA procedure timelines supplied evidence that a parallel Espoo procedure with synchronised public participation phases might be feasible.

Nord Stream proposes to prepare the documentation for the consultations under the Espoo Convention in English and to arrange for translation into the nine local languages of the Baltic Sea countries. The contents of the Espoo documentation and the entire timeline of the Espoo procedure will be agreed in detail with the national permitting authorities and the national Espoo focal points.

In accordance with the Espoo Convention, the proposed content of the documentation for the consultations under the Espoo Convention shall comprise:

- Description of the entire project and its purpose
- Non-technical summary and thematic maps
- Description of alternatives and the 0-alternative
- Description of key environmental and social issues covering the entire project area, such as sediment dispersion, munitions, fish and fishery, maritime safety, cultural heritage and Natura 2000 areas
- Description of the cross-border environment likely to be significantly affected
- Description of the assessment of potential transboundary environmental impacts
- Description of mitigation measures to minimise possible transboundary and cumulative impacts
- Outline of transboundary monitoring and environmental management programme.

Transparency with a focus on dialogue in the country-specific language is key to Nord Stream's communication policy. During the public participation phases of the national permitting processes and the Espoo consultations, the Project Permitting Team will participate in a series of public hearings in each Baltic Sea country which will be organised by the permitting authorities. Project information for the public will be supported by materials in the nine languages of the Baltic Sea bordering countries.

An indicative timeline for the Espoo Consultation procedures, which will finally depend on the development of the Project and on authorities' decisions, is as follows:

- Joint notification of all affected Parties..April 2013
- First public participation phase..April 2013 – May 2013
- Submission of Espoo documentation..December 2014
- Second public participation phase...................................January 2015 – March 2015

6.2 Public participation

Nord Stream AG is dedicated to transparent communication of the Project and active consultation with relevant stakeholders: regulatory bodies, non-governmental organisations, experts, affected communities, and other interested and affected parties. The aim of active stakeholder engagement is to disseminate information about the Project and to give stakeholders an opportunity to express their views on the Project. Stakeholder concerns and comments can then be taken into account in developing the Project and in assessing and mitigating potential impacts. Consultation is also invaluable in identifying useful information regarding baseline conditions and concerning vulnerable resources and receptors in the study area.

Nord Stream AG has already engaged with various stakeholder groups to inform them about the envisaged Project and to understand their views towards the Project.

For the realisation of its existing pipelines Nord Stream AG has been following an extensive and transparent communications strategy using various communications channels to disseminate information about the Project. It is Nord Stream AG's aim to continue with its proven and active stakeholder engagement approach through regular, genuine dialogue with relevant regulatory bodies, designated experts, affected communities and other stakeholders of the Project.

Nord Stream AG plans to set up a Stakeholder Engagement Plan to assist the Project in establishing its long-term consultation and engagement processes. This is in line with international best practice for major infrastructure projects. The Project's stakeholder engagement programme is aimed at including the following:

- Distribution of public information via media, print media (leaflets, brochures) and the Project's website as well as upon individual request
- Arranging for public information tours in Baltic Sea bordering countries to inform locally and in person about the Project
- Providing electronic copies of various Project-related documents on the Project's website.

The DEA is the single point of contact and coordinating authority for the Nord Stream Extension Project in Denmark. The DEA will consult other competent authorities and seek their guidance in the review and assessment of the EIA report. Table 6.2 gives an overview of the authority stakeholders in Denmark.

Table 6.2 Authority stakeholders in Denmark.

Authority	Area of responsibility
Danish Energy Agency (DEA) - Energistyrelsen	Permitting and EIA authority
Danish Nature Agency (DNA) - Naturstyrelsen	Nature protection, including Natura 2000 areas
Danish Environmental Protection Agency (DEPA) - Miljøstyrelsen	Environmental protection
Danish Maritime Authority (DMA) - Søfartsstyrelsen	Ship traffic and maritime safety
Admiral Danish Fleet (ADF) - Søværnets Operative Kommando	Military security and safety at sea, including handling of conventional and chemical munitions
Danish Emergency Management Agency (DEMA) - Beredskabsstyrelsen	Danish National Fire and Rescue Service, including unit responsible for cleaning of vessels that have been in contact with chemical warfare agents
Danish Geodata Agency - Geodatastyrelsen	Responsible for spatial data infrastructure, surveying, mapping and cadastral and chartered surveyor administration. Authority for issuing of survey permits and sea map corrections/updates
Heritage Agency of Denmark - Kulturstyrelsen The Viking Ship Museum (VSM) - Vikingeskibsmuseet	Matters concerning cultural heritage. The Viking Ship Museum works under the Heritage Agency and is the museum responsible for heritage issues in the Danish part of the Baltic Sea
Ministry of Food, Agriculture and Fisheries - Ministeriet for Fødevarer, Landbrug og Fiskeri	Commercial fishery matters
Bornholm Municipality - Bornholms Regionskommune	Matters involving Bornholm

The number of non-governmental stakeholders is limited - the following stakeholders will be considered in the stakeholder engagement planning:

- People of Bornholm (targeted information on the project in preparation for concrete project activities of relevance to Bornholm)
- The Danish Society for Nature Conservation
- World Wide Fund for Nature (WWF), Denmark
- Greenpeace Denmark
- NOAH, Friends of the Earth Denmark
- Baltic Development Forum
- Danish Fishermen's Association.

7 Preliminary baseline conditions

A preliminary description of existing conditions in the project area in Denmark is presented in the following sections. The purpose of describing the present state of the environment (baseline conditions) is to identify the resources and receptors that are particularly sensitive to disturbance and/or may be subject to economic or protective value. It also serves as a baseline for determining the environmental impacts from preparation, construction, pre-commissioning and operation of the Nord Stream Extension Project.

7.1 Physico-chemical environment

7.1.1 Bathymetry

The Baltic Sea is a rather shallow inland sea divided by several sub-basins or deeps, which are separated by shallow areas. Figure 7.1 show the regions and sub-basins in the southern Baltic Sea.

The mean depth of the Baltic Sea is approximately 56 m, and the total volume is approximately 20,900 km^3. The deepest parts, up to 459 m, are found in the Landsort Deep in Swedish waters.

The deep basins in Danish waters include the Arkona Basin and the Bornholm Basin. The maximum depth is 55 m in the Arkona Basin and 106 m in the Bornholm Basin. The Bornholm Strait separating the Arkona Basin from the Bornholm Basin has maximum depths of 45 m. The inflow to the Arkona Basin is controlled by the sills at Darss and Drogden. The outflow out of Bornholm Basin is controlled by the Stolpe Channel separating the Bornholm Basin and the Gotland Deep and reaches depths of approximately 60 m.

Bathymetry data for the Baltic Sea has been extracted from the MIKE C-map database and is shown in Figure 7.2.

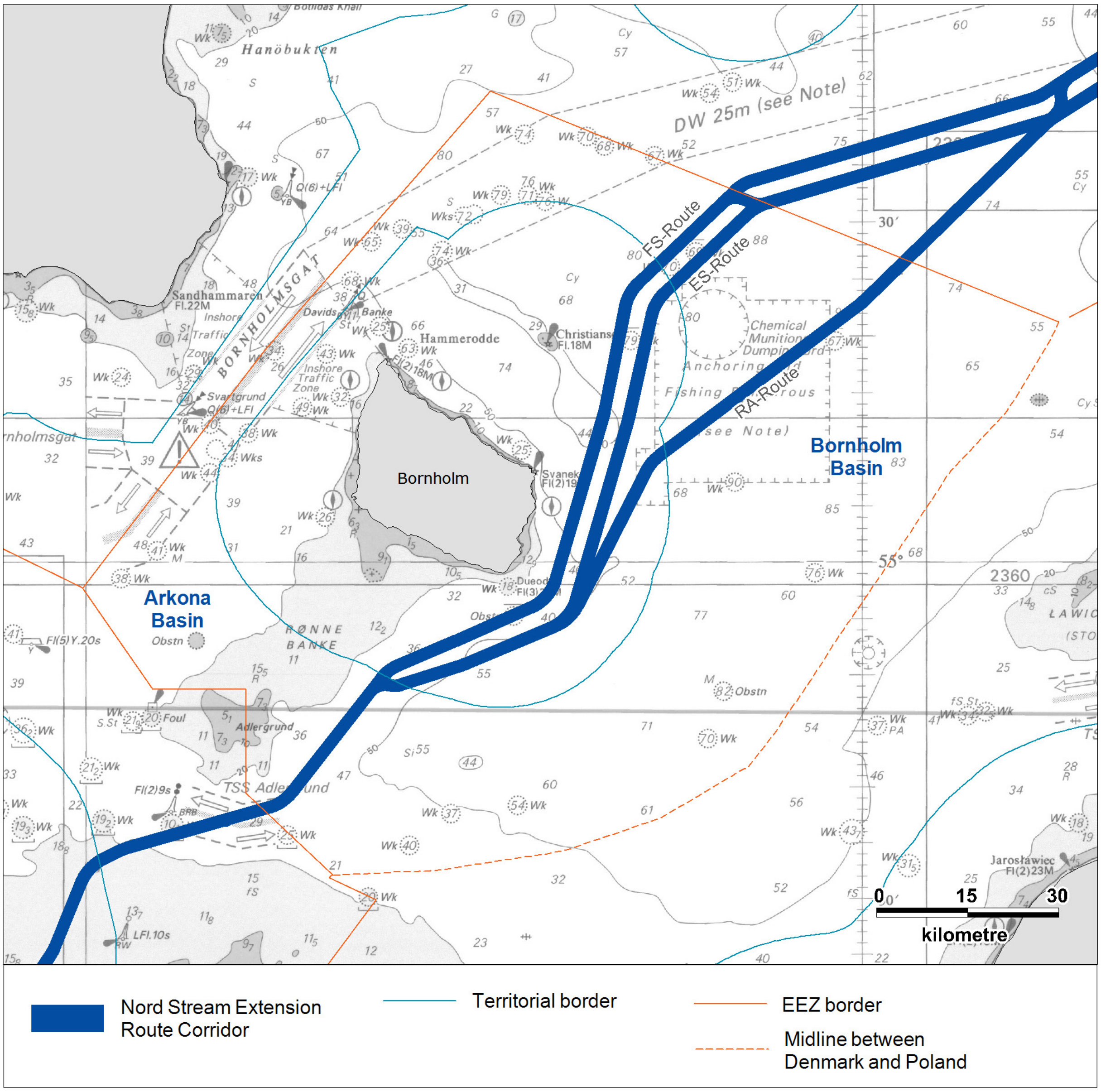

Figure 7.1 Sub-basins and deeps in Danish waters.

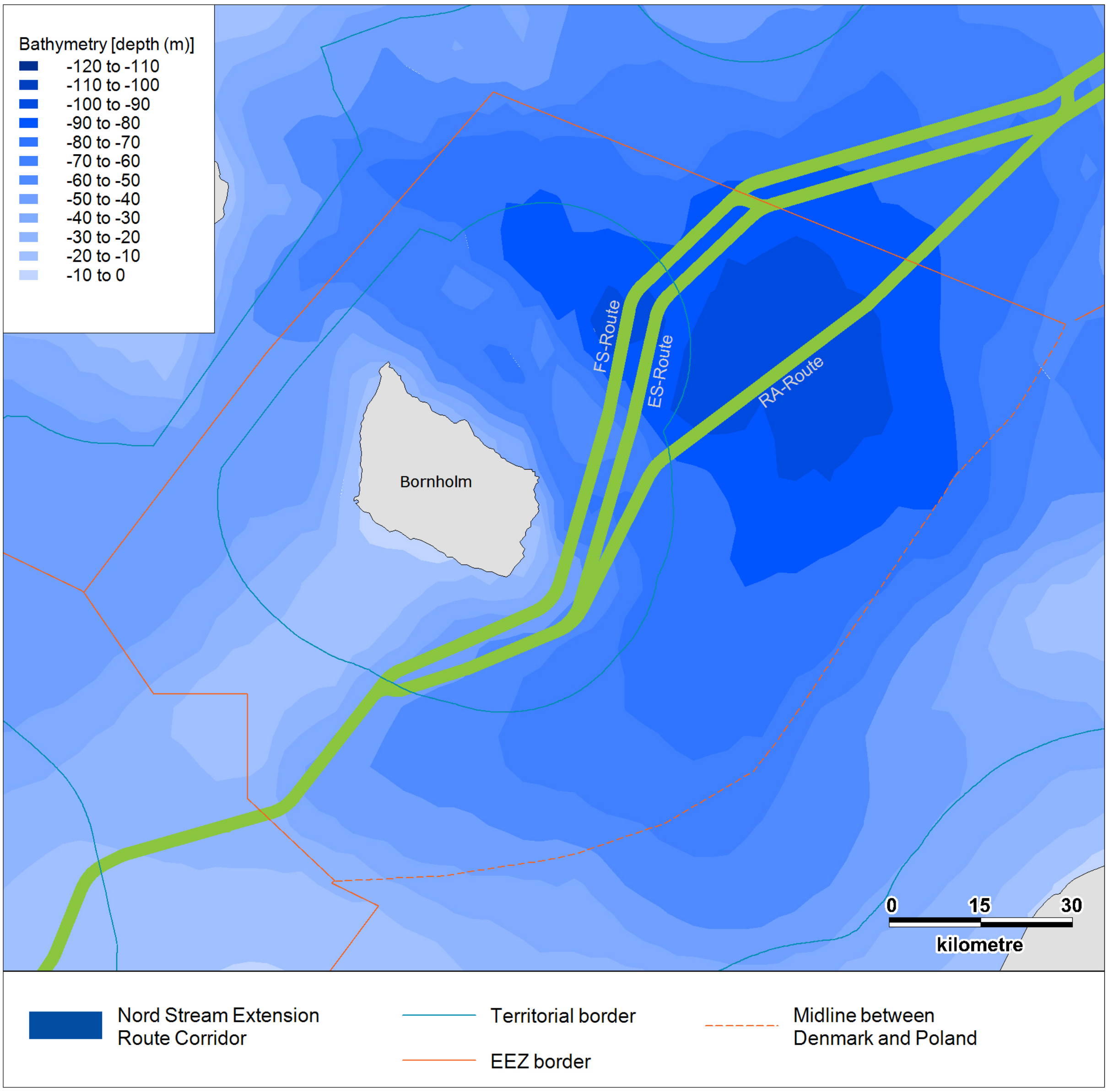

Figure 7.2 Bathymetry in Danish waters.

7.1.2 Hydrography and water quality

With a heavy load of freshwater from rivers and a relatively low inflow of salt water from the North Sea, the Baltic Sea is heavily stratified. Due to inflows of saline water from the Kattegat to the Baltic Sea, there is a clear salinity gradient from almost oceanic conditions in the northern Kattegat to almost freshwater conditions in the innermost Gulf of Finland. Major inflows of saline water through the Danish straits are rare and take place during strong storms in the late autumn or winter months.

The salinity of the surface water decreases from 30-35 psu in the North Sea to almost 0 psu in the innermost Gulf of Finland. Salinity levels increase with depth. Salt water flowing in through the Sound and the Belt Sea will flow into the Baltic Sea at its appropriate density level. It does not easily mix and tends to flow at the bottom into the Baltic Sea. During the monitoring in connection with the Nord Stream Project, it was revealed for the first time that there are strong interleaved currents of saline water in the halocline in the Bornholm Basin (35-55 m above the seabed) that might be due to inflow of new saline water. At the same time, the less saline surface water flows out of the Baltic. The boundary between these two water masses, known as the halocline, is a layer of water where salinity levels change rapidly. Like a lid, the halocline limits the vertical mixing of water.

The formation of a strong halocline in the Baltic Sea makes it almost impossible for the surface and bottom waters to mix, which makes it nearly impossible for particles and dissolved substances in the deep-water layers to leave the system via the surface layers. If substances like nutrients and pollutants are dissolved, they are likely to re-circulate to the bottom sediments.

During spring and summer, solar warming from above produces a warm layer approximately 10-25 m thick, which is mixed by the wind and identical in temperature throughout its depth. Beneath this mixed surface layer, a thermocline develops. The thermocline can be very sharp, and temperatures can drop 10°C within a few metres. Because of the effect of temperature on density, this thermocline is very stable and effectively suppresses vertical exchange between the surface layer and the deeper layer.

A seasonal thermocline is common for the Baltic Proper, with an upper boundary at 10-30 m depending on location and season. The permanent halocline is normally at 55-65 m depth. Baltic Sea water is almost always stratified due to temperature and/or salinity.

Stratification prevents vertical mixing of water and thereby the transport of oxygen from the surface to the bottom. The basins of the Baltic Sea are frequently out of oxygen, and oxygenation is only possible through major saline inflows from the North Sea. Oxygen-depleted conditions lead to anaerobic processes. When bacteria degrade organic matter in anoxic conditions, hydrogen sulphide is formed.

The content of heavy metals and organic pollutants in water is in general low, as they normally attach to particles and organic matter in the bottom sediments. In the past, pollutants were measured in seawater, but in low concentrations. Today, pollutants are primarily measured in bottom sediments or in biological material (animals and plants).

The Baltic Sea is a eutrophic environment, with enhanced levels of the nutrients nitrogen and phosphorus. Eutrophication is a condition in an aquatic ecosystem where high nutrient concentrations stimulate algae growth, which leads to imbalanced functioning of the system. The increased amount of organic matter that sinks to the sea bottom causes an increase in oxygen consumption and subsequently oxygen deficits, which leads to the death of benthic organisms. The extent of bottom waters with hypoxic (< 2 mg O_2/l) and anoxic (< 0 mg O_2/l) conditions is shown in Figure 7.3. The nutrient concentrations in the Baltic Sea are strongly related to location, depth and season.

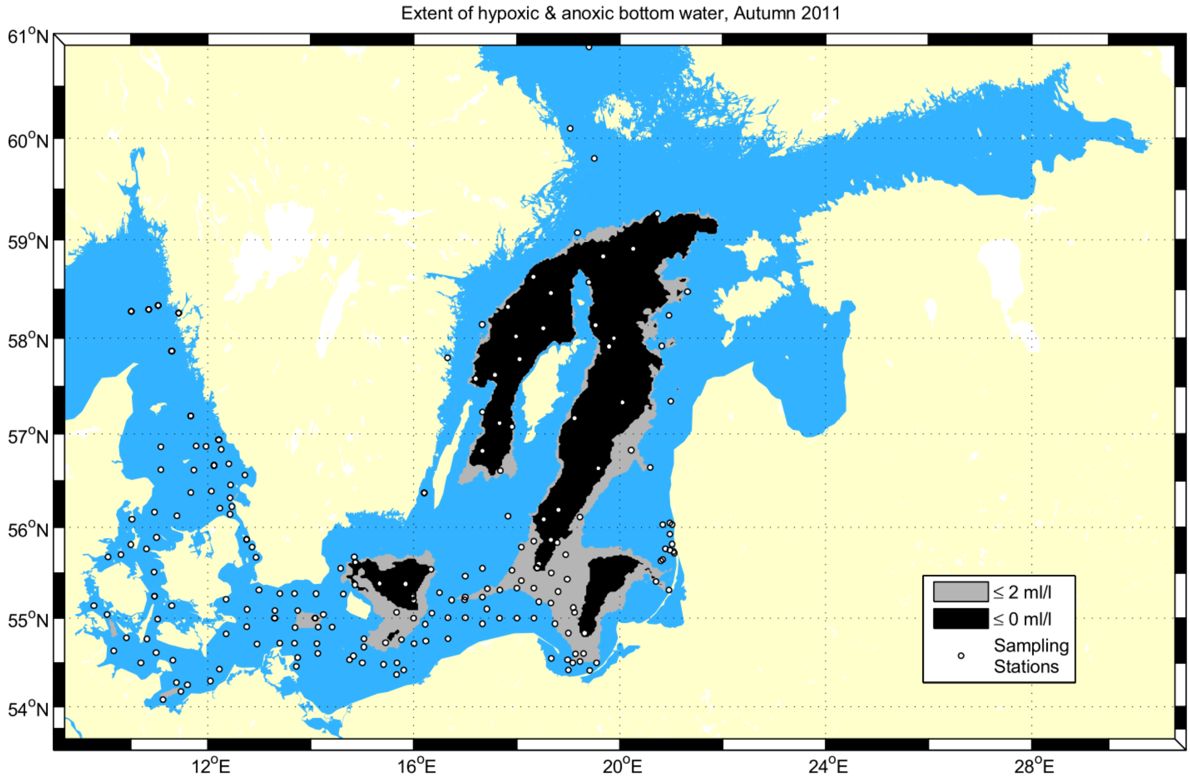

Figure 7.3 Bottom waters with hypoxic (< 2 mg O_2/l) and anoxic (< 0 mg O_2/l) conditions in Baltic Proper, autumn 2011, SMHI, 2011 /2/.

7.1.3 Meteorology

Meteorological processes have a strong influence on the environmental conditions of the Baltic Sea. These processes influence the water temperature and ice conditions, the regional river runoff and the atmospheric deposition of pollutants on the sea surface. Moreover, they also govern water exchange with the North Sea and the transport and mixing of water within the Baltic Sea.

The Baltic Sea is located within the west-wind zone, where low-pressure weather systems coming from the west or south-west dominate the weather scene. Winds of storm force, i.e. at least 25 m/s, occur mainly from September to March.

In the deeper part of the Baltic Sea, ice appears normally as drift ice that moves along with the currents and winds. Drift ice and deformed ice can easily get packed against each other or other obstacles, which can result in pack ice or in vast ice ridges.

During normal and mild winters, the waters around Bornholm are ice-free. During severe winter conditions most of the Baltic Sea is covered by ice, and during very severe winters the ice can potentially cover the waters around Bornholm. Experience from construction works during ice conditions was gained during the harsh winters of 2010 and 2011. The ice extent during winter 2010/2011 in the Baltic Sea was the largest since the record winter of 1987. On 25 February, the season's maximum ice cover occurred, with more than 300,000 km^2 of the sea surface covered by ice (see Figure 7.4) /3/.

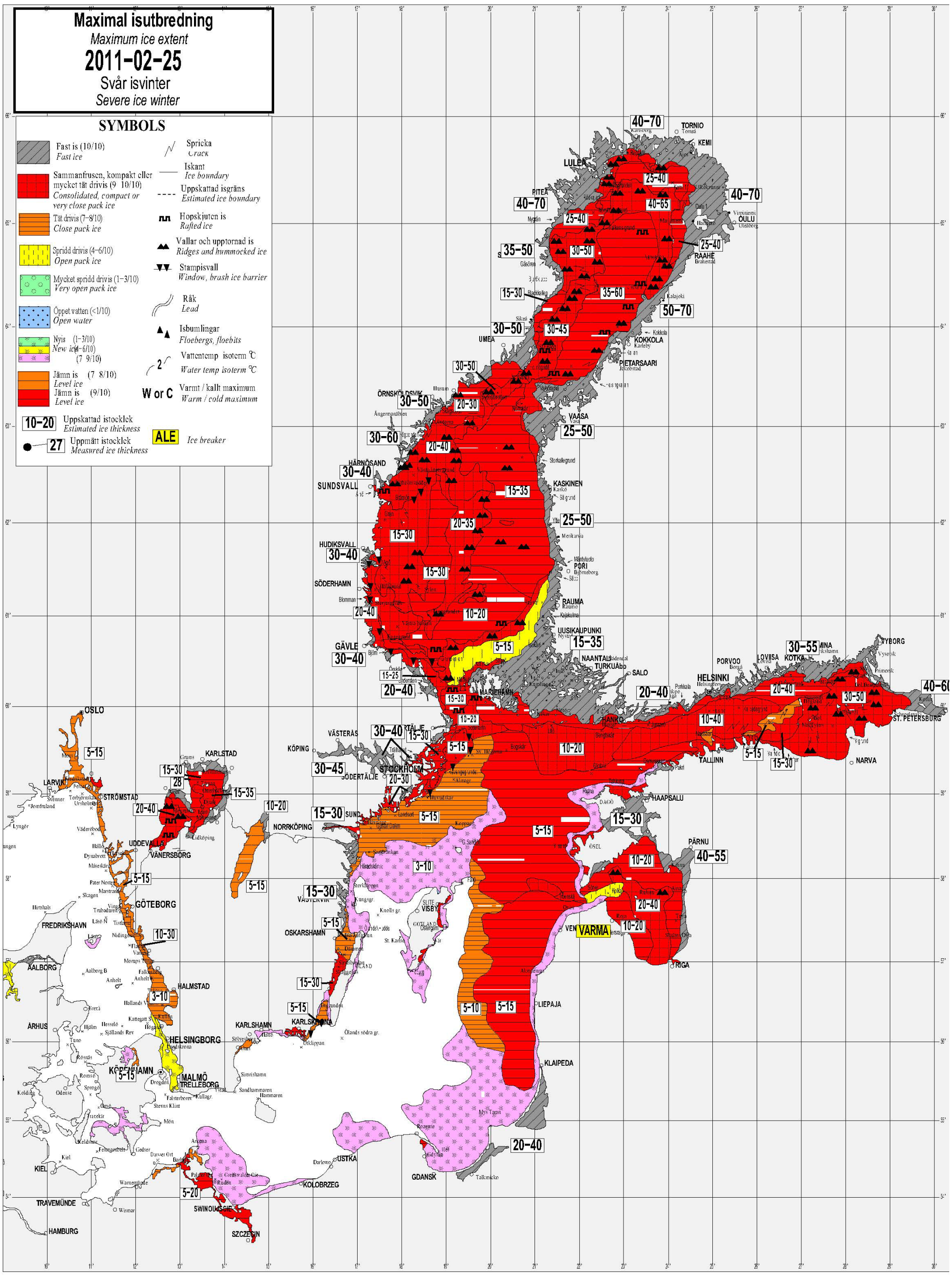

Figure 7.4 Ice conditions in the Baltic Sea, 25 February 2011, SMHI.

The ice problems mainly affected the Nord Stream Project at the landfalls and in the Gulf of Finland. The waters around Bornholm were not affected by ice, but pipes at the stockyards in Sweden had to be de-iced before being shipped to the lay barge in Danish waters.

7.1.4 Surface sediments and contaminants

Glacial deposits are found in the entire Baltic Sea area and are dominated by glacial till. The tills consist of poorly sorted mixtures of grain sizes ranging from clay to boulders. When tills crop out on the sea floor or are covered by only a thin veneer of marine sediments, boulders and stones are often spread over the sea floor. In addition to the tills, sorted glacial deposits are also found, comprising mainly sand/rock deposits. Exposed till or till covered by very thin sand layers is found in the highly dynamic near-shore areas with strong sediment movement and erosion of the seabed.

The recent marine sediments typically consist of clay and mud with a high organic content. They retain a loose texture and are transported into deeper or sheltered areas. The distribution of sediments is governed by a number of factors, such as water depth, wave size, current pattern, position of halocline and supply and type of material.

Two general zones can be outlined:

- Zones of deposition
- Zones of erosion.

Deposition zones cover areas such as deep basins or sheltered areas, whereas zones of erosion are found in areas exposed to wave- or current-induced water motion. Along the route corridor options in Danish waters, the seabed mainly consists of soft clay with organic content (mud), sandy mud, sand and coarser sediments.

Contaminants with the potential to cause ecotoxicological effects on the ecosystem and/or bioaccumulate (accumulate in organisms) have been deposited on the seabed over centuries. Most of the contaminants have an anthropogenic origin and enter the marine environment via rivers, surface run-off, direct waste water discharges as well as atmospheric precipitation.

In general, high concentrations of metals and organic contaminants in sediment are found in deposition zones such as the Bornholm Basin and the Arkona Basin. Low concentrations of heavy metals and organic contaminants are found in erosion areas, such as Rønne Banke.

In Danish waters the most heavily contaminated deposition zone in the Bornholm Basin accumulation area north and east of Bornholm. The area is characterised by fine sediments and a high concentration of organic matter, and high concentrations of almost all organic and inorganic contaminants are found in this area. The area south of Bornholm is slightly less contaminated.

The data of eutrophication parameters (nitrogen and phosphorus) indicates a more or less uniform distribution pattern in the Baltic Sea.

7.1.5 Dumped chemical munitions

Chemical munitions were not used during World War II, but both the Allied and German forces stockpiled large quantities of chemical munitions. After the war, Germany was ordered to destroy approximately 65,000 tonnes of stockpiled chemical munitions. Russian forces undertook the bulk of this task during the summer of 1947. Due to scheduling and financial restrictions, the Bornholm Basin and the Gotland Deep were chosen as dumping sites, as they are the deepest locations in proximity to the German harbours (Peenemünde and Wolgast) from which the munitions were shipped. HELCOM has concluded that approximately 40,000 tonnes of chemical munitions, containing approximately 13,000 tonnes of chemical warfare agents (CWA), were dumped in the Baltic Sea. It is estimated that 11,000 tonnes of CWA were dumped northeast of Bornholm.

In the Bornholm Basin mostly mustard gas bombs have been dumped. Significant amounts of monochlorobenzene and phenyldichloroarsine (organoarsenic blister gas) have also been dumped, along with minor amounts of a number of other chemical warfare agents, such sternutator gas (Clark I and II, Adamsite) and tear gas /4/.

Chemical munitions are also believed to have been thrown overboard during transit to the dumping sites. Therefore, an area where fishing with bottom trawling equipment anchoring and seabed intervention works is discouraged has been defined around the actual dumping site due to the risk of encountering dumped chemical munitions. Fishermen trawling inside these areas are not compensated if their catch is ruined by chemical munitions. A larger area has been defined in which fishing vessels are required to have cleaning and first aid equipment on board in case of exposure to chemical munitions (the so-called HELCOM area). The various areas are shown in Figure 7.5.

7.1.6 Conventional munitions and mine areas

The Baltic Sea was heavily mined during World War II, and even though known mine areas were swept after the war, thousands of mines still rest on the seabed today. The largest quantity of mines is located in the Gulf of Finland, and in the northern and central parts of the Baltic Sea. Though mainly used for the dumping of chemical munitions, the site northeast of Bornholm might also hold other types of ordnance, such as conventional munitions and grenades. This dumping site is presented in Figure 7.5.

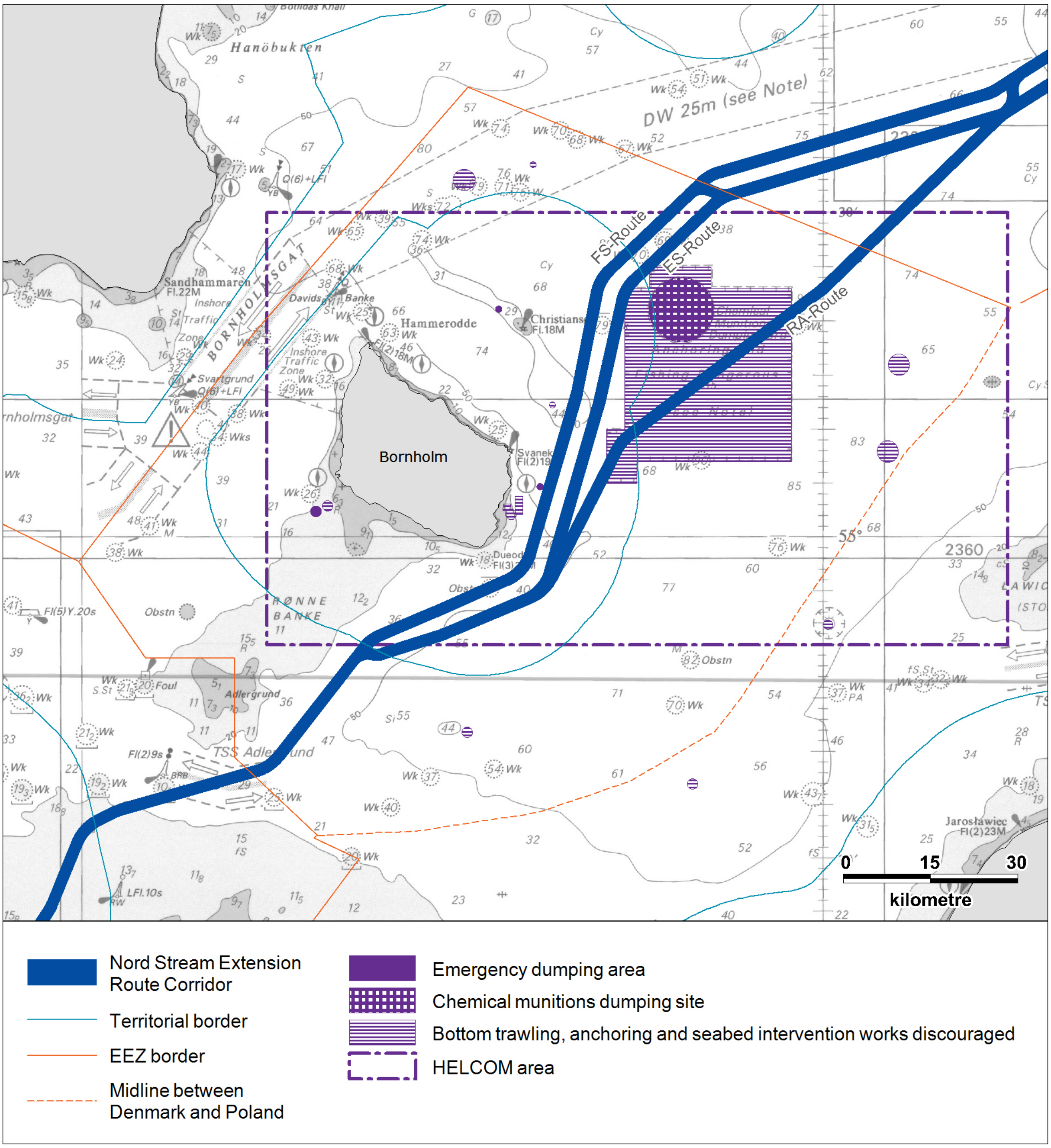

Figure 7.5 Chemical munitions dumping sites and risk areas in Danish waters.

7.1.7 Climate and air

The route corridor options in Danish waters are some distance away from land-based air pollution sources, and the air quality is in general good, with low concentrations of, e.g. NO_X,

SO_2 and particles. There are mobile air pollution sources on the sea in the form of exhaust gases from vessels, and ship traffic contributes to the background air pollution levels.

Air pollutants from ships are regulated by the MARPOL Convention of the International Maritime Organization (IMO). The Baltic Sea is an Emission Control Area where special rules are adopted regarding, e.g. fuel quality and air emissions. Special fuel quality provisions exist to reduce SO_X, with the sulphur content in fuels being limited to 1.0% in 2010 and 0.1% in 2015. The IMO Tier III emission standard is valid in the Baltic Sea and limits the NO_X emission for diesel engines.

7.1.8 Noise

In Danish waters, the distance to the closest residence, holiday settlement or protected area is approximately 8-10 km (Snogebæk at Bornholm), depending on the route corridor option.

Noise sources along the route corridor options consist mainly of sound from vessels.

7.2 Biological environment

7.2.1 Pelagic environment (plankton and larvae)

The biological pelagic environment in this context consists of phytoplankton and zooplankton. Phytoplankton is an important element in the aquatic environment because of its fundamental role in the production in higher trophic levels, such as zooplankton, fish, etc. Phytoplankton serves as an indicator of both environmentally driven changes as well as undesirable manmade disturbances.

In the southern Baltic Proper the spring bloom starts in March. In July and August blooms of cyanobacteria take place. Cyanobacteria can form massive visible sea surface accumulations of several weeks' duration throughout the Baltic Sea.

7.2.2 Benthic environment (benthic flora and fauna)

Macroalgae need light for photosynthesis. The maximum depth in the Baltic Sea where benthic flora can be found is about 35 m; below this depth, macroalgae are completely absent in the Baltic Sea. The areas closest to the Nord Stream Extension route corridor options in Danish waters where macroalgae can be found are on the shallowest parts of Rønne Banke southwest of Bornholm.

Benthic fauna in the open Baltic Sea sedimentary habitats follow the physical settings, such as salinity, topography, temperature and food supply, and are influenced by periods of oxygen deficiency. Benthic fauna are normally absent below the permanent halocline due to anoxic conditions in the bottom water. As the halocline starts at approximately 60 m depth, there will be few or no benthic fauna on the seabed in deeper areas.

The benthic fauna are characterised by very few species accounting for the majority of the abundance and biomass. The most common species are in general the bivalve *Macoma balthica* and *Mytilus edulis* and the crustaceans *Monoporeia affinis* and *Saduria entomon*.

In May 2008, samples of macrozoobenthos were collected at 28 stations along the Nord Stream route in Danish waters. The depth at the sampling stations was between 30 m and 91 m. Benthic fauna was observed at 22 stations and absent at six stations north and east of Christiansø, with water depths between 74 m and 91 m. About 21 species were identified. The most diverse groups were polychaetes (eight species), crustaceans (six species) and bivalves (four species).

Abundance at stations in Danish waters was highly variable, ranging from 0 individuals/m^2 to more than 3,000 individuals/m^2. The abundance was mostly more than 500 individuals/m^2 above the halocline and very low or non-existing in deeper water.

Eight species accounted for 90% of the abundance and even more of the biomass of the benthic fauna. The most common and abundant species were the bivalves *Macoma balthica* and *Mytilus edulis*, the polychaetes *Terebellides stroemi*, *Pygospio elegans*, *Scoloplos armiger* and *Bylgides sarsi*, the crustacean *Pontoporeia femorata* and the pri-apulid *Halicryptus spinulosus /5/*.

Due to stagnation periods in combination with eutrophication-induced hypoxia/anoxia, benthic 'ecological deserts' annually cover large parts of the sea floor. Analyses of oxygen data, covering the period 1960-2011 shows a distinct regime shift in 1999. During the first regime, 1960 to 1999, hypoxia affected large areas and volumes while anoxic conditions affected only minor deep areas. After the regime shift in 1999 both the areal extent and volume of hypoxia and anoxia are elevated to levels never recorded before. The bottom areas of the Baltic Proper (including the Gulf of Finland and the Gulf of Riga) affected by anoxic conditions have increased from 5%, before the regime shift, to 15% after /2/. The oxygen levels in the Baltic Proper offshore areas remain at the lowest level since record-keeping began in the 1960s. Ten percent of the water volume in the Baltic Sea is now completely oxygen-free /6/. The bottom areas concerned are below the halocline and at depths greater than 60-70 m.

7.2.3 Fish

The marine species cod, herring and sprat comprise the large majority of the fish community in both biomass and number in the Baltic Sea. The monitoring of fish in 2010 and 2011 in connection with the Nord Stream Project shows that in addition to cod (*Gadus morhua)*, herring (*Clupea harengus*) and flounder (*Platichthys flesus*), the species of plaice (*Pleuronectes platessa*), sprat (*Sprattus sprattus*), turbot (*Psetta maxima*), three- and four-bearded rockling (*Gaidropsarus vulgaris* and *Enchelyopus cimbrius*) and whiting (*Merlangius merlangus*) are present in the project area. The area northeast of Bornholm is completely dominated by cod, while the shallower area south of Bornholm has more variation in species.

Cod is the main predator on herring and sprat, and as herring and sprat prey on cod eggs there are trophic interactions between cod, herring and sprat that periodically may exert a strong influence on the state of fish stocks in the Baltic. Climate-driven changes in the salinity, temperature and oxygen content of the water affect the recruitment and growth of cod, herring and sprat. Hydrographic-climatic variability (i.e. low frequency of inflows from the North Sea, warm temperatures) and heavy fishing over the last 10 to 15 years have thus led to a shift in the fish community from cod to clupeids (herring, sprat) /7/. Salmon (*Salmo salar*), sea trout (*Salmo trutta*) and eel (*Anguilla anguilla*) could also be present in the area of the route corridor options.

Herring spawn in coastal waters, and sprat spawn throughout the Baltic Sea. Cod primarily spawn in the Bornholm Basin and in Stolpe Channel (a small area between Bornholm Basin and Gdansk Basin). Historical spawning areas of cod are shown in Figure 7.6.

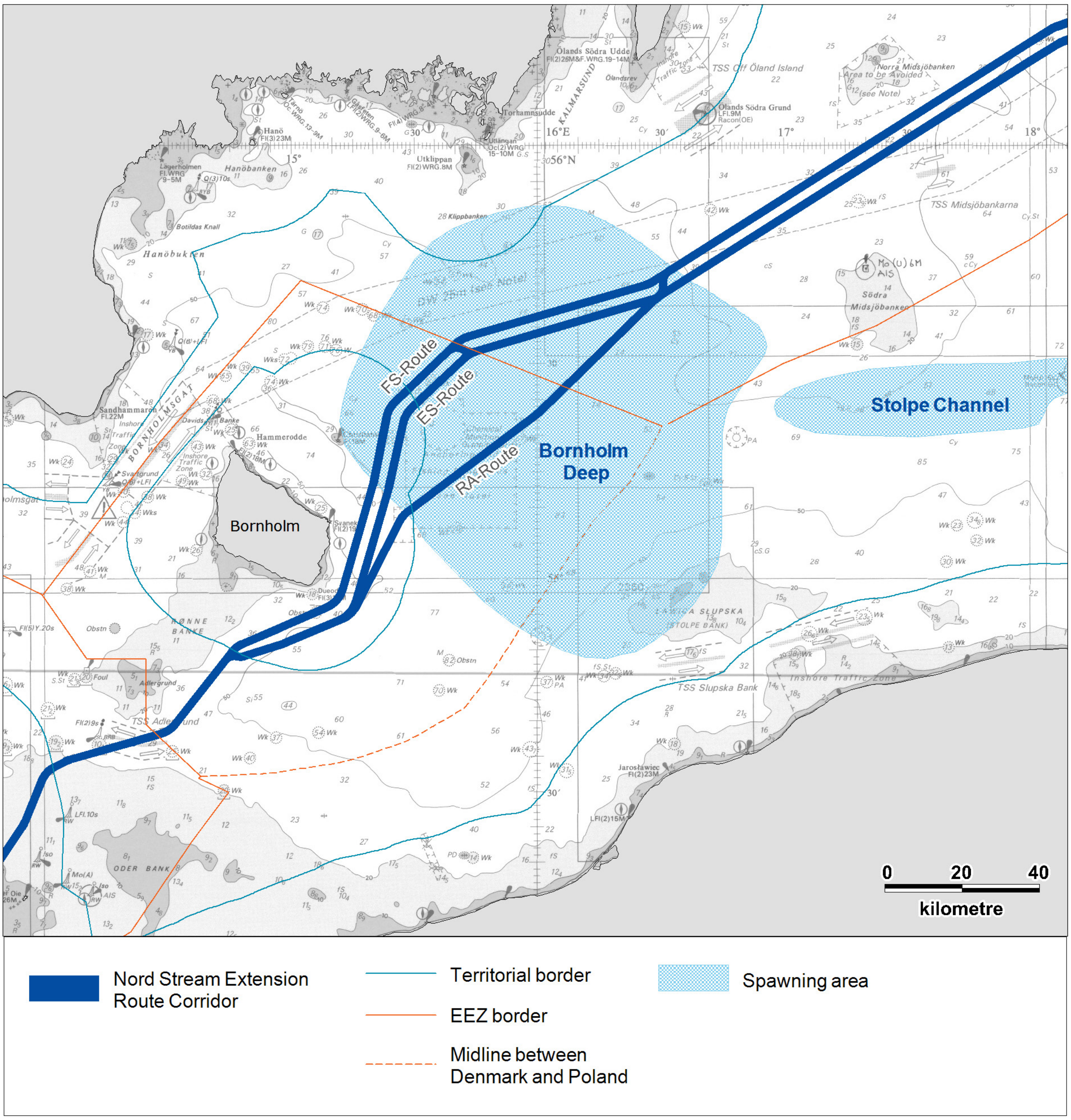

Figure 7.6 Historical spawning areas for cod in Danish waters /8/.

7.2.4 Marine mammals

The only resident cetacean species in the Baltic Sea is the harbour porpoise (*Phocoena phocoena*). There are three resident species of seals: the grey seal (*Halichoerus grypus*), the harbour seal (*Phoca vitulina*) and the ringed seal (*Phoca hispida baltica*). Haul-out sites for seals in the area are shown in Figure 7.7.

The distribution of harbour porpoise in the Baltic declines rapidly east of the Gedser/Darss underwater ridge. Harbour porpoise are resident in the southern Baltic Sea, particularly along the German coast, but they have also been recorded regularly along the Polish coast. In addition, they are regularly recorded in the Kadet Channel, which is likely to be of key importance in the movement of porpoise between the Baltic Sea and Kattegat/Skagerrak. As the population in the Baltic Sea only consists of approximately 600 individuals, the distribution in general is scarce.

The grey seal is the most abundant seal species in the Baltic Sea. Most of the Baltic grey seals are distributed from the northernmost part of the Bothnian Bay to the south-west waters of the Baltic Proper. In the Baltic Proper, harbour seals are only found in Kalmarsund. The only known important haul-out and breeding sites for harbour seals are at Falsterbo and Saltholm in Øresund and in Kalmarsund. The main dwelling areas for ringed seals are typically around islands or islets in the northern Baltic Sea, where ice cover is normal during the winter period. The ice cover can occasionally extend down to the Baltic Proper.

A grey seal colony has recently been established at Ertholmene east of Bornholm. The distance from the closest route corridor is approximately 11 km.

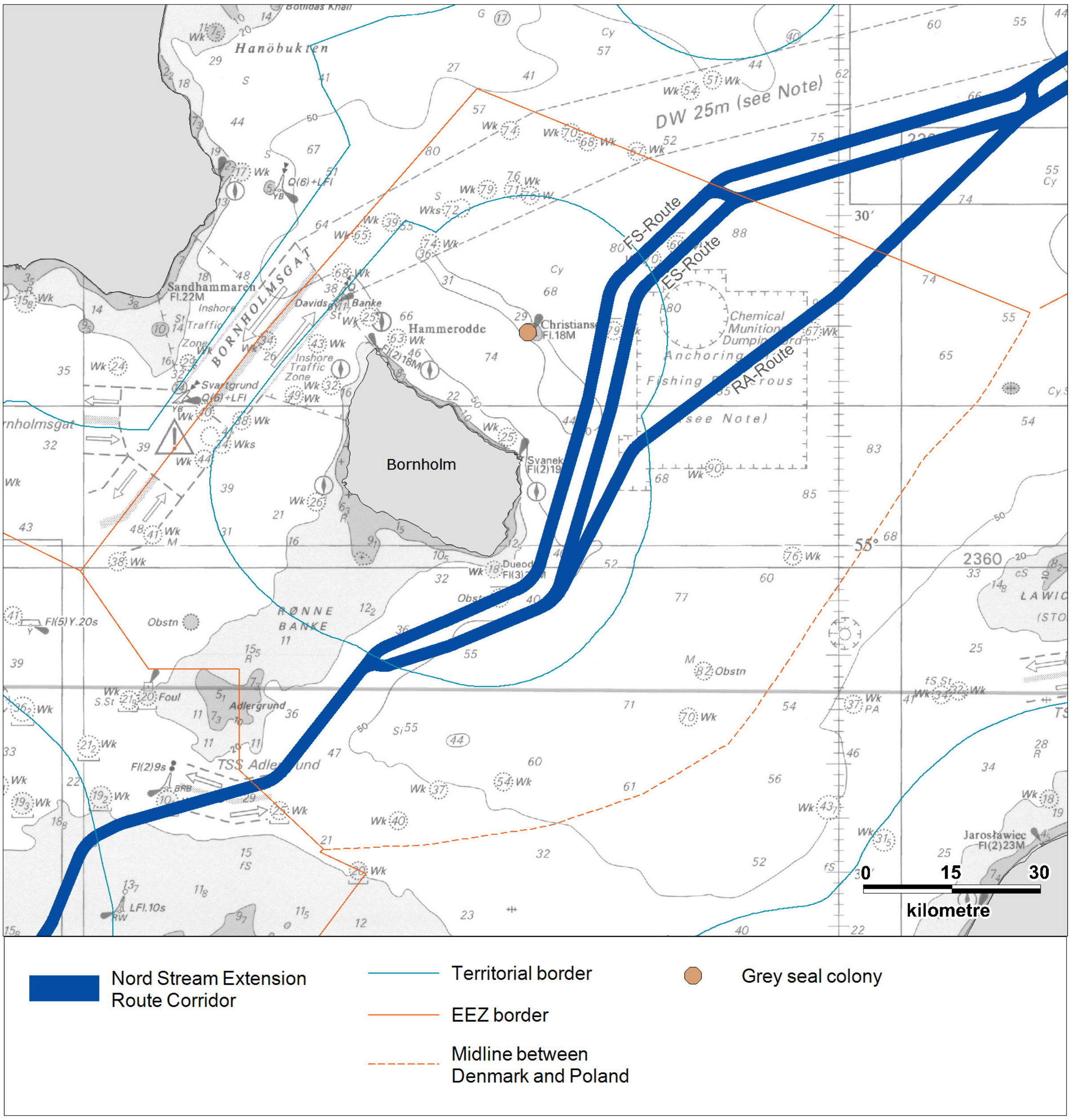

Figure 7.7 Haul-out and breeding sites for seals in Danish waters.

7.2.5 Birds

The Baltic Sea is an important wintering location for seabirds. The shallower areas (< 30 m) are particularly important, as the birds feed on benthic organisms. The open and deeper parts of the Baltic Sea are generally used by a pelagic group of species, such as razorbill (*Alca torda*), guillemot (*Uria aalge*), herring gull (*Larus argentatus*), mew gull (*Larus canus*) and great black-backed gull (*Larus marinus*).

Ertholmene northeast of Bornholm is important for wintering, migrating and breeding birds, mainly common eider (*Somateria mollissima*) razorbill and guillemot. Rønne Banke south of Bornholm is important for wintering and migrating birds, especially long-tailed duck (*Clangula hyemalis)*.

7.2.6 Protected areas

The EC Directive on the Conservation of Wild Birds and the EC Directive on the Conservation of Natural Habitats and Wild Flora and Fauna establish the legislative framework for protecting and conserving Europe's wildlife and habitats. The directives implement the requirements of the Bonn Convention on the Conservation of Migratory Species and the Bern Convention on the Conservation of European Wildlife and Natural Habitats in community law.

At the centre of the policy is the creation of Natura 2000 for habitats and species, a coherent ecological network of protected areas across the EU. These areas are considered to be of outstanding international significance and important to maintaining biodiversity in the EU. The purpose of Natura 2000 is to maintain or restore the favourable conservation status of habitats and species in their natural range.

The Natura 2000 network comprises:

- Areas for the conservation of bird species listed in the Birds Directive as well as migratory birds
- Areas for the conservation of habitat types and animal and plant species listed in the Habitats Directive.

There are two Natura 2000 areas in Danish waters that should be taken into consideration regarding the construction and operation of the Nord Stream Extension.

Ertholmene is an area of 1,256 ha, located east of the northern part of Bornholm. The marine area is designated Natura 2000 on the basis of its reef structures. The area is also designated based on the bird species common guillemot and razorbill. The Natura 2000 area is restricted to islands and to areas with water depths less than 50 m. The reefs around Ertholmene are relatively densely covered by brown algae at water depths less than 10 m and by common mussel *(Mytilus edulis)* down to approximately 12 m depth. The island of Græsholm is an important breeding area for birds, especially guillemots and razorbills. Guillemots also winter in the area. Græsholm also houses the second largest colonies of herring gull and common eider in Denmark.

Adler Grund and Rønne Banke is an area of 31,900 ha, located west of Bornholm. The area is a designated Natura 2000 area on the basis of its reefs and sandbanks, and on the basis of the Annex II species harbour porpoise. Adler Grund and Rønne Banke are important locations for wintering long-tailed ducks.

The Natura 2000 areas in Danish waters are shown in Figure 7.8.

Other protected areas include Important Bird Areas (IBAs), Ramsar Areas, Baltic Sea Protected Areas (BSPAs) and UNESCO sites. There is one combined IBA and Ramsar site of particular concern regarding potential impacts in Danish waters.

Ertholmene east of Bornholm is designated as an IBA because it is the only known Danish site with breeding razorbills and guillemots. It is also important for breeding common eider. All three of these bird species feed offshore. Even though neither Bakkebrædt og Bakkegrund nor Adler Grund and Rønne Banke have been designated as IBAs, they are both important locations for wintering birds, including long-tailed ducks.

The IBAs and Ramsar sites are shown in Figure 7.9.

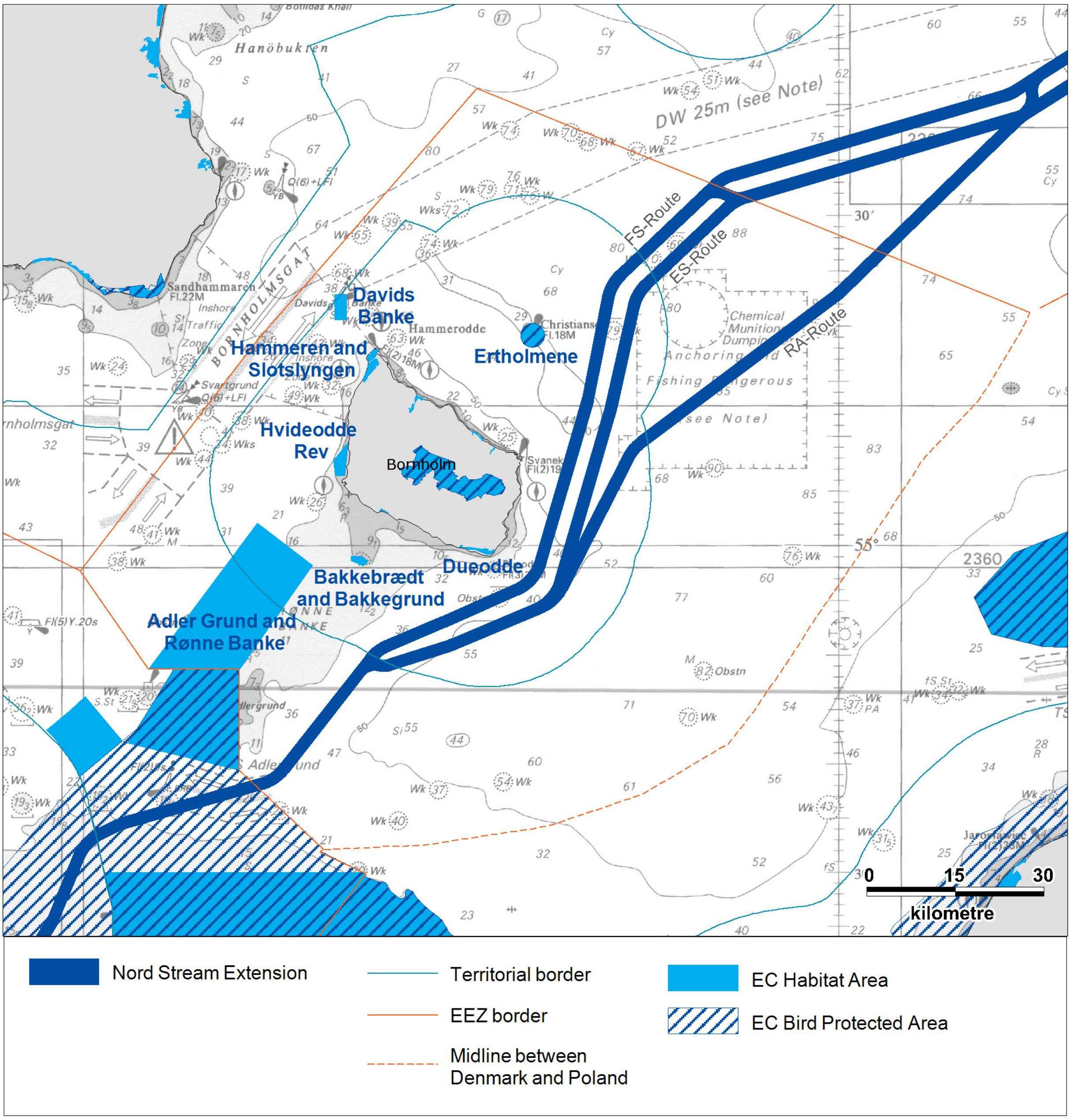

Figure 7.8 Natura 2000 areas, according to the Birds and Habitats directives, in Danish waters.

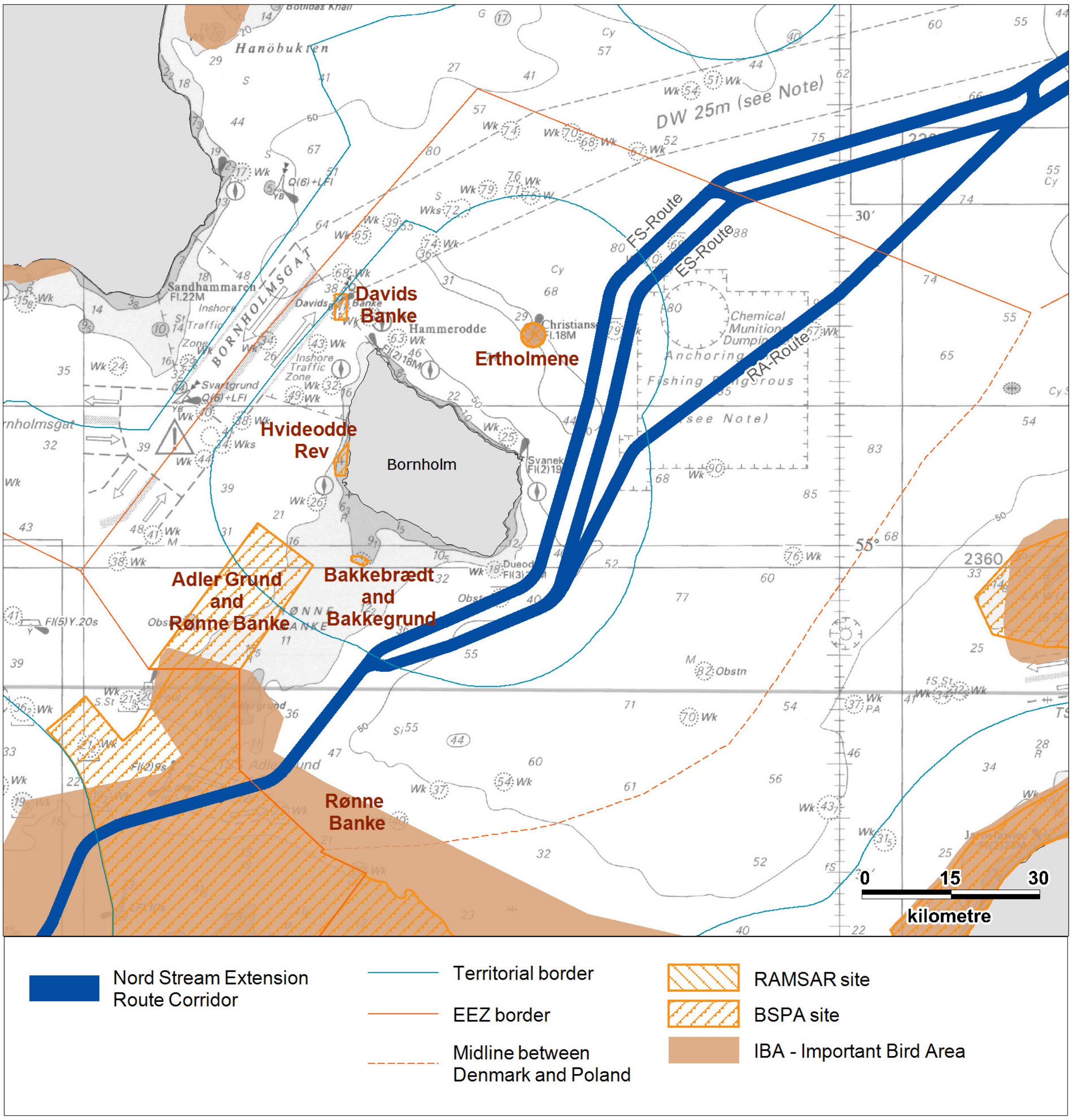

Figure 7.9 Protected areas in Danish waters.

7.3 Socio-economic environment

7.3.1 Shipping and shipping lanes

Ship traffic from the North Sea enters the Baltic Sea either via the Kadet Channel, located between Denmark and Germany, or through Oresund between Denmark and Sweden.

The Bornholmsgat between Bornholm and the Swedish mainland is of exceptional importance to shipping. The area constitutes one of the most heavily-trafficked and complex areas of the Baltic Sea, and is used by the largest vessels voyaging into and out of the Baltic Sea. In order to heighten maritime safety in this relatively narrow passage, Sweden and Denmark have, through the IMO, introduced a traffic separation schemes (TSS), under which, among other things, northbound and southbound traffic is separated. A similar TSS also exist in the Kadet Channel, north of Rügen

The route north of Bornholm is the primary sailing route for international traffic through the Baltic Sea. Cargo ships dominate along this route, comprising approximately 60% of the traffic. This is followed by tankers, which constitute around 15% of the ship traffic. More than 50,000 ships pass through the Bornholmsgat each year.

The route south of Bornholm represents a collection of sailing routes for traffic towards ports in the south-east of the Baltic Sea, such as Gdansk, Kaliningrad and Klaipeda. More than 50% of the ships travelling along this route are cargo ships. Approximately 13,000 ships pass south of Bornholm each year.

The main shipping routes in Danish waters are shown in Figure 7.10, and ship traffic intensities are shown in Figure 7.11.

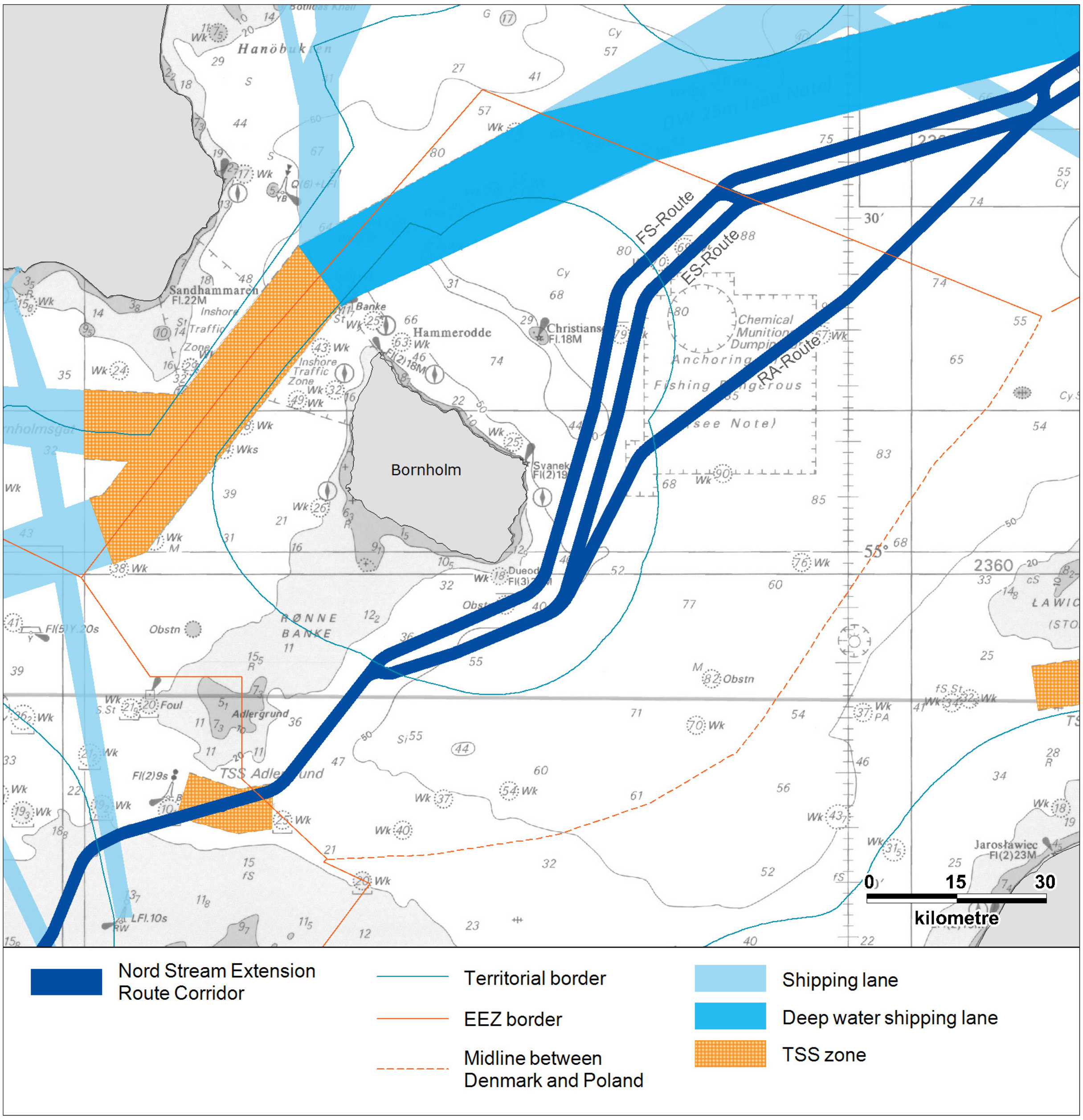

Figure 7.10 Shipping routes in Danish waters.

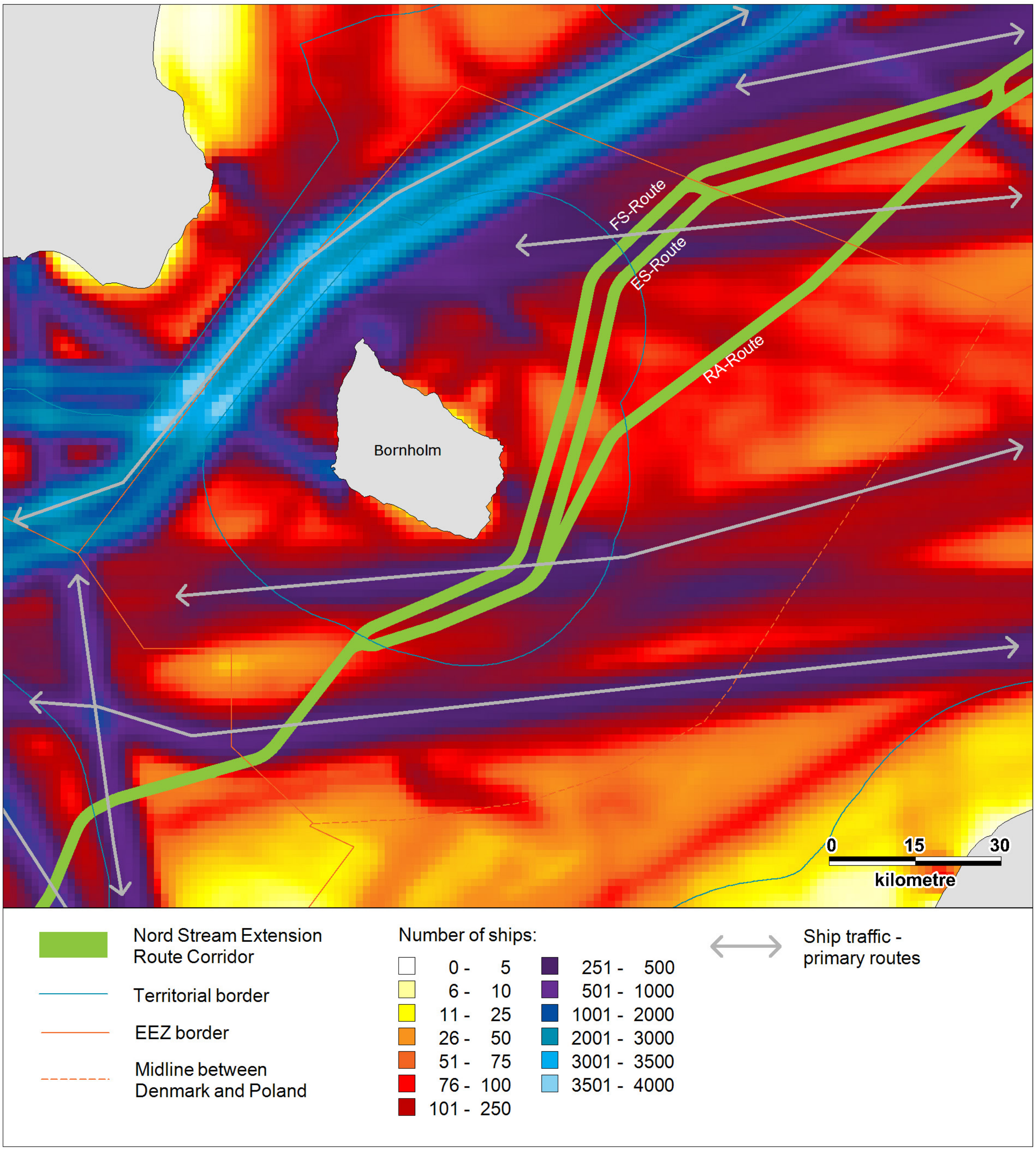

Figure 7.11 Shipping intensity in Danish waters (based on AIS data from 2009).

7.3.2 Fishery

Outside coastal areas, trawls are the main gear type in the Baltic Sea. Mid-water trawls are used mainly to capture herring and sprat, and bottom trawls are used mainly for cod and flounder. In addition, mid-water and high-opening trawls are also used for cod when low oxygen conditions prevent the species from living near the bottom. Mid-water trawls are used throughout the Baltic Sea, whereas bottom trawls are used mainly in the Baltic Proper and in the south-western Baltic Sea.

Cod, herring and sprat dominate the fish community both in terms of biomass and number. These species are the most important commercial species, comprising around 90% to 95% of the total weight of commercial catches in the Baltic Sea. In addition to these three species, flatfish, such as flounder, turbot and plaice, and salmon are of relatively high economic importance in the Baltic Proper.

The most important area for fishery in Danish waters is located west, north and east of Bornholm and the majority of the catches in this area is taken by fishermen from Denmark, Sweden and Poland. The commercially most important fish species in this area are: cod, sprat, herring, flounder, plaice, turbot which is mainly caught by trawling (bottom and pelagic) whereas salmon is targeted by long-line fishery.

In order to protect spawning cods, a central part of the main spawning area in the Bornholm Deep has been closed to all fisheries during the main spawning season (1 May to 31 October) since the mid-1990s.

The most important areas for fishery of relevance to the Nord Stream Project in Danish waters are shown in Figure 7.12.

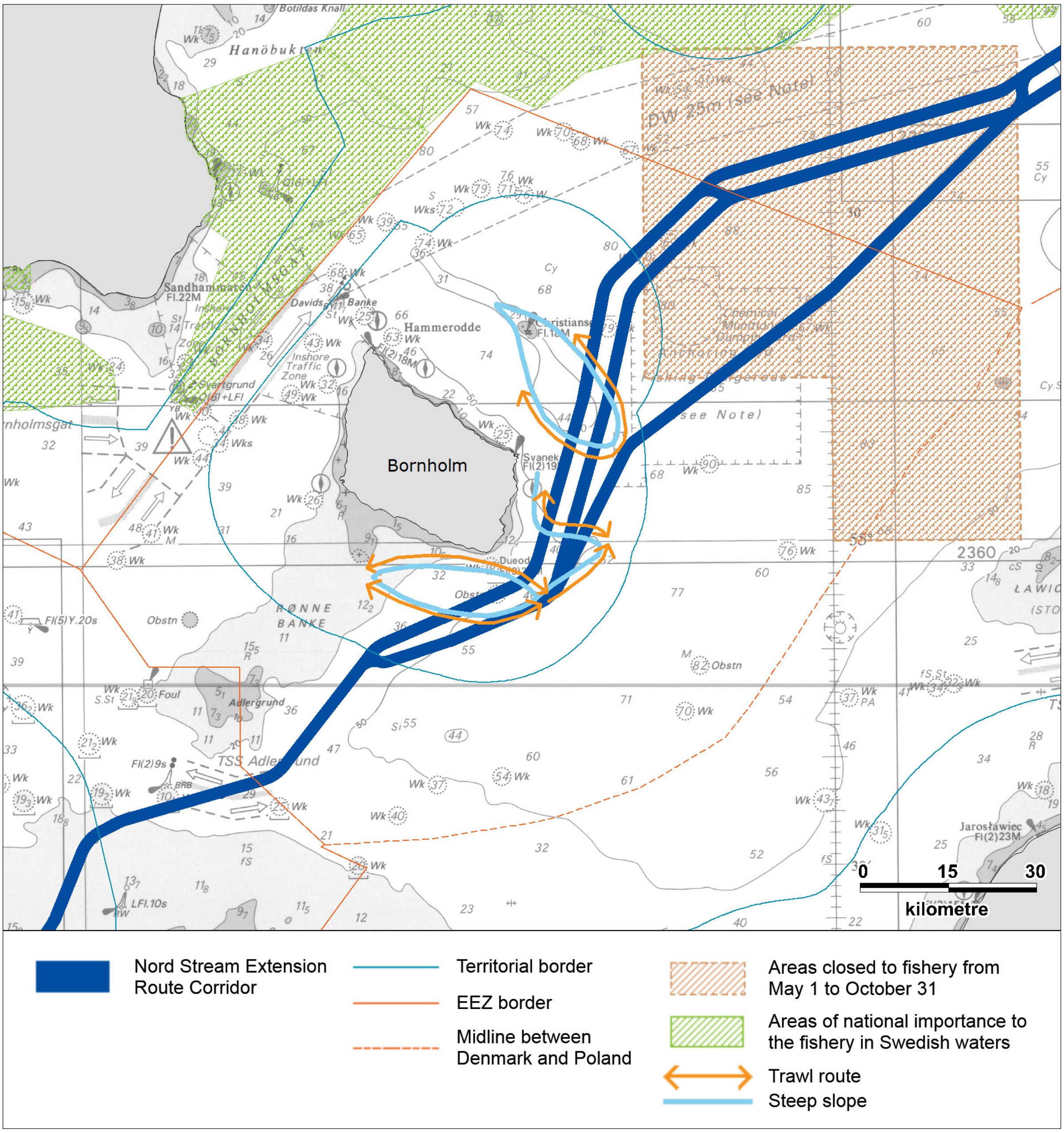

Figure 7.12 Important fishery areas in Danish waters.

7.3.3 Cables, pipelines and wind farms

Existing and planned infrastructure comprises mainly cables, pipelines and wind farms. Numerous telecommunications and power cables are installed on the seabed of the Baltic Sea. The only gas pipeline currently installed in the Baltic Sea, the Nord Stream Pipeline, runs from Vyborg in Russia to Lubmin near Greifswald in Germany. At present, there are no wind farms along the route corridor options. However, plans have been made for a wind farm at Kriegers Flak and for a natural gas pipeline, Baltic Pipe, between Poland and Denmark.

Existing and planned infrastructure in the Danish project area are shown in Figure 7.13. There are a number of active telecommunications cables and power cables in the area; in addition one inactive cable runs from Poland to Denmark. Table 7.1 provides an overview of active and inactive cables that crosses the route corridor options.

Table 7.1 Telecommunications and power cables.

Name	Route	Type	Owner	Active/inactive
DK-RU1	Karlslund (DEN) – Kingisepp (RUS)	Telecommunications	TDC	Inactive
DK-PL2	Gedebak Odde (DEN) – Mielno (POL)	Telecommunications	TDC	Active
DK-PL1	(DEN) – (POL)	Telecommunications	TDC	Inactive
Baltica Seg1	Kolobrzeg (POL) – Dueodde (DEN)	Telecommunications	Polish Telecom	Active
SWEPOL HVDC	Stärnö (SWE) – Bruskowo (POL)	Power (main cable)	Svenska Kraftnät	Active
SWEPOL MCRC	Stärnö (SWE) – Bruskowo (POL)	Power (return cable)	Svenska Kraftnät	Active
GK-22	-	Telecommunications	Deutsche Telecom	Active

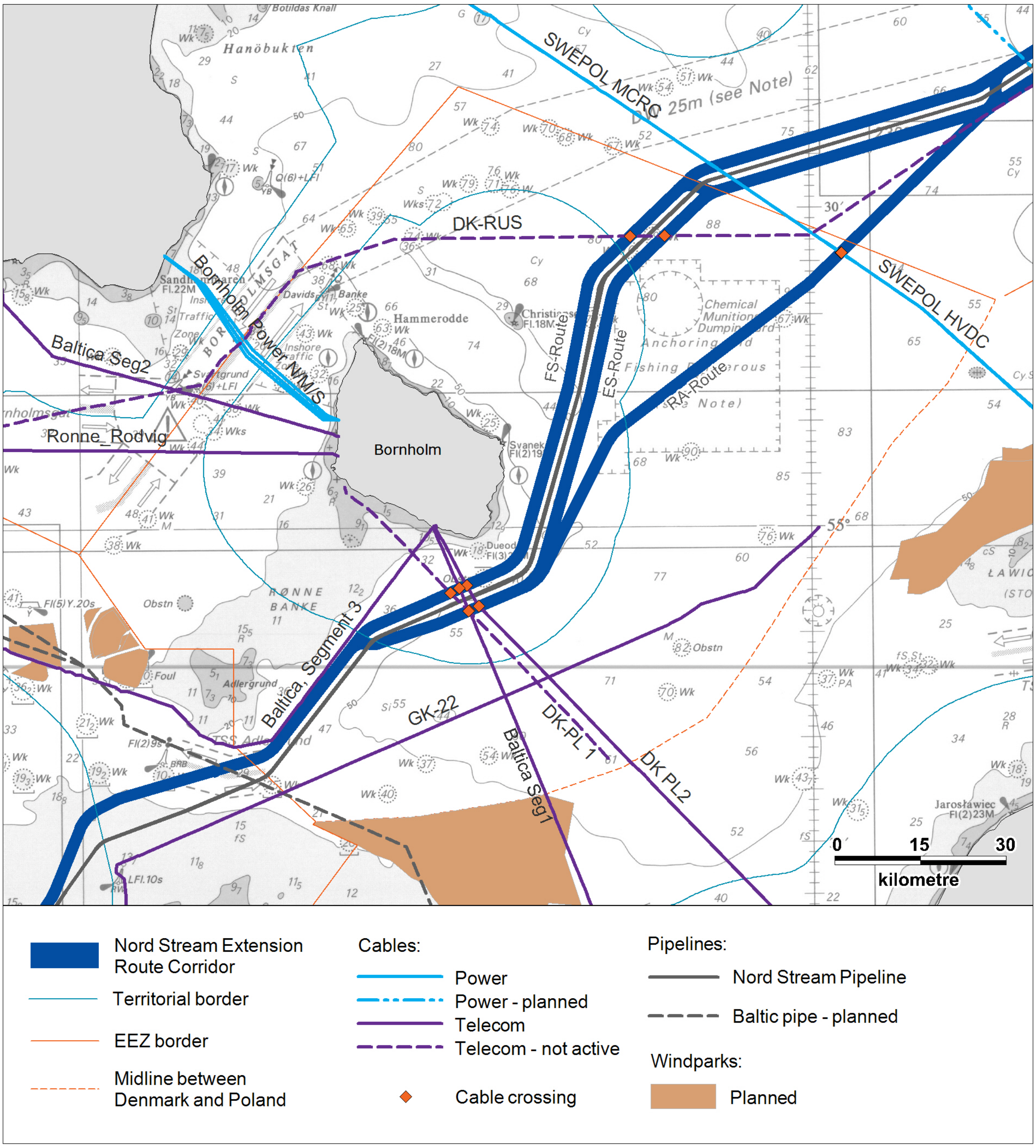

Figure 7.13 Existing and planned infrastructure in Danish waters. Note: There is limited information available on the location of the DK-PL1 inactive telecommunications cable and the GK22 active telecommunications cable outside of Danish waters.

7.3.4 Raw material extraction sites and exploitable natural resources

The seabed in the Baltic Sea is extremely varied with regard to both topography and sediment distribution. The marine sediments may comprise valuable raw material resources, especially for construction purposes. Several countries around the Baltic Sea have expressed interest in extracting marine sediments. However, the extraction of marine sediments is limited by the fact that the variety of suitable dredging equipment decreases with increasing water depth. Furthermore, the costs of extraction and transportation increase with distance from the coast. Therefore, most exploitation of sediments occurs at water depths below 20 m.

In Denmark, several areas for extraction of raw materials are located in the vicinity of the project area, mainly on Rønne Banke southwest of Bornholm. The construction of the Femern Fixed Link in the Femern Belt is expected to begin within the next five years. It is planned that the Femern Fixed Link will be using large amounts of raw material extracted at Kriegers Flak and Rønne Bank. This will at times lead to comprehensive off-shore activities in these areas. In the event that the Nord Stream Extension and Femern Fixed Link projects are constructed in parallel, cumulative effects will be taken into account.

Existing and planned natural resource extraction areas are shown in Figure 7.14.

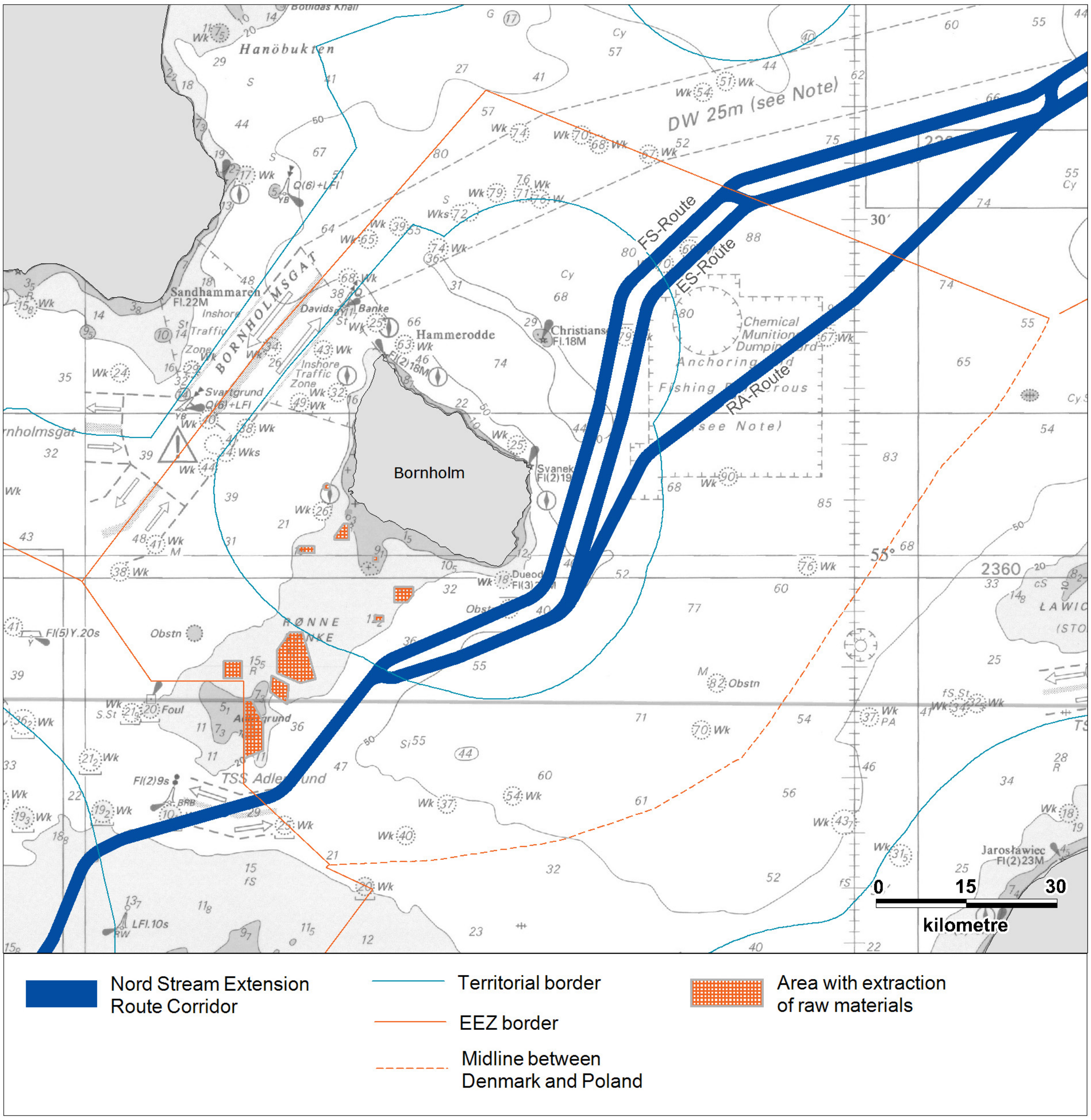

Figure 7.14 Possible exploitable natural resources in Danish waters.

7.3.5 Cultural heritage

Due to physical conditions in the deeper parts of the Baltic Sea (low salt content, relatively low temperatures, low oxygen content, etc.) and the absence of shipworm, the decomposition of wood and other organic materials progresses slowly. Consequently, the preservation of organic materials is exceptional. The preservation value and scientific potential of underwater cultural remains are therefore great in the Baltic Sea. The fact that the underwater cultural environment has been exempt from much of the exploitation that has taken place on land only adds to the potential archaeological value of the underwater cultural remains.

In deep Danish Baltic waters the cultural heritage values comprise mainly shipwrecks, as submerged Stone Age settlements are not likely to be found.

Shipwrecks reflect a diverse group of vessels that vary in age, size and type. Some shipwrecks are of little archaeological interest, whereas others are unique either due to construction method, degree of preservation, historical context or similar. A shipwreck must not necessarily be fully intact to be of archaeological interest. Even some highly degraded shipwrecks can yield valuable information after thorough investigations of hull remains, equipment, cargo and other artefacts. The ‘ancient monument area’ of a wreck site is not only the hull itself, but the total deposit and distribution area of remains from a broken wreck.

Some known shipwrecks are marked on sea charts, but it is probable that the pipelines will be placed in the vicinity of undiscovered wrecks, as it was the case with the Nord Stream pipelines. Known shipwrecks are shown in Figure 7.15.

According to § 29g in the Danish Act on Museums, cultural heritage and wrecks of ships etc. which must be assumed lost more than 100 years ago in outer territorial waters are protected.

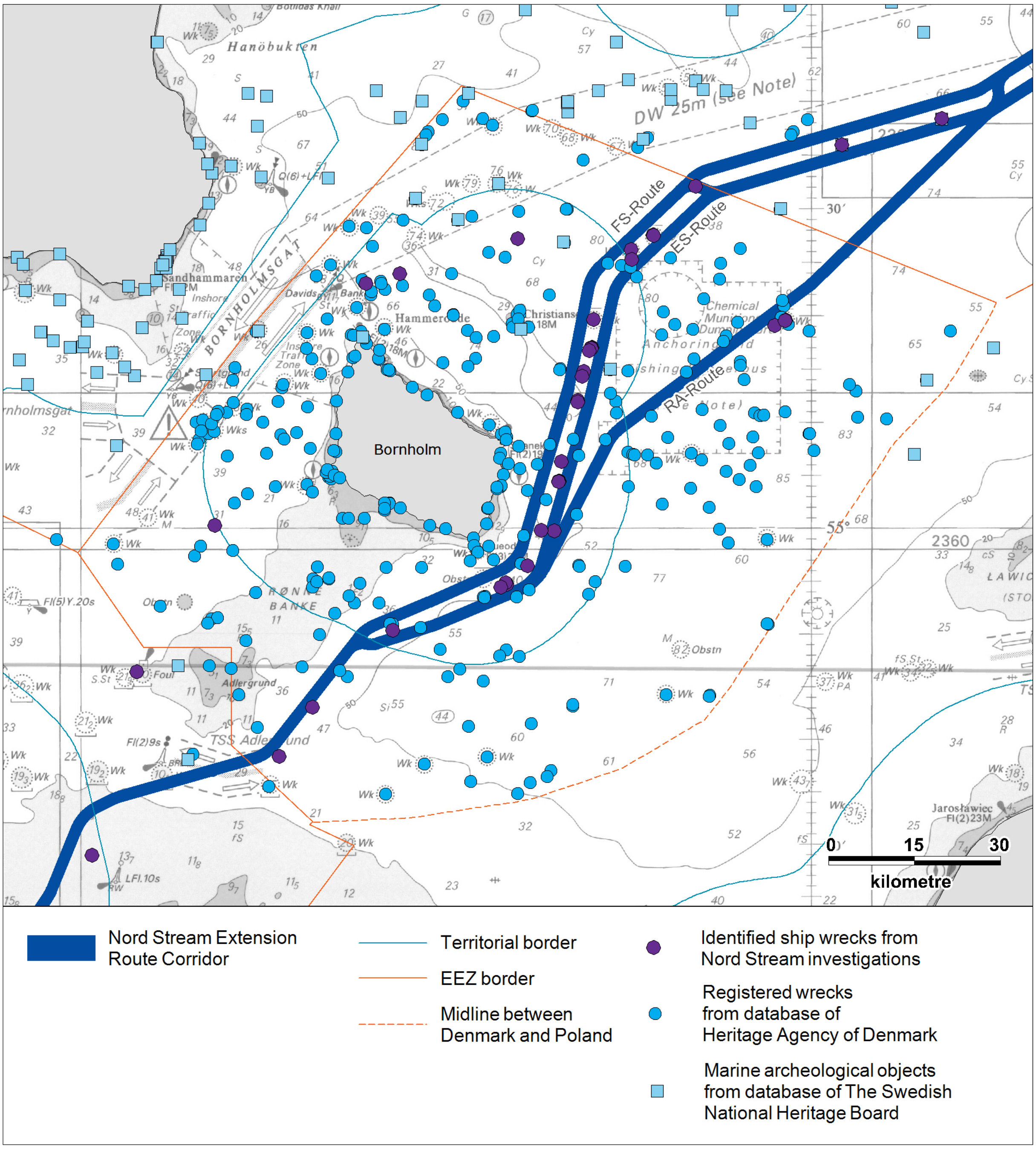

Figure 7.15 Location of registered shipwrecks in Danish waters.

7.3.6 Military practice areas

There are three military practice areas in Danish waters. All three are temporary shooting areas. During exercises, which are held on average six times per year, ships are officially forbidden to enter these areas. The area south of Bornholm is only used for shooting from land, whereas the other two areas are used for naval shooting exercises. Exercise periods are announced in Notice to Mariners one month in advance and are announced daily on the radio (Danmarks Radio, DR) on 1062 kHz at 17.45 hours.

According to a letter from the German Military District Administration North (dated 16 January 2007), a military submarine diving area east of Bornholm should be considered. The area is outside the German EEZ in the region of the Danish EEZ but is administered by the German Naval Command. The exercise area is used by submarines throughout the year on a regular basis for training and exercises, down to a few metres above the seabed.

The military practice areas in Danish waters are shown in Figure 7.16.

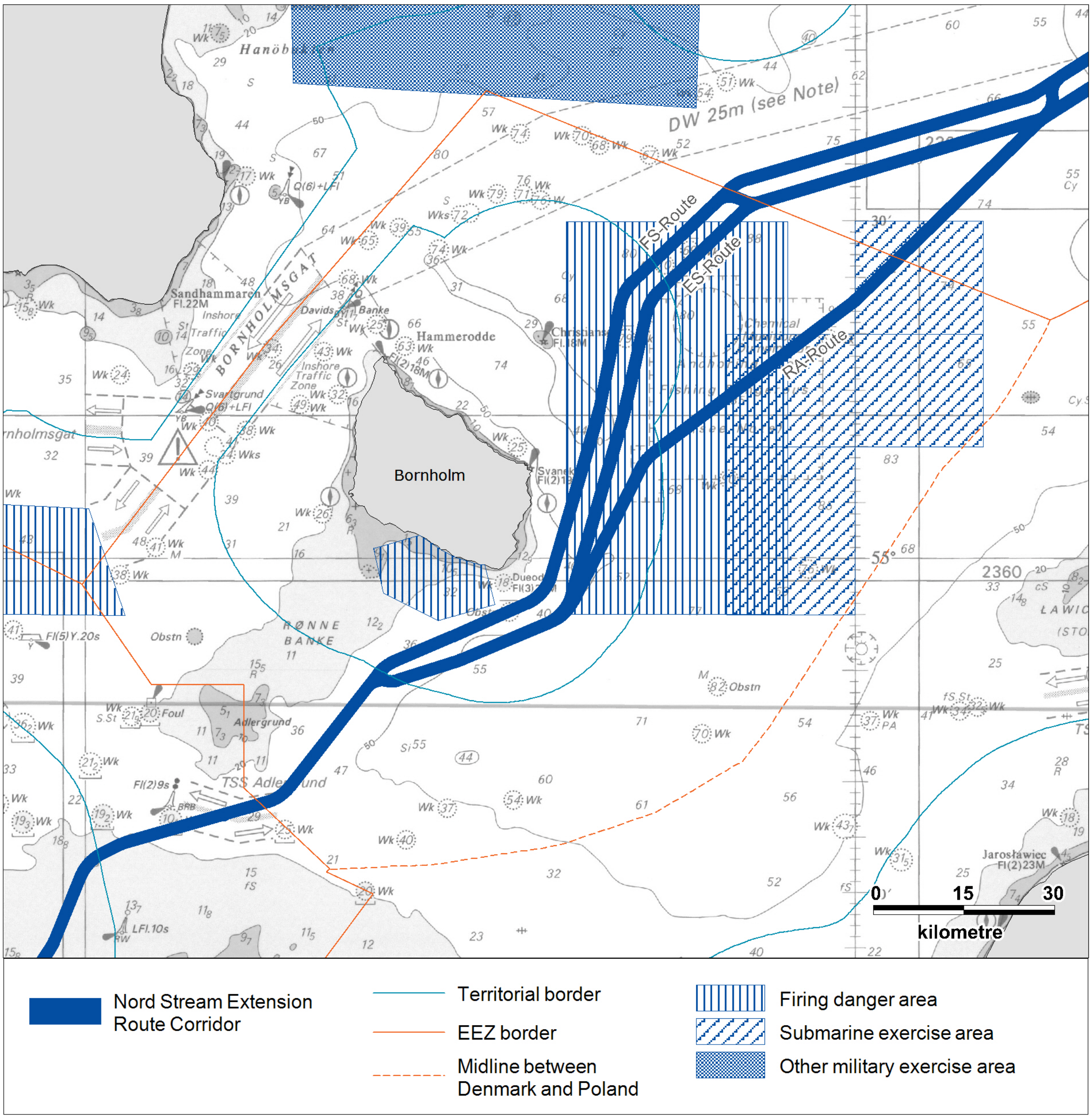

Figure 7.16 Military practice areas in Danish waters.

7.3.7 Environmental monitoring stations

Environmental monitoring is a well-established function of the Helsinki Convention (HELCOM). Monitoring of physical, chemical and biological variables in the open sea began in 1979. The Environment Committee decided that for management reasons the different programmes should be integrated into a common structure, and thus the Cooperative Monitoring in the Baltic Marine Environment (COMBINE) was instituted in 1992. COMBINE monitoring stations are located throughout the Baltic Sea. Various parameters are measured at different stations, including physical and chemical measurements, phytoplankton and primary production, zooplankton, benthic fauna and microbiology. From the stations there are long sequences of data from a fixed position, and it is valuable to have continuous monitoring at the same position.

In addition to the HELCOM long-term monitoring stations, various national institutes also carry out long-term monitoring at a number of locations throughout the Baltic Sea. All identified long-term monitoring stations are shown in Figure 7.17.

The most important monitoring stations to take into consideration are those in close vicinity (< 3 km) of the routes and where on the parameter monitored is bottom sediment (contaminants, benthic macrozoobenthos). Stations in close vicinity (< 3 km) of the routes in Danish waters are only used for monitoring of water quality and are listed in Table 7.2.

Table 7.2 Monitoring stations within 3 km from route corridor options in Danish waters.

Type	Name	Distance from route corridor (km)			Parameter monitored
		FS	ES	R-A	
HELCOM/SMHI	BY4	2.6	-	-	Water quality
HELCOM	OMTF0200	2.6	-	-	Water quality
HELCOM	OMTF0212	-	-	1.0	Water quality

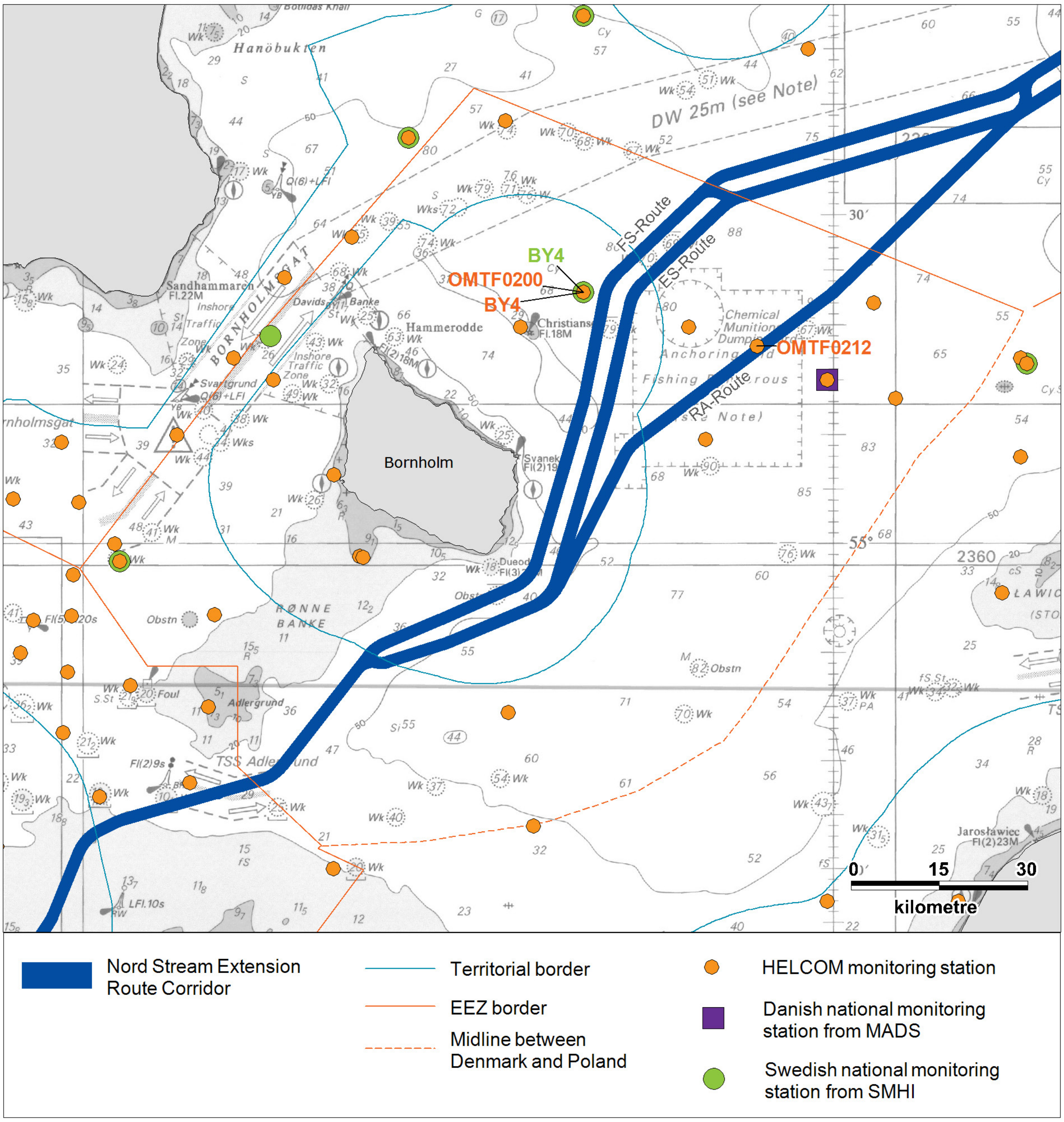

Figure 7.17 Environmental monitoring stations in Danish waters.

8 General approach to baseline description

8.1 Baseline description

A description will be made for relevant environmental aspects and areas that may be affected by the Nord Stream Extension. The baseline description will be elaborated on the basis of desk studies and results from field investigations and will consist of:

- Bathymetry
- Water quality and hydrography
- Meteorology
- Seabed sediments and contaminants
- Conventional and chemical munitions
- Climate and air
- Noise
- Pelagic environment (plankton and larvae)
- Benthic environment (benthic flora and fauna)
- Fish
- Birds
- Marine mammals
- Protected areas (international and national)
- Shipping and shipping lanes
- Fishery
- Cultural heritage (submerged settlements and shipwrecks)
- Existing and planned installations (pipelines, cables, wind farms, etc.)
- Raw material extraction sites and exploitable natural resources
- Military exercise areas
- Environmental monitoring stations.

Particular attention is provisionally anticipated to be required for the following aspects:

- Field investigations of dumping sites for chemical and conventional munitions
- Risk assessments for shipping traffic
- Evaluations of sediment dispersion during seabed intervention operations, including evaluation of impact from turbidity and organic and inorganic pollutants on the marine environment, especially in case of seabed intervention works near chemical munitions dumping sites
- Evaluation of benthic environment in areas with seabed intervention works
- Specification of fishery catches (tonnes/euro value) for every country inside the ICES rectangles that are crossed/affected by the Nord Stream Extension pipelines.

Application of special analysis tools is anticipated in relation to sediment dispersion and sedimentation, via mathematical and numerical modelling, with dispersion rates based on experience with the relevant type of activity. Results of monitoring in connection with the Nord Stream Project will be included. Seabed character will be identified through compiled results from previous route surveys and from additional field investigations.

8.2 Route, engineering and construction surveys

Several marine surveys will be conducted in connection with the Nord Stream Extension Project to gather specific information on seabed conditions, topography, bathymetry and objects such as wrecks, boulders, ordnance, etc. This information will be used for route planning, detailed design and assessment of installation methods. The following sections provide a short overview of the surveys that will be performed before, during and after installation of the pipeline.

The surveys are expected to be concentrated around three different corridors:

- Installation corridor (+/- 7.5 m on either side of the specified route alignment). This corridor is based on the specified installation tolerance for normal pipe-lay defined in the contract with the installation contractor
- Security corridor (+/- 25 m either side of the specified route alignment). This corridor is based on the effects of underwater explosion on the pipeline, e.g. due to munitions on the seabed. The corridor width has been based on engineering analyses of munitions types found in the Baltic Sea and the distance at which an explosion can cause damage to the pipeline
- Anchor corridor (+/- 1 km on either side of the specified route alignment). Within this corridor, anchors from the lay vessel may be laid during installation of the pipeline.

8.2.1 Reconnaissance survey

A reconnaissance survey will be carried out in 2013 to facilitate selection of the preliminary pipeline route based on information on geological and anthropogenic features. The objectives are:

- To establish seabed topography, shallow geological model and identify active geomorphological processes in the area
- To identify and map potential geological features, environmental constraints, anthropogenic remains (cultural heritage, munitions, debris) and third-party infrastructure that have the potential to influence pipeline design and long-term integrity.

8.2.2 Engineering, geophysical and geotechnical survey

Engineering, geophysical and geotechnical surveys will be performed during 2013 to 2015 to provide the required data to optimise the pipeline route and detailed pipeline design (including the seabed intervention measures required to ensure the long-term integrity of the pipeline system). The objectives are:

- To refine the seabed topography and shallow geological model along the selected route
- To refine the accuracy and information on anthropogenic remains and on the configuration of third-party infrastructure
- To perform a detailed assessment of soil types and their variability, definition of the soil characteristics in terms of geotechnical parameters for detailed design, including the assessment of pipeline/seabed interaction (pipeline stability, embedment and

pipeline on-bottom configuration), foundation of rock berms to be installed as pre-lay or post-lay intervention, assessment of trenchability and the soils' chemical properties.

The geophysical surveys and geotechnical investigations will be conducted through several steps following the route adjustment and optimisations. Corridors nominally 250 m wide will be investigated with geophysical equipment and geotechnical sampling along the two pipeline centre lines.

8.2.3 Munitions screening survey

Munitions from World War I, World War II were dumped in the Baltic Sea. A munitions screening survey will be performed to identify the presence of potentially unexploded munitions and/or chemical munitions in the installation corridor. Such munitions could constitute a danger for the construction workers, the pipeline and the environment during the installation works and the operational life of the pipeline system. The survey objectives are:

- To identify and map targets that may represent potential munitions and may have the potential to influence pipeline design, installation and long term integrity
- To perform a visual inspection of targets and classification to identify potential munitions
- To integrate anomalies and objects identified and targets from previous investigations and correlation with public domain data.

8.2.4 Cultural heritage survey

Cultural heritage in the Baltic Sea is primarily related to shipwrecks and submerged Stone Age settlements. The identification of cultural heritage objects will be based on interpretations of side scan sonar data and sub-bottom profile data collected during the reconnaissance and geophysical survey. Identified shipwrecks within the pipeline corridor will be visually inspected by remotely operated vehicle (ROV).

Side scan sonar data from the surveys and inspection videos will be given to marine archaeologists at the Viking Ship Museum for evaluation of cultural heritage value.

An overview of the coverage of the different surveys that will be performed during the engineering and munitions screening surveys are shown in Figure 8.1.

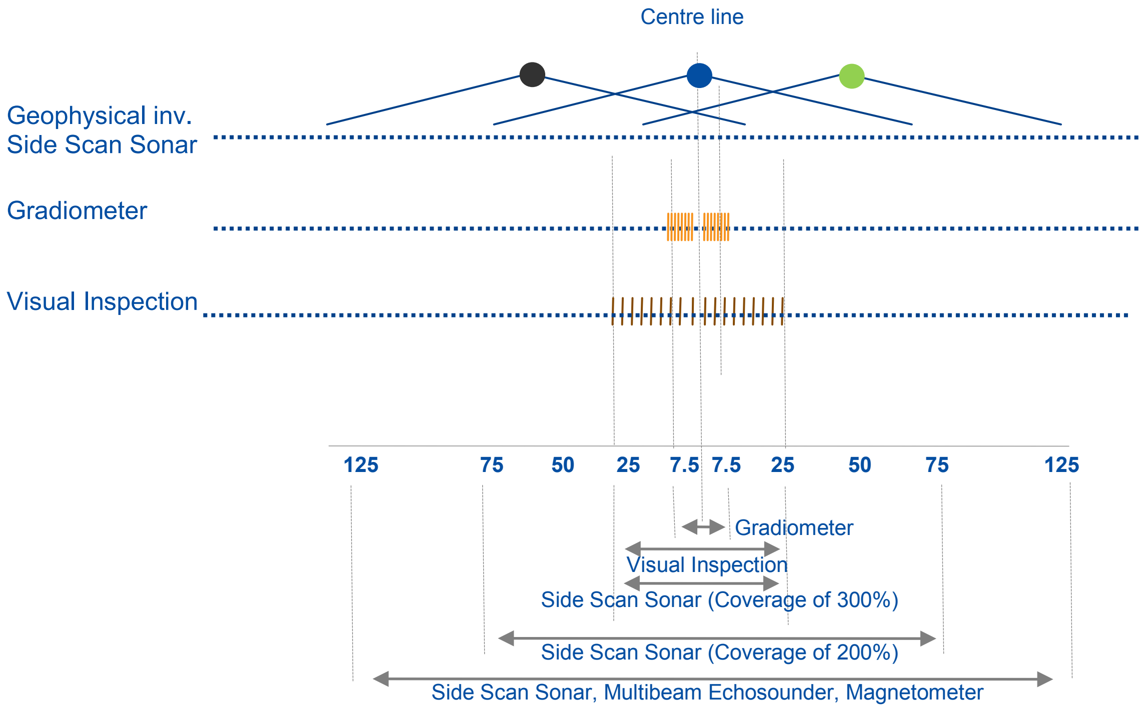

Figure 8.1 General level of detail of the engineering and munitions screening surveys.

8.2.5 Anchor corridor survey

Prior to the installation of the pipeline(s), an anchor corridor survey will be undertaken to identify and catalogue obstructions within the lay-vessel anchor corridor. The survey will mainly be conducted in a 1 km wide corridor to each side of the route alignment. The objectives for the anchor corridor survey are:

- To map potential hazards to anchoring and the environment and provide the basis for an anchoring risk assessment
- To identify hazards such as potential munitions, anthropogenic debris, geological features, obstructions and existing infrastructure
- To identify and map areas and features of cultural heritage to be safeguarded.

The anchor corridor survey will comprise four phases as follows:

- Geophysical survey (bathymetric survey, sidescan survey and magnetometer survey)
- Visual inspection by ROV
- ROV based gradiometer survey in critical areas
- Expert evaluation of survey findings.

Where munitions, cultural heritage and other potentially dangerous debris are identified, anchor exclusion zones will be established. The installation contractor will then develop anchor patterns and procedures to ensure that the areas of concern are not impacted by the anchors or the sweep of the anchor wires. In critical sections the anchor patterns will be submitted to the relevant authorities.

The anchoring procedures will be risk assessed as far as the potential risk to safety and environment. Based on the results of the risk assessment various mitigation measures will be developed. These may include the use of buoyancy on the anchor wires, 'live anchors' i.e. tugs rather than placing the anchors on the seabed or clear the munitions.

It is anticipated that conventional and/or chemical munitions will be identified during the anchor corridor survey. All conventional munitions identified within the 50 m wide security corridor will be cleared as part of the preparatory activities before construction, whereas all munitions identified within the anchoring corridor will be cleared if deemed necessary following expert assessment by the installation contractor as described above in the anchor corridor survey scope. Chemical munitions may be left in place, if they are not armed.

8.2.6 Pre-lay survey

A pre-lay survey will be performed just prior to the commencement of construction work. The scope of the pre-lay survey is to confirm the previous route survey and to ensure that no new obstacles are found on the seabed. A pre-lay survey comprises:

- ROV-based bathymetric survey to establish seabed conditions prior to seabed intervention works. Such surveys will be performed along the pipeline route to and from the theoretical touchdown points at both ends of the proposed rock berm
- ROV-based bathymetric survey including of rock berms and adjacent shoulders, i.e. theoretical touchdown points where the pipeline will be in contact with the natural seabed
- ROV-based bathymetric surveys to establish the extent of berm settlement and the necessity of additional rock placement prior to pipeline installation
- ROV-based pre-lay visual inspection survey.

8.2.7 Construction support survey

Full survey capability will stand by to perform any ad hoc survey activities that may arise during pipeline construction. It will comprise:

- Full geophysical spread: multibeam echosounders, sidescan sonars, sub-bottom profilers and magnetometers
- ROVs for visual inspection work.

8.2.8 As-laid survey

To document the pipe-laying, an as-laid survey will be performed once the pipelines have been laid on the seabed by the pipe-laying vessel. The survey will establish the as-laid position and condition of the pipelines and will comprise:

- Bathymetry and side-scan sonar measurements
- Visual inspection by ROV.

8.2.9 As-built survey

As a final documentation of the pipeline installation, an as-built survey will be conducted. It will be carried out after seabed intervention, trenching, rock placement, etc., i.e. after the pipelines have been completed. The survey will demonstrate that the pipelines have been installed correctly. Therefore, it must establish that the required trench depth has been achieved, the extent of backfill and rock placement is as designed, and that the integrity of the pipelines has been maintained. The survey typically includes a visual inspection of the pipeline by ROV.

A typical survey vessel and an ROV are depicted in Figure 8.2.

Figure 8.2 Typical survey vessel, the Saipem Grampian Surveyor (left) and ROV ready for launch (right). Photos by Saipem S.p.A.

8.3 Environmental field surveys

In most cases, the baseline conditions will be described based on already available data and information. However, field surveys will be necessary if the data or information does not exist or if updated information is needed. The following field surveys are suggested in relation to the Nord Stream Extension:

- Seabed sediment
- Macrozoobenthos
- Chemical warfare agents.

It is planned to carry out all field surveys during 2013. The scopes of the different investigations are described below.

8.3.1 Seabed sediment

Inorganic and organic chemical contaminants enter the Baltic Sea via several routes. The main means are atmospheric deposition, advective supply from rivers and exchange with the surrounding seas through the Danish straits. The general distribution patterns of contaminants in the Baltic Sea are complex. Many of the contaminants are hydrophobic, i.e. they tend to adsorb to particulate matter and settle on the seabed. This adsorption takes place especially to fine-grained sediments and to particulate organic matter. Other contaminants exist as particulate matter from the beginning.

Settled sediments and their associated contaminants may be re-suspended after initial sedimentation to the seabed. Contaminated sediments may be subject to re-suspension caused by currents, waves, bioturbation, trawling, etc. Re-suspension events mix the top sediment and also facilitate its long-distance transport, depending on the physical settings, sediment conditions, etc. Eventually, the majority of the transported fine-grained sediments and their associated contaminants end up in deposition zones for fine-grained sediments, primarily in the deep parts of the Baltic Sea.

The purpose of the seabed sediment survey is to map the physical and chemical character of the surface sediment along the route corridor options for the Nord Stream Extension. This will be done in order to support the EIA development. Furthermore, the data can support modelling for spreading of sediment and contaminants in relation to intervention works in sensitive areas.

It is suggested to conduct seabed sampling at 10 km intervals along route corridor options. Samples will be described in the field and later analysed for predefined physical and chemical parameters in designated laboratories.

Parameters to be investigated

Sediment samples from all seabed sampling stations will be analysed for the parameters described below.

Physical analysis:

- Dry matter
- Loss on ignition
- Grain-size distribution, including median grain size of the sediment and silt/clay fraction.

Chemical analysis:

- Total organic carbon (TOC), total nitrogen (TN) and total phosphorus (TP)
- Trace metals: arsenic (As), cadmium (Cd), cobalt (Co), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), vanadium (V) and zinc (Zn)
- 16 PAHs: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanth-rene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benz(b)fluor-anthene, benz(k)fluoranthene, benz(a)pyrene, dibenz(a,h)anthra-cene, benzo(ghi)-perylene and indeno(123cd)pyrene
- Organic tin compounds: monobutyltin (MBT), dibutyltin (DBT) and tributyltin (TBT)
- Seven individual chlorobiphenyls (CB) congeners (earlier analysed as PCB): CB 28, CB 52, CB 101, CB 118, CB 138, CB 153 and CB 180
- Hexachlorobenzen, trans-chlordane, cis-chlordane, alpha-HCH, beta-HCH and gamma-HCH
- DDT compounds: o,p-DDT, p,p-DDT, o,p-DDD, p,p-DDD, o,p-DDE and p,p-DDE;
- Trans-nona chlor.

Methodology

Before any seabed sediment sampling takes place, a three-to-five-minute video sequence covering the sediment surface at and around each sampling station shall be recorded. Subsequently, still photos of characteristic features on the seabed will be extracted from the video footage for describing the sediment surface conditions at the stations.

Before seabed sampling begins, measurements of salinity (conductivity), temperature, density (depth) and dissolved oxygen concentration (CTDO profiling) from the surface to the bottom at intervals not exceeding 1 m shall be undertaken at each sampling station. Verification of the concentration of dissolved oxygen 1 m above the seabed surface shall be carried out at all sampling stations.

Sediment sampling should be carried out as core samples with a haps core sampler (or another similar core sampler). If the presence of rocks on the seabed or in the sediment prevents the haps core sampler from closing properly, a free-fall core sampler or a Van Veen Grab sampler can be used instead.

One sediment sample will be taken at each station. On deck, each core sample will be photographed and described with regard to sediment composition, colour, smell and extent of oxidized surface layer. Four subsamples of predefined size from the upper 2 cm of the core sample will be taken for physical-chemical analysis. One subsample will go to physical analysis and the other to chemical analysis. The remaining subsamples shall be stored as backup.

Samples will be handled, stored and delivered to the laboratory in accordance with HELCOM guidelines. However, procedures shall be approved by the laboratory chosen to carry out the analyses.

8.3.2 Macrozoobenthos

The biota in the open Baltic sedimentary habitats largely follows the physical settings (salinity, temperature, sediment composition, current velocity and water depth), water quality (in particular the frequency and duration of oxygen depletion occurrences) and food supply. Due to stagnation periods in combination with eutrophication-induced hypoxia/anoxia, benthic 'ecological deserts' cover more than 30% of the seafloor (more than 100,000 km^2) annually, inducing secondary successional patterns that seldom lead to 'mature' benthic communities. The current anoxic conditions in the deep waters seem to be persistent and independent of seasonality, whereas coastal hypoxia is largely seasonal.

Oxygen concentrations in the bottom water are of primary importance to invertebrates close to or in the seabed. Tolerance to low oxygen concentrations is in general species-specific, but it also depends on the rate of oxygen decline, the duration of low oxygen concentrations, and the temperature affecting respiration. An oxygen concentration below 2 mg/l (hypoxia) is increasingly critical for fauna, and the development of anoxic conditions and release of toxic hydrogen sulphide prevent the survival of macrozoobenthos.

Results from the benthos survey in carried out in Danish waters in 2008 for the Nord Stream project showed that macrozoobenthos was scarce or absent at depths deeper than 74 m. The oxygen concentration in the bottom water was between 1.8 mg/l and 12.7 mg/l. The concentration decreased below the halocline (60 m) and was reduced to 2-3 mg/l at depths greater than 75 m /5/.

The purpose of the benthos survey is to map the current situation and the variations in the benthic macrozoobenthos communities along the different route corridor options for the Nord Stream Extension. This will be done in order to support the EIA development. Results from the benthos survey together with the results from the physical and chemical analysis of the seabed (see Section 8.3.1) will be used to map and describe variations in the habitats along the various route corridor options.

It is suggested to conduct seabed sampling at 10 km intervals along the route corridor options. Each benthos sample will be analysed for the number of species and the number of individuals per species in a designated laboratory. Furthermore, biomass determination will be carried out in accordance with HELCOM recommendations.

Parameters to be investigated

Sediment samples from all benthos sampling stations will be analysed for the parameters described below.

Biological analysis:

- Determination of species, abundance and biomass
- Habitat conditions (video recording).

Methodology

After the procedure for seabed sediment sampling has been conducted (see Section 8.3.1), sampling for macrozoobenthos will be carried out. A Van Veen grab sampler (0.1 m^2) will be used as bottom sampler.

Three sediment samples will be taken from every station for further analysis. On deck, each core sample will be photographed and described with regard to sediment composition, colour, smell and extent of oxidized surface layer. The samples will be sent for analysis at a laboratory accredited and certified to perform the above-mentioned analysis.

Sampling, sieving (1 mm sieve) and storage/preservation of samples will be carried out in accordance with HELCOM guidelines for soft-bottom sampling. However, minor variations may be advisable, e.g. the use of ethanol instead of formaldehyde for fixation.

8.3.3 Chemical warfare agents

HELCOM has concluded that approximately 40,000 tonnes of chemical munitions, containing approximately 13,000 tonnes of chemical warfare agents (CWA), were dumped in the Baltic Sea after World War II (see Section 7.1.5). During the monitoring in connection with the Nord Stream Project no intact warfare agents were found in any of the samples. Instead of the actual agents, minor traces of degradation products were detected in a few of the samples. Due to the large attention for CWA special attention will be given to this topic during surveys for the Nord Stream Extension.

The purpose of the CWA baseline survey is to map the concentrations of CWA in the surface sediment along the route corridor options for the Nord Stream Extension Project in Danish waters. The results shall support the EIA development in Denmark.

The objective of the survey is to perform seabed sampling at 2.5 km intervals along the route corridor that passes through the zone east of Bornholm where bottom trawling, anchoring and seabed intervention works is discouraged and at 5 km intervals along the remainder of the routing in Danish waters. This since the ES and FS corridors are parallel to the Nord Stream route and existing data therefore can complement the assessments. The route corridor is shown in Figure 7.5.

Parameters to be investigated

Sediment samples from all stations will be analysed for the following parameters:

Chemical analysis:

- Adamsite (DM)
- Clark I (DA)
- Phenyldichloroarsine (PDCA)
- Sulphur mustard gas (H)
- Triphenylarsine (TPA)
- Trichloroarsine (TCA)
- A-Chloroacetophenone (CN)
- Tabun (GA)
- Lewisite I (L1)
- Lewisite II (L2)
- Degradation products of DM, DA, PDCA, TCA, H, L1, L2.

Methodology

Sediment sampling will be conducted with a haps core sediment sampler or a similar core sampler. Alternatively, if sediment samples cannot be taken with a core sampler, a Van Veen grab sampler can be used. Surface sediment for chemical analysis will be taken from 0-5 cm depth.

One sediment sample will be taken at each station. On deck, each core sample will be photographed and described regarding sediment composition, colour, smell and extent of oxidized surface layer. For analysis of CWA, the upper 5 cm of the core will be sliced off, and approximately 70 ml will be transferred to each of two plastic bottles.

The samples will be frozen immediately after sampling. On the ship the samples will be kept frozen at -18 to -20°C. Following the sampling campaign one of the subsamples from each station will be transported frozen to a laboratory certified for CWA analyses. The remaining subsamples will be stored frozen as backup. Samples for CWA analysis will be handled, stored and delivered to the laboratory in accordance with guidelines developed during previous campaigns.

9 General approach to environmental impact assessment

The purpose of the EIA is to establish and describe the direct and indirect impacts of the planned activity. Aspects to be considered include people, animals, plants, land, water, air, the climate, the landscape and the cultural environment; the management of land, water and the physical environment in general; and other management of materials, raw materials and energy. Another purpose is to enable an overall assessment to be made of the impact on human health and the environment /1/. The assessment comprises impacts from the preparatory, construction, pre-commissioning, operation and decommissioning phases.

Impact parameters are identified from the description of the Project (project activities that are likely to have an effect on the environment) and from previous experience acquired during the Nord Stream Project. Specific parameters are identified qualitatively and quantitatively via the description of construction activities and machinery and equipment applied.

All aspects are subject to investigation via desk studies, including review of literature and charts, and consultation of relevant authorities and institutions, including results from the geotechnical, geophysical and environmental investigations along the final route corridor options. Field investigations are applied where information via desk studies, etc., is insufficient. Results from the monitoring in connection with the Nord Stream Project will provide significant input.

Geophysical and geotechnical surveys will be performed within a main survey corridor of 1 km to either side of each route's centreline and may be extended into a 'development' corridor within a further 1 km to either side of the routes' centrelines in the event that obstacles are found within the main survey corridor. Specific surveys along the pipeline route for detection of cultural heritage objects as well as conventional and chemical munitions on and in the seabed will also be performed. In addition to these route surveys, additional field investigations will be considered in vulnerable marine areas, e.g. areas with valuable biotopes, flora, fauna or areas of special concern.

9.1 Definition of impact area and impacts to be studied

The impact assessment will be carried out within a corridor along the pipeline routes where impacts could occur. The width of this corridor (impact area) will depend on the specific environmental conditions, the presence of potential receptors and on the nature of the different construction works that will be conducted along the different pipeline route.

At locations offshore, where the pipelines will be lowered and placed directly on the sea floor by the lay vessel without seabed intervention works, outside shipping lanes and far from environmentally sensitive areas, the width of the corridor for the impact assessment will be relatively restricted (a few kilometres).

At locations offshore, where the pipeline will be laid near sensitive areas, such as shipping lanes and protected areas, and where seabed intervention works could lead to suspended sediment and sedimentation, the width of the corridor for the impact assessment will be extended. The specific width will depend on individual circumstances, e.g. protected areas,

areas with enhanced concentrations of contaminants or chemical warfare agents and areas with seabed intervention works. The impact area might be extended:

- In areas near munitions dumping sites
- In areas that are vulnerable (to be identified during the description of existing conditions or through field investigations)
- Where the pipeline routes cross/or are located close to shipping lanes.

The specific impacts to be studied and the suggested methodologies to be applied are further described in Section 10.

9.2 Methods for impact assessment and evaluation criteria

The overall purpose of the EIA is to describe the aspects of the environment that are likely to be significantly affected by the proposed project, including population, fauna, flora, sediment, water, air, climatic factors and material assets including archaeological heritage and landscapes and the interrelationship between the above factors. The criteria are described below with the overall significance of the impacts and are also shown in Table 9.1.

It is suggested that the following criteria are applied for the evaluation of the environmental impacts:

Scale/intensity of effects

- No effect: there will be no effects on structure or function within the affected area
- Minor effect: there will be minor effects on structure or function inside the affected area
- Medium effect: there will be partial effects on structure or function inside the affected area
- Large effect: there will be a complete change within the affected area.

Geographical extent of effects

- Local effects: there will be changes in the immediate vicinity of the pipelines-/construction site. Effects are restricted to the pipeline route corridor (2 km wide)
- Regional effects: there will be effects outside the immediate vicinity of the pipelines (local effects), outside the pipeline corridor
- National effects: there will be effects on a national scale
- Transboundary: there will be effects extending into other countries in the Baltic Sea
- Global effects: there will be effects on a global scale (e.g. emission of greenhouse gases).

Duration of effects

- Short-term: effects during and immediately after the construction period
- Medium-term: effects lasting up to two years after the construction period ends
- Long-term: effects lasting more than two years beyond the end of the construction period

- Permanent: effects that cause a permanent change in the impact target, a resource or receptor.

<u>Sensitivity/reversibility</u>
- Low: A resource or receptor that is not important for the functionality of a system-/environment, or which is important but resistant to changes caused by the project and which will quickly return to its original state when activities end
- Medium: A resource or receptor that is important for the functionality of a system-/environment and not resistant to changes caused by the project, but which over time will return to its original state when activities end
- High: A resource or receptor that is vital for the functionality of a system/environment, which is not resistant to changes caused by the project, and which will not return to its original state when activities end.

<u>Overall significance of impacts</u>
- No impact: there will be no impacts on the environment
- Minor impact: the structure or functions in the area will be affected partially, but there will be no impact outside the affected area, and impacts will be short-long term without significant impacts on the environment
- Moderate impact: the structure or function in the area will be changed, but the impact will have no significant effects outside the affected area. Impacts will be medium to long term without significant impacts on the environment
- Significant impact: the structure or function in the area will be changed, and the impact will also have effects outside the area. Impacts will be long-term and significant.

An overview of the suggested criteria to be used in the impact assessment is shown in Table 9.1.

Table 9.1 Criteria to be used in the environmental impact assessment for the Nord Stream Extension Project.

Scale/intensity of effect	Geographical extent of effect	Duration of effect	Sensitivity/ reversibility	Overall significance of impact
No Minor Medium Large	Local Regional National Transboundary Global	Short-term Medium-term Long-term Permanent	Low Medium High	No impact Minor impact Moderate impact Significant impact

It is foreseen that various methods will be utilised for the impact assessment, including:

- The use of mathematical and numerical modelling to determine the extent of interaction between a project activity and the receiving environment
- The use of Geographical Information Systems to plot receptors in relation to the pipeline route and the sphere of influence of an impact (determined by modelling, previous studies and available literature)

- Statistical evaluation
- The use of desk studies and field surveys
- Prior experience of the EIA team
- Existing data and knowledge gained during the Nord Stream Project.

The evaluation criteria of each aspect will be documented in the EIA to ensure full transparency of the assessment. Where applicable, parameters will be compared with guideline values (if available) or other defined standard values in scientific literature.

9.3 Cumulative impacts

Cumulative impacts occur when various impacts cause a different effect when assessed together than when assessed individually. A cumulative impact assessment should take into account other past, present and future human activities.

Possible cumulative impacts from the Nord Stream Extension Project during operation are related to:

- Spatial planning (occupation of seabed)
- Mixing of water masses
- Blocking of inflowing saline water
- Trawl fishery.

The cumulative impacts will be assessed based on analyses of existing data and sea charts, modelling results and discussion with fishermen.

No significant cumulative impacts caused by construction are expected to occur, since the impacts are typically of temporary nature. However, the construction of the Femern Fixed Link in the Femern Belt is expected to begin within the next five years. It is planned that the Femern Fixed Link will use large amounts of raw materials extracted at Kriegers Flak and Rønne Bank. This will at times lead to comprehensive offshore activities in these areas. In the event that the Nord Stream Extension and the Femern Fixed Link projects are constructed in parallel, cumulative effects will need to be taken into account.

9.4 Indirect environmental impacts

The indirect impacts foreseen are those associated with the transport of line pipe, rock and concrete mattresses.

Transport of line pipe, rock and concrete mattresses from the place of shipment to the construction vessels will cause air emissions and locally increase the noise levels. Currently no shipment is planned from harbours in Denmark.

9.5 Transboundary impacts

Potential transboundary impacts from activities in Danish waters will be assessed by the Project Developer for both planned activities and unplanned events. The following activities and events will receive special attention when assessing the possible transboundary impact of preparatory activities, the construction activities and the operation of the additional pipelines in the Baltic Sea:

- Seabed sediment dispersion due to pipe-laying, trenching, and rock placement
- Disturbance of dumped chemical warfare agents
- Sediment dispersion, noise and pressure waves due to munitions clearance
- Water discharge during pre-commissioning
- Maritime safety during construction and operation
- Impact on commercial fishery
- Present and future installations (cables, wind turbines, pipelines, etc.)
- Potential unplanned events, including spills, and pipeline failure.

Nord Stream's comprehensive environmental and social monitoring programme established for Nord Stream Pipelines 1 and 2 includes monitoring before, during and after construction of the pipelines. The five tailored national monitoring programmes were prepared in agreement with relevant national authorities. They are focused on environmentally sensitive areas and other receptors that potentially could be affected by the construction and operation of the Nord Stream pipeline system.

The results of the various monitoring campaigns undertaken during the preparatory activities, during construction activities of the first two pipelines and their early operation phase were regularly issued to the respective national authorities for their review and approval. The monitoring results already reflect the effectiveness of the impact minimization measures implemented into project design and project implementation.

As a general conclusion it can be stated that Nord Stream Project activities did not cause any unforeseen environmental impact in the Baltic Sea. A comparison of results from the baseline surveys in 2010 and the impact surveys carried out 2011 and 2012 showed only a minor and temporary transboundary effect from Nord Stream construction activities.

Based on the monitoring results after completion of construction and one year of operation, construction of Nord Stream Pipelines 1 and 2 resulted in insignificant, at maximum minor transboundary impacts.

9.6 Comparison of alternatives

A description of an alternative route is a requirement for an overall assessment of the effects of the planned activity. The comparison of alternatives includes environmental, technical and economic aspects. It will also be possible to compare the risks associated with each alternative. To facilitate the comparison, the impact of each aspect will be presented in a matrix or a table.

9.7 Evaluation of gaps and uncertainties

Gaps and uncertainties in the assessment will be described, and an evaluation will be made if they are significant.

10 Scope of impact assessment

This section presents the scope for the impact assessment and investigations which will be conducted for the Nord Stream Extension Project. The assessment approach is described for each environmental aspect, and experiences from the Nord Stream Project are included.

The EIA process for the Nord Stream Project and the initial environmental monitoring during their construction have provided valuable experience with regard to the impacts of a pipeline project in the Baltic Sea. The scale, geographical distribution and duration of impacts was calculated, modelled and assessed and subsequently verified by *in situ* monitoring. The impact on the environment from the Nord Stream Extension Project is foreseen to be on a similar scale as the Nord Stream Project. So far, impacts from the Nord Stream Project have been verified as being minor, locally limited and short-term in the Danish EEZ and Danish territorial waters.

Sections 10.1, 10.2 and 10.3 present the impacts which will be studied for the Nord Stream Extension Project in Denmark.

10.1 Impacts assessment on the physical-chemical environment

10.1.1 Bathymetry

In shallow water areas the pipeline on the seabed could be an obstacle or barrier for vessels with large draughts. In these areas the pipeline might be trenched into the seabed in order to maintain the depth of the seabed. In case of uneven seabed, rock berms could be placed in order to even the seabed. Trenching or rock placement might also be relevant in areas in need of extra on-bottom stability due to the impact from hydrodynamic loads. Both rock berms and the pipeline will occupy an area of the existing seabed. The main impacts on bathymetry to be assessed in the EIA are list in Table 10.1.

Impacts on the seabed will be studied from the results of pre-lay and post-lay surveys where the bathymetry will be measured along the pipeline.

Table 10.1 Main potential impacts on bathymetry/seabed to be assessed.

Project phase	Activity	Potential impact
Preparatory activities	Munitions clearance	Creation of depressions and elevations
Construction	Trenching Rock placement	
Operation	Pipelines and rock berms on seabed	Occupation of seabed

Experience from the Nord Stream Project:

Results from the pre-lay and post-lay surveys have shown that one to two years after construction of the Nord Stream pipelines, significant embedment (~50% of the pipelines' diameter) has been observed in many areas of the pipelines in Danish waters.

Post-lay trenching by ploughing of both pipelines was undertaken at shallow areas east of Bornholm in areas prone to hydrodynamic loads. Due to a hard and stony bottom trenching did not reach the required depth to ensure proper on-bottom stability of the pipelines at all locations. Therefore, spot rock placement was carried out in some areas.

10.1.2 Hydrography and water quality

Disturbance of the seabed during construction activities may cause sediment particles to be suspended into the water column. Likewise, contaminants and nutrients can be released to the water column by disturbance of the seabed. The presence of the pipeline on the seabed may affect the current pattern close to the pipeline. Release of nutrients and contaminants as a result of sediment spreading is a possible impact mechanism in relation to water quality; this is separately described in Section 10.1.3. The main impacts on hydrography and water quality to be assessed in the EIA are list in Table 10.2.

The assessment of the possible impacts on hydrography and water quality will be based on modelling and experience from the Nord Stream Project.

Table 10.2 Main potential impacts on hydrography and water quality to be assessed.

Project phase	Activity	Potential impact
Preparatory activities	Munitions clearance	Suspension and spreading of sediments Spreading of nutrients and contaminants
Construction	Pipe-laying Anchor-handling Trenching Rock placement	
Operation	Pipelines on seabed	Change in currents close to pipeline Change in vertical mixing between water masses

Experience from the Nord Stream Project:

Monitoring of dense salty water inflows from the North Sea into the Bornholm Basin has shown that the Nord Stream pipelines do not cause significant mixing of the stratified layers in the water column or blocking of the inflow of saline water to the Baltic Sea. No significant impact on hydrography is predicted from the Nord Stream Extension Project. However, this will be assessed further based on the actual location of the pipelines.

Experience from the Nord Stream Project demonstrated that construction works can be carried out without significant impacts on the surrounding environment. Careful project planning ensured that activities causing sediment spill were carried out in a manner most conducive to avoiding/decreasing negative impacts on the water quality.

The main impact of concern during construction of the Nord Stream project was an increase in the level of suspended sediments in the water column, causing increased turbidity (decreased transparency) of the water. The expected effect from this impact was assessed to be minor, which was supported by the monitoring results. The extent and duration of elevated levels of suspended sediments were local and short-term only, causing no harmful effect on the surrounding environment.

Another potential risk from re-suspension of seabed sediments is related to the release of inorganic contaminants (e.g. copper and mercury), organic contaminants (e.g. PCBs and DDTs) and nutrients (nitrogen and phosphorous) into the water column. Contaminants with the potential to cause ecotoxicological effects on the ecosystem have been deposited on the seabed over centuries. Most of the contaminants have an anthropogenic origin and enter the marine environment via rivers, surface run-off, direct waste water discharges as well as atmospheric precipitation. The methodology for assessment of impacts from contaminants in the surface sediment is described in Section 10.1.3.

10.1.3 Contaminants in the surface sediment

During construction works, seabed sediments will be re-suspended, and contaminants and nutrients can potentially be mobilised. The main source of contaminants and nutrients from the Project is thus not emission of chemicals in the traditional sense but instead a consequence of redistribution of particle-associated contaminants and nutrients that are already present in the seabed sediments of the Baltic Sea. The main impacts from contaminants and nutrients to be assessed in the EIA are listed in Table 10.3.

The evaluation of impacts from contaminants and nutrients will be based on results from field surveys, analyses, modelling and experience from the Nord Stream Project.

Table 10.3 Main potential impacts from contaminants and nutrients in sediment to be assessed.

Project phase	Activity	Potential impact
Preparatory activities	Munitions clearance	Spreading of contaminants and nutrients
Construction	Pipe-laying Anchor-handling Trenching Rock placement	
Operation	-	None

Experience from the Nord Stream Project:

The monitoring for post-lay trenching of the Nord Stream pipelines has documented that the sediment spill and sediment spreading is minor, and the assessments carried out in the EIA prior to construction were conservative, i.e. on the safe side. Therefore, the environmental impacts of sediment spreading and sedimentation were even smaller than those assessed in the EIA report.

10.1.4 Dumping sites for chemical munitions

In order to investigate the extent of chemical munitions, a geophysical munitions screening survey will be conducted along the route corridor options. If encountered, munitions that are a threat to the pipeline will be removed before any construction activities, or minor re-routes for the pipelines will be made.

In general it is assumed that chemical munitions dumped after World War II are not armed; typically, the canisters of artillery shells have corroded away so that only some of the warfare agents and explosives remain. This means that if the remains of chemical munitions, e.g. lumps of mustard gas, are disturbed during construction, they will either be buried, pushed away and/or broken in pieces.

Because one of the route corridor options for the Nord Stream Extension crosses the zone east of Bornholm where fishing with bottom trawling equipment, anchoring and seabed works is discouraged due to the risk of encountering dumped chemical munitions, the part of the route that traverses this area will be surveyed with a focus on chemical munitions. Sediment sampling and analysis of warfare agents will be conducted in this area. The impact assessment will be based on the results from the munitions screening survey and the sediment sampling and analyses. A thorough comparison of the route options will be done based on the survey results.

If intact or semi-intact chemical munitions are encountered in the pipeline corridor during construction, safety precautions will be followed in agreement with relevant authorities. Pipeline construction (pipe-laying, anchor-handling and post-lay trenching) in areas with chemical munitions is assessed to be manageable if adequate precautionary measures are implemented. Construction of the Nord Stream Pipeline in Danish waters was supervised by the Danish Admiral Fleet, and similar measures are anticipated to be applied for the Nord Stream Extension Project. The main impacts from dumping sites of chemical munitions to be assessed in the EIA are listed in Table 10.4.

Table 10.4 Main potential impacts from chemical munitions to be assessed.

Project phase	Activity	Potential impact
Preparatory activities	Munitions clearance	Spreading of CWA
Construction	Pipe-laying Anchor-handling Trenching Rock placement	
Operation	-	None

Experience from the Nord Stream Project:

Both pre- and post-construction investigations were carried out for intact and semi-intact chemical munitions as well as for the concentrations of CWA in the seabed sediment during the Nord Stream Project. No intact warfare agents were found in any of the analysed samples. Instead of the actual agents, minor traces of degradation products were detected in approximately 10% of the samples. Results from the investigations showed no increased level of CWA in the seabed sediment due to construction activities.

10.1.5 Climate and air

The majority of construction works that generate air pollutants is some distance from land and inhabited areas. Air pollutants such as NO_X generally contribute to eutrophication, photochemical oxidant formation and acidification. The CO_2 from combustion of marine bunker oils contributes to global warming.

The impacts on climate and air will be based on literature and experience from the Nord Stream Project. The main impacts on climate and air to be assessed are listed in Table 10.5.

Table 10.5 Main potential impacts on climate and air to be assessed.

Project phase	Activity	Potential impact
Preparatory activities	Munitions clearance	Emissions of air pollutants
Construction	Pipe-laying Anchor-handling Trenching Rock placement	
Operation	-	None

Experience from the Nord Stream Project:

The total load of emissions from the Nord Stream Project was estimated and compared with the magnitude of emissions load from the existing ship traffic in the Baltic Sea. The calculations showed that the emissions loads during the years of construction of the Nord Stream pipeline (2010-2012) was in the level of maximum 0.21% of annual CO_2 emissions from existing ship traffic, maximum 0.17% of annual NO_X emissions and maximum 0.23% of annual SO_2 emissions.

The overall significance of the impact of emissions on the air quality was assessed to be minor.

10.1.6 Noise

Noise impacts will be identified by considering the various project activities during construction and operation. Construction activities will result in both atmospheric and underwater (acoustic) noise. Ships' motors, cranes and generators will be the main source of atmospheric noise, whereas munitions clearance and rock placement will be the main source of acoustic noise. Acoustic noise and pressure waves caused by munitions clearance can potentially have a major impact on fish and marine mammals in the immediate vicinity; munitions clearance is however not anticipated in Danish waters. Depending on the level and intensity, noise can be disturbing and cause avoidance reactions among fish and seals. Gas flowing through the pipeline generates some noise during operation.

The impacts from noise will be assessed from comparable noise values, noise plots for underwater noise and guidelines from literature. Experience gained from munitions clearance during construction of the Nord Stream pipelines will support the assessment. The main impacts from noise to be assessed in the EIA are listed in Table 10.6.

Table 10.6 Main potential impacts from noise to be assessed.

Project phase	Activity	Potential impact
Preparatory activities	Munitions clearance	Airborne and underwater noise
Construction	Pipe-laying Anchor-handling Trenching Rock placement	
Operation	Gas flowing in pipeline	Underwater noise

Experience from the Nord Stream Project:

Noise levels from construction and operations activities were evaluated during the Nord Stream Project and concluded to be comparable to ambient noise. Results from underwater noise measurements performed during and after construction have shown that construction and trenching of the Nord Stream pipeline generated noise at a level and spectral distribution that was similar to that of one or more commercial ships. These acoustic disturbances were localised and temporary and hence also in that respect resembled the noise radiated by a commercial vessel

10.2 Impacts assessment on the biological environment

10.2.1 Pelagic environment

Neither the construction nor the operation of the pipeline system is anticipated to have any impact on the pelagic environment. The impact assessment will be based on literature and experience from the Nord Stream Project. The impacts on the pelagic environment to be assessed in the EIA are listed in Table 10.7.

Table 10.7 Main potential impacts on the pelagic environment to be assessed.

Project phase	Activity	Potential impact
Preparatory activities	Munitions clearance	Suspension of disturbed sediments
Construction	Pipe-laying Anchor-handling Trenching Rock placement	
Operation	-	None

Experience from the Nord Stream Project:

Based on results of monitoring during the construction of the Nord Stream pipelines, the overall impacts on the pelagic environment (plankton and larvae) were assessed to have been negligible. The reason was the local character of sediment disturbances during pipe-laying with the anchored lay barge and during post-lay trenching. In the deepest areas the permanent halocline effectively prevents nutrients dissolved in seawater from reaching the uppermost layers. Moreover, the majority of the phosphorus and nitrogen re-suspended by the construction works are mostly bound to particulate organic matter and clay particles and are therefore not available for the growth of algae in the photic zone.

10.2.2 Benthic environment

Benthic fauna in particular will be impacted by the pipeline's occupation of the seabed. Where the seabed is covered with rock material or the pipeline itself, any existing life beneath will be destroyed. The significance of this depends on local circumstances, which ultimately determine the abundance of benthic species. The composition of the benthic community at the pipeline surface might, however, be different from the original composition, due to the changed surface characteristics e.g. rock material or concrete weight-coating instead of sand or mud. The most important factor in the development of the benthic community is the presence of oxygen in the sediment water interface. Indirect effects may happen in areas where relocation of suspended sediments occurs, because settling sediments may cover benthic fauna.

The possibility and degree of this phenomenon will be assessed by modelling the spreading of sediments (Section 10.1.2). The overall significance to the benthic communities (area impacted, recovery time) will be evaluated based on the modelling results and on the general knowledge of the living requirements of the species in question. A baseline survey will be conducted along the pipeline routes, where sediment samples will be taken and analysed for macrozoobenthos, see Section 8.3.2.

Impacts on macrozoobenthos will be assessed based on modelling results, results of the field survey for benthic fauna and the seabed properties along the route corridor options, literature and experience from the Nord Stream Project. The main impacts on the benthic environment to be assessed in the EIA are listed in Table 10.8.

Table 10.8 Main potential impacts on the benthic environment to be assessed.

Project phase	Activity	Potential impact
Preparatory activities	Munitions clearance	Changes or loss of benthos due to direct impact on seabed Changes of benthos due to relocation of disturbed sediments
Construction	Pipe-laying Anchor-handling Trenching Rock placement	
Operation	Pipeline on seabed	Creation of new habitats

Experience from the Nord Stream Project:

The monitoring of benthos in connection with the Nord Stream Project has shown that the impacts on benthos have a local extent, and that benthic communities to some extent have re-established on the surface of the pipeline and rock berms (epifauna) and in the sediment close to the pipelines (infauna).

10.2.3 Fish

Impacts on fish will be identified by considering the various project activities during construction. The impact assessment will be based on information on the geographical distribution of physical and chemical changes in the water column. Due to the relatively limited amount of maintenance activities, no impacts are foreseen during the operation phase.

Impacts on fish will be assessed based on modelling results of sediment spreading (Section 10.1.2), previous experience and relevant literature on behaviour of the fish species in question. Table 10.9 list the main impacts on fish to be assessed in the EIA.

Table 10.9 Main potential impacts on fish to be assessed.

Project phase	Activity	Potential impact
Preparatory activities	Munitions clearance	Noise and pressure wave Suspension of disturbed sediments
Construction	Anchor-handling Trenching Rock placement	Avoidance reactions and breeding success of fish
Operation	Pipeline on seabed	Reef effect of pipeline

Experience from the Nord Stream Project:

Investigations during the Nord Stream EIA process showed that the impact on fish was minor Monitoring during Nord Stream construction indicated that sediment-spreading from, e.g. post-lay trenching, is so limited that the impact on fish is minor (e.g. avoidance reactions) or non-existent. During operation, the pipeline might function as an object that attracts fish.

10.2.4 Marine mammals

Impacts on marine mammals will be identified by considering the various project activities during construction. Potential impacts from different project activities are avoidance reaction, physical injury and hearing impairment. Indirect impacts could come from changes in food availability. Due to the relatively limited amount of maintenance activities, no impacts are foreseen during the operation phase.

Impacts on marine mammals will be assessed based on modelling results of sediment spreading (Section 10.1.2), assessments of impacts on the physical and chemical environment, information regarding the presence of seal populations and experience from the Nord Stream Project. Table 10.10 lists the main impacts on marine mammals to be assessed in the EIA.

Table 10.10 Main potential impacts on marine mammals to be assessed.

Project phase	Activity	Potential impact
Preparatory activities	Munitions clearance	Noise and pressure wave Suspension of disturbed sediments
Construction	Pipe-laying Anchor-handling Trenching Rock placement	Disturbance and sediment spreading
Operation	-	None

Experience from the Nord Stream Project:

During the construction of the Nord Stream Pipeline observers of marine mammals were on board the pipe-laying vessel. No marine mammals or impacts on marine mammals were observed during the installation of the pipelines.

10.2.5 Birds

The distance from the route corridor options to the closest IBA at Ertholmene is more than 10 km (see Figure 7.8). Due to the great distance no significant impacts on birds are foreseen. Impact assessment will be based on literature and experience from the Nord Stream Project. Table 10.11 lists the main impacts on birds to be assessed in the EIA.

Table 10.11 Main potential impacts on birds to be assessed.

Project phase	Activity	Potential impact
Preparatory activities	Munitions clearance	Noise and pressure wave Suspension of disturbed sediments
Construction	Pipe-laying Anchor-handling Trenching Rock placement	Disturbance and sediment spreading Noise and lights
Operation	-	None

Experience from the Nord Stream Project:

Monitoring from the Nord Stream Project showed that the extent of enhanced turbidity was small and that the construction vessels moved several kilometres each day, far away from bird habitats. No significant impacts were observed during the Nord Stream Project.

10.2.6 Protected areas

Impacts on protected areas will be identified by considering the various activities during the project. The potential interference of the construction of the pipelines with the protected areas will most likely be related to water quality (from sediment spreading). Impacts will be assessed on different types of protected areas along the route corridor (Natura 2000 areas, Ramsar areas, seal sanctuaries and IBAs).

Impacts assessment will be based on modelling results of sediment spreading (Section 10.1.2), results of the baseline surveys, experience from the Nord Stream Project and relevant literature.

Table 10.12 lists the main impacts on protected areas to be assessed in the EIA.

Table 10.12 Main potential impacts on protected areas to be assessed.

Project phase	Activity	Potential impact
Preparatory activities	-	None
Construction	Pipe-laying Anchor-handling Trenching Rock placement	Suspension and spreading of sediments
Operation	-	None

Experience from the Nord Stream Project:

Modelling and monitoring of sediment-spreading have shown that the geographical extent of a possible effect is small. The seabed intervention works undertaken for the Nord Stream Project (post-lay trenching) generated very little turbidity in the immediate vicinity of the plough and had no impacts on protected areas.

10.3 Impacts assessment on the socio-economic environment

10.3.1 Shipping and shipping lanes

The location of pipelines close to shipping lanes increases the risk of damage from dragged anchors and sinking ships. The route corridor options in Danish waters are far from the emergency anchoring zones north of Bornholm; however, to investigate whether the routes are critical to emergency anchoring and dropped and dragged anchors, and to identify possible mitigation measures, a risk assessment will be performed (see Section 11).

During construction the impacts are related to disturbance of existing ship traffic in the area and risk of collision with construction vessels. In order to minimise the impact on maritime traffic during construction, a safety zone around the lay vessel will be established and monitored by anchor handling vessels acting like guard vessels, as was done for Nord Stream. The anchor handling vessels will contact ships with a course toward the lay barge and advise them to change their course. Furthermore, before and during construction the locations of the construction vessels will be announced on notice to mariners in order to increase awareness of the vessel traffic associated with the Nord Stream Extension Project. Table 10.13 lists the main impacts on shipping and shipping lanes to be assessed in the EIA.

Table 10.13 Main potential impacts on shipping and shipping lanes to be assessed.

Project phase	Activity	Potential impact
Preparatory activities	Munitions clearance	Disturbance of existing ship traffic in the area and risk of collision with construction vessels
Construction	Pipe-laying Anchor-handling Trenching Rock placement	
Operation	Pipelines on seabed	Stuck anchors

Experience from the Nord Stream Project:

During pipe-laying a safety zone was established around the lay vessel where third-party ships were not allowed to enter. No incidents in relation to ship traffic occurred. Risk assessments showed low and acceptable risk.

10.3.2 Fishery

During construction, all third-party vessels, including fishing vessels, will be prohibited from entering the safety zone around the pipe-laying vessel. Fishing vessels may have to alter their fishing paths when approaching construction areas, though this will be for only a limited time period. Impacts can also include trawls becoming stuck under the pipeline or difficulties in trawling across the pipeline.

Impacts on fishery and possible risks to fishing vessels will be assessed based on experience from the Nord Stream Project and literature related to other pipeline projects in the North Sea. Table 10.14 lists the main impacts on fishery to be assessed in the EIA.

Table 10.14 Main potential impacts on fishery to be assessed.

Project phase	Activity	Potential impact
Preparatory activities	Munitions clearance	Safety zone preventing fishing activities
Construction	Pipe-laying Anchor-handling Trenching Rock placement	
Operation	Pipelines on seabed	Disturbance of bottom trawling and damage to fishing equipment

Experience from the Nord Stream Project:

Experience from the Nord Stream Project has shown that the presence of the pipelines on the sea floor may have a potential impact. Trawls can become stuck under the pipelines, which can result in damage or loss of equipment. Through dialogue with fishery associations, common approaches to mitigate potential impacts were established. A special trawl board which makes it easier to trawl across the pipeline was developed and offered (via a payment which made purchase possible) to the fishermen whose work was affected by the pipelines. Furthermore, the pipelines were post-lay trenched in many important trawling areas. It can also be mentioned that one to two years after construction of the Nord Stream pipelines, significant embedment (~50%) has already been observed in many of the sections of the pipelines in Danish waters.

During construction, weekly updates on the location of construction vessels and fixed monitoring equipment were issued to the fishing community to ensure minimum disturbance for fishermen.

Through mitigation measures and dialogue with fishery associations and fishery authorities the impact on fishery was assessed to be minor.

10.3.3 Cables, pipelines and wind farms

The assessment of impacts on infrastructure will be mainly related to the interaction between the planned pipelines and existing pipelines and cables. Crossing structures of the existing pipelines and cables will be agreed with the owners so that no impacts on the cables and pipelines are expected during construction and operation.

The Nord Stream Extension pipelines might cross the Nord Stream pipelines. Procedures and methods will be described in more detail, should this materialise, but it is expected that rock placement will be used to separate the pipelines. Depending on the position of the crossing, the height of the crossing structure above the seabed might influence bottom currents or fishery. The impact of a potential crossing in Danish waters will be assessed.

The route corridor options in Danish waters are far from planned wind farms and no impacts on wind farms are foreseen. Table 10.15 lists the main impacts on cables, pipelines and wind farms to be assessed in the EIA.

Table 10.15 Main potential impacts on cables, pipelines and wind farms to be assessed.

Project phase	Activity	Potential impact
Preparatory activities	Munitions clerance	Agreement procedure with cable and pipeline owners
Construction	Pipe-laying Anchor-handling Trenching Rock placement	
Operation	Pipelines on seabed	Restriction in use of the occupied area

Experience from the Nord Stream Project:

For the Nord Stream Project, all cable positions were fixed by surveys and inspections by remotely operated vehicles (ROV), and all owners were approached. Crossing agreements covering rights, obligations and procedures for crossing were made. The crossings have been constructed in a manner that ensured the pipelines and the cables remained at a safe distance from each other.

10.3.4 Raw material extraction sites and exploitable natural resources

The route corridor options in Danish water are 6-7 km from the raw material extraction sites on Rønne Banke (see Figure 7.14), and no impacts on these extraction sites are foreseen.

The impact assessment will be based on a study of the raw material extraction sites in the project area and relevant literature. Table 10.16 lists the main impacts on raw extraction sites to be assessed in the EIA.

Table 10.16 Main potential impacts on raw material extraction sites to be assessed.

Project phase	Activity	Potential impact
Preparatory activities	-	None
Construction	-	
Operation	Pipelines on seabed	Restriction in use of the occupied area

Experience from the Nord Stream Project:

The Nord Stream pipeline route did not cross any raw material extraction areas in Danish waters. It was assessed that there were no impacts related to extraction sites in connection with the Nord Stream Project.

10.3.5 Cultural heritage

In order to identify unknown shipwrecks geophysical route surveys will be conducted along the route corridor options. The survey data will be scrutinized for anomalies, shipwrecks and other cultural artefacts. The survey data can be made available for evaluation by the Viking Ship Museum on request. The identification of shipwrecks can lead to minor route changes during the initial stage of the project. Any cultural heritage in vicinity of the route corridor options will lead to mitigation measures, e.g. a detailed plan for anchor-handling for the lay barge.

The impact assessment on cultural heritage will be based on results from the geophysical route surveys, evaluations by marine archaeologists, relevant literature and experience from the Nord Stream Project. Table 10.17 lists the main impacts on cultural heritage to be assessed in the EIA.

Table 10.17 Main potential impacts on cultural heritage to be assessed.

Project phase	Activity	Potential impact
Preparatory activities	Munitions clearance	Damage of cultural heritage objects on the seabed
Construction	Pipe-laying Anchor-handling Trenching Rock placement	
Operation	Maintenance rock placement and surveys	

Experience from the Nord Stream Project:

During the Nord Stream route surveys a number of shipwrecks were identified. The Viking Ship Museum on behalf of the Danish Agency for Culture undertook several assessments of the collected survey data. A rudder located in close vicinity of the Nord Stream pipeline route was salvaged by Nord Stream and the Viking Ship Museum in 2009 prior to pipeline installation.

During construction of the pipelines, safety zones were established around a number of cultural heritage objects in order to avoid damage by the lay barge anchors. Monitoring of the identified shipwrecks after construction has shown that no impacts have taken place.

10.3.6 Military practice areas

The route corridor options cross military practice areas in Danish waters (see Figure 7.16). A military submarine practice area used by the German navy east and south of Bornholm could also be affected. No significant impacts are predicted, but this requires that the Admiral Danish Fleet agree to the crossings.

Impacts assessment will be based on consultations with the Admiral Danish Fleet. Table 10.18 lists the main impacts on military practice areas to be assessed in the EIA.

Table 10.18 Main potential impacts on military practice areas to be assessed.

Project phase	Activity	Potential impact
Preparatory activities	Munitions clearance	Restricted use of military area
Construction	Pipe-laying Anchor-handling Trenching Rock placement	
Operation	Monitoring and surveying Pipelines on the seabed	

Experience from the Nord Stream Project:

Nord Stream AG engaged with the Danish Admiral Fleet regarding military practice areas during the Nord Stream Project, e.g. making sure that military exercises in relevant areas did not coincide with construction activities.

10.3.7 Environmental monitoring stations

Monitoring stations in close vicinity to the pipelines could be affected by sediment suspension and spreading and change in currents and erosion/sedimentation patterns around the pipelines. Routing will avoid these monitoring stations wherever possible.

Impact assessment will be based on the results from the sediment spreading modelling and dialogue with relevant authorities and institutions. Table 10.19 lists the main impacts on environmental monitoring stations to be assessed in the EIA.

Table 10.19 Main potential impacts on monitoring stations to be assessed.

Project phase	Activity	Potential impact
Preparatory activities	Munitions clearance	Suspension and spreading of disturbed sediments
Construction	Pipe-laying Anchor-handling Trenching Rock placement	
Operation	Pipeline on seabed	Change in hydrographical conditions

Experience from the Nord Stream Project:

During the Nord Stream Project, the impact on environmental monitoring stations was assessed based on their distance from the pipeline and the construction activities that were planned to take place in the area. No environmental monitoring stations in Danish waters were affected.

11 Risk assessment

In order to ensure that the risk to the public is acceptable, detailed risk assessments are to be performed for both the construction and the operation phases of the Nord Stream Extension. The risk assessments will follow the typical methodology given in Figure 11.1. Each of the different phases are outlined in the following.

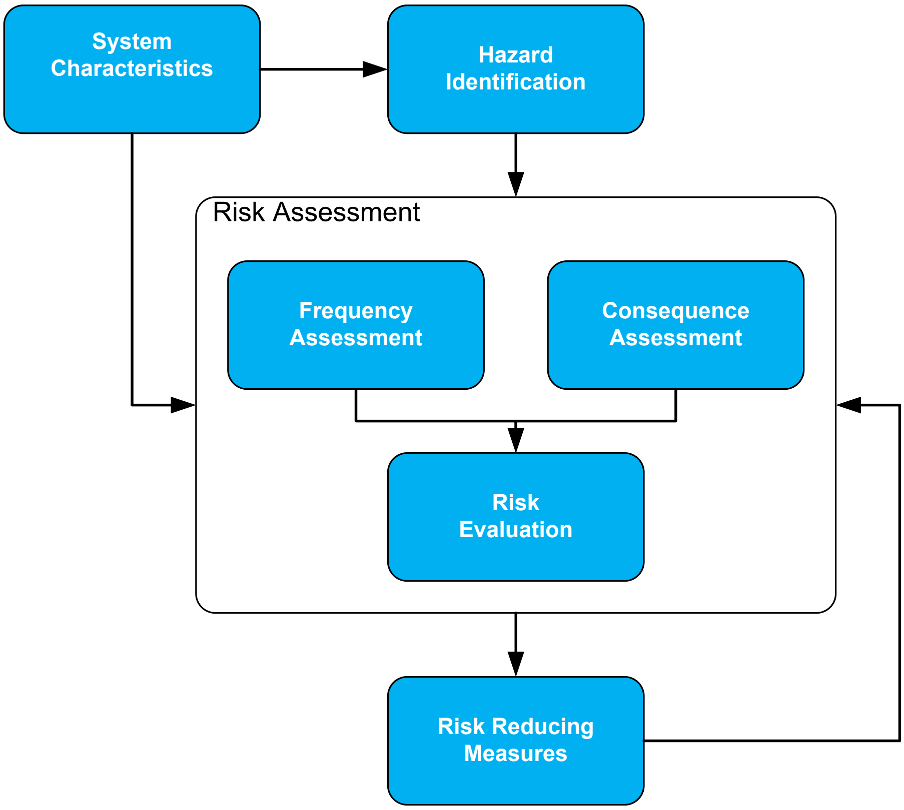

Figure 11.1 Risk assessment methodology.

Initially, the system characteristics are established. This covers the relevant background information which is used as input to the hazard identification process and the risk assessment. Typical information related to pipeline risk assessments is:

- Pipeline route and pipeline characteristics (size, materials, gas composition, etc.)
- Seabed conditions
- Areas with dumped munitions
- Ship traffic (normal traffic in the Baltic Sea, traffic forecasts and construction related traffic)
- Areas with trawling.

A hazard identification (HAZID) workshop will be performed with the purpose of identifying all hazards related to the subsea pipeline system. A HAZID workshop is a structured, team-based process that identifies hazards for a specific system. As part of the hazard session workshop, risk reducing measures will be recorded for each hazard. Hazard workshops will be held to cover both the operational and the construction phase. The hazards will be used as input to the detailed risk assessment. Typical hazards for subsea pipelines are:

Construction phase:

- Ship collisions between construction vessels and normal ship traffic
- Oil spills from construction vessels
- Dropping of line pipes
- Damage to existing subsea installations
- Interference with military areas and activities
- Contact with objects on seabed (e.g. munitions).

Operation phase:

- Material and mechanical defects (e.g. corrosion)
- Dragged munitions (e.g. due to trawling)
- Dragged and dropped anchors
- Dropped objects
- Sinking ships
- Sabotage/terrorism
- Subsea landslides
- Interference with military areas and activities.

The frequency of each hazard occurring (how often a subsea gas release will take place) and the resulting consequences will be studied in detail using mathematical modelling. The consequences for the public are related to exposure from subsea gas release and oil spills.

The risk is then evaluated and compared with the acceptance criteria. If the risk is not acceptable, risk-reducing measures (mitigation) will have to be identified and implemented. If the risk is acceptable it will be reduced according to the ALARP (as low as reasonably practicable) principle. This means, amongst others, that the risk should be reduced as long as the cost of implementing the measure is not grossly disproportionate to the benefits.

The outcome of the risk assessment is also used in the design of the pipeline in order to ensure that the integrity of the pipelines is sufficient; e.g. in areas with high ship traffic trenching or protection of the pipeline may be necessary.

The risks will be assessed for the different route corridor options in order to compare them from a risk and safety point of view.

12 Mitigation measures

Nord Stream AG recognises that implementation of special measures to prevent and reduce pollution and environmental impacts from the pipelines during preparations, construction, operation and decommissioning are necessary. An environmental management system will be established to deal with both anticipated impacts and emergency response. Examples of foreseen precautionary measures that may be relevant are listed below.

Precautions to reduce spreading of sediments from seabed intervention works

- Optimisation of pipeline routes to avoid uneven seabed, which will minimize the need for trenching/rock placement
- Use of trenching methods (ploughing) that reduce spreading of sediments
- Use of rock placement method (fall pipe) that brings rock to a position only a few metres above the seabed.

Measures to mitigate impact on environmentally sensitive areas

- Optimising of pipeline routes to avoid significant impact on designated values in protected areas
- Adaptation of the timetable for the construction works in light of seasonal fluctuations of sensitivity, e.g. spawning periods and wintering birds.

Measures to reduce the risk of vessel accidents

- Safety zone around the lay barge and anchor-handling vessels
- Special attention and precautions when entering shipping lanes and heavily trafficked areas
- Announcement of maritime safety information in Navtex and Notice to Mariners.

Emergency response arrangements

- Prevention measures to mitigate environmental accidents
- Emergency response set-up for mitigating impacts caused by environmental accidents (e.g. oil spill).

Precautions to mitigate conflicts with existing or planned infrastructure

- Consulting with other stakeholders to coexist in the same area
- Establishing procedures for crossing cables and pipelines to avoid any unwanted impacts from cable crossings.

Non-indigenous species

- The IMO guidelines with respect to exchange of ballast water will be observed.

13 Environmental monitoring

The Project Developer plans to develop and implement a focused, fit-for-purpose Environmental Monitoring Programme for the Project with the following objectives:

- Meet the requirements of the national permit
- Verify the broad findings of the modelling used to predict impacts
- Ensure that the construction and operation of the Project is not causing impacts not previously identified in the EIA
- Ensure that the construction and operation of the Project is not causing known impacts to a greater significance than predicted
- Verify the effectiveness of mitigation measures
- Identify at an early stage unforeseen adverse effects and take remedial action
- Monitor the rehabilitation of the environment post-construction.

Monitoring will be directed at those areas of environmental sensitivity that are predicted to experience potentially significant impacts from the Project or where there is significant uncertainty related to the impact assessment. The Environmental Monitoring Programme is planned to be a direct response to the assessed environmental impacts and issues, specifically those requiring mitigating measures and monitoring, and to address particular reporting requirements at the national and international levels.

The main impact of concern during the construction of the Nord Stream Pipeline was an increase in the level of suspended sediments in the water column. The expected effect from this impact was assessed to be minor, which was supported by the monitoring results. All measured levels of suspended sediment concentrations were in line with, or significantly lower, than the expected levels. On a few occasions, high concentrations of suspended sediment were measured close to specific construction activities. However, the extent and duration of these elevated levels were local and short-term, with no harmful effect on the surrounding environment.

The results clearly demonstrate that the expected impacts modelled prior to the construction phase were conservative. All monitoring results confirmed the expected impact levels assessed in the national environmental impact assessments and verified that construction-related impacts were minor, local and short-term.

The environmental monitoring programme for the Nord Stream Project in Danish waters covers the parameters shown in Table 13.1. General conclusions can be drawn for other parameters, making further investigation for the Nord Stream Extension Project redundant. Therefore it is assessed that the monitoring programme for the Nord Stream Extension Project could be more limited, drawing on the knowledge and results gathered during the Nord Stream Project. The actual programme will depend on the chosen route and any permit conditions the authorities may establish.

Table 13.1 Parameters for the Nord Stream monitoring programme for Denmark.

Environmental parameters
Monitoring of fish along pipeline
Monitoring of benthic fauna (infauna / epifauna)
Monitoring of water quality
Monitoring of hydrographical conditions in the Bornholm Basin (inflow of saline water)
Monitoring of chemical warfare agents and chemical munitions
Socio-economic parameters
Monitoring/mitigation measures at national and international monitoring stations
Monitoring of cultural heritage
Monitoring of maritime traffic

The suggested monitoring programme for the Nord Stream Extension Project is shown in Table 13.2 and Table 13.3. Some of the parameters may be excluded, depending on further lessons learned from on-going monitoring of the Nord Stream Project and on the final route for the Nord Stream Extension pipelines.

Table 13.2 Suggested environmental parameters for the Nord Stream Extension monitoring programme for Denmark.

Environmental parameters	Comments
Monitoring of benthic infauna	Benthic infauna may be impacted during construction, particularly during seabed intervention works. The re-establishment of benthic infauna is normally monitored in projects of this nature.
Monitoring of water quality	Turbidity monitoring during the Nord Stream Project showed that the area with an enhanced concentration of suspended sediments is small. Monitoring of turbidity is only suggested if seabed intervention works are carried out very close to vulnerable areas or if special conditions are stipulated in the permit.
Monitoring of chemical warfare agents	In the area east of Bornholm in which fishing vessels are required to have cleaning and first aid equipment on board in case of exposure to chemical munitions monitoring for chemical warfare agents will be necessary during construction.

Table 13.3 Suggested socio-economic parameters for the Nord Stream Extension monitoring programme for Denmark.

Socio-economic parameters	Comments
Monitoring/mitigation measures at national and international monitoring stations	Monitoring stations close to the pipeline route may have to be moved. Sampling at the stations should not coincide with nearby construction work.
Monitoring of cultural heritage	If cultural heritage is encountered close to the pipeline route, monitoring will be necessary to ensure that no damage occurs during construction.
Monitoring of maritime traffic	During construction close monitoring of ship traffic in the construction zone is necessary to mitigate against accidents.

14 Overall timeline for the Project

The preliminary time schedule for the Project's permitting and construction phase is illustrated in Figure 14.1.

The Project was initiated with a feasibility phase comprising a feasibility study and conceptual design, which was completed during 2012. This document presents the findings of the feasibility phase.

Throughout the entire Project development, route surveys will be undertaken to support engineering, permitting and construction and comprise both route surveys, detailed munitions screening surveys and cultural heritage surveys.

Engineering comprises basic design followed by detailed design, during which continuous optimisations of the route and design are implemented based on input from, e.g. surveys and environmental and risk assessments. These optimisations will take place until the start of construction. Follow-on engineering (i.e. the handover to operations and close out) begins at the start of construction and continues until after the start of operation.

Submission of the present EIA programme to the responsible authorities initiates the EIA phase, which covers the assessment of environmental impacts under the national legislation as well as the transboundary assessment of environmental impacts under the Espoo Convention. The EIA is part of the documentation for the construction permit application that must be obtained before start of construction. In Denmark, the construction permit application is followed by an operations permit application for each of the two pipelines.

During the engineering and permitting phases, other preparatory activities, such as production and concrete coating of line pipe and setting up infrastructure and logistics, takes place.

Construction is intended to follow a time schedule similar to that of the Nord Stream Project. The schedule takes into consideration geographical and time constraints, such as ice cover in the Gulf of Finland, spawning in the Baltic Proper, etc. Construction is initiated onshore and at the landfalls before offshore construction starts. As preparation for the pipe-laying, the route undergoes a final survey and certain seabed intervention works are performed together with preparations for the crossing of existing cables and pipelines. Offshore construction is planned to start in April 2016, with the main construction activities in Danish waters taking place in winter 2016/17 and winter 2017/18.

Pre-commissioning includes cleaning, gauging and flooding of the pipelines, followed by pressure-testing, dewatering and drying. This phase also comprises hyperbaric tie-in of the different pipeline sections. Subsequent to pre-commissioning the pipelines are filled with gas (commissioning) to prepare them for operation. The pipelines are planned to enter into operation in October 2017 and October 2018, respectively.

Activities during the operation phase include regular inspections and maintenance and repairs as required. At the end of the pipelines' lifetime they will be decommissioned. The Project's pipelines will be designed for an operating life of at least 50 years.

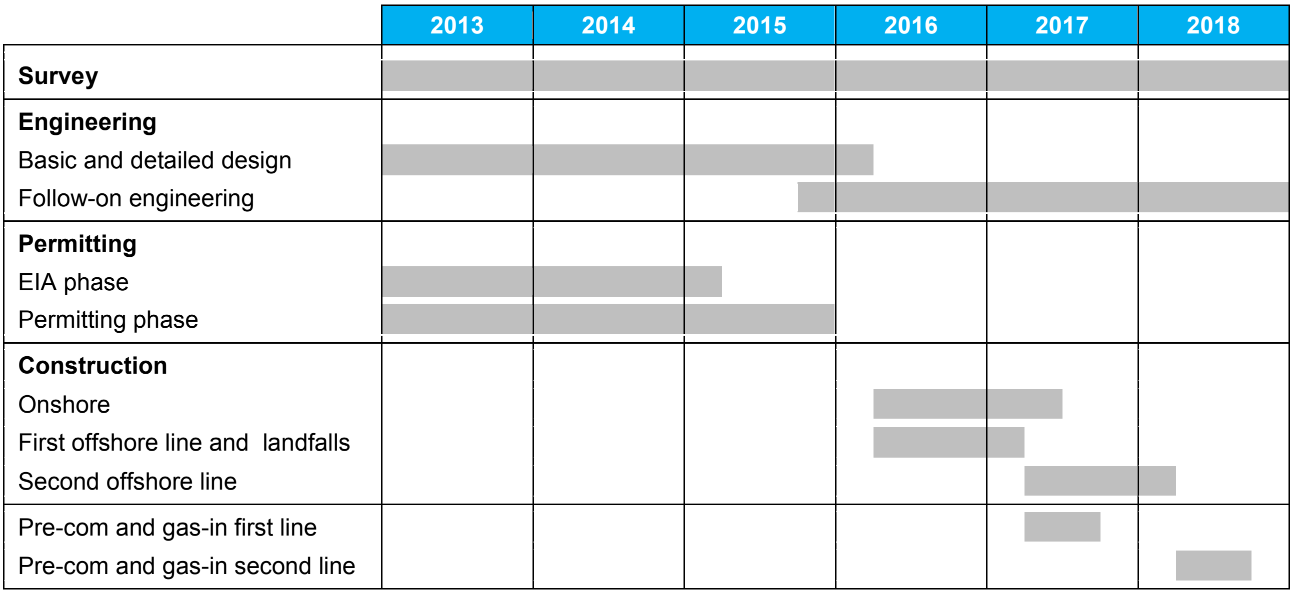

Figure 14.1 Preliminary timeline for the permitting and construction phase for the Nord Stream Extension Project.

15 Content of the environmental impact assessment report (EIA report)

According to the requirements in the Danish Statutory Order no. 632 of 11/06/2012, the following list provides an overview of the content of the Danish EIA report /1/:

1. Non-technical summary
2. Background
3. Project description, including a description of the project's:
    a. physical characteristics
    b. use of materials
    c. emissions
    d. decommissioning possibilities
4. Alternatives, including a description of the:
    a. investigated alternatives
    b. 0-alternative
    c. justification for choice of alternative
    d. future development possibilities
5. Existing conditions in the project area (environmental baseline), including a description of:
    a. humans
    b. flora and fauna
    c. seabed
    d. water
    e. climate and air
    f. material assets, including cultural heritage
6. Approach to EIA and methods applied
7. Impact assessment of the preferred pipeline route and design, including the impacts from:
    a. the pipeline system as a whole
    b. the use of natural resources
    c. the emission of polluting compounds
    d. the cause of nuisances
    e. the deposition of waste
8. Risk assessment
9. Transboundary impacts
10. Mitigation measures
11. Environmental management system (EMS)
12. Emergency preparedness
13. Evaluation of gaps and uncertainties
14. Proposed environmental monitoring
15. Overall time schedule and milestones
16. Parties who have contributed to the EIA report

16 References

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