ADJUSTMENTS TO ENVIRONMENTAL IMPACT ASSESSMENT

– HEJRE TIE-BACK TO SOUTH ARNE

Appendix 1

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1. Introduction

This appendix to the Environmental Impact Assessment (EIA) for the development of the Hejre Field (Doc. No. HEA-GEN-SA-REP-0004) provides updates and clarifications necessitated by recent changes in regulatory requirements and their interpretation. It also incorporates the inclusion of newly identified Annex IV species, minor operational adjustments, and an updated project schedule for the field development. The purpose of this appendix is to ensure that the EIA remains fully aligned with current legal frameworks and operational realities, thereby maintaining compliance and transparency throughout the project lifecycle.

1.1 Executive Summary (this appendix)

This appendix to the Environmental Impact Assessment (EIA) for the Hejre tie-back to South Arne project provides a comprehensive update, ensuring full compliance with current regulatory requirements and reflecting recent project modifications and environmental developments.

Key highlights for regulatory review:

- The project scope has been reduced, since the Lunde well will not be drilled. The pipeline and cable route have been adjusted, reducing the additional protection zone and eliminating the need for new route and seismic surveys. These changes are reflected in the updated EIA, and the associated impacts have been re-evaluated and found to be reduced.

- Mitigation measures for underwater noise have been strengthened. The project will implement a “slow start” procedure for the use of acoustic equipment (USBL/LBL), avoiding the risk of permanent or temporary hearing impairment in marine mammals. This approach is supported by recent scientific studies and aligns with recent Danish interpretation of the legislation. The impact of underwater noise is assessed as local, short-term, and negligible with mitigation; behavioural effects are considered fully reversible.

It is concluded that mitigation measures are needed for underwater noise from USBL and LBL activities, where a “slow start” is needed to insure no impact on marine mammals.

By taking in the mitigating measures on underwater noise, it is ensured that the environmental impacts of the Hejre tie-back to South Arne Development arising from known and expected activities are not significant.

1.2 Overview of this document

Following the criteria set out below, this document addresses what has changed since the Hejre tie-back to South Arne EIA was submitted, re-assesses the impact of any relevant changes and re-evaluates the conclusion in the Hejre tie-back to South Arne EIA on the likely significance of the effects of the Hejre tie-back to South Arne Development on the environment (not limited to downstream scope 3 emissions).

In considering what has changed since the Hejre tie-back to South Arne EIA was submitted, and whether updates to the Hejre tie-back to South Arne EIA are required, INEOS E&P A/S (hereinafter INEOS) has considered whether:

- Changes occurred in the status or timeline of the Hejre tie-back to South Arne re-development and/or activities described in the Hejre tie-back to South Arne EIA which have since been adjusted or have been decided not to be carried out as part of the development of Hejre.
- Relevant legislation, guidance and policy have been revised or introduced.

I addition some minor updates have, in dialogue with the Danish Energy Agency, been performed in the EIA regarding; stock of herring and mackerel, assessment of placement of rock and concrete mattresses, alternative to in-situ disposal of cable and pipeline, update section using older references and further assessment of cumulative effects.

2. Revised and updated assessment

This section is presented in the following context:

- All changes mentioned in the document are incorporated in the updated 2026 Hejre tie-back to South Arne EIA
- In this section, paragraph or chapter references / headings refer to those paragraphs or chapters of the updated Hejre tie-back to South Arne EIA
- All chapters in the Hejre tie-back to South Arne EIA have been updated according to section 2.1 and 2.2.

2.1 Reduction and adjustment of Hejre tie-back to South Arne Development

Changes have occurred in the status or timeline of the Hejre tie-back to South Arne Development and/or activities described in the Hejre tie-back to South Arne EIA which have since been adjusted or decided not to be carried out as part of the development of Hejre. The scope and associated impact of previously planned activities taken out of the development plans have thus been removed from the Hejre EIA. The reductions and adjustments are listed below:

- The optional well Lunde will not be drilled. This means that there will be only 3 instead of 4 wells in production. The scope has thus been removed from Hejre EIA. The associated impact has been reduced accordingly.
- Pipeline and cable have been slightly relocated. This is done to place them with in the safety zone of the existing 12” pipeline to the Gorm platform. The two pipelines will be parallel to each other and there will be no crossings. This means that no route survey and no seismic survey is needed since data from the trenching of the existing pipeline can be used instead. Due to this, the pipeline and cable will be 33 km instead of 30 km long. The updated additional protection zone is reduced from 11.2 to 2.4 km2, due to the placement next to a pipeline in an existing protection zone. The new pipeline route is as shown in Figure 2-1.

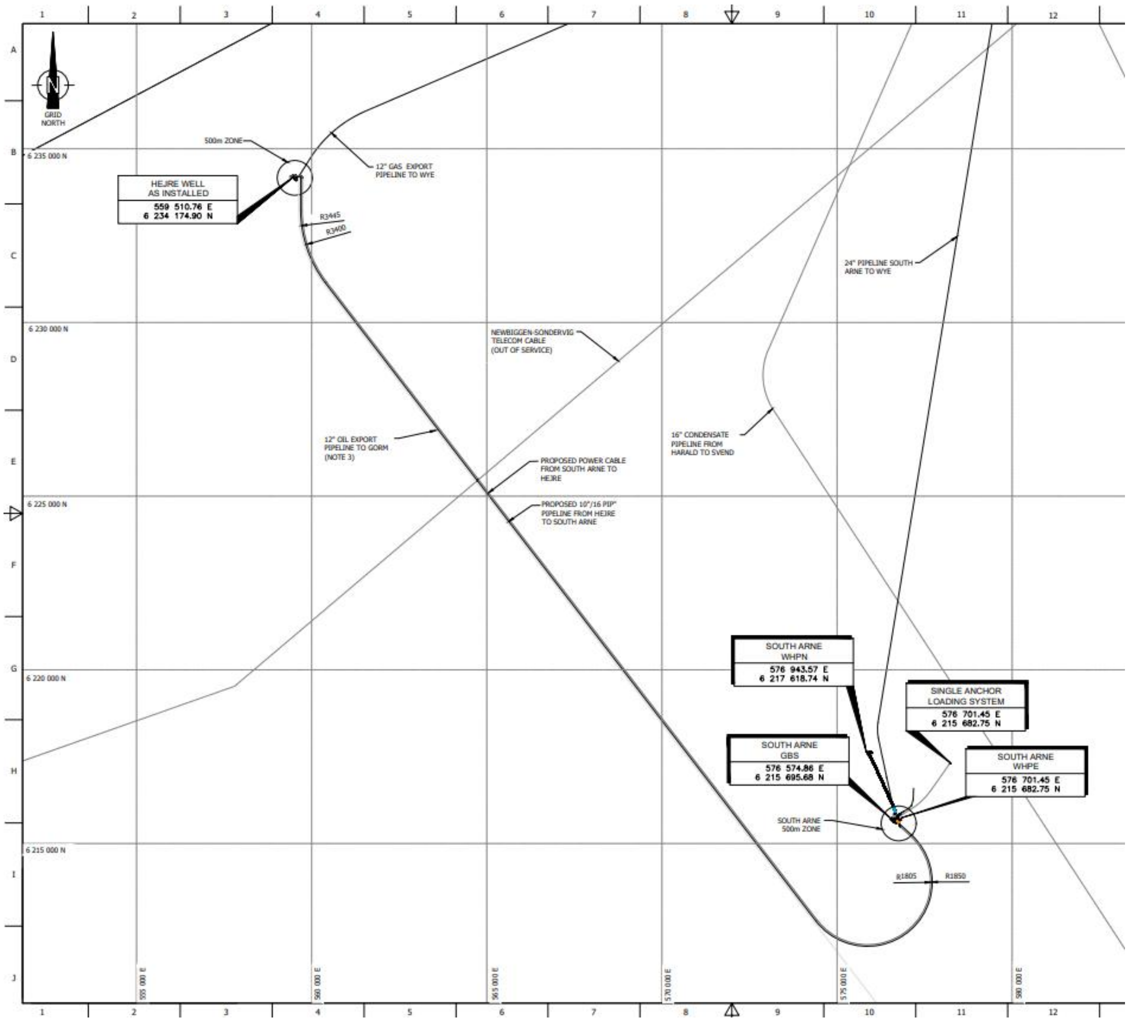


Figure 2-1 Pipeline and power cable route from Hejre to South Arne

- There are adjustments in the time schedule due to the decision from the Energy Board of Appeal, the new timeline is seen in Figure 2-2. The main changes are:
  - Movement of Topsides offshore activities (transportation, installation and hook-up) from 2027 to 2028.
  - Movement of the pipeline offshore installation activities from 2026 to 2028.
  - Movement of the offshore drilling scope (perforation and clean-up) from Q3 and Q4 2027 to Q1 and Q2 2027.

  These changes move first oil from Q4 2027 to Q4 2028.

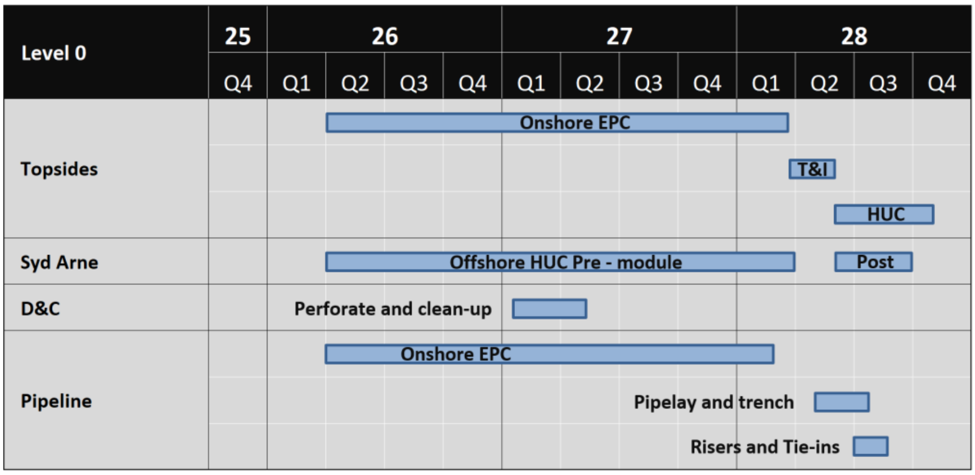


Figure 2-2 High-level time schedule for the Hejre field re-development. ***Abbreviations:*** *D&C: Drilling and completion, EPC: Engineering, Procurement, Construction, T&I: Transport and Installation, HUC: Hook-Up and Commissioning.*

- The volumes from well clean-up have been revised during the detailed design. The volumes have decreased from 3,600,000 to 967,000 Sm^3 gas and from 7,800 to 3,000 Sm^3 oil. Due to the change in the timeline, where perforation and clean-up are before Topsides installation, both oil and gas will be flared during clean-up operation.

2.2 New/updated regulation and process

During the period since the Hejre tie-back to South Arne EIA was prepared and until today the following has happened:

- An Annex IV species, European sturgeon (*Acipenser sturio*) has been listed as a native in Denmark, and the ocean quahog (*Arctica islandica*) is listed as threatened and declining habitats and species in the OSPAR Annex V.
- Mitigation of underwater noise from equipment as USBL and LBL will be mitigated with slow start. Further this type of equipment was not in detail described and included in production phase and decommissioning and have therefore been added.
- The public hearing period in 2023 was 8 weeks. The public hearing of the revised EIA is minimum 30 days. The specific sentence regarding hearing period has been updated in the EIA document.

2.3 Chapters generically updated

In the chapters 2, 4, 5, 7, 11, 12, 15, 17, 18 and 20 are only very few changes, all consequential corrections due to the context described in section 2.1 and 2.2 above.

2.4 EIA Chapter 1 – Non-technical summary

This is a summery chapter. It is updated accordingly to the other chapters with regards to both re-development scope and environmental impacts.

2.5 EIA Chapter 3 – National and international legislation

The Climate and Energy section, 3.8, has been updated to reflect the downstream scope 3 requirements described in the Addendum. The following text has been added:

The Energy Board of Appeal found that the EIA did not include a description of the Project's indirect effect on the climate resulting from the combustion of hydrocarbons extracted under the permit. On this basis, the Board assessed that the EIA was not suitable as a sufficient basis for decision-making when the climate impacts resulting from the combustion of the extracted hydrocarbons were not included and addressed in the EIA. The Board has not thereby taken a position on whether there will be a significant impact on the climate as a result of the burning of the extracted hydrocarbons.

INEOS E&P A/S disagrees with the Board's decision, including its interpretation that it should be required, including pursuant to the EIA Directive, to assess the impact of the combustion of the extracted hydrocarbons as part of its environmental impact assessment of the project. However, the Board annulled the approval of the revised development plan for the Project, and the Addendum has been prepared to adapt to the Board's decision solely for INEOS to expedite a renewed approval. Accordingly, INEOS maintains the right to challenge the Board's decision before the Danish Courts and disagrees with the view that the assessment of indirect climate effects in an EIA requires a scope 3 assessment.

The methodology and terminology applied in the Addendum are without prejudice to the approaches applied to any other project when assessing their "indirect effects" in an EIA. INEOS E&P A/S, in consultation with the Danish Energy Agency, has been referred to conduct an assessment in alignment with the United Kingdom Department for Energy Security & Net Zero (DESNZ) guidance, "Environmental Impact Assessment (EIA) – Assessing effects of downstream scope 3 emissions on climate. Supplementary guidance for assessing the effects of downstream scope 3 emissions on climate from offshore oil and gas projects" (DESNZ, 2025).

2.6 EIA Chapter 6 – Description of existing environment

In section 6.4.1. Benthic Fauna and Biodiversity (D1) has been added the following on the Ocean quahog on the OSPAR Annex V:

The ocean quahog (*Arctica islandica*) was found at several stations with an average density of 6.7 individuals/m^2 across all stations.

The section on fish has been updated to include the Annex IV species sturgeon. A new section, 6.6.5 has been added.

6.6.5 European sturgeon (*Acipenser sturio*)

The European sturgeon is listed in appendix II and IV of the Habitats Directive (Directive 92/43/EEC). The European sturgeon is an anadromous migrating species that used to breed in larger European rivers. It used to be a regular guest in Danish Waters but has never been known to breed in Danish rivers. When it was more common (up to the middle of the 19th century) the catches were of very large individuals, up to200 kg. However, the sturgeon was over-fished in all European Waters, and its riverine habitat was destroyed by damming or extraction of seabed, and since the late 19th century, catches have been very rare and of very small individuals, even down to 1.5 kg.

In marine environments, young individuals (2-7 years) typically first inhabit estuaries, and the juveniles later carry out long distance migrations in marine waters to feed over several years until they become adult sturgeons (10-16 years old, depending on sex and latitude). Hereafter mature fish return to their natal river to reproduce. Once the eggs are laid, the adult sturgeons swim back to sea in a few days' time (Visser et al. 2020 and Gessner et al. 2023). At sea and in estuaries it feeds on benthic organisms (Møller & Carl, 2019).

The historical catch records show occurrences across most regions (Figure 6-18), with the highest catch numbers found along the coastal areas of the North Sea and Skagerrak (Møller & Carl, 2019).

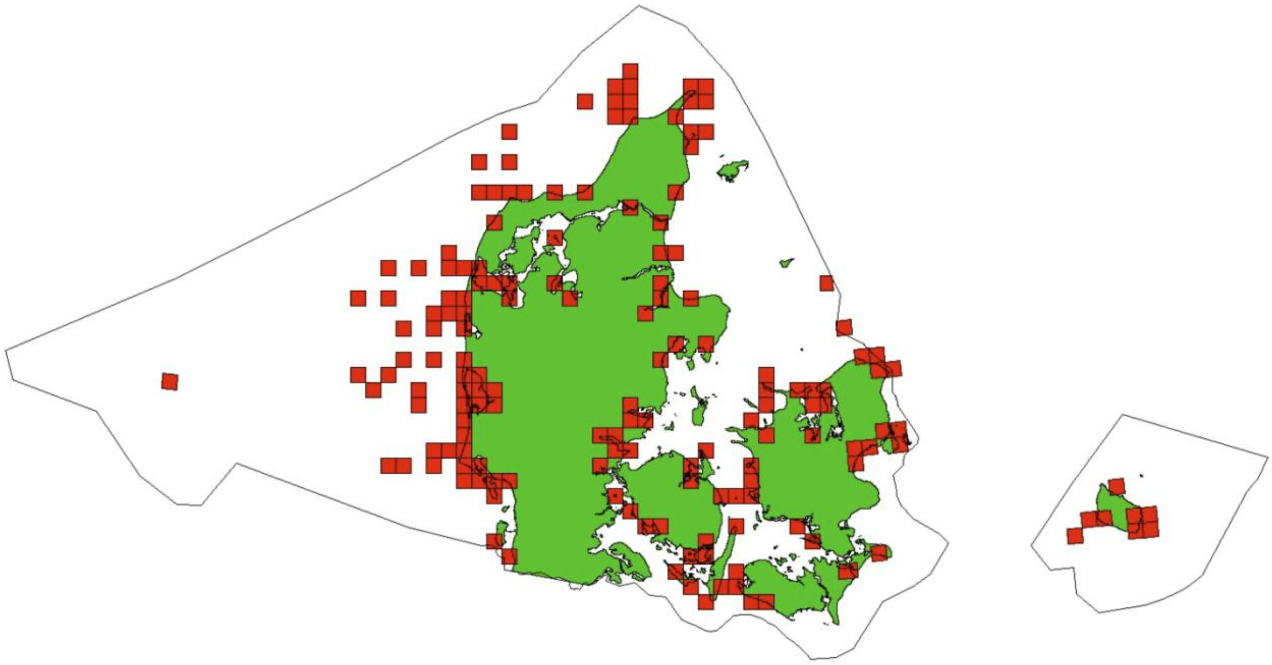


Figure 6-18. Distribution of historical catches of European Sturgeon in Danish Waters. Copied from Møller & Carl, 2019).

In 2007, a release program for European sturgeon was initiated in the German river Elbe and in French rivers, where it used to breed. Since then, stray individuals have begun appearing in Danish marine waters in catches. The released sturgeons were tagged, and data indicates that several of the sturgeons caught originated from the river Elbe. The rising number of records in the North Sea is therefore believed to be linked to this reintroduction effort, but the species has not yet been found to naturally breed, perhaps because the released individuals are not yet sexually mature. Because the species is very rare and perhaps mostly costal, there is little chance to find it near the project area. The species only breed in rivers.

2.7 EIA Chapter 8 – Environmental impact of planned activities during construction phase

In section 8.3.1.2 "Impacts on benthic fauna and fish" have the flowing been added regarding respectively European sturgeons and ocean quahog:

European sturgeons are anadromous and primarily coastal species but may appear in the project area as successful releases has caused the species to begin appearing as bycatch in the North Sea. It is however still rare events (OSPAR, 2020), and as such it is not expected to find European sturgeons in the study site. Studies on effects of underwater noise have shown that sturgeons react to events that cause vibrations of the seafloor (Popper & Calfee, 2023) by leaving the area (Krebs, Jacobs, & Popper, 2016). This is covered in chapter 8.5.2. It is therefore expected that sturgeons will move away from the area, where the cable is being placed, rather than staying and being killed. This may also protect the species from chemical pollution during the project activities. It is also expected, based on the above literature, that sturgeons will come back when the disturbance is over. These behavioural reactions are not considered deliberate disturbance in an area of special importance for breeding, resting or migration, because the activities take place in a limited impacted area that is not considered particularity important for European species that is a predominantly coastal species. Further, it is not a breeding site, as sturgeons are anadromous and strictly breed in rivers, and this project can therefore not negatively impact breeding sites.

Due to the rarity of European sturgeons, especially offshore, the lack of breeding habitat near Hejre and the short-term effect of disturbance due to this project, it is assessed that the project activities will not cause a deterioration or destruction of breeding or resting sites for this Annex IV-species.

…

The ocean quahog (*Arctica islandica*) is listed as threatened and vulnerable in accordance with OSPAR list of threatened and declining habitats and species, and thus protected from adverse human impacts through the obligations defined in the OSPAR Annex V. It is associated with soft bottom habitats as those present in the project area and can reach densities of up to >100 individuals/m^2 within its distribution range. Though it is found to be lower in the North Sea with typical densities <12 individuals/m^2. The reported average density of 6.7 individuals/m^2 (OSPAR, 2009).

The impact is reversible and the affected area constitutes <0,001 % of the habitat distribution in the region and is well below the threshold given in the MSFD for disturbance (25%) thus conserving sea floor integrity as defined in MSFD. While benthic species, including individuals of *A. islandica,* are likely to be lost, the function of the habitat will not be permanently affected, and allow recolonization of benthofauna. Although growth and recruitment are low for the *A. islandica*, it will not be permanently excluded from the impacted area. As a result, the project will not have adverse effects on *A. islandica* on a population level or at regional scale, nor will it alter species composition or biotic function of the habitat as a whole.

In section 8.5.1.1 Potential impacts of underwater noise on marine mammals have been updated and revised:

The possible effects of underwater noise on cetaceans and seals include:

- **Hearing damage.** Intense underwater noise may damage hearing of cetaceans and seals. Loss of hearing is particularly serious for cetaceans because they use sound for communication, navigation and location of food. Seals may also loose hearing.
- **Behavioural reactions.** Underwater noise may cause avoidance reactions and other behavioural effects of cetaceans and seals, such as changes in surfacing, breathing and diving behaviour, cessation of feeding, aggression, aversion and panic (Dähne et al 2013, Thompson et al. 2010,

Tougaard et al 2009, Southall et al 2007, Stone 2003). Behavioural impacts to acoustic exposure are generally variable, context-dependent, and less predictable than the effects of noise exposure on hearing.

- **Masking.** Because cetaceans depend on the underwater acoustic environment for orientation (echolocation) and communication an emitted cetacean sound can be obscured or interfered with (masked) by manmade underwater noise (Tougaard 2014); and
- **Vocalisation.** There are examples of whales changing their vocalisation because of underwater noise (IWC 2007, Weilgart 2007).

The most used predictor for TTS and PTS is the sound exposure level (SEL), cumulated over a period of at least two hours. Guiding threshold values of sound exposure levels that may cause TTS or PTS or behavioural/avoidance reactions for harbour porpoise, white-beaked dolphin, minke whale and seals are presented in Table 8-12. These species have been assessed to be relevant for projects located in the North Sea (DCE, 2021). The National Marine Fisheries Service (2024) has published, new TTS and PTS threshold. These values will form the base of the update of guidelines on underwater noise from piling by DEA (DEA 2022) and is therefore included in Table 8-12 for comparison.

It can be seen that the threshold for onset of PTS (now called AUD INJ) is respectively 4 and 7 dB higher for harbour porpoise and dolphin, and that TTS is respectively 4 and 8 dB higher for harbour porpoise and dolphins. This means that the results of the modelling performed for this assessment based on the old values, are precautionary. Therefore, the results of the modelling are used knowing that the calculated ranges are likely to be too large, and hence worst case. In general, the harbour porpoise seems to be the most sensitive species to underwater noise. However, due to a lack of studies, it is precautionarily assumed that harbour and grey seals behaviourally react to the same levels of underwater noise as harbour porpoises.

Table 8-12 Sound exposure levels, that are harmful to cetaceans and seals. 'I-type sounds' are characterised by having a very fast onset, short duration and with a large bandwidth. This is typically regarded as impulse sounds. Sounds that do not fulfil these three characteristics are 'Other sounds' (Based on DEA 2022). The table is updated with relevant impulse values from NOAA Fisheries on which the updated DEA guidelines will be build. PTS is here termed AUD INJ. National Marine Fisheries Service (2024).

Impact	I-type sounds SEL (cum) (dB re 1µPa2s)[2]	Other sounds SEL (cum) (dB re 1µPa2s)[3]	I-type and other sounds SPL dB re 1 µPa
Harbour porpoise (very high frequency cetacean)			
Sound exposure level causing permanent threshold shift (PTS)	155 (159*)	173	
Sound exposure level causing temporary threshold shift (TTS)	140 (144*)	153	
Behavioural reactions			103
White beaked dolphin (high frequency cetacean)			
Sound exposure level causing permanent threshold shift (PTS)	185 (193*)	198	
Sound exposure level causing temporary threshold shift (TTS)	170 (178*)	178	
Minke whale (low frequency cetacean)			
Sound exposure level causing permanent threshold shift (PTS)	183 (183*)	199	

Impact	I-type sounds SEL (cum) (dB re 1µPa2s)[2]	Other sounds SEL (cum) (dB re 1µPa2s)[3]	I-type and other sounds SPL dB re 1 µPa
Sound exposure level causing temporary threshold shift (TTS)	168 (168**)	199	
Seals (Harbour seal and grey seal)			
Sound exposure level causing permanent threshold shift (PTS)	185 (183*)	201	
Sound exposure level causing temporary threshold shift (TTS)	170 (168**)	181	

* Weighted AUD INJ onset (old PTS) as weighted cumulative sound exposure level over 24 hours ($L_{E,P,\ 24\ h}$) re 1 µPa^{2}s. National Marine Fisheries Service (2024).
** Weighted TTS onset threshold (SEL24h). National Marine Fisheries Service (2024).

Noise from acoustic equipment

The pre- and post-pipeline installation survey of the pipeline route is planned to be ROV based. The ROV surveys will take place along two longitudinal lines along the proposed pipeline route (Figure 5-8). Each line is expected to be approximately 33 km long, and each survey is expected to last about 1.5 days

The ROV pre- and post-installation surveys will use a number of acoustic instruments: an echosounder (ES), a multibeam echosounder (MBES), Doppler Velocity Log (DVL), Velocity Sensor (VS), Altimeter, Obstacle Avoidance Sonar (OAS) and Side Scan Sonar (SSS). All will be based on a frequency content above the hearing threshold of marine mammals (i.e. >180 kHz), and they will therefore not be described or assessed any further.

Trenching and cable/pipeline laying is assumed to employ Ultra Short Baseline (USBL) to ensure the correct positioning and depth of the pipeline and cable at the seabed. The cable and pipeline will be placed on the seafloor. Hereafter each will be trenched down. Trenching down is expected to take about twenty days in total for both pipeline and cable and is planned to take place in Q2 2028. During this time, the USBL system will be used to keep track of the work on the seabed. It is not yet known which USBL system will be used for the trench/underwater plough, and for this assessment it is assumed that the parameters of the USBL system for the cable laying will be the same as for the ROVs USBL system. An LBL (Long range Baseline) system will be used under installation of tie-in spools. This is performed following the pipeline trenching and is estimated to take a day for each pipeline end. The LBL grid will be 45 meters times 10 meters at Hejre and 35 meters times 10 meters at Syd Arne.

Use of USBL

The 3D position of the ROV will be determined with a USBL system. The planned USBL system will be alike a Kongsberg cNODE transponder and alike a Kongsberg HiPAP 501/502. The specifications of this system is stated in Table 8-13. A USBL system sends signals back and forth between the mother vessel and the ROV, and each transceiver and transponder emits a signal every 0.5 sec. The frequency content is between 20-30 kHz, where cetaceans and seals hear very well. A recent study from the North Sea documented effects of USBL pulses on presence of harbour porpoises and found that harbour porpoises disappeared for up to 3 hours following USBL pulses (Mikaelsen et al. 2025). That study also calculated deterrence range based on recordings of USBL signals in the North Sea and the harbour porpoise behavioural reaction criterium of 103 dB SEL (see Table 8-12 above) and found that it varied between 1.1 and 5.5 km for the same USBL system and vessel. In this assessment the 5.5 km will precautionarily be used as the range for which harbour porpoises and all other marine mammals will be deterred.

Table 8-13 Specifications of the USBL and LBL systems planned for the pre-survey.

Equipment (alike)	Type	Placement	Frequency (kHz)	Source level (SPL), dB re 1 μPa@1 m	Pulse duration (msec)	Repetition rate (Hz)	Directionality (°)
Kongsberg HiPAP 501/502	USBL transceiver	Below the vessel	20.5 - 29.6	189 (182 with directionality)	30	0.5	180
Kongsberg cNODE	USBL transponder	On ROV	20 - 34	188	30	0.5	360 (omni-directional)
Sonardyne ROVNav6	LBL transceiver	On seafloor	19-34	187-196 (4 Levels)			Omni-directional

Use of LBL

The LBL system is essentially the same as the USBL system, except that here, the transponders are deployed at the seabed emitting signals to the working vessel. LBL systems use networks of sea-floor mounted baseline transponders as reference points for navigation. These are generally deployed around the perimeter of a work site. The LBL technique results in very high positioning accuracy and position stability that is independent of water depth. It generally can reach a few centimeters of accuracy. LBL systems are generally employed for precision underwater survey work where the accuracy or position stability of ship-based (USBL) positioning systems does not suffice.

In the Hejre tie-back to South Arne Project the LBL system will be used for spool metrology, i.e. to perform an accurate survey of the distance between the installed pipeline end flange and the connecting platform riser. As part of the survey a network of transponders will be placed in a grid at seabed, and on a bracket mounted on the pipeline flange as well as on the riser flange. After placing the transponders, a number of distance measurements between all the different transponders are performed and these measurements are finally used to calculate (geometrically) the length and heading of the closing tie-in spool. These measurements will be used in the fabrication of the spool onshore, and subsequent installation offshore by divers, and therefore the accuracy of the spool geometry is of high importance.

Typically, an LBL array will consist of 5-6 transponders located at the pipeline flange and at the riser flange and in a grid between these flanges in order to obtain a number of distance measurements, which can be used to calculate the correct distance and angle between the riser and pipeline flange. The LBL grid will be 45 meters times 10 meters at Hejre and 35 meters times 10 meters at South Arne. A number of data sheets for potential instruments has been viewed and they are all rather similar in parameters. One example of LBL parameters for a potential LBL system for the project is shown in Table 8-13. The duty cycle and individual pulse/signal duration are not published in public datasheets and vary by command/data rate and environmental conditions, however a duty cycle of 5-10 ms is commonly for this application, similarly a pulse duration of 10-30 s is typical for a full LBL cycle (Open-Source Information).

For this assessment a modelling study was carried out to assess the potential for inflicting temporary or permanent hearing damages in marine mammals, i.e. TTS or PTS from USBL (INEOS, 2025). TTS and PTS can only be inflicted within the auditory range where a given species can hear, and it has therefore only been calculated for use of the USBL system, and not the other mentioned acoustic systems. The results are given Table 8-14. Behavioural reactions for harbour porpoise and seals are however based on Mikaelsen et al. 2025 and are not modelled. The modelling was performed before the Mikaelsen study was published. The distances stated in Tabel 8-14 are thus the most conservative distance for potential impacts on marine mammals. For behavioural reactions, it's maximum a moving 5.5 km zone, where animals are displaced and expected to reappear within hours after the vessel has moved on based on Mikaelsen et al 2025. Since the parameters of the LBL and USBL systems are rather similar, the results for the USBL system also apply to the LBL system as a minimum, because there may be 1-2 more LBL units than the four USBL units (1 transceiver + 3 transponders) in the modelling study (Table 8-14). However, because mitigation will always be applied for both systems and with only one USBL or LBL unit to deter marine mammals before the systems are run in normal operation, the risk is functionally the same for both systems, because the risk of hearing impairment is reduced to 0 m following mitigation. And recall that the modelled ranges are precautionary based on the updated threshold values for onset of TTS and PTS (National Marine Fisheries Service 2024). For mitigation see chapter 8.5.1.2 and 8.5.1.3.

Table 8-14 The results of the modelling show the impact distances for marine mammals using the USBL model HiPAP and 3 transponders, assuming that the animals will flee at 1.5 m/s from they hear the first pulse. (Low power setting, -18 dB). Impact threshold limits for marine mammals and associated impact distances regarding impulsive noise (cumulative noise (SELcum, weighted) and peak noise exposure (unweighted)). LF =Low Frequency, HF = High Frequency, VHF = Very high frequency hearing, PCW =Phocid Carnivores hearing in water. (INEOS, 2025)

Marine Mammal Group	TTS SELcum (weighted)*	TTS peak (unweighted)**'	PTS SELcum dB re 1 mPa²s (weighted)*	PTS Peak (unweighted)**	Behaviour
Minke Whales, LF, distance	0 m*	0 m **	0 m *	0 m**	50 m (transducer)
White-beaked dolphin HF, distance	0 m*	0 m **	0 m *	0 m**	50 m (transducer)
Harbour porpoise, VHF, distance	1700 m	0 m	180 m	0 m	5500 m**** (transducer/transponder)
Seals, PCW distance	0 m	0 m	0 m	0 m	5500 m**** (transducer/transponder)

*DEA, 2023
** Southall et al, 2019 Marine mammal exposure criteria
*** Russel 2016
**** Mikaelsen et al. 2025.

The total duration for the use of LBL and USBL is expected to be around 25 days.

Noise from vessels, rigs rock dumping and dynamic positioning system (DP)

All vessels and rigs intended used in this project emit underwater noise that may deter marine mammals. For all vessels within 500 m of a platform, it is mandatory to use a dynamic positioning system (DP). A DP system keeps the vessel in place with the help from GPS's to inform the bridge of the vessels exact position with regards to the platform. The vessel is then kept in position by use of thrusters that may be placed both in the stern, bow and midway on the vessel. The DP system may be manually adjusted by the captain or fully autonomous. The DP system is mandatory and cannot be mitigated except as explained below in chapter 8.5.1.2 by beginning to test thrusters before entering the 500 m zone. Based on harbour porpoises' reactions to vessel noise in general (Bas et al. 2017; Wisniewska et al. 2018) the noise of the thrusters will deter at least harbour porpoises.

Rock and mattrass dumping also create underwater noise. Both the vessels that will likely need thrusters to stay at the right position, and from the rocks impacting the seafloor. A recent assessment of effects af artificial reefs on harbour porpoises concludes that the main noise source during rock dumping is the vessel, thrusters and activity on the vessel, and less the actual stones impacting the seafloor. Based on the harbour porpoise behavioural reaction criteria of 103 dB re 1 mPa VHF-weighted (Table 8-12), they estimate a deterrence range of about 700-1200 m, and that the effect on harbour porpoises for a short period of rock duping in the North Sea is minor (Sveegaard, Teilmann, & Tougaard, 2024).

A number of scientific studies have been conducted on the reactions of harbour porpoises to vessel noise. It is therefore known that harbour porpoises' echolocation is masked by high-frequency noise (Hermannsen et al., 2025), and that high-frequency noise is emitted at relatively high levels from a wide range of ship sizes from very small leisure crafts to large tankers (Hermannsen et al., 2014). In captivity, experiments have been conducted on four harbour porpoises that were exposed to recordings of ship passages with medium to high-frequency noise at low levels. All harbour porpoises reacted with strong stereotyped reactions at levels corresponding to distances of approximately 1 km from the ships (Dyndo et al., 2015). In the wild, acoustic data loggers have been attached to wild harbour porpoises, and their behaviour and foraging have been monitored while they swam freely and naturally in parts of Danish waters, which are heavily trafficked. Here it was seen, that despite the fact that harbour porpoises hear ship noise 17-89% of the time, they reacted strongly to high noise levels. The behavioural changes consisted, among other things, of stopping foraging (Wisniewska et al., 2018). In the Black Sea, harbour porpoises have been seen to show behavioural reactions to ships at an average distance of approximately 400 m. Here, the animals stopped what they were doing, whether it was foraging, sleeping, moving, etc., and changed their behaviour (Bas et al., 2017). Since harbour porpoises have a very high metabolism, it is problematic for them to be interrupted in their foraging, especially in the period September - February, when they increase their blubber layer for the winter and the females are simultaneously pregnant and/or lactating (Gallagher et al., 2021; Rojano-Doñate et al., 2018).

This is especially problematic if harbour porpoises are disturbed over long periods in very important habitat used for foraging or deterred entirely from such areas over long periods to areas with insufficient prey. In the case of the Hejre project the disturbance is over a small area and very short period, and it is not in specifically important habitat (Waggit et al. 2019, Gilles et al. 2016, Stokholm, 2025 and Sveegaard et al. 2018). Further, the activity of disturbance with USBL/LBL take place from May to October, and the disturbance is therefore assessed as a minor impact below. The cetaceans can move back into the area and continue using it as before when the cable-laying is done, since the activities is not assessed to kill individuals or reduce the population size.

Vessel noise cannot be mitigated, and behavioural reactions are to be expected in harbour porpoises to a range of 400-1000 m from each vessel based on the above. The same is assumed the case for all other marine mammals that occur in the area. However, the vessel moves continuously, and it is therefore a moving zone of exclusion, and not the entire 33 km pipeline from which the animals are repelled.

8.5.1.2 Mitigation of the USBL system

Given that the USBL system has been modelled to inflict both TTS and PTS in harbour porpoises, a mitigation approach in the shape of a *slow start* has been developed (INEOS 2025) to reduce the risk of TTS or PTS. The slow start has been calculated by modelling. In the modelling it is assumed that harbour porpoises are some 100 m away when they hear the first pulse, as they are deterred from vessels. 100 m is therefore the first distance at which the USBL signal is assumed heard. This is rather precautionary, as harbour porpoises are likely deterred by the vessel noise itself to a range of 400-1000 m from the vessel in the first place. The USBL is run with the lowest possible source level. From hearing the first pulse, it is assumed that harbour porpoises begin fleeing at an assumed 1.5 m/s perpendicular to the direction of the vessel. Further, the modelling takes into account the harbour porpoise hearing threshold (Table 8-12) and the source level and frequency content of the USBL system as well as the range at which receiving the pulse may lead to TTS (Table 8-13). The calculation looks as follows:

1,700m (distance of TTS) - 100m (deterrence by vessel testing thrusters))/1.5 m/s (flee rate)*20% safety margin = 21.3 minutes slow start.

From this calculation it follows that slow start playing out signals at the lowest possible level, and only from the vessel, every 30 s for 22 minutes before the USBL system is run in its normal state, can be carried out without damaging harbour porpoise hearing, and at the same time deterring them from the area (INEOS 2025).

It is assumed that harbour porpoises, and other marine mammals, will leave the area once they begin hearing the USBL pulses, which the Mikaelsen et al. 2025 study also suggests. This slow start procedure will therefore decrease the risk that harbour porpoises and other marine mammal species are exposed to levels that could inflict TTS or PTS. The behavioural reactions cannot be mitigated for any species and are instead utilised to reduce the risk of hearing impairment.

It is further suggested to begin the slow start as the vessel is approaching the 500 m safety zone of the platform from which the pre-and post-pipeline installation survey and cable laying will commence. Entering this zone, the vessel must conduct a dynamic positioning test. The DP system is required for safety, working so close to oil and gas platforms. The mitigation procedure is suggested as follows (INEOS 2025):

As part of the standard procedure, the DP system of the vessel will be tested in a DP trial before entering the safety zones. During DP trials, the underwater noise will be generated by thrusters such as:

- 2x Rolls Royce Kamewa 700 kW bow thrusters, and
- 2x Rolls Royce Aquamaster 1500 kW stern thrusters
- During the DP trial the ‘’slow start’’ procedure will be initiated by activating the USBL transceiver at the lowest level.
- Vessel arrival outside safety zone and set-up on DP. To ensure that there are no marine mammals within 100 meters of the vessel there will be a test of the DP trusters on the vessel for two minutes prior to the onset of the slow start procedure of the USBL vessel unit.
- USBL pole lowered into water
- “Slow start” initiated: 1 USBL activated in USBL topside software (no actual transponder placed in the water). The USBL unit emits sonar pulses every 30 seconds for 22 minutes. Low power mode setting, and beam width will remain the same during the entire soft start operation.
- Vessel commences DP trials/checklist while “slow start” ongoing.
- Vessel moves inside safety zone while “slow start” is ongoing
- Operations continue as normal.
- If the operation is discontinued for more than 20 minutes the slow start procedure will be repeated

Following the slow start, the risk of hearing impairment is reduced to an assumed 0 m, as all harbour porpoises have had time to, and are here assumed to, have left the area before the USBL is operated in normal mode (Table 8-15). It is likely that also dolphins, minke whales and seals respond similarly, but this has not been modelled, as harbour porpoises are the most sensitive species.

Table 8-15. Impact ranges following mitigation in terms of slow start (INEOS 2025)

Marine Mammal Group	TTS SELcum (weighted)*	TTS peak (unweigthed)**	PTS SELcum dB re 1 mPa2s (weigthed)*	PTS Peak (unweighted)**	Behaviour***
Harbour porpoise, VHF, distance	0 m	0 m	0 m	0 m	5500 m

*DEA, 2023.

** Southall et al, 2019 Marine mammal exposure criteria.

*** Mikaelsen et al. 2025.

8.5.1.3 Mitigation of the LBL system

Mitigation of the LBL units will be performed from the vessel, from where the LBL units on the seafloor can be controlled. It will be performed as for USBL with one unit over 30 minutes with a duty cycle of 1 signal per 0.5 minute to allow animals to leave the area. The 30 minutes are chosen as a precautionary measure since there are six LBL units working at the same time, as opposed to the four USBL units. But recall that the modelling values are precautionary based on the updated threshold values for onset of TTS and PTS (National Marine Fisheries Service 2024).

Assessment of impact from use of USBL and LBL

Based on the above considerations, the potential impacts from the pre- and post-pipeline installation surveys of the pipeline route, the laying of the pipeline and cable, and the spool metrology are assessed to be fully reversible and short term (<30 days in total) because mitigation is employed. By employing mitigation, the risk of inflicting hearing impairment in marine mammals are assessed to be reduced significantly.

Annex IV-species have specific protection requirements including prohibition of all forms of deliberate capture or killing of these species in the wild, deliberate disturbance of these species particularly during the period of breeding, rearing and migration and deterioration or destruction of breeding sites and resting places.

From Article 12(1) of the Habitats Directive it follows that activities must not result in

a) deliberate capture or killing of an Annex IV species.

b) deliberate disturbance of an Annex IV species within its natural range, particularly during periods when the animals are breeding, caring for their young, hibernating, or migrating.

c) deliberate destruction or collection of eggs in the wild.

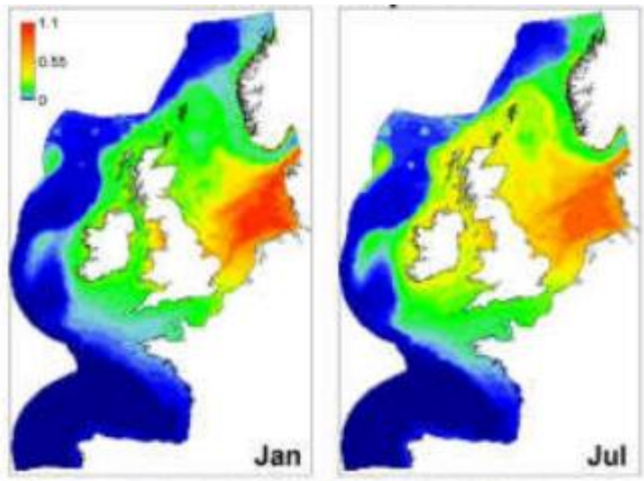
d) damage to or destruction of breeding or resting sites within the natural range.

The prerequisite is that the ecological functionality of a breeding or resting site for Annex IV species is maintained at least at the same level as previously.

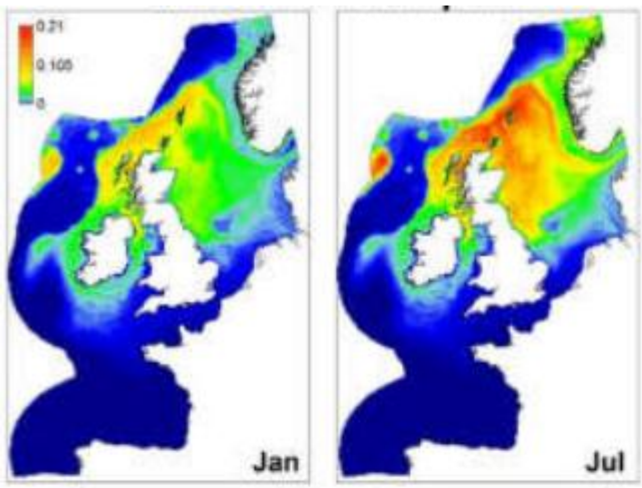
“Deliberate” actions are to be understood as actions carried out by a person or authority who knows that their action is likely to lead to an infringement against a species, but nevertheless intends to commit this infringement, or at least consciously accepts the expected outcomes of their actions (European Commission, 2021). Deliberate disturbances are assessed in this context in the following.

Cetacean Annex IV-species of relevance in the Danish North Sea include the harbour porpoise, the white-beaked dolphin and the minke whale (DCE, 2021). The hearing of harbour porpoise and white-beaked dolphin are respectively very high frequency and high frequency. Calculations of TTS and PTS for seals, harbour porpoises, white-beaked dolphins and minke whales are shown in Table 8-12 (INEOS 2025). After the modelling was performed, the first audiogram of a minke whale was published and showed that minke whales can hear frequencies up to 90 kHz (Houser et al. 2024). For this assessment it is therefore precautionarily assumed that minke whales will react to USBL signals at the same range as harbour porpoises, however this has not been verified with studies. Oppositely this means that the mitigation employed for harbour porpoises will also work for minke whales if they are deterred (Table 8-12).

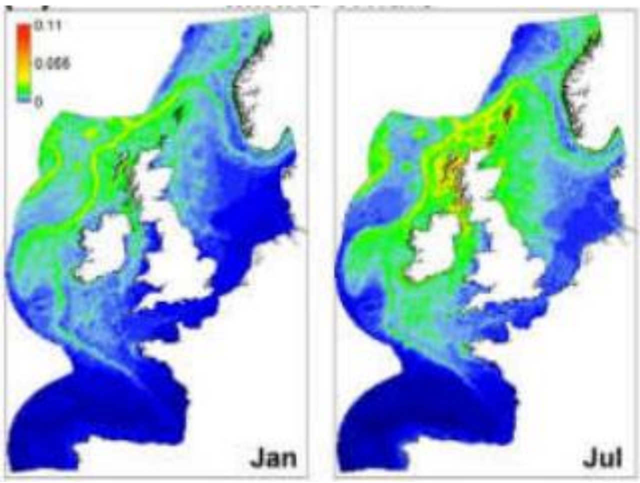
The distribution of the harbour porpoise, the white-beaked dolphin and the minke whale in the North Sea has been modelled by Waggit et al. 2019 (Figure 8-2). The harbour porpoise is the most common marine mammal in Danish waters and harbour porpoises in the project area are expected to belong to the North Sea Population. The white-beaked dolphin is typically found in the northern part of the North Sea, while the minke whale is found in both the central and northern part of the North Sea, particularly during the summer (Figure 8-2). The populations of harbour porpoises, white-beaked dolphins and minke whale in the North Sea are all assessed to be in favourable conservation status (DCE, 2021).



Harbour Porpoise



White-Beaked Dolphin



Minke Whale

Figure 8-2 Modelled spatial distribution in animals per km² in January and July in the North-East Atlantic for harbour porpoise, white-beaked dolphin and minke whale. Note a different colour gradient used for each species. From Waggit et al. 2019.

The offshore activities at Hejre are expected to take place between January and May 2027 for the well perforation and clean-up and within the weather window from March to October 2028 for the remaining offshore activities. The noise from the rigs, machinery, etc. will take place within these periods. The pipeline activities, including pre- and post-installation surveys, trenching, pipelay and rock dumping are expected to take place between March and May 2028.

Cetaceans are probably most sensitive to potential impacts from underwater noise during the period where they mate, deliver the calf and the initial nursing. Harbour porpoises mate during July-September, deliver during the spring and summer with a peak in June. White-beaked dolphins mate during May-August and give birth during the summer. Minke whales mate and deliver during late winter to early spring.

The harbour porpoise and white-beaked dolphin breed during part of the weather window for the activities from April to September. No breeding areas have been established for neither the harbour porpoise nor the white-beaked dolphin, but calves have been observed throughout the North Sea during the SCANS' surveys (Hammond et al 2002, Hammond et al. 2013, Hammond et al. 2017, Gilles et al. 2023) and high percentages of harbour porpoise mother-calf pairs were for example observed in the Danish North Sea in the pre-investigation area for the North Sea Energy Island (Kyhn et al. 2024). DCE has recently assessed the North Sea with regards to where harbour porpoises are sensitive to underwater noise from offshore wind, and points to the area of Hejre as of medium sensitivity. This relates to the density of animals in the area (Stokholm et al. 2025). From a precautionary approach breeding may take place in the vicinity of the project area. It is noted that the implementation of slow start will allow the cetaceans to flee the area and thus reduce the potential for permanent and temporary threshold shifts significantly so that no individuals will be harmed. Individuals will hence be deterred from the activities of this project within some maximum 5.5 km based on best available knowledge, and the behavioural reactions cannot be mitigated. However, these behavioural reactions are not considered *deliberate disturbance* because they are short term and take place in an area that is not of specific importance for breeding, resting or migration, because the activities take place in a limited impacted area that is not considered particularly important for any of the cetacean species in the North Sea, nor is a known breeding site. Further, in combination with implementation of a slow start, the disturbance is short-term and fully reversible within hours, and it is assessed that the ecological functionality of the area for marine mammals will not be impacted.

For the minke whales, they are for this assessment assumed to be equally sensitive to noise from USBLs/LBLs as harbour porpoises, as recent measurements of minke whale hearing have showed that they are sensitive to noise up to 90 kHz (Houser et al. 2024). Surveys counting marine mammals have only been conducted in the North Sea during Spring-Autumn and predominantly in Summer, where all SCANS surveys have been conducted (Hammond et al 2002, Hammond et al. 2013, Hammond et al. 2017, Gilles et al. 2023). Incidental sightings from oil and gas platforms have shown that minke whales are often sighted around the platforms (Delefosse et al. 2017), but mostly in Summer. This most likely means that they are too difficult to observe in Winter where the days are short and often dark, and the weather not conducive for observing small fins in the surface, and it must be assumed they are present year-round. As they are assumed to mate and deliver during late winter to early spring, it is not likely, that minke whales will be impacted by the activities during their most sensitive periods, as the pre- and post-pipeline installation surveys and cable laying will be conducted in second quarter of the year.

It is assessed that the project activities will not cause a deliberate disturbance, deterioration or destruction of breeding or resting sites for the Annex IV-species as the disturbance take place in a limited area that is not considered of specific importance for breeding, resting or migration for minke whales, nor is a known breeding site. Further, in combination with implementation of a slow start, the disturbance is short-term and fully reversible within hours, and it is therefore assessed that the ecological functionality of the area for minke whales will not be impacted.

Noisy activities besides from USBL/LBL during completion, repair of well, installation of topside and laying of pipelines are all expected to exceed the threshold for triggering avoidance and other behavioural impacts of harbour porpoise, which react at very low levels (see Table 8-12). Harbour porpoises have been shown to react to low levels of vessel noise in several studies (see above). However, field studies around the drilling rig *Noble Koskaya* and its support vessel *Northern Seeker* in the German sector of the Doggerbank showed that harbour porpoises were present within a few hundred meters of the rig. The rig was stationary and fixed to the platform (Todd et al. 2009).

It is concluded that the project activities at Hejre and South Arne is not expected to exceed the sound exposure levels that are harmful to cetaceans and seals following the proposed mitigation for each start-up of USBL or LBL systems, in the shape of a 22 or 30 minutes, respectively, slow start with a USBL ping from the mother vessel every 30 s. The project activities are expected to have a local impact only, due to the described activities. The impact is assessed to result in potential avoidance by marine mammals of the area within some 5.5 km of the USBL/LBL activities. This zone moves with the working vessel, or is stationary for the LBL, and animals return within hours after the vessel has moved on. It is hence not the entire 33 km pipeline route, from which the animals are deterred, but a moving 5.5 km zone. The site is not assessed to be an important area for marine mammals (Stokholm 2025), although marine mammals may be present and utilise the area, and as the impact is expected to be temporary within the moving 5.5 km (<3 hours) and local (<5.5 km) the overall impact is assessed to be insignificant. The total amount time a USBL will be used is app. 25 days during construction and the impacts are therefore short-term. The cetaceans can move back into the area and continue using it as before when the cable-laying is done, since the activities is not assessed to kill individuals or reduce the population size.

The project activities are expected to take place within the weather window from March to October. But because hearing impairment will be mitigated and because the behaviourally effects are fully reversible within hours, this impact assessment is expected to be valid regardless of when the project activities take place during the weather window.

The risk assessment on underwater noise in section 8.5.3 has been updated:

Table 8--18 Environmental severity and risk of impacts of underwater noise generated from the activities at the rigs, pipe laying and support vessel activities.

Impact	Extension of impact	Duration of impact	Magnitude of impact	Severity of impact	Probability of impact	Environmental risk
Impacts of noise from rig	Local	Short term	Small	Insignificant impact	Highly probable	Negligible
Impacts of pre- and post installation survey– underwater noise	Local	Short term	Small	Insignificant impact with mitigation	Highly probable	Negligible
Impacts of underwater noise from support vessels	Local	Short term	Small	Insignificant impact	Highly probable	Negligible
Impact of noise from USBL/LBL during pipeline and cable laying	Local	Short term	Small	Insignificant impact with mitigation	Highly probable	Negligible

A section 8.5.4 on risk assessment of underwater noise on European Sturgeon has been added:

8.5.4 Risk assessment of underwater noise on European sturgeon

The European sturgeon, as an Appendix IV species, is considered independently in the assessment below. There is a notable lack of published research examining the impacts of underwater noise on sturgeons overall, and specifically on European sturgeons. Popper & Calfee (2023) provide a comprehensive overview of the available studies concerning sturgeon hearing and their responses to human-generated sound. Given Arthur N. Popper’s status as a leading authority on fish auditory systems and their responses to underwater noise, this review serves as the foundation for evaluating the potential effects of underwater noise from the Hejre project on European sturgeons.

The review’s findings indicate that sturgeons, including the European sturgeon, are capable of hearing frequencies up to approximately 1 kHz, with optimal hearing sensitivity around 50 Hz. Furthermore, it is highly probable that sturgeons detect only particle motion, rather than sound pressure, unlike some other fish species that utilise the swim bladder for this purpose. The ability to sense sound pressure developed later in fish evolution in species with auxiliary structures such as the swim bladder, which converts pressure changes into particle motion. Like other benthic species, sturgeons can also perceive signals transmitted through the substrate.

Sturgeons are able to detect the sounds produced by passing vessels, but they are unlikely to perceive USBL signals, as these are emitted at frequencies well above the sturgeons’ hearing range.

Nevertheless, extremely loud underwater noises can still harm fish that possess a swim bladder, even if they cannot hear the sound itself. Such intense vibrations can affect the swim bladder, and if strong enough, may lead to ruptures or damage to adjacent organs like the liver and kidney.

Research on sturgeon behavioural responses to underwater noise is limited. One study tracked Atlantic sturgeons acoustically and found that individuals avoided areas where pile driving was taking place, only returning once the activity had ceased. This research was conducted in the Hudson River, but it was unclear whether the sturgeons responded to particle motion in the water or through the substrate (Krebs, Jacobs, & Popper, 2016). Another investigation (Balazik et al., 2020) examined how Atlantic sturgeons reacted to dredging operations and found no significant changes in movement patterns. However, the study did not measure sound levels, making it impossible to determine if the noise was detectable to the sturgeons in terms of particle motion. Notably, since European sturgeons spawn exclusively in rivers, their eggs and larvae would not be impacted by the Hejre project.

Based on the information above, it is likely that European sturgeons can detect and respond to the process of laying cables on the seabed, as this activity generates vibrations that sturgeons are able to perceive. It is also probable that any sturgeons present in the vicinity would temporarily leave the area during cable-laying operations and return once the work is completed, which aligns with observed behaviour in response to the much more intense disturbance of pile driving—where sturgeons returned after the activity ceased. These behavioural reactions are not considered deliberate disturbance in an area of special importance for breeding, resting or migration, because the activities take place in a limited impacted area that is not considered particularity important for European sturgeons that is a predominantly coastal species. The sturgeons can move back into the area and continue using it as before when the cable-laying is done, since the activities is not assessed to kill individuals or reduce the population. Further it is not a breeding site, as sturgeons are anadromous and strictly breed in rivers. It is considered unlikely that European sturgeons would be affected by USBL or LBL systems, since these devices emit signals in the 20–60 kHz range, which is well above the sturgeons' hearing threshold.

The overall assessment is shown in Table 8-19 below.

Table 8-19 Environmental severity and risk of impacts of underwater noise generated from the activities at the rigs, pipe laying and support vessel activities on European sturgeon.

Impact	Extension of impact	Duration of impact	Magnitude of impact	Severity of impact	Probability of impact	Environment al risk
Impacts of noise from rig	Local	Short term	Small	Insignificant impact	Unlikely	Negligible
Impacts of pre- and post-installation survey – underwater noise	Local	Short term	Small	Insignificant impact with mitigation	Unlikely	Negligible
Impacts of underwater noise from support vessels	Local	Short term	Small	Insignificant impact	Unlikely	Negligible
Impact of noise from USBL/LBL during pipeline and cable laying	NA	NAa	NA	NA	NA	NA

2.8 EIA Chapter 9 – Environmental impact of planned activities during production phase

The impact overview diagram and table have been updated to include underwater noise from surveys and maintenance during the production phase:

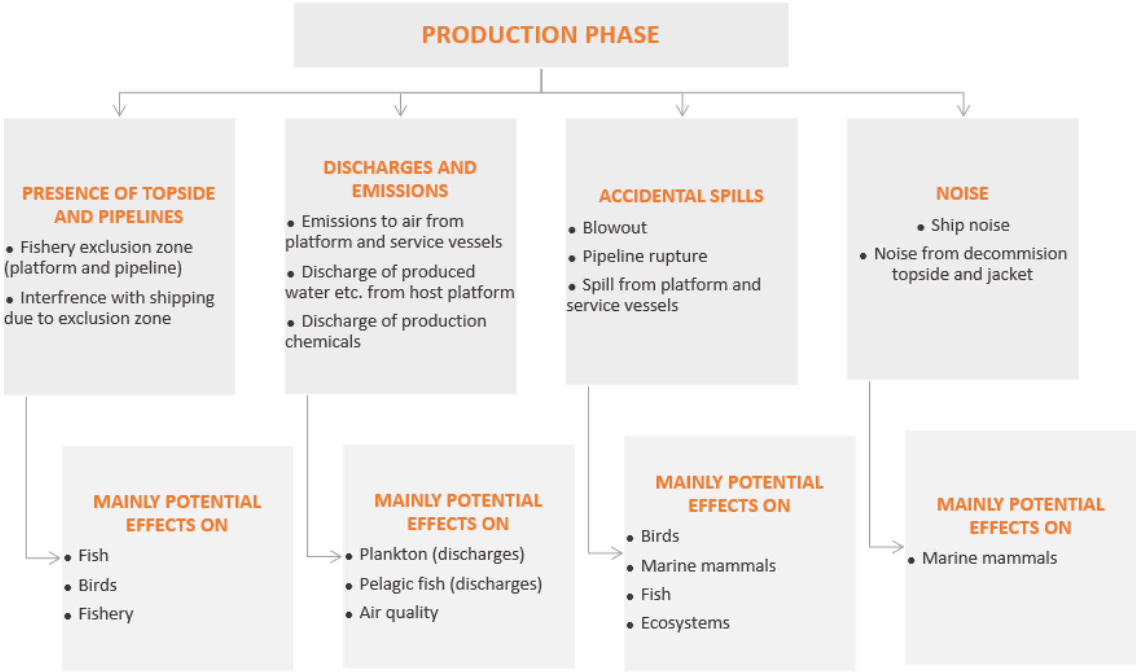


Figure 9-1 Overview of impacts during the production phase assessed in the EIA.

Table 9-1 Overview of impacts during the production phase assessed in the EIA

Activity	Potential Impacts
Presence of structures Rig, including 500 m safety zone and pipeline including 200 m exclusion zone	Interference with shipping due to safety zone
Discharges and emissions Discharge of produced water from Hejre (at discharge point on South Arne) Emissions to air	The discharge may affect marine organisms, particularly pelagic organisms such as plankton including fish eggs and larvae Release of particulates and gaseous compounds (SOx, NOx, VOC, CO, CO_2, CH_4) from generators, compressors and other machinery on the production platform and due to flaring operations
Underwater noise	Inspection and maintenance of the Hejre platform, cables, pipeline etc may require use of vessels and ROV with USBL, noise types that may cause TTS, PTS and deterrence.
Accidental spills Blowout Accidental spills from platforms and ships	Extremely rare events. Experience from previous blow outs and oil spills at sea have shown that it is mainly birds, marine mammals, fish, coastal ecosystems, fisheries, aquaculture and tourism that may be affected Economic loss to fisheries, aquaculture and tourism due to oiling. Mainly birds, plankton, fish eggs and larvae may be affected.

Section 9.4 on impact of planned discharges from South Arne has been updated re. the European sturgeon:

The modelling shows that the PEC/PNEC ratio is exceed <5000 meters from the platform. Discharge of chemicals will affect pelagic species consisting of fish, fish larvae, zooplankton and phytoplankton in the affected area. Whereas benthic species such as the European sturgeon is less likely to be affected as the chemicals are dispersed and diluted in the pelagic parts of the water column before potentially being dispersed to the bottom. Since the duration of the impact is short term and the magnitude of the impact is small, it is assessed that the impact of discharge on pelagic organisms including pelagic fish stocks, is negligible. For benthic species such as the appendix IV species, the European sturgeon, no impact is expected as the chemicals are dispersed at the surface and diluted in the pelagic parts of the water column before potentially appearing on the seabed.

A section has been written regarding underwater noise during production:

9.7 Impacts of underwater noise during the production phase

Various inspections of underwater and possibly maintenance of structures such as cables, pipelines and platform are necessary during the production phase. Such operations require vessels, ROV and potentially acoustic equipment. With the exception of USBL, only acoustic equipment inaudible (i.e. >180 kHz) to marine mammals will be used and can be screened out of the assessment. All use of the USBL and potentially LBL will use mitigation prior to full use. The mitigation will adhere to the procedures thoroughly described in chapter 8.5.1.2.

Following mitigation, the risk of hearing impairment to marine mammals in terms of both TTS and PTS will be reduced to 0 m, which means that a marine mammal needs to be right below the vessel to receive a USBL pulse with a high enough received level to cause TTS or PTS. The overall impact from impacts of underwater noise during the production phase is therefore assessed as negligible.

It is assessed that with the mitigation described in chapter 8.5.1.2., the risk of inflicting hearing damages, TTS or PTS, is effectively reduced. It is noted that the implementation of slow start will deter individuals from the site of activity in this project within some maximum 5.5 km based on best available knowledge, and the behavioural reactions cannot be mitigated. However, these behavioural reactions are not considered *deliberate disturbance* in an area of special importance for breeding, resting or migration, because the activities take place in a limited impacted area that is not considered particularity important for any of the cetacean species in the North Sea, nor is a known breeding site. Further, with the implementation of a slow start, the disturbance is short-term and fully reversible within hours, and it is assessed that the ecological functionality of the area for marine mammal species will not be impacted.

European sturgeons cannot hear USBL or LBL signals (chapter 8.5.2). Therefore, potential disturbance of this species during the production phase pertains to work causing vibrations of the seafloor. In such events, sturgeons will likely leave the area and return once the disturbance is over (Krebs, Jacobs, & Popper, 2016) (Popper & Calfee, 2023). These behavioural reactions are not considered deliberate disturbance, because they are short term, fully reversible and take place in a very limited impacted area that is not considered particularity important for European species that is a predominantly coastal species. The sturgeons can move back into the area and use it as before when the activity is over, because no individuals are killed. Further it is not a breeding site, as sturgeons are anadromous and strictly breed in rivers.

Table 9-8. Environmental severity and risk of impacts of underwater noise during production.

Impact	Extension of impact	Duration of impact	Magnitude of impact	Severity of impact	Probability of impact	Environmental risk
Underwater noise from inspections	Local	Short-term	Small	Minor impact	Probable	Negligible

2.9 EIA Chapter 10 - Environmental impact of planned activities during decommissioning

Section 10.2 on impacts of discharges to sea has been updated with information on European sturgeon:

European sturgeons are anadromous and primarily coastal species but may appear in the project area as successful releases has caused the species to begin appearing as bycatch in the North Sea. It is however still rare events (OSPAR, BDC2020/European or Common sturgeon, 2020), and as such it is not expected to find European sturgeons in the study site as it is a predominantly coastal species. Studies on effects of underwater noise have shown that sturgeons react to events that cause vibrations of the seafloor (Popper & Calfee, 2023) by leaving the area (Krebs, Jacobs, & Popper, 2016). This is covered in chapter 8.5.2. It is therefore expected that sturgeons will move away from the area, during decommissioning as this involves removing cables and pipes in the seafloor that will cause vibrations of the seafloor that sturgeons may hear. This may also protect the species from chemical pollution during the decommissioning activities. It is also expected, based on the above literature, that sturgeons will come back when the disturbance is over. These behavioural reactions are not considered deliberate disturbance in an area of special importance for breeding, resting or migration, because the activities take place in a limited impacted area that is not considered particular important for European sturgeons that is a predominantly coastal species. Further, it is not a breeding site, as sturgeons are anadromous and strictly breed in rivers, and the decommissioning of the Hejre field can therefore not negatively impact breeding sites.

The section 10.6 on impacts from underwater noise has been updated to include noise from underwater ROV-operations during decommissioning:

Various operations underwater are necessary during the decommissioning. Such operations require vessels, ROV and potentially acoustic equipment. With the exception of USBL, only acoustic equipment inaudible (i.e. >180 kHz) to marine mammals will be used and can be screened out of the assessment. All use of the USBL will be with mitigation prior to full use. The mitigation will adhere to the procedures thoroughly described in chapter 8.5.1.2.

Following mitigation, the risk of hearing impairment to marine mammals in terms of both TTS and PTS will be reduced to 0 m, which means that a marine mammal needs to be right below the vessel to receive a USBL pulse with a high enough received level to cause TTS or PTS. The overall impact from impacts of underwater noise during decommissioning is therefore assessed as negligible.

It is noted that the implementation of slow start will deter individuals from the site of activity in this project within some maximum 5.5 km based on best available knowledge, and the behavioural reactions cannot be mitigated. However, these behavioural reactions are not considered *deliberate disturbance* in an area of special importance for breeding, resting or migration, because the activities take place in a limited impacted area that is not considered particularity important for any of the cetacean species in the North Sea, nor is a known breeding site. Further, with the implementation of a slow start, the disturbance is short-term and fully reversible within hours, and it is assessed that the ecological functionality of the area for marine mammals will not be impacted.

European sturgeons are anadromous and primarily coastal species but may appear in the project area as successful releases has caused the species to begin appearing as bycatch in the North Sea. It is however still rare events (OSPAR, BDC2020/European or Common sturgeon, 2020), and as such it is not expected to find European sturgeons in the study site during decommissioning. Studies on effects of underwater noise have shown that sturgeons react to events that cause vibrations of the seafloor (Popper & Calfee, 2023) by leaving the area (Krebs, Jacobs, & Popper, 2016). This is covered in chapter 8.5.2. It is therefore expected that sturgeons will move away from the area, during decommissioning if this causes activity in the seafloor such as removing cables and pipes, rather than staying and being killed. This may also protect the species from chemical pollution during the project activities. It is also expected, based on the above literature, that sturgeons will come back when the disturbance is over. These behavioural reactions are not considered deliberate disturbance in an area of special importance for breeding, resting or migration, because the activities take place in a limited impacted area that is not considered particularity important for European sturgeon that is a predominantly coastal species. Further, it is not a breeding site, as sturgeons are anadromous and strictly breed in rivers, and this project can therefore not negatively impact breeding sites.

2.10 EIA Chapter 11 – Environmental impact of accidental oil and chemical spills

In section 11.1.7 Impacts on [ocean quahog,] fish eggs- and larvae of oil from a blowout incident has been added assessment for ocean quahog:

The ocean quahog (*Arctica islandica*) is listed as threatened and vulnerable in accordance with OSPAR list of threatened and declining habitats and species and thus protected from adverse human impacts through the obligations defined in the OSPAR annex V and can be present in the project area. While the primary pressure on the species is from physical disturbance of the sea floor, an oil spill will as described result in the release of a range of chemical compounds such as PAH's which are known to potentially affect benthic fauna.

A study carried out by Webster and Fryer (2022) found that though concentrations of PAH's in shellfish and sediments in the North Sea were above the natural background levels, measured concentrations were ERL and thereby assessed not to have adverse effects on bivalves. Depending on the scale and duration of the outlet, concentrations may reach levels exceeding ERL thus potentially adversely affecting benthic fauna, including *A. islandica*. A similar impact from other chemicals cannot be ruled out.

The adverse effects of such an event will be limited to areas directly affected by the spill and the magnitude of the impact will decrease with distance to the source.

In section 11.1.10.1 Impacts on German, Dutch and UK Natura 2000 areas south of Hejre, has been added assessment for European sturgeon:

Impacts on European sturgeon

Due to the rarity of European sturgeons, especially offshore, the lack of breeding habitat near Hejre and the short-term effect of disturbance due to this project, it is assessed that a potential blow-out will not cause a deterioration or destruction of breeding or resting sites for this Annex IV-species. Further sturgeons breed in rivers and eggs or larvae can therefore not be affected.

…

European sturgeon eggs are not at risk, because the species breed in rivers.

2.11 EIA Chapter 13 – Socio-economic assessment

The section 13.4.1. on changes in fish catches due to prohibition zones has been updated, due to minor requirement for extension of safety zones:

A safety zone is established around the legacy pipeline from Hejre to Gorm. The new pipeline will largely follow this existing safety corridor, meaning that only approximately 6 km new safety zone will be required. This additional safety zone will extend 200 m on either side of the pipeline route, stretching from the current safety zone to the 500 m safety zone at South Arne. Overall, the new safety zone will cover just 2.4 km², representing only a small fraction of the 41F4 area.

The potential loss of fishing grounds due to the new pipeline's safety zone is minimal when compared to the wider fishing areas in which 41F4 account for just 0.6 % of North Sea catches. Consequently, any reduction in fish catches resulting from the Hejre tie-back to South Arne project is considered insignificant in the context of total catches in the North Sea.

2.12 EIA Chapter 14 – Cumulative effects assessment

In Chapter 14 has the following been added regarding cumulative effects and assessment hereof:

For potential cumulative impacts from underwater noise, it is not a simple assessment as it is not possible to just add the various noise levels from different projects and multiply with an effect on receptor level.

Cumulative impacts may arise by a combination of different project activities and the underwater noise levels from these different activities, which should also take into to account noisy activities from other projects, standby vessels and service vessels to the platforms in the area, fisheries, offshore wind (not relevant at Hejre), commercial shipping, military activities, scientific cruises etc. happening at the same time in the and area. There are many human activities at sea that emit underwater noise. Getting all the relevant information temporally and spatially for these activities in advance for a specific area and period to make a factual assessment of cumulative impacts on receptor level, is not possible. It is not known where the fisheries will go, or how the commercial shipping will develop in numbers.

It should be expected that appendix IV species in the North Sea are consecutively exposed to anthropogenic underwater noise that may be at levels that cause behavioural reactions. The Mikaelsen et al. 2025 study is a good example of this, showing that the predominant source of USBL signals in a pre-investigation area for an offshore windfarm investigated with geophysical surveys using USBL, was actually USBL signals from trawlers. Trawlers use a sort of USBL system with several transponders using the same frequencies and source level as normal USBL systems. In the fishery it is called catch control systems, and they use it to monitor their trawls in a number of quantitative ways all through the year with no permissions necessary and no reporting required. Trawlers are everywhere and they use catch control systems, and these sounds are a likely part of the everyday soundscape for marine mammals in the North Sea. Because of all the different moving noise sources and a lack of knowledge on the timing and physiological effects of each at the level of the individual receptor, it is not a simple task to accurately assess cumulative impacts from underwater noise, and the scientific community is working on models for how to accurately assess effects from individuals to populations from underwater noise.

A more accurate cumulative impact assessment requires knowledge on the energetic effect of the individual sources on individual receptor level in the first place, which is only beginning to emerge. Models are being developed such as the PCoD (Population Consequences of Disturbance) and PCAD (Population Consequences Of Acoustic Disturbance Model) models, but they are not yet ready. Until such models are available, it must be assumed that the assessed project is not the only disturbance the animals encounter and that multiple exposures can negatively impact fitness if the animals are moved to areas where there is not enough prey to maintain their metabolism (Gallagher et al. 2021). So far, this does not seem to be the case for the North Sea, where the three assessed cetacean appendix IV species harbour porpoise, white-beaked dolphin and minke whale in the North Sea, all are assessed to be in favourable conservation status (DCE, 2021). Further, the assessed area is not a key habitat for these cetacean species, or for the European sturgeon.

It is in this project expected that underwater noise will be generated during the good weather window by for example ship activities and from platform modification in addition to short term activities e.g. from the pre-installation survey, and this is a very local effect of max 5.5 km. It is expected that it will be the noisiest activity in addition to the specific frequencies that will determine the distance from which the cetaceans may experience TTS and PTS or be deterred. This means that when a USBL or LBL is in use following mitigation, they determine behavioural impact of about 5.5 km for harbour porpoises, which is the most sensitive species, whereas when the pipeline is drenched down, it is more likely the vessel noise that determines behavioural impact of 400-1000 m, and when the rocks and matrasses are dumped, it is a behavioural impact range of 700-1200 m for harbour porpoises (Sveegaard et al. 2023). Each of these impacts takes place consecutively and except from commercial shipping (see Figure 6-25) and trawling, no other activities are expected to take place in the maximum impact range of 5.5 km. Even if both a commercial vessel and a trawler is present within this range, all cetaceans may swim in a direction without impact, or at least in a direction of decreasing sound pressure level. This will be the case for construction, production and decommissioning. Therefore the cumulative impacts of underwater noise on appendix IV species is assessed to be negligible as the impact is short-term (longest duration is during construction: 25 days), in a limited area and fully reversible.

The section 14.1 Cumulative effects with offshore energy related activities have been updated with information on plans for windfarms and energy island in the North Sea. No new information on other types of cumulative activities has found needed to be added:

According to the present stage of development of the above-mentioned plans for wind farms it can be determined that cumulative effects will not appear, since the tendering of offshore wind farms in Denmark had to rerun. The two first plants, where of only one is in the North Sea (Nordsø Midt) have to be installed for minimum capacity in 2032.The location of Nordsø Midt, can be seen in Figure 14-3. The Hejre re-development is planned to be finalised in 2028 and there will therefore not be any cumulative effect.

Figure 14-3: Locations of three areas for wind farms in tender with deadline in 2026 and 2028.

The timing of the re-development of Hejre will be earlier than the realisation of the energy island since this project has been postponed and as earliest will be realised in 2036.

2.13 EIA Chapter 16 – Natura-2000 assessment

The section 16.4 Status and conservation objectives has been generally updated and white-beaked dolphin and minke whales have been added:

16.4.4. Status and conservation objectives 2032 *White-beaked dolphin*

White beaked dolphin (*Lagenorhyncus albirostris*) is relatively common in the northern part of the North Sea and may be encountered at Dogger Bank (Geelhoed et al 2014, Hammond et al 2013, Reid, et al. 2003). White beaked dolphin is much less abundant than harbour porpoises. The total population in the North Sea is only about 16,500 individuals (Hammond et al. 2013).

White-beaked dolphins are acrobatic and social animals that are typically found in pods of 4-6 animals. They will frequently ride on the bow wave of fast-moving vessels and jump clear of the water surface. White beaked dolphin mates from May to August and the delivery occur the following summer after a gestation period of about 11 months. They primarily feed on fish such as herring, cod, haddock, whiting and hake but may also prey on squid, octopus and benthic crustaceans.

White-beaked Dolphin *Lagenorhynchus albirostris* has most recently been assessed for *The IUCN Red List of Threatened Species* in 2018. *Lagenorhynchus albirostris* is listed as Least Concern (Kiszka & Braulik, 2018).

16.4.5. Status and conservation objectives 2618 Minke whales

Minke whale (Balaenoptera acutorostrata) may be observed at the Dogger Bank (Geelhoed et al. 2014, Hammond et al. 2013, Kinze 2007, Reid et al. 2003). The minke whale is the only species of baleen whale that occurs regularly in the North Sea. The population in the North Sea has been estimated to about 19.000 individuals (Hammond et al. 2013).

Mating and delivery take place from late winter to early spring. The female gives birth to a calf every year or every second year. The gestation period is 10 months, and nursing of the calf takes place for 3-6 months. Minke whales primarily feed on pelagic fish such as herring and sprat and small crustaceans.

Common Minke Whale Balaenoptera acutorostrata has most recently been assessed for The IUCN Red List of Threatened Species in 2018. Balaenoptera acutorostrata is listed as Least Concern (Cooke, 2018).

The section 16.7.2 Impacts of underwater noise has been updated with the following:

Impacts from underwater noise during the construction phase has been assessed to be negligible (section 8.5). The primary noise source and concern is the use of USBL during first the pre-installation survey of the pipeline route, then cable laying and last the post survey of the pipeline route. Since USBL can cause permanent hearing impairment, its use will be mitigated in this project to fully reduce the risk of hearing impairment. The mitigation is described in chapter 8.5.1.2. Potential impacts are therefore only on behaviour of marine mammals, and these are assessed to be short term and fully reversible with hours. All vessel-based activities are in themselves expected to cause avoidance reactions for harbour porpoises within some 400-1000 m. Activities using USBL will cause deterrence within some 5.5 km range around the vessel as it moves along (Mikaelsen et al. 2025). With the planned use of mitigation for each use of USBL or LBL, it is not expected that the project activities at Hejre and South Arne will exceed the sound exposure levels that are harmful to cetaceans and seals (section 8.5).

Impacts of underwater noise during production have been assessed to be negligible (section 9.7). The primary noise sources will be as for the construction phase from vessels and use of USBL and LBL. Use of USBL and LBL will be fully mitigated to effectively reduce the risk of PTS and TTS.

Impacts from underwater noise during the decommissioning phase has been assessed to be negligible (section 10.6). Noisy activities during decommissioning include broad band noise from heavy lift vessels and service vessels, which may cause harbour porpoises to react to the noise, however underwater noise from vessels is not expected to exceed the threshold for hearing damage. In addition to the noise from vessels there will potentially be underwater noise from diamond wire cuttings, although this is not expected to lead to hearing damage of marine mammals (section 10.5). If USBL or similar will be used, mitigation will be in place at start-up.

Based on the above considerations and assessments, underwater noise from the Hejre re-development will have insignificant impact on the conservation objectives of the habitat types and species in the Natura 2000 sites.

It is expected that the noise from vessels and cutting works potentially will scare cetaceans (Annex IV species) to safe distances from the working field. If noise work occurs that may cause PTS or TTS, mitigation will be employed to fully reduce this risk.

2.14 EIA Chapter 19 – Project design and impact mitigation

The section 19.6 Underwater noise has been updated to the following:

For the pre- and post-installation USBL using ROV survey of the pipeline route, and for the pipeline and cable laying itself the project will adhere to "Standard terms for preliminary investigations at sea" from the Danish Energy Agency (2018). A slow start procedure for USBL and LBL will be followed with a single signal emitted every 30 second for respectively 22 and 30 minutes to prevent hearing impairment in marine mammals.

2.15 EIA Chapter 21 – References

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3. Conclusion

The Hejre tie-back to South Arne EIA has been updated with a reduced scope and updated on environmental matters as Annex IV species and OSPAR Annex V species as well as new interpretation of the legislation for mitigating underwater noise.

Mitigation measures are needed for underwater noise from USBL and LBL activities, where a “slow start” is needed to insure no impact on marine mammals.

By taking in the mitigating measures on underwater noise it is ensured that the environmental impacts of the Hejre tie-back to South Arne Development arising from known and expected activities are not significant.

Annex A Competent Experts

Name	Company	Title	Relevant Qualifications Experience
Withheld	NIRAS	Withheld	Biologist specialized in bioacoustics and underwater noise. 19 years of experience with research, monitoring, assessments and advisory. Oil & gas, offshore wind and other.
Withheld	NIRAS	Withheld	Marine biologist. 8 years of experience in working with marine biodiversity + 3 years of experience within marine policy and EIA projects, on EU directives and OSPAR/HELCOM.
Withheld	INEOS	Withheld	Master degree in Environmental and Safety Management. 18 years of S&E experience in offshore oil and gas production.
Withheld	INEOS	Withheld	Environmental Engineer. 20 years of experience with oil and gas industry. Several years of experience with EIA projects, environmental permits and EU Emission Trading System (ETS).
Withheld	INEOS	Withheld	Environmental Engineer. Approximately 17 years of experience in undertaking EIA Projects and obtaining environmental permits. 7 years with project within the oil and gas industry.