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CABLE SYSTEMS IN THE SWEDISH EXCLUSIVE ECONOMIC ZONE — IMPACT ASSESSMENT

CABLE SYSTEMS IN THE SWEDISH EEZ — IMPACT ASSESSMENT

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APPENDICES

1. INTRODUCTION

1.1 Background

This report is an impact assessment supplementing the permit application for construction of two subsea cable systems in the Swedish Exclusive Economic Zone (EEZ) south of Skåne. The impact assessment has been compiled on behalf of Energinet Eltransmission A/S (Energinet) for the planned cable connection that will connect the Energy Island Bornholm with the Danish electricity grid on Zealand, Denmark. The project is part of the Energy Island project initiated by the Danish Government, which includes the construction of approximately 3 GW offshore wind power in the Baltic Sea off the coast of Bornholm as well as the construction of associated subsea cables to Zealand and Germany. The planned cable route is shown in Figure 1-1. The impact assessment is an appendix to the permit application for constructing the subsea cables in accordance with Section 15a of the Continental Shelf Act (1966:314) (Kontinentalsockelförordning, KSL). The compilation of the impact assessment was preceded by a consultation process in which content and issues that may be of particular importance for the assessment were discussed. An Espoo consultation was also carried out.

This impact assessment concerns the planned construction of the two cable systems in the Swedish EEZ. The other parts of the cable route within the Danish waters are being considered and handled under the provisions of Danish legislation.

1.2 Administrative information

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The impact assessment was compiled by Ramboll Sweden AB, and the following consultants were involved: Håkan Lindved, Therese Stark, Ann Ajander, Kajsa Palmqvist, Ingemar Abrahamsson, Lotta Persson and Claire Hébert.

1.3 General information about the project and the applicant

Energinet is an independent public operator under the Danish Ministry of Climate, Energy and Utilities. Energinet owns, operates, and develops the Danish transmission systems for electricity and natural gas. The Danish Government plans to establish two wind parks with a production capacity of approximately 3 GW off the coast of Bornholm as part of the Energy Island Bornholm project. Energy Island Bornholm will serve as a regional energy hub that will supply Denmark and neighbouring countries with electricity from 2030. This impact assessment concerns the planned construction of the two cable systems in the Swedish EEZ. In parallel with the present permitting process, investigations and permit application processes are also undertaken for the construction of the planned wind farms and cables within Danish waters. These are being considered and handled under the provisions of Danish legislation.

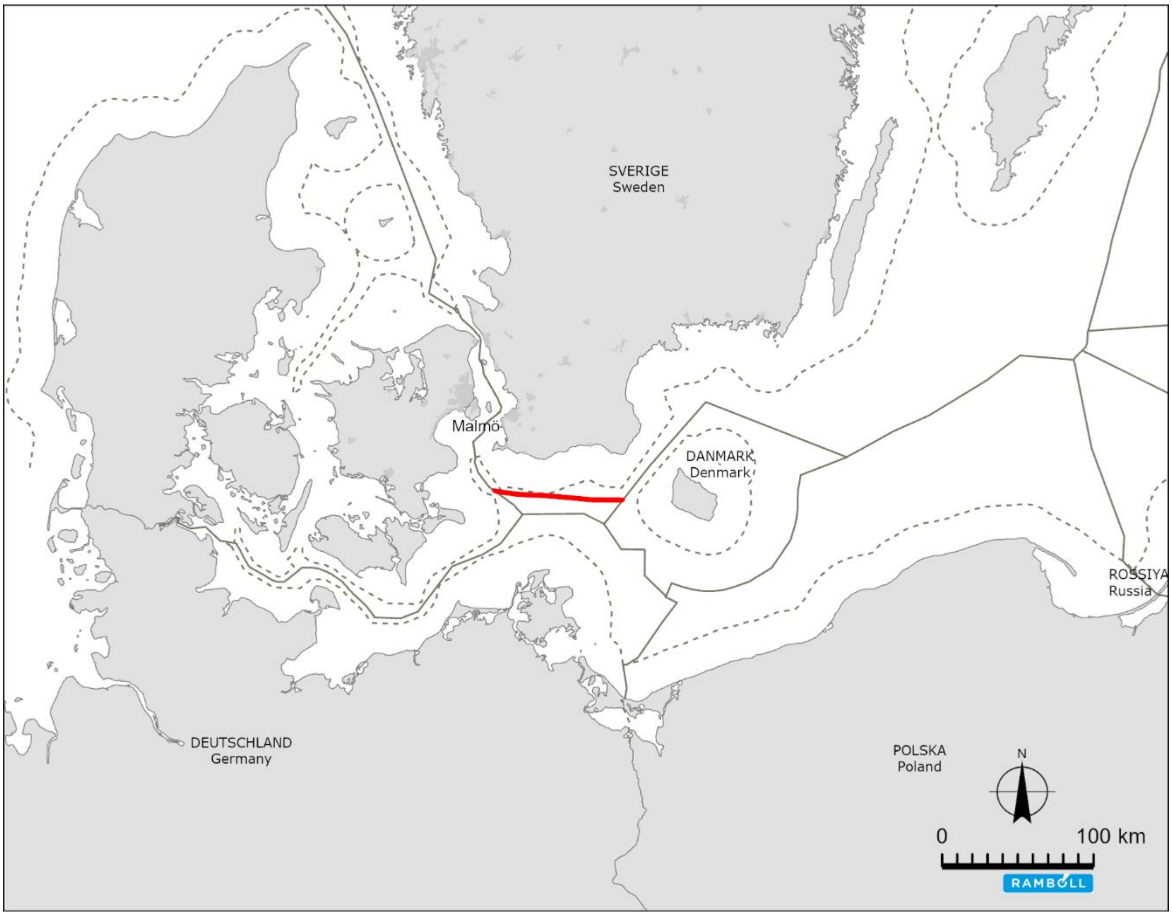

Figure 1-1. Location of the planned cable corridor in the Swedish EEZ.

2. LEGISLATION, PERMIT APPLICATION PROCESS AND CONDITIONS

The planned cable connection between Bornholm and Zealand pass through the Swedish EEZ on the Swedish continental shelf. The construction of subsea cables on the Swedish continental shelf requires a permit in accordance with Section 15a of KSL.

Under international law, states enjoy full sovereignty within their territory. In addition, coastal states have obtained certain jurisdiction and sovereign rights within the EEZ and on the continental shelf outside the territorial boundary of the coastal state. This follows from the express provisions of the United Nations Convention on the Law Of the Sea of 10 December 1982 (UNCLOS).

According to Article 79.1 of the UNCLOS, all states have the right to lay subsea cables and pipelines on the continental shelf. According to Article 79.2 of the UNCLOS, a coastal state, in this case Sweden, may not prevent the laying or maintenance of such cables or pipelines, if the project owner takes reasonable measures for (i) examination of the continental shelf; (ii) processing of its natural resources; and (iii) to prevent, limit and monitor contamination from pipelines.

The UNCLOS does not allow a coastal state to impose additional or stricter requirements/conditions than those provided for in Article 79 of the UNCLOS, i.e. what follows from points (i) to (iii) above.

Sweden has implemented Article 79 of the UNCLOS, i.e., the right of all states to lay pipelines, through Section 15a of KSL. A permit under Section 15a of KSL may only be subject to the conditions necessary to:

(i) enable the exploration of the continental shelf and the extraction of its natural resources;
(ii) prevent, limit, and monitor contamination from pipelines; and
(iii) protect the possibility of using and repairing existing subsea cables and pipelines.

In accordance with the UNCLOS, Sweden is cannot impose requirements or conditions other than those specifically stated in Section 15a of KSL. This means that consideration of a permit application under Section 15a of KSL is not subject to a formal requirement for consultation or the preparation of an impact assessment. Despite the fact that there is no formal requirement, Energinet has chosen to carry out a voluntary consultation process and impact assessment, corresponding to an environmental impact assessment, as part of the application for the planned project.

2.1 Consultation process

A consultation for the scope and definition of the impact assessment was carried out with authorities, stakeholders and organisations. Energinet has also notified surrounding countries of the operations via the Swedish Environmental Protection Agency in accordance with the Convention on Impact assessment in a Transboundary Context, the Espoo Convention. Consultation under the Espoo Convention is currently in progress.

The consultation was carried out in spring 2022 and opinions were received and compiled in the consultation report, Appendix C1.

3. PROJECT DESCRIPTION

The planned project may be divided into 3 phases – construction, operation and decommissioning. A detailed technical description has been compiled and submitted as appendix to the permit application. This chapter provides an overview of the planned project including its location, design and expected activities.

3.1 Location

The project area for the planned cable systems in Swedish EEZ is located in the southwestern part of the Baltic Sea. The cable route runs parallel to the Baltic Pipe gas pipeline; see Figure 3-1. Baltic Pipe is an existing pipeline that was built in a collaboration project between the Polish transmission network company Gaz-System and Energinet.

The project area consists of a 85 km long and 1000 m wide cable corridor stretching from the Swedish/Danish EEZ border by Bornholm to the Swedish/Danish EEZ border by Zealand. The corridor has been extended from the consultation phase to include 500 m south of the Baltic Pipe following comments received during the consultation phase. Potential wind power operators in the area see advantages in the cables being laid at least partially south of the Baltic Pipe. The option to use the area south of the Baltic Pipe is also advantageous if unforeseen events (chapter 16) are encountered in the northern part of the corridor.

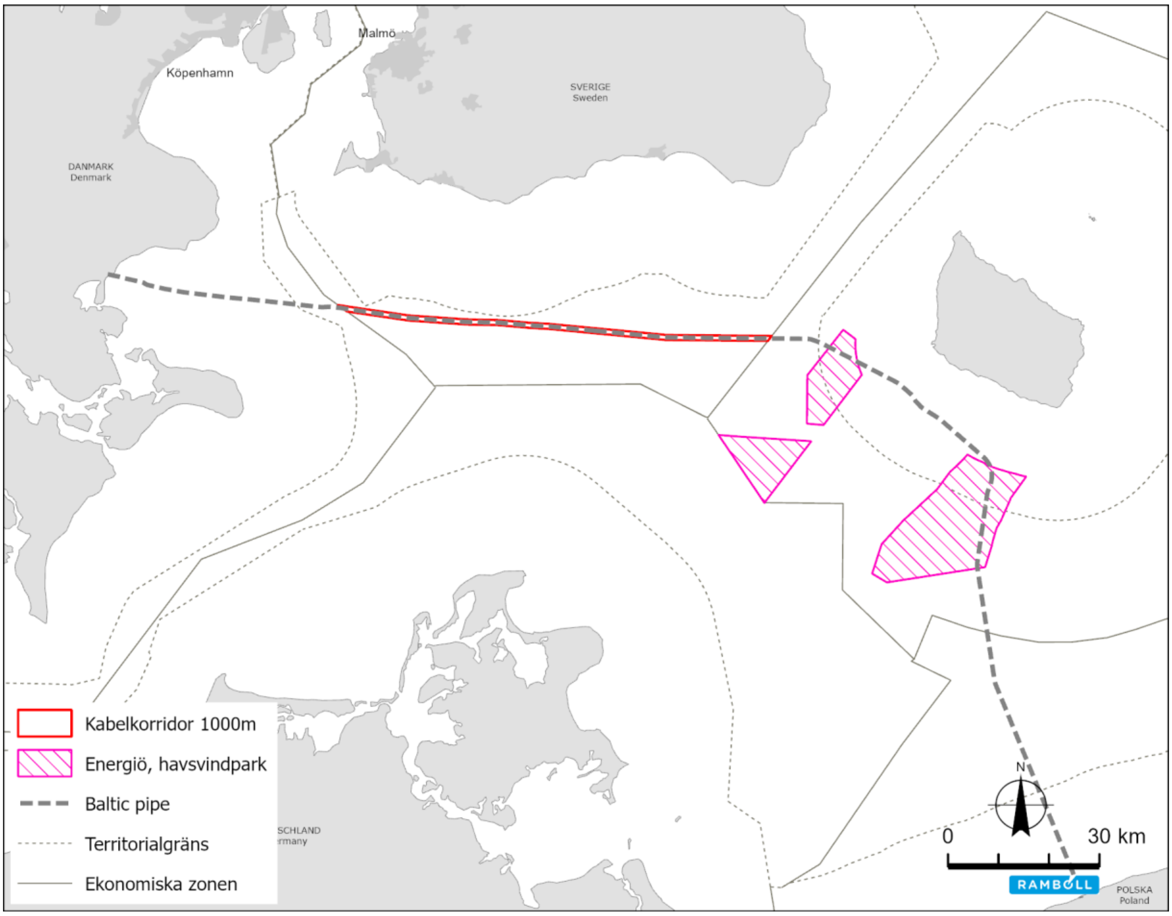

Figure 3-1. Location of the cable corridor. The figure also shows Energinet's proposed wind farms in the Energy Island Bornholm project (separate permit application in Denmark).

3.2 Design of the cable systems

The planned cable corridor is designed to accommodate up to two bundled High-Voltage Direct Current (HVDC) cable systems with a maximum capacity of 1.2 GW each and a total of up to 2.4 GW. The construction period is expected to last up to three years per cable system in the period 2025-2030.

The cable systems will be bipolar systems, which transfer energy through a closed circuit of two high-voltage conductors of opposite polarity. Each HVDC bundle will be configured with four cables: two HVDC (each with a maximum voltage of up to ± 525 kV), a metal return conductor and a fibre optic cable; see Figure 3-2. The diameter of a cable bundle is 0.3-0.4 m.

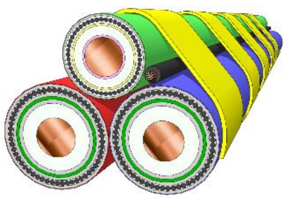

Figure 3-2. The bundle configuration of the cable systems will consist of four cables: two HVDC cables, a metal return and a fibre optic cable.

3.3 Construction phase

3.3.1 Installation

Works will be conducted in proximity to cable installation works to confirm that no new obstacles have emerged on the seabed since the exploration surveys were conducted. The works are a prerequisite for conducting route clearance and finalization of the detailed engineering design, for example decisions on detailed adaptation of the route.

UXO verification is conducted in the entire cable corridor to check if the route is clear or if any unexploded ordnance has surfaced or appeared on the seabed since previous UXO survey was performed. The verification is done to ensure that the planned works can be carried out safely. The work is carried out using passive magnetometers (MAG), that are towed behind a vessel. The speed is estimated to be approximately 20 - 30 km/day, resulting in an expected duration of 1 month for the entire cable corridor. If UXO have appeared, identification is conducted by visual inspection using a remotely operated vehicle (ROV) or by a diver. If this happens, it is treated as an unplanned event. See section 16.1.

Prelay works including a crossing investigation, will be carried out for the entire cable corridor immediately prior to cable installation. The works will confirm to what extend the route is estimated to have the same survey data as before, include a review of bathymetry with respect to changes and possible obstacles, and verify other objects that may affect cable-laying operations. The rate of progress is estimated to be approximately 20 - 30 km/day, resulting in an expected duration of 3 months for the entire cable corridor.

one of the works within the Swedish EEZ will include seismological methods such as sub-bottom profiles or other surveys that may cause noise impacts of importance to marine mammals. The works will also not include drilling methods such as rotary drilling.

In addition, any obstacles encountered along the selected route need to be removed. Route clearance typically involves a pre-lay grapnel run (PLGR), although the final choice of equipment will depend on the specific bottom conditions existing. Larger obstructions may be removed using for example a remote operated grad, see Figure 3-3. Large boulders can be pushed or pulled aside. If the obstacle is too large to be moved, the cable route may be adjusted within the cable corridor to pass around the obstacle.

Figure 3-3. Equipment for removing obstacles such as boulders.

Each cable system will be laid in an approximately 1 - 2 m wide and 1 – 2 m deep trench to protect it from damage. It cannot be ruled out that in some locations will require a deeper burial depth due to local conditions, such as loose sediment. To determine the exact depth at which the cable systems will be laid, a cable burial risk assessment study will be carried out based on data collected during the construction phase.

The planned distance between the cable systems is 100 – 200 m if space allows. A larger distance will reduce the risk of disconnecting the wind farms of Energy Island Bornholm if the cable systems are damaged simultaneously by e.g., a dragging anchor. If certain complicated conditions occur i.e., when passing protected marine areas or other significant areas of interest the distance between cable systems can on shorter distances be less than 100 m. However, this will complicate later service on the cable systems.

It is not possible to transport the cable systems in their entirety. Since one vessel cannot transport cables for the entire route, the bundled cables are installed in sections. The cables will be joined, but the exact number and position of joints cannot be determined in advance. is performed on board the vessel and will take approximately two weeks per joint. Meanwhile, the vessel will stay anchored at the specific location. Protection of joints may be conducted using a mass flow excavator (MFE) on selected hot spots to move sediment. Then the trench around the joint is refilled with sediment or other covering as described in the cover section. During construction, it is ensured that, as far as possible, the necessary joints are not placed in hot spots, for example in shipping routes, where it would be inappropriate for cable system vessels to be stationary for a long time.

Three principal methods considered for cable lay and burial are:

1. The cable system is laid in a pre-lay prepared trench
2. The cable system is laid and buried simultaneously (SLB method)
3. The cable system is laid on the seabed and buried by a post-lay trencher (PLB method)

Currently, the expected preferred burial method is cable lay in pre-excavated trenches, especially in the western part of the cable route but possibly also in the eastern part.

The methods, and current variations thereof, are described in more detail below. However, given technological developments, it cannot be ruled out that other technologies and methods may prove preferable at the time of construction. However, such methods will not entail more far reaching consequences than those considered to be the worst case according to the environmental assessment.

The following methods may be relevant for laying the cable systems, depending on bottom conditions. The sediment spillage described under each method is a measure of the proportion of sediment handled that becomes suspended in the water. This is described in more detail in section 8.1.

- Ploughing to create pre-lay trenches
- Marine plough
- Mechanical excavation (chain excavator)
- Flushing/jetting
- Covering with stone

Ploughing may be used with most bottom conditions but is mainly used with hard bottom substrates such as compact clay and sand. The method is applicable especially where the depth is greater than 30 m. The width of the seabed affected by the trenching will be approx. 1 - 2 m depending on the size of the grab on the excavator, but the width of the footprint of the seabed including the plough track is estimated to be approx. 10 – 15 m wide, and including soil moved by plough approx. 20 – 30 m. The material dug up is placed beside the trench or at another designated place and used for backfilling after the cable system is in place. Before the cable system is laid in the trench, it may be necessary to clear the trench by excavation or suction dredging. To protect the cable system, it may be necessary to first fill the trench with crushed rock before natural sediment is backfilled on top.

Estimated sediment spillage from ploughing is 3.5 - 4% and the speed of ploughing operations is estimated to be 0.1-1 km/day. The method is considered applicable in the West section of the cable corridor, which may also be applied in the East section. It is estimated that the cable system can be laid at a speed of 2–3 km/day.

By using **a marine plough,** the bottom sediment is ploughed, and the cable system is laid directly afterwards (Figure 3-4). The ploughing method may be fast, with minimum impact on the seabed, but some factors may mean that this solution is not ideal, such as (too) hard sediment and (many) occurrences of cable or pipeline crossings. The speed is estimated to be 0.1–2 km/day, but this depends on bottom conditions. West section of the cable corridor, which may also be applied in the East section. It is estimated to take about 2 months to implement and that it will contribute sediment spillage of approximately 2%.

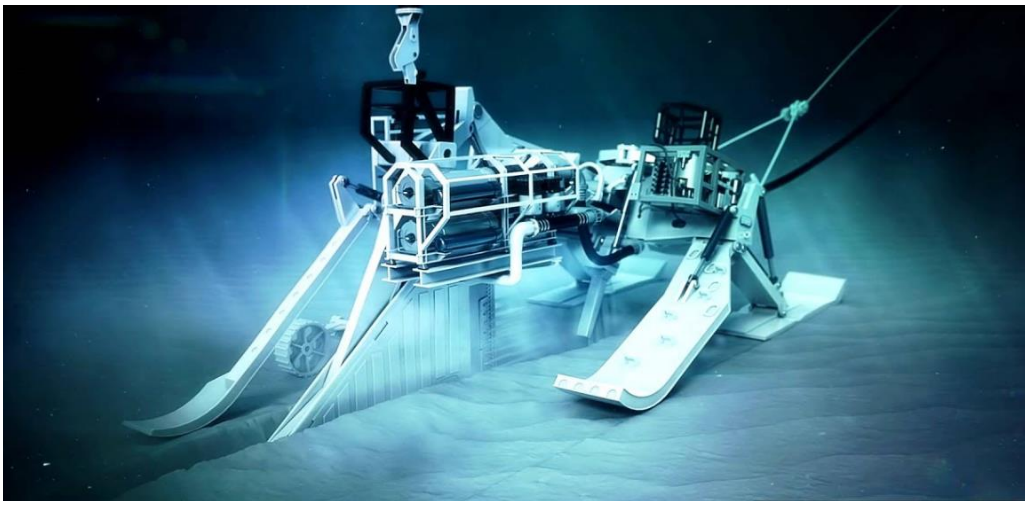

Figure 3-4. Example of a marine plough (Primo Marine, 2022).

In **mechanical excavation**, saws or wheels with teeth are used to dig a trench with vertical sides, and the method is used with hard bottom conditions. The trench will be approximately 1 - 2 m wide and the estimated sediment spillage is approximately 4 %. The expected speed is 0.1 - 2 km/day. This method is unlikely to be used. However, it is not possible to completely exclude its use in the western part of the cable corridor.

With **flushing/jetting**, nozzles are used that flush water into the seabed under the cable system and create a compartment that is filled with fluidised material (suspended sediment). The flushing method is usually used in granular materials such as silt, sand or peat. It is also an effective method where there is a thick layer of soft sediment (silt) and/or sand on the seabed. The width of the seabed affected by the flushing would be approximately 0.7 - 1.2 m. The estimated sediment spillage from the method is approximately 4%. The expected speed of the method is 0.5 - 2 km/day.

It may be necessary to **cover** the cable systems if the cables cannot be laid or can only be partially laid in the sediment. In this case, the cable system is covered with crushed rock (often 10-40 cm in diameter) that is dumped from ships/barges, sometimes with the help of a telescopic arm. The expected extent of the cover is approximately 2 - 3 m. If pre-dug trenches are covered, the extent will be the same as the width of the trench. The estimated sediment dispersion from the method is approximately 0.15 %. However, the method is only considered to be necessary over a very limited section. Natural sediment is then laid on top of the cover.

Crossings

It is expected that crossings will be managed using rock dumping. Below is an illustration of typical design of a pre-lay rock berm (i.e., the separation between the crossed asset and the crossing asset) and a post-lay rock berm (i.e., the protection of the crossing asset). Typically, a separation of approximately 1 m is considered sufficient, and if the crossed asset is buried deeper than 1 m it is not always necessary to perform pre-lay rock dumping and the cable would instead be laid directly on the seabed. In cases where burial of the crossed asset is smaller than 1 m a pre-lay rock berm should be expected. The pre-lay rock berm will typically be installed with a minimum heigh of 0.3 m and a maximum heigh of 1.3 m.

The minimum cover from post-lay rock berm is 0.5 m relative to the top of the cable system. An alternative to a post-lay rock berm may be concrete mattresses or a separator system (plastic rings) that are installed around the cable systems. Another alternative to a post-lay rock berm is to lower the third-party infrastructure so that no rock berm is needed. The choice of design will be related to third-party requirements, local requirements, existing conditions, costs, and other criteria.

3.3.2 Post-lay

The as-buried work is carried out continuously along sections of the cable route as cable laying and burial progress. The purpose of the work is to verify that the cable is buried to the required depth, in the correct position and that there are no areas where the cable may be overstressed, exposed, or present a snagging hazard.

The as-built work is carried out along the entire cable route after the cable has been laid and buried and installation is completed. The purpose of the work is to determine that the cable burial depth meets the specification defined by the developer.

3.3.3 Preliminary time schedule for construction

An overview of the schedule, outlining the sequence and preliminary timing of the construction works, is shown in Table 3-1. All offshore works are weather dependent, but the intention is for all work to be carried out in one season per cable system, and a continuous construction phase is generally considered to be positive from the point of view of disturbance. Construction will take place using special ships or barges, and the work will continue around the clock. The work will move along the entire route, so the impact on individual locations will be considerably more short-lived than indicated in the table.

The work causing sediment dispersion is estimated to be carried out for 2-4 months per cable system.

Table 3-1. Overview of preliminary schedule. Colours indicate the proposed period during which the work is carried out and do not indicate the duration of the individual work.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
The project: Construction works in the Swedish EEZ							
Pre-lay and UXO							
Clearing the route							
Preparation of crossings and pre-executions							
Cable laying, joints, burial, protection, as-buried							
As-built							

3.4 Operation phase

A routine inspection survey with cable tracker is expected every 5-7 years. Otherwise, routine inspections are usually not necessary for subsea cables, which are designed to require minimum maintenance. Regular inspections of crossings can be required as part of the entered crossing agreements.

3.5 Decommissioning phase

After the operation phase, the cable systems will be decommissioned. The life span of the power cables is approximately 40 years, but the operational life may be extended. The technical options and the most suitable solutions for the decommissioning of the subsea cable system are likely to change over the life of the cable system. In some cases, leaving the cables in place may have the least impact on the environment. If the cables are removed, they will be disposed of in accordance with current legislation at that time and the parts that can be used for other purposes will be recycled.

A plan for the decommissioning will be developed towards the end of the operation phase, and the methods will reflect the technical knowledge acquired during the cables' operational period. A decommissioning plan will be developed in consultation with the relevant authorities and in accordance with the legislation in force at the time of decommissioning.

4. SCOPING

4.1 Scoping of content

Scoping is an important step in preparation of an impact assessment, as it identifies the environmental aspects that are likely to be of most importance and eliminates those that are of little importance. In this way, scoping is helps to obtain the relevant focus and level of detail in the impact assessment.

During the consultation process, the scope of the impact assessment was identified. Table 4-1 provides an overview of the scope of the impact assessment.

Table 4-1. Overview of the scope of the impact assessment and what environmental aspects are addressed.

Environmental aspect	Included in the impact assessment	Comment
Soil and groundwater	No	Soil and groundwater are not affected by the construction of cable systems
Surface water	Yes	
Natural environment	Yes	
Landscape	No	The landscape is not changed
Recreational activities	Yes	National interest in outdoor activities is included; other outdoor activities are not considered to be affected at all
Human health	No	The distance from areas in which people are present is large and there is no impact from noise and air pollution
National interests	Yes	
Environmental goals	No	Not relevant
Environmental quality standards for surface water	No	Considered not affected owing to large distance from bodies of water
Marine Strategy Framework Directive	Yes	
Cultural environment	Yes	
Natural resources	No	The cable systems will not affect any sites used or expected to be used for the extraction of raw materials. The extraction of raw materials is therefore not addressed in the impact assessment.

The assessment takes into account the effects on the environmental aspects included of the project's construction, operation and decommissioning phases.

4.2 Geographical scope

The impact assessment includes the project within the Swedish EEZ, including cross-boundary effects. The project for the cables in Danish waters is considered in a separate permit application under Danish legislation, which also highlights cross-border impact. The different environmental aspects have different geographical scope, depending on the nature of the environmental aspect.

4.3 Temporal scope

The impact assessment must describe a time frame within which most of the effects on the environmental aspects included is expected to occur. Construction of the cable systems is estimated to be carried out during one or two construction campaigns. Once in place, the cables are estimated to be in operation for at least 40 years. Potential effects during operation and decommissioning are also included.

5. ALTERNATIVES

5.1 Selected alternative

Early in the process, negotiations on collaboration agreements were conducted with neighbouring countries (Germany and Sweden) to decide on the optimum cable route. However, only Germany was interested in connecting to Energy Island Bornholm. Consequently, the Danish Government decided that Energy Island Bornholm would prepare for a cable route between Bornholm and Zealand and a route for interconnector cables to connection gates at the Danish/German EEZ border. In the present work, the potential impact is assessed for the cable route in Swedish EEZ.

The selected alternative for the cable route is located parallel to the Baltic Pipe gas pipeline (constructed in 2021), where the cable systems are planned to be installed within a 1000 m wide corridor, see Figure 3-1. Energinet considers the selected alternative to be the preferred alternative for several reasons. The total footprint on the seabed and potential barrier effects may be minimised by following the existing Baltic Pipe route. The main alternative is also the shortest route through the Swedish EEZ between Bornholm and Zealand and will therefore cause the least direct impact on the seabed.

In addition, the existing exploration survey data from the Baltic Pipe project can be reused as basis for the impact assessment, along with exploration survey data obtained from potential wind power operators in the area has also been provided for the assessments. By reusing existing data, potential environmental effects from exploration survey activities are avoided.

5.2 Location study and evaluation criteria

In 2021, Energinet had an initial location study conducted (Ramboll, BALTIC SEA ENERGY ISLAND Cable route development, 2021) for the cable connection between Energy Island Bornholm and Zealand to identify the most suitable cable route corridors. The point of departure was to find possible alternatives for the location of the cable corridor that met the technical requirements of the project and were also appropriate to environmental and other interests such as Natura 2000 sites, shipping, fisheries and military activities.

The initial location study identified the three possible routes shown in Figure 5-1. Two of these routes (alternatives A1 and A2) pass through the Swedish EEZ, and one route (alternative B) passes through the German EEZ. Routes A1 and A2 follow the same corridor within the Swedish EEZ and differ only with respect to landfalls on Bornholm in Danish territorial waters. An in-depth analysis was carried out in which routes A1, A2 and B were analysed and ranked environmentally and technically according to the criteria in Table 5-1.

In 2021–2022, the Danish authorities clarified the location of possible landfall areas on Bornholm and Zealand. A more northern location for landfalls on Zealand was preferred and contributed to the route through Swedish waters becoming even more advantageous.

In the consultation phase in 2022, two more alternative routes within the Swedish EEZ were studied, namely a northern route around the Skåne Havsvindpark (offshore wind farm) project area (option C) and a southern route that follows the border of the Swedish EEZ (option D). See Figure 5-1. These alternatives were assessed according to the same criteria as set out in Table 5-1. As explained in the following section, alternative A was selected as the most appropriate, while alternatives B, C, and D were excluded based on the assessment criteria in Table 5-1.

As for the alternatives through the Swedish EEZ, it is not possible to avoid a route through the Sydvästskånes utsjövatten Natura 2000 site because this site extends all the way from the mainland to the boundary of the EEZ. As a point of departure for the evaluation of the different alternative routes, an important factor was therefore to minimise the impact on the designated species and habitats of the Natura 2000 site.

Table 5-1. Assessment criteria for the location study from 2021.

Criteria
Shortest possible length (i.e., a shorter construction period, smaller footprint on the seabed, less fuel consumption and less material consumption for cable production)
Impact on protected areas, e.g., Natura 2000 sites
Impact on the cultural environment, e.g., wrecks and Stone Age settlements on the seabed
Impact on shipping traffic
Impact on commercial fisheries
Impact on existing and planned infrastructure, e.g., other cables, pipelines and wind farms
Protective distance of 200 m from existing cables and pipelines
Crossings with existing cables and pipelines
Space for cable vessels during installation
Cable corridor width of 1000 m
Avoidance of shallow areas, steep bathymetry, difficult geology for cable installation or extremely soft sediment, etc.
Avoidance of anchorages, dumping and dredging areas, areas with dumped ordnance, etc.

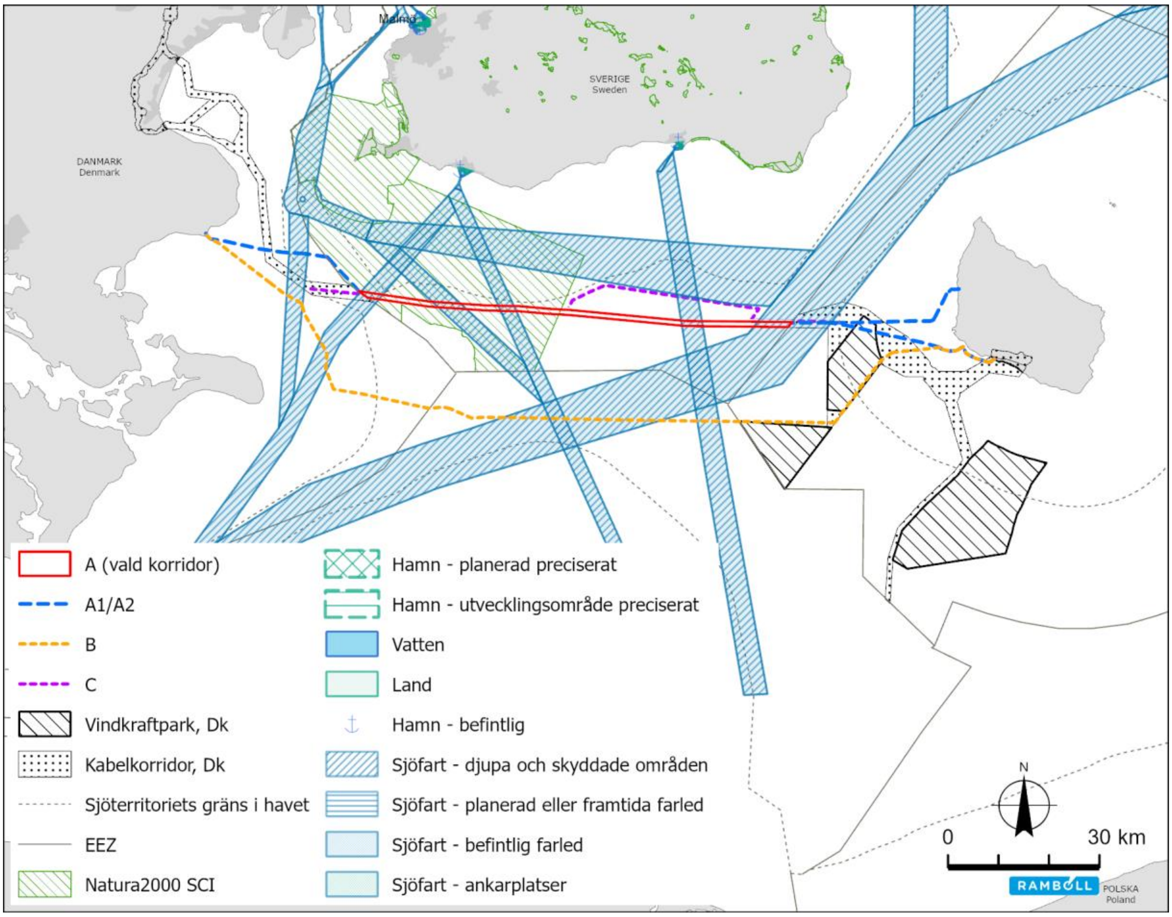

Figure 5-1.Studied alternative locations for the cable route between Energy Island Bornholm and Zealand, including ship traffic interests and Natura 2000 sites. The selected cable corridor within Swedish EEZ and planning areas for subsea cables, offshore windfarms and onshore areas are also shown.

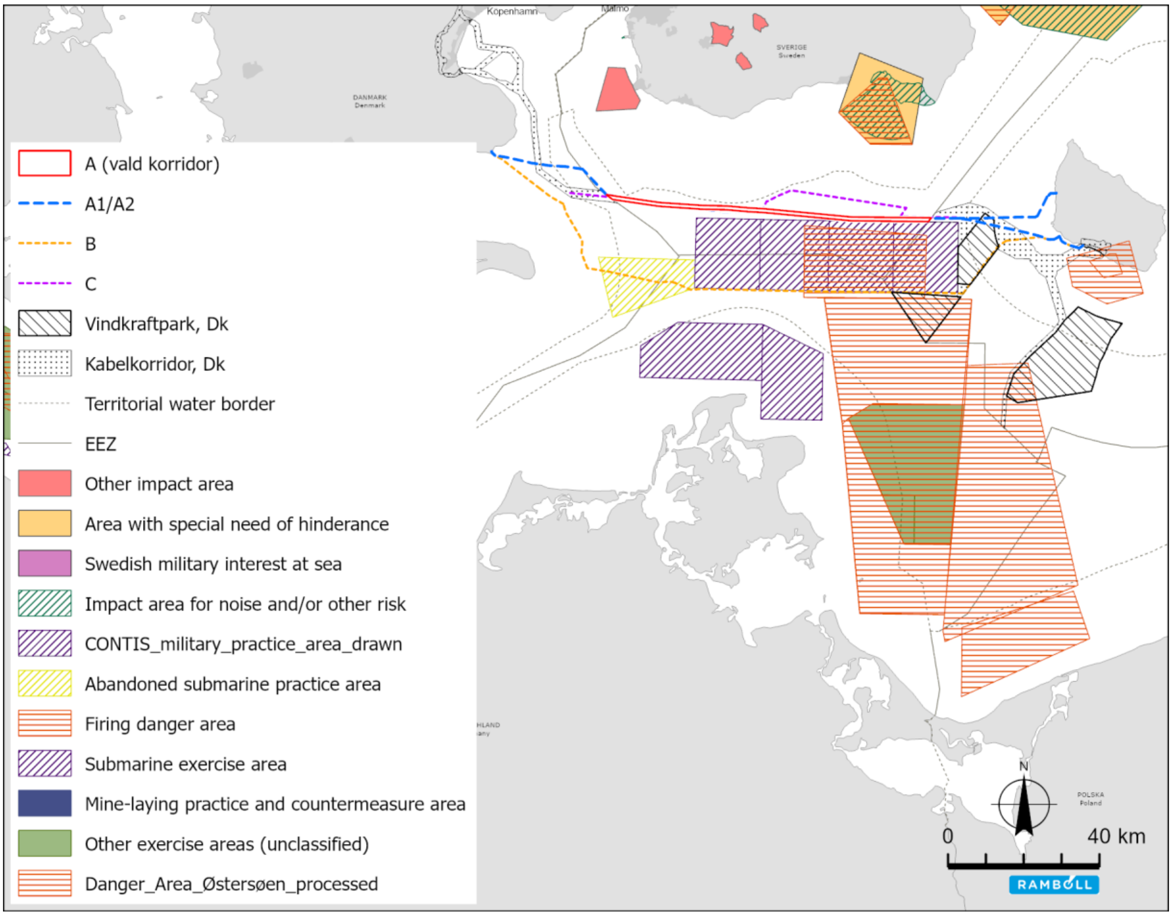

Figure 5-2. Studied alternative locations for the cable route between Energy Island Bornholm and Zealand, including areas of military interests. CONTIS military area corresponds to the NATO area described in the text The selected cable corridor within Swedish EEZ and planning areas for subsea cables, offshore windfarms and onshore areas are also shown.

5.2.1 Alternative A - the selected alternative

Based on the initial location study, alternative A was assessed to be the most suitable route for the cable connection between Energy Island Bornholm and Zealand. The location of the planned cable corridor is shown in Figure 5-1.

Compared to the other alternatives, alternative A has been assessed to be the route that best meets the project's requirements. This is the preferred route in term of both technology and environment/surroundings.

The selected route has no impact on the large NATO military area (BRAVO 2 – 5) located south of the route, which is considered a prerequisite given the current geopolitical situation in Europe and the Baltic Sea. The NATO area is used for military submarine exercises and is not considered to be able to coexist with the planned operations. See also below regarding the impact on the NATO area.

Alternative A is the shortest route compared to the other alternatives (B, C and D) and consequently the route with the smallest footprint on the seabed of the Baltic Sea. As a consequence,, the construction period is minimised and thus potential effects on shipping and commercial fisheries. The project's total carbon footprint is minimized because less resources will be spent on cable production and transportation.

The selected route runs parallel to the Baltic Pipe gas pipeline, which has already been installed. The Baltic Pipe project is a collaboration between Energinet and the Polish transmission network company for natural gas, GAZ-SYSTEM S.A. Energinet therefore has very good knowledge of the area in question and the expected environmental effect of the operations applied for. The extensive survey data produced within the framework of Baltic Pipe may therefore be reused by Energinet in this project. This data has also been supplemented with further detailed survey data from other wind power developers in the area. By reusing existing data, potential environmental effects from exploration surveys may be completely avoided. For example, seismic methods such as sub-bottom profiles, which could potentially affect harbour porpoises in the area can be avoided. The same applies to sediment sampling and rotary drilling methods that could potentially cause local effects at the sampling sites.

The selected route passes through the Sydvästskånes utsjövatten Natura 2000 site. The protected area is large, and the cable route that has been selected to avoid protected habitats - biogenic reefs and sandbanks. The aim of the planned operations is also to ensure that other sensitive habitats are avoided during laying, see appendix C to the application. The designated species in the Natura 2000 site are harbour porpoises, grey seals and harbour seals. The planned operations are not assessed to give rise to any significant impact on these marine mammals. A route closer to the mainland is generally assessed to be worse owing to lower water depth and probably greater presence of protected habitats and species such as seals. There may also be other potential effects on the typical species of the nearby habitats, mainly cod. In this respect, too, the route selected is assessed to be preferable to other alternatives. See, for example, below regarding sediment dispersal for the route through the German EEZ and its risk of impact on spawning grounds for fish populations in the Arkona Basin, including cod.

An additional aspect to consider is that wind farms are planned within the corridor of the route selected. Three different projects are planned in an overlapping area, but only one project can be realised. By following the route of Baltic Pipe, the impact on any future wind farms is assessed to be limited as far as possible. The potential for coexistence was assessed to be good, as confirmed by the consultations carried out and the adaptation of the cable route.

5.2.2 Alternative B – Route through German EEZ

Based on the location study, alternative B was assessed to be the least suitable alternative as it fulfils the purpose of the project least from a technical and environmental/environmental perspective.

Alternative B through the German EEZ is the longest route compared to the other alternatives (A, C and D) and consequently the route with the largest footprint on the seabed of the Baltic Sea. The time required for completing the construction phase would be longer compared to the other alternatives, resulting in a higher potential impact on shipping and commercial fishery interests. The project’s carbon footprint is larger owing to increased resource consumption for cable production and transport. Furthermore, the environmental effect in the form of sediment dispersal, underwater noise, etc. is more extensive.

is not previously surveyed so exploration surveys would have to be included in the project. Exploration surveys include the use of methods such as low frequency sub bottom profiler and cone penetrations tests that may potentially disturb Baltic Sea harbour porpoise in the area, as well as core sampling and box core sampling tests that require sediment removal at each sampling site. Additional sediment sampling would also be required at a number of sampling stations again having the potential for local disturbances.

The route passes close to a NATO area (BRAVO 2 – 5) and an abandoned exercise area for submarines. Because of this use, unexploded ordnance (UXO) is likely to be encountered within and around this area. The volume of potential military equipment that would need to be removed prior to cable laying is therefore expected to be higher, and this also contributes to increased vessel activity and ordnance detonation that could potentially disturb harbour porpoises and other species in the area.

Alternative B would also cross and run along shipping routes to a greater extent, potentially leading to greater impact on vessel traffic and causing disruption during construction, maintenance and repair operations. Works along shipping routes also increase nautical risks.

To ensure compliance with the German maritime plan, shipping routes should be crossed by the shortest possible route, which was not assessed to be possible owing to other marine constraints, in particular the NATO (submarine) area, in which coexistence was not assessed to be possible. In the unlikely event that laying in the NATO area were to be accepted, the cable laying could cause greater impact on the environment owing to the likely increased presence of UXO.

Finally, the route would require a substantially increased cable burial depth to protect the cable from the risk of damage from on-going military activities, and it would involve crossing a major shipping lane at a non-optimum angle that involves a longer distance in a busy area. As a result, this would result in increased sediment spill and a higher risk of potential impact on the breeding grounds of fish populations in the Arkona Basin, compared to the other alternatives.

Overall, alternative B is assessed to have the highest environmental effect of the alternatives studied, while it is also the least preferred alternative from a technical point of view.

5.2.3 Alternative C - Northern route around the Skåne Havsvindpark in Swedish EEZ

In 2022, a northern route around the Skåne Havsvindpark project area (one of the three wind power projects) was studied. This alternative C is shown in Figure 5-1 and is called route C. According to this alternative, the cable route would follow the northern boundary of Skåne Havsvindpark's project area in the Swedish EEZ, before returning to the Baltic Pipe route. This alternative was abandoned for several reasons. Firstly, it would be longer and thus affect a larger area of the seabed. Secondly, it would be located very close to a nearby shipping, lane which would pose a risk to the cable but also a potential effect on the ship traffic during construction. Finally, the project would be dependent on the permitting and construction of the Skåne Havsvindpark project not yet approved, meaning that the potentially negative consequences mentioned would occur quite unnecessarily. The route would also cross the area where the internal cable network from the wind farm meets the offshore transformer platform, which could lead to problems if any of the cables needed to be repaired or similar.

5.2.4 Alternative D - More southerly alternative in Swedish EEZ

In addition, a more southerly alternative was considered, which meant a route that follows the boundary of the Swedish EEZ. Such an alternative involves a longer cable route and would cross the NATO area, in which coexistence is not assessed to be possible. At the same time, such an alternative does not avoid the Natura 2000 site either, as this extends to the boundary of the Swedish EEZ. This route would also have consequences for the Krieger's Flak II wind farm, which has now been approved, and another wind farm located at Krieger's Flak in the Danish EEZ.

Assuming that it would be permitted to pass through the NATO area, the cable systems would have to be buried significantly deeper in the seabed to avoid risks associated with military submarine exercises. This would lead to more sediment dispersal than other alternatives, resulting in a higher risk of affecting the cod population in the Arkona Basin, among other things.

Owing to the military use of the NATO area, UXO is likely to be found within the area. Consequently, the amount of military equipment that would need to be removed is likely to be higher along this alternative, resulting in increased vessel activity in the area and detonations with high sound levels that could potentially harm harbour porpoises and other species in the area. In addition, there is a relatively large area within the NATO area in which exercises take place, with the risk of firing, bombing, artillery, torpedoes, missiles, etc.

The route has not previously been studied, which means that there is no geotechnical and environmental data for the area. Environmental and seabed surveys therefore need to be carried out. Among other things, exploration surveys include the use of methods such as low frequency sub bottom profiler and cone penetrations tests that may potentially disturb Baltic Sea harbour porpoise in the area, as well as core sampling and box core sampling tests that require sediment removal at each sampling site. Additional benthos sampling would also be required at a number of sampling stations again having the potential for local disturbances.

Overall, the more southerly alternative within the Swedish EEZ was therefore considered to be unsuitable for the planned cable system.

5.4 Zero alternative

The zero alternative means that no action is taken and the planned project is not realised. As a result, the Energy Island Bornholm project cannot be realised and the approximately 3 GW wind power cannot be transferred to Zealand and neighbouring countries. Consequently, it will be more difficult for Denmark to achieve its target of a 70% reduction in greenhouse gas emissions by 2030 and to meet the EU’s political commitment to be carbon neutral by 2050.

The zero alternative therefore represents the environmental conditions in the area without the cable systems. The zero alternative, that the applied construction activities are not approved, means that there is no intervention on the seabed beyond the continuous impact in the area because of, for example, bottom trawling. The zero alternative also means that the potential effects from construction activities in the form of noise, sediment dispersion, and electromagnetic fields around the cable during operation will not occur.

Without cable systems from Energy Island Bornholm, the entire Energy Island Project is at risk. Denmark will encounter problems achieving its national climate goals. In addition, there will be no development of the innovative investment in energy islands as hubs for energy and the technologies that will scale up and accelerate the expansion of offshore wind production facilities needed to achieve European independence from fossil energy sources, not least from individual countries such as Russia.

Not installing the cable systems counteracts the 2020 Baltic Sea Offshore Wind Joint Declaration of Intent, signed by the European Commission, the Baltic States, Sweden, Finland, Poland and Germany. The declaration of intent states that cooperation is needed to achieve the massive wind power potential of 93 GW in the Baltic Sea. Furthermore, it counteracts that Sweden at a later stage can connect to Energy Island Bornholm and through this connection deliver or receive renewable energy to the future integrated regional energy network in the Baltic Sea region.

5.3 Alternative methods

There are several different alternative methods available for installing the subsea cable systems. They are presented in section 3.3. All methods described in the section may be used, depending on different existing bottom conditions. An alternative method that has been excluded is vertical injection/jetting assisted plough, as this method is not considered a suitable construction method in the area.

6. IMPACT ASSESSMENT METHOD

The impact assessment is carried out by first identifying the potential environmental effects from the planned activities. Then, this is followed by a description of the existing conditions in the area and an assessment of how the potential environmental effect will affect the existing conditions. The totality of how the planned activities change the existing environmental conditions represents the impact of the project.

The following terms are used:

- Impact – which means that changes occur in the environment as a result of the project's activities (for example sediment dispersal, sound, physical disturbance, etc.)
- Environmental effect – direct or indirect effects that are positive or negative, temporary or permanent, occur in the short, medium or long term; the impact (for example physical damage, impediments to activities) that occurs at the receptor as a result of the impact
- Receptor – environmental assets (for example specific species or habitat) or socioeconomic/economic assets (for example commercial fisheries, shipping) that may be affected
- Environmental value – the value of the aspect in question in the area in which an environmental effect occurs
- mitigation measure – measures taken to prevent, impede, counteract or remedy the negative environmental effect, which means a measure to reduce the magnitude of the impact
- Consequence – final assessment of the consequence for the receptor

6.1 Methods for describing the existing conditions

A description of the existing conditions is produced on the basis of information from, for example, authorities and organisations, scientific literature, inventories and various reports that report the state of the environment.

Site-specific studies, inventories and expert assessments were used for detailed descriptions of the existing conditions. Surveys and inventories carried out to determine the existing conditions are shown in Table 6-1. The existing studies and investigations that form the basis of the assessments stem from the Baltic Pipe project and the data for the examination of Ørstedt's offshore wind farm in Skåne. The impact assessment for Baltic Pipe was used in some cases when separate reports were unavailable (Ramboll, 2019f). Similarly, the impact assessment for Skåne Havsvindspark was also used (Ørstedt, 2021). The studies used are solid, carried out recently and are complete. They provide an adequate basis for describing the existing conditions and for carrying out the impact assessment. In addition, Ramboll was responsible for the consideration process for both Baltic Pipe and Skåne Havsvindspark.

Table 6-1. Existing surveys/inventories used to determine the existing conditions.

Subject	Done, year	Date of report	Complete report name
Sediment sampling for contamination	2008	Acquired in 2022	SGUs Kartvisare
	2018	16 April 2019	Baltic Pipe Offshore Pipeline – Permitting and design Final Report - Geochemistry
	7 May 2021	July 2021	Skåne Offshore Wind Farm – Environmental toxins in sediment (confidential)
Sediment conditions	September 2017 – April 2019	7 May 2019	Report No. 1 Interpretive Geophysical Survey Report – Final Route – Danish Territorial and EEZ waters, Swedish EEZ and Polish Territorial and EEZ waters
		25 October 2019	Geophysical survey operational report
Harbour porpoise study	Summary of knowledge	28 February 2019	Baltic Pipe Offshore Pipeline – Permitting and design - Harbour porpoises in relation to the Baltic Pipe gas pipeline in Sweden – Baseline and assessment report
Marine mammals	November 2017 and October 2018.	22 May 2019	Baltic Pipe Offshore Pipeline – Permitting and design Final report – Marine mammals
	March to May 2019 and March 2020 to April 2021	18 August 2021	Marine mammal studies for Skåne Offshore Wind Farm Baseline study March 2019
Marine archaeology	2019	7 May 2020	Baltic Pipe Offshore Pipeline – Permitting and design Marine archaeological report – Sweden
Avifauna (birds)	November 2017, twice winter 2017/2018, March 2018, April, May, August and October 2018.	31 May 2019	Baltic Pipe Offshore Pipeline – Permitting and design Final report – Avifauna
	2019-2020	29 June 2021	Skåne Offshore Windfarm AB Migrating birds at Skåne Offshore Wind Farm
Water chemistry (hydrochemistry)	22 February and 26 March and between 22 July and 28 July 2018.	29 April 2019	Baltic Pipe Offshore Pipeline – Permitting and design Final Report - Hydrochemistry
Fish	January and October 2018	31 May 2019	Baltic Pipe Offshore Pipeline – Permitting and design Final Report -Ichthyofauna
Macrozoobenthos	2018	4 June 2019	Baltic Pipe Offshore Pipeline

Subject	Done, year	Date of report	Complete report name
			– Permitting and design Final Report - Macrozoobenthos
Infauna and epifauna	May 2021	August 2021	Skåne Offshore Wind Farm – Description of infauna and epifauna
Phytobenthos	2018	30 May 2019	Baltic Pipe Offshore Pipeline – Permitting and design Final report - Phytobenthos
Commercial fisheries	2017-2019	23 September 2021	Skåne Offshore Windfarm AB Impact assessment, Skåne Offshore Wind Farm

6.2 Impact assessment method

The impact assessment covers the consequences that may arise during the construction, operation and decommissioning phases of the project. A systematic approach was used to identify and assess the project's potential environmental effects and the consequences that may arise. To mitigate consequences, various mitigation measures are also identified to avoid, minimise, or reduce impact which, if they are a commitment, are taken into account in the final assessment of consequences.

The environmental value, environmental effect and consequences are assessed based on various questions:

- How high is the effect? How often and when does the effects occur? Is the effect temporary or permanent?
- What is the value of that which is exposed to the impact? Is the value affected positively or negatively?
- What will be the consequence for the value in relation to the extent of the effect?

The consequence is assessed based on the magnitude of the effect and the environmental value of the receptor in question. The impact assessment covers the impact of the planned operations, taking into account commitments on mitigation measures.

The magnitude of the effect and the value of the receptor are concepts that must be stated as objectively and transparently as possible and imply that the impact assessment must show how they were determined.

To focus the impact assessment on the relevant aspects, the impact assessment is defined.

6.2.1 Identification and assessment of the environmental effect of the project

The impact is identified based on the project's activities at different stages. This impact means an effect that must be important for different receptors.

Impacts have been identified for the project which include sediment dispersal, underwater sound and physical disturbance on the seabed and above the water surface. Studies and modelling used to assess the effects of the impact are shown by and were based on modelling carried out in the Baltic Pipe project and also own studies.

Table 6-2. Studies and surveys carried out to determine effects.

Subject	Done, year	Date of report	Complete report name
Sediment modelling	Modelled in 2008-2017	15 March 2019	EIA Baltic Pipe
Underwater noise from construction and operation	Modelling	15 March 2019	EIA Baltic Pipe
Electromagnetic field	2022	19 April 2022	Energinet
Underwater noise from UXO	Modelling	6 April 2021	Underwater Noise Mitigation during UXO Clearance – Sweden
Marine risk analysis	2022	June 2022	Energy Island Bornholm technical report- Navigational safety for export cable (Sweden)

6.2.2 Scope of the impact assessment

To ensure that the impact assessment is not unjustifiably extensive, it is limited to those receptors for which environmental effect of any significance may arise or to aspects specifically highlighted in the consultation process. The purpose of the definition is to give the impact assessment an appropriate scope and level of detail so that it is more accessible. For receptors that are clearly not relevant to the consideration, no impact assessment is carried out. If the magnitude of the effect is no/negligible or the environmental value is no/negligible, no further assessment of consequences is made. Therefore, if the effect is extremely limited in magnitude (for example in time or distribution) and if the receptor is not sensitive to the resulting impact, the environmental aspect is not studied further in the impact assessment. This definition is departed from in cases in which an assessment was specifically considered to be of interest in the context of the consultation.

6.2.3 Magnitude of environmental effect

The magnitude of the environmental effect must be related to the receptor to be assessed. For example, it may be based on the sensitivity of different T-species to sound, pollution levels or other impacts. The magnitude is determined according to the impact that may occur at the receptor, for example a certain content that produces an impact on the receptor to be assessed.

When assessing the magnitude of the effect, the methods, designs, equipment, etc. that have the greatest impact are used, where alternatives are not excluded in the technical description. Therefore, a worst-case scenario is applied when determining the magnitude of the effect. For each impact factor, for example, the most environmentally negative type of construction method or design is used for the assessment.

The following circumstances are also taken into account, where relevant, when assessing the magnitude of the effect:

1. The geographical extent of the effect (local within the project area, regional, national or global)
2. The duration of the effect – negligible (≤ 1 day), short-term (1 day to 2 months), long-term (2 month to a few years) or permanent (cable system life)
3. The time of year at which the effect arises or continues linked to the receptor
4. Frequency – often (several times a day), regular (once a month) or rarely (a few times a year)

The magnitude of the environmental effect may be negligible/no, small, moderate or large. In general, it was assumed that if an environmental effect is lower than current guideline values for a receptor, it is assessed to be no/negligible.

Since the environmental effect must be related to the receptor, it may vary for the same activity. For example, the impact of suspended sediment in the construction phase may be moderate for fish while it is small or negligible for seals.

6.2.4 Level of environmental value

The environmental value of a receptor must be related to the area in which a potential environmental effect arises but also be seen in a broader perspective. For example, if the receptor is commercial fisheries, an assessment of the environmental value must take into account the active fisheries in the area affected in relation to the fisheries from a regional perspective. Another example: if the receptor is seals, the environmental value must be assessed according to the extent to which seals exploit the area exposed to an environmental effect and how viable the population is regionally.

The environmental value indicates a sensitivity or susceptibility for the receptor in connection with the project and is assessed as large, moderate, small or no/negligible. For the different receptors, for example, specific qualities, specific character and statutory protection are important in the assessment.

For biological receptors, different criteria are used to determine the level of the environmental value, for example protection value, sensitivity to change, adaptability or population magnitude.

For socioeconomic receptors, utilisation factors and existing regulations or guidelines that describe, for example, the conservation value of specific sites/activities or social values such as cultural, economic, historical or outdoor values, may be used to determine the level.

The level of the environmental value must be determined taking into account the area in which the impact occurs, for example in the area physically utilised or in the area in which a certain level of pollution or sound level is present. Even if a receptor has high value at national or regional level, the environmental value does not have to be high at local level in the area in which the impact occurs. For example, if there is no commercial fishery of significance in the area in which an impact occurs, the environmental value will be small or negligible.

6.3 Assessment of environmental effects

The consequence is indicated on a five-point scale (no/negligible to very large) by combining the level of the environmental value with the magnitude of the environmental effect according to Table 6-3. In addition to the magnitude of the effect, the consequence also describes how it was determined with further comments on the importance of the consequence, for example with regard to the natural environment, society and the economy, where appropriate.

Table 6-3. Matrix for assessing consequences, example colours for consequences.

	Large environmental effect	**Moderate environmental effect**	**Small environmental effect**	**Negligible/ no environmental effect**
High environmental value	very large consequence	large consequence	moderate consequence	no/ negligible consequence
Moderate environmental value	large consequence	moderate consequence	small consequence	no/ negligible consequence
Low environmental value	moderate consequence	small consequence	small consequence	no/ negligible consequence
No/negligible environmental value	no/ negligible consequence	no/ negligible consequence	no/ negligible consequence	no/ negligible consequence

6.4 Other assessments

For national interests, Natura 2000, environmental quality standards, cumulative effects, cross-border impact and risks, assessment methods have been used that do not follow the method described above. These may be aspects for which the assessment is not on a graduated scale; the consequence either occurs or does not, whether it is acceptable or not. Conditions for assessments are specified below:

6.4.1 Assessment of national interests

An assessment is made of whether the operations may lead to a lasting impact on the designated values of the national interest that counteracts the purpose of the national interest.

6.4.2 Assessment of Natura 2000 site

Assessment is of the impact on conservation status. This means that an assessment is made of the extent to which the operations may harm the habitats intended to be protected in the Natura 2000 site and whether the operations may cause a disturbance which may significantly impede the conservation of the protected species.

A conservation plan must be drawn up within each Natura 2000 site. This document describes the purpose, conservation measures and conservation objectives of each Natura 2000 site. The aim of conservation measures is to achieve and maintain the established conservation objectives over time. Conservation objectives are central to permit considerations of the impact of operations on a Natura 2000 site and must form the basis of the assessment of whether a permit may be granted in accordance with Chapter 7, Section 28b, of the Environmental Code (Naturvårdsverket, 2017).

The conservation status of a habitat refers to the sum of the factors that affect a habitat and its typical species that may affect its natural distribution, structure and function in the long term, and the long-term survival of the typical species. The conservation status of a habitat is considered to be favourable when:

- its natural or traditional range and the areas it covers in this region are stable or increasing,
- the specific structure and functions necessary for its maintenance in the long term exist and are likely to exist for the foreseeable future, and
- the conservation status of its typical species is favourable.

The conservation status of a species refers to the sum of the factors affecting the species concerned which may affect the long-term natural distribution and abundance of its populations. The conservation status of a species is considered to be favourable when:

1. data on the population development of the species concerned shows that the species will remain a viable part of its habitat in the long term,
2. the natural or traditional habitat of the species is neither decreasing nor likely to decrease in the foreseeable future, and
3. there is and is likely to continue to be a large enough habitat for the species' populations to be maintained in the long term.

For assessments of the impact on a Natura 2000 site, support is available in environmental effects and impact assessments for bottom flora/fauna, birds, mammals, and other species.

6.4.3 Assessment of the impact on environmental quality standards and the Marine Strategy Framework Directive

An assessment is made of how the operations may affect environmental status and whether the operations may affect the conditions for complying with the environmental quality standards for the marine environment. In offshore activities, it is not normally relevant to assess other environmental quality standards, for example those for groundwater, outdoor air, noise or fish and mussel water.

6.4.4 Cumulative effects

Assessment is made of how the planned operations interact with existing and approved operations to create additive, antagonistic effects (the cumulative effect is lower than the sum of the individual effects) or synergies (the cumulative effect is higher than the sum of the individual effects). Planned but not yet approved operations are also taken into account, to the extent possible, on the basis of available information.

6.4.5 Cross-border impact

An assessment is made of how the planned operations may affect biological and socioeconomic assets in a cross-border context. This assessment is based on the methodology in section 6.3.

6.4.6 Assessment of risks and unplanned events

No impact assessment is carried out for risk because the disturbances that an accident may lead to are not continuous or may never occur. Instead, an assessment is made of whether the risks of accidents are acceptable or not.

7. MARINE PLANS

The Government has adopted the marine plans developed by the Swedish Agency for Marine and Water Management (HaV), which are designed to provide guidance on how marine areas in Sweden should be used. The aim of the plans is to move towards future use that is best suited for the different areas. The marine plans along the cable corridor are presented in Figure 7-1. The eastern parts of the cable corridor in the Swedish EEZ go through areas designated for general use (Ö267). It is specifically stated for the planning area that 'The laying, operation and maintenance of data and telecommunications cables, power cables, pipelines and gas pipelines must be enabled where appropriate'. Throughout the plan area there are designated areas for shipping, commercial fisheries and sand extraction, which are described separately in each section of the impact assessment. Within the plan area, special consideration must be given to high cultural environment values in management, planning and permit consideration.

The western parts of the proposed cable corridor run through an area (Ö284) of natural value. This area must be conserved and developed to ensure biodiversity and promote ecosystem services. In addition, this plan area contains shipping and commercial fisheries values, but special consideration must also be given to cables and high cultural environment values in the same way as for plan area Ö267. Immediately south of the cable corridor in the western part of the route, there is an area designated as a study area for energy recovery.

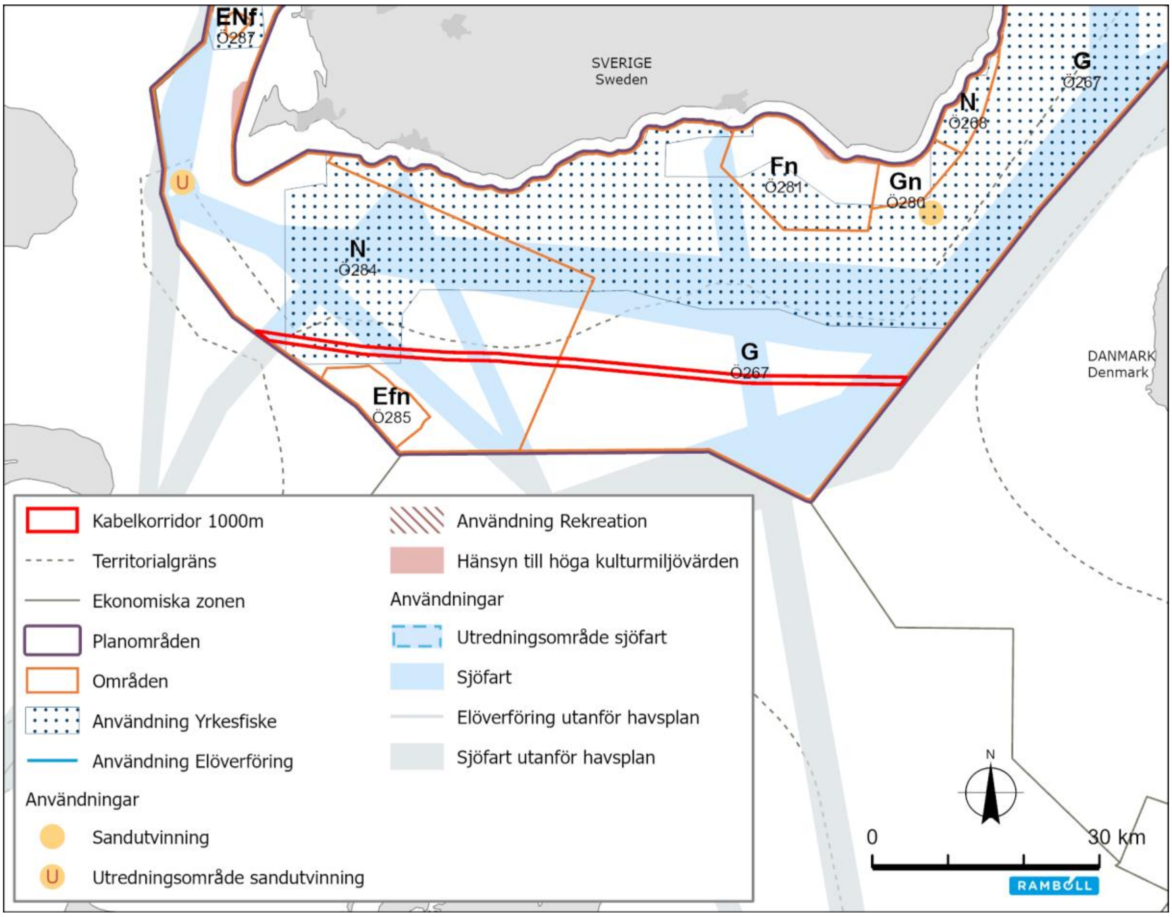

Figure 7-1. Marine plans adopted 2022.

8. IMPACT AND MITIGATION MEASURES

8.1 Sedimentation and suspended sediment

Construction activities such as trenching, covering and installation of cable systems give rise to sediment dispersion by stirring up sediment and mixing it into the water. The suspended sediment spreads from the site of activity to surrounding areas and increased sediment dispersion may affect the surrounding environment. When the sediment particles then sink to the bottom (are deposited as sediment), this also affects the surrounding bottom areas.

The different expected methods to install the cable system are presented in section 3.3.1. It has not been decided which specific method will be used, but all proposed methods are estimated to have a concentration of dispersed sediment below 5%. Works causing sediment dispersion is estimated to last for approximately 2-4 months per cable system.

Numerical modelling of sediment dispersion caused by construction activities has been applied (Ramboll; 2019f). The modelling was carried out with the assumption that the pipeline from Baltic Pipe would be buried 2 m into the sediment, which is described in more detail below. Since a pipeline has a significantly large circumference, the modelling is considered to be conservative compared to the planned construction work. However, the construction work here will consist of two cable systems that will be built approximately 100-200 m apart if space permits. The sediment modelling carried out assumed spillage of 5%, which is also a reasonable assumption for the planned operations.

Sediment dispersion occurs during work on the seabed, mainly trenching, but may also occur when rock is being laid or other cover applied. The extent of sediment dispersal depends on factors such as the type of activity, the type of bottom material and the type of equipment used (for example a plough). The dispersal also depends on the hydrodynamic conditions existing in the area. The spillage is transported in the water until it is finally deposited as sediment in an area from which it is not resuspended, an accumulation bottom. Before this happens, the sediment may be deposited and resuspended several times, depending on soil conditions and grain size. This may contribute to an increase in the background concentration that is naturally present in the area.

Sediment dispersal was conservatively modelled for trenching because this activity has the greatest impact in terms of sediment dispersal. For the Baltic Pipe project, the trenching was modelled in the areas in which extra pipeline protection was assumed to be required for shipping routes. As a conservative assumption, the percentage of sediment dispersed during trenching was set at 5% in the model. However, the actual percentage is expected to be lower. When the modelling was carried out, it was assumed that the sediment would consist primarily of clay, which consists of a relatively large proportion of fine-grained sediment that remains in suspended form in the water for a long time. The survey results confirmed that most of the route in the Swedish EEZ had fine-grained sediment on the seabed (especially in the deeper, eastern part). Parts of the seabed in the western part consist of silt to fine sand and/or moraine. Therefore, the results of the numerical modelling are considered to be representative.

The dispersion of sediment associated with laying rock was assessed to be subordinate to the other construction methods. The assumption was based on analyses and experience gained from monitoring during the construction of Nord Stream in 2010-2012 (Nord Stream 2 AG, 2017).

The modelling was performed for three different hydrographic conditions (normal, summer and winter). Winter conditions are considered to be the period that produces the most dispersion of sediment owing to harsher weather conditions and are used to represent a worst-case scenario for sediment dispersion. The results show that an excess concentration of 10 mg/l is exceeded only in the immediate vicinity of the trenched sections and for a duration of less than 12 hours. Concentrations of dispersed sediment of 10 mg/l is comparable to the natural background concentration in the area. See also section 9.2. An excess concentration of 5 mg/l occurs in a slightly wider area (up to a few km) but for the same duration of less than 12 hours.

The results from the modelling (for trenching in winter conditions) show that sedimentation is low and in very limited areas in close proximity to the trenched sections. The volume deposited does not exceed 1 kg/m^2, which corresponds to a layer of approximately 1 mm. This means that the deposited sediment layer may be calculated to be a maximum of 1 mm. The level of natural sedimentation in the Arkona Basin was calculated to be 2.2 mm per year (Christiansen, o.a., 2002).

8.2 Underwater noise

Sound in water occurs to different extents and naturally and/or anthropogenically. Underwater noise refers to anthropogenically (human) generated sound, while sound generated by factors such as rain, wind and thunderstorms is called natural underwater sound. Both anthropogenic and natural sound may occur at the same time, which may make it difficult to assess where the sound originates from and its environmental effect. It is therefore impossible to strive for a zero level.

Underwater sound and noise may have an impact on the marine environment and marine fauna by, for example, causing stress in animals and interfering with sound-based communication or orientation, which entails an increased risk for various animal species. Noise from ships was previously measured at sites throughout the Baltic Sea as part of a project to study the influence of anthropogenic noise in the Baltic Sea (Tougaard et al, 2017). The model shows that there is a connection between very busy shipping routes and a high level of underwater noise. The highest values are 127 dB re 1 µPa, which were measured along the major shipping routes.

During the construction and operation phases, existing operations will give rise to underwater noise. The predominant underwater noise during the construction of the cable system is estimated to come from ship engines and possible laying of stone, which is on a par with normal ship traffic. The level of underwater noise it will cause depends on the vessels used. The underwater noise implies a temporary increase in the levels in the surroundings. The increased noise level ceases when ship traffic ceases. During the installation phase, some verification studies will take place (section 3.3). However, no equipment will be used that produces high noise levels.

The underwater noise in the area is expected to stem largely from the existing ship traffic in or near the area. The background noise in the area comes from both biotic and abiotic factors and is at a frequency of between 1 Hz and approximately 100 kHz. The average sound levels within the main shipping routes were shown to vary between 100 and 130 dB re 1 µPa, within a frequency range of 50-200 Hz (Nord Stream 2 AG, 2017). Previous studies showed that noise from the construction of pipelines (including ploughing the seabed) in the Baltic Sea is of the same order of magnitude and may be compared to continuous noise from shipping (Johansson & Andersson, 2012). For ploughing, the average level from the ship Far Samson was 126.0 dB re 1µPa with source level 183.5 dB re 1µPa at 1m. For the pipe laying itself, the sound level was 130.5 dB re 1 µPa (i.e., approximately 4.5 dB higher), which was mainly because more construction vessels were required than for the ploughing activity.

Laying rock in connection with construction is also expected to contribute to some noise distribution underwater. However, previous studies showed that the noise measured noise from laying rock was difficult to distinguish from the ship noise (Nedwell J.R., 2004). Modelling carried out within Nordstream 2 examined noise from laying rock, which was assumed to be the construction work that contributed to the highest noise levels. The risk of harm to marine mammals during the construction phase was calculated using the modelling. Cumulative SEL and impact distance were calculated for two different positions along the pipeline. The modelled noise levels were not high enough to induce permanent threshold shift (PTS), even if a seal or harbour porpoise were to be right next to the rock laying, while temporary threshold shift (TTS) could occur in marine mammals if they were within a distance of 80 m from the rock laying vessel for a period of 2 hours (Sveegaard S, 2016).

The noise levels that arise in connection with planned operations are thus not expected to exceed the existing background levels that arise from ship traffic in the area.

Clearance of any ordnance may give rise to underwater noise, which was modelled in the Baltic Pipe project. Unplanned events are assessed in section 16.

8.3 Physical disturbance of the seabed

The physical disturbance of the seabed may be short-term or long-term depending on the methods used for construction or the construction of structures on the seabed. A physical disturbance of the seabed may also occur during operation if, for example, repairs or maintenance are required involving physical interaction with the seabed.

Long-term physical disturbance occurs if the cable systems cannot be buried in the seabed and need to be covered by rock or concrete mattresses. If the cable systems are constructed on a soft bed, this habitat will thus disappear and be replaced by a small area of hard bed. The size of this area will be a very small part of the total area on which the cable systems are constructed as the cable systems will be buried in the seabed and only covered as protection if they cannot be buried in the sediment.

The burial of the cable systems will cause a short-term impact on the seabed owing to the disturbance that occurs with the burial of the cable systems and the space required on the seabed for the equipment used. The highest maximum temporary impact on the seabed will be in an area 30 m wide and will affect the entire 85 km route of the cable systems. A maximum of two cable systems will be constructed, which means that the total area in which a temporary disturbance may occur will be 5.1 km^2.

The physical disturbance may mean that the seabed habitat is affected. Sandbanks and reefs could be affected if they exist along the route. The impact is normally temporary because natural marine geological processes and bioturbation restore the seabed environment. Using verification studies in connection with the construction phase, valuable habitats may be avoided by laying the cable route past these areas.

Marine archaeological sites have been identified in the corridor, but it cannot be ruled out that additional remains will be found in connection with the studies carried out during the construction of the cable systems. The laying of cables could entail damage to marine archaeological remains. It is assessed to be possible to avoid impact through the choice of route within the cable corridor.

During operation, any protection for the cable systems may need to be filled and improved, which means additional materials may be added to the seabed above the cable systems. Such improvement will probably only be required for a small part of the area above the cable systems. The cable systems are designed to be used for at least 40 years, but their operational life may be extended.

8.4 Physical disturbance above the surface

It is mainly during the construction of the cable systems that physical disturbance above the surface may arise from the presence of construction vessels and other equipment used. During operation, there will only rarely be ships in the area to perform maintenance – they will mainly be needed if the protection in the form of coverage for the cable systems needs to be replenished. In the rare event that a cable system needs to be repaired, this is managed as an unplanned event. See section 16.2.

The vessels may, through their physical presence, affect birds, other vessels in the area and commercial fisheries. To reduce the risk of collision during construction and operation, temporary protection zones of 500 m, which move with the vessels, will be located around the project-related vessels. The cable system laying vessels will move at a speed of 0.1-2 km/day. The task of safety zones is to ensure that no unauthorised persons come too close to the project-related vessels during construction and operation. The positions of the project-related vessels will be announced in the Swedish Maritime Administration's 'Notices to Mariners' (NtM) so that passing vessels are informed about the safety zones.

8.5 Electromagnetic field

Electromagnetic field (EMF) is the collective name for the electric and magnetic field that is formed around an electrical cable. The electric field is formed by voltage differences between the conductor and the surroundings and is measured in Volt per metre (V/m). The strength of the electric field depends on the voltage, and it decreases sharply as the distance from the electrical cable increases.

The magnetic field occurs as a result of the current flowing through the electrical cable. The strength of the magnetic field is measured in tesla (T) and varies depending on the strength of the current which in turn depends on variations in electricity production. If the electrical cable is carrying alternating current, the magnetic field will change direction with the frequency (Hz) at which the current alternates, and in the case of direct current, the magnetic field will be static. If several electrical cables are adjacent to each other and if the current is phase shifted (for alternating current), the magnetic field is attenuated. The strength of the magnetic field decreases with increased distance to the electrical cable. The maximum magnetic field has been calculated and at 1.2 GW and 525 kV will be 27 µT at the centre when the cable system is buried 1 m and gradually decreases as the distance from the centre increases. For comparison with the maximum strength of the magnetic field, the Earth's magnetic field is about 50 µT. Figure 8-1 shows how the magnetic field decreases as the distance from the electrical cable increases.

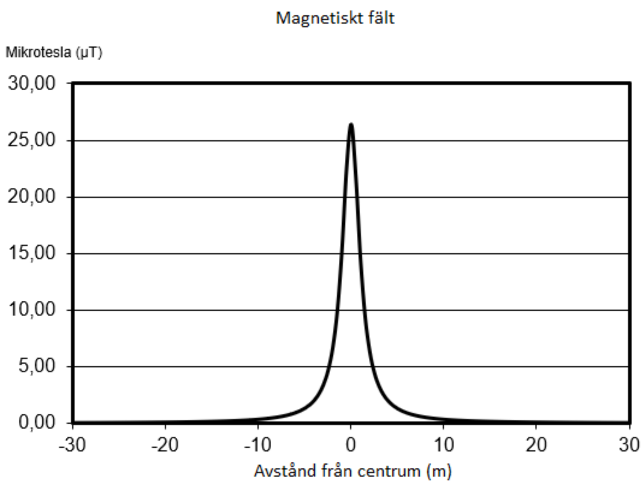

Figure 8-1. The graph shows how the magnetic field rapidly decreases as the distance increases.

Up to two cable systems will be laid, each in its own trench about 100–200 m apart. They will be buried about 1-2 m below the seabed, which means that the magnetic field at the seabed at a depth of 1 m will be about 27.0 μT at the centre of the cable system.

8.6 List of mitigation measures

Energinet will take the following mitigation measures to reduce the impact of planned construction and operational activities:

- In the construction phase, in conjunction with the installation, data will be verified along the entire cable route, including the Natura 2000 site. The data are interpreted by relevant personnel to verify the extent to which the route is still free of valuable habitats and archaeological finds. By optimising the route, protected habitats in the Natura 2000 site in the form of reefs may be avoided.
- If, during the laying of subsea cables within the Natura 2000 site, areas with large quantities of blue mussels are found, Energinet will, to a reasonable extent, adjust the cable routing within the cable corridor in such a way as to limit the impact on these areas.
- To protect cod reproduction, trenching will be avoided during the months of June and July.
- A 500 m protection zone will be established around project-related vessels during construction, operation and decommissioning. The protection zone is maintained by contacting vessels in the immediate area and informing them of ongoing activities.
- Construction activities will be communicated to the Swedish Maritime Administration's Ufs database to inform other ship traffic and reduce the likelihood of accidents.
- A distance of at least 50 m from an ancient monument/wreck to the cable system will be maintained. If other marine archaeological objects are found, this may entail minor changes to the route and may mean that the corresponding protection zone remains in place around the finds.
- Consultation will take place with the Swedish Armed Forces so that the construction work does not coincide with exercises.
- Consultations and agreements on crossings and distances to other infrastructure owners in and around the cable corridor will be carried out before the cable laying begins.
- In the area around the potential stone age relics, excavation monitoring with an archaeologist will take place during the construction phase.
- In cases where UXO must be cleared by explosion, mitigation measures must be implemented to avoid or reduce possible impacts on fish, diving seabirds and marine mammals. The use of so-called scaring equipment (e.g., audible signals and seal scarers) and marine mammal observers are standard procedures to be carried out for UXO clearance.

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9. EXISTING CONDITIONS AND IMPACT ASSESSMENT

9.1 Bathymetry

The bathymetry of the sea floor is described in Figure 9-1 and Figure 9-2. The Baltic Sea is a partially enclosed inland sea connected to surrounding seas by the shallow and narrow straits between Denmark and Sweden, which connect the brackish waters of the Baltic Sea with the saltier waters of the North Sea. The bathymetry is characterised by basins separated by different thresholds. The Western Baltic Sea is relatively shallow, with water depths of less than 100 m (the greatest depth of the Baltic Sea is 459 m). The Bornholm Basin is the area east of Bornholm, and the shallower Arkona Basin extends west from Bornholm towards Denmark. The proposed Swedish route runs through the Arkona Basin. The average depth of the Arkona Basin is 23 m, and the greatest depth is 53 m.

Detailed geophysical field studies covering bathymetry and hydrology are available to analyse. These form the basis for the technical and safety aspects of the detailed route planning.

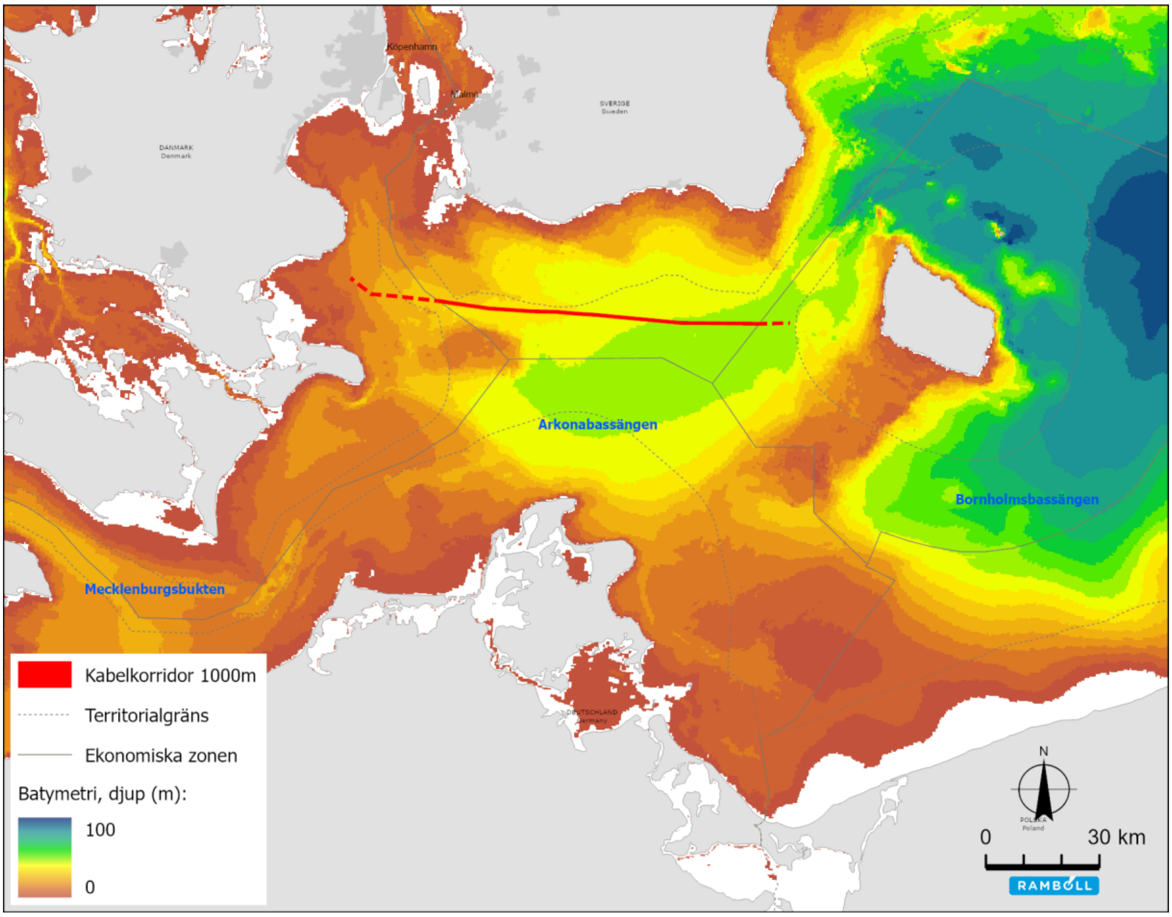

Figure 9-1. Bathymetry in and around the project area (HELCOM, 2022).

The bathymetry in the relevant area for the cable route in the Swedish part of the project varies between about 33 m in the western part to about 47 m in the eastern part within the Swedish exclusive economic zone.

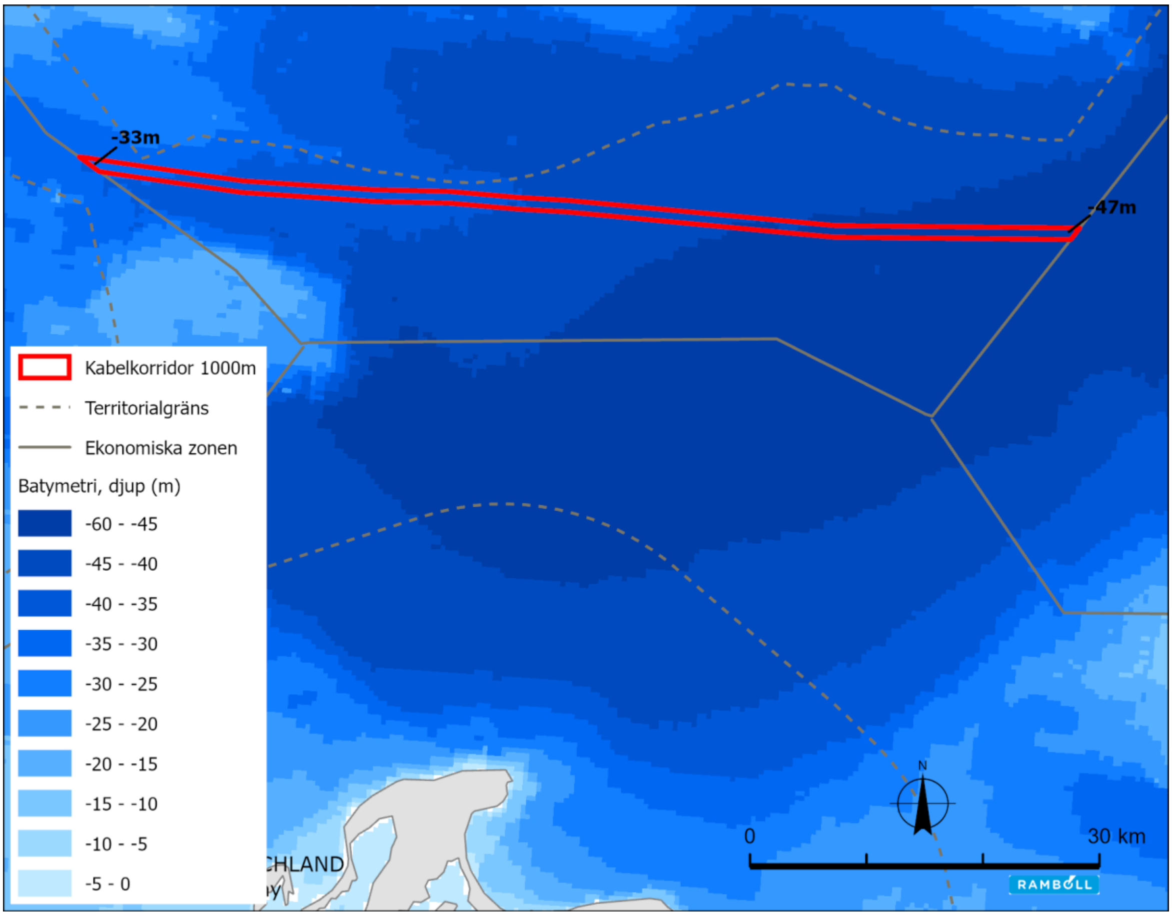

Figure 9-2. Bathymetry in the project area (HELCOM, 2022).

9.2 Hydrography and water quality

The Baltic Sea is a brackish inland sea. The salinity is determined by the supply of fresh water from precipitation and land as well as the inflow of saltier water from the Kattegat through the Danish straits. The large inflows of water into the Baltic Sea through the Danish straits are relatively rare, and the last major inflow of water occurred in 2014 (SMHI, 2022). The water inflows are crucial for the salt and oxygen content in the deep parts of the Baltic Sea as saltier water has a higher density and flows into the deep parts, displacing or mixing with the older water with a lower salt and oxygen content. A reduced inflow of oxygen-rich water thus contributes to a lower oxygen content that can give rise to suboxic or completely anoxic bottoms. Figure 9-3 shows suboxic or completely anoxic bottoms in the autumn of 2020 (SMHI, 2022). On bottoms that are completely anoxic, hydrogen sulphide can occur when organic material decomposes. Hydrogen sulphide is deadly and the animals that cannot escape these areas will thus die.

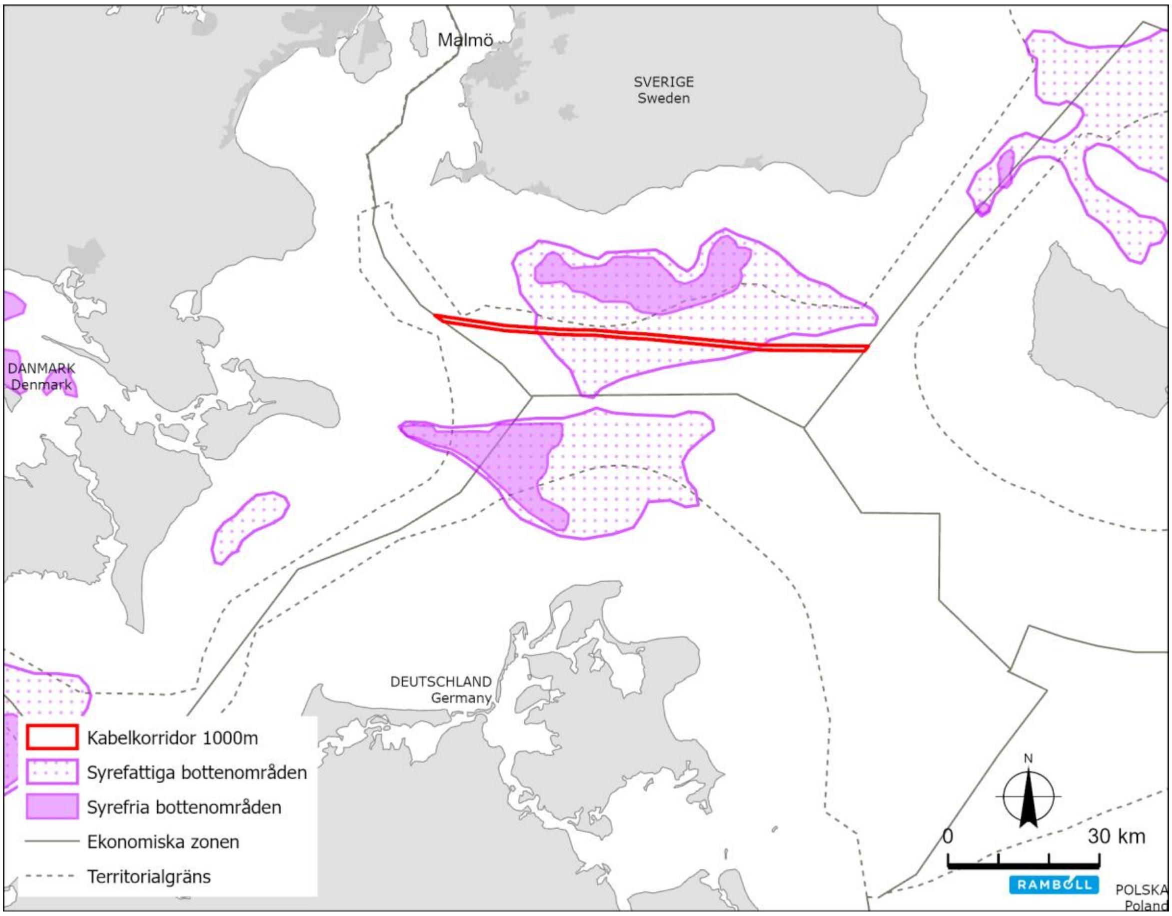

Figure 9-3. Suboxic (syrefattiga) and anoxic (syrefria) areas on the seabed in the Baltic Sea in autumn 2020 (SMHI, 2022).

Due to salinity and temperature differences that cause the masses of water to have different densities, water stratification occurs. The layer between two masses of water with different salinity is called a halocline, and the layer between two masses of water with different temperatures is called a thermocline. Water stratification limits the vertical mixing of the two different masses of water. In the Arkona Basin, the halocline lies at a depth between 20-30 m where the upper mass of water has a salinity of 8-11 psu while the deep water has a salinity of 10-15 psu. During the summer, a thermocline forms at a depth of between 15-30 m with warmer water on top and colder water in the lower mass of water. When the air temperature falls again in the autumn, the thermocline disappears from the water (Snoeijs-Leijonmalm & Andrén, 2017).

In the Sound (Öresund), the measured natural background concentrations of suspended sediment are between 0-2 mg/l in calm weather during the winter, while in the summer they are slightly higher. During periods of strong winds, concentrations can rise up to 40 mg/l (Naturvårdsverket, 2009). Measurements in the Arkona Basin and in the southern Baltic Sea show background concentrations between 2-12 mg/l, and the depth in these places varies between 16-47 m. The suspended sediment concentrations were higher over the shallow bottoms and the water close to the bottom (Christiansen, o.a., 2002).

9.3 Sediments and pollutants

The surface sediments of the seabed along the planned cable route vary depending on the geology and morphology of the seabed as well as on how exposed the seabed is to waves and currents.

Analysis of sediment types has been carried out based on geophysical surveys, and a map showing the conditions on the seabed has been produced, see Figure 9-4. The examination of the bottom substrate was carried out throughout the cable corridor. The results show that the bottom sediments consist of clay and silt in the eastern part of the cable corridor while in the west they consist of clay, silt, fine sand and moraine (Ramboll, 2020a), (Clinton Marine Survey, 2022).

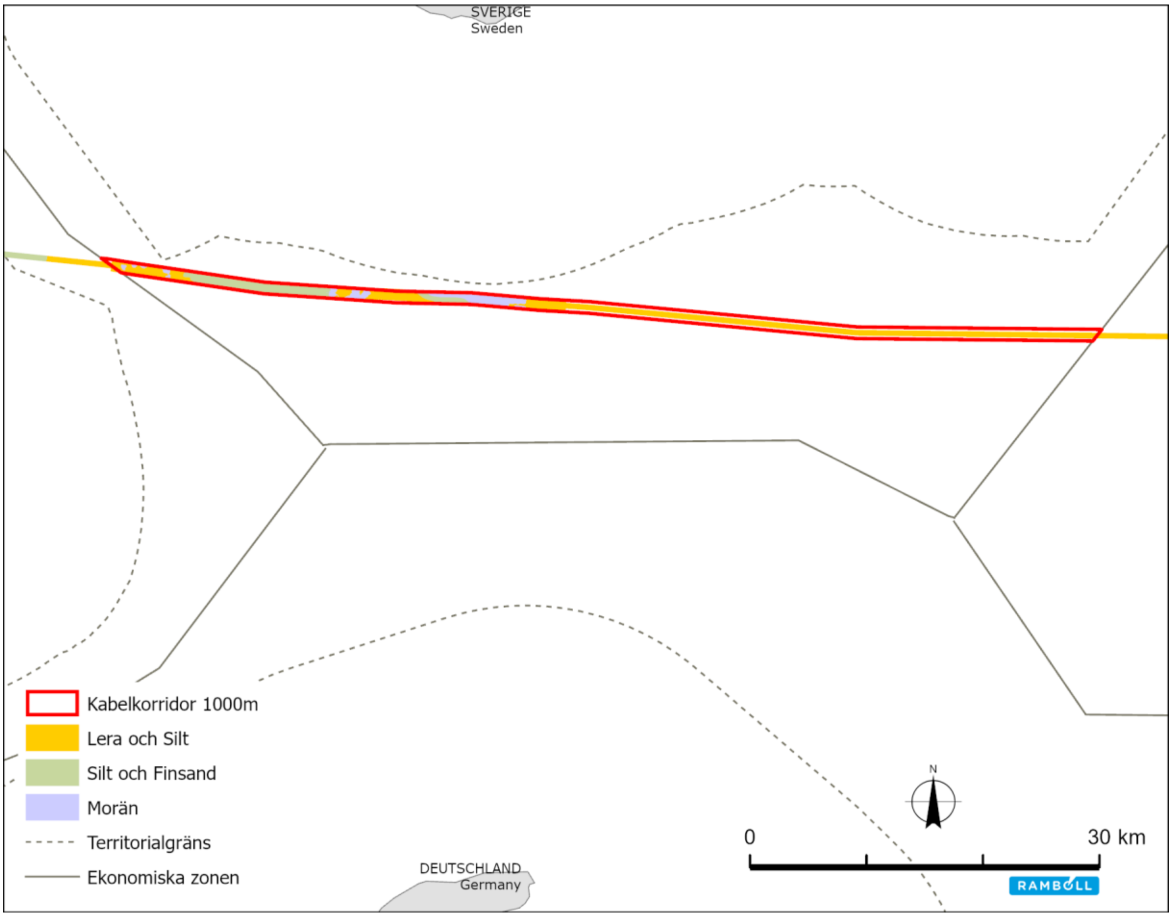

Figure 9-4. Bottom substrate in the project area.

The Arkona Basin is an accumulation area for fine-grained sediment, while shallower areas covered with sand are considered to be bottoms that alternate between deposition and erosion depending on the time of year. The area around Baltic Pipe is expected to be fairly undisturbed as the pipeline was laid on top of the sediments. Both heavy metals and organic pollutants have a tendency to be adsorbed on fine-grained sediments and particles of organic material. Therefore, the highest concentrations of pollutants can be expected to occur in seabed sediments in the deepest areas of the route in the Arkona Basin. Most of the pollutants are expected to be found in the shallower sediments.

From the first sediment sampling, surface sediment samples were collected in 2018 from a depth of 0-0.1 m at eight stations with a Van Veen grab sampler. Some sampling stations are located outside the corridor, but as they are located in the immediate area, they have been included in the evaluation. The next sampling was carried out in 2021 at ten stations using a box core where samples were taken from depths of 0-2 cm and 50-55 cm. Data for sampling stations obtained from SGU were taken using a small grab at a depth of 0-10 cm in 2008. All sampling sites with analyses of the pollutants found are shown in Figure 9-5.

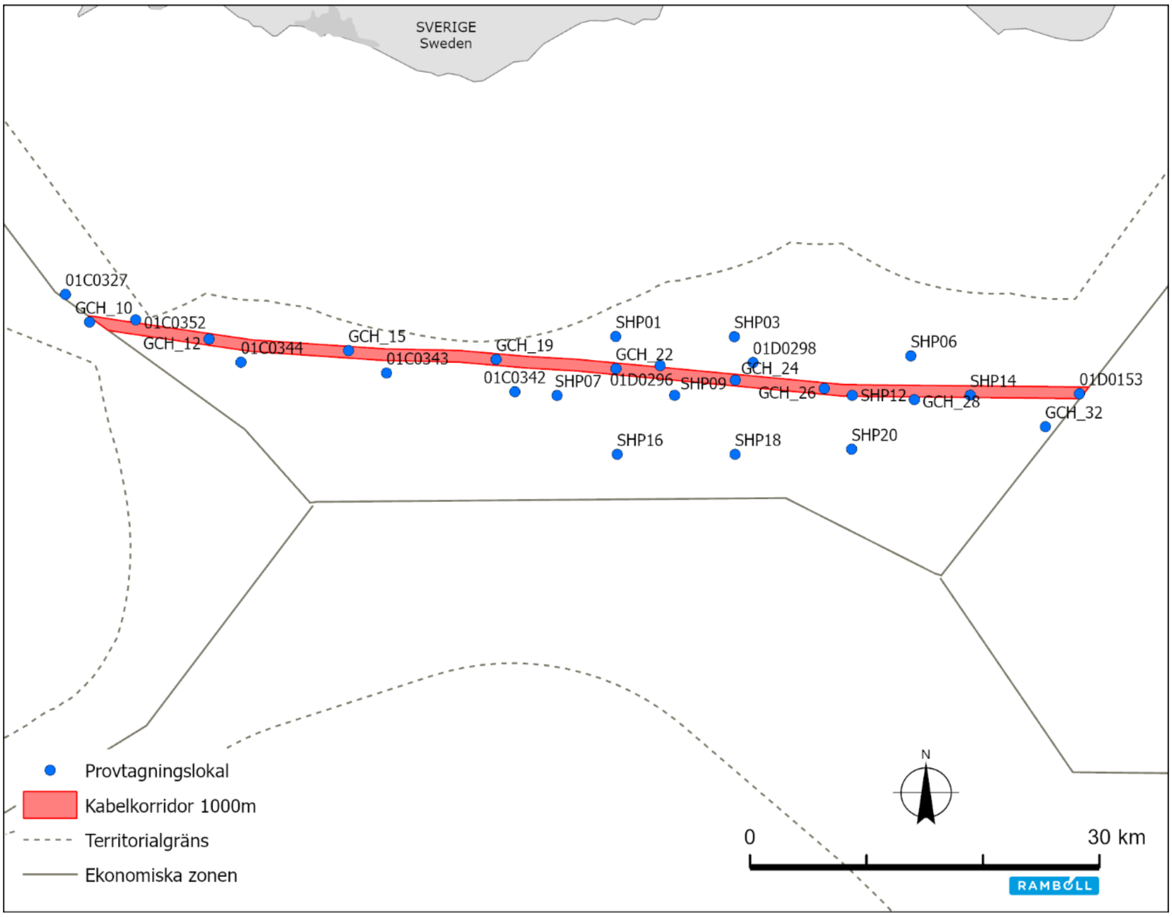

Figure 9-5. Sampling points in terms of degree of pollution.

Assessment criteria

To see how the results vary in relation to natural background concentrations, the results are classified based on the Swedish Environmental Protection Agency's assessment criteria (Naturvårdsverket, 1999). This classification is not comparable to a risk assessment based on the measured concentrations. For metals and organic substances, the Swedish Environmental Protection Agency's assessment criteria contain comparative values corresponding to the median value of pre-industrial values. Based on these comparative values, the report uses a deviation classification on a five-point scale where class 1 means concentrations equal to or lower than the comparison value and class 5 means very large deviation from/very high content compared to the comparison value.

SGU (2017) has since produced an update of the Swedish Environmental Protection Agency's report regarding organic environmental pollutants in marine sediments. Like the Swedish Environmental Protection Agency's report, this classification is not related to ecotoxicological effects. The classification is based on measured concentrations in samples from coastal and offshore sediments. Unlike report 4914, this report presents a classification for tributyltin (TBT). The pollution levels are divided into five different classes In a similar way to the Swedish Environmental Protection Agency's assessment criteria, see Table 9-1.

Table 9-1. Description of state classes for metals and organic substances according to assessment criteria from (Naturvårdsverket, 1999).

Class	1	2	3	4	5
Metals	No deviation	Small deviation	Significant deviation	Large deviation	Very large deviation
Organic substances	No content	Low content	Medium content	High content	Very high content

For the assessment of environmental effects, environmental quality standards (EQSs) specified in the Swedish Agency for Marine and Water Management (2019) can be used. These assessment criteria are impact-based. However, EQSs for sediment concentrations have only been produced for the elements lead (Pb) and cadmium (Cd) and the organic pollutants fluoranthene, anthracene and tributyltin (TBT).

Tributyltin (TBT) was widely used in ship paint and in antifouling agents, but the substance has been banned worldwide since 2001. The main source of TBT is leakage from ships treated with TBT.

Sediment sampling results

A summary of all results is found in Appendix C2.

The analyses with respect to metals show that the content of chromium corresponds to class 5 according to (Naturvårdsverket, 1999), but in all the more recent samples taken, the maximum chromium content corresponds to class 3 This confirms that the sampling methodology for chromium is most likely not comparable in the older samples. In the samples in the far west, measured concentrations correspond to class 1 or class 2. In other parts, there are levels of arsenic, lead and cadmium up to class 4. The remaining substances correspond to class 3 or lower. Of the deeper samples taken (0.5-0.55 cm), only concentrations up to class 3 were measured for all substances analysed. In conclusion, this suggests that in the western parts of the area, metal analyses correspond to no or small deviation. For the eastern parts, there are slightly higher levels of arsenic, lead and cadmium (significant deviation).

The results with regard to organic pollutants tend to be similar to metals. In the westernmost areas (up to and including test point GCH 19/01C0343) concentrations of PCBs, PAHs, chlordanes, DDT and HCH occur in the surface sediments in class 1-3 while in the eastern part of the cable corridor, concentrations of the same substances were measured up to class 5. One of the sampling points (SHP20) was an exception, where PAHs and PCBs were measured at concentrations corresponding to class 5 for all parameters analysed. However, this sampling point is outside the planned cable corridor. In the deeper sediments (50-55 cm), PAHs were analysed, and the concentrations mainly corresponded to class 1-2. Of the organic tin compounds, TBT and its degradation products DBT and MBT were detected. All measured TBT concentrations correspond to levels in class 1-3.

The environmental quality standard (EQS) for anthracene was exceeded in most sampling points. The EQS for TBT was exceeded at most of the stations. For cadmium, lead and fluoranthene, the EQS was not exceeded at any sampling point.

In conclusion, the highest concentrations of pollutants (corresponding to very large deviations or very high content) were measured in seabed sediments in the deepest areas of the route. However, most of the contaminants were found in the shallower sediments. As the pollutants bind to fine-grained particles, these will not be released to the mass of water. The particles will hardly disperse at all, as the sediment dispersion is very local and short-term, see section 8.1.

9.4 Bottom fauna

9.4.1 Existing conditions

Bottom flora and fauna, also called benthic flora and fauna, include plants and animal organisms that live on or in the seabed. The benthic flora of the Baltic Sea is mainly limited by the availability of light, which is relative to the depth of the water and the concentration of dispersed sediment, but also by the type of bottom substrate. Usually, access to light is very limited at depths greater than 20 m. Since the planned cable systems are planned located in areas with a depth of about 33 m to 47 m, it is assessed that there cannot be any bottom vegetation in the cable corridor. Surveys of benthic vegetation were carried out in the Polish and Danish parts of the Baltic Pipe project, and these confirm that no vegetation is found at depths below 21 m (Ramboll, 2019h).

The bottom fauna consists of epifauna and infauna, which are animal species found on and in the seabed, respectively. The species composition in the populations of benthic fauna of the Arkona Basin depends on various biotic and abiotic factors. The physical conditions that determine the composition of the bottom fauna are primarily substrate type (including any reef structures), light, salinity, temperature, oxygen content, organic material, water movement, but also water quality.

Some parts of the seabed in the cable corridor arew suboxic, see Figure 9-3. For these reasons, the benthic biodiversity is limited. Since many species are not adapted to such conditions, the species composition consists mainly of opportunistic species with high growth and short life cycles, such as several species of bristle worms (*Polychaeta*) and mussels (*Bivalvia*).

In the area where the cable systems will be laid, studies were carried out in 2018 and 2021 on the macrozoobenthos, which here consists of the benthic macrofauna larger than 1 mm (Ramboll, 2019c; Marine Monitoring AB, 2021). Samples were taken on the soft bottom every five kilometres along the route. In addition, in the western part of the area, within the Natura 2000 site, a more thorough survey was carried out, with an ROV camera and a further 20 sampling stations (Figure 9-6). In the eastern part of the area, sampling and video filming were carried out at 20 stations (Marine Monitoring AB, 2021).

The results showed that mussels and bristle worms made up the bulk of the macrozoobenthos, accounting for 38% and 35% respectively of the abundance in the samples. Bristle worms also had the higher diversity, with 16 taxa (Ramboll, 2019c). The most common soft-bottom taxa, found in more than half of the stations, were Baltic macoma (*Limecola balthica)* (found in all sampling stations), northernnguille (*Astarte borealis)*, crustacea (*Diastylis rathkei)*, bristle worms (*Scoloplos armiger, Bylgides sarsi*, *Ampharete balthica*, *Pygospio elegans*, *Terebellidae)*, and the cactus worm (*Priapulus caudatus)*. The mussels accounted for virtually the entire biomass (93%) of the macrozoobenthos on the soft bottom (Ramboll, 2019c). The studies from 2021 confirmed these results, with additional common species such as the ellipticalnguille (*Astarte elliptica)* and crustaceans (*Diastylis lucifera)* (Marine Monitoring AB, 2021).

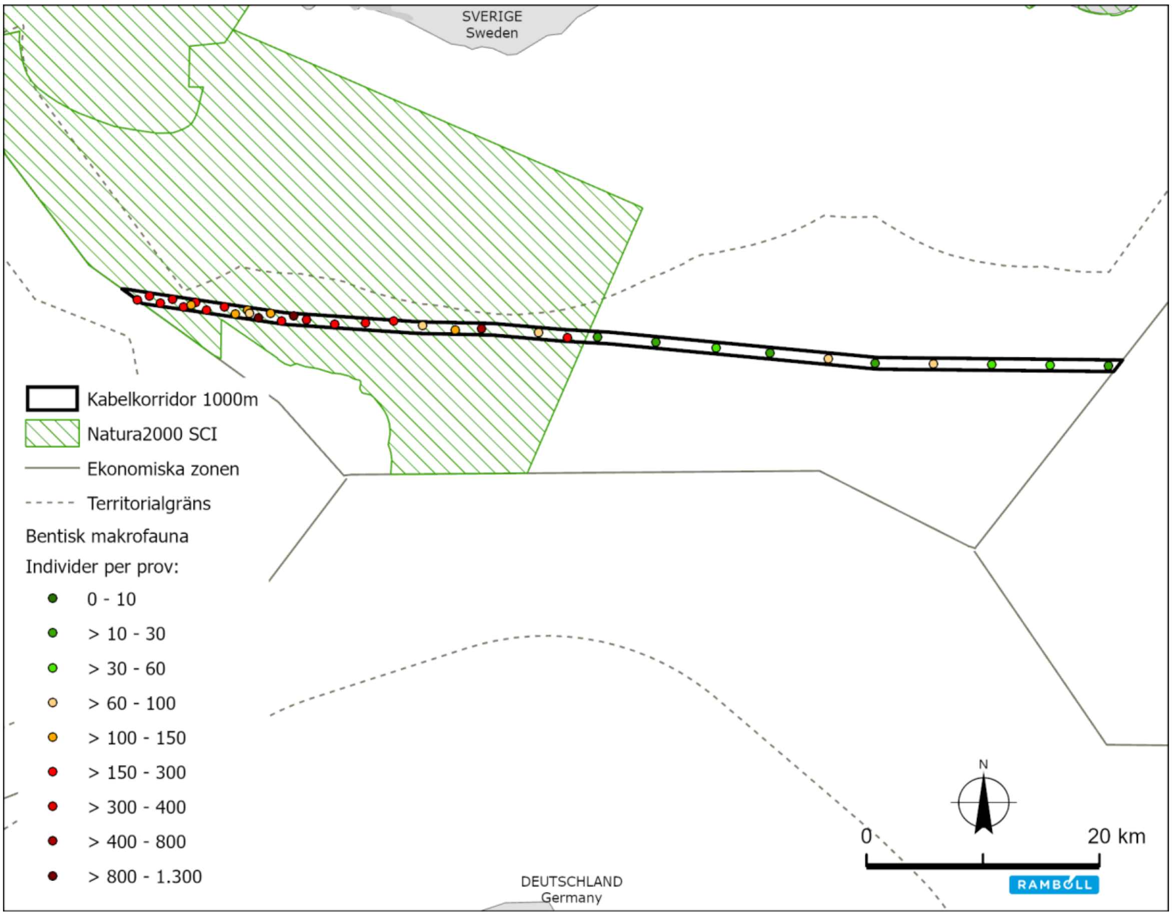

Figure 9-6. Presence of benthic macrofauna in the cable corridor (Ramboll, 2019c).

Physical sampling of bottom fauna showed the highest number of species in the western part of the cable corridor, within the Natura 2000 site, with a maximum of 22 species in one station (Ramboll, 2019f).

In addition, in the western part of the corridor, within the Natura 2000 site, a careful study was carried out with an ROV camera and physical sampling. Video filming of the seabed in the Natura 2000 site showed in some places small sand castings formed by lugworms (*Arenicola marina*), as well as areas of blue mussels (*Mytilus* spp) found on hard substrates. Lugworms and blue mussels help to create biotopes with certain living conditions for other organisms on the seabed, such as some crustaceans (see also 11.1). In the Baltic Sea, blue mussels have a single, locally uniform and geographically relatively homogeneous gene pool. This is because they are thought to be a hybrid between *Mytilus edulis* and *Mytilus trossulus* and should therefore be called [Baltic] *M. trossulus* x *M. edulis* (Väinölä & Strelkov, 2011). In this report, the genus *Mytilus* spp is used. In the Natura 2000 site, a large blue mussel biomass was found in four sampling stations. Other species that were sometimes found in large numbers or with a large biomass are generally the same species found outside the Natura 2000 site: Baltic mussels, *Astarte* the mussel species, bristle worms, lugworms and large Laver spire shells (*Peringia ulvae*) (Ramboll, 2019f).

The bottom fauna in the cable corridor consists of common species with a large geographical spread such as the Baltic mussel, the lugworm and various species of worms, crustaceans and mussels (Tyler-Walters, 2016; Tillin, 2016; Budd & Rayment, 2001; WoRMS, 2022). All species found during sampling are listed in Table 9-2. No animal species found is included in the 2020 Red List, except for the blunt gaper (*Mya truncata),* which is listed as vulnerable. In HELCOM's Red

List for the Baltic Sea and the Kattegat, the species is classified as Near Threatened (SLU Artdatabanken, 2022). However, only one individual was found during sampling (Marine Monitoring AB, 2021). Large specimens of blunt gaper live buried in bottoms, at a depth of about 40 cm. If specimens are dug up, they cannot bury themselves again (SLU Artdatabanken, 2022). The species' population has declined sharply in recent years, by almost 15%, and the probable reasons are suboxic conditions that can be caused by eutrophication combined with poor water exchange (HELCOM, 2013).

Table 9-2. Benthic species found during sampling on the Swedish route and at relevant stations (Ramboll, 2019c; Marine Monitoring AB, 2021)

Species	Common name	Species	Common name
Anthozoa (coral animals)		**Hydrozoa (hydrozoans)**	
Halcampa duodecimcirrata	Twelve-tentacled burrowing anemone	*Campanulariidae*	
Bivalvia (mussels)		*Gonothyraea loveni*	
Arctica islandica	Ocean quahog	**Nemertea (ribbon worms)**	
Astarte borealis	Northern astarte	*Lineidae*	
Astarte elliptica	Elliptical astarte	**Oligochaeta (worms)**	
Astarte juv.		*Enchytraeidae*	Pot worms
Cerastoderma glaucum	Lagoon cockle	*Tubificoides benedii*	
Limecola balthica	Baltic macoma	**Polychaeta (bristle worms)**	
Mya arenaria	Soft-shell clam	*Alitta succinea*	Pile worm
Mya truncata	Blunt gaper	*Alkmaria romijni*	
Mytilus spp.		*Ampharete baltica*	
Tellinidae juv.	Tellins	*Arenicola marina*	Lugworms
Bryozoa (moss animals)		*Aricidea (Strelzovia) suecica*	
Alcyonidioides mytili		*Aricidea cerrutii*	
Amphiblestrum auritum		*Baltidrilus costatus*	
Einhornia crustulenta		*Bylgides sarsi*	
Crustacea		*Capitella capitata agg.*	
Balanus crenatus		*Chone duneri*	
Bathyporeia pilosa		*Dipolydora quadrilobata*	
Carcinus maenas	Shore crab	*Fabricia stellaris*	
Crassicorophium crassicorne		*Fabriciola baltica*	

Species	Common name	Species	Common name
Cyathura carinata		*Hediste diversicolor*	Ragworm
Diastylis lucifera		*Neoamphitrite figulus*	
Diastylis rathkei		*Neoamphitrite* sp.	
Gammarus salinus		*Nephtys caeca*	
Jaera (Jaera) albifrons agg.		*Nephtys ciliata*	
Jaera (Jaera) syei		*Nephtys hombergii*	
Monoporeia affinis		*Polydora ciliata*	
Mysidae		*Pygospio elegans*	
Pontoporeia femorata		*Scoloplos armiger*	
Rhithropanopeus harrisii	Harris mud crab	*Terebellidae*	Spaghetti worms
Saduria entomon		*Terebellides stroemii*	
Gastropoda (snails)		**Priapulida (penis worms)**	
Hydrobiidae	Mud snails	*Halicryptus spinulosus*	
Onoba semicostata	Sea snail	*Priapulidae*	
Peringia ulvae	Laver spire shells	*Priapulus caudatus*	
Retusa obtusa	Arctic barrel-bubble	**Pycnogonida (sea spiders)**	
		Nymphon brevirostre	

9.4.2 Impact assessment

Bottom flora is not thought to exist in the cable corridor, which means that there can be no impact or consequences. Therefore, this section only describes the potential impact on bottom fauna. The following impact factors during construction and operation have been identified, see Table 9-3.

Table 9-3. Potential impact on the bottom fauna.

Potential impact	Construction	Operation
Suspended sediment	X	
Sedimentation	X	
Physical disturbance of the seabed	X	X

9.4.2.0 Suspended sediment

Changed conditions

Construction of cables will disturb the sediment and a local and temporary increase in suspended sediment concentration will occur in the water closest to the bottom in close proximity to the trenched sections. During the construction work, the excess concentration of suspended sediment above 10 mg/l is not expected to last longer than 12 hours and even then only in the immediate vicinity of the trenched sections. An excess concentration of 5 mg/l occurs in a slightly wider area (up to a few km from the cable route) but with the same duration of less than 12 hours (see 8.1).

Assessment

Construction

An increase in suspended sediment can potentially affect bottom fauna through reduced light and food availability. It can also clog the feeding apparatus of filtering benthic organisms with increased load (Naturvårdsverket, 2009).

For bottom fauna, the exposure time of the dispersed sediment together with the elevated concentration is an important factor in the degree of impact on the organisms (Newcombe & MacDonald, 1991). The bottom fauna found in the cable corridor is adapted to the regional background concentrations, which are between 2-12 mg/l with periods when the concentrations can increase to 40 mg/l, for example in winter storms (Naturvårdsverket, 2009; Christiansen, o.a., 2002). The expected duration and concentrations of suspended sediment are within the natural variations in the Arkona Basin. The excess concentration will not exceed 10 mg/l for longer than 12 hours, which is a time comparable to the duration of a winter storm. In addition, studies show that several of the species that dominate the bottom fauna in the cable corridor such as the Baltic mussel (Budd & Rayment, 2001), the blue mussel (Tillin, Mainwaring, & Tyler-Walters, 2016; Tyler-Walters, 2008; Kiørboe et al., 1980), the lugworm (Tyler-Walters, 2016) and the ocean quahog (Tyler-Walters & Sabatini, 2017) can tolerate a temporary increase in suspended sediment. Overall, the environmental effect on bottom fauna of increased suspended sediment concentrations from the construction works is considered to be negligible.

Since the increase in suspended sediment is estimated to be limited to the immediate area of the trenched sections, only a very small part of the bottom fauna population in the Arkona Basin will be affected. The bottom fauna in the cable corridor consists of common species with a large geographical spread such as Baltic mussels, lugworms and various species of worms, crustaceans and mussels. No animal species found is included in the 2020 Red List, except for the blunt gaper (*Mya truncata),* which is listed as vulnerable. The blunt gaper species is likely to be dispersed over a larger area, and the threat to the species is likely to be suboxic conditions. Overall, the environmental value is considered to be negligible.

With a negligible environmental effect and a negligible environmental value, the consequence of suspended sediment during the construction phase on the bottom fauna is considered to be negligible. This assessment also includes bottom fauna populations in the Natura 2000 site.

9.4.2.1 Sedimentation

Changed conditions

The suspended sediment will settle onto the seabed and its bottom fauna. The sedimentation will occur for limited periods and will be in addition to the natural sedimentation. The results from the modelling show that sedimentation will amount to a maximum of 1 mm in very limited areas in close proximity to the trenched sections.

Assessment

Construction

An increase in sedimentation could potentially affect bottom fauna by suffocating some sessile (immobile) species that are not adapted to additional sedimentation.

The bottom fauna found in the cable corridor is adapted to the regional background sedimentation amounting to 2.2 mm per year in the Arkona Basin (Christiansen, o.a., 2002), and between 1-4 mm per year according to a second study (Jonsson, 2003). In a study by the Swedish Environmental Protection Agency, mobile fauna is considered to be able to tolerate a thin covering of settled sediment (approximately 10 cm) by digging up towards the sediment surface (Naturvårdsverket, 2009). Other studies also show that several of the species that dominate the bottom fauna in the cable corridor, such as the Baltic mussel (Budd & Rayment, 2001; Brafield & Newell, 1961), the lugworm (Tyler-Walters, 2016) and the ocean quahog (Tyler-Walters & Sabatini, 2017; Powilleit et al., 2006), can tolerate sedimentation of less than 5 cm. Blue mussels are a less mobile species and are therefore more sensitive to temporarily increased sedimentation (Tyler-Walters, 2008). This is especially true where blue mussels form biogenic reefs and cannot dig their way up towards the sediment surface (Tillin, Mainwaring, & Tyler-Walters, 2016). Although they appear to be sessile, however, blue mussels can move a little to change position to return to the surface again when buried by sand, especially if sedimentation is less than 2 cm (Last, Hendrick, Beveridge, & Davies, 2011; Holt, Rees, Hawkins, & Seed, 1998; Essink, 1999). Sedimentation of 1 mm is therefore not considered to affect mussels. Given that the bottom fauna species present in the area can dig up through the thin covering that can occur from construction, the populations of bottom fauna are not considered to be sensitive to the sedimentation that is expected. Overall, the environmental effect on the bottom fauna is considered to be negligible.

Sedimentation is estimated to be limited to a small area along the cable corridor. This means that only a very small part of the bottom fauna population in the Arkona Basin is located within the area subject to increased sedimentation. The bottom fauna in the cable corridor consists of common species with a large geographical spread such as the Baltic mussel, the lugworm and various species of worms, crustaceans and mussels. None of the animal species found is included in the 2020 Red List, except for the blunt gaper (*Mya truncata),* which is listed as vulnerable and of which only one individual was found during the survey. In addition, the bottom fauna in the area is not sensitive to sedimentation. The environmental value for the bottom fauna within the impact area is considered to be negligible.

With a negligible environmental effect and a negligible environmental value, the consequence of sedimentation during the construction phase on the bottom fauna is considered to be negligible. This assessment also includes bottom fauna populations in the Natura 2000 site.

9.4.2.2 Physical disturbance of the seabed

Changed conditions

During the construction phase, the burial of the cable systems will cause a short-term impact on the seabed. With two cable systems, this means that the largest total area where a temporary disturbance may occur is 5.1 km^2, that is, with a corridor up to 30 m wide (footprint as described in section **Fejl! Henvisningskilde ikke fundet.**) for each cable along 85 km of the cable route in the Swedish exclusive economic zone. Generally, the cables will be buried in existing sediments, which means that the bottom substrate will not be altered. During ploughing, the material dug up will be laid on the side of the trench or at another designated place and used for backfilling after the cable is in place.

During the operation phase, there will be no disturbance to the seabed as cables are buried using existing sediments. In a small number of places of limited size for cable crossings (see **Fejl! Henvisningskilde ikke fundet.**) the cable systems will be covered with crushed rock during the construction phase. In these places, a small part of the soft bottom will be used and will be replaced by a hard-bottom habitat in the long term.

Assessment

Construction

During the construction phase, the seabed will be temporarily disturbed and a significant part of the bottom fauna present on the site will not survive. The impact on the environment is temporary because natural marine geological processes and recolonising bottom fauna with associated bioturbation will restore the bottom environment. The impact of the seabed disturbance on the bottom fauna depends on how quickly the species affected will recolonise the disturbed seabed and recover. This mainly depends on the life cycle rate of the species but also on the size of the area affected. The smaller the affected area, the easier and faster the larvae of organisms living in the immediate area can recolonise, for example through transport in the mass of water. Several Swedish studies show that the order of magnitude of recolonisation is 1-3 years, but variation may occur (Naturvårdsverket, 2009).

Several of the species found in the cable corridor have a short life cycle that allows them to quickly recolonise benthic marine environments. The lugworm (*Arenicola marina*) and bristle worms such as *Scolopolos armiger* are opportunistic and recruit quickly and preferentially to disturbed areas (Tyler-Walters, 2016). Studies show that Baltic mussels have a strong resilience. Adult animals spawn at least once a year with great abundance (Caddy, 1967). Larvae can spread over long distances, and development is fast with sexual maturity reached in less than 2 years. Adult individuals nearby can contribute to recolonisation too by moving into the area. The Baltic mussel population is expected to have recovered in less than 5 years, most likely after one year (Budd & Rayment, 2001; Bonsdorff, 1984). Mobile species such as the crustacean *Diastylis rathkei* have the potential to recolonise the biotope rapidly through migration of adults (Tillin, 2016). The ocean quahog is a long-lived, slow-growing clam that can take more than 5 years to mature (Tyler-Walters & Sabatini, 2017). This means that the ocean quahog population in the cable corridor may not achieve the same age structure within 1-3 years of construction.

Blue mussel populations are also considered to have a strong ability to recover from physical environmental disturbances, and the population can recover within 1-5 years (Holt, Rees, Hawkins, & Seed, 1998; Tyler-Walters, 2008; Tillin, Mainwaring, & Tyler-Walters, 2016). In the case of biogenic reefs of blue mussels, studies show that a good annual recruitment can allow them to recover quickly, although this cannot always be guaranteed due to the episodic nature of blue mussel recruitment and the influence of local parameters (Mainwaring et al., 2014; Seed & Suchanek, 1992). Blue mussels with a high coverage found within the Natura 2000 site (see also 11.1) could be affected if they cannot be avoided along the route. Through visual inspection in preparatory studies at the installation stage, these areas will be identified and avoided as far as possible.

Overall, the environmental effect is considered to be negligible because no permanent disturbance of the bottom fauna occurs as a result of the construction works and because the area affected is very small (<5.1 km^2), which means that only a very small part of the Arkona Basin's bottom fauna is located within the area affected.

None of the animal species found is included in the 2020 Red List, except for the blunt gaper (*Mya truncata),* which is listed as vulnerable. Blunt gapers are likely to be found in small numbers along the cable route but in greater abundance throughout the Arkona Basin. The bottom fauna species located in the cable corridor will not be affected at the population level. Since the bottom fauna within the impact area consists of common species with a large geographical spread and there are species that are sensitive to physical disturbance of the seabed, the environmental value is considered to be low.

The consequence of physical disturbance of bottom fauna during the construction phase is considered to be negligible as a result of negligible environmental effect and negligible environmental value. This assessment also includes bottom fauna populations in the Natura 2000 site.

Operation

During the operation phase, there is no change in the seabed because the cables are buried. Long-term changes in bottom conditions (continuing during the operation phase) can occur where the cable systems cannot be buried in the seabed and need to be covered by stone, rock-berms or concrete mattresses. In these few places, a small part of the seabed surface area will be used. Here, the new bottom conditions can benefit other benthic habitats, for example, rock and concrete can form a hard substrate where sessile bottom fauna can attach and grow. Since this impact will occur in very small areas, the environmental effect is considered to be negligible.

By covering the soft bottom with rock, the soft-bottom fauna will be lost and replaced with the hard-bottom fauna. The environmental value for the soft-bottom fauna is considered to be negligible in these places because existing species are common and are found throughout the Arkona Basin.

The environmental effect has been considered to be negligible like the environmental value, which means that the consequence during the operation phase is considered to be negligible. This assessment also includes bottom fauna populations in the Natura 2000 site.

9.4.3 Overall impact assessment

Table 9-4 summarises the impact assessment for the bottom fauna.

Table 9-4. Overall assessment of the consequences for bottom fauna.

Impact factor	Level of environmental value	Magnitude of environmental effect	Consequence
Construction phase			
Suspended sediment	Negligible	Negligible	Negligible
Sedimentation	Negligible	Negligible	Negligible
Physical disturbance of the seabed	Negligible	Negligible	Negligible
Operation phase			
Physical disturbance of the seabed	Negligible	Negligible	Negligible

9.5 Fish

9.5.0 Existing conditions

The Baltic Sea is an inland sea with a salinity that is too low for some marine species of fish but too high for other freshwater species of fish. In the area of the cable corridor there are 110 species of fish and lamprey. The salinity has a strong influence on which species can reproduce in the area. Table 9-5 shows the percentage of fish species with regular reproduction in the Arkona Basin, with regular presence but no reproduction, with temporary presence, or with uncertain presence or presence with uncertainty about whether reproduction takes place in the area (HELCOM, 2020). The species which have a regular presence but no reproduction or which are in the area temporarily come from the saltier Kattegat.

Table 9-5. Percentage of fish species in the Arkona Basin with their presence and possible reproduction (HELCOM, 2020).

Arkona Basin	Fish species
Regular reproduction	35%
Regular presence but no reproduction	16%
Temporary presence	45%
Uncertain presence, or present but uncertain reproduction	3%

In 2018, surveys of the fish fauna were carried out in the area (Ramboll, 2019b). The surveys carried out were bottom trawling and acoustic studies combined with midwater trawling. Bottom trawling was used to determine the make-up and biomass of demersal fish species. For pelagic fish, the spatial spread and density were determined using the acoustic method. Midwater trawling was carried out to determine the composition and biomass of certain species of fish. Table 9-6 shows the number of the most commonly caught fish species in Swedish waters during the surveys that were carried out.

Table 9-6. Species and number of individuals caught during bottom and midwater trawling (Ramboll, 2019b). Only species with more than 50 captured individuals are shown in this table.

Species	Number
European sprat (*Sprattus sprattus*)	39,569
Atlantic herring (*Cleupea harengus*)	7,600
Atlantic cod (*Gadus morhua*)	3,921
European flounder (*Platichthys flesus*)	3,254
European plaice (*Pleuronectes platessa*)	3,145
Whiting (*Merlangius merlangus*)	3,068
Common dab (*Limanda limanda*)	649
Saithe (*Pollachius virens*)	53

Sprat and herring were caught in the largest quantities but were small individuals in relation to the total biomass (weight). Cod had the largest total biomass of all the species caught followed by the flounder.

All species in Table 9-6 have regular reproduction in the Arkona Basin with the exception of whiting which has a regular presence but no reproduction and saithe which has only a temporary presence in the area (HELCOM, 2020). Below is a description of the species from Table 9-6 which have regular reproduction in the Arkona Basin or are relevant to the activity and the impact assessment.

European sprat

The European sprat lives in large sandbanks near the coast and is mainly pelagic. They usually reside at a depth of 10-50 m but can be present down to 150 m. They avoid cold surface water and during the winter form large sandbanks that overwinter in deeper water (Kullander, Nyman, Jilg, & Delling, 2012). Sprats spawn in the Baltic Sea in March-August (Havs- och vattenmyndigheten, 2022). In the Bornholm and Gdansk Basins, spawning begins in February but further north it starts later (HELCOM, 2021). Spawning takes place from the surface down to 40 m and both the eggs and larvae float freely in the water. The eggs require a salinity of at least 5-6 ‰ in order to remain buoyant (Kullander, Nyman, Jilg, & Delling, 2012). Figure 9-7 shows potential spawning areas and spawning areas with a high probability of sprat. According to the map, the cable corridor overlaps with a potential spawning area for sprat.

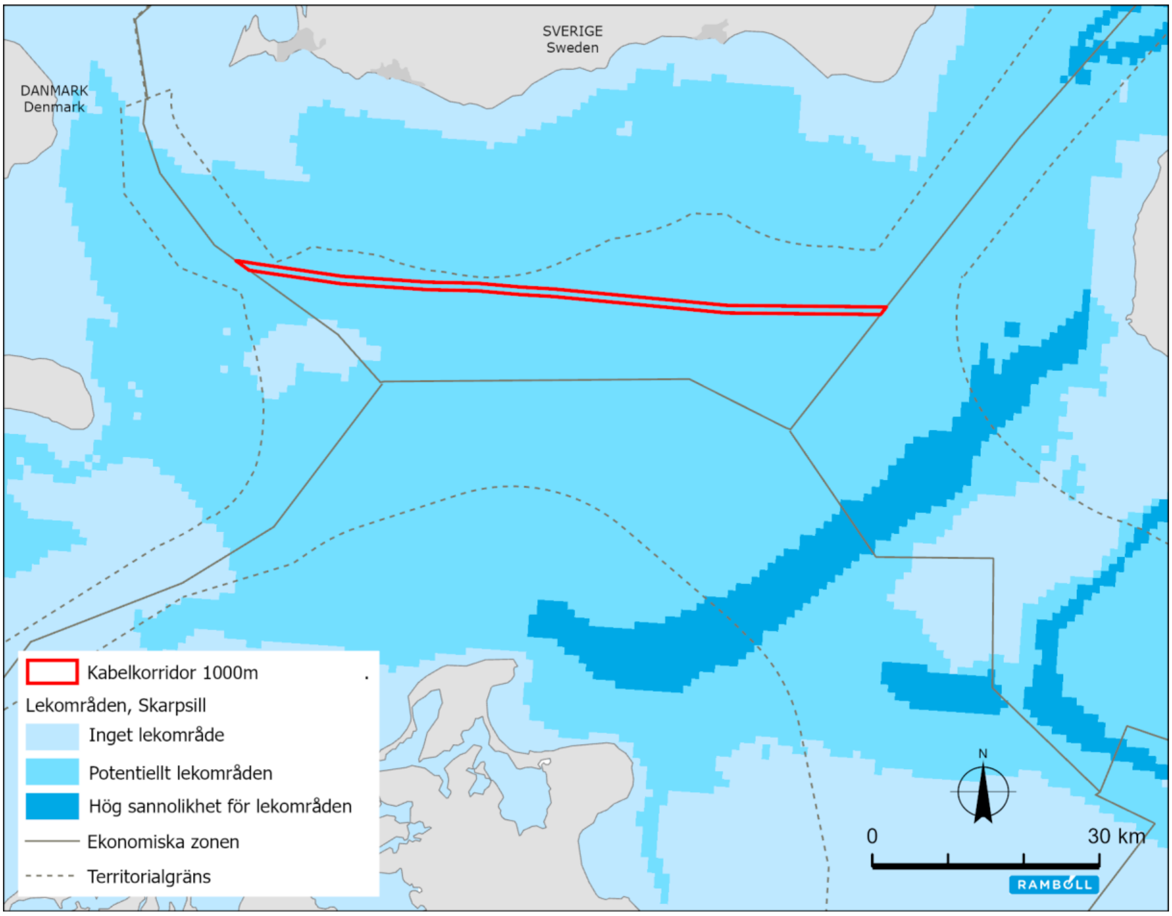

Figure 9-7. Potential spawning areas and spawning areas with a high probability of sprat (HELCOM, 2022e).

The spawning biomass in the Baltic Sea has been declining since 1997 but has always been above the stock size at which there is a high probability that the ability of the stock to reproduce will decrease. The average weight of the sprat has decreased which is due to greater competition between individual sprats, whose number has increased due to higher temperatures and reduced predation from cod (Havs- och vattenmyndigheten, 2022).

Herring

The herring is a schooling fish that has a pelagic lifestyle down to a depth of 200 m, deeper during the day and shallower at night. The herring migrates during the season to areas to feed, spawn or overwinter. Spawning takes place on sand, rock or gravel bottoms from the surface down to a depth of 10 m. The eggs sink to the bottom and stick to the bottom substrate. In the Baltic Sea there are both spring and autumn spawning herring, however the spring spawning herring is predominant (Kullander, Nyman, Jilg, & Delling, 2012). Figure 9-8 shows potential spawning areas and spawning areas with a high probability of herring. The cable corridor is not located in an identified spawning area for herring.

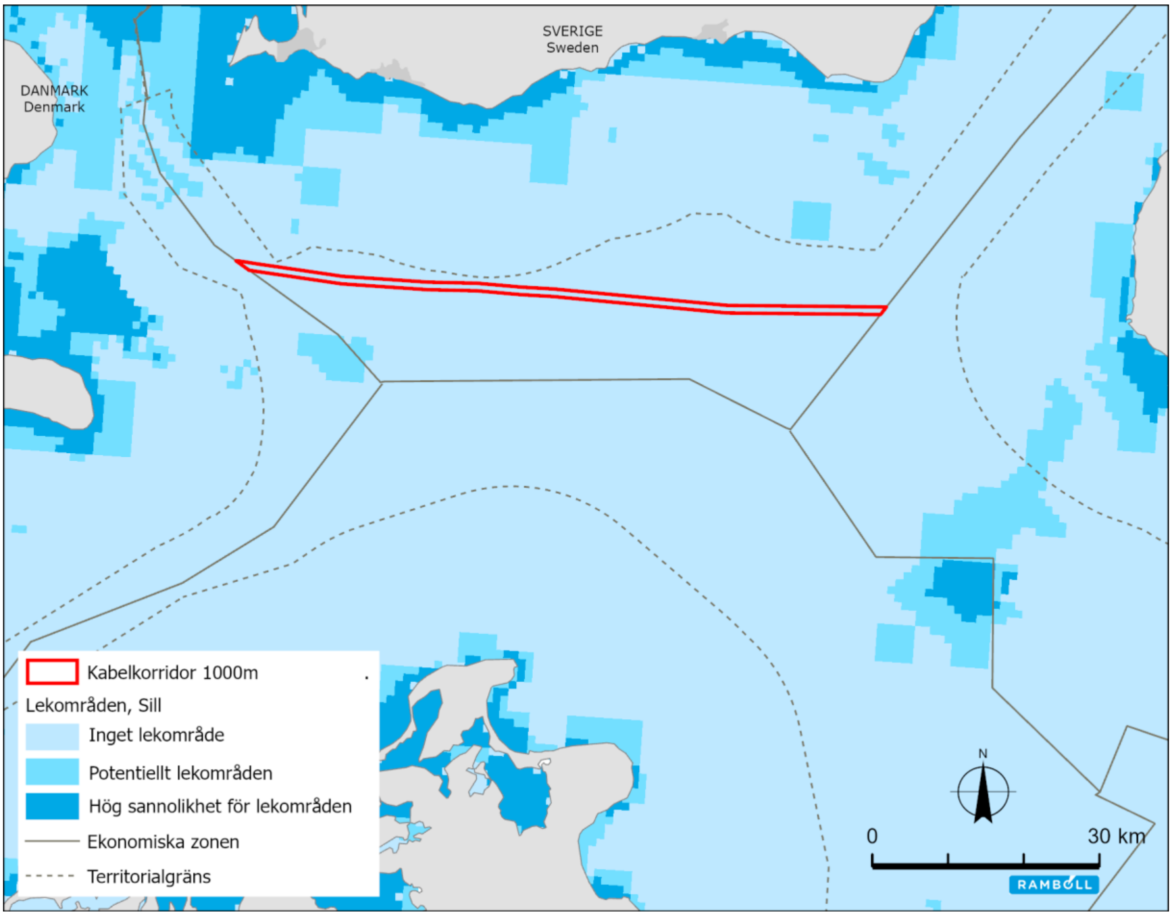

Figure 9-8. Potential spawning areas and spawning areas with a high probability of herring (HELCOM, 2022d)

Herring in the southwest Baltic Sea is considered together with spring spawning herring in the Kattegat and Skagerrak because of its migratory behaviour. However, the stock consists of several different populations of herring. The spawning biomass of spring spawning herring in the Skagerrak, Kattegat and southwest Baltic Sea has declined since the mid-2000s to the lowest level of the time series in recent years. Since 2007, the amount of spawning biomass is below the threshold at which there is a high probability that the ability of the stock to reproduce will decrease (Havs- och vattenmyndigheten, 2022).

Cod

The cod in the Baltic Sea is divided into two stocks by ICES (International Council for the Exploration of the Sea), a stock west of Bornholm, which also includes the Belt Sea and the Sound, and a stock east of Bornholm. These two stocks mix with each other in the area of the Arkona Basin with the exception of cod from the Belt Sea and the Sound, which do not mix with cod east of Bornholm (Havs- och vattenmyndigheten, 2022).

The cod is a predatory fish that is usually found at depths of 10-200 m. Cod are found throughout the Baltic Sea up to the Gulf of Bothnia, but the spawning areas are located in the Baltic Proper and the Belts. The western cod stock spawns in four different areas: (1) The Kattegat and the Sound, (2) Little and Great Belt, (3) Bay of Kiel, Ferman Belt and Bay of Mecklenburg and (4) Arkona Basin. Figure 9-9 shows areas with a high probability of cod spawning. In the Arkona Basin, cod also spawn for the eastern stock. Cod stocks in the Baltic Sea have a protracted spawning period of about 6-7 months with short periods of 1-2 months when spawning peaks. Cod spawning begins at the earliest in the areas that lie west, and later in the season the farther east spawning takes place. Peak spawning in the Kattegat and the Sound occurs during January-February, in the Bay of Kiel and the Bay of Mecklenburg during March-April and in the Arkona Basin during May-June (Hüssy K. , 2011), and others report that the peak occurs during June-July (Bleil, Oeberst, & Urrutia, 2009). The eastern stock spawns between March-October with the peak during May-August, with some variations from year to year (Hüssy, o.a., 2016).

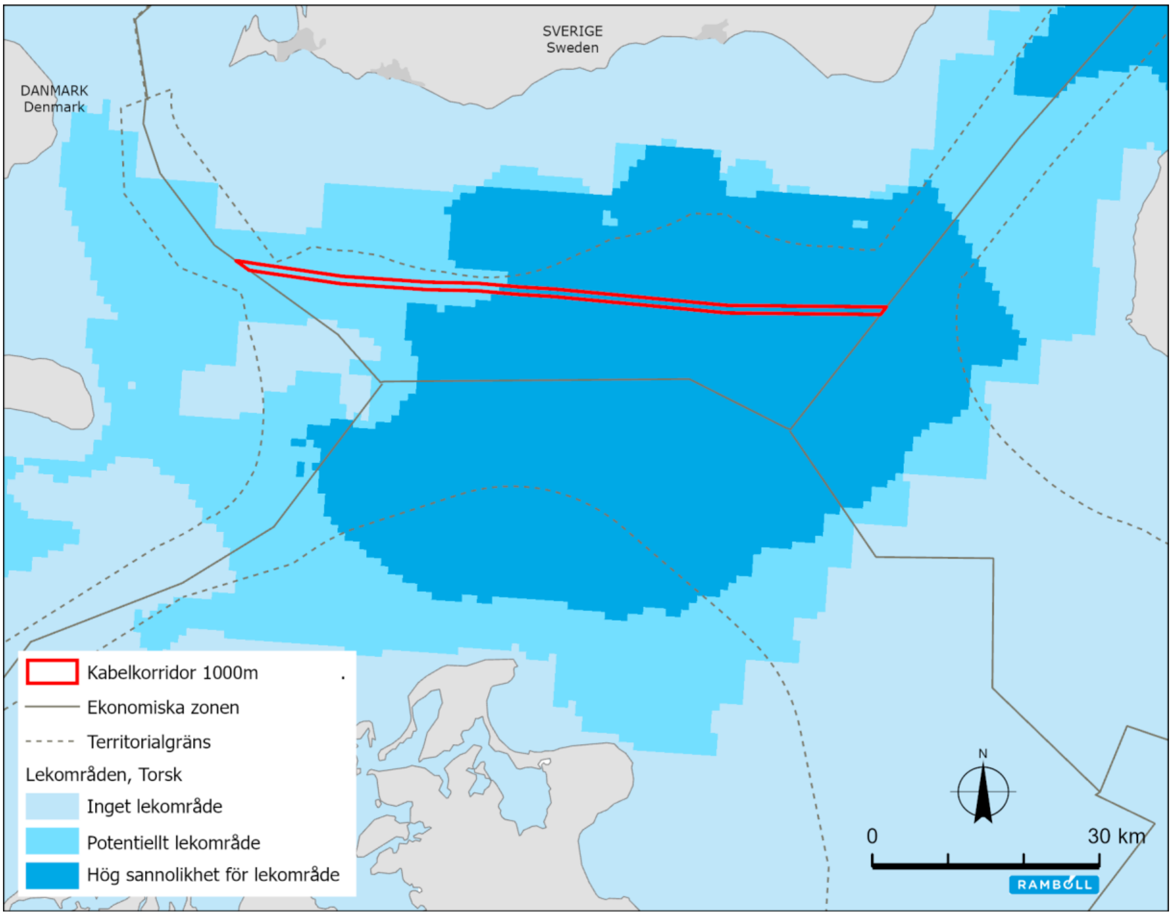

Figure 9-9. Potential spawning areas and spawning areas with a high probability of cod (HELCOM, 2022b)

In the Baltic Sea, the cod have adapted to the low salinity in that their eggs have a lower density and can thus remain buoyant in the brackish water (Kullander, Nyman, Jilg, & Delling, 2012). For reproduction to be successful, a salinity of at least 11-12‰ is required for the eastern stock and 15-16‰ for the western stock. In order for the eggs to have a neutral buoyancy, 14.5 ± 1.2‰ and 20-22‰ is necessary for the eastern and western stock respectively (Nissling & Westin, 1997). These conditions cannot always be achieved due to the fact that new oxygen-rich and saltier water does not always enter the Baltic Sea, see also section 9.2, especially further into the Baltic Sea for example east of Bornholm. During spawning, the male courts the female with display movements and a grunting sound generated by the swim bladder. Cod eggs as well as larvae live in the free mass of water (Kullander, Nyman, Jilg, & Delling, 2012).

For the western stock, since 2009, the quantity of mature fish has hovered around the threshold at which there is a risk to the cod's ability to reproduce. For the past five years, the western stock has been below this limit. For the eastern stock, since 2009, the quantity of mature fish has fallen since 2015 and is now below the threshold at which there is a risk to the cod's ability to reproduce. The poor state of cod in the eastern stock over the past 10 years is due, among other things, to poor oxygen conditions, which affect the cod by reducing the number of suitable habitats for example. Another reason is a reduced incidence of forage fish and a sharp increase in parasites linked to the larger population of grey seals. From this year (2022), the entire Baltic Sea has prohibited the targeted fishing of cod (Havs- och vattenmyndigheten, 2022). According to the 2020 Red List, the species is assessed as Vulnerable (VU) (SLU Artdatabanken, 2022).

Flounder

The flounder has recently been split into two species, the European flounder and the Baltic flounder (*P. flesus* and P. *solemdali* (HELCOM, 2021)respectively). Adult individuals of both species forage in shallow coastal areas during the summer and swim out to deeper areas in the winter (Havs- och vattenmyndigheten, 2022). The species spawn in the Baltic Sea from March or April to June (Kullander, Nyman, Jilg, & Delling, 2012). The European flounder spawns in deep water in the western and southern parts of the Baltic Sea and in the deeper parts of the Baltic Proper, see Figure 9-10. The eggs develop pelagically. The Baltic flounder spawns along the coast in shallow areas with lower salinity and on shallow offshore banks in the northern Baltic Proper and the northern Baltic Sea. The eggs of this species develop on the seabed. The Baltic flounder is only found in the northern and central Baltic Sea, whereas the European flounder is also found in the Skagerrak, the Kattegat, the Sound and the Baltic Sea up to the Åland Sea (Havs- och vattenmyndigheten, 2022).

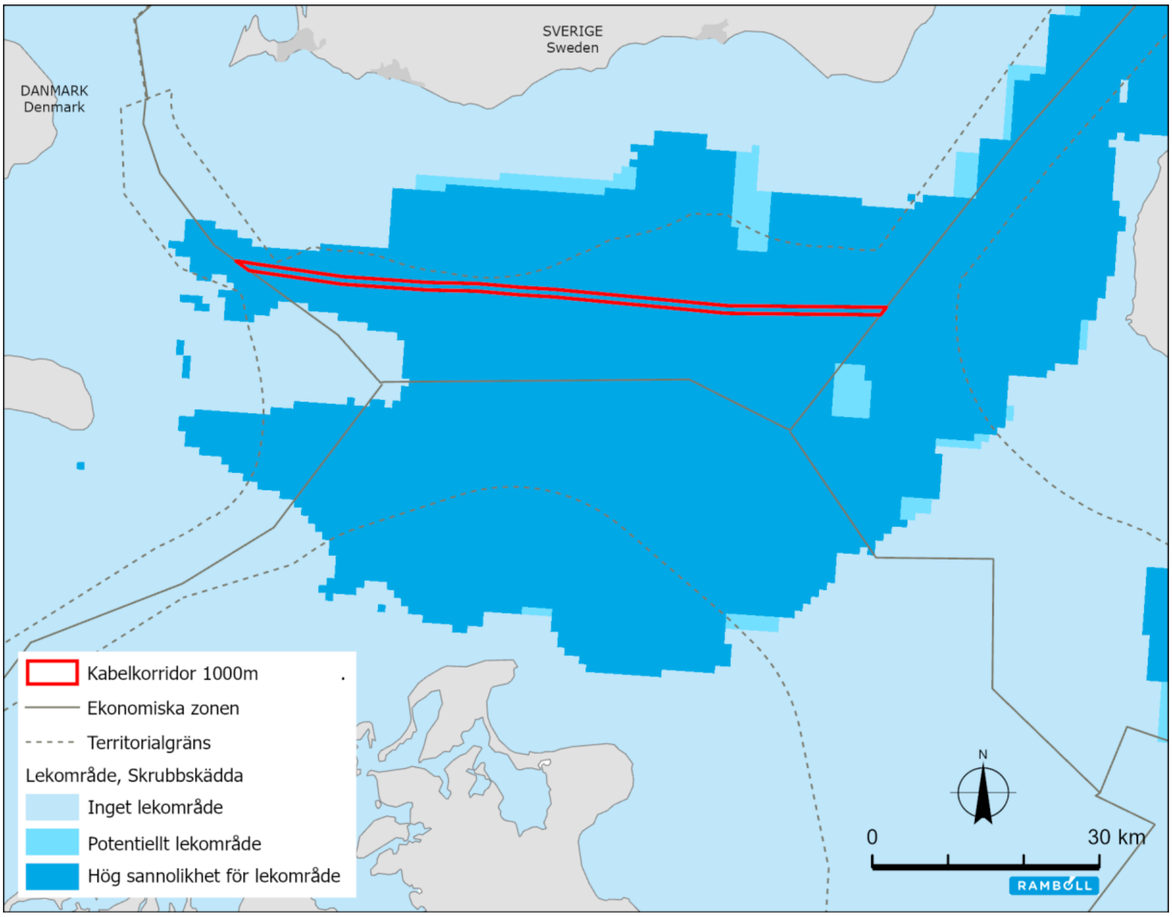

Figure 9-10. Potential spawning areas and spawning areas with a high probability of European flounder (HELCOM, 2022c).

The flounder in the southern Baltic Sea is treated as one stock as it is not possible to separate the two species. However, it is estimated that the European flounder represents 85% of the stock while the Baltic flounder represents 15% of the southern Baltic Sea stock. In the late 80s, the flounder was significantly more common than today, and the average length has decreased significantly since the late 1970s (Havs- och vattenmyndigheten, 2022).

European plaice

Plaice usually live at 10-30 m on mainly clay and sandy bottoms. The species spawns in the Baltic Sea during November-April, although a salinity of at least 13 ‰ is required for reproduction to be successful. Spawning takes place at a depth of 20-60 m and the eggs are pelagic (Kullander, Nyman, Jilg, & Delling, 2012).

The quantity of mature fish in the Baltic Sea has increased since 2013 and in 2020 the stock was well above the biomass threshold below which the stock should not be fished at the level that produces the maximum sustainable yield (Havs- och vattenmyndigheten, 2022).

Common dab

The dab is a marine species also found in the Baltic Sea. The species usually lives at a depth of 20-40 m on sandy, gravel and clay bottoms. For reproduction, a salinity of at least 18 ‰ is required so that the eggs can stay buoyant (Kullander, Nyman, Jilg, & Delling, 2012). Spawning takes place in the Baltic Sea during April-June from a depth of 30 m. Eggs and larvae are pelagic (Havs- och vattenmyndigheten, 2022).

There are indications that there are several different stocks of dab in the Baltic Sea, but until this is clarified, the species is treated as one stock. The weight of dab caught per hour has increased by a factor of three since the early 2000s and has remained stable since 2010. Dab is caught mainly as a by-catch in trawl fishing (Havs- och vattenmyndigheten, 2022).

European eel

The eel (*Anguilla anguillaa*) is found in all Swedish waters, in freshwater on land as well as along the west coast and in the Baltic Sea. In Sweden, almost all eels are females. The eel in the Baltic Sea begins its migration to the Sargasso Sea, located between Bermuda and the West Indies, to spawn when it is about 14 years old. When the eel begins its migration, it has changed from a so-called yellow eel into a silver eel, by which time feeding has become impossible (Kullander, Nyman, Jilg, & Delling, 2012). The migration takes place at night close to the water surface (Westerberg, Lagenfelt, & Svedäng, 2007) and begins in late summer or autumn, reaching the Sargasso Sea in the spring. After the eel has spawned, it is presumed to die (Kullander, Nyman, Jilg, & Delling, 2012). Eel larvae are transported back to the coasts of Europe by the currents, a journey that takes between 1-3 years (Havs- och vattenmyndigheten, 2022).

The population of eels consists of a single stock with very little genetic variation and a very wide distribution in Europe (Havs- och vattenmyndigheten, 2022). Population recruitment has decreased by over 90% between the 1980s and 2010s. Compared to the 1950s, recruitment has decreased by 95-99%. The decrease is serious in the North Sea area and in the Baltic Sea compared to other places in Europe. The reason for the decline in the population is not clear, but it may be due to climate change, migration obstacles, fishing, environmental toxins, parasites and more. According to the 2020 Red List, the species is assessed as Critically Endangered (CR) (SLU Artdatabanken, 2022).

9.5.1 Impact assessment

This section describes the potential impact on fish. The following impact factors during construction and operation have been identified, see Table 9-7.

Table 9-7. Potential impact on fish.

Potential impact	Construction	Operation
Suspended sediment	X	
Sedimentation	X	
Underwater noise	X	
Physical disturbance of the seabed	X	
Electromagnetic field		X

9.5.1.0 Suspended sediment

Changed conditions

During construction, the installation of the cable systems will cause sediment from the seabed to enter the mass of water. The works on the seabed for the cable trench will produce an excess concentration of suspended material of 10 mg/l for less than 12 hours in the immediate area. An excess concentration of 5 mg/l will occur over slightly larger areas (up to a few km) but with the same duration of less than 12 hours. For more information, see section 8.1. Works which create dispersed sediment will be avoided while cod spawning is thought to be at its most intensive, in the months of June and July.

Assessment

Construction

The fish's response to sediment dispersion is species-specific. What determines the response is the concentration of suspended material and how long the fish are exposed to the concentration in question (exposure time). An analysis by Karlsson, Kraufvelin, & Östman (2020) of previously published studies shows that in general, concentrations up to 100 mg/l of suspended sediment with an exposure time of less than 14 days have little direct impact on all life stages of fish. For shorter periods (maximum 24 hours), adult and juvenile individuals of many species can survive concentrations up to 1000 mg/l (Karlsson, Kraufvelin, & Östman, 2020). Depending on the species, behavioural effects may occur at elevated levels of suspended material. For cod and herring, levels above 3 mg/l may cause them to avoid the dispersed sediment (Westerberg, Rönnbäck, & Frimansson, 1996).

In general, adult and juvenile fish are not as sensitive to suspended sediment as eggs and larvae. The latter have little opportunity to move away from turbid water. In particular, pelagic eggs are sensitive as suspended material can stick to the eggs and weigh them down causing them to sink towards the seabed (Karlsson, Kraufvelin, & Östman, 2020). The buoyancy of cod eggs in the Sound has been shown to decrease when exposed to suspended sediment. Concentrations above 5 mg/l can negatively affect buoyancy, and after about 80 hours the buoyancy decreases by about 7 ‰. Yolk-sac larvae of cod have a higher mortality rate when exposed to levels of suspended material above 10 mg/l (Westerberg, Rönnbäck, & Frimansson, 1996).

The sediment dispersion occurs within a limited area along the site or the route of ongoing work on the seabed, and the duration of the sediment dispersion will be short. The increase in concentration is within natural variations in the Arkona Basin. After 12 hours, the suspended material resediments and the sediment dispersion ceases. The activities will move along the entire route so the impact on individual locations will be short-lived. The impact will thus be limited in time at each location. Sediment dispersion-generating works for each cable system will take place locally and in the worst case for 2-4 months of the cod spawning period, which lasts a total of 6-7 months. Trenching that can cause sediment dispersion is avoided during June and July. The fact that construction can cause low levels of suspended sediment with a short duration could give rise to a change in behaviour of cod and herring, for example, but the levels are considered to be so low that no direct negative effects on adult and juvenile fish will occur. However, the levels of the suspended sediment could affect any cod eggs and larvae in the immediate vicinity of ongoing work on the seabed. The environmental effect is considered to be low.

At levels of suspended material above 5 mg/l, sediment dispersion may have adverse effects on cod eggs. Reduced buoyancy can lead to eggs sinking to the bottom where they do not survive. The proportion of cod spawning areas in the entire Arkona Basin that could be affected over time by concentrations above 5 mg/l is estimated at around 4%. The calculation is based on the assumption that a 3 km wide area along the cable route is affected by concentrations above 5 mg/l. This means an impact area of 156 km^2 which represents 4% of a 3,875 km^2 area with a high probability as a spawning area. The natural mortality of cod eggs is very high. An extremely limited increase in the mortality of cod eggs is therefore not expected to have a negative impact on cod populations in the area. However, due to the fact that cod is classified as vulnerable according to the Red List and thus particularly worthy of protection, the environmental value is considered to be moderate.

The impact assessment is based on the most sensitive species, in this case cod. Overall, the environmental value is considered to be moderate and the environmental effect low. Thus, the consequence is considered to be small.

9.5.1.1 Sedimentation

Changed conditions

When the suspended sediment from construction descends to the seabed, sedimentation occurs. This sedimentation will take place in close proximity to the areas where the cable systems are trenched into the seabed. The modelling shows that the sedimentation will amount to a maximum of 1 mm.

Assessment

Construction

Sedimentation can affect fish eggs on the seabed by covering them up, thereby causing suffocation. In the area where the cable systems will be laid, there are not thought to be any seabed areas of importance for spawning fish where they might lay their eggs on the bottom. An indirect effect that could arise from sedimentation is that the bottom fauna, which is the food source of several fish species, is covered up. Section 9.4.2.1 assesses the impact of sedimentation on the bottom fauna, and the assessment shows that there will be no significant impact on the bottom fauna and thus on the food source of several fish species.

Sedimentation will be very slight (≤1 mm) and over a small area, and it is likely that any fish eggs on the seabed in the area will not be affected by such limited sedimentation. The environmental effect is considered to be negligible.

There is not thought to be a significant quantity of fish eggs in the limited area potentially subject to sedimentation that may affect the survival of the eggs. In relation to other areas with fish eggs on the seabed, this proportion is insignificant. The environmental value is therefore considered to be negligible.

With a negligible environmental effect and negligible environmental value, the consequence is considered to be negligible.

9.5.1.2 Underwater noise

Changed conditions

The laying of the cable systems will generate underwater noise. The predominant underwater noise sources will be ship engines and rock placement, both of which are in the same order of magnitude as normal ship traffic (see further details in section 8.2). Underwater noise from the construction activities will not differ from the noise normally present in the area.

Assessment

Construction

The environmental effect consists in the behavioural reactions of fish as a result of underwater noise. The spread of underwater noise will be limited to the immediate area around the construction work for the cables, rock placement, etc. and has a local transient effect that slowly moves along the cable route. The environmental effect is considered to be negligible.

The fish population along the cable route is not thought to deviate significantly from other parts of the Arkona Basin, which means that only an extremely small proportion of fish stocks are affected by the construction works. Fish stocks are generally affected in the area of the sea where cod in particular is threatened. Overall, the environmental value for fish along the cable route is considered to be low.

With a negligible environmental effect and low environmental value, fish are considered to suffer negligible consequences as a result of underwater noise in connection with the construction work.

9.5.1.3 Physical disturbance of the seabed

Changed conditions

Due to the construction work on the seabed, demersal organisms will temporarily disappear along the cable route. The dominant fish species in the Arkona Basin have pelagic eggs that are not affected by physical disturbances of the seabed. Demersal fish can be temporarily frightened away by the works on the seabed.

Assessment

Construction

The area affected by physical disturbances is localised along the cable route. Recolonisation of bottom fauna from surrounding bottoms is expected to occur within a few years. The loss of bottom fauna as a food supply for fish is minor in relation to the food resource in general and will not constitute a limitation. The environmental effect is considered to be negligible.

The fish stocks of demersal species along the cable route are not thought to differ from other parts of the Arkona Basin, which means that only an extremely small proportion of fish stocks will be affected by the works disturbing the seabed. Demersal fish are distributed throughout the Arkona Basin. The cod finds forages partly on the bottom and is particularly threatened, but it also has a wide geographical distribution. Overall, the environmental value for fish along the part of the bottom disturbed by cable laying is considered to be low.

With a negligible environmental effect and negligible environmental value for fish on disturbed bottoms, the consequence is considered to be negligible.

9.5.1.4 Electromagnetic field

Changed conditions

When the cables are put into operation, electromagnetic fields are generated around the cables. The magnetic field strength is estimated to be a maximum of 27 μT at the centre 1 m above the cable system at the seabed. If the cable is laid deeper, the magnetic field will be weaker.

Assessment

Operation

Electromagnetic fields can affect eels and cartilaginous fish (sharks and rays). Cartilaginous fish can sense electric fields, which they use to locate prey, but cartilaginous fish are not normally found in the Baltic Sea. The magnetic field around the electrical cable drops very quickly with distance and at about 10 m the strength is zero. Eels use the Earth's magnetic field to navigate over large areas towards the Sargasso Sea where they spawn. The electrical cables could therefore affect the eel's ability to orient itself to the geomagnetic field. This could result in delayed migration for the eel, causing an increase in energy consumption (Lagenfelt, Andersson, & Westerberg, 2012). However, studies have shown that the magnetic field that occurs around electrical cables does not affect the eel's migration (Westerberg H. , Lagenfelt, Andersson, Wahlberg, & Sparrevik, 2006), a finding which is also supported by laboratory studies where magnetic fields of 95 μT (50 Hz)[1] did not elicit any effects on the eel's swimming behaviour (CSA , 2019). The eel does not take the fastest route to the Sargasso Sea. The migration takes 1-3 years at a speed of 3-47 km/day, and they occasionally migrate in the opposite direction (Righton, o.a., 2016). Overall, electromagnetic fields are considered to have a negligible environmental effect for fish.

Electromagnetic fields along the cables could affect an extremely small part of the eel population migrating out of the Baltic Sea. The majority of eels are likely to migrate along the coasts and other eels only need to cross the cables once. The eel is an endangered species for which impacts in the form of high fishing pressure, power plants and migration obstacles determine the size of the population. Overall, the environmental value for fish that might be affected by magnetic fields is considered to be low.

The consequences for fish due to electromagnetic fields are considered to be negligible because the environmental value is considered to be low and the environmental effect negligible.

9.5.2 Overall impact assessment

Table 9-8 summarises the impact assessment for the bottom fauna.

Table 9-8. Overall assessment of the consequences for bottom fauna.

Impact factor	Level of environmental value	Magnitude of environmental effect	Consequence
Construction phase			
Suspended sediment	Moderate	Low	Low
Sedimentation	Negligible	Negligible	Negligible
Underwater noise	Low	Negligible	Negligible
Physical disturbance of the seabed	Negligible	Negligible	Negligible
Operation phase			
Electromagnetic field	Low	Negligible	Negligible

[1] For comparison, the strength of the Earth's static magnetic field is about 50 μT.

9.6 Marine mammals

9.6.1 Existing conditions

The marine mammals that are mainly present in the southern Baltic Sea are the harbour porpoise, the grey seal and the harbour seal.

Harbour porpoise

The harbour porpoise is the only resident whale species in the Baltic Sea. It is found all year round in the Baltic Sea, the Skagerrak and the Kattegat. Studies have confirmed that there are three distinct populations; the Baltic Sea population, the Belt Sea population and the North Sea population, see Figure 9-11. The Baltic Sea population and the Belt Sea population are found in the Baltic Sea. The harbour porpoise usually appears alone or in smaller groups consisting, as a rule, of a female and her calf, groups of juveniles or solitary sexually mature males (SLU Artdatabanken, 2022a).

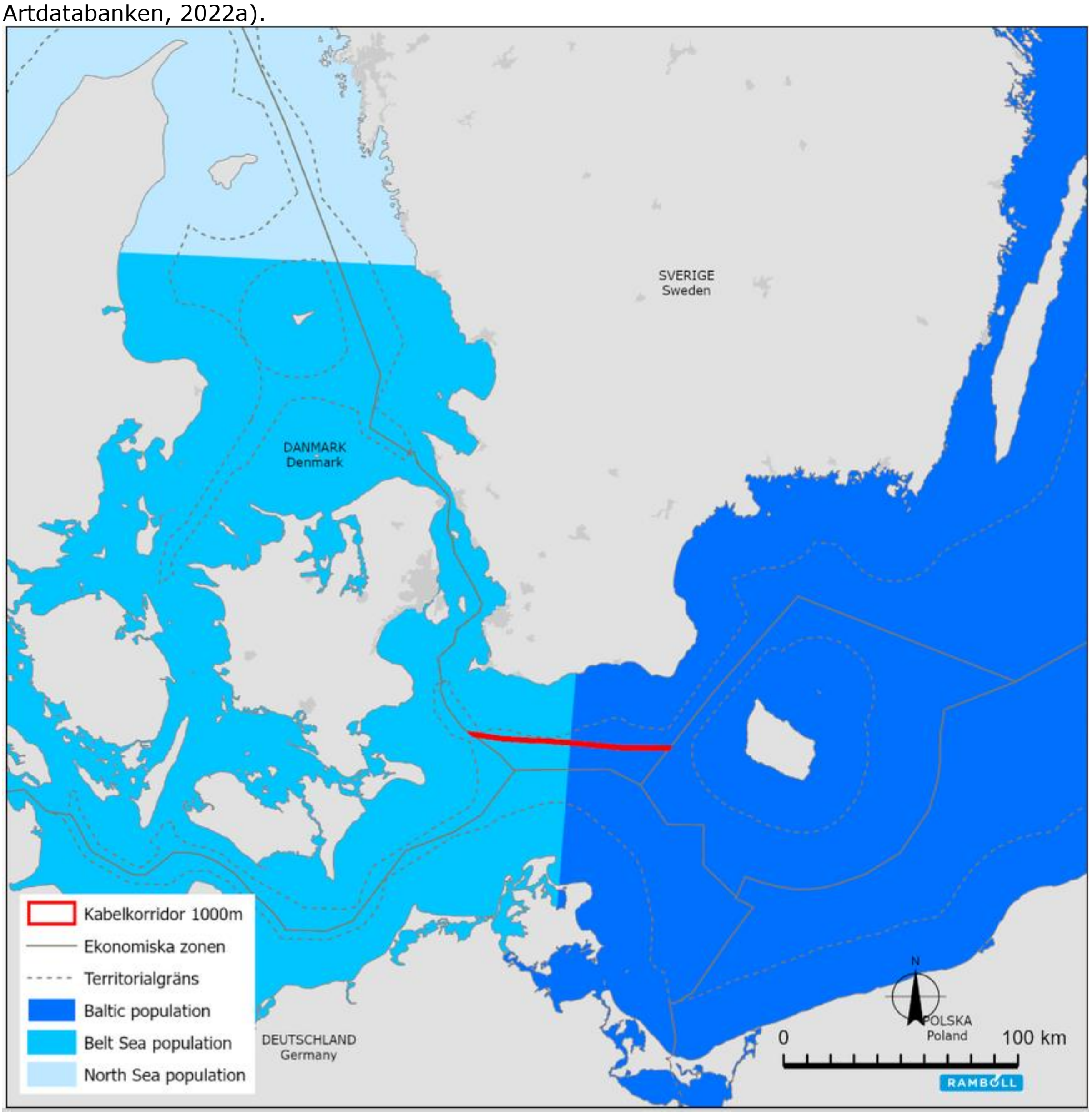

Figure 9-11. Distribution of different harbour porpoise populations along the project area (Carlström & Carlén, 2016).

The harbour porpoise is considered to be of least concern and is no longer red-listed in Sweden. However, the harbour porpoise population in the Baltic Sea is considered separately as it is genetically distinct from the other populations. The Baltic Sea population is decreasing sharply in number and, combined with the fact that the number of reproductive individuals is low, the Baltic Sea population is classified as "critically endangered" (SLU Artdatabanken, 2020). Through the scientific project SAMBAH (Statistical Acoustic Monitoring of Baltic Sea Harbour porpoises), the presence of harbour porpoises has been investigated in the Baltic Sea, the Skagerrak and the Kattegat. The number of harbour porpoises in the Baltic Proper was estimated at about 500 individuals, making the Baltic Sea population the smallest harbour porpoise population in the world (SAMBAH, 2016).

The harbour porpoise is protected under the EU Habitats Directive (92/44/EEC), Annexes II and IV. On the basis of the Directive, the Swedish Government has also designated several new Natura 2000 sites in Swedish waters for the protection of harbour porpoises. One of these areas is "Sydvästskånes utsjövatten", see 10.8.1. The harbour porpoise is protected under the Species Protection Ordinance (*Artskyddsförordningen*) and listed in Appendix II to the Bonn Convention, Appendix II to the Berne Convention, Annex A to CITES and ASCOBANS.

HELCOM has categorised the Baltic Sea population as critically endangered and the Belt Sea population as vulnerable on its Red List (HELCOM, 2013e).

The Swedish Agency for Marine and Water Management has developed a special action programme to improve the conservation status of harbour porpoises in Swedish waters. The programme will run in the years 2021-2025 and will be used as a guidance document (Havs-och vattenmyndigheten, 2021).

The harbour porpoise needs constant access to food as it is a small whale with a high metabolic rate because it lives in cold and temperate waters. This is especially true of the females, which can be pregnant and lactating at the same time. The main food in Swedish waters consists of various fish species such as herring, small cod, gobies, sand eels and hagfish. Their dives are usually quite shallow and short, but they can reach depths of over 220 m (Havs-och vattenmyndigheten, 2022a). The harbour porpoise has very sensitive hearing and it depends on being able to hear not only sounds from the surroundings but also the echo of its own signals. The hearing of the harbour porpoise is best in the frequency range of about 10 kHz to 160 kHz (Tougaard & Michaelsen, 2018). They use echolocation with high-frequency clicking sounds to orient themselves, search for fish and communicate (Havs-och vattenmyndigheten, 2021).

In the Baltic Sea, the harbour porpoise mating period is around July-August and calving occurs about 10-11 months later in May-July the following year. The females usually give birth to a calf every two years or, rarely, each year. The calves then suckle for about 8-10 months. Key areas for harbour porpoises and their habitats have been identified based on harbour porpoise observation data. In the Skagerrak, the Kattegat and the Sound, areas were identified using harbour porpoises equipped with satellite transmitters in Danish waters, while in the Baltic Sea, calculations were based on an acoustic inventory (Havs-och vattenmyndigheten, 2021). A total of eight protected areas have been identified for harbour porpoises in Swedish waters, of which Hanö Bay, south of Öland, the Middle Banks and Hoburgs Bank, and Northern Öland are used by the Baltic Sea population. The Belt Sea population mainly uses Fladen and Lilla Middelgrund, Stora Middelgrund and Northern Sound (Öresund) as well as the southwest Baltic Sea, at least during the summer. There was no analysis of important areas during the winter months for harbour porpoises in the southwest Baltic Sea (Havs-och vattenmyndigheten, 2021). During May-October, a large proportion of the Baltic Sea population gathers in the areas from the Middle Banks and

Hoburgs Bank. As this occurs during the harbour porpoise's reproductive period, this is considered to be the population's most important reproductive area. During November-April, the population then spreads out over a larger part of the Baltic Sea and may coexist with the Belt Sea population (Havs-och vattenmyndigheten, 2021).

During the summer period (May-October), only the Belt Sea population is expected to be present along the planned cable route, see Figure 9-12. A mixture of the two populations and a lower number of individuals is expected in the area during the winter period (November-April) (SAMBAH, 2016). The highest concentration of harbour porpoises can be expected in the western part of the planned cable route. The density in the project area during the summer period is between 0 and 0.57 individuals/km^2 and during the winter period between 0 and 0.37 individuals/km^2 (SAMBAH, 2016; Teilmann, 2017).

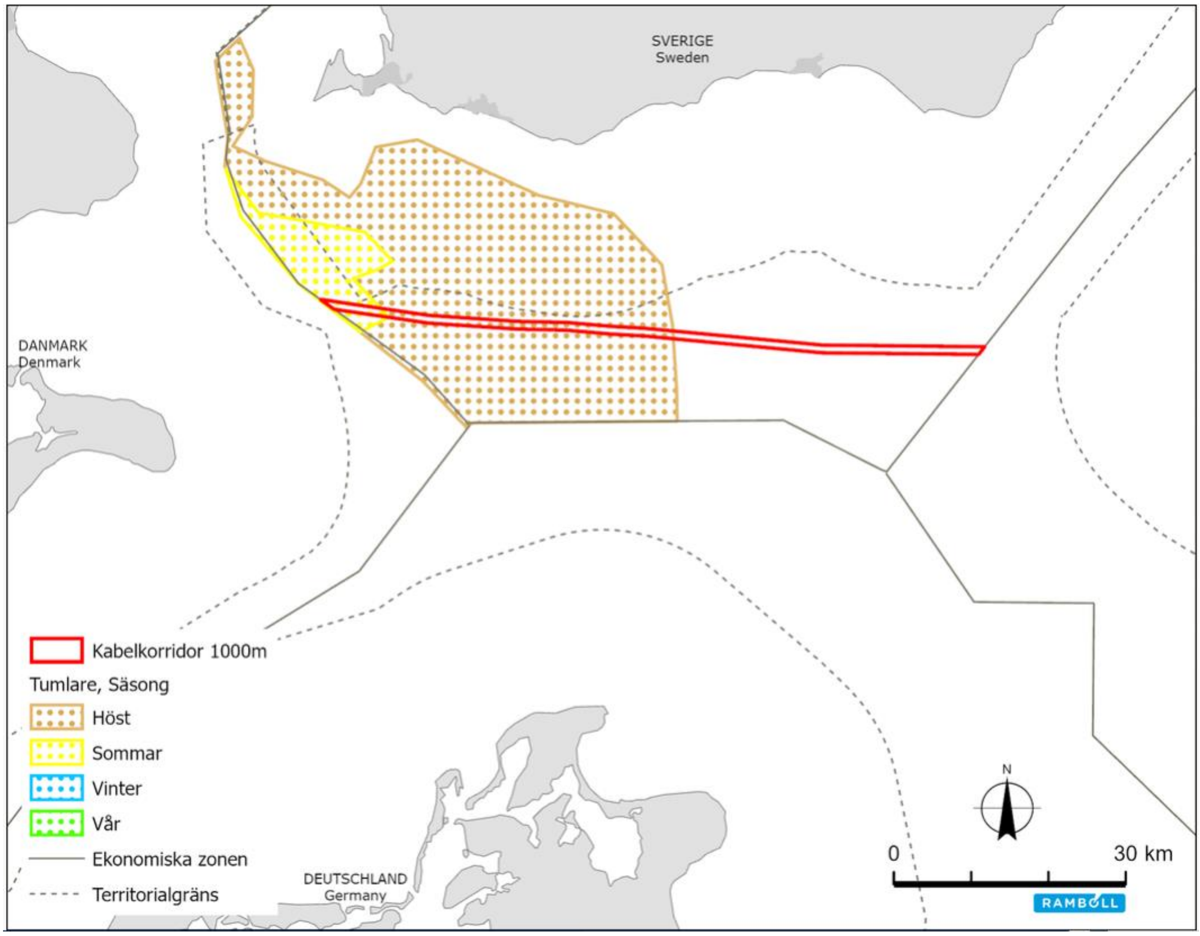

Figure 9-12. Probability of harbour porpoises in the area during the seasons, interpreted from (SAMBAH, 2016).

As part of the Baltic Pipe project, the presence of harbour porpoises in the area was investigated with the help of 20 C-PODs that were placed along the planned route of the pipeline and in the immediate area. Background noise was also examined using three SM4M sensors. The survey with C-PODs was conducted during the period November 2017 to April 2018. Despite some problems with the devices, probably due to malfunctions, the coverage was between 90-95%. The results showed the presence of harbour porpoises mainly in the western part of the survey area, which was consistent with previous surveys in the SAMBAH project (Ramboll, 2019d) .

A later survey covering half of the eastern corridor showed that harbour porpoises frequently reside in the area but to a lesser extent than in areas further west (BioConsult SH, 2021). The survey included aerial observations (15 conducted during the period March 2019-February 2021) and 12 C-PODs (April 2020 to April 2021) as well as a review of the literature. The seasonal presence of harbour porpoises in the survey area was in line with the results of the SAMBAH project, i.e., low in the spring and higher during the summer and autumn. During the winter there was then a sharp decrease (BioConsult SH, 2021).

Seals

Both harbour seals and grey seals can be observed in the cable corridor. As part of the harbour porpoise surveys in 2021, the presence of seals was also investigated. The results showed that seals were present in the area in almost all seasons but in low numbers and not at any particular locations (BioConsult SH, 2021).

Harbour seal

The harbour seal is present along the coasts of northern Europe, including on the west coast of Sweden, south of the Sound and in a limited area on southern Öland and the southern Småland coast. The population is increasing and is considered to be of least concern in Sweden (SLU Artdatabanken, 2022b). In total in Sweden, the population of harbour seals is estimated at about 14,900 individuals, with most of the population on the west coast. In the Baltic Sea, the number of individuals amounts to about 400, of which about 200 individuals belong to the Kalmar Strait population, which is probably isolated from other groups. The Kalmar Strait population is categorised as vulnerable. There is also a colony of about 60 individuals at Måkläppen in Falsterbo (SLU Artdatabanken, 2022b).

Harbour seals like to live in coastal areas with access to larger areas with shallow bottoms. They rest in groups on islets and sheltered skerries. Good resting spots are also needed when they moult, which happens from the latter part of July to the end of August (SLU Artdatabanken, 2022b). Their food consists of about 30 different T-species of fish including herring and dab, and they can hunt and catch fish in the dark (Havs-och vattenmyndigheten, 2022b).

In Swedish waters, the mating season is in June-July and harbour seal cubs are born in June of the following year (Havs-och vattenmyndigheten, 2022b).

The harbour seal is protected under the EU Habitats Directive (92/44/EEC), Annexes II and V, Appendix III to the Berne Convention and Appendix II to the Bonn Convention (the Kalmar Strait population). It is also listed as a protected species in the Natura 2000 site Sydvästskånes utsjövatten, see 10.8.1. The nature reserve Måkläppen on the Falsterbo peninsula has Sweden's only colony of both harbour seals and grey seals.

HELCOM has categorised the harbour seal as least concern on its Red List (HELCOM, 2013e).

Grey seal

The grey seal is the most common species of seal in the Baltic Sea. At present in Sweden, there are sites with grey seals from the Falsterbo peninsula in Skåne to Haparanda in Norrbotten. Most of the grey seals are present in the coastal archipelagos of Stockholm and Södermanland, but there are also large colonies in the Bothnian Sea and the North Kvarken and along the south coast. A small number of grey seals are also present along the Swedish west coast (Havs-och vattenmyndigheten, 2022c). Sweden's only colony of both harbour seals and grey seals is located at the nature reserve Måkläppen on the Falsterbo peninsula. For the grey seal, this is its only permanent settlement along the coast of Sweden in the southern Baltic Sea. The grey seal is listed in Annex 2 to the Habitats Directive, Appendix III to the Berne Convention and Appendix II to the Bonn Convention. The species is listed as a protected species in the Natura 2000 site Sydvästskånes utsjövatten, see 10.8.1.

Grey seals occur mainly in coastal areas as well as on islets and skerries. They live most of the year in colonies. It is estimated that there are between 37,500-50,000 grey seals in the entire Baltic Sea (HELCOM, 2022). The population is increasing and is considered to be of least concern in Sweden. In the Baltic Sea, the grey seal gives birth to its young from late February to early April. Especially in the period from May to June, they gather in large colonies on the most remote islets of the archipelago to moult. The grey seal's food consists mostly of schooling and demersal fish such as herring, eelpout, flatfish, but also salmon and cod (SLU Artdatabanken, 2022c).

The grey seal is categorised as least concern on HELCOM's Red List (HELCOM, 2013e).

9.6.2 Impact assessment

This section describes the potential impact on marine mammals. The following impact factors during construction and operation have been identified, see Table 9-9.

Table 9-9. Potential impact on marine mammals.

Potential impact	Construction	Operation
Suspended sediment	X	
Underwater noise	X	X

9.6.2.0 Suspended sediment

Changed conditions

The sediment modelling showed a maximum excess concentration of 10 mg/l in the immediate area of the trenching activity, while an excess concentration of 5 mg/l occurs over somewhat longer distances (a few km). Concentrations of dispersed sediment of 10 mg/l is comparable to the natural background concentration in the area during high winds. The duration of the elevated concentrations is less than 12 hours for both 5 mg/l and 10 mg/l, see also section 8.1.

Assessment

Construction

Bottom sediment can become temporarily suspended in the water mass when construction work takes place on the seabed. This can have a temporary negative impact on marine mammals through poor visibility, impaired water quality, and the possible need to change behaviour patterns due to sediment dispersion. Harbour porpoises use echolocation to search for food and to orient themselves. Seals partly use their eyesight but can also hunt for food in the dark and use their whiskers. Both harbour porpoises and seals are thus not dependent on good visibility and are otherwise mobile and can swim away from conditions that are unfavourable.

The spread of suspended sediment can cause behavioural changes in cod and herring, for example, which would indirectly affect harbour porpoises foraging in deeper water. In the construction phase, sediment dispersal will be short-term and local with low concentrations outside the construction area. The concentrations are considered to be so low that no direct adverse effects on fish will occur (see section 9.5.2). Since neither harbour porpoises nor fish are stationary in the area, this is not considered to have any bearing on foraging by the marine mammals – they can follow the sandbanks of fish. Overall, the environmental effect of suspended sediment is thus considered to be negligible.

Only a very limited proportion of the harbour porpoise and seal populations will be exposed to elevated sediment concentrations. The area over which marine mammals move is very large and only a fraction may be exposed to elevated suspended sediment concentrations. However, the environmental value is considered to be high for these reasons: the species are protected within the Natura 2000 site *Sydvästskånes utsjövatten;* harbour porpoises belonging to the Baltic Sea population are critically endangered; and each individual is valuable. With a negligible environmental effect and a high environmental value, the consequence for marine mammals is considered to be none or negligible.

9.6.2.1 Underwater noise

Changed conditions

During the construction phase, the predominant source of underwater noise is considered to be ship engines and possible rock placement. The underwater noise generated is considered to be approximately the same level as from normal ship traffic but involves a temporary increase in noise levels in the surroundings. The planned works (section 3.2) does not involve equipment that produces high noise levels.

Assessment

Construction

Underwater sounds and noise can have a negative impact on marine mammals by, for example, causing stress, disrupting their behaviour, or interfering with their sound-based communication or orientation. The additional noise can also lead to temporary hearing loss (TTS), permanent hearing loss (PTS) or impairment of the ability to detect and identify other sounds (so-called masking). The risk of PTS and TTS is not considered to be relevant in the construction phase, see also section 8.2.

Harbour porpoises exposed to underwater noise exceeding their hearing threshold by about 40-50 dB react behaviourally by swimming away. This reaction has been shown to exist in response to both impulse sounds and in more continuous ship noise (Havs-och vattenmyndigheten, 2021). It is mainly in the vicinity of the cable corridor and the construction vessels that underwater noise will occur.

In the Baltic Pipe project, Aarhus University has produced a report in which they state that no significant impact on harbour porpoises is expected to occur from the construction and operation of the planned pipeline within the Swedish exclusive economic zone (Sveegaard, S. Holst Palner, M.K. Tougaard, J. , 2019). A review of previous surveys concerning underwater noise (see section 8.2) shows that the noise levels arising from planned activities are not expected to exceed the existing background levels arising from existing ship traffic in the area. Underwater noise occurs immediately and ceases directly after the activity ends. The distribution of noise from ship traffic and rock placement is local. The noise is similar to the daily noise from ship traffic in the area, and the brief passage through the area during construction is considered to be marginal in relation to other ship traffic. During the construction phase (see section 3.3.1) no equipment will be used that produces high noise levels in frequency ranges harmful to marine mammals.

The environmental effect of underwater noise is thus considered to be negligible. Only a limited proportion of the harbour porpoise and seal populations will be exposed to underwater noise. The environmental value is considered to be high because the species are protected within the Natura 2000 site *Sydvästskånes utsjövatten* and the harbour porpoise has the highest environmental value as the Baltic Sea population is critically endangered. The consequence for marine mammals is thus considered to be negligible.

Operation

During the operation phase, underwater noise is expected to come from ship engines relating to inspection and maintenance activities along the cable route. The installation normally requires minimal maintenance, and inspections are expected to take place very rarely. The underwater noise generated in the operation phase will be similar to the disturbance generated during the construction phase. The environmental effect is thus considered to be negligible, and the environmental value is considered to be high. Overall, the consequence for marine mammals is considered to be negligible.

9.6.3 Overall impact assessment

Table 9-10 summarises the impact assessment for marine mammals.

Table 9-10. Overall assessment of the consequences for marine mammals.

Impact factor	Level of environmental value	Magnitude of environmental effect	Consequence
Construction phase			
Suspended sediment	Large	Negligible	Negligible
Underwater noise	Large	Negligible	Negligible
Operation phase			
Underwater noise	Large	Negligible	Negligible

9.7 Birds

9.7.1 Existing conditions

The Baltic Sea is generally an important area for seabirds and migratory birds and is a winter residence for a large number of wintering seabirds. However, at the current state of knowledge, the area along the route of the cable corridor is considered not to constitute an important area for birds (Länsstyrelsen Skåne, 2016). The western part of the cable route in Swedish waters passes the Natura 2000 site Sydvästskånes utsjövatten which was primarily designated for the protection of seabed habitats, harbour porpoises and seals. There was not thought to be any reason to designate the Natura 2000 site as an SPA, providing protection under the Birds Directive. However, the northwest part of the area is designated as a wintering and resting area for various waterfowl (Naturvårdsverket, 2022).

BirdLife's IBA programme (Important Bird and Biodiversity Areas) has established a worldwide network of important areas for birds and biodiversity. All important areas for birds are located long distances from the planned cable corridor (Figure 9-13). Note that seabirds are often attracted to shallow areas (less than 30 m) so they can forage underwater, for example on mussel reefs or sandbanks (Durinck, 1994). The bathymetry in the relevant area for the cable route in the Swedish part of the project varies between about 33 m in the western part to about 47 m in the eastern part within the Swedish exclusive economic zone (see section 9.1).

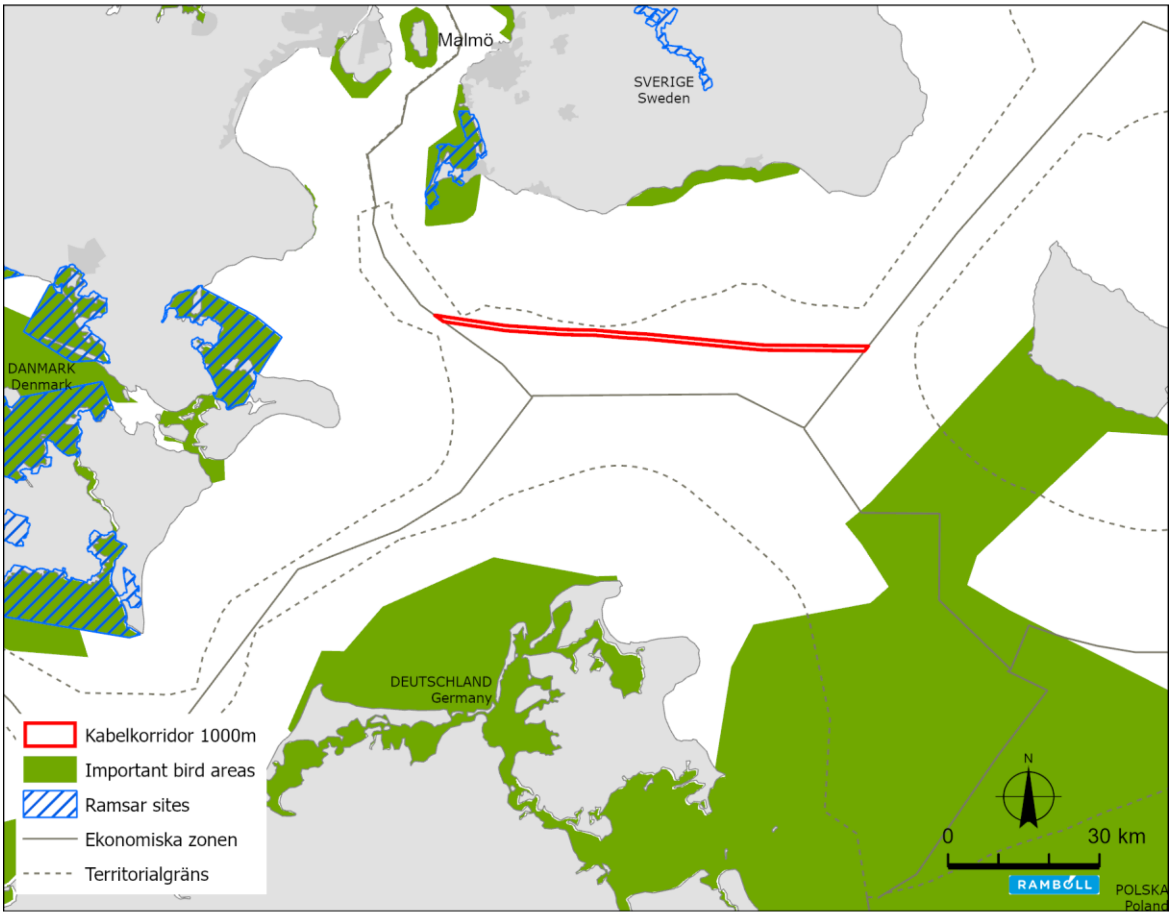

Figure 9-13. Internationally designated areas; IBAs (Important Bird and Biodiversity Areas) and RAMSAR areas (BirdLife International, 2022).

Studies show that smaller populations of long-tailed duck, little gull, common gull, European herring gull, great black-backed gull, common guillemot and black guillemot are occasionally present in the area during the winter (Durinck, 1994). Results from a bird survey conducted in the process of seeking permits for a wind farm on Krieger's Flak showed that the dominant bird species in the area was the common gull (60%) (Vattenfall/Sweden offshore wind AB, 2015).

In the area where the cable systems are planned, seabird and migratory bird surveys were carried out in 2018, 2019 and 2020 (Ramboll, 2019a; WSP & Bio Consult SH, 2021). The results showed that seabirds observed were the long-tailed duck as well as the red-throated diver and black-throated diver, especially in the southwest part of the route in the vicinity of the Krieger's Flak area which has shallower waters (Ramboll, 2019f). However, the number of long-tailed ducks observed in the immediate area of the route was low (<50 individuals/ km^2). The red-throated diver and black-throated diver were mainly observed in February with up to 50–250 individuals/km^2 in several locations. The other species noted close to the route were the common gull, the European herring gull, the great black-backed gull, the red-breasted merganser, the common guillemot, the common razorbill and a few common eider and common scoter individuals. None of these bird species exceeded a density of 50 individuals/km^2 in close proximity to the cable corridor during the months of January to March. In the survey conducted in April 2018, the density of common gulls, European herring gulls, great black-backed gulls, common guillemots, and common razorbills was slightly higher, with up to 50–250 individuals/km^2 (Ramboll, 2019a).

For migratory birds, in 2018 a survey station was installed in the middle of the route with the aim of showing general patterns of spring migration. During the spring survey, 32 migratory bird species were observed, the most common of which were common eiders, common cranes, great cormorants, common razorbills, Canada geese and unidentified geese and passerines, as well as lower numbers of long-tailed ducks and common scoters (Ramboll, 2019a). Among the observed bird species are several species found in the 2020 Red List (see Table 9-11).

Surveys conducted in 2019-2020 in the eastern parts of the area provide similar results to previous surveys. Birds observed were gulls (great black-backed, European herring, lesser black-backed, common and little gulls), divers (red-throated and black-throated), auks (common guillemot and common razorbill), terns (common, Arctic and little terns), great cormorants, common cranes, geese and ducks, a majority of which were common eiders, Eurasian wigeons and common scoters (WSP & Bio Consult SH, 2021). Surveys confirmed that the density of birds was low, and that the area is not an important place for resting and wintering birds. The studies also showed that the area was of very limited value for common eiders and other foraging birds because the sea was too deep (WSP & Bio Consult SH, 2021; Ramboll, 2019f).

Table 9-11. Species of birds contained in the 2020 Red List and most commonly found in surveys (Ramboll, 2019a; WSP & Bio Consult SH, 2021). NT=near threatened, VU=vulnerable, EN=endangered, '-' =least concern

Species	IUCN Red List	EU Red List	Swedish Red List
Long-tailed duck (*Clangula hyemalis*)	VU	-	EN (wintering population)
Common eider *(Somateria mollissima)*	NT	EN	EN
Red-throated diver (*Gavia stellata*)	-	-	NT
European herring gull (*Larus argentatus*)	-	-	VU
Great black-backed gull (*Larus marinus*)	-	-	VU
Common gull (*Larus canus*)	-	-	NT
Eurasian wigeon (*Mareca penelope*)	-	-	VU

9.7.2 Impact assessment

This section describes the potential impact on birds. The following impact factors during construction and operation have been identified, see Table 9-12.

Table 9-12. Potential impact on birds.

Potential impact	Construction	Operation
Physical disturbance above the surface	X	X

9.7.2.0 Physical disturbance above the surface

Changed conditions

Physical disturbance above the surface consists of the presence and movement of ships in the plan area and the proximity of the plan area. Increased presence and traffic of vessels will occur mainly during the construction phase with construction vessels and other vessels used, and to a lesser extent during operation with vessels that may be used to carry out inspection or maintenance activities. A zone of 300–400 m around the vessels is considered to be affected by the activity. The cable system laying vessels move slowly, at a speed of 0.1–2 km/h. Work is expected to be carried out in two construction campaigns.

Assessment

Construction

The presence and movement of ships has a potential impact on birds which may be disturbed by the presence of ships, or injured in collisions with ships.

Several species that may be present in the plan area are red-listed birds: the long-tailed duck, the common eider, the red-throated diver, the common gull, the European herring gull and the great black-backed gull. Several other species were observed such as the black-throated diver, the red-breasted merganser, the common scoter, the common crane, the great cormorant, the common razorbill and the common guillemot. However, the density of seabirds is quite low over the year and especially in the immediate area of the route (Ramboll, 2019a). In addition, at the current state of knowledge, the area along the route of the cable corridor is considered not to constitute an important area for birds (Länsstyrelsen Skåne, 2016).

The birds near the ship activity may be disturbed and move elsewhere by diving, swimming, or flying. This wastes energy, foraging time and resting time, contributing to the weakening of individuals. In addition, the presence of vessels may cause a collision hazard because the birds can be attracted to the artificial light from the ships, especially during bad weather or at night. During the construction phase of the Nord Stream pipeline, studies showed that very few birds collided with ships used in the plan area (Nord Stream, 2014). The sensitivity of birds to the presence of vessels is considered to be small given their ability to move away from the source of disturbance. The ship traffic that will be used for the construction phase will be limited compared to the other ship traffic in the area (see 9.9 and associated figure). In addition, the cable system laying vessels move slowly, at a speed of 1–2 km/h. The intensity of the disturbance is therefore low, and the duration is short and temporary (<1 year), as all the work is expected to be able to be carried out in one or two campaigns of a few months (depending on weather conditions). In addition, ship traffic from the construction phase is considered insignificant compared to the usual local ship traffic that takes place in the vicinity. Overall, the environmental effect on birds is considered to be negligible.

A zone of about 400 m where birds might be affected is small in comparison with the total available area for birds in the sea area. No particularly important areas are affected. The density of seabirds is relatively low in close proximity to cable route. The environmental value for birds in the area that may be disturbed is considered to be negligible.

With a negligible environmental effect and a negligible environmental value, the consequence for birds as a result of the construction phase is considered to be negligible.

Operation

During the operation phase, vessels will be used along the route to perform inspections and maintenance. Routine inspection of the cables is usually not necessary as the installation requires minimal maintenance, which means that maintenance and inspections are expected to take place very rarely. Disturbance to birds in the operation phase is expected to be similar to the disturbance that may occur during the construction phase, although to a much lesser extent. For these reasons, the environmental effect and the environmental value are considered to be negligible, and the consequence is thus negligible.

9.7.3 Overall impact assessment

Table 9-13 summarises the impact assessment for birds.

Table 9-13. Overall assessment of the consequences for birds.

Impact factor	Level of environmental value	Magnitude of environmental effect	Consequence
Construction phase			
Physical disturbance above the surface	Negligible	Negligible	Negligible
Operation phase			
Physical disturbance above the surface	Negligible	Negligible	Negligible

9.8 Cultural environment

This section concerns marine archaeological relics and the cultural environment at sea, in particular shipwrecks and possible stone age relics in the project area.

9.8.0 Existing conditions

Sweden has a legal maritime zone, called the contiguous zone, which extends no more than 24 nautical miles measured from the baselines, see the Act on Sweden's Contiguous Zone (*lag (2017:1273) om Sveriges angränsande zon*). Within the contiguous zone, measures may be taken to protect ancient monuments, antiquities, and other items of archaeological or historical interest. The Cultural Environment Act (*Kulturmiljölagen (1988:950)*) thus applies within the contiguous zone.

The ship traffic in the Baltic Sea has been intensive for many centuries and the Baltic Sea is well known for its many well-preserved marine archaeological shipwrecks. Southern Skåne's coastline has one of the highest incidences of wrecks in the Baltic Sea. In the deeper parts of the Baltic Sea, there are good conditions for wooden structures to be preserved and conserved thanks to low salinity and low water temperatures and the absence of shipworm. This means that the decomposition of wood and other organic material is slow. The value of well-preserved underwater cultural relics is high in the Baltic Sea and has great scientific importance. Since the underwater cultural environment is not subject to exploitation in the same way as on land, the archaeological value is high (Riksantikvarieämbetet, 2022)

Relics from shipwrecks, etc., which occurred before 1850 are classed as ancient monuments. A shipwreck that occurred after 1850 can also be classed as an ancient monument by the county administrative board if it is of particular interest in terms of its national heritage value (von Arbin & Bergstrand, 2014). Ancient monuments are protected under the Cultural Environment Act and must be protected from damage or active disturbance, and it is forbidden to displace, remove or excavate an ancient monument without permission. The protection applies to all ancient monuments, even those which are yet unknown. If archaeological items are encountered during ongoing construction activities at sea, the work must be suspended, and the find reported to the county administrative board.

Sea level changes since the last ice age have meant that the former land and coastal area where people used to live is now under water. Stone age relics can therefore be found below sea level down to a depth of at least 25–30 m in the Swedish part of the Baltic Sea (Bergström et al, 2018). According to an archaeological risk assessment regarding potential Stone age relics, areas at a depth of around 35 m below current sea level cannot be ruled out (Ramboll, 2020b). Analyses of seabed depths show that the current seabed in the project area is 35–45 m. In the far west within the Swedish part, the depth is slightly less, but still more than 30 m.

Within most of the cable corridor, the seabed is too deep to have been dry land during the Stone age but in the far west there may be areas with the right conditions for archaeological relics of settlements from the (Ramboll, 2020b) early Holocene. A marine archaeological investigation was carried out in 2020 (Ramboll, 2020b). The result showed four wreck positions and two potential locations for stone age settlements, see Figure 9-14. According to the archaeological risk assessment, there are geophysical data, bathymetric analyses and geological and archaeological knowledge which suggest the possibility that there are well-preserved stone age relics within the planned cable corridor (Ramboll, 2020b). Two primary areas of interest were found, see Figure 9-14.

Known wrecks may be marked on charts and registered wrecks appear in the Swedish National Heritage Board's national register of ancient monuments and other national heritage monuments (*Fornsök*). In the area around the coast of southern Skåne and along the cable corridor, there are known marine archaeological objects such as ship remains. However, not all registrations in *Fornsök* are ancient monuments (shipwrecks from before 1850) – more recent ships/boat remains are reported too. A scan of the seabed and filming of potential archaeological objects were carried out, which resulted in the identification of a few more wrecks (Ramboll, 2020b). Two of them possibly foundered before 1850, and two are highly likely to have foundered before the year 1850. The location of these wrecks and ancient monuments is shown in Figure 9-14. The entire corridor is located within the contiguous zone.

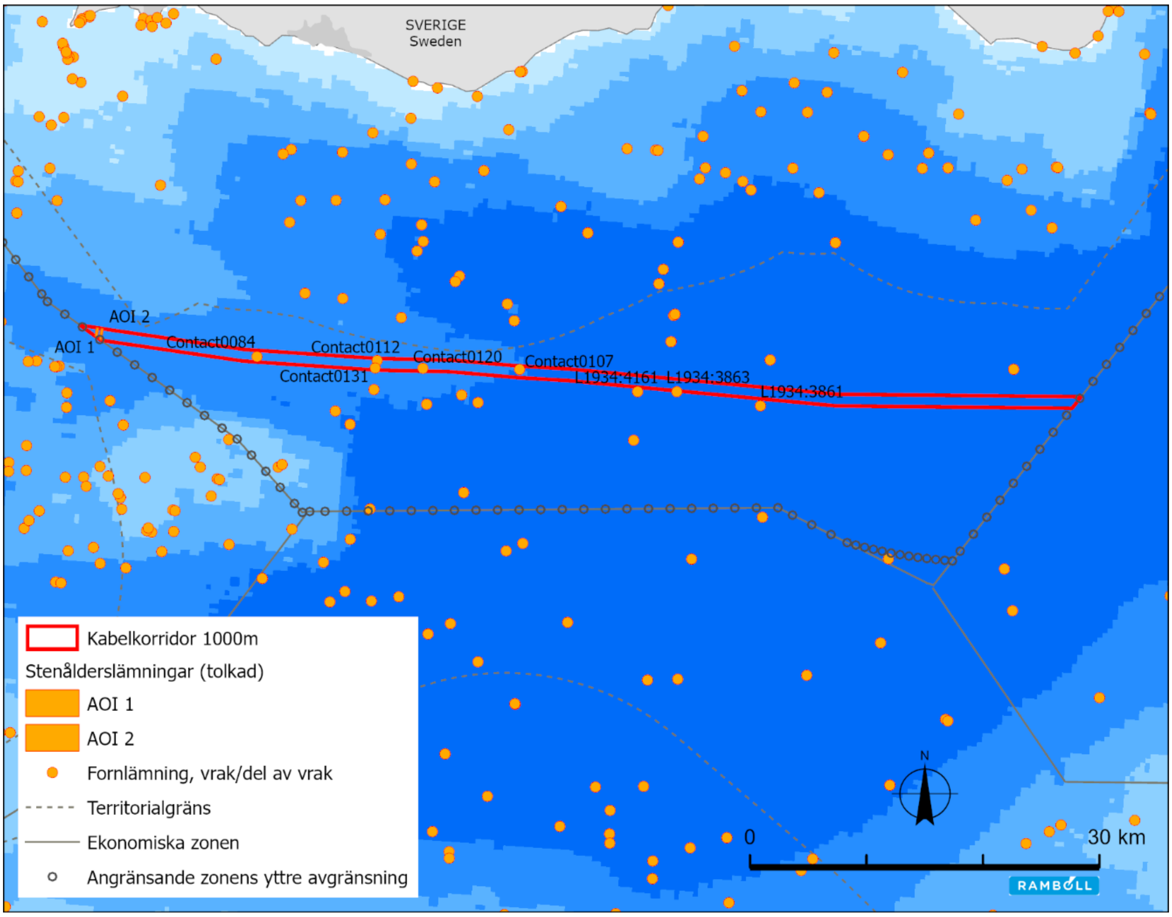

Figure 9-14. Registered ancient monuments and wrecks (Riksantikvarieämbetet, 2022). The relics marked with Contact no. were identified during surveys and are located within the planned cable corridor (Ramboll, 2020b).

In the western part of the corridor there are two areas AOI1 and AOI2 where it cannot be ruled out that there are stone age relics (Ramboll, 2020b).

The objects identified in *Fornsök*, and previously found objects, are listed in Table 9-14 with object numbers for each relic and the distance to the planned cable corridor. All remains are located within the contiguous zone.

Table 9-14. Ancient monuments and other relics within or near the planned cable corridor.

<table>
<tr><th>ID</th><th>Type</th><th>Distance from the cable corridor</th><th>Comment</th></tr>
<tr><td>Contact 0084</td><td>Anchor</td><td>Within the cable corridor</td><td></td></tr>
<tr><td>Contact 0107</td><td>Wreck, probable ancient monument</td><td>Within the cable corridor</td><td>Wooden parts spread over an area of about 160x85 m.</td></tr>
<tr><td>Contact 0112</td><td>Wreck</td><td>Within the cable corridor</td><td>Relatively intact wreck located in an area of about 65x25 m.</td></tr>
<tr><td>Contact 0120</td><td>Wreck</td><td>Within the cable corridor</td><td>Wrecks scattered over an area of at least 150x85 m.</td></tr>
<tr><td>Contact 0131</td><td>Wreck</td><td>Within the cable corridor</td><td>Mostly intact wreck with parts scattered over an area of 60x60 m.</td></tr>
<tr><td>L1934:3861</td><td>Ship/boat relic</td><td>600 m south of the cable corridor</td><td>A 35 m long German steamer, wrecked in 1926. Upright with a slight list.</td></tr>
<tr><td>L1934:3863</td><td>Ship/boat relic</td><td>70 m south of the cable corridor</td><td>Not confirmed in the field</td></tr>
<tr><td>L1934:4161</td><td>Ship/boat relic</td><td>390 m south of the cable corridor</td><td>The wreck of a German cruiser located at a depth of 48 m. Torpedoed in 1915.</td></tr>
<tr><td>AOI1</td><td>Potential stone age relic</td><td>Within the cable corridor</td><td rowspan="2">The west and east sides of a slightly elevated moraine formation meeting a former lake/bay. Represents archaeologically interesting areas with the right conditions for settlements and preservation of buried remains from the early Holocene.</td></tr>
<tr><td>AOI2</td><td>Potential stone age relic</td><td>Within the cable corridor</td></tr>
</table>

9.8.1 Impact assessment

This section describes the potential impact on the cultural environment. The following impact factors during construction and operation phases have been identified, see Table 9-15.

Table 9-15. Potential impact on the cultural environment.

Potential impact	Construction	Operation
Physical disturbance of the seabed	X	

9.8.1.0 Physical disturbance of the seabed

Within the project area ancient monuments and wrecks are identified which may be affected at the construction phase if the cables are placed too close to these. To avoid impact, mitigation measures will be taken. The marine archaeological report will be used to avoid interference with identified ancient monuments. A distance of at least 50 m from an ancient monument/wreck to the cable trench will be maintained. If other marine archaeological objects are found, this may entail minor changes to the route and may mean that the corresponding protection zone remains in place around the finds. In the area around the potential stone age relics, excavation monitoring with an archaeologist will take place during the construction phase. No environmental effect on cultural relics is expected.

The marine cultural environment is well preserved in the Baltic Sea and its archaeological and cultural value is generally high. Each wreck is unique, but for relevant wrecks in the corridor, no particularly high value has been attributed. The value of any stone age settlements is, at the current state of knowledge, difficult to assess. Overall, the environmental value for the cultural environment is considered to be moderate within the cable corridor.

With mitigation measures taken, there will be no impact at the construction phase and thus there will be no environmental effect on marine archaeological objects. As a result, there will be no consequence for the cultural environment.

Once the cables are in place and put into operation, there is no impact on the cultural environment as the cables are located away from identified objects with a margin of protection. At the operation phase, there will be no consequence.

9.8.2 Overall impact assessment

Table 9-16 summarises the impact assessment for the cultural environment.

Table 9-16. Overall assessment of the consequences for the cultural environment.

Impact factor	Level of environmental value	Magnitude of environmental effect	Consequence
Construction phase			
Physical disturbance of the seabed	Moderate	None	None

9.9 Shipping and shipping routes

9.9.1 Existing conditions

The Baltic Sea is one of the world's busiest seas, where approximately several thousand ships are constantly in motion. Shipping is an important means of transport and accounts for a large proportion of Sweden's domestic freight transport. For international freight transport, shipping completely dominates, with about 90 percent of exported goods partly moving by ship (Baltic Sea 2020, 2022; Havs- och Vattenmyndigheten, 2022e).

Along the coast of Skåne there are several ports which are important for ferry services and freight transport. One of Sweden's largest ports is Ystad with ferry services and freight transport to Poland as well as Bornholm. The port of Trelleborg is a traffic hub between Scandinavia and Europe and is Scandinavia's largest ferry port. Ferry connections are available with Poland, Germany and Lithuania. Many of the cars imported to Sweden come to the port of Malmö, from where there are also ferries to Copenhagen and northern Germany (Trafikverket, 2022; Trelleborgs hamn, 2022; CMP Malmö, 2022).

Ship traffic uses an extensive network of shipping routes, and Figure 10-5 section 10.7 describes shipping routes of national importance in the southern Baltic Sea. The project area is used extensively by shipping and there are several shipping routes. Route systems are sections covered by maritime traffic control, aiming to direct maritime traffic to specific areas and reduce the risk of accidents for international shipping. They are determined by the International Maritime Organisation IMO. Along the routes there are traffic separation systems (TSS), areas where maritime traffic is separated into different traffic lanes. Figure 9-15 below illustrates traffic intensity in the Swedish part of the project. The figure also illustrates defined routes that are used by most of the ship traffic in the area according to traffic separation systems (TSS). (Transportstyrelsen, 2022)

The project area crosses the busiest shipping lane in the Baltic Sea (Gedser-Svenska Björn) which runs along Sweden's southeast coast, in the area between Sweden and Bornholm, as well as four shipping routes and several ferry services to Germany and Poland. North of the project area is another busy shipping route, which does not overlap with the project area, see Figure 9-15 and Figure 10-5. A nautical risk analysis has been conducted and the results are presented in Appendix C3 with a summary in section 15.

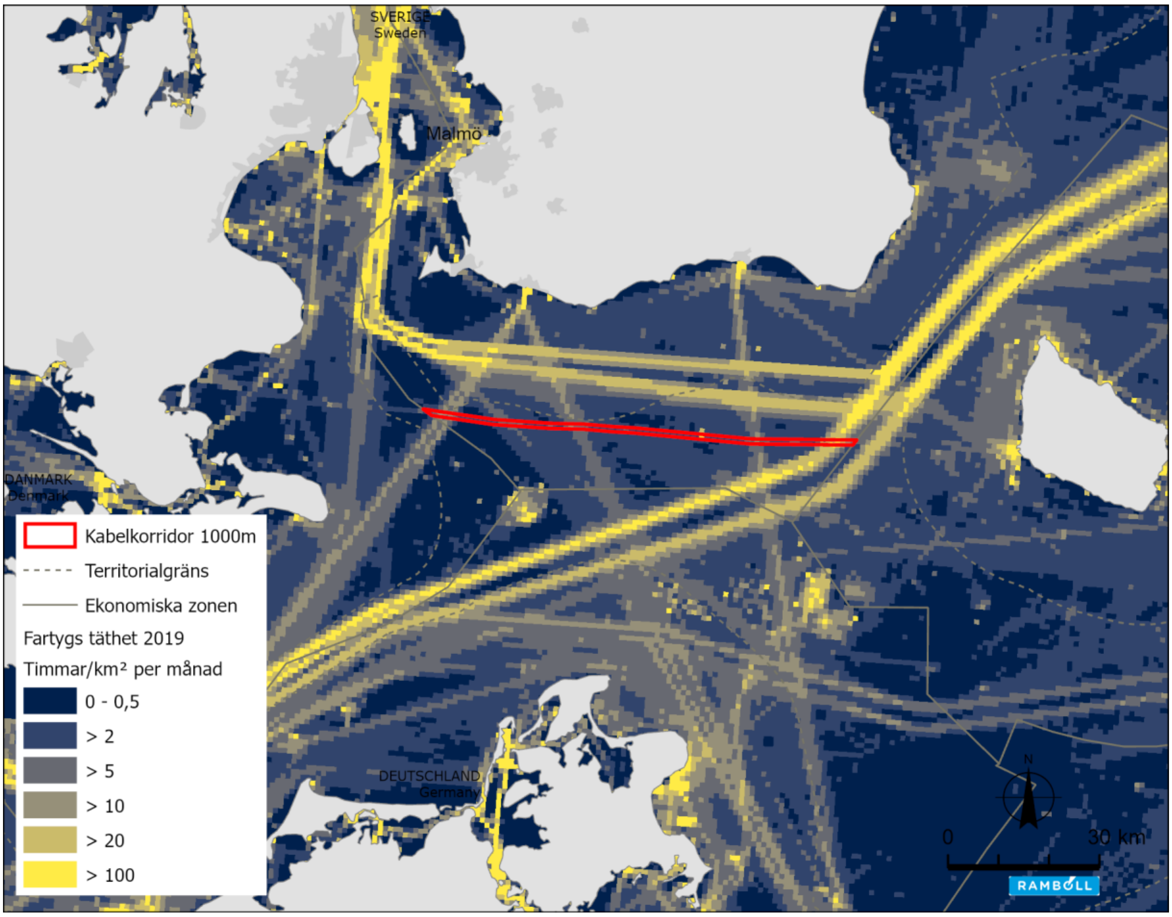

Figure 9-15. The intensity of ship traffic and shipping routes in the southern Baltic Sea (EMODnet, 2022).

9.9.2 Impact assessment

This section describes the potential impact on shipping and shipping routes. The following impact factors during construction have been identified, see Table 9-17.

Table 9-17. Potential impact on shipping and shipping routes.

Potential impact	Construction	Operation
Physical disturbance above the surface	X	

9.9.2.0 Physical disturbance above the surface

Cable installation will involve a certain increase in ship traffic in the area, mainly during the construction period. This mainly concerns the working vessels that perform cable laying and trenching and that move along the route of the cable lines. Some of the shipping routes in the area are heavily trafficked. Working vessels in the shipping routes increase the risk of collision because they are not in motion in the same way as other ships using the shipping routes, and this is why protection zones are established. There will also be ship traffic with material transports to and from the cable laying vessels. Works involving ships will be dispersed over time and space throughout the construction phase.

The Swedish Maritime Administration and the Swedish Transport Agency will be contacted in good time before the construction work begins to consult on the measures required to protect against disruptions in shipping. The construction work will be communicated to the relevant authorities and maritime traffic in the area through the Swedish Maritime Administration's Notices to Mariners (Ufs). Energinet has commissioned a nautical risk analysis, see section 15, and measures from this will be taken into account during the construction phase.

To reduce the risk of collision with other vessels, for example, temporary safety zones will be introduced around working vessels during construction and operation. For construction vessels, the protection zones are 500 m. For project-related vessels without safety zones, the same navigation rules apply as for other commercial vessels. As the cable systems lie in an east-west direction, the shipping routes will be crossed in one place each, as perpendicular as possible, which means there will be a direct impact on shipping, but it will be local and temporary for each shipping lane. The shipping routes have a depth of more than 33 m and thus the depth of the water is not a physical limitation for the ship traffic. Other ships will be able to steer around the area with a safety zone. The impact on ship traffic is thus considered to be negligible.

The construction vessels carry out work at the crossings of several shipping routes which are important for shipping, including the deep-water shipping lane with substantial traffic. In addition, shipping routes are crossed with ferry services to and from the continent. Shipping and shipping routes in the area affected are considered to have a high environmental value. With a high assessed environmental value and a negligible environmental effect, the consequence for shipping is considered to be negligible.

9.9.3 Overall impact assessment

Table 9-18 summarises the impact assessment for the shipping and shipping routes.

Table 9-18. Overall assessment of the consequences for shipping and shipping routes.

Impact factor	Level of environmental value	Magnitude of environmental effect	Consequence
Construction phase			
Physical disturbance above the surface	Large	Negligible	Negligible

9.10 Commercial fisheries

9.10.1 Existing conditions

The commercial fishery in the Baltic Sea targets both marine and freshwater species, but over the past 20 years it has mainly focused on herring and sprat, which together account for about 90% of total catches (ICES, 2020). There is also a cod fishery, but landings of cod have gradually decreased since the 1980s. The composition of the catch is to some extent determined by salinity, as the presence of marine species decreases, while freshwater species increase, from south to north. The catches are used for both food and industrial purposes. The Baltic Sea fishery also targets demersal species, such as plaice and flounder, as well as migratory species, such as sea trout and salmon.

In recent years, the reported total landings from the Baltic Sea have amounted to about 650,000 tonnes (ICES, 2020). During the 1970s and 1980s, significantly larger quantities were landed as a result of the plentiful supply of cod and herring in particular. Even in the 1990s, catches were high, especially of sprat. Swedish catches in the Baltic Sea (incl. the Sound) have varied between 100,000 and 140,000 tonnes over the past 10 years (Havs- och vattenmyndigheten, 2021a). More than 90% of the catch weights were herring and sprat. Catches of cod fell sharply over the time period. Almost 6,000 tonnes of cod were landed from the Baltic Sea in 2014, while the quantity for 2020 was only 365 tonnes.

The EU's Common Fisheries Policy regulates commercial fishing in the Baltic Sea. This means that all EU countries are subject to the same rules, such as decisions on fishing quotas and total allowable catches for the fish stocks covered by the CFP. As a result of the declining trend in the eastern cod stock, the cod fishery in the southern parts of the Baltic Sea has been suspended since autumn 2019. Targeted fishing for cod is, with some exceptions, banned for the time being following a decision by the EU. In addition, since 2020, all fishing (with some exceptions) has been prohibited during specific spawning closure periods to protect cod spawning. In 2021, the spawning closure occurred from 15 May to 15 August within catch area 24, which covers the entire southwest part of the Baltic Sea between the Belt Sea in the west and Bornholm in the east.

Landings of cod from the southern Baltic have decreased significantly as a result of lower cod fishing quotas and fishing restrictions in recent years. In the Belt Sea, the Sound and the southwest Baltic Sea, cod catches halved in the 2010s (Naturvårdsverket, 2011a). Landings of herring and sprat have also decreased from the southwest part of the Baltic Sea. Within ICES rectangle 39G3, where most of the cable corridor is located (see Figure 9-17), landings from larger Swedish vessels decreased significantly over the period 2010-2020 (Figure 9-16). Catches from midwater trawls gradually decreased while bottom trawling has been very limited since 2017. In 2020, virtually no fishing was conducted from larger Swedish vessels within ICES rectangle 39G3.

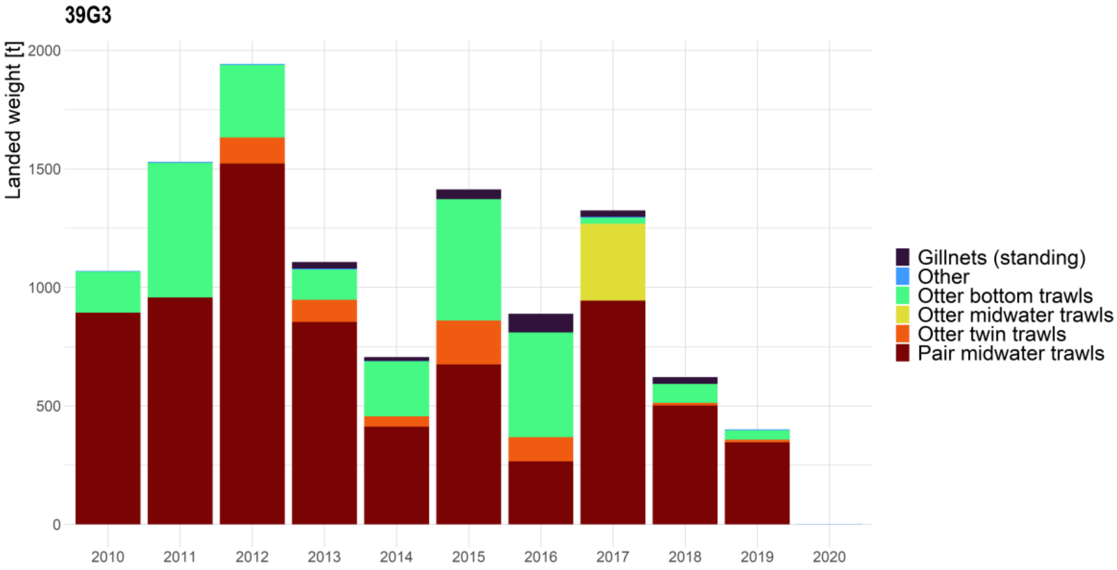

Figure 9-16. Landed catches (tonnes) from larger Swedish vessels (≥ 12 m) from ICES rectangle 39G3 over the years 2010–2020. Broken down into types of gear: gillnets, bottom trawls, midwater trawls, twin trawls and others. Based on data collected from SLU.

Eel fishing has also been restricted within the EU Member States. Since 2018, there has been a three-month comprehensive ban period on eel fishing in the sea. The aim is to reduce the impact of fishing on the European eel stock. In addition, there is a national eel fishing ban along the Swedish coast, which means that only fishermen issued with eel fishing permits are allowed to fish for eel in the Baltic Sea, the Sound and the southern Kattegat (Naturvårdsverket, 2011a).

Available catch data for the Baltic Sea are provided for ICES rectangles (approximately 30 x 30 nautical miles). The ICES rectangles are a grid to facilitate analysis and visualisation of catch data. In the Baltic Sea, all commercial fishing vessels must submit a logbook or a monthly catch report. The logbook contains information about fishing for specified fish species (dates, fishing gear used, ICES rectangle and catch in kilograms). The data can be used to give a picture of what and how much is caught. The Baltic Sea is also divided into catch areas that are used to regulate and control fishing by means of fishing quotas or restrictions. The southwest Baltic Sea has catch areas 23, 24 and 25 (Figure 9-17).

During January and February 2018, bottom trawling was carried out to map the abundance and presence of fish stocks along the planned cable corridor. The species that dominated catches at the exploratory fishing stations within the Swedish EEZ was sprat, while cod accounted for the highest catch weight (Ramboll, 2019f).

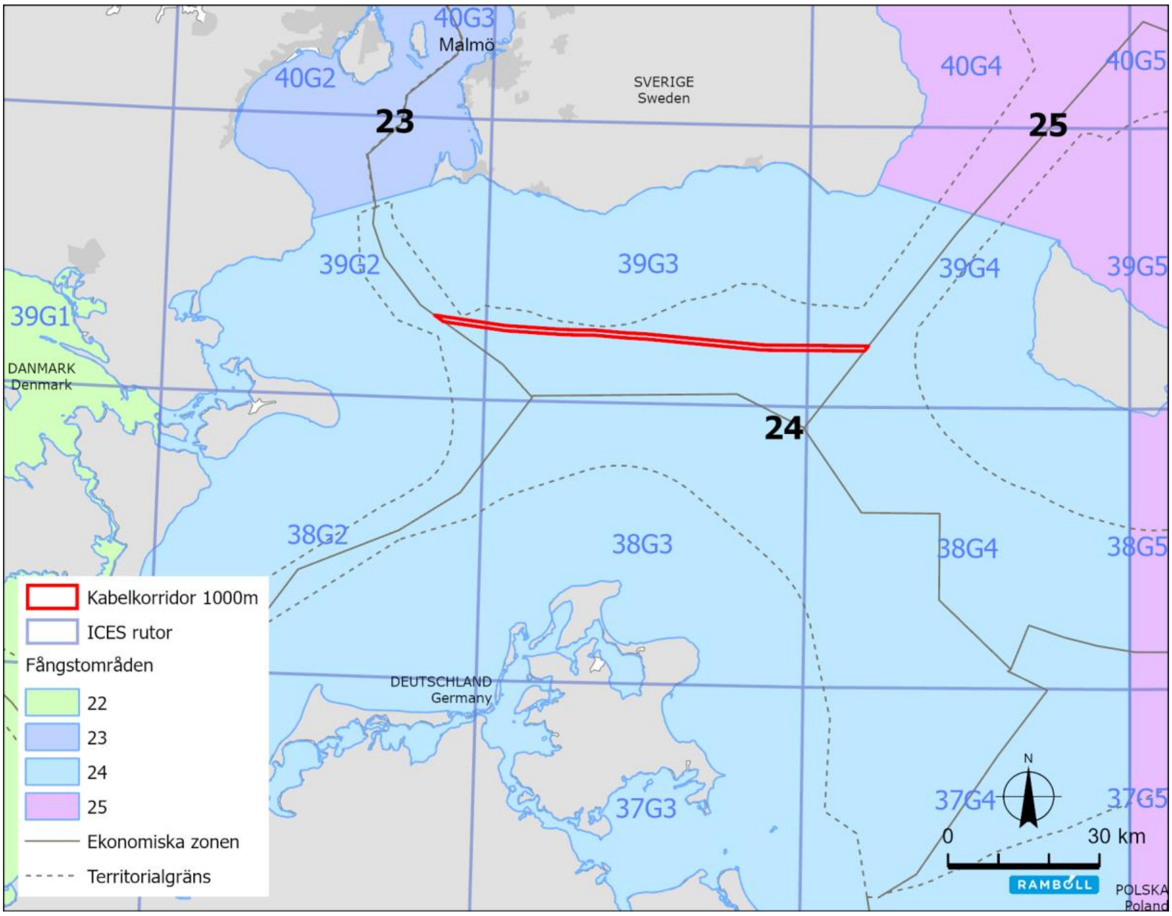

Figure 9-17. ICES rectangles in the southwest Baltic Sea within catch area 24. The cable corridor is mainly located within 39G3. An ICES rectangle is about 56 km x 56 km in size (ICES, 2022).

Fishing methods

The fishing methods used along the route of cable systems in the Swedish exclusive economic zone are mainly midwater trawls and bottom trawls. Fishing with gillnets also occurs but only to a small extent, see the section about catches and types of gear below.

Midwater trawls (pelagic trawls) are mainly used to catch herring and sprat. The catch is used for human consumption and to produce fish meal and fish oil. Mesh sizes below 32 mm catch fish for industrial use while sizes above 32 mm are mostly used for catches intended for consumption. Sprat is mainly caught by midwater single or pair trawling. Sprat is caught all year round, but the main fishing season is in the first half of the year.

Bottom trawls are common fishing gear in the southwest part of the Baltic Sea. Flatfish are often by-catches in cod fishing, but in some areas and during certain periods there is targeted fishing for flatfish with bottom trawls. Bottom trawls with a small mesh size are sometimes used when fishing for herring and sprat.

Gillnets are mainly used in shallow waters but are also used for bottom fishing at greater water depths. Gillnets are used to fish for cod, flatfish, and herring. The use of drift nets has been banned in the Baltic Sea since 2008.

Catches and types of gear

Landed catches from ICES rectangles 38G3, 38G4, 39G3 and 39G4 are reported in Figure 9-18. The planned corridor for the cable systems, within the Swedish exclusive economic zone, is mainly located within the rectangle 39G3, see Figure 9-17.

Catch data for the years 2017–2019 have been obtained from Sweden, Denmark, and Poland. It is predominantly these three nations that engage in commercial fishing in the Arkona Sea. Germany also fishes in the area, but almost exclusively within the ICES rectangle 38G3. Total landings from the four ICES rectangles amounted to 14,290 tonnes/year in 2017-2019 (Figure 9-18). The annual landings from Polish vessels amounted to just over 6,100 tonnes, while the landings from Swedish and Danish vessels amounted to about 4,100 and 4,000 tonnes respectively. Catches were significantly lower from the ICES rectangle 39G3, within which the main part of the planned cable corridor is located, than from the other three rectangles.

There is a clear national pattern in the distribution of catches between the different ICES rectangles. Within 38G3, Danish and Polish fishing dominated (Figure 9-18). From 38G4, it was mainly Polish ships that landed fish. In 39G3, Polish and Swedish fishing dominated, and catches were relatively small. In 39G4, catches were highest, and fishing was dominated by fishing vessels from Sweden and Denmark. In 2017-2019, landings from ICES rectangle 39G4 increased while they decreased from the other three.

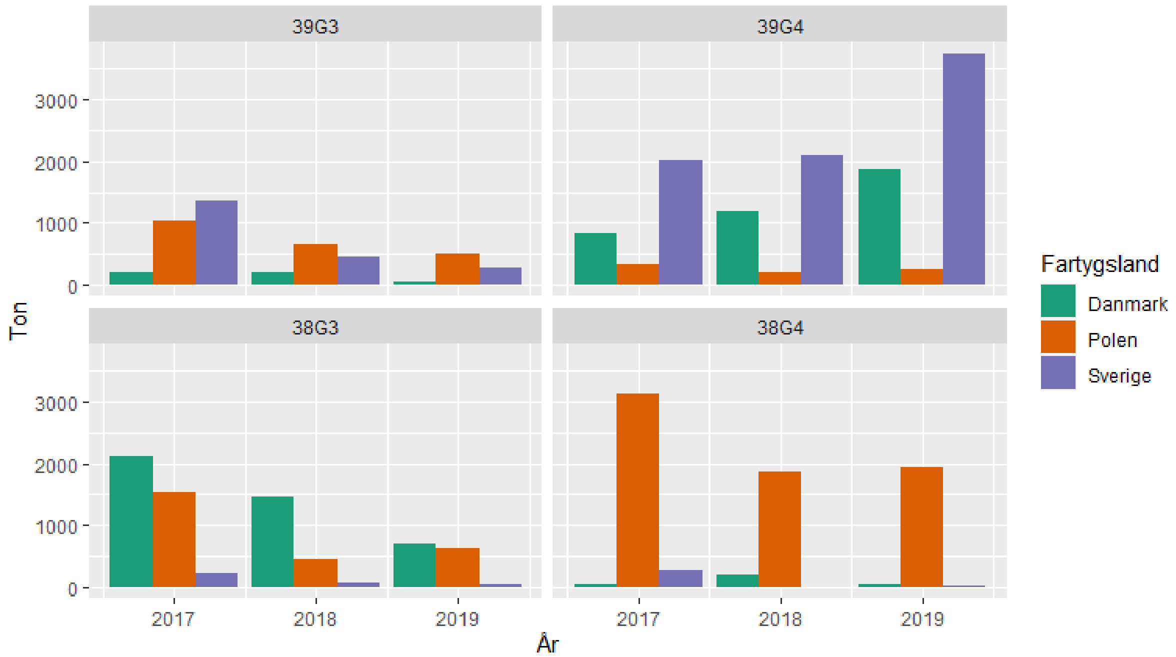

Figure 9-18. Landings (tonnes) by nation from ICES rectangles 38G3, 38G4, 39G3 and 39G4 in the years 2017–2019. Based on data obtained from the Swedish Agency for Marine and Water Management (Swedish vessels), the Danish Fisheries Agency (Danish vessels) and the Ministry of Agriculture and Rural Development (Polish vessels).

Fishing in the four ICES rectangles is carried out almost exclusively with different types of pelagic trawls (71%) and bottom trawls (25%), see Figure 9-19. Fishing with gillnets, longlines and Danish seines occurs only to a very limited extent. The distribution of gear types does not differ significantly between the different ICES rectangles. The proportion of catches with pelagic trawls is slightly higher in 39G3 while bottom trawls take a larger share of catches in 38G3 and 39G4. Fishing with gillnets and longlines occurs in all rectangles but to a very small extent in 38G3 and 39G3. Between 2017 and 2019, catches with pelagic trawls increased in 39G4 while they decreased in the other three rectangles. Bottom trawl catches, on the other hand, did not show any clear changes over the period.

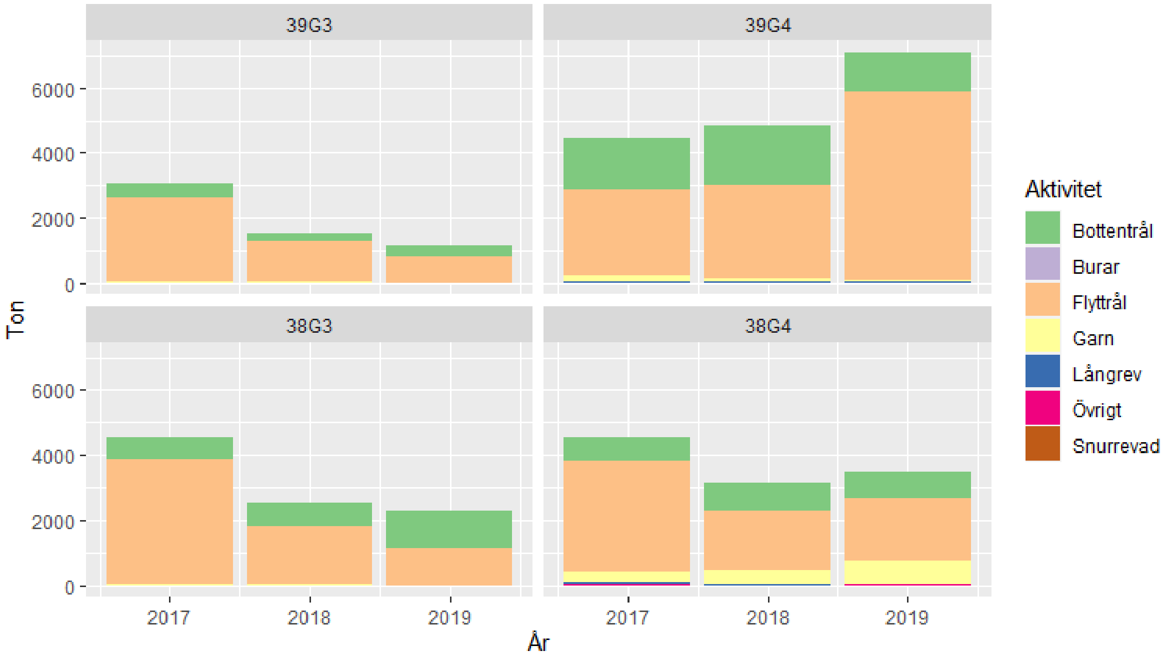

Figure 9-19. Landings (tonnes) by gear type from ICES rectangles 38G3, 38G4, 39G3 and 39G4 in the years 2017–2019. Based on data obtained from the Swedish Agency for Marine and Water Management (Swedish vessels), the Danish Fisheries Agency (Danish vessels) and the Ministry of Agriculture and Rural Development (Polish vessels).

Within the four ICES rectangles, landings from Swedish and Danish vessels were dominated by herring (52%), sprat (20%), and cod (20%), see Table 9-19. Plaice, European flounder, whiting, turbot and salmon were caught in smaller quantities and other species accounted for less than 0.2% of total landings.

Table 9-19. Average value of annual landings (tonnes/year) from ICES rectangles 38G3, 38G4, 39G3 and 39G4 in the years 2017–2019. Based on catch data obtained from the Swedish University of Agricultural Sciences (Swedish vessels) and the Danish Fisheries Agency (Danish vessels). The catch data collected from Poland were not specified at T-species level and cannot be reported.

Fish species	Sweden (tonnes/year)	Denmark (tonnes/year)	Total (tonnes/year)
Atlantic herring (*Clupea harengus*)	2,607	1,583	4,190
European sprat (*Sprattus sprattus*)	705	902	1,607
Atlantic cod (*Gadus morhua*)	689	920	1,609
European plaice (*Pleuronectes platessa*)	17	276	293
European flounder (*Platichthys flesus*)	29	237	266
Whiting (*Merlangius merlangus*)	15	53	68
Turbot (*Scophthalmus maximus*)	22	4.2	26
Atlantic salmon (*Salmo salar*)	0.003	10	10
Other species	5.3	8.6	14
Total	4,140	3,993	8,133

From ICES rectangle 39G3, within which the main part of the cable corridor is located, landings from Swedish and Danish vessels were dominated by herring (69%), cod (20%) and sprat (6%), see Table 9-20. Catches from ICES rectangle 39G3 were lower than from the other three ICES rectangles for all species. In particular, annual catches of sprat were very small in comparison with the total catches in the four ICES rectangles.

Table 9-20. Average value of annual landings (tonnes/year) from ICES rectangle 39G3 in the years 2017–2019. Based on catch data obtained from the Swedish University of Agricultural Sciences (Swedish vessels) and the Danish Fisheries Agency (Danish vessels). The catch data collected from Poland were not specified at T-species level and cannot be reported.

Fish species	Sweden (tonnes/year)	Denmark (tonnes/year)	Total (tonnes/year)
Atlantic herring (*Clupea harengus*)	638	144	782
European sprat (*Sprattus sprattus*)	73	0.3	73
Atlantic cod (*Gadus morhua*)	164	60	224
European plaice (*Pleuronectes platessa*)	5.4	13	18
European flounder (*Platichthys flesus*)	4.0	2.5	6.5
Whiting (*Merlangius merlangus*)	3.4	11	14
Turbot (*Scophthalmus maximus*)	5.0	0.2	5.2
Atlantic salmon (*Salmo salar*)	0.003	0.1	0.1
Other species	2.4	0.1	2.5
Total	895	232	1,127

Fishing effort

Figure 9-20 shows the fishing effort in hours from Swedish vessels in ICES rectangles 38G3, 38G4, 39G2, 39G3 and 39G4 during 2017–2019. Fishing was more intensive in 39G4 than in the other rectangles, which is consistent with the distribution of catch quantities (see Figure 9-18). Apart from isolated exceptions, the fishing effort did not exceed 20 hours per C-square along the cable corridor. Fishing pressure was slightly higher in the eastern part of the cable corridor than in the western part.

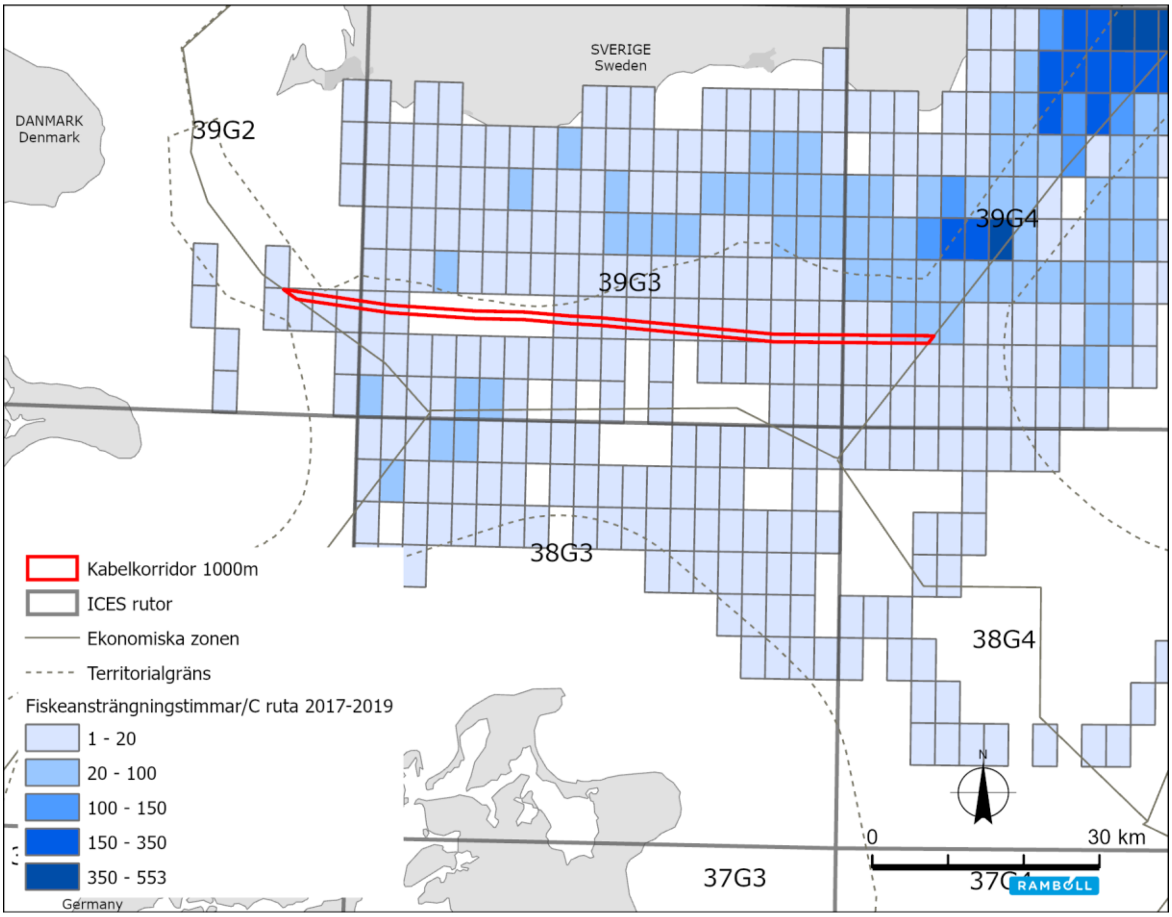

Figure 9-20. Fishing effort (hours per C-square) from Swedish vessels in ICES rectangles 38G3, 38G4, 39G2, 39G3 and 39G4 in the years 2017–2019. The data is based on VMS and logbook data from the Swedish University of Agricultural Sciences (Swedish vessels). C-squares are a system of spatially unique areas within a latitude/longitude-based global grid.

9.10.2 Impact assessment

This section describes the potential impact on commercial fishing. The following impact factors during construction and operation have been identified, see Table 9-21.

Table 9-21. Potential impact on commercial fishing.

Potential impact	Construction	Operation
Physical disturbance above the surface	X	
Physical disturbance of the seabed		X

9.10.2.0 Physical disturbance above the surface

Changed conditions

During constructing, a safety zone is established around the construction vessels. For the construction vessels, the safety zone is expected to reach 500 m. The safety zones follow the ships as they move along the cable corridor. Within the cable corridor, up to two cable systems will be constructed. One cable system will be laid first, followed (after 1-4 years) by the other. Security zones will therefore need to be established on two separate occasions. The size of the safety zone will be determined in consultation with Swedish authorities.

Assessment

Construction

In the southwest Baltic Sea, there is normally considerable trawling for herring, sprat and cod. In recent years, however, fishing has been very limited as a result of the fishing restrictions imposed to protect the eastern Baltic cod stock. It is likely that future EU regulation will involve catch restrictions and severe quota limits until cod stocks have recovered. Any recovery is likely to take many years. The area is therefore considered to have little value for commercial fishing during the construction phase.

During construction, the safety zones prevent fishing activities around the vessels during the period of laying. Commercial fishing may thus temporarily lose potential fishing grounds and may also need to adjust trawling if fishing is carried out while construction work is ongoing. The restrictions and inconveniences imposed on commercial fishing are considered to be negligible bearing in mind the existence of alternative fishing grounds outside the temporary safety zones. The environmental effect is therefore considered to be negligible.

Commercial fishing is considered to have a low value during the construction phase due to the very limited commercial fishing currently carried out around the cable corridor.

With a negligible environmental effect and low environmental value, the consequence for commercial fishing is considered to be negligible.

9.10.2.1 Physical disturbance of the seabed

Changed conditions

At cable crossings or at crossings with other services, rock placement on the seabed is necessary to separate and protect the cables or pipelines. Bottom trawling can thus be made more difficult during the operation phase as the areas after rock placement can be a physical obstacle to trawling.

The buried cable system is not considered to make fishing with bottom trawls more difficult as it will be installed at a depth of 1-2 m below the seabed.

Assessment

Operation

The cable systems will be built along the Baltic Pipe pipeline at a distance not exceeding 500 m. The pipeline is expected to create an obstacle to bottom trawling along a large part of its route within the Swedish exclusive economic zone. The additional restrictions on trawling due to the areas with rock placement along the export cables are considered to cause a negligible deterioration in the conditions for fishing. Especially bearing in mind the availability of alternative fishing grounds outside the cable corridor. The environmental effect is therefore considered to be negligible.

During the operation phase, commercial fishing is expected to regain the conditions for fishing that existed before the current fishing restrictions were introduced. Commercial fishing is thus considered to have a moderate value. With a negligible environmental effect and moderate environmental value, the consequence for commercial fishing in the cable corridor is considered to be negligible.

9.10.3 Overall impact assessment

Table 9-22 summarises the impact assessment for commercial fishing.

Table 9-22. Overall assessment of the consequences for commercial fishing.

Impact factor	Level of environmental value	Magnitude of environmental effect	Consequence
Construction phase			
Physical disturbance above the surface	Low	Negligible	Negligible
Operation phase			
Physical disturbance of the seabed	Moderate	Negligible	Negligible

9.11 Military areas

9.11.1 Existing conditions

In addition to the national interests for total defence described in section 10.5, there are other military interests that may be affected by the activities. Just south of the cable corridor is a NATO area for submarine exercises and an area where weapons may be fired, see Figure 9-21.

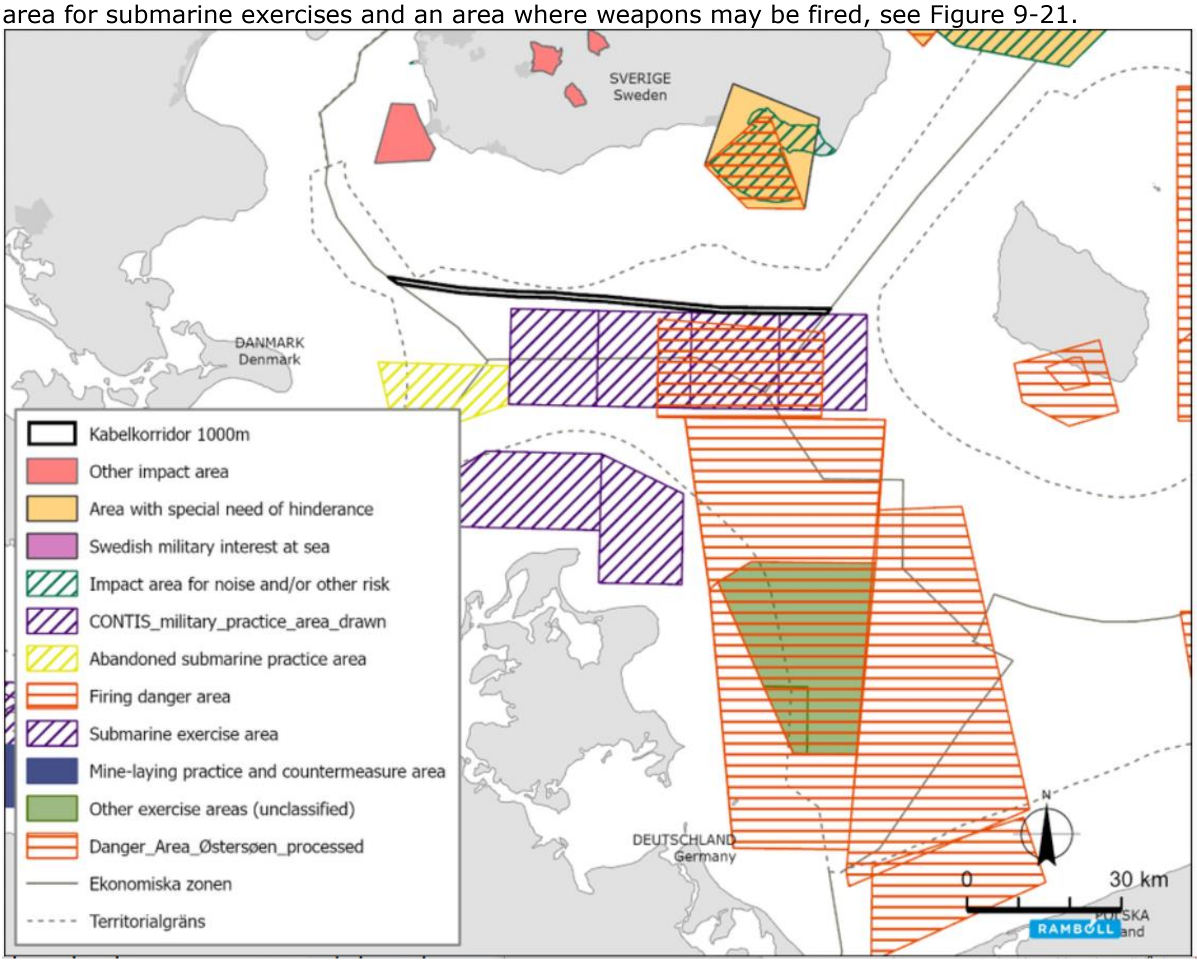

Figure 9-21. Military areas around the project area.

9.11.2 Impact assessment

This section describes the potential impact on military areas. The following impact factors during construction and operation have been identified, see Table 9-23.

Table 9-23. Potential impact on military areas.

Potential impact	Construction	Operation
Physical disturbance above the surface	X	X

9.11.2.0 Physical disturbance above the surface

Changed conditions

It is mainly during the construction of the cable systems that physical disturbance above the surface may arise from the presence of construction vessels and other equipment used. During constructing of the cable system, a safety zone is established around the construction vessels. For the construction vessels, the safety zone will reach 500 m and will follow the ships as they move along the cable corridor.

Assessment

Construction

During the construction phase, the vessels with the associated safety zone (500 m) will move along the cable route and in the vicinity of two military training areas. Distances to the training areas are about 50 m and about 540 m respectively. The activities involving ships will be dispersed over time and space throughout the construction phase. To avoid any impact on military training activities in the area, the planned construction works will be carried out in consultation with the relevant authorities and the construction works will be adjusted accordingly. Military activities including submarine exercises and international exercises will thus not be affected. The environmental effect is therefore considered to be negligible.

A small part of otherwise large military training areas will be affected by a temporary protection zone. Overall, the military interests in the overlapping area are judged to have a high environmental value as training areas are of great importance for military and international exercises.

With a high environmental value and a negligible environmental effect, the consequence for the military areas is considered to be none or negligible.

Operation

During operation, there will only rarely be ships in the area to perform maintenance – they will mainly be needed if the protection in the form of coverage for the cable systems needs to be replenished. During operation of the cable system, ships carrying out inspections or repairs will have a safety zone of 500 m. The safety zones follow the vessels as they move along the cable system. No planned maintenance will be performed, and inspections are expected to take place infrequently. Disruption to military training activities in the operation phase will be similar to the disruption that occurs during the construction phase. The environmental value is thus considered to be high, and the impact is considered to be negligible. Overall, the consequence for military exercise activities is considered to be negligible.

9.11.3 Overall impact assessment

Table 9-24 summarises the impact assessment for the military areas.

Table 9-24. Overall assessment of the consequences for the military areas.

Impact factor	Level of environmental value	Magnitude of environmental effect	Consequence
Construction phase			
Physical disturbance above the surface	Large	Negligible	Negligible
Operation phase			
Physical disturbance above the surface	Large	Negligible	Negligible

9.12 Infrastructure

9.12.1 Existing conditions

Cables, pipelines and wind farms are the main types of existing permanent infrastructure that may be encountered in or adjacent to the cable corridor, see Figure 9-22. In addition to the fixed installations, radio signals occur in the atmosphere.

Baltic Pipe is a gas pipeline for the transmission of natural gas which runs parallel to the project area. The pipeline project investigated a laying corridor that varies between 500-1000 m in width. Baltic Pipe was placed on top of the sediments. For the investigated cable corridor in this examination, construction is planned with a safety distance from the pipeline of 200 m. If necessary, separate crossing agreements will be drawn up.

Ørsted and OX2 have submitted separate applications to build a wind farm where the existing cable route passes straight through the wind farm in question. The Baltic Pipe route will also pass through the planned wind farms and the existing cable route will be built with safety distances to the pipeline and the turbines in each planned wind farm. In the same area, Eolus is also planning a wind farm (Arkona wind farm).

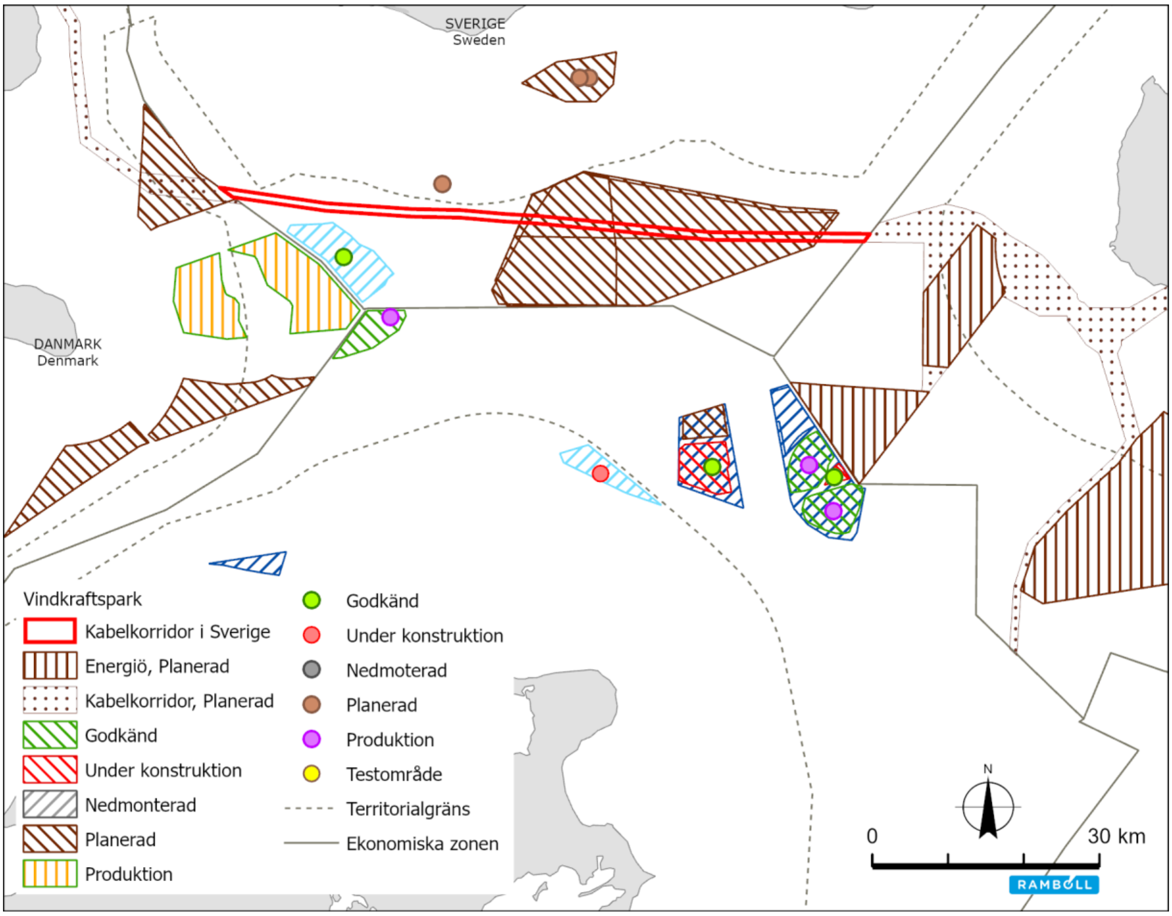

Figure 9-22. Wind farms at different stages of development. (EMODnet, 2022).

The planned cable route crosses a few installations within the Swedish exclusive economic zone, see Figure 9-23. There will be a crossing of a power line that runs between Germany and Sweden and is owned by Baltic Cable AB (Statskraft). In 2024, Svenska Kraftnät and 50 Hertz plan to build a power line (Hansa Power Bridge) that will cross the cable route. Telia owns five cables for telecommunications that have been taken out of service. Subsea Environmental Services owns a cable system that is also out of service. Several cables with unknown owners are located in the area and are crossed by the cable corridor.

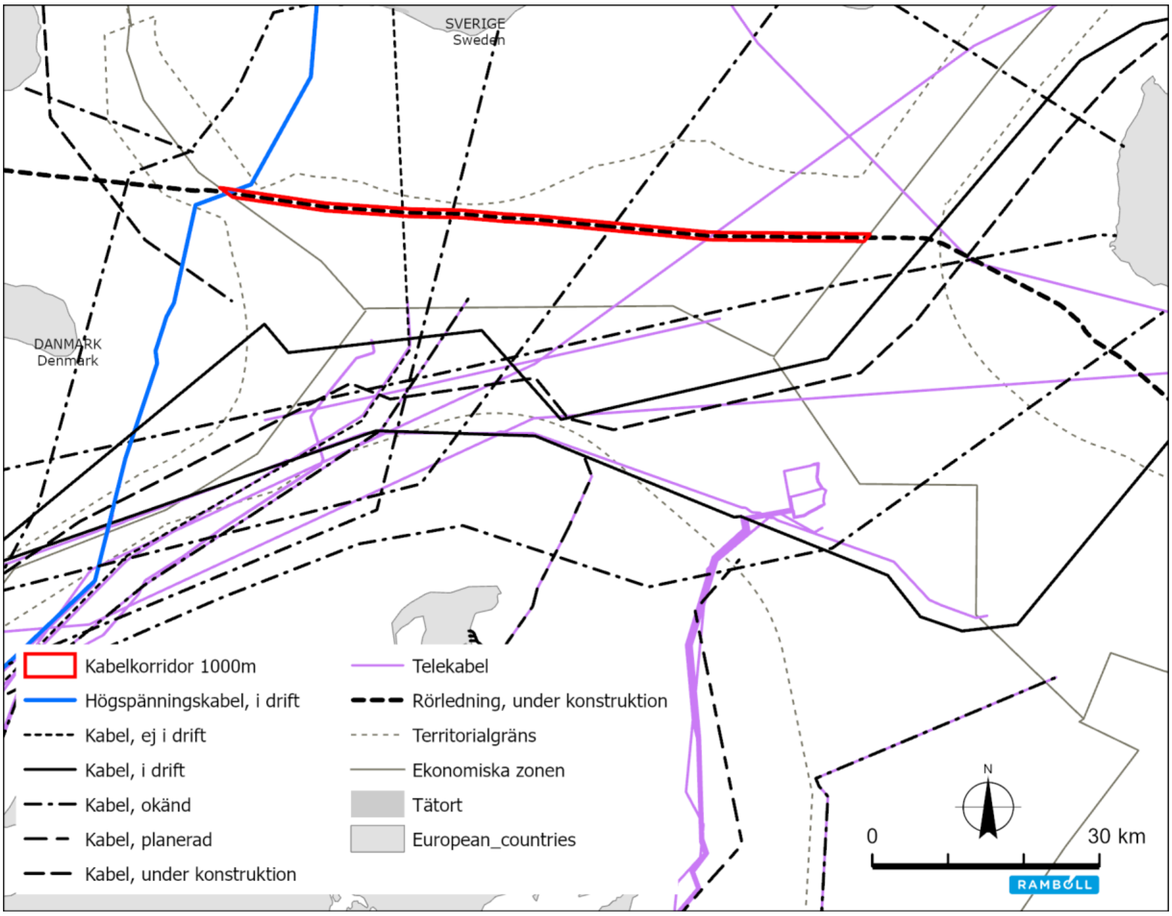

Figure 9-23. Infrastructure in the area (source: (EMODnet, 2022), (HELCOM, 2022), (Gaz System, 2019).

9.12.2 Impact assessment

This section describes the potential impact on infrastructure. The following impact factors during construction and operation have been identified, see Table 9-25.

Table 9-25. Potential impact on infrastructure.

Potential impact	Construction	Operation
Physical disturbance of the seabed	X	
Presence of pipeline		X

9.12.2.0 Physical disturbance of the seabed

Changed conditions

Construction activities for the cable route cause physical disturbance to the seabed and can potentially cause damage to previously installed cables, services and other infrastructure located in the area.

Assessment

Construction

Infrastructure located in the area is of great importance to its customers who are adversely affected in the event of any outages caused by damage. The installations have a high economic value for the owners who, in the event of any damage, cannot influence or alleviate the supply to their customers. Maritime installations are thus judged to have a high environmental value.

To avoid damage to existing maritime installations, dialogue will take place with owners of relevant (existing or planned) infrastructure to be crossed by the cable route, and an agreement on how the crossing will be carried out will be in place before the construction activities begin. Through the agreements with other infrastructure owners on how crossings will be carried out, no damage will occur and the environmental effect is thus considered to be negligible.

With a high environmental value and a negligible environmental effect, the consequence for infrastructure is considered to be negligible.

Operation
When the cable corridor is in operation, disturbances at cable crossings may occur when maintenance or inspections of the other installations must be carried out. This may entail costs for the owners of the installations. The environmental value of the infrastructure is considered to be high.

Since the owners of crossing infrastructure will be involved in the construction phase with regard to how cable crossings should be handled to reduce the risk of negative impact also during operation, the environmental effect is considered to be small.

With a high environmental value and a negligible environmental effect, the consequence for infrastructure is considered to be negligible, as with the construction phase.

9.12.3 Overall impact assessment

Table 9-26 summarises the impact assessment for infrastructure.

Table 9-26. Overall assessment of the consequences for infrastructure.

Impact factor	Level of environmental value	Magnitude of environmental effect	Consequence
Construction phase			
Physical disturbance of the seabed	Large	Negligible	Negligible
Operation phase			
Presence of pipeline	Large	Negligible	Negligible

10. NATIONAL INTEREST AND AREA PROTECTION

10.1 National interest for wind power

10.1.1 Description of value

An area designated as a national interest for wind power is considered particularly suitable for electricity production from large-scale wind power based on the area's wind conditions, size and water depth. An area of national interest for wind power must be protected against activities that could significantly impair the creation or use of facilities for energy production.

Within the Swedish exclusive economic zone south of Skåne there are two designated areas of national interest for wind power, see Figure 10-1. Both are located outside the planned cable corridor and the one to the north is far away from it. The southern wind farm area, Krieger's Flak, is located near the cable corridor in the economic zone between Sweden, Denmark and Germany. A wind farm is planned on the Swedish part of Krieger's Flak, and on the Danish side of Krieger's Flak there has been a wind farm with 72 turbines since the summer of 2021. Also, on the German part of Krieger's Flak there is a wind farm with 80 wind turbines (4COffshore, 2021). The planned cable corridor will be adjusted so that it is outside the national interest.

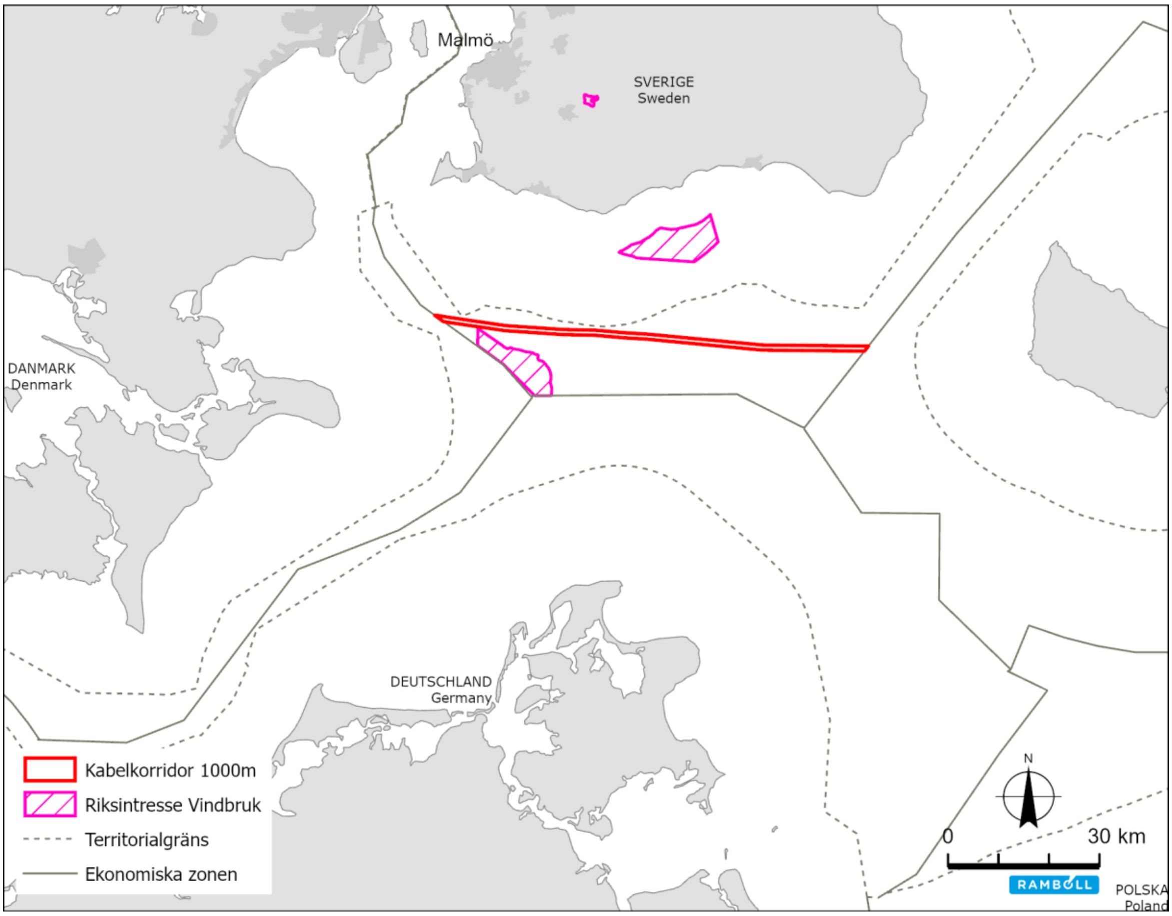

Figure 10-1. National interest for wind power and the planned cable corridor (Energimyndigheten, 2022).

10.1.2 Assessment

The temporary disruptions caused by the construction work or the location of the cable systems on the seabed do not constitute a significant impairment to the function or value of the national interest for wind power in the vicinity of the area.

10.2 National interest for nature conservation and nature reserves

10.2.1 Description of value

Areas of national interest for nature conservation relate to areas which are of importance from a general point of view due to their natural benefits, and which must be protected against activities that could significantly harm the natural environment.

There are no national interests for nature conservation in the vicinity of the planned cable corridor. The nearest area of national interest in the sea is called *Måkläppen-Limhamnströskeln* which is also part of the Natura-2000 sites called *Falsterbohalvön* and *Falsterbo-Foteviken* and partly also constitutes a nature reserve. These are located about 15 km north of the cable corridor. On the mainland there are more areas of national interest as well as other protected areas, see Figure 10-2.

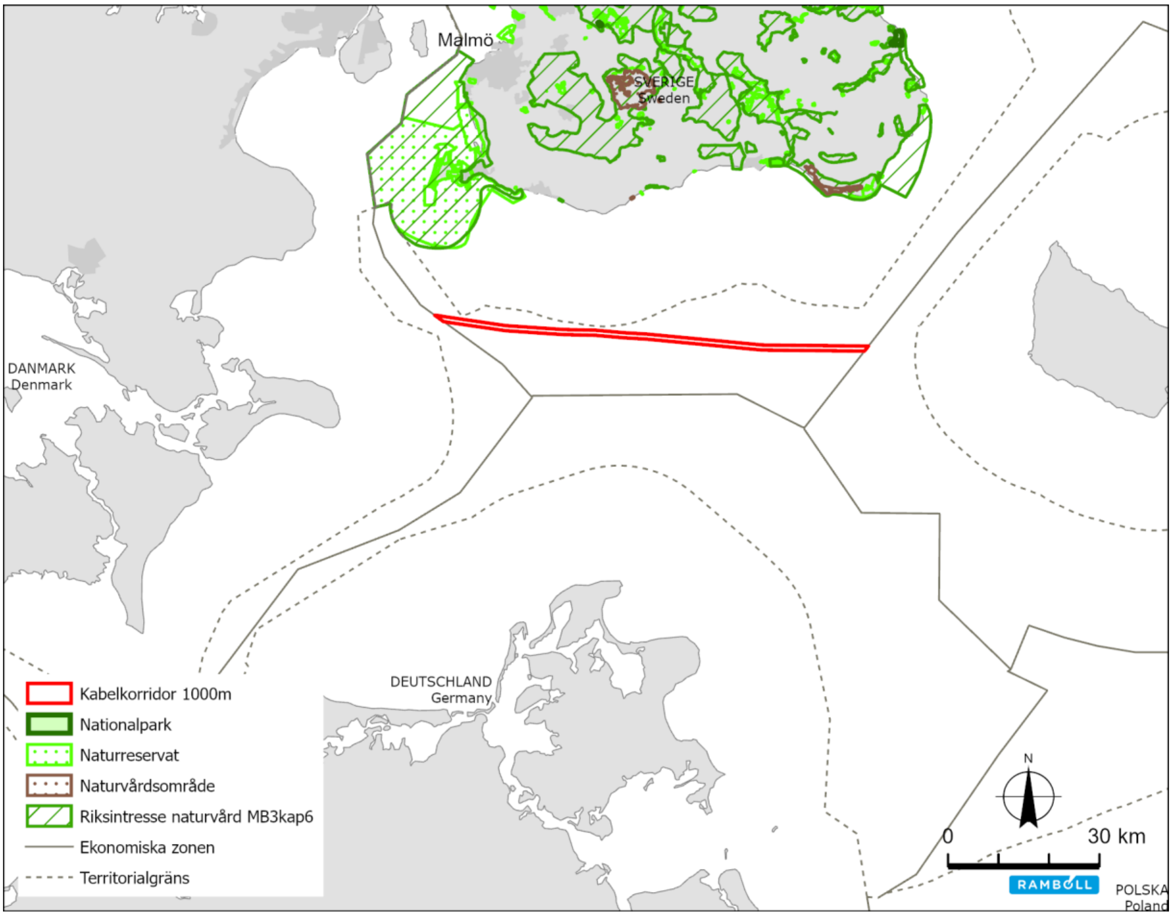

Figure 10-2. National interest for nature conservation and other protected areas and the planned cable corridor (Naturvårdsverket, 2022a).

10.2.2 Assessment

The temporary disruptions caused by the construction work or the location of the cable systems in the seabed do not constitute a significant impairment to the function or value of the national interest for nature conservation.

10.3 National interest for the cultural environment

10.3.1 Description of value

An area of national interest for cultural environment conservation is a cultural environment that is unique or special regionally, nationally, or internationally. Areas of national interest for cultural environment conservation must be protected against activities that could significantly harm the cultural environment.

Within the cable corridor, there are no national interests for cultural heritage conservation. On land along the coast of Skåne, about 25-30 km north of the planned cable, there are several national interests for the cultural environment.

10.3.2 Assessment

The temporary disruptions caused by the construction work or the location of the cable systems in the seabed do not constitute a significant impairment to the function or value of the national interest for the cultural environment in the area.

10.4 National interest for outdoor recreation

10.4.1 Description of value

Areas of national interest for outdoor recreation must have special qualities for outdoor recreation such as natural and cultural environments and a varied landscape.

In the area where the cable systems are planned, there are no national interests for outdoor recreation. Along the coast of Skåne there are national interests for outdoor recreation, such as the Skanör-Falsterbo peninsula with the Höllviken-Trelleborg coastline and the Trelleborg-Abbekås-Sandhammaren-Mälarhusen-Simrishamn coastline. These are located at about 25-30 km north of the cable corridor.

10.4.2 Assessment

The temporary disruptions caused by the construction work or the location of the cable systems in the seabed do not constitute a significant impairment to the function of the national interest for outdoor recreation.

10.5 National interest for total defence

10.5.1 Description of value

National interests for the military component of total defence include national interests that can be reported openly and national interests that cannot be reported for reasons of secrecy. National interests for the military component of total defence include firing ranges, proving grounds, airfields, naval exercise areas, technical systems, and facilities. According to the Swedish Armed Forces, these constitute a fundamental production resource for all units of the Armed Forces and the areas are considered to provide nationally important benefits and qualities for the protection of Sweden.

Along the Swedish coast there are areas that are national interests for total defence, see Figure 10-3. The closest to the cable corridor is a firing range called *TM0038 Kabusa skjutfält*, located about 8 km east of Ystad. For the Kabusa firing range, the impact areas are noise or other hazards, as well as areas with special obstacle clearance requirements. The area extends into the water, and the distance from its southern border to the cable corridor is about 15 km.

The peninsula at Falsterbo-Skanör, just over 20 km north of the cable corridor, is an "Other impact area". The area is of importance for the military component of total defence. For reasons of secrecy, only one impact area is reported for the area and the specific area of national interest is not shown on public maps.

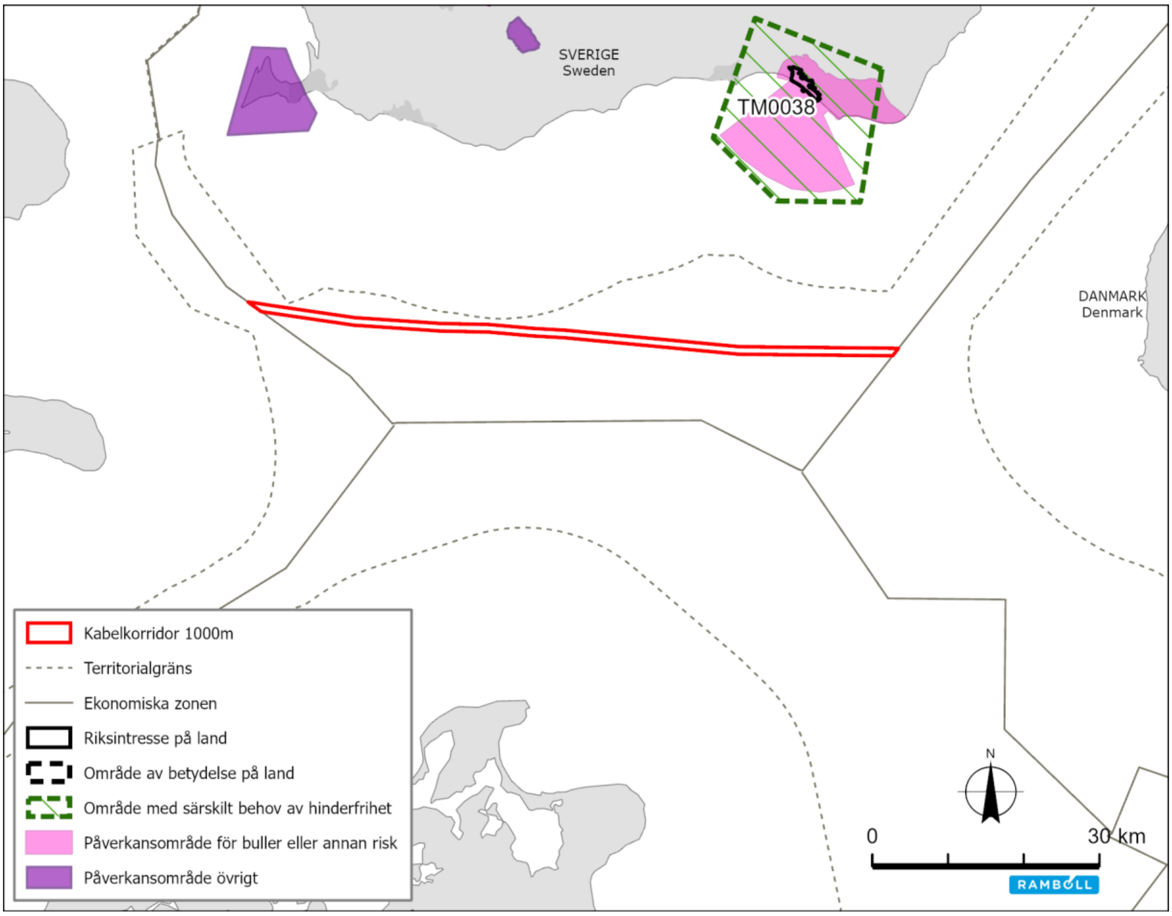

Figure 10-3. National interest for total defence in Sweden and the planned cable corridor (Försvarsmakten, 2022).

10.5.2 Assessment

The temporary disruptions caused by the construction work or the location of the cable systems in the seabed do not constitute a significant impairment to the function of the national interest for total defence.

10.6 National interest for commercial fishing

10.6.1 Description of value

The national interest for commercial fishing describes areas of water that are important for commercial fishing or for aquaculture. These areas must, as far as possible, be protected against activities which could significantly impede the operation of these industries. To enable fishing to take place within a defined area of the sea, it is an important prerequisite that there are ports able to provide services to fishing vessels and that there are landing opportunities. The most important home ports and/or landing ports are therefore also considered to be a national interest for commercial fishing.

In the relevant part of the Baltic Sea there are two areas of national interest for commercial fishing, see Figure 10-4. The cable corridor passes the southern part of the national interest area called *RI YF 12 Falsterbo utsjöområde* which constitutes a catch area.

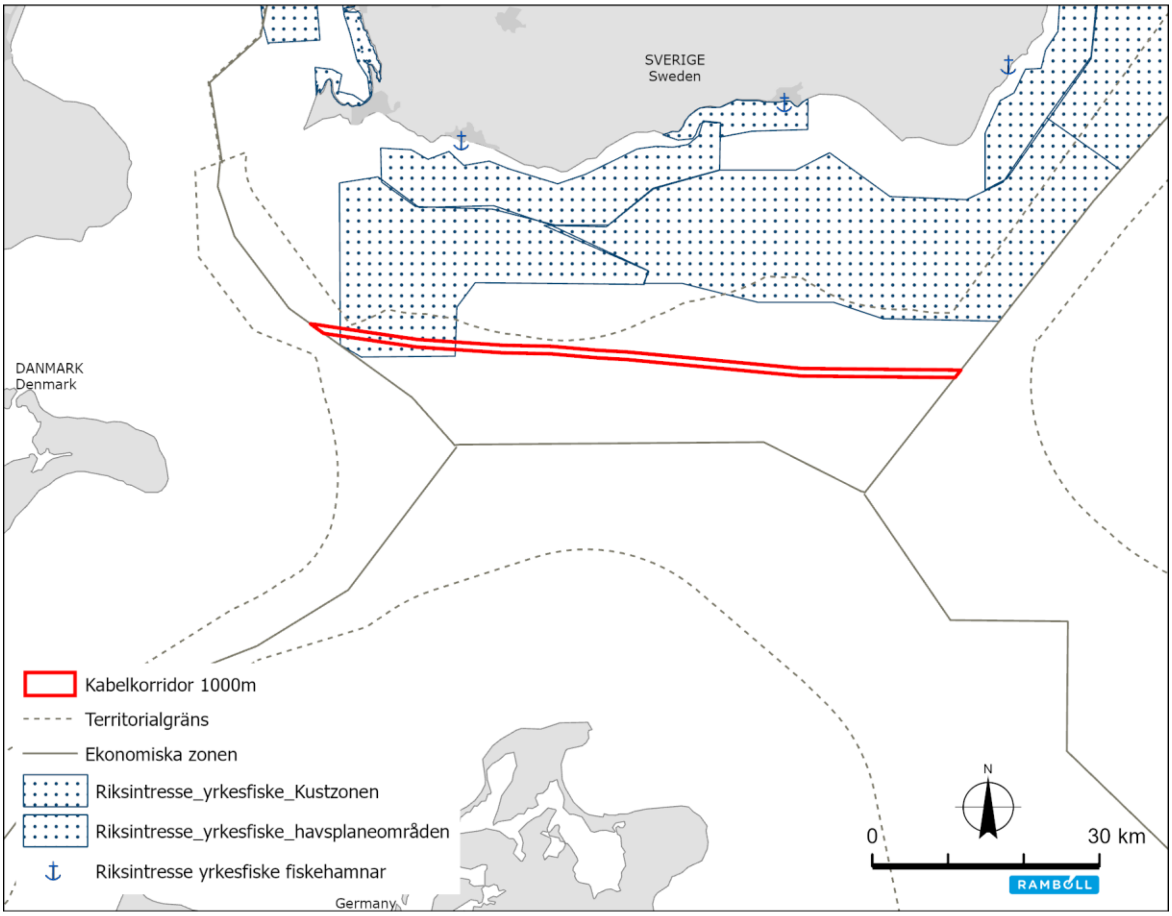

Figure 10-4. National interest for commercial fishing and the planned cable corridor (Havs- och vattenmyndigheten, 2022a)

10.6.2 Assessment

During construction, safety zones prevent fishing activities around the vessels during the period of laying. Commercial fishing may thus temporarily lose potential fishing grounds and may also need to adjust trawling if fishing is carried out while construction work is ongoing. The restrictions and inconveniences imposed on commercial fishing are considered to be negligible bearing in mind the existence of alternative fishing grounds outside the temporary safety zones. The temporary disruptions caused by the construction work are not considered to constitute a significant impairment to the function or value of the national interest for commercial fishing.

The cable systems are located within the same corridor as the Baltic Pipe gas pipeline, which is considered to be an obstacle to bottom trawling along a large part of its route within the Swedish exclusive economic zone. The additional restrictions on trawling arising from the areas with rock placement along the cables systems are considered to cause a negligible deterioration in the conditions for fishing. Especially bearing in mind the availability of alternative fishing grounds outside the cable corridor. The operation phase is not expected to result in a significant increase in the area excluded from commercial fishing and thus does not significantly impair the function and value of the national interest for commercial fishing.

10.7 National interest for shipping and shipping routes

10.7.1 Description of value

The Swedish Transport Administration identifies the ports and shipping routes, as well as areas in general, that perform such special functions for the maritime transport system that the land and water areas affected are considered to be of national interest for communication facilities. The national interest for shipping can consist of ports as well as shipping routes. The main shipping lane that leads to a port of national interest or to major ports is, for example, a national interest. The designation as a national interest is intended to protect the function of the shipping lane.

Figure 10-5 shows shipping routes designated as of national interest for shipping in the southern part of the Baltic Sea.

The shipping routes crossed by the cable corridor are:

- Trelleborg – Gedser, sea route no. 21
- Blenheim – Krieger's Flak, sea route no. 8
- Trelleborg – Sassnitz, sea route no. 22
- Ystad – Sassnitz, sea route no. 23
- Gedser – Svenska Björn, sea route no. 20

The ports of Malmö, Trelleborg and Ystad are designated as of national interest for communications.

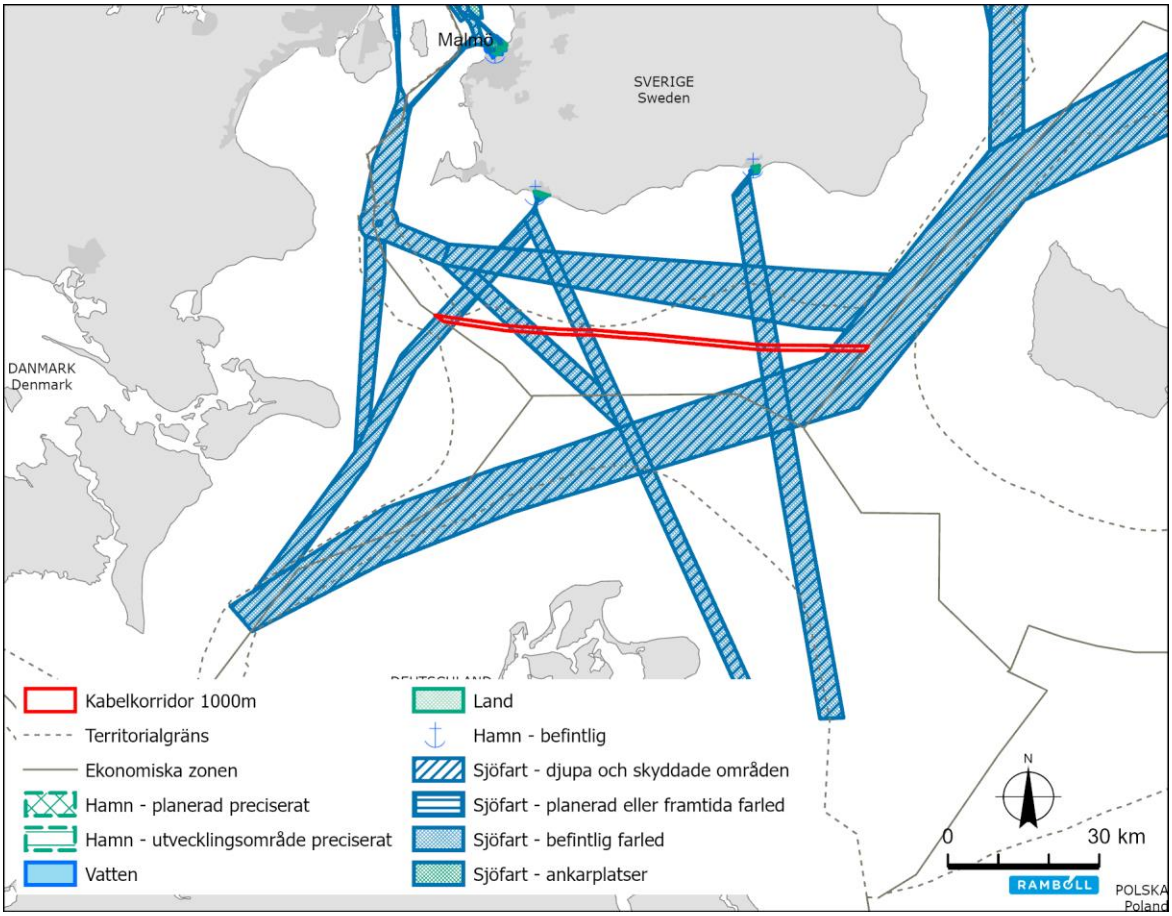

Figure 10-5. National interest for shipping and shipping routes (Trafikverket, 2022).

10.7.2 Assessment

Cable installation will involve a certain increase in ship traffic in the shipping routes due to the presence of working vessels, mainly during the construction period. The shipping routes are heavily trafficked and working vessels in the shipping routes increase the risk of collision because they are not in motion in the same way as other ships using the shipping routes. The construction period within the areas of national interest will last a few hours and there is plenty of room to sail in the water alongside the national interests. Measures to protect against maritime traffic disruptions and mitigation measures in the form of temporary safety zones will be taken. This is described in more detail in section **Fejl! Henvisningskilde ikke fundet.** above.

The temporary disruptions caused by the construction work do not constitute a significant impairment to the function or value of the national interest for shipping in the area.

10.8 International protection

10.8.1 Description of value and assessment

Through international conventions, Sweden has undertaken to protect a network of valuable marine areas in the Baltic Sea and the Northeast Atlantic. Sweden has an international responsibility for the areas to ensure that their benefits are not lost.

There are internationally protected military areas nearby, which are described in section 9.11. The IBAs (Important Bird and Biodiversity Areas) are addressed in section 9.7. MPAs (Marine Protected Areas) are designated in HELCOM's network to protect and conserve species, habitats, and ecosystems in the marine environment, see Figure 10-6. They are located long distances from the planned cable corridor and are considered not to be affected.

The activities are thus not considered to harm the function or value of the internationally protected areas.

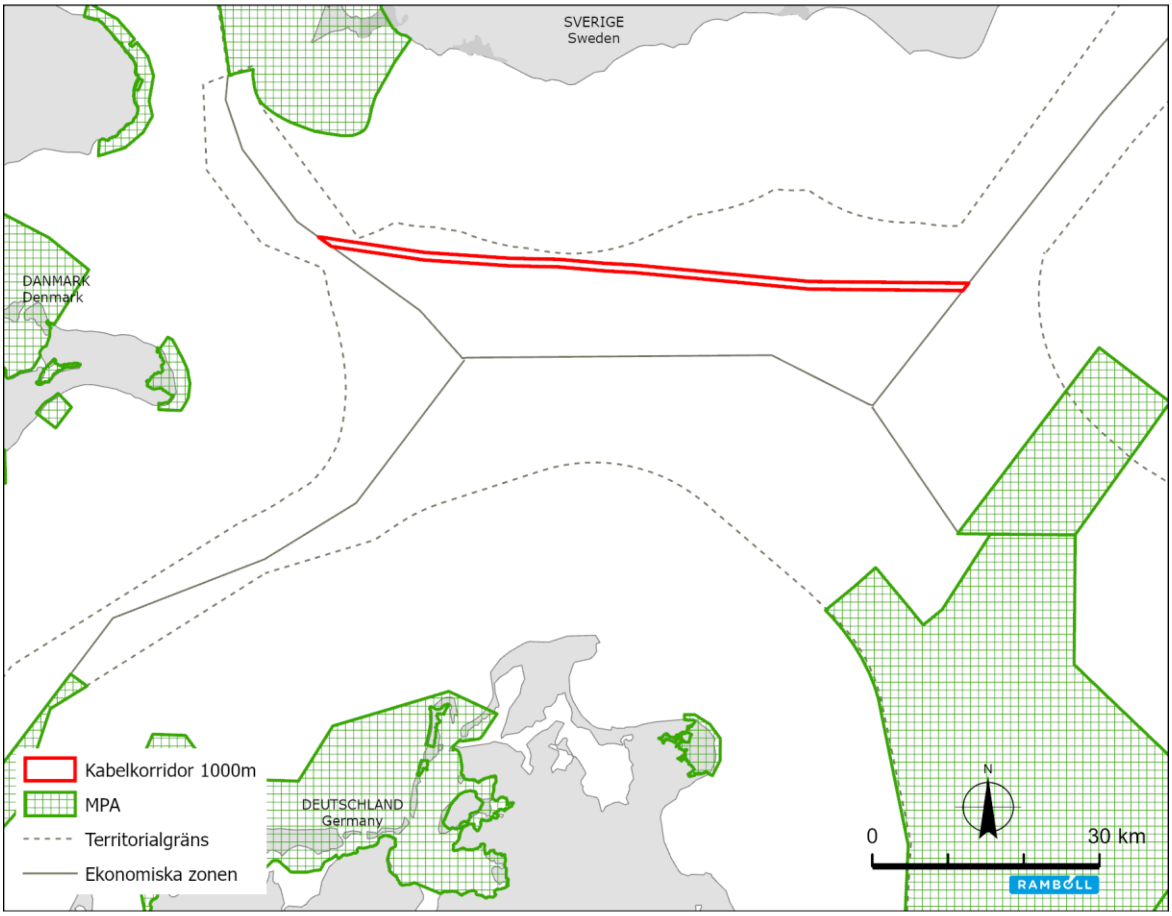

Figure 10-6. MPA areas (HELCOM, 2022a).

11. NATURA 2000

11.1 Description of value

Natura 2000 is an EU network aimed at protecting and conserving biodiversity. Natura 2000 sites can be designated on the basis of either of the EU's two nature conservation directives: the Birds Directive and the Habitats Directive. Areas designated to comply with the Birds Directive are called SPAs (Special Protected Areas). Protected areas defined on the basis of the criteria of the Habitats Directive are called SCIs (Sites of Community Importance). Figure 11-1 shows Natura 2000 sites in and around the project area.

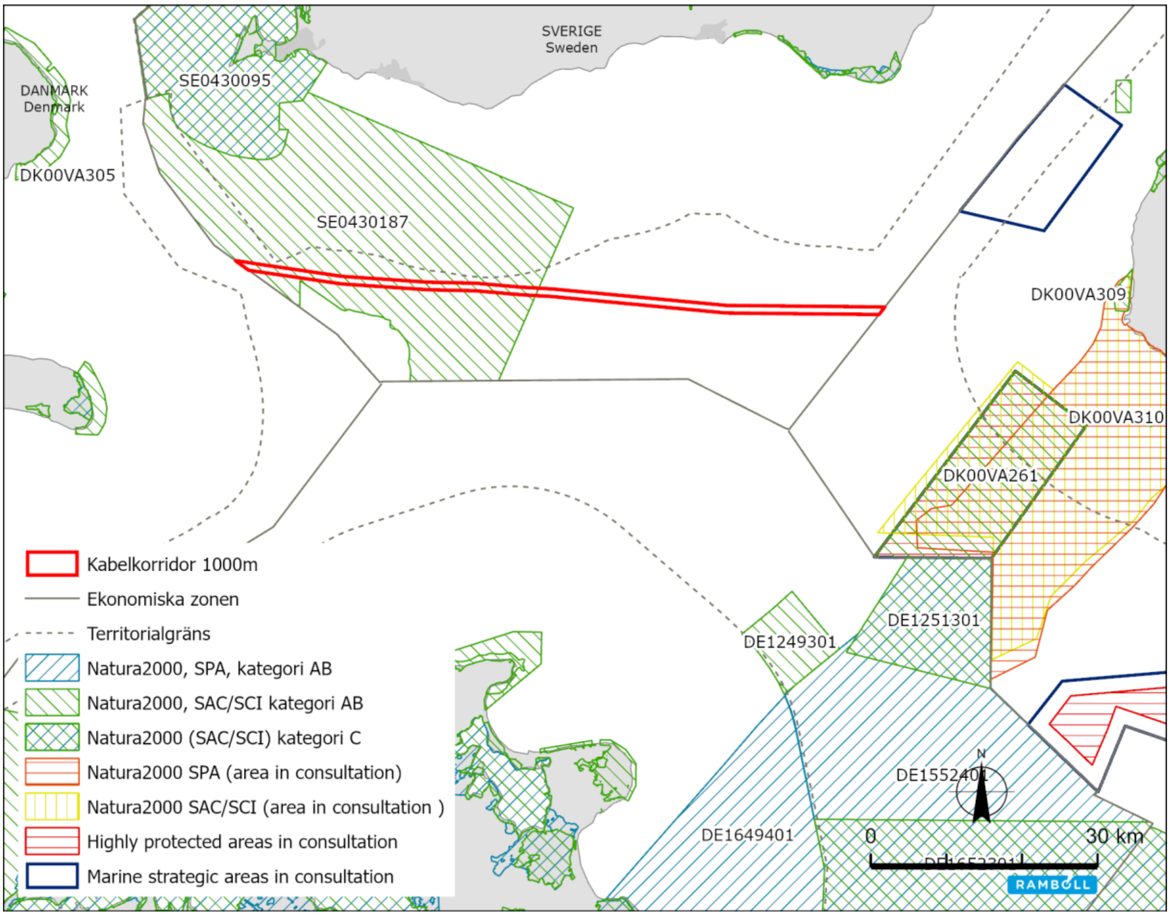

Figure 11-1. Natura 2000 sites (EEA, 2022).

The cable corridor passes through the Natura 2000 site Sydvästskånes utsjövatten (SE0430187), see Figure 11-1. The Natura 2000 site is protected under the Habitats Directive. The site does not currently have a conservation plan outlining its conservation objective or purpose. Designated habitat types in the Natura 2000 site are reefs (1170) and sandbanks (1110) and designated species are grey seal (1364), harbour seal (1365) and harbour porpoise (1351). The depth of the Natura 2000 site varies between 10 and 44 m and the bottom is dominated by soft bottoms, mostly sand, but with elements of hard bottom. The northwest part of the area is an important wintering and resting area for various birds (Naturvårdsverket, 2022).

Areas of distribution are a quantitative measure to describe the distribution of a habitat type. With information about these areas, it is possible to formulate goals, measure and follow up the distribution of the habitat type. Table 11-1 contains the distribution areas of designated habitat types in the Natura 2000 site Sydvästskånes utsjövatten, which was established in a government decision of 2016.

Table 11-1. Surface areas of designated habitat types in the Natura 2000 site Sydvästskånes utsjövatten.

Habitat types	Surface area
Sandbanks (1110)	43,813 ha (438.13 km^2)
Reefs (1170)	199.4 ha (1.99 km^2)

11.1.1 Studies within the Natura 2000 site

The studies carried out in the Natura 2000 site with relevance to the project activities are set out below.

County Administrative Board of Skåne

In 2019, on behalf of the County Administrative Board of Skåne, a video survey was carried out in the Natura 2000 site Sydvästskånes utsjövatten (Länsstyrelsen Skåne, 2019). The study will be part of the basis for developing a conservation plan for the Natura 2000 site and a possible strengthening of site protection. Within the Natura 2000 site, a total of 345 sites of 25 m^2 each were surveyed at depths of between 9-45 m and an average depth of 31 m. To classify the habitat types within the sites, a visual estimation of the substrate was made and combined with depth data and observations of fauna. The report on the Natura 2000 site surveys further states that for the habitat types reefs and sandbanks, "additional information on the topographical elevation of the sites relative to the surroundings [...] is required. The substrate information was indicative because there were no type-specific species", and that the surveys cannot be used as a basis for planning "physical interventions, new activities, etc.". The predominant habitat type was biogenic reefs (1171) which were present in 34% of the sites surveyed. Biogenic reefs can be created by living attached sessile organisms, in this blue mussel banks. 21% of the sites contained non-vegetated sandbanks (1113) while sandbanks with vegetation (1112) were found in only 2% of the sites. The remaining 43% of the sites surveyed could not be classified as any Natura 2000 habitat type (Länsstyrelsen Skåne, 2019). Figure 11-2 shows the results of the study commissioned by the County Administrative Board within the Natura 2000 site. To be able to produce a map of the results, data from the studies need to be interpolated, in other words data must be added between the sampled sites to obtain a comprehensive map of the area. The authors of the report write that due to the small area that was investigated, the study carried out within the Natura 2000 site cannot form the basis for planning "physical interventions, new activities, etc.".

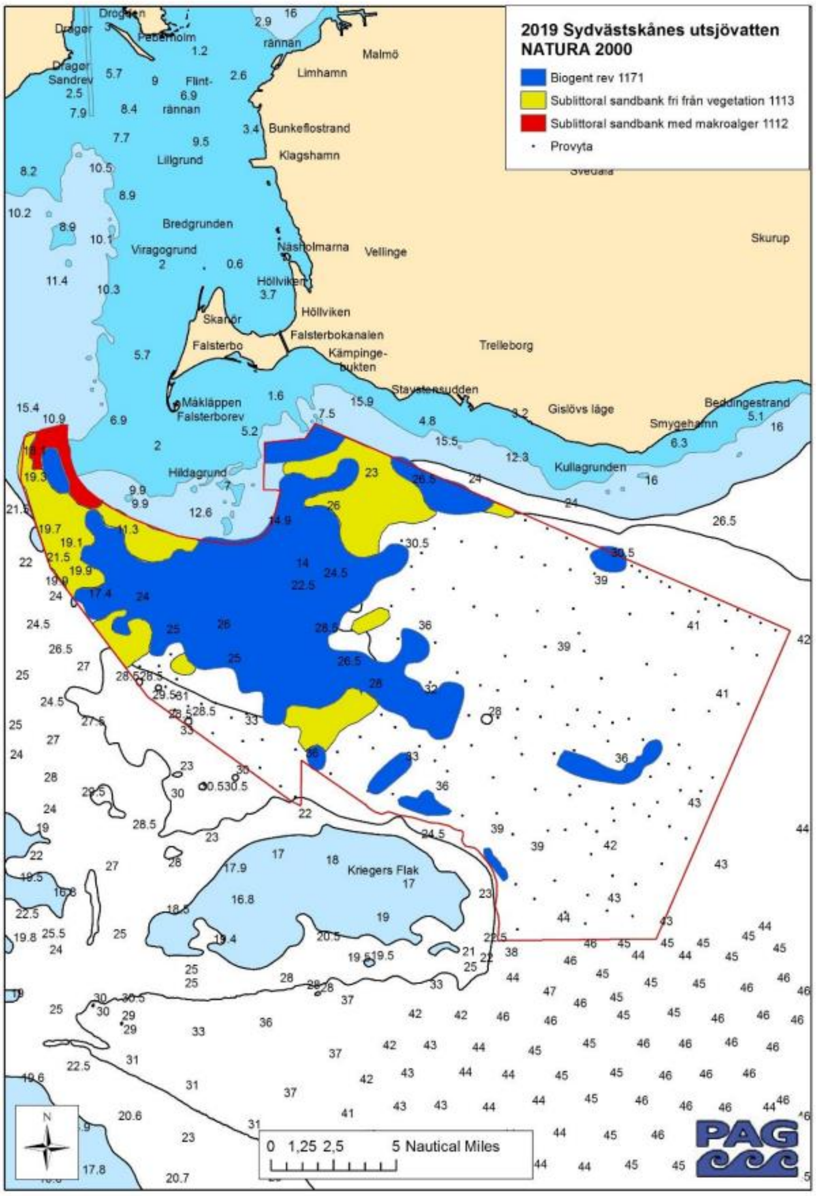

Figure 11-2. Habitat types and their estimated distribution in the Natura 2000 site Sydvästskånes utsjövatten. (Länsstyrelsen Skåne, 2019).

Studies within the project area

In 2018 and 2019, macrozoobenthos surveys were carried out within the Natura 2000 site along the cable corridor using a Van Veen grab sampler (Ramboll, 2019c) and video filming of the seabed (ROV) (Ramboll, 2019e). For the macrozoobenthos, samples were taken every 5 km within the cable corridor with a further twenty stations in the Natura 2000 site. The video filming of the seabed took place along the entire cable corridor.

Video filming of the seabed within the Natura 2000 site showed habitats that could be divided into four different categories:

- Fine-grained sediments (sand, silt and clay) with lugworm castings (*Arenicola marina*), which have a coverage of >10%. These castings help to form to a landscape on the bottom with raised mounds or pits of 10-20 cm.

- Complex hard bottom with moraine together with hard surfaces of rock and boulders in patches, surrounded by fine-grained sediment. Hard structures have a coverage of >10% of the surrounding seabed.
- Fine-grained sediments (sand, silt and clay) with elements of particulate organic material. The bottom surface is smooth and almost completely devoid of structures rising up from the bottom.
- Fine-grained sediments (sand, silt and clay) with a covering of mussels in patches (>10% coverage). Stones covered in mussels are usually also found in the area.

Figure 11-3 shows the distribution of these habitat categories within the Natura 2000 site.

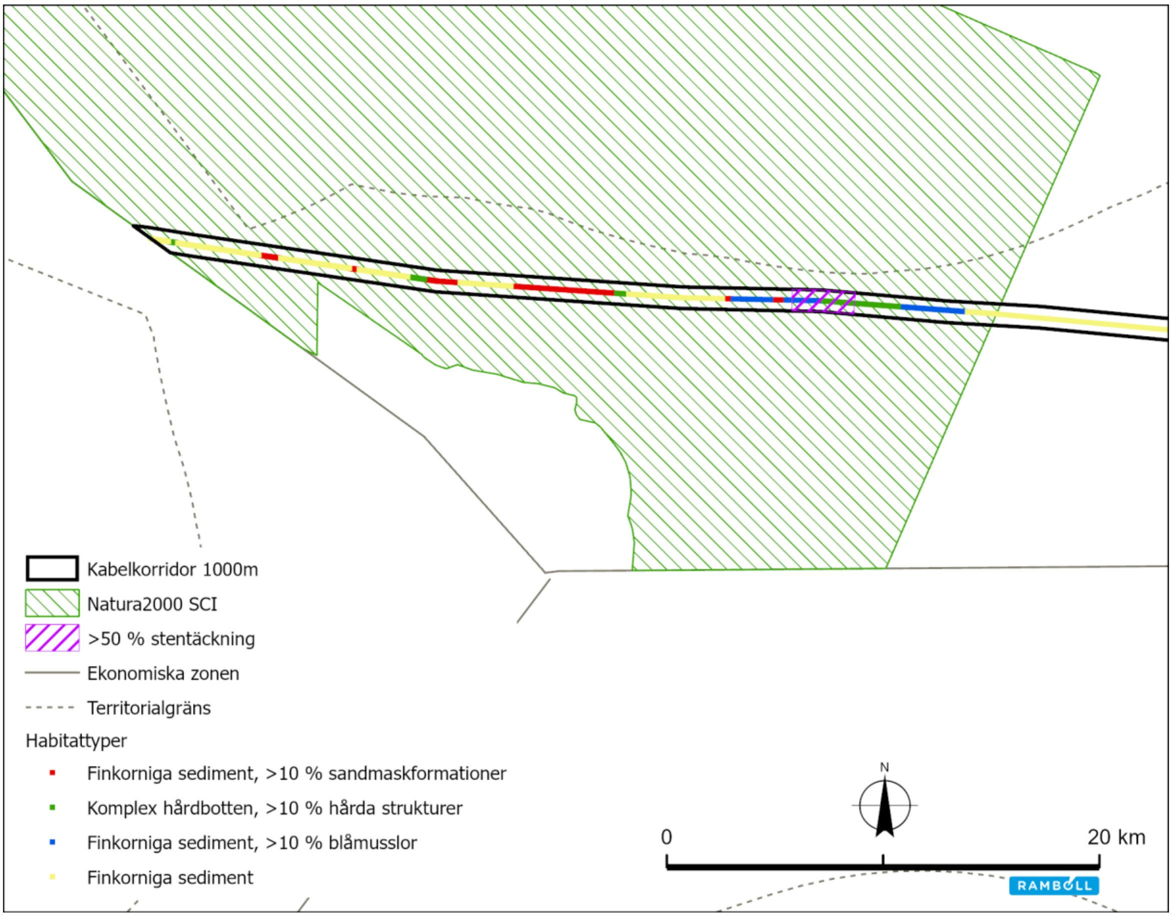

Figure 11-3. Map of the four different categories of habitats found from video filming of the seabed in the Natura 2000 site Sydvästskånes utsjövatten (Ramboll, 2019e).

In about half of the route surveyed in the Natura 2000 site, scattered in different places, there were small mounds and pits (±20 cm) created by the lugworm species (*Arenicola marina*). These lugworms are mainly found on beaches from low tide down to 20 m (Moen & Svensen, 2008) which is why the depth at which it was found during the survey is considered an unusually great depth for the species to live.

The filming also showed the growth of bottom fauna (e.g., blue mussels) on rocks and other hard structures, which was confirmed in the sampling of bottom fauna, although the method used is not optimal for sampling hard-bottom fauna.

Sampling of bottom fauna with the Van Veen grab sampler identified four locations with a high biomass of blue mussels within the Natura 2000 site. Other species found with a high individual density or with a high biomass were the Baltic mussel, polychaete worms of the species *Pygospio elegans* and *Terebellides stroemii*, Laver spire shells (*Peringia ulvae*), lugworms and mussels of the genus *Astarte*.

11.1.2 Identified habitat types and their distribution

Within the Natura 2000 site Sydvästskånes utsjövatten, there are two different identified habitat types: sandbanks and reefs. For these habitat types, the Swedish Environmental Protection Agency has produced guidelines (Rambøll, 2021a; 2011b) in which the typical and characteristic species (T-species and K-species) for each habitat type are also listed. The identified habitat types are described below with their distribution within the cable corridor where construction will take place.

Sandbanks (1110)

The habitat type sandbanks described in the guidelines exist at a maximum depth of 30 m and are always covered with water. They must be topographically distinct from their surroundings and consist mainly of sandy sediments. However, there may be elements of block and stone or clay, gravel and shell gravel. Due to the varying bottom substrate, both hard-bottom and soft-bottom species are present in the habitat type. The sandbanks can be either non-vegetated or covered in macroalgae or seaweed. The habitat type offers habitats for both soft-bottom and hard-bottom species. The sandbanks located further out to sea often serve as a refuge for species that have been crowded out of coastal areas (Rambøll, 2021a). The conservation status of the habitat type sandbanks in the Baltic Sea is poor and deteriorating, and the habitat type is in need of action (Naturvårdsverket, 2020).

Presence of the habitat sandbanks within the cable corridor

Within the Natura 2000 site, four K-species were found in the sampling of bottom fauna (Ramboll, 2019f). The surveys further identified nine species of fish, all of which are T-species and three which are also K-species (Ramboll, 2019b). Four bird species that are T-species are occasionally present in the area, two of which are also K-species for the habitat type sandbanks (Ramboll, 2019a). See Table 11-2 for a list of K-species and T-species present in the Natura 2000 site for the habitat type sandbanks.

The survey carried out by the County Administrative Board of Skåne (2019) of the habitat types within the Natura 2000 site shows that the cable corridor will pass through an area that has been described as non-vegetated sandbanks (1113), which is a subtype of the habitat type sandbanks (1110), and three areas classified as the biogenic habitat type reefs. In total, 0.0007% of the seabed has been surveyed. Therefore, to obtain the information about the habitat types, an interpolation took place between the sampling points, which means that there will be uncertainty in the map produced by the County Administrative Board, see Figure 11-2. This uncertainty is also addressed in the report, which states that the surveys cannot be used as a basis for planning "physical interventions, new activities, etc.". The map produced by the County Administrative Board is therefore highly likely to overestimate the distribution of biogenic reefs within the Natura 2000 area. The County Administrative Board's report further states that "additional information on the topographical elevation of the blocks relative to the surroundings" is needed in order to be able to carry out a correct classification of the habitat type. Such surveys have been carried out along the cable route and the results are briefly summarised below under each relevant habitat type.

Table 11-2. K-species and T-species for the habitat type sandbanks identified during the surveys within the Natura 2000 site Sydvästskånes utsjövatten.

Species	K-species	T-species	Red List 2020
Bottom fauna			
Baltic mussels *(Macoma balthica)*	K-species		LC
Sand gaper (*Mya arenaria*)	K-species		LC
Ragworm (*Hediste diversicolor*)	K-species		NE
Saduria entomon	K-species		LC
Fish			
Sand goby (*Pomatoschistus minutus*)	K-species	T-species	LC
Three-spined stickleback (*Gasterosteus aculeatus*)		T-species	LC
Atlantic cod (*Gadus morhua*)		T-species	VU
European plaice (*Pleuronectes platessa*)	K-species	T-species	LC
European flounder (*Platichthys flesus*)	K-species	T-species	LC
European sprat (*Sprattus sprattus*)		T-species	LC
Atlantic herring (*Clupea harengus*)		T-species	LC
Turbot (*Psetta maxima*)		T-species	LC
Eel (*Anguilla anguilla*)		T-species	CR
Birds			
Long-tailed duck (winter) (*Clangula hyemalis*)		T-species	EN
Black-throated diver (winter) (*Gavia arctica*)	K-species	T-species	LC
Red-throated diver (winter) (*Gavia stellata*)	K-species	T-species	NT
Common eider (*Somateria mollissima*)		T-species	EN

An analysis of sediment types within the Natura 2000 site, see section 9.3, shows that the seabed consists of moraine, clay and silt as well as silt to fine sand, see Figure 11-4. These bottom substrates are not considered to be able to form topographically distinct areas consisting mainly of sandy sediments, as described by the Swedish Environmental Protection Agency for the habitat type sandbanks (Rambøll, 2021a).

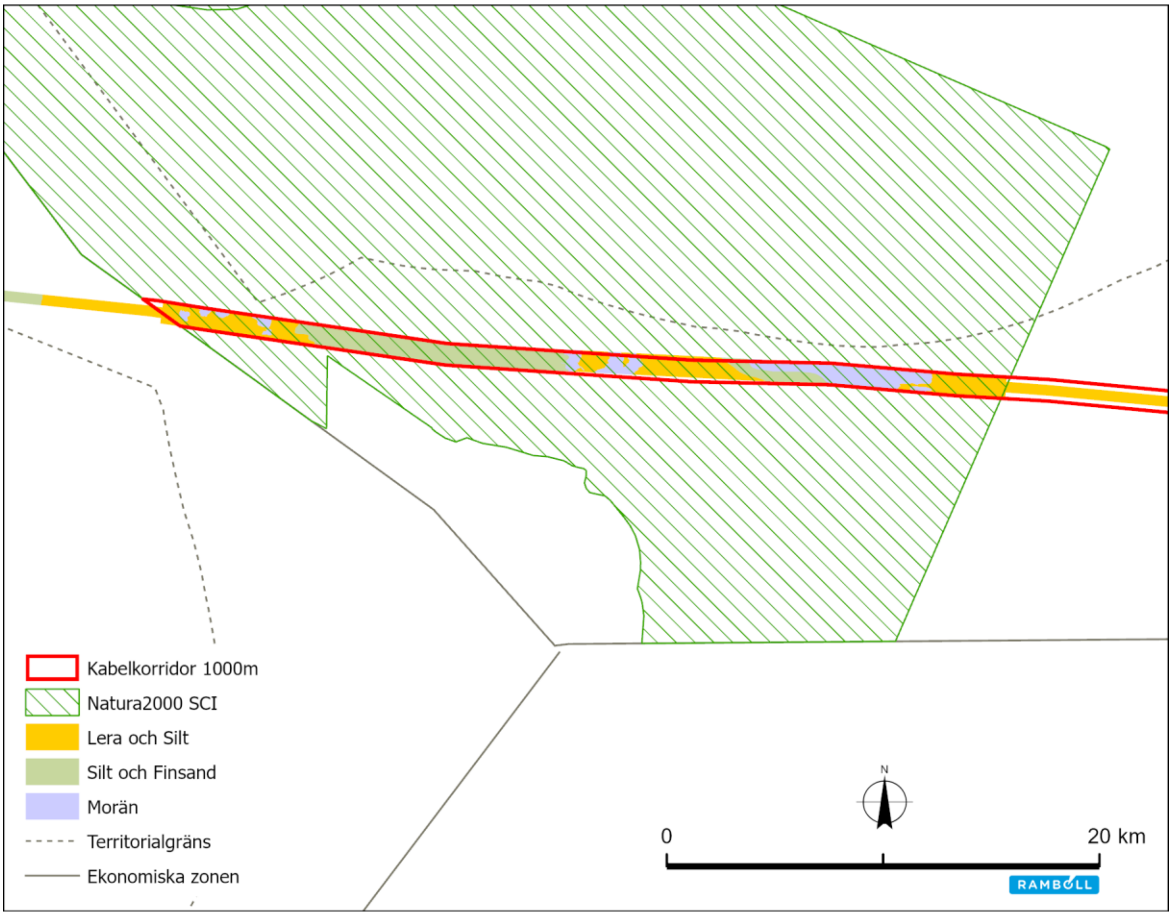

Figure 11-4. Sediment on the seabed based on sampling in the cable corridor.

The cable route within the Natura 2000 site runs at a depth of between 33-47 m. According to the above definition from the Swedish Environmental Protection Agency (stating that the habitat type is found at a maximum depth of 30 m (Rambøll, 2021a)), the habitat type sandbanks does not exist within the route of the cable systems.

Due to the great depth of the cable corridor and the absence of topographically distinct areas with mainly sandy sediments, the habitat type is not considered to exist within the route of the cable corridor in the Natura 2000 site. This will be verified before the cable systems are laid.

Reefs (1170)

The habitat type reefs is described in the guidelines for the habitat type as topographically distinct because it is higher than the surroundings and consists of biogenic and/or geological formations of hard substrate. Reefs occur on both hard and soft bottoms. Reefs are frequently characterized by a zonation of benthic algae and animal species. Mussel banks are classified as this habitat type if the coverage is at least 10%. The boundary between a reef and the surrounding bottom is where soft-bottom surfaces account for more than 50% of the reef formation and/or where the coverage of biogenic formations falls below 10% (Naturvårdsverket, 2011b). Biogenic reefs (1171), a subtype of the habitat type reefs, are a habitat type in which the physical structure of the bottom is mainly formed by living sessile organisms, such as blue mussel banks. The surface area of the biotope is normally no more than 20 ha, however, there is no lower limit to the size (Naturvårdsverket, 2014). The boundary of the biotope is normally the distribution limit of the species that forms the biogenic reef. Habitats nearby such as adjacent areas of water are included to the extent that they are necessary in order to preserve the benefits of the biotope

(Naturvårdsverket, 2014). The conservation status of the habitat type reefs in the Baltic Sea is poor and deteriorating, and the habitat type is in need of action (Naturvårdsverket, 2020).

Presence of the habitat reefs within the cable corridor
Only one species of bottom fauna was found within the Natura 2000 area that is both a K-species and T-species: the blue mussel (Ramboll, 2019c). Four different T-species of fish were found in the surveys carried out, of which all are T-species and only one is also a K-species (Ramboll, 2019b). See Table 11-3 for a list of K-species and T-species found in the Natura 2000 site for the habitat type reefs.

Table 11-3. K-species and T-species for the habitat type reefs identified during the surveys within the Natura 2000 site Sydvästskånes utsjövatten.

Species	K-species	T-species	Red List 2020
Bottom fauna			
Blue mussel (*Mytilus edulis*)	K-species	T-species	LC
Fish			
Atlantic herring (*Clupea harengus*)		T-species	LC
Atlantic cod (*Gadus morhua*)		T-species	VU
Shorthorn sculpin (*Myoxocephalus scorpius*)	K-species	T-species	LC
Viviparous eelpout (*Zoarces viviparus*)		T-species	LC

Video filming of the seabed within the planned cable corridor (Ramboll, 2019e) shows that >10% blue mussel coverage occurs in two sections in the Natura 2000 site, both in the east, see Figure 11-3. The first section located in the far east is 3 km and the next section is 3.5 km. Areas with >50% coverage of rock occur in about 3 km of the cable corridor and overlap by 1 km with the 3.5 km section containing blue mussels with >10% coverage.

Only one surveyed area in the eastern part of the cable corridor overlaps with the survey commissioned by the County Administrative Board and where blue mussels occur. However, this surface is not topographically distinct from the surrounding seabed as described by the Swedish Environmental Protection Agency (2011b). The surveys that have been carried out also show few K-species and T-species linked to the habitat type within the survey corridor. In light of this and the surveys carried out along the cable corridor, it is therefore likely that the habitat type does not exist within the project area. If the habitat type were to be found here, its distribution is likely to be very limited.

11.1.3 Identified species and their distribution
Section 9.6 contains a more detailed description of the marine mammals harbour seal (1365), grey seal (1364) and harbour porpoise (1351), which are designated species within the Natura 2000 site Sydvästskånes utsjövatten.

The overall situation of seals and harbour porpoises in the Baltic Sea population is considered poor in the Baltic Sea, with the exception of the grey seal, where the situation has improved to be favourable. The habitat status is still unsatisfactory for harbour seals and harbour porpoises due to eutrophication and environmental toxins, and populations are too small in relation to the reference values. The prospects for these species are therefore considered to be poor. This is especially true for harbour porpoises in the Baltic Sea population as there is uncertainty about population fertility, health status and the effects of by-catch. For the seals, however, there are positive signs, as stocks are slowly recovering, partly because problems relating to environmental toxins have become less serious. For the Belt Sea harbour porpoise population, the status is favourable. The threats facing it consist primarily of risks of physical interference. The ranges of the marine mammals are large enough, with the exception of harbour seals in the Baltic Sea. The common seal population is expected to increase over time (Naturvårdsverket, 2020).

In a study done for the Krieger's Flak wind farm in Denmark, the common seal, the grey seal and other marine animals were studied using GPS transmitters. This study found that the grey seal moved across vast areas, including the Natura 2000 site, all year long. The common seal moved in a smaller area during the summer, however, which at the time also included the Natura 2000 area, than it did in winter and spring (Niras & Aarhus Universitet, 2015). There are no resting places on land for seals within the Natura 2000 site, as the entire Sydvästskånes utsjövatten area is at sea. Given the distance to sites on land, the Natura 2000 site is probably only used as a foraging area for the two seal species.

In winter, the site is probably used by harbour porpoises from populations inhabiting the Baltic Sea, the Great Belt and the Little Belt. It is probably only the seals populating the Great Belt and Little Belt that move through the area during the summer (Naturvårdsverket, 2022). In summer (May–October), most of the Baltic Sea population is located east of Öland, around the northern and southern Midsjöbankarna and Hoburgs bank (Carlström & Carlén, 2016). Thus, from November to April, the Baltic Sea population may be within the Natura 2000 site Sydvästskånes utsjövatten. Further details are available in section 9.6 on marine mammals.

11.2 Assessment

11.2.1 Suspended sediment

Changed conditions

The concentrations caused by sediment dispersion will be very low at 10 mg/l for less than 12 hours in the immediate area for the excavated sections; compare this to concentrations of up to 40 mg/l in high winds (see section 9.2). Within the Natura 2000 site, the pollution levels are within classes 1–3; the point furthest to the east is within classes 4–5 for organic substances and class 4 for metals. Both metals and organic substances are essentially bound to particulates and are not released into the water (see further details in section 9.3).

Assessment

Construction

For the marine mammal species designated in the Natura 2000 site (harbour porpoises, grey seals and common seals), the impact of suspended sediment is assessed in section 9.6.2.0. The consequence of this is considered negligible because levels are low, and the animals do not fully rely on their eyesight when they hunt.

The habitat type sandbanks will not be affected by the sediment dispersion caused by the construction works. Sediment dispersion can affect natural reef habitats, however, if they are made up of mussels as this will have an environmental effect on beds of living mussels. No the habitat type sandbanks are found within the cable corridor cutting through the Natura 2000 site, nor is it likely that natural reef habitats are found within the cable corridor. However, the suspended sediment from the construction works could affect the T-species associated with sandbanks and reef habitats within the Natura 2000 site.

The impact of sediment dispersion on benthic fauna and fish is assessed in sections 9.4.2 and 9.5.1 respectively, and the consequences are considered as negligible and small, respectively. To avoid significant, direct and adverse effects of sediment dispersion on fish and shellfish (which includes bivalve molluscs), the total concentration of suspended sediment should be less than 100 mg/l, but not exceed 1000 mg/l and, in the event, for no longer than a maximum of

24 hours. A two-week duration at a concentration of 100 mg/l upwards does not seem to greatly elevate the mortality rate for the vast majority of species and stages of life, especially if the water is cold and rich in oxygen. (Karlsson, Kraufvelin, & Östman, 2020) These are significantly higher concentrations than those that may arise from construction work.

For cod and herring, concentrations as low as 3 mg/l can cause behavioural changes if they avoid the sediment dispersion. The buoyancy of cod eggs can be affected by concentrations as low as 5 mg/l, but yellow bag cod larvae also have a higher mortality rate at concentrations exceeding 10 mg/l. (Westerberg, Rönnbäck, & Frimansson, 1996) The sediment dispersion will not have any direct adverse effects on adult or juvenile cod or herring. For cod eggs and larvae, temporary adverse effects may arise from sediment dispersion, but the area affected is considered marginal and will not affect the cod populations, (see further details in section 9.5.1).

For benthic fauna, the time of exposure to sediment dispersion together with an elevated concentration is crucial for how much if any impact this has on the organisms (Newcombe & MacDonald, 1991). The Environmental Protection Agency (2009) concludes that in the case of "effects of sediment dispersion, exposure time is an important factor, and it cannot be proven that benthic fauna are affected by short-term sediment dispersion".

The environmental effect is considered as negligible due to only a limited spread of sediment with low concentrations lasting for a short period of time. Contaminants will be bound to sediment and will not affect the designated species nor T-species associated with the natural habitats. Sediment concentrations are within the levels that can naturally occur in the area. According to the line of reasoning in the above, therefore, it is considered that the conservation status of the habitat and its species, including the designated species, will not be affected.

11.2.2 Sedimentation

Changed conditions

The suspended sediment will settle onto the seabed. The sedimentation will amount to a maximum of 1 mm near the excavated sections. The level of natural sedimentation in the Arkona Basin is 2.2 mm per year (Christiansen, o.a., 2002).

Assessment

Construction

It is assessed that the designated species of marine mammals (harbour porpoises, grey seals and common seals) in the Natura 2000 site are not affected by the temporary increase in sedimentation.

It is possible that the sandbanks and reef habitats could be affected by sedimentation from the construction works. However, within the cable corridor of the Natura 2000 site, there are no the habitat type sandbanks and there are probably no natural reef habitats where beds of blue mussels could be affected. However, sedimentation from the site could affect T-species associated with sandbanks and reef habitats within the Natura 2000 site.

An assessment of how benthic fauna and fish are affected by sedimentation is presented in sections 9.4.2 and 9.5.1. The consequences for both of these receptors were considered negligible. Since natural sedimentation occurs within the area, benthic fauna was also found to be habituated to this process. Studies have shown that mobile benthic fauna are relatively resistant to being covered by sedimentation (about 10 cm) (Naturvårdsverket, 2009). Even blue mussels can withstand being covered by a layer of sediment up to 2 cm and can dig their way up to the seafloor surface (Last, Hendrick, Beveridge, & Davies, 2011; Holt, Rees, Hawkins, & Seed, 1998;

Essink, 1999). Fish could be affected if sedimentation covers their food by overlaying benthic fauna, but as benthic fauna are not affected by this, the fish will not be affected either. Benthic fish eggs could be affected by being covered with sedimentation, yet as the sedimentation is very limited, it is unlikely that this will have any significant impact.

The environmental effect is considered negligible as sedimentation is limited within an area of direct proximity to where the laying of the cable systems will take place. Therefore, it is assessed that the conservation status of the natural habitat and its species, as well as the designated species, will not be affected.

11.2.3 Underwater noise

Changed conditions

The laying of cable systems will generate underwater noise. The predominant underwater noise will be emitted by vessel engines and the laying of rock, both of which are in the same order of magnitude as normal shipping traffic (see further details in section 8.2). See 16.1 for an assessment of the clearance of any UXO.

Assessment

Construction

For the designated species of marine mammals (harbour porpoises, grey seals and common seals), an assessment is made in section 9.6.2 where the consequence is considered negligible as the behavioural reactions to underwater noise generated by the works is considered small.

No sandbanks or reef habitats will be affected by underwater noise during the cable-laying works. However, underwater noise can affect T-species, mainly fish, associated with natural habitats found in the Natura 2000 site.

Section 9.5.1 includes an assessment of how fish are affected by underwater noise, and the consequence is considered negligible as the impact will be limited to the immediate vicinity of the cable-laying corridor and for a brief period as the cable systems are being laid in the sea floor. As the Baltic Sea is heavily trafficked by ships, fish are already habituated to underwater noise. The underwater noise arising from the planned activity will not exceed the existing background levels found in the surroundings. This means the activities will not affect the fish more than the other shipping traffic within their surroundings. Therefore, due to the limited level of underwater noise, it is unlikely that the this will have any significant impact on fish.

For the designated species of marine mammals, an assessment is made in section 9.6.2 where the consequence was considered negligible as the behavioural reactions due to underwater noise from the works are considered small.

As the underwater noise will be on a par with shipping traffic in the area and will only be temporary within a limited area, the environmental effect is considered negligible. Therefore, it is assessed that the conservation status of the natural habitat and its species, as well as the designated species, will not be affected.

11.2.4 Physical disturbance of the seabed

Changed conditions

During the cable-laying process, the seabed will be disturbed by the installation of the up to two cable systems. The width at which the disturbance will occur will be at most 30 metres for one cable system within the cable corridor and will pass through the Natura 2000 site. This means that 0.2% of the sea floor of the Natura 2000 site will be disturbed by both cable systems.

Assessment

Construction

It is assessed that the designated species of marine mammals (harbour porpoises, grey seals and common seals) in the Natura 2000 site will not be affected by the impact of a temporary increase in sedimentation.

No the habitat type sandbanks are found within the cable corridor within the Natura 2000 site, and it is unlikely that natural reef habitats are found here either. However, the area is an important natural reef habitat for blue mussels, which are designated as both a K-species and a T-species due to the structure of the three-dimensional habitats they build up, which serve as a source of food and protection for other species. In addition to this, blue mussels reduce the effects of erosion in areas of sand, gravel and rock. Also, the presence of mussels has a positive effect on water quality as they filter the water, bind nutrients and reduce sediment dispersion (Kraufvelin, Bryhn, & Olsson, 2021). The blue mussel is in the Viable category of the 2020 Swedish Red List. There is no quantitative monitoring of the mussel population or its distribution within Swedish waters, however, which means that it is not possible to assess whether a possible reduction of the species would put it in a red list category (SLU Artdatabanken, 2022). Compared to the North Sea, where much data indicates that the population is decreasing, the range of the blue mussel within the Baltic Sea does not seem to be decreasing (Kraufvelin, Bryhn, & Olsson, 2021).

Before the construction phase, the location of blue mussels within the cable corridor will be investigated to avoid disturbing any natural reef habitats if these are found within the cable corridor. To reduce the impact on any large populations of blue mussels within the Natura 2000 site, the route of the cable corridor will be adjusted to avoid these areas.

The impact of the physical disturbance of the seabed on benthic fauna, and thus on T-species associated with sandbanks and reef habitats within the Natura 2000 site, is assessed in section 9.4.2, and the consequence is considered negligible due to the restricted area affected and by the fact that the benthic fauna will recover within a few years. Since no the habitat type sandbanks are found within the cable corridor, these will not be affected by the physical disturbance of the seabed. Nor will any reefs within the cable corridor be affected as these will be avoided wherever possible by a feasibility study of the seabed before the cable-laying process begins. Since only a small area of the seabed will be affected by the cable-laying process and because areas with a high proliferation of mussels will be avoided by altering the route, the environmental effect is considered negligible. Therefore, it is assessed that the conservation status of the natural habitat and its species will not be affected.

11..1 **Physical disturbance above the surface**

Changed conditions

During the construction phase, the presence of the project-related vessels will constitute a physical disturbance above the surface. The vessels move at a speed of 0.1–2 km/h when cable systems are being laid.

Assessment

Construction

It is assessed that the designated species of marine mammals (harbour porpoises, grey seals and common seals) in the Natura 2000 site are not affected by the significance of a temporary disturbance above the surface.

The physical disturbance above the surface from project-related vessels could affect birds that are T-species for sandbanks habitats.

The impact on birds by the physical disturbance above the surface and the consequence is assessed in section 9.7 and is considered negligible due to the low density of these birds, because they can move away from the disturbance, and because the impact occurs within a very limited area. In addition to this, normal vessel traffic in the area is significantly greater than the presence of project-related vessels, which is why it is unlikely that any significant impact could occur. The environmental effect is therefore considered negligible. Therefore, the conservation status of the sandbanks habitat and its T-species, which are birds, is not considered to be affected.

11.3 Overall assessment

It is assessed that there will be no significant impact on the designated habitat types sandbanks and reefs, and no impact on the conservation status of the designated species harbour porpoises, common seals and grey seals within the Natura 2000 site Sydvästskånes utsjövatten. The range of the natural habitats will remain the same and the structure and function of the natural habitats will be upheld. The conservation status of T-species associated with the sandbanks and reef habitats will also remain the same and will not affected by the activity, i.e., the activity will not aggravate the favourable conservation status of these species. No populations of T-species will be affected nor will their range decrease as a result of the planned activities. A compilation of the assessment of the impact on typical species for sandbanks and reef habitats is found in Table 11-4 and Table 11-5.

Table 11-4. K-species and T-species for the habitat type sandbanks identified during the surveys within the Natura 2000 site Sydvästskånes utsjövatten.

Species	Impact on conservation status
Fish	
Cod	Cod is a vulnerable species according to the Red List. The threats consist of excessive fishing pressure and structural changes to the ecosystem. Planned works and operation of cable systems do not change the functioning of the ecosystem. The activities are considered to have a minor adverse effect during the cable-laying process, but mitigation measures will be taken in the form of time restrictions. Overall, the planned activities are not considered to have a significant impact on the conservation status of cod.
Plaice, flounder, sand goby and turbot	Plaice, flounder, sand goby and turbot are common demersal species. It is assessed that the temporary changes to their natural habitat arising from the laying and decommissioning of cable systems in the form of suspended sediment, sedimentation, underwater noise and physical disturbance of the seabed will not have any significant effect on the species or their conservation status. Nor is it expected that their conservation status will be affected by the operation of the cable system.
Herring, sprat and three-spined stickleback	Herring, sprat and three-spined stickleback are common pelagic species. It is assessed that the temporary changes to their habitat – in the form of suspended sediment, sedimentation, underwater noise and physical disturbance of the seabed – arising from the laying and decommissioning of cable systems will not significantly affect these species or their conservation status. Nor is it expected that their conservation status will be affected by the operation of the cable system.
European eel	The threat to the favourable conservation status of eels has not been fully elucidated. Hypotheses exist about changing currents in the oceans but

Species	Impact on conservation status
	also increased mortality due to fishing, in power plants and as a result of various viruses and parasite infections. The occasionally discussed impact on eels are the electromagnetic fields that arise around power lines on the seabed that constitute a barrier, prevent or make spawning difficult. This is threat is not raised by SLU, however, and investigations have not been able to show a significant impact (see section 9.5.2). Therefore, the planned activities are not considered to affect the conservation status of the eel.
Birds	
Long-tailed duck (winter) and the common eider	Long-tailed ducks and eider ducks are highly endangered species where oil spills at sea, trawling, and reduced biomass of mussels are some of the reasons why these species have declined. Neither the planned cable-laying or decommissioning measures nor the operation of cable systems are considered to have any significant impact on these species or their conservation status (see the assessment of birds, section 9.7).
Black-throated diver (winter)	The black-throated diver is a viable species, and neither the planned cable-laying and decommissioning measures nor the operation of cable systems are considered to have any significant impact on this species or its conservation status (see the assessment of birds, section 9.7).
Red-throated diver (winter)	According to the Red List, the red-throated diver is a vulnerable species. The threats at sea consist of the displacement effects of shipping, commercial fishing, sand mining (dredging), wind farms, etc., but also by oil-inflicted injuries or getting stuck in fishing nets. Neither the planned cable-laying and decommissioning measures nor the operation of cable systems are considered to have any significant impact on this species or its conservation status (see the assessment of birds, section 9.7).

Table 11-5. Assessment of the impact on the conservation status of T-species for natural reef habitats identified during the surveys within the Natura 2000 site Sydvästskånes utsjövatten.

Species	Impact on conservation status
Benthic fauna	
Blue mussel	The blue mussel is a commonly occurring species in the Baltic Sea. Temporary changes associated with the laying of cable systems may locally affect individual mussels but do not pose a threat to the population or the species' conservation status within the Natura 2000 site. No significant impact is foreseen during operation and therefore this will not impact its conservation status.
Fish	
Herring and cod	For an assessment, see Table 11-4
Shorthorn sculpin and eelpout	Shorthorn sculpin and eelpout are common demersal species. It is assessed that the temporary changes to their natural habitat arising from the laying and decommissioning of cable systems in the form of suspended sediment, sedimentation, underwater noise and physical disturbance of the seabed will not have any significant effect on the species or their conservation status. Nor is it expected that their conservation status will be affected by the operation of the cable system.

12. THE MARINE STRATEGY FRAMEWORK DIRECTIVE AND ENVIRONMENTAL QUALITY STANDARDS

The Marine Strategy Framework Directive aims to achieve or maintain a good environmental status of Europe's marine environments. The directive is introduced into Swedish legislation through Chapter 5 of the Swedish Environmental Code, the Swedish Marine Environment Regulation (2010:1341) and the regulations of the Swedish Agency for Marine and Water Management (HVMFS 2012:18). The environmental quality standards (EQS) are a legal instrument that will serve as a tool to maintain or achieve a good environmental status in the sea out to the border of Swedish exclusive economic zone. The area affected by project includes the Arkona Basin and the southern section of the Sound.

Good environmental status

Appendix 2 of HVMFS 2012:18 lists the 11 descriptors used to assess human impact on marine ecosystems (see Table 12-1). The descriptors include both receptors and influencing factors. The descriptors considered relevant to assess with regard to the environmental effect of the project are presented in Table 12-2. The assessment of the environmental status of descriptors is based on a number of various criteria and associated indicators. The following assessments take account of these criteria and indicators.

Overall, the impact is expected to be small for descriptors 1, 4 and 6 during the construction phase. For other descriptors, the impact will be negligible. During operation, the impact will be negligible for all descriptors.

Table 12-1. Descriptors for assessing a good environmental status according to HVMFS 2012:18.

Good environmental status
Descriptor 1. Biodiversity
Descriptor 2. Invasive species
Descriptor 3. Commercially exploited fish and shellfish
Descriptor 4. Marine food webs
Descriptor 5. Eutrophication
Descriptor 6. Integrity of the seabed
Descriptor 7. Permanent changes to hydrographic conditions
Descriptor 8. Concentrations and effects of hazardous substances
Descriptor 9. Hazardous substances in fish and other marine food
Descriptor 10. Marine rubbish
Descriptor 11. Underwater noise

Table 12-2. Assessment of the impact on the environmental status of relevant descriptors from potential impact factors in the project's construction phase. The impact will be negligible during operation.

Descriptor	Potential impact	Impact assessment
Descriptor 1, Biodiversity maintained: The quality and existence of natural habitats and the distribution and abundance of species are consistent with existing geomorphological, geographical, and climatic conditions.	• Physical disturbance of the seabed • Sediment dispersion and sedimentation • Underwater sound • Physical disturbance above the surface	Assessments of the effects on environmental values are accounted for in Chapters 9 and 11 (Natura 2000). The effects of the influencing factors will be negligible or small. The consequences are assessed as negligible for benthic fauna, marine mammals, and birds, and as small for fish. In Natura 2000 site

Descriptor	Potential impact	Impact assessment
		Sydvästskånes utsjövatten, neither the protected natural habitats (sandbanks, reefs) nor the species (seals and harbour porpoises) will be adversely affected.
Descriptor 4, Food webs: All parts of the marine food webs, to the extent that these are known, are present to a normal extent and are diverse at levels that are sufficient to ensure long-term populations of the species and to maintain their full reproductive capacity.	• Physical disturbance of the seabed • Sediment dispersion and sedimentation • Underwater sound • Physical disturbance above the surface	Assessments of the effects on environmental values are accounted for in Chapters 9 and 11 (Natura 2000). The effects of the influencing factors will be negligible or small. The consequences are assessed as negligible for benthic fauna, marine mammals, and birds, and as small for fish. In Natura 2000 site Sydvästskånes utsjövatten, neither the protected natural habitats (sandbanks, reefs) nor the species (seals and harbour porpoises) will be affected negatively.
Descriptor 6, Integrity of the seabed: The integrity of the seabed remains at a level which ensures the structure and functions of the ecosystems and ensures that benthic ecosystems in particular are not affected negatively.	• Physical disturbance of the seabed • Sediment dispersion and sedimentation	Assessments of the effects on environmental values are accounted for in Chapters 9 and 11 (Natura 2000). The effects of the influencing factors will be negligible or small. The consequences are assessed as negligible for benthic fauna, marine mammals, and as small for fish. In the Natura 2000 site Sydvästskånes utsjövatten, neither the protected natural habitats (sandbanks, reefs) nor the typical species will be adversely affected.
Descriptor 11, Energy, including underwater noise: The input of energy, including underwater noise, is at a level that will not affect the marine environment negatively.	• Underwater noise	Assessments of effects on environmental values are presented in Chapters 9 and 11 (Natura 2000). The impact on and consequences for the marine environment from underwater noise are considered negligible.

Environmental quality standards

To achieve good environmental status, eleven different environmental quality standards (EQS) have been established for the marine environment. Appendix 3 of HVMFS 2012:18 lists the environmental quality standards and the indicators which are measured/examined to assess compliance with the EQS. The impact on EQS which could potentially be affected based on the environmental effects of the cable systems are specified in Table 12-3.

The planned cable-laying works and the operation of the cable systems will not result in any infusion of nutrients or contamination. The physical impact on the seabed is largely temporary and limited. A small impact on fish may arise from suspended sediments during the construction phase, but effects will be short-term. The impact of underwater noise on fish and marine mammals will be negligible.

According to the assessments presented below, which are based on the impact assessments in Chapter 9, the planned activities will not jeopardise or counteract the conditions for complying with the EQS for the marine environment.

Table 12-3. Assessment of the impact on the relevant environmental quality standards from potential impact factors in from the construction phase. The impact will be negligible during operation.

Environmental quality standard	Potential impact	Impact assessment
C.4 Environmental quality standard The existence, species composition and size dispersion of the fish community must enable important food-web functions to be maintained.	• Physical disturbance of the seabed • Sediment dispersion and sedimentation • Underwater sound	Assessments are accounted for in Section 9.5. The environmental effect on and consequences for fish and the fish community are considered small.
D.1 Environmental quality standard The scope and dimensions of the seabed area that is unaffected by human activity must provide the conditions for maintaining the structure and function of the seabed for each type of natural habitat.	• Physical disturbance of the seabed	Assessments are presented in sections 9.4 (benthic fauna) and 11 (Natura 2000). The effects on and consequences for benthic fauna are considered negligible. In the Natura 2000 site Sydvästskånes utsjövatten, neither the protected natural habitats (sandbanks, reefs) nor the typical species will be affected negatively.
E.2 Environmental quality standard Human activity must not cause harmful impulsive noise within the habitats of marine mammals during periods of time when these animals are sensitive to disturbance.	• Underwater sound	An assessment is presented in section 9.6 (marine mammals). The effects of impulsive sound on and consequences for marine mammals are considered negligible.

13. CUMULATIVE EFFECTS

Cumulative effects are defined as environmental effects caused by the impact of the current project in combination with the effects of other projects. This could involve other the laying of similar cables or pipelines or, e.g., wind farms in the vicinity of the current project as well as other activities or areas that give rise to disturbances. These other projects have an impact that may be irrelevant by itself but which, when combined with the impact of the current project's activities, could have a significant cumulative impact. According to practice, only permitted and existing projects should be included in this assessment, but in this case the account will also include planned projects based on known information wherever possible.

Activities, areas with restrictions, and projects identified as being able to have a cumulative impact together with the project are shown in Figure 13-1 below and described in Table 13-1. This involves wind farms at different stages of development and the existing infrastructure in the form of cables.

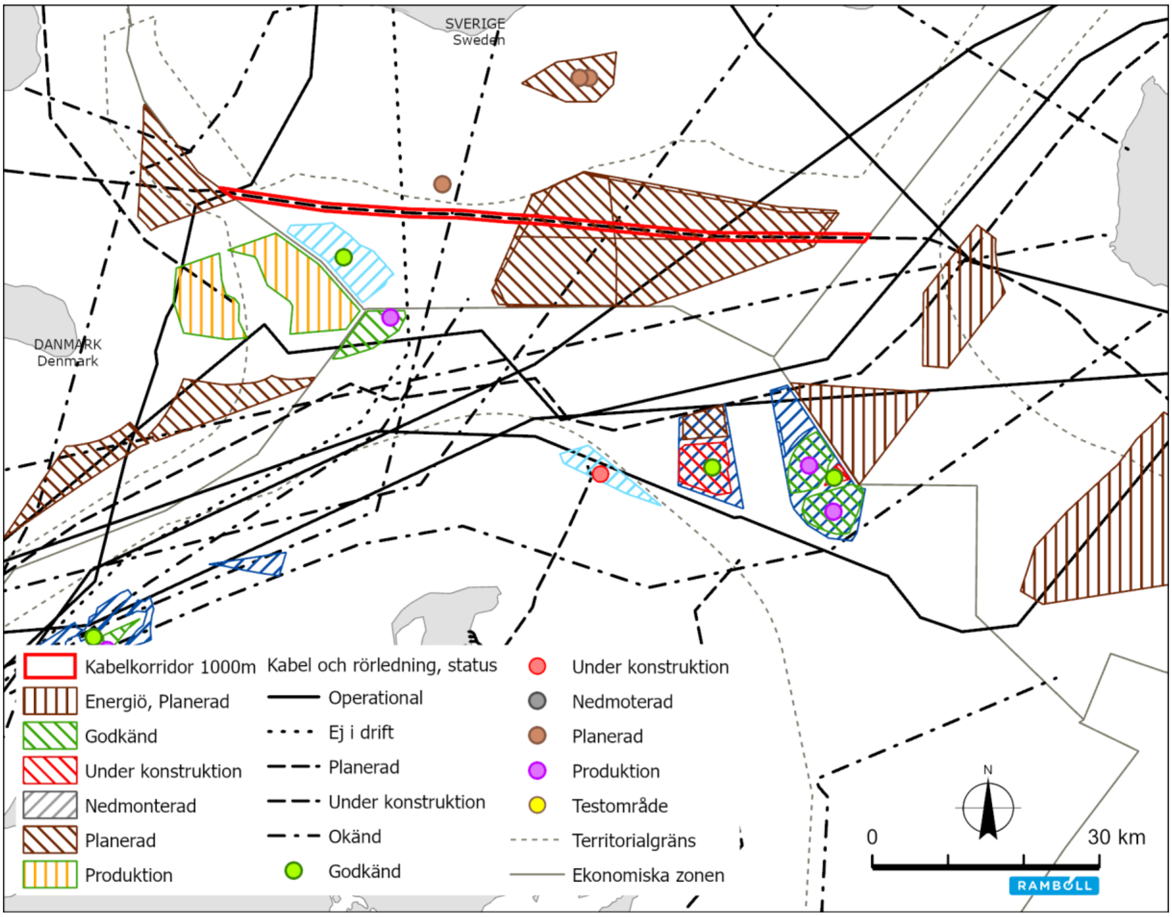

Figure 13-1 Existing and planned projects in the south Baltic Sea.

According to the project's preliminary time schedule, the first cable system will be constructed in 2026–2027 in order to be able to connect the first offshore wind turbines of Energy Island Bornholm in 2028, and all turbines by 2030. A compilation of wind farms and cables/pipelines is provided in Table 13-1.

Table 13-1. Planned and ongoing projects located up to 20 km from the cable corridor.

Project	Description	Project owner	Status/Schedule	Relation to the cable corridor
Cables/ pipelines				
Baltic Pipe	Gas pipeline between Denmark and Poland	Energinet, Gaz system	Laid Operational start-up in 2022	In parallel with planned cables, 200–500 m
Hansa Power Bridge	Planned electrical cables between Sweden and Germany	Svenska power grid	Construction start 2024 Commissioning in 2026	Crosses the planned cable corridor
Export cables for Krieger's Flak	Planned electrical cables between Sweden and the Krieger's Flak wind farm	Vattenfall	Permission obtained	Crosses the planned cable corridor
Wind farms				
Krieger's Flak	Planned wind farm within Sweden's EEZ	Vattenfall	Planned start of construction: 2027 Installation: 2027–2029	South of the cable corridor
Energy Island Bornholm	Planned wind farms within Denmark's EEZ	Energinet	Planned start of construction: 2026	The cable corridor runs west of the planned wind farm
Skåne Offshore Wind Farm	Planned wind farm within Sweden's EEZ	Örsted	Permit application submitted in 2021. The EIA was announced in the summer of 2022. Possible start of construction: 2028	The cable corridor runs through the planned wind farm
Arkona Offshore Wind Farm	Planned wind farm within Sweden's EEZ	Eolus Vind	Planned. Consultation process runs throughout 2022. Unclear when/if permission will be granted, and the wind farm will be built.	The cable corridor runs through the planned wind farm
Triton	Planned wind farm within Sweden's EEZ	OX2 AB	Permit application submitted; unclear when/if permission will be granted, and the wind farm will be built	The cable corridor runs through the planned wind farm
Sydkusten vind	Planned wind farm south of Trelleborg.	Kustvind AB	Trelleborg Municipality decided in September 2021 to use its municipal veto to reject the project.	North of the cable corridor

13.1 Cumulative effects with existing or permitted projects

It appears that the construction of the Krieger Flak wind farm and the laying of a cable system to Sweden are planned to take place within roughly the same period, which is why there may be cumulative effects from sediment dispersion and increased traffic in the area. The planned cable corridor will need to cross a planned cable system where separate agreements are made between the two developers. Thus, the impact of sediment dispersion during the construction phase for the two operations could increase in the area. If the construction works establish protection zones around their respective sites, the cumulative impacts should be quite limited. If sediment dispersion is increased by the cumulative effects, this will occur in the western part of the cable corridor and not in the eastern part where cod are likely to spawn, so a cumulative impact on cod is not expected. By maintaining safe distances to construction vessels, it is also estimated that there will be no cumulative impact from the likelihood of vessel collision.

13.2 Cumulative effects with planned projects

Cumulative effects together with other planned projects occur mainly in the construction phase and if the projects are implemented at the same time. In this event, there may be temporary local effects with other projects in the local area. The cable route passes through three planned offshore wind farms, none of which have been permitted yet. All three wind farms are roughly within the same area (see Figure 13-1). However, it is unlikely that these wind power projects will have cumulative effects. This is because it is unlikely that the construction phases of the projects can take place at the same time. However, dialogue with the wind power operators is ongoing to ensure safety and the best possible collaboration for all parties. Once the cable systems are in place, no cumulative effects are expected to occur.

Other planned wind power projects are located at such a great distance that no cumulative effects are expected to occur during either the construction or operation phases.

14. CROSS-BORDER EFFECTS

Cross-border effects are defined as impacts that transcend national borders. Wherever it is likely that an activity or measure will affect another country, the cross-border impact should be assessed. This is regulated in the Espoo Convention, and the countries concerned should be informed of the activity and its cross-border impact pursuant to Article 3 of the Convention. The planned cable corridor is located within Swedish exclusive economic zone bordering Denmark and Germany. This makes these two countries stakeholders and identifies them as countries where a potential cross-border impact could occur. For further details about the Espoo process, see Chapter 2.1.

The impacts which are assessed as having potential cross-border effects come from underwater noise, suspended sediments and the restrictions that may arise for commercial fisheries. Cross-border effects are essentially the same as the effects accounted for in Chapter 9. The consequences of these effects are considered negligible for all aspects that have been assessed, except for fish (cod) where a minor impact can be expected. It is assessed that this impact will also be outside Swedish exclusive economic zone, and the assessed consequence has taken into account the entire spawning area within the Arkona Basin.

15. NAUTICAL RISK ANALYSIS

Energinet has had a marine risk analysis prepared for the project, which can be found in its entirety in Appendix C3. A summary of the analysis is found below. Although the project area is heavily trafficked by ships entering or leaving the Baltic Sea, the major shipping routes pass to the north and south of the project area. Overall, the planned operations are considered a relatively well-known phenomenon, and with a strong focus on the crossings of shipping routes and the risk mitigation measures in these areas, the overall risk is considered acceptable.

15.1 Risks during the construction phase

The construction phase requires multiple vessels to carry out various activities in the area, including vessels with reduced manoeuvrability under the international maritime rules COLREG, Regulation 3. Accidents resulting from the construction works are estimated and described as changes in the return periods of vessel-collision scenarios in a normal year, without construction activities, and during the years of construction. A return period is defined as the expected intervals at which an event occurs, calculated as the number of years.

Most of the construction activities take place through areas outside the main shipping routes. However, the project area crosses several shipping routes, and construction activities in these areas poses an increased likelihood of collisions between ships.

The return period for all types of collisions in the project area is estimated to be approximately 650 years in a normal year without planned activities and 200 years during the construction phase, without taking account of specific risk mitigation measures. Collisions during a normal year mainly concern collisions involving passing ships in existing lanes, as intersecting ship traffic along the corridor is limited. During the construction phase, the greatest risk will be collisions between existing vessel traffic and installation vessels moving slowly along the cable corridor. The area outside the project area is heavily trafficked along the main shipping routes where the number of incidents and accidents is significantly higher, regardless of activity, in relation to the cable corridor.

The greatest risk is associated with the area near the TSS in Bornholmsgat, where the return period during planned operations will be 440 years on average. This is comparable to a "normal" year where the return period for collisions specifically within this part of the cable corridor is estimated to be 12,000 years. Even if the risk increases during the construction phase, risk mitigation measures will be able to partly control this.

With the following proposed risk mitigation measures, the risk associated with the construction phase is considered acceptable:

- Information about the construction work will be communicated to the relevant authorities, and navigation in the area through the Swedish Maritime Administration's "Notices to Mariners" (NtM)
- A safety distance of 500 m around installation vessels with limited manoeuvrability
- Possible use of guard ships

15.2 Risks during the operation phase

The risk to shipping traffic in the area during the operation phase is considered small, as regular maintenance of the cable systems is usually not required. However, some repair activities after cable damage are foreseen. The most likely incidents concern fishing activities with bottom trawls and accidental anchor dragging. Trawling normally takes place outside the main shipping routes, which means that repair activities are likely to take place in less congested areas where there is only a limited risk. Anchor-dragging incidents can occur along the main shipping routes. Repair work carried out in places where shipping routes are crossed is assessed as being comparable to the risks during the construction phase involving vessels with limited manoeuvrability. Thus, the risks are similar and risk mitigation measures resembling those for the construction activities should be implemented in these events.

15.3 Risks during the decommissioning phase

It is assessed that the risks during the decommissioning phase resemble those during the construction phase. However, it is worth pointing out that the volume of ship traffic, the presence of wind farms and obstacles in the area may have changed since this analysis was carried out.

16. UNPLANNED INCIDENTS

16.1 Unexploded ordnance

The Baltic Sea has several risk areas involving weapons, mostly related to the Second World War. These may consist of unexploded ammunition, mines or other objects that pose a risk (UXO).

At present, there are no indications that UXO need to be cleared or relocated within the cable-laying area as the survey and clearance done for Baltic Pipe and the corridors are the same. However, this situation will be verified as part of the construction phase to confirm this. If ordnance – contrary to expectations – are found along the cable route, dialogue will be entered into with the relevant authorities (Swedish Coast Guard, county administrative board of Skåne and the Swedish Armed Forces). It can be beneficial to dispose of UXO, rather than leaving them behind to avoid the risk if, for example, fishermen or vessels need to drop anchor in an emergency.

If possible, Energinet will lay the cable systems (within the cable corridor) past UXO. If this is not possible, Energinet will undertake to move the object to a suitable place on the seabed, where there is less risk of unwanted detonation or to make sure that the UXO is dealt with on land by trained personnel. Where the clearance of UXO is required, appropriate mitigation measures must be implemented in agreement with the relevant authorities to protect marine mammals. In cases where UXO must be cleared by explosion, mitigation measures must be implemented to avoid or reduce any impact on fish, diving seabirds and marine mammals. The use of so-called scaring equipment (e.g., audible signals and seal scarers) and marine mammal observers are standard procedures that must be implemented for the clearing of UXO. If mitigation measures are applied, it assessed that hearing damage, such as PTS and TTS for harbour porpoises, will not occur. It should be pointed out that it is highly unlikely that UXO will be encountered in this area.

16.2 Damage to or unforeseen maintenance of cable systems

There is no general maintenance planned for the cable systems during its service life. Completion of support structures for cable crossings or repairs arising from erosion are possible maintenance measures. Only if the cable system is damaged for whatever the reason (e.g., anchoring) will repair maintenance in the form of for example a jointing be required (see section 6.4). A typical cable repair includes multiple vessels that are at the site of the repair during a period of about one month or less, depending on the extent of the damage. The potential impact could be the disturbance of the seabed and the construction a safety zone around the ships doing the repair or maintenance works. The impact on both biological and socio-economic values will be resemble those accounted for during the construction phase. The same mitigation measures as during the construction phase will be implemented, which is why the consequences are considered negligible.

17. CONSEQUENCES OF DECOMMISSIONING

The cable systems are designed to be in operation for at least 40 years. An extension of the lifetime may be considered, if relevant at the time. When the cable systems are no longer in operation, they will be decommissioned. The actual decommissioning method will be agreed with the relevant authorities well in advance of the decommissioning. It is not possible to specify the method to be used at this time, as it will depend on legislation as well as the technical options available at the time of decommissioning and how the environmental conditions have developed. The cable systems can either be left buried in the seabed or taken up on land for recycling.

17.1 Consequences of leaving the cable systems in sea floor sediments

Leaving the cable systems in the seabed sediments will have consequences that are similar to those described for the operation phase. Since the cables are no longer operating, the electromagnetic field will no longer exist. Similarly, repairs and maintenance of the cable systems will no longer be required. An assessment of the consequences if the cable systems are left in the sea floor is found in Table 17-1.

Table 17-1. Consequences of leaving the cable systems in sea floor sediments after decommissioning

Receptor	Impact factor	Consequences during operation	Consequences after decommissioning	Remark
Benthic fauna	Physical disturbance of the seabed	Negligible	Negligible	The element of hardground habitat remains
Fish	Electromagnetic field	Negligible	None	A cable system that has not been commissioned has no electromagnetic fields
Marine mammals	Underwater noise	Negligible	None	Maintenance ceases, no significant ship traffic
Birds	Physical disturbance above the surface	Negligible	None	Maintenance ceases, no significant ship traffic
Commercial fishing	Physical disturbance of the seabed	Negligible	Negligible	Paving at cable crossings remains
Military areas	Physical disturbance above the surface	Negligible	None	Maintenance ceases, no significant ship traffic
Infrastructure	Presence of pipeline	Negligible	Negligible	Other construction of infrastructure on the seabed

National interests in the area are not expected to be affected by leaving cable systems in the seabed. Also, the Natura 2000 site Sydvästskånes utsjövatten is not expected to be affected by cable systems that are left behind.

Overall, the consequences of leaving the cable systems in the seabed when decommissioning are considered negligible.

17.2 Consequences of demolishing the cable systems upon decommissioning

Demolition of the cable systems means that they are removed from the sea floor sediments, the consequences of which resemble the construction phase in the form of sediment dispersion, underwater noise, protection zones, etc. The consequences of demolishing the cable systems upon decommissioning are accounted for in Table 17-2.

Table 17-2. Consequences of demolishing the cable systems upon decommissioning.

Receptor	Impact factor	Consequences during operation	Consequences after decommissioning	Remark
Benthic fauna	Suspended sediment	Negligible	Negligible	Effects similar to those during the construction phase
Benthic fauna	Sedimentation	Negligible	Negligible	Effects similar to those during the construction phase
Benthic fauna	Physical disturbance of the seabed	Negligible	Negligible	Effects similar to those during the construction phase
Fish	Suspended sediment	Small	Small	Effects similar to those during the construction phase
Fish	Sedimentation	Negligible	Negligible	Effects similar to those during the construction phase
Fish	Underwater noise	Negligible	Negligible	Slightly less impact than during the construction phase, no laying of rock
Fish	Physical disturbance of the seabed	Negligible	Negligible	Effects similar to those during the construction phase
Marine mammals	Suspended sediment	Negligible	Negligible	Effects similar to those during the construction phase
Marine mammals	Underwater noise	Negligible	Negligible	Slightly less impact than during the construction phase, no laying of rock
Birds	Physical disturbance above the surface	Negligible	Negligible	Effects similar to those during the construction phase
Cultural environment	Physical disturbance of the seabed	None	None	No cultural environment objects along the cable route
Shipping and shipping routes	Physical disturbance above the surface	Negligible	Negligible	Effects similar to those during the construction phase
Commercial fishing	Physical disturbance above the surface	Negligible	Negligible	Effects similar to those during the construction phase

Receptor	Impact factor	Consequences during operation	Consequences after decommissioning	Remark
Military areas	Physical disturbance above the surface	Negligible	Negligible	Effects similar to those during the construction phase
Infrastructure	Physical disturbance of the seabed	Negligible	Negligible	Demolition can be complicated but feasible if cables or pipelines are laid on top of the cable systems.

National interests in the area are not expected to be affected by leaving cable systems in the sea floor. It is assessed that the Natura 2000 site Sydvästskånes utsjövatten will not be significantly affected if the cable systems are demolished.

Overall, it is estimated that there will be a small consequence for fish in the event of demolition of the cable systems, while other consequences will be negligible.

18. PROPOSAL FOR CONTROL AND FOLLOW-UP

The following section presents a proposal for a control programme. Detailed planning and implementation of the programme will be developed in consultation with the competent authority (the Swedish Coast Guard). In dialogue with the relevant authorities, the place, method and period of controls will also be determined.

The purpose of a control programme is to ensure that the mitigation measures adopted have the desired effect and to reduce the environmental effect as much as possible. In addition, a control programme can be used to monitor changes in a receptor that are considered to be affected by the project to a certain extent.

Below, a control programme is presented for the purpose of controlling the following:

- Restoration of the seabed and benthic habitats in the Natura 2000 site Sydvästskånes utsjövatten
- Ship traffic, to minimise the risk of collision with cable-laying vessels
- Consideration of wrecks
- Possible effect of mitigation measures in the event of UXO is to be cleared

After the construction phase, the as-built coordinates for cable systems the will be reported.

18.1 Restoration of the seabed and benthic habitats in the Natura 2000 site Sydvästskånes utsjövatten

The purpose of the control is to follow up on the restoration of the seabed in the Natura 2000 site Sydvästskånes utsjövatten. In sections of the Natura 2000 site, construction works include excavation and possibly some laying of rock that could disturb the seabed. The control will include monitoring by means of underwater video of the seabed (ROV, drop video, etc.) and by taking samples of benthic fauna to examine how the seabed and its habitats are being recolonised and recovering. This will be accounted for in a report/memorandum.

18.2 Ship traffic, to minimise the risk of collision

The purpose of controlling and monitoring shipping is to minimise the risk of collisions or other accidents involving commercial shipping and vessels carrying out cable-laying activities for the project. A number of activities will be carried out to achieve this goal. Safety zones will be implemented around all vessels involved in the construction works below the surface. Vessels within the project area or other project vessels may serve as surveillance vessels during certain construction activities or in particularly sensitive areas, such as shipping routes. Information on upcoming and ongoing construction activities will be provided to the relevant authorities. During the cable-laying works, a daily report on the cable-laying activities will be recorded. These reports will include the name, call sign, current position and plan of each vessel. Before and during the cable-laying works, the positions of the cable-laying vessels will be communicated to the "Notices to Mariners" (ufs@sjofartsverket.se) from the Swedish Maritime Administration, so that passing vessels are kept informed of the current positions of the cable-laying vessels.

18.3 Consideration of wrecks and stone age settlements

The purpose of controlling the cultural environment is to document any wreck sites and stone age settlements before the construction works and to take these into account during the construction process. Preliminary investigations will be carried out before the construction process (pursuant to section 8.6) to map out the exact position of the finds. To prevent damage to wrecks and stone age settlements, a safety distance will be implemented during the construction works. After the construction phase, it will be verified that no wrecks or stone age settlements have been damaged by carrying out inspections similar to those done during the preliminary investigation, the results of which will be reported to the relevant authority.

18.4 The effect of mitigation measures in the event ordnance must be cleared

In the event that UXO must be cleared (unplanned incident, see section 16), mitigation measures will be implemented to protect marine mammals. The purpose of the control is to ensure the adequacy of the mitigation measures taken to protect marine mammals from the effects of underwater noise during the clearance of UXO. Marine mammals must then be monitored with the help of observers, etc., to ensure that seals and harbour porpoises have been frightened away from the area within which the animals could be physically injured. "Seal scarers" should also be used before the clearing begins. This is done to ensure that marine mammals are protected from significant impacts.

19. OVERALL ASSESSMENT

In summary, the consequence for all designated receptors is considered negligible or small. The overall assessment for the construction phase is presented in Table 19-1 and for the operation phase in Table 19-2. The comprehensive assessment for national interests and international protection is presented in Table 19-3.

Table 19-1. Overall assessment of the impact assessment for the construction phase.

	Impact factor	Environmental value	Environmental effect	Consequence
Benthic fauna	Suspended sediment	Negligible	Negligible	Negligible
	Sedimentation	Negligible	Negligible	Negligible
	Physical disturbance of the seabed	Negligible	Negligible	Negligible
Fish	Suspended sediment	Moderate	Low	Low
	Sedimentation	Negligible	Negligible	Negligible
	Underwater noise	Low	Negligible	Negligible
	Physical disturbance of the seabed	Negligible	Negligible	Negligible
Marine mammals	Suspended sediment	High	Negligible	Negligible
	Underwater noise	High	Negligible	Negligible
Birds	Physical disturbance above the surface	Negligible	Negligible	Negligible
Cultural environment	Physical disturbance of the seabed	Moderate	None	None
Shipping and shipping routes	Physical disturbance above the surface	High	Negligible	Negligible
Commercial fishing	Physical disturbance above the surface	Low	Negligible	Negligible
Military areas	Physical disturbance above the surface	High	Negligible	Negligible
Infrastructure	Physical disturbance of the seabed	High	Negligible	Negligible

Table 19-2. Overall assessment of the impact assessment for the operation phase.

	Impact factor	Environmental value	Environmental effect	Consequence
Benthic fauna	Physical disturbance of the seabed	Negligible	Negligible	Negligible
Fish	Electromagnetic field	Low	Negligible	Negligible
Marine mammals	Underwater noise	High	Negligible	Negligible
Birds	Physical disturbance above the surface	Negligible	Negligible	Negligible
Commercial fishing	Physical interventions on the seabed	Moderate	Negligible	Negligible

Military areas	Physical disturbance above the surface	High	Negligible	Negligible
Infrastructure	Presence of pipeline	High	Negligible	Negligible

Table 19-3. Overall assessment of current national interests and international protection.

	Assessment
Natura 2000	No impact on designated natural habitats or on the conservation of designated species.
National interest wind farms, nature conservation and natural environment, cultural environment, recreational activities, total defence, commercial fishing, shipping and shipping routes	Does not significantly damage the function or value of the national interest
International protection	Does not significantly damage the function or value

Overall, the impact under the Marine Environment Directive is considered small or negligible during the construction phase and negligible during the operation phase in terms of all descriptors.

It is assessed that there will be no significant impact on the designated sandbanks and reef habitats nor will the conservation of the designated species (harbour porpoises, common seals and grey seals) be worsened in the Natura 2000 site Sydvästskånes utsjövatten. The conservation status of K-species and T-species associated with the sandbanks and reef habitats will also remain the same and will not affected by the activity, i.e., the activity will not worsen the favourable conservation status of these species.

20. UNCERTAINTIES

Various supporting reports, studies and simulations have been used in the drawing up of this impact assessment. Wherever possible, it has been strived to obtain a picture that is as realistic and comprehensive as possible, but this is difficult to achieve to the full, of course, which is why a certain amount of uncertainty remains.

Wherever the method or technique to be used has been unclear, a worst-case scenario was applied for the assessments. Below is a review of designated uncertainties for the project's environmental assessment.

20.1 Technology

At present, no final decision has been reached concerning which method will be used for the laying of the cable systems, but a worst-case scenario has been used to assess the dispersion of sediment and seabed surface.

20.2 Simulation of sediment dispersal

The model used to calculate sediment dispersal is based on the laying of a pipeline to a depth of about 2 metres. The circumference of the pipeline (just under 1 metre) is larger than the circumference of the respective cable system (0.3–0.4 m), which means that the dispersion of sediment is considered overestimated. Overall, however, the results of the modelling are considered reliable.

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