Department for
Business, Energy
& Industrial Strategy

RECORD OF THE HABITATS REGULATIONS ASSESSMENT UNDERTAKEN UNDER REGULATION 5 OF THE OFFSHORE PETROLEUM ACTIVITIES (CONSERVATION of HABITATS) REGULATIONS 2001 (As Amended).

BP Greater NEP 3D Towed-streamer (Endurance + BC39)

Issued May 2022
Rev 3.0

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1 INTRODUCTION

1.1 The Habitats Regulations, The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended) and the Offshore Habitats Regulations[1], provide for the designation of sites for the protection of habitats and species of international importance. These sites are called Special Areas of Conservation ("SACs"). These Regulations also provide for the classification of sites the protection of rare and vulnerable birds and for regularly occurring migratory species within the UK and internationally. These are called Special Protection Areas ("SPAs"). SACs and SPAs together, referred to as European sites in legislation, form part of the UK's national site network.

1.2 The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended) transposed the Directives into UK law for activities consented under the Petroleum Act 1998. The Offshore Petroleum Activities (Conservation of Habitats) (Amendment) Regulations 2007 extend certain provisions of the 2001 regulations.

1.3 Regulation 5(1) of the 2001 Regulations provides that: *The Secretary of State shall, before granting any Petroleum Act licence, any consent, any authorisation, or any approval, where he considers that anything that might be done or any activity which might be carried on pursuant to such a licence, consent, authorisation or approval is likely to have a significant effect on a relevant site, whether individually or in-combination with any other plan or project, including but not limited to any other relevant project, make an appropriate assessment of the implications for the site in view of the site's conservation objectives*.

1.4 Any plan or project, which either alone or in-combination with other plans or projects would be likely to have a significant effect on a qualifying site must be subject to an Appropriate Assessment to determine the implications for a site's integrity and conservation objectives. Such a plan or project may only be agreed after ascertaining that it will not adversely affect the integrity of a European site unless there are imperative reasons of overriding public interest for carrying out the plan or project.

1.5 An application to undertake a Marine Survey by BP Exploration Operating Company Limited (hereafter BP) was submitted to the Department for Business Energy and Industrial Strategy (BEIS) on 2 December 2021 and approved following the completion of an HRA on 4 April 2022.

1.6 On 3 May 2022 BP submitted a variation (GS/1530/2) to the consented survey requesting the use of wider line spacing between the consecutive survey lines. By doing so this could increase

[1] These Regulations, which transpose the requirements of Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora ("the Habitats Directive") and Council Directive 2009/147/EC on the conservation of wild birds ("the Birds Directive"), aim to ensure the long-term conservation of certain species and habitats by protecting them from possible adverse effects of plans and projects. Note that the European Union (Withdrawal) Act 2018 confirms that the body of EU law transposed into UK legislation at the time that the UK exits the EU has been retained, such that it will continue to have effect in domestic law after the end of the Implementation Period as defined in the European Union (Withdrawal) Act 2018.

the extent of noise impacts occurring during the course of one day. Consequently, the HRA has been revised based on the information presented in the variation.

1.7 This is a record of the Appropriate Assessment in the form of a Habitats Regulations Assessment (HRA), undertaken by the Secretary of State for BEIS in respect of a proposed BP NEP 3D Towed-streamer (Endurance + BC39) that may cause a significant effect on European sites.

1.8 The proposed surveys relevant to this assessment are not directly connected with, or necessary to, the management of any European sites but may affect them. The purpose of this HRA is to determine whether the proposed surveys will adversely affect the integrity of any European designated site.

2 SURVEY DESCRIPTION

2.1 The following is a summary of the proposed surveys, further details may be found within the application (BP 2021a, b, 2022a).

2.2 The proposed survey will be undertaken at the Endurance and BC39 reservoir sites. The aim of the survey is to obtain data on the structure of the Endurance and BC39 reservoir sites that have been identified as potential carbon capture, utilisation and storage geological structures. The combined Endurance and BC39 areas are referred to as the Greater NEP area (BP 2021a).

2.3 The Greater NEP survey area covers 1,800 km^2 and is located in UKCS Blocks 42/22, 25 and 30, 43/18, 19 and 21 – 30, 43/21 and 26. The Greater Working Area covers 3,090 km^2 (Figure 1) (BP 2021a,b).

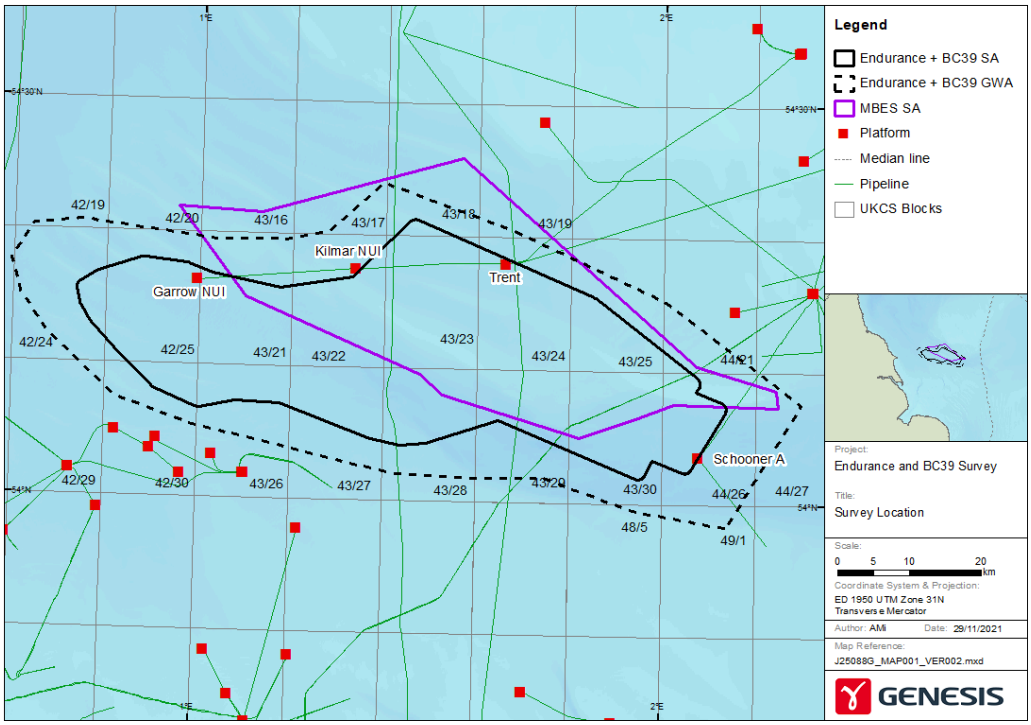


Figure 1: Location of the proposed BP NEP Endurance and BC39 surveys showing survey and greater working areas .

2.4 The survey is scheduled to be undertaken between 1 April and 15 August 2021 and expected to last a total of 92 days. However the use of airguns is anticipated to be for no more than 64 days (BP 2021a,b).

2.5 In addition to the above survey, a bathymetric survey using a multibeam echosounder sound source will be undertaken independent of the Greater NEP survey. The bathymetric survey will

cover an area of approximately 1,500 km^2 and use an autonomous surface vessel (Figure 1) (BP 2021a). No further information on the bathymetric survey are presented in the application.

2.6 Details of the sound sources from the equipment to be used is presented in Table 1 (BP 2022a).

Table 1: Survey parameters.

Array Parameter	Greater NEP Area
Survey	Four arrays each comprising 5 1900LLXT airguns
Duration (days)	Up to 92 days
Source	1 x 20, 1 x 40, 2 x 60, 2 x 150 cu. in. airguns
Total volume (cu. In).	400
Sound pressure (dB re 1 µPa (0-p))	246.5
Sound pressure (dB re 1 µPa (p-p))	252.1
Sound exposure level – (dB re 1 µPa^{2}s)	219.5
Peak frequency (Hz)	70
Source point interval (m)	6.25
Towed depth (m)	15
Vessel speed (knots)	4.5

2.1 The proposed seismic survey will be undertaken along predetermined lines. In total 200 lines will be surveyed with a total length of survey line of 9,200 km. Each survey line will be 200 m apart but each consecutive line surveyed being between 1 km and 20 km apart. At the end of each line, each line turn is estimated to last no less than 120 minutes (BP 2021b, 2022b,c,d).

Multi-beam echosounders

2.2 Multi-beam echosounders are used to measure water depth and use multiple (>100) transducers to send out a relatively broad swath of sound covering a large, fan-shaped area of the seabed beneath the vessel. The sound source level, operating frequencies, firing rate and pulse duration vary depending on the depth of the area under investigation. Maximum source levels for the most powerful, deep-water systems are 236-238 dB re 1 µPa-m (zero-peak) and operate at frequencies typically between 10 – 200 kHz. In relatively shallow water depths typically found in the southern North Sea, multi-beam echosounders operate at a relatively lower sound source and at higher frequencies of between 200 to 500 kHz, that are outwith the hearing range of most marine species (SCAR 2002, Danson 2005, IHO 2005, Lurton 2016).

3 DESIGNATED SITES

3.1 The proposed surveys are being undertaken in waters within or adjacent to a number of European sites and it is recognised that potential impacts that could cause a likely significant effect could occur to a number of qualifying species both within and outwith designated sites.

3.2 Based on the information presented within the application, including the results from the noise modelling undertaken in support of the application and advice received during consultation (JNCC 2022a), One SAC has been identified as having qualifying species at risk of a likely significant effect from the proposed survey (Figure 2).

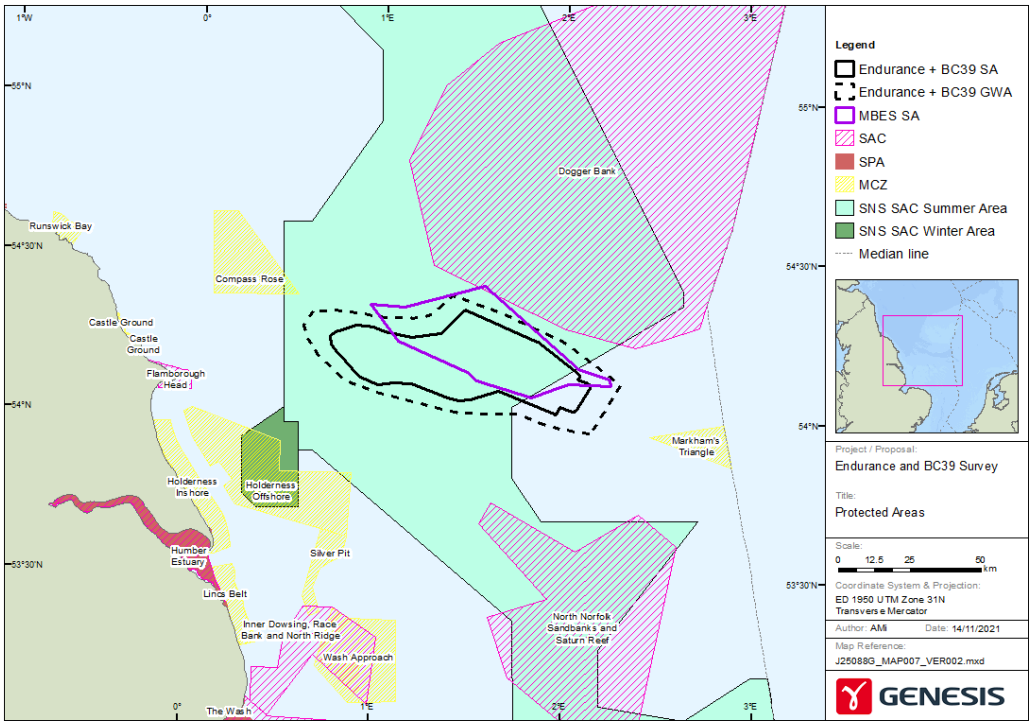


Figure 2: Location of proposed BP Greater NEP seismic survey and designated sites.

3.3 The qualifying sites and species relevant to this HRA are:

- Southern North Sea SAC (Harbour porpoise),

3.4 The proposed Greater Working Areas and Survey Areas overlap with the Southern North Sea SAC.

3.5 No Likely significant effects have been identified for any other European site.

Qualifying features

3.6 Based on the information presented within the application and advice received from consultation (JNCC 2022a) it has been determined that the HRA should consider alone and in-combination the potential direct and indirect impacts on:

- Harbour porpoise.

Harbour porpoise

3.7 The harbour porpoise (*phocoena phocoena*) is a qualifying species for the:

- Southern North Sea SAC,

3.8 The harbour porpoise is the smallest and most abundant cetacean species in UK waters. They occur widely across shelf waters predominantly either individually or in small groups but larger aggregations have been reported (Defra 2015), with group sizes varying with season (Clark 2005). Harbour porpoise have a very broad distribution occurring predominantly over the continental shelf. Higher densities occur in areas of up-wellings and strong tidal currents and in water depths of predominantly between 20 and 40 m (Clark 2005, Whaley 2004). Their distribution may also be strongly correlated with seabed type, with areas of sandy gravel being preferred and this may be linked to prey availability (Clark 2005).

3.9 Harbour porpoise occur widely across the North Sea. Data from the three Small Cetacean Abundance in the North Sea (SCANS) surveys indicate that that there may have been a southward shift in the distribution of harbour porpoise in the North Sea. In the early 1990's harbour porpoise were widespread but appear to have occurred predominantly around eastern Scotland and the northern North Sea to the southern North Sea (Hammond *et al*. 2013). Since the 1990's harbour porpoise continue to be widespread across the North Sea but densities have increased in the southern and central North Sea. The cause of this apparent change in the distribution of harbour porpoises across the North Sea is unclear but may be related to changes in prey availability (IAMMWG *et al.* 2015).

3.10 Following the completion of the most recent SCANS survey (SCANS III), the latest estimated harbour porpoise populations within the whole of the SCANS survey area is 424,245 (CV 313,151 – 596,827). Since 1994 the population of harbour porpoises within the SCANS surveyed area has remained relatively stable (Hammond *et al*. 1995, Hammond 2006, Hammond *et al.* 2017).

3.11 There are three Management Units identified for harbour porpoise in the north-east Atlantic, of which, the Southern North Sea SAC lies within the North Sea Management Unit. The harbour porpoise population within the North Sea Management Unit was originally estimated to be 227,298 (176,360 – 292,948) (IAMMWG 2015). This estimated population of harbour porpoise is recognised to have been derived from data collected in 2005 and 2016 during a single month and that the harbour porpoise population within the SAC will vary across seasons and years. The

population estimated from the Joint Cetacean Protocol (JCP), where abundance and distribution data from multiple sources collected over a period of time have been integrated, is 333,808 individuals (JNCC 2017a). The revised population estimate for the North Sea Management Unit is 346,601 (289,498 – 419,967) (IAMMWG 2021). This population estimate has been used for the purposes of this assessment.

3.12 Harbour porpoise densities vary seasonally and across the Southern North Sea SAC (Evans and Teilmann 2009). Site-specific surveys undertaken by wind farm developers have shown considerable variation in the spatial and temporal distribution of harbour porpoises across years (e.g. Forewind 2013, SMart Wind 2017). Typically, peak abundance has been reported to occur between May and July at sites across the Dogger Bank area and between September and April at sites further south (e.g. Forewind 2014, SMart Wind 2015, EAOWL 2015). Lowest reported abundance across nearly all wind farm surveyed areas occurs between November and February, although the poorer survey conditions that occur predominantly during the winter months may be a contributing factor in the lower number of harbour porpoise recorded during this period.

3.13 Based on data in the JCP database highest densities in the central and northern area of the SAC occur during the summer period with modelled harbour porpoise densities greater than 3.0 per km^2 occurring widely. During the winter period the distribution of harbour porpoise in the southern North Sea changes, with reduced densities over the central and northern area but an increase in densities in nearshore waters and the southern part of the SAC (Heinänen and Skov 2015).

3.14 Surveys undertaken across the southern North Sea, including areas within and encompassing the SAC, have reported lower densities of harbour porpoise than that estimated from JCP data. Densities reported from SCANS III surveys are from between 0.888 ind./km^2 in SCANS block O and 0.607 ind./km^2 in SCANS block L (Hammond *et al.* 2017). Similarly, data obtained across the Dogger Bank area including the Southern North Sea SAC, in 2011 recorded a density of 1.88 ind./km^2 (Gilles *et al.* 2012). Data obtained from surveys undertaken at offshore wind farms located within or adjacent to the SAC indicate densities vary across the site and across seasons. Mean densities reported from surveys undertaken by offshore wind farm developers range from 0.11 ind./km^2 at Triton Knoll offshore wind farm including a 1 km buffer to 2.87 ind./km^2 within the Hornsea subzone 3 wind farm area plus a 4 km buffer (TKOWFL 2011, SMart Wind 2017).

3.15 Tagging studies undertaken in Denmark indicate that harbour porpoises are highly mobile and range widely in the North Sea, with individuals tagged in the Skagerrak travelling up to 100 km per day, with a mean distance of 24.5 km per day (Sveegaard 2011). Individuals tagged in Danish waters were recorded off the east coasts of England and Scotland (Sveegaard 2011).

3.16 Harbour porpoise swimming speeds vary with the highest recorded swimming speeds being 4.3 m/s (Otani *et al.* 2000). Mean recorded speeds are typically around 1 m/s (Otani *et al.* 2000,

Kastelein *et al.* 2018). When disturbed by noise harbour porpoise can increase swimming speeds with increasing sound levels. Studies using playback experiments of pile-driving sounds have reported increases in swimming speed from an average of 1.2 m/s to 2.0 m/s at sound levels of 154 dB re 1 µPa that were sustained for at least 30 minutes (Kastelein *et al*. 2018).

3.17 Although harbour porpoises may dive to depths of up to 226 m and remain submerged for up to five minutes, they more frequently undertake relatively shallow dives of a short duration, with a mean depth of 14 m and duration of 44 seconds (Santos and Pierce 2003, Otani *et al*. 1998, 2000). Studies undertaken on 14 tagged harbour porpoise in Danish and adjacent waters reported that on average harbour porpoise spend 55% of the time in the upper 2 m of the surface waters. The most frequent dive depths were between 14 m and 32 m, with the maximum depth dived of 132 m. The number of dives per hour increased from an average of 29 dives hr^{-1} between April and August to 43 dives hr^{-1} in October and November when it was presumed that higher levels of foraging activity occurred to compensate for the higher energy requirements required during the cooler winter period (Teilmann *et al*. 2007).

3.18 Harbour porpoise use echolocation to detect and track individual prey and are opportunistic feeders, foraging close to the seabed or near the sea surface, preying on a wide range of fish species including, herring (*Clupea harengus*), whiting (*Merlandius merlangus*), Gadoids spp. sprats (*Sprattus sprattus*), gobi (*Pomatoschistus minutus*) and sandeels (*Ammodytes* spp.), and their prey will vary during and between seasons (DeRuiter 2008, Santos and Pierce 2003, IAMMWG *et al.* 2015). The prey of harbour porpoise may change over time with a reported long-term shift in prey from clupeid species to sandeels and gadoid species (IAMMWG *et al*. 2015), indicating that harbour porpoise may be opportunistic feeders capable of feeding on a variety of species.

3.19 Studies undertaken in Denmark indicate that their local distribution may be correlated with prey availability (Sveegaard 2011). Due to the relatively high metabolic rate of harbour porpoise and the relatively small size of their predominant prey it has been suggested that harbour porpoise require a reliable source of food and frequent food consumption in order to maintain their body weight, with increased consumption in cooler environments (Kastelein *et al*. 1997, Wisniewska *et al*. 2016; 2018).

3.20 Harbour porpoise have a maximum life expectancy of 24 years, with an average life expectancy of around 12 years in UK waters (Lockyer 2003, Learmouth *et al.* 2014). Females become sexually mature at between three and five years old (Lockyer 2003, Learmouth *et al*. 2014). Breeding is thought to occur primarily during the summer months between May and September, particularly in August, with calving 10 months later. Calves are nursed for eight to ten months but may remain with the mother until a new calf is born (Defra 2015, Lockyer 2003, Weir *et al*. 2007).

3.21 The range at which marine mammals, including harbour porpoise, may be able to detect sound arising from offshore activities depends on the hearing ability of the species and the frequency of the sound. Other factors that can affect the potential impact include ambient background noise, which can vary depending on water depth, seabed topography and sediment type. Natural conditions such as weather and sea state and existing sources of human produced sound can also reduce the auditory range.

3.22 Porpoises are generally considered to be 'high frequency' or 'very high frequency' specialists with a relatively poor ability to detect lower frequency sounds (Southall *et al.* 2007, 2019). Studies undertaken on captive harbour porpoises indicate that porpoises have a functional hearing range of between 250 Hz and 180 kHz with their best hearing between 16 to 140 kHz and their maximum sensitivity between 100 and 140 kHz. It is within the frequency range of 130 to 140 kHz that harbour porpoise echolocate (Miller and Wahlberg 2013).

3.23 Their ability to detect sound below 16 kHz or above 140 kHz falls sharply (Kastelein *et al.* 2012, 2015, Southall *et al*. 2007). Harbour porpoise are therefore most sensitive to sound sources between 16 to 140 kHz and, although potentially audible, they are unlikely to be sensitive to sound either above or below those frequencies.

3.24 Harbour porpoise use echolocation to communicate and detect prey. Reported sound levels produced range from between 166 to 194 re: 1 µPa (rms SPL) and 178 and 205 dB re. 1 µPa (peak – peak SPL), with a mean level of 191 dB re. 1 µPa (peak – peak SPL) and within the peak frequency range of 110 to 150 kHz (Villadsgaard, *et al*. 2007, Miller and Wahlberg 2013, MMO 2015).

Prey species

3.25 Fish are not qualifying species for the Southern North Sea SAC. However, potential impacts on fish that are prey for harbour porpoise could affect the integrity of the site by reducing their prey base. Harbour porpoise prey on a variety of fish species that could be impacted by the proposed survey including gobies, Sandeel Spp., whiting, herring and sprat (JNCC and NE 2019).

3.26 Sandeels are one of the most abundant fish in the North Sea occurring widely over suitable sandy substrates where, once the larvae have settled, they remain in the area (Heath *et al.* 2011). Although widespread, sandeel distribution is highly substrate specific as they depend on seabed habitat comprising a high proportion of medium and coarse sands (particle size 0.25 - <2 mm) with low silt content (Holland *et al*. 2005).

3.27 Between September and April sandeels remain largely buried in the seabed except when spawning during December and January and when feeding during the late spring and summer (Greenstreet *et al.* 2006, Van der Kooij *et al*. 2008).

3.28 Within the Southern North Sea SAC sandeels occur across the site with their main spawning area over the Dogger Bank and a wider nursery area across most of the SAC (Judd *et al.* 2011).

3.29 Fish hearing is based on detecting particle motion directly stimulating the inner ear. However, those with swim bladders are also able to detect pressure waves and can detect a wider range of frequencies and sounds of lower intensity than fishes without swim bladders (Popper 2003). Fish with swim bladders that possess a coupling mechanism between the swim bladder and the auditory system, e.g. herring and sprats, are recognised to be hearing specialists. Fish that have swim bladders but lack a mechanised coupling mechanism or do not have swim bladders, e.g. sandeel spp. are considered hearing generalists and have a relatively lower sensitivity to sound than fish that have swim bladders and a coupling mechanism.

3.30 Studies on the behaviour of fish from noise, largely using play-back experiments, have reported a range of behavioural responses including avoidance behaviour, changes in swimming speed and direction (e.g. Hawkins 2014, Mueller-Blenkle *et al.* 2010) and reduced antipredator responses (Everley *et al.* 2016).

3.31 Sandeels are not considered to have sensitive hearing (Popper *et al.* 2014). Studies undertaken using airguns indicate that sandeels have distinct but weak reactions to seismic airguns with initial startle responses reducing in frequency with on-going noise, and no increased mortality was detected (Hassel *et al.* 2004).

3.32 There are limited studies assessing potential impacts on eggs and larvae. Results indicate that there is potential for increase in mortality when larvae are exposed to an airgun sound source with peak sound pressure levels of 220-242 dB re 1 μPa^2 (unknown measure), but only within 5 m of the airgun (Popper *et al*. 2014).

Information Sources

3.33 This HRA draws on a number of information sources relating to the proposed project and the site designation which should be read in conjunction with this report including:

- BP (2021a). Greater NEP 3D Towed-streamer (Endurance & BC39) Seismic Survey EAJ. December 2021.
- BP (2021b). Application GS/1332/0 (Version 1). Application to carry out a Marine Survey. 2 December 2021.
- BP (2022a). Greater NEP 3D Towed-streamer (Endurance & BC39) Seismic Survey EAJ. Updated March 2022.
- BP (2022d). Greater NEP 3D Towed-streamer (Endurance & BC39) Seismic Survey EAJ. May 2022.
- Natura 2000 – Standard Data Form. Site: UK0030395. Southern North Sea. JNCC (2019).

- Guidance for assessing the significance of noise disturbance against Conservation Objectives of harbour porpoise SACs. (England, Wales & Northern Ireland). JNCC (2020).
- Harbour Porpoise (*Phocoena phocoena*) possible Special Area of Conservation: Southern North Sea. Conservation Objectives and Advice on Activities. JNCC and NE (2019).

3.34 References to technical papers and other documents are given in the text as necessary.

4 POTENTIAL IMPACTS

4.1 The potential impacts arising from the proposed survey are sound from the airguns. No other sources of potential impact that could affect qualifying habitats or species have been identified.

4.2 The airguns used in the seismic surveys are pneumatically-driven impulsive transducers that generate high intensity, low frequency, short duration sound pulses at regular intervals of typically between every 10 to 15 seconds. The seismic source geometry is designed to focus the output from the array vertically downwards minimising any horizontally propagating sounds (OGP/IAGC 2004). The level of sound generated by an airgun array depends on various factors including gun volume, array design, the number of airguns, spacing and air pressure. Field measurements of the sound emitted by airgun arrays used by the oil and gas industry show that levels of source intensity expressed as peak SPL range from 235 to 259 dB re 1µPa- m (Richardson *et al*. 1995, OSPAR 2009). The frequency range of emitted energy is typically in the 5 Hz to 500 Hz range and strongest from 10 to 120 Hz, but with some energy in the 500 Hz to 1 kHz range (Richardson *et al*. 1995, Hermannsen *et al.* 2015).

Marine Mammals

4.3 There is a substantial volume of literature describing the potential effects of sound on marine mammals, and summarised in e.g. Thomsen *et al.* (2006), Southall *et al.* (2007, 2019) and OSPAR (2009).

4.4 There are four main types of potential effect from noise that are recognised within the marine environment:

- *Fatal effects* caused by significant levels of noise in close proximity to the receptor.
- *Physical injury*, specifically hearing impairment, which can be permanent or temporary. These effects can impact on the ability of marine mammals to communicate, forage or avoid predators.
- *Behavioural effects* such as avoidance, resulting in displacement from suitable feeding or breeding areas, and changes in travelling routes.
- *Secondary impacts* caused by the direct effects of noise on potential prey causing a reduction in prey availability.

4.5 The range at which marine mammals may be able to detect sound arising from offshore activities depends on the hearing ability of the species and the frequency of the sound with harbour porpoise more sensitive to relatively high frequencies compared with many other marine mammals. Other factors which may affect the potential impact of sound on marine mammals includes ambient background noise, which can vary depending on water depth, seabed topography and sediment type. Natural conditions such as weather and sea state and other existing sources of human produced sound, e.g. shipping, can also reduce the auditory range.

Fatal effects

4.6 If source peak pressure levels from the proposed operations are high enough there is the potential for a lethal effect on marine mammals. Studies suggest that potentially lethal effects can occur to marine mammals when the peak pressure level is greater than 246 or 252 dB re. 1 µPa (Parvin *et al.* 2007). Damage to soft organs and tissues can occur when the peak pressure level is greater than 220 dB re. 1 µPa.

Physical injury

4.7 Underwater sound has the potential to cause hearing damage in marine mammals, either permanently or temporarily. The potential for either of these conditions to occur is dependent on the hearing bandwidth of the animal, the duty cycle of the sound source and duration of the exposure (Southall *et al*. 2019, OSPAR 2009).

Behavioural Change

4.8 Potential changes in behaviour may occur depending on the sound source levels and the species' and individuals' sensitivities. Behavioural changes can include changes in swimming direction, diving duration, avoidance of an area and reduced communication.

4.9 Masking effects may also cause changes in the behaviour as the level of sound may impair the detection of echolocation clicks and other sounds that species use to communicate or detect prey, thus causing them to alter their behaviour.

Secondary Effects

4.10 There is potential for impacts on prey species to affect harbour porpoise, in particular possible impacts of noise on fish species.

5 NOISE MODELLING

5.1 To assess the potential environmental impacts from the proposed survey the applicant has undertaken noise modelling using outputs derived from a Gundalf airgun model and a directional propagation model (BP 2021a).

5.2 Results from the modelling indicate the extent at which the onset of a Permanent Threshold Shift (PTS), Temporary Threshold Shift (TTS) or disturbance could occur from the airguns during the proposed survey on marine mammals.

5.3 The modelling indicates that the thresholds at which the onset of PTS is predicted to arise in harbour porpoise are not exceeded based on the cumulative SEL metric (Table 2) (BP 2021a).

5.4 The results from the modelling indicate that there is a risk of behavioural effects, e.g. displacement and disturbance to a harbour porpoise within an area of 8.9 km, based on a disturbance threshold of 145 dB re 1 µPa2s (Table 2) (BP 2021a).

5.5 The potential area over which disturbance to harbour porpoise is predicted to arise over the course of 24 hours is 1,720 km^2. Overall, the survey is predicted to cause a disturbance impact over an area of 3,400 km^2, depending on which of the two surveys is being undertaken (BP 2021a).

5.6 Injury to fish is not predicted to arise from airgun noise based on a cumulative SEL threshold of between 207 dB re 1 µPa2s for fish with swim bladder involved in hearing and 219 dB re 1 µPa2s for fish without swim bladders. There are no data available to assess the potential area of disturbance to fish species.

Table 2: Predicted extent of potential auditory injury (PTS) and disturbance to harbour porpoise from the proposed surveys (Source BP 2021a).

Survey	PTS		Disturbance		
	Distance (m)	Area (m^2)	Distance (km)	24 hr Area (km^2)	Total area (km^2)
Greater NEP seismic	Not exceeded	0	8.9	1,720	3,400

6 EFFECTIVE DETERRENT RADIUS / RANGE

6.1 The Effective Deterrent Radius / Range (EDR) has been proposed by the Statutory Nature Conservation Bodies (SNCBs) as a means to measure potential impacts on harbour porpoise within the SAC (JNCC 2017b,c; 2020). The EDR is an empirically derived generic distance within which deterrence, i.e. displacement, of harbour porpoise is predicted to occur. The EDR are based on published studies that have monitored the effects on harbour porpoise from various activities and reflects the overall loss of habitat if all animals vacate the area (e.g. Defra 2015). It is an area of displacement as opposed to disturbance, which may be greater.

6.2 The published precautionary EDR are presented in Table 3 (JNCC 2020). Relevant to this assessment are the EDRs for seismic surveys. The JNCC have advised that due to the relatively small size of the airguns to be used during the surveys that the EDR to be used in this assessment should be 12 km (JNCC 2022a).

Table 3: Precautionary Effective Deterrent Ranges (EDR) (Source: JNCC 2020).

Activity	Effective Deterrent Range (km)
Monopile	26
Unexploded Ordnance	26
Pin-pile [1]	15
Monopile with noise abatement	15
Conductor piling	15
Seismic survey	12
High Resolution Geophysical Surveys	5

[1] Pin-piles are '*smaller diameter piles that secure jacket structures'* although no definition as what diameter a pin-pile should be has been provided in published advice (JNCC 2020).

6.3 The SNCBs recognise that future data may require the suitability of the EDR to be reconsidered if it is found to be inappropriate (JNCC 2020).

7 CONSERVATION OBJECTIVES

7.1 Conservation Objectives constitute a necessary reference for identifying site-based conservation measures and for carrying out HRAs of the implications of plans or projects (JNCC and NE 2019). They outline the desired state for any European site, in terms of the features for which it has been designated. If these features are being managed in a way which maintains their nature conservation value, they are assessed as being in a 'favourable condition'. An adverse effect on the integrity of a site is likely to be one which prevents the site from making the same contribution to favourable conservation status for the relevant feature as it did at the time of its designation (English Nature 1997).

7.2 The purpose of an Appropriate Assessment is to determine whether a plan or project adversely affects a site's integrity. The critical consideration in relation to site integrity is whether the plan or project affecting a site, either individually or in-combination, affects the site's ability to achieve its conservation objectives and favourable conservation status.

Southern North Sea SAC

7.3 The Southern North Sea SAC was designated as a SAC in 2019. The site covers an area of 36,951 km^2 and is designated for harbour porpoise.

7.4 Harbour porpoise are also protected throughout European waters under the provisions of Annex IV and Article 12 of the Habitats Directive, which are outwith the scope of this assessment. Harbour porpoise in UK waters are considered part of a wider European population and the mobile nature of this species means that the concept of a 'site population' is not thought to be appropriate for this species. Site based conservation measures therefore aim to complement wider ranging measures that are in place for the harbour porpoise (JNCC and NE 2019).

7.5 The Conservation Objectives for harbour porpoise are designed to ensure that human activities do not, in the context of maintaining site integrity:

- kill, or injure harbour porpoise (directly or indirectly),
- prevent their use of significant parts of the site (disturbance / displacement),
- significantly damage relevant habitats, or
- significantly reduce the availability of prey.

Southern North Sea SAC Conservation Objectives:

To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status for Harbour Porpoise in UK waters.

In the context of natural change, this will be achieved by ensuring that:

1. Harbour porpoise is a viable component of the site,
2. There is no significant disturbance of the species, and
3. The condition of supporting habitats and processes, and the availability of prey is maintained.

Source: JNCC and NE 2019

7.6 Harbour porpoises are considered to be a 'viable component' of the site if they are able to survive and live successfully within it. The first Conservation Objective aims to minimise the risk from activities that cause unacceptable levels of impact on harbour porpoise using the site, specifically those that could impact on the Favourable Conservation Status of harbour porpoise (JNCC and NE 2016, 2019).

7.7 The '*integrity of the site*' is not defined in the Conservation Objectives. However, EU and UK Government guidance defines the integrity of a site as ''*the coherence of the site's ecological structure and function, across its whole area, or the habitats, complex of habitats and/or populations of species for which the site is or will be classified*' (EC 2000, Defra 2012). Therefore, the integrity of the site applies to the whole of the site and it is the potential impacts across the whole of the site that are required to be appropriately assessed. Pressures that would affect site integrity include:

- killing or injuring harbour porpoise (directly or indirectly),
- preventing their use of significant parts of the site (disturbance / displacement),
- significantly damaging relevant habitats,
- significantly reducing the availability of prey. (JNCC and NE 2019).

7.8 The second Conservation Objective states that there should be '…*no significant disturbance of the species'* and that '*Disturbance is considered significant if it leads to the exclusion of harbour porpoise from a significant portion of the site'* (JNCC and NE 2019).

7.9 *'Supporting habitats and processes'* relate to the seabed and water column along with the harbour porpoise prey.

7.10 JNCC advise that it is not appropriate to use the site population estimates in any assessments of effects of plans or projects (i.e. Habitats Regulation Assessments), as it is necessary to take into

consideration population estimates at the Management Unit level to account for daily and seasonal movements of the animals (JNCC 2017d; JNCC and NE 2019), .

7.11 There are no formal thresholds at which impacts on site integrity are considered to be adverse. However, a threshold of 1.7% of the relevant harbour porpoise population above which a population decline is inevitable has been agreed with Parties to the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS), with an intermediate precautionary objective of reducing the impact to less than 1% of the population (Defra 2003, ASCOBANS 2015). This threshold relates to impacts from fisheries by-catch on harbour porpoise where the impact on the harbour porpoise is permanent, i.e. up to 1.7% of the population may be caught as by-catch before a population decline is inevitable. An equivalent level of impact from disturbance, which is temporary and non-lethal, on a population will have a lower level of impact on the population compared to that from a fisheries by-catch.

7.12 The lack of agreed population thresholds either at the Management Unit level or site level, below which evidence demonstrates there would not be an adverse effect, does not prevent objective judgements to be made on site integrity.

7.13 Draft thresholds to assess and manage the effects of noise on site integrity have been proposed by the JNCC and NE (JNCC 2017b,c; JNCC and NE 2019, JNCC 2020). The proposed approach is not based on a population level impact but is instead based on a temporal and spatial level where a proportion of the area within the SAC may be affected over a period of time.

7.14 The JNCC and NE advice is that *'noise disturbance within the site should not exclude harbour porpoise from more than 20% of the site on any given day. Over a season, the advice is that an average loss of access to more than 10% of the SAC should be considered significant, recognising that within the SAC the abundance of harbour porpoise per unit habitat is generally higher than the equivalent sized habitat in the rest of the relevant Management Unit. Management of temporary habitat 'loss' to below defined area/time thresholds is therefore designed to ensure that it continues to contribute in the best possible way to the maintenance of the species at FCS.'* (JNCC 2020).

7.15 The potential extent of noise causing disturbance that would meet these proposed thresholds and therefore impact on the integrity of the site are presented in Table 4. The results indicate that should the impact occur wholly inside the SAC that, within the 'summer' area a sound source alone or in-combination causing disturbance for one day over an area of 7,390 km^2 would risk impacting site integrity. This is equivalent to a circular radius of noise out to 41.5 km. To exceed the threshold for the 'winter' area, noise in any one day should not extend over an area of more than 2,537 km^2; equivalent to a circular radius of 28.4 km.

7.16 Over the course of a season the total extent of potential disturbance on average per day should, in the 'summer' area, not extend over an area of more than 3,695 km^2; equivalent to a radius of

noise of 29.3 km and in the 'winter' area should not extend over an area of more than 1,269 km^2, equivalent to a radius of 20.1 km.

Table 4: Estimated extent sound levels capable of causing displacement disturbance in order to impact on site integrity.

Site	Area (km^2)	1 day threshold		Seasonal threshold	
		20% of area (km^2)	Distance to threshold (km)	10% of area (km^2)	Distance to threshold (km)
Southern North Sea SAC	36,951	7,390	48.5	3,695	34.3
'summer' area April - September	27,028	5,406	41.5	2,701	29.3
'winter' area October - March	12,696	2,539	28.4	1,270	20.1

The 'Distance to threshold' presumes sound propagation is circular in shape, i.e. the distance is the equivalent to a radius of circular noise.

7.17 Unlike the daily threshold, the area of the SAC that can be affected over the course of a season is an average over the season. The seasonal average is calculated by summing the proportion of the site impacted (for the relevant season) over the number of days the impact will occur and then averaging across the total number of days within that season, i.e. 183 days in the summer period and 182 days in the winter period. This provides a seasonal average spatial effect.

7.18 This assessment is based on both the potential impact on the North Sea Management Unit population using the ASCOBANS thresholds and the SNCB threshold approach.

7.19 In order to undertake any meaningful assessment using the threshold approach accurate information on the timing, duration and extent of activities being undertaken is required. Where this information is lacking or where speculative 'worst-case' scenarios are used there is little or no confidence that the results will bear any resemblance to the true extent of impact within the SAC on any single day or across the course of a season. Furthermore, where there are multiple activities being undertaken the probability of all the worst-case scenarios occurring on any single day are often so remote that it is unrealistic for it to be reasonably expected to arise. Where this occurs the use of 'average' daily/seasonal impacts from each of the activities has been used, which provides a more probable and realistic extent of impact upon which an assessment can based.

7.20 The HRA has been carried out in light of best scientific knowledge with reference to the Conservation Objectives of the SAC and the potential impacts on the integrity of the site (EC 2010).

8 IN-COMBINATION IMPACTS

8.1 Under the Habitats Regulations, it is necessary to consider the in-combination effects of plans or projects on European Sites. These refer to effects, which may or may not interact with each other, but which could affect the same receptor or interest feature (i.e. a habitat or species for which a European site is designated).

8.2 The in-combination assessment includes plans or projects that are subject to licences which are:

- Under construction,
- Permitted application(s), but not yet implemented,
- Submitted application(s), not yet determined,
- Projects identified in the relevant Development Plan (and emerging Development Plans),
- Sites identified in other policy documents, as development reasonably likely to come forward.

Renewable energy activity

8.3 A source of potentially significant in-combination underwater noise impact is from pile driving activity occurring during the construction of offshore renewable developments, particularly offshore wind farms.

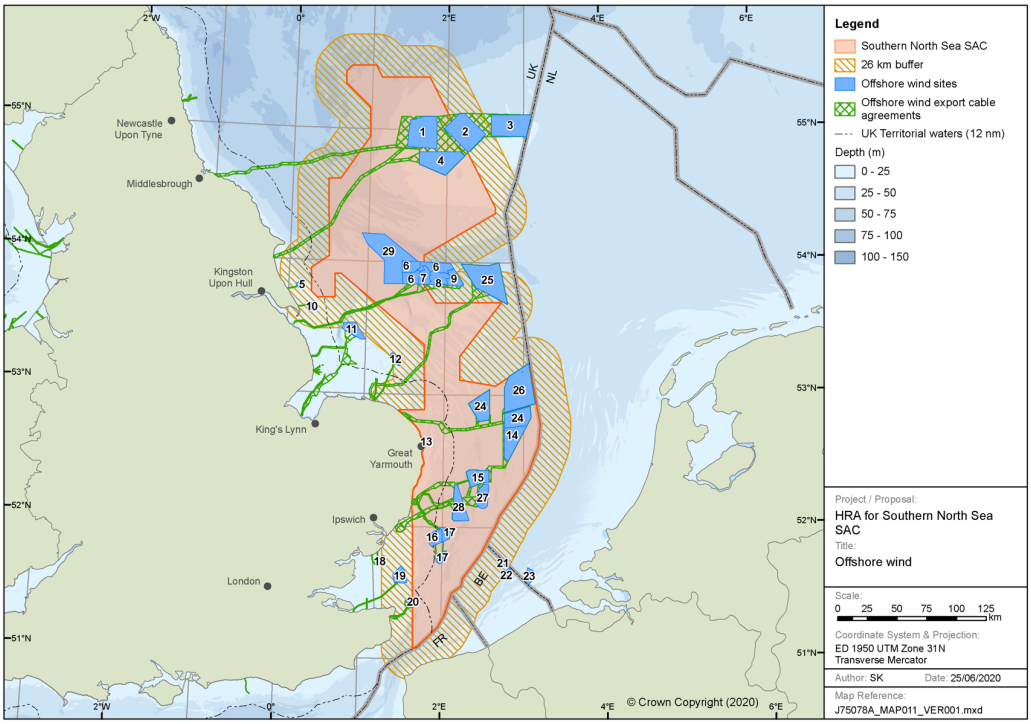
8.4 There are 21 UK offshore wind farms that lie wholly within the Southern North Sea SAC or are within 26 km of the boundary which is identified by the JNCC as an area that harbour porpoises may be displaced from by noise arising from pile-driving activities (JNCC 2017b, JNCC 2020). (Table 5 and Figure 3). One wind farm (Triton Knoll) is currently undertaking offshore construction but has completed pile-driving and Hornsea Two has started pre-construction activities offshore, including the clearance of unexploded ordnance (UXO). All other wind farms are either operating, consented but not started offshore construction or have submitted applications and are awaiting determination.

8.5 There are further additional wind farms located in Dutch and Belgium waters that could during construction impact on the Southern North Sea SAC. In the Dutch sector, offshore construction at the Borssele I and II wind farms has largely been completed and no piling is being undertaken. Offshore construction at the Borssele III and IV wind farms started in October 2019 and is on-going. Noise mitigation technology is being used at these wind farms during pile-driving activities.

8.6 In Belgium the SeaMade wind farms: Mermaid and Seastar are under construction. However, all the monopile foundations have been installed.

Table 5: Offshore wind farms located within 26 km of the Southern North Sea SAC.

Wind farm	Status
Round 1	
Scroby Sands	Operating
Round 2/2.5	
Dudgeon	Operating
Galloper	Operating
Greater Gabbard	Operating
Gunfleet Sands II	Operating
Humber Gateway	Operating
Thanet	Operating
Triton Knoll	Operating
Westermost Rough	Operating
Round 3	
Dogger Bank A	Offshore construction started
Dogger Bank B	Onshore construction started
Dogger Bank C	Onshore construction started
Sofia	Consented
East Anglia One	Operating
East Anglia One North	Consented
East Anglia Two	Consented
East Anglia Three	Consented
Hornsea Project One	Operating
Hornsea Project Two	Offshore construction started
Hornsea Project Three	Consented
Hornsea Project Four	Application submitted
Norfolk Vanguard	Consented
Norfolk Boreas	Consented
Belgium	
SeaMade (Mermaind and Seastar)	Operating
Netherlands	
Borssele I and II	Operating
Borssele III and IV	Operating



1	Dogger Bank B (Creyke Beck B)	16	Greater Gabbard
2	Sofia (Teesside B)	17	Galloper
3	Dogger Bank C (Teesside A)	18	Gunfleet Sands II
4	Dogger Bank A (Creyke Beck A)	19	London Array
5	Westermost Rough	20	Thanet
6	Hornsea Project 2	21	THV Mermaid
7	Hornsea 1 (West)	22	Belwind I
8	Hornsea 1 (Centre)	23	Borssele II
9	Hornsea 1 (East)	24	Norfolk Vanguard East
10	Humber Gateway	24	Norfolk Vanguard West
11	Triton Knoll	25	Hornsea Project Three
12	Dudgeon	26	Norfolk Boreas
13	Scroby Sands	27	East Anglia One
14	East Anglia Three	28	East Anglia Two
15	East Anglia One North	29	Hornsea Project Four

Figure 3: Offshore wind farms located within 26 km of the Southern North Sea SAC.

8.7 Of the offshore wind farms that are relevant to the in-combination assessment the Dogger Bank A offshore wind farm could be pile-driving from June 2022 onwards. The exact dates that construction works will commence are not known.

8.8 An application to undertake UXO clearance from between July 2021 to end of September 2021 and from April 2022 to November 2022 has been submitted to the MMO for the Sofia offshore wind farm (SOWFL 2020, SOWFL 2021a).

8.9 An estimated 50 items of UXO are to be cleared within the wind farm array area and along the cable export route. Three methods of disposal have been identified: low order deflagration, high

order detonation and relocation. Low order deflagration will be undertaken at all but a maximum of five locations within the Southern North Sea SAC (SOWFL 2021a,b).

8.10 Where High Order Detonation are undertaken for items of UXO greater than 50 kg, bubble curtains will be used, where conditions allow, between land fall and KP85 and only between the dates of 16 August and 16 October 2022 (SOWFL 2021c).

8.11 A variation to an existing Marine Licence (MLA/2018/00503/2) to clear UXO at the Hornsea Two offshore wind farm has been submitted to the MMO (MMO 2022a). The variation requests that the licence end date is extended from 31 March 2022 to 30 September 2022.

8.12 The licensed number of detonations will not be increased, the remaining 40 permitted detonations (as of December 2021) may take place during this time period.

8.13 For items of UXO greater than 50 kg, bubble curtains must be used to mitigate against noise when undertaken in water depths of between 5 m and 40 m and when currents are less than 1.5 m/s (MMO 2019a). Out of 60 detonations undertaken to date four (6.5%) have been undertaken without bubble curtains (SOWF 2021a). Subsequently, the applicant has confirmed that they will use low-order deflagration for any future clearance of UXO.

Aggregate extraction and dredging activity

8.14 Existing localised aggregate dredging occurs primarily in the southern half of the SAC, along the east coast (Figure 4). In 2019 there were 29 aggregate production areas and five Exploration and Option areas covering an area of 579.2 km^2. Five of the aggregate areas occur in the 'summer' area of SAC covering 77.7 km^2 and the rest occur in the 'winter' area of the SAC and cover an area 533.8 km^2, with some sites occurring in both the 'winter' and 'summer' areas.

8.15 Studies have indicated that harbour porpoise may be displaced by dredging operations within 600 m of the activities (Diederichs *et al*. 2010). Noise modelling previously undertaken for aggregate assessments have predicted significant levels of avoidance at ranges of 500 m from suction dredging (Parvin *et al* 2008 (referenced in Hanson Aggregates Marine Ltd 2013)).

8.16 On a precautionary assumption that there is a level of behavioural displacement out to 600 m, there is potential for an area of 1.13 km^2 to be affected at each active dredging location. There are currently three aggregate production areas in the 'summer' area and 26 in the 'winter' area. Although the level of dredging activity within each of the active licence areas is unknown, as a worst-case scenario, with dredging occurring within each dredging area, porpoise may be displaced from an area of 3.39 km^2 in the 'summer' area and 29.38 km^2 in the 'winter' area. Therefore, a very small proportion (0.01% of the summer area and 0.2% of the summer area) of the SAC may be impacted by noise arising from dredging activities.

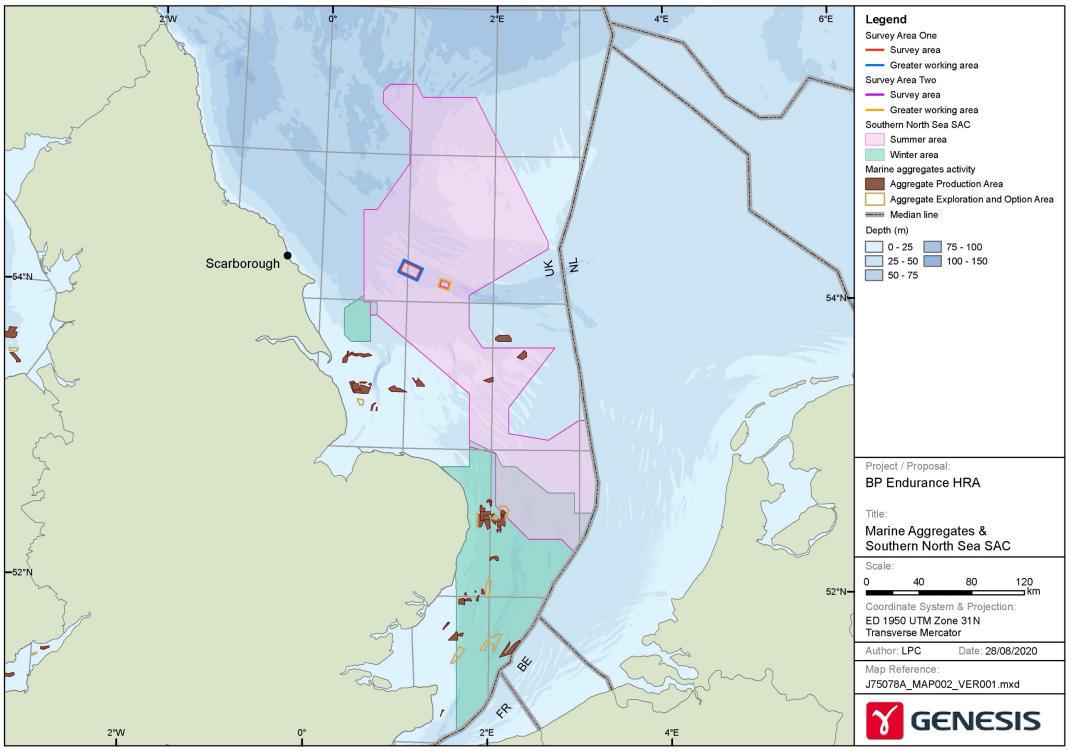


Figure 4: Existing marine aggregate activities in the Southern North Sea SAC.

Oil and gas activity

8.17 There is a long history of oil and gas activities within the boundaries of the Southern North Sea SAC. Since 1965, when the first well was spudded (first drilled), there has been extensive oil and gas development with a total of 117 installations installed within the SAC. The vast majority (94%) of all the installations within the boundary of SAC are located in the 'summer' area of the site (Figure 5) (OGA NDR 2020).

8.18 Seismic surveys have regularly been undertaken within the SAC over the last 50 years, with a total of 23 2D or 3D seismic surveys carried out within the SAC between 2008 and 2017. The majority of surveys during this period took place in the northern half of the SAC, where the most recent oil and gas activity has occurred (Figure 6).

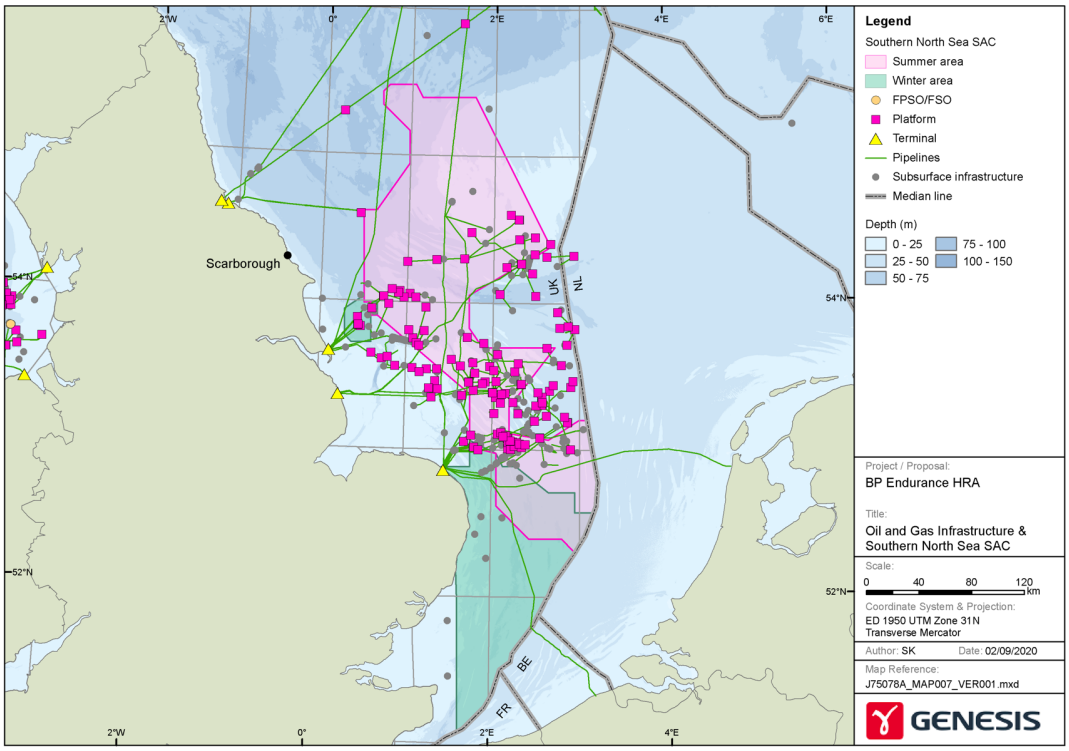


Figure 5: Existing oil and gas infrastructure within the Southern North Sea SAC.

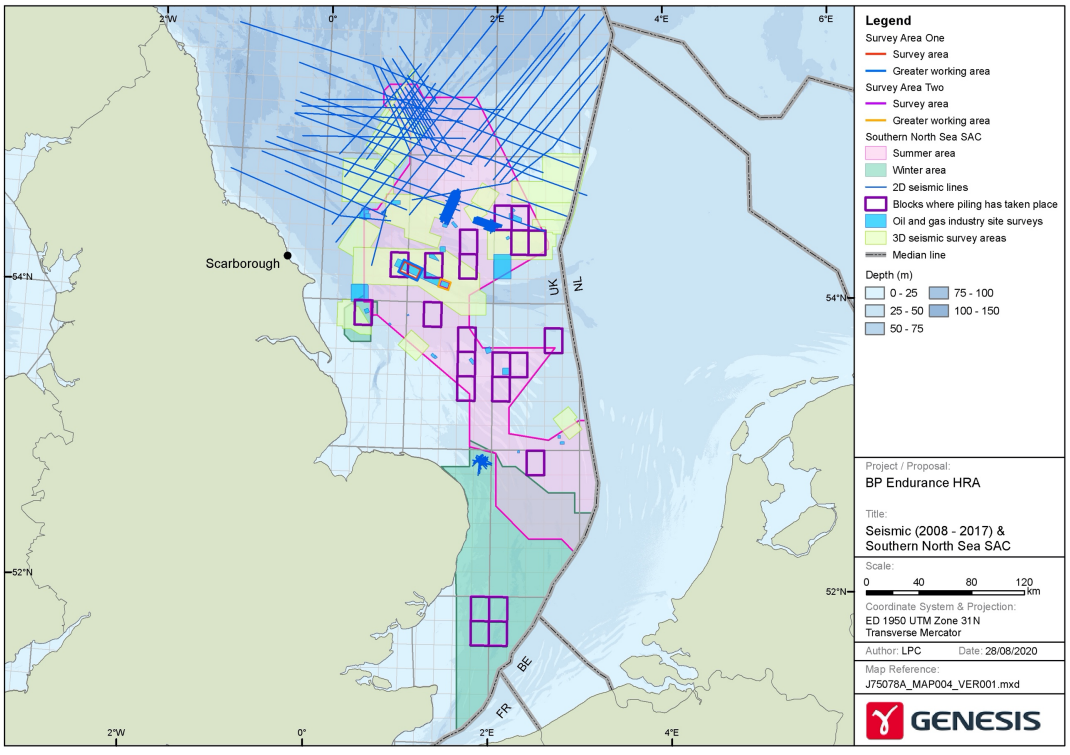


Figure 6: Oil and gas industry related seismic surveys undertaken within the Southern North Sea SAC between 2008 and 2017.

8.19 BEIS are aware of planned oil and gas related activities within the SAC during the period the proposed survey will be undertaken. However, none of the proposed activities relate to geophysical or seismic surveys or other similar activities capable of causing levels of noise that could cause disturbance to harbour porpoise.

Shipping

8.20 Impacts from shipping on harbour porpoise within the SAC have been identified as arising from shipping noise and collision impacts. Shipping noise is the predominant anthropogenic source of noise within the marine environment and is reported to have a negative effect on harbour porpoise within the SAC when vessel traffic exceeds 80 vessels per day (JNCC 2017d). Shipping has been on-going in the southern North Sea for many hundreds of years and the area is important for shipping, with relatively high numbers of vessels occurring within it. Based on vessel track lines, in 2015 a total of 269,018 vessels track lines were recorded transiting across the SAC; an average of 737 vessels per day (MMO 2017a).

8.21 The level of vessel activity across the 'summer' and 'winter' areas of the SAC differs (Figure 7). There is relatively widespread vessel activity in low densities across the 'summer' area, with 76% of the quadrants having less than seven vessels per week and 17% having less than one vessel per week. Compared with the 'winter' area of the SAC where 14% of the quadrants had, on average, less than seven vessels per week and only 1% had less than one vessel per week. In contrast 11% of the 'winter' area had more than 70 vessels per week compared with none in the 'summer' area. The areas with relatively higher levels of shipping (>24 vessels per day), occur over 4% of the 'winter' area. Therefore, the 'winter' area has relatively localised, higher density, areas of vessel traffic compared with the 'summer' area that has widespread but low density vessel traffic.

Fishing activity

8.22 Fishing occurs widely across the southern North Sea and has also been on-going in the area for many hundreds of years. The majority of current fish landings are obtained from areas adjacent to the SAC but there is widespread fishing activity in the southern half and north-eastern edge of the SAC and relatively moderate to high levels of fishing activity along the western edge of the central part of the SAC (Figure 8) (MMO 2017b). Note however, this does not include the activities of non-UK registered vessels that will occur within the site or vessels greater than 15 m in length.

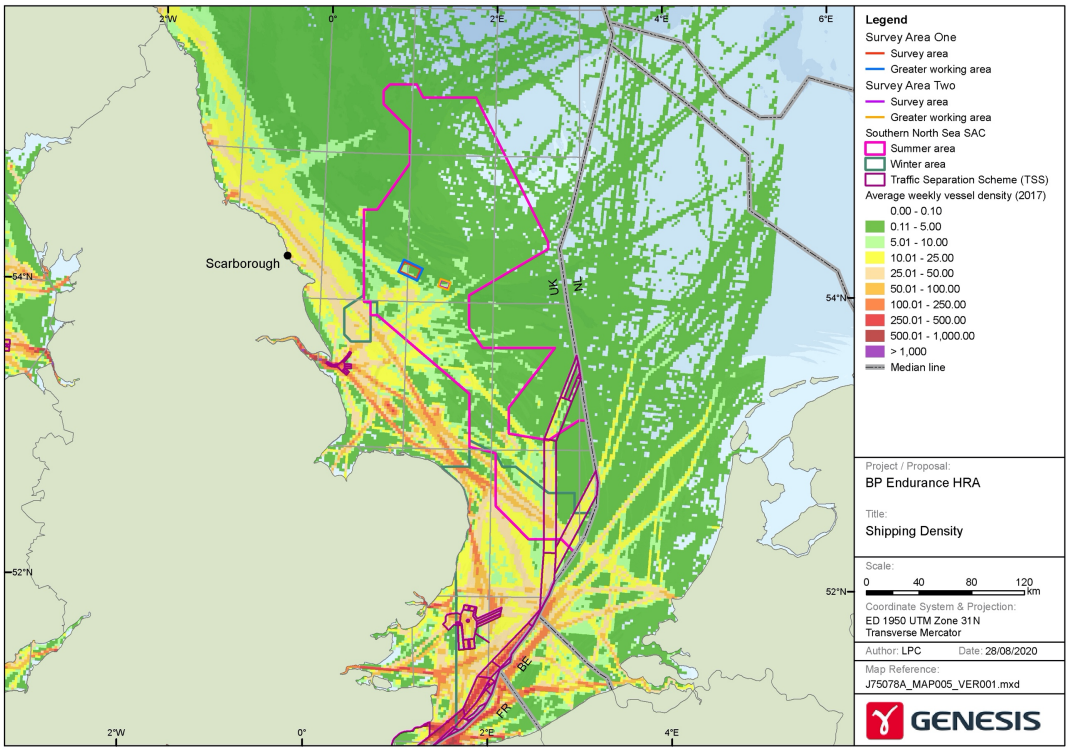


Figure 7: Shipping density within the SAC during 2015.

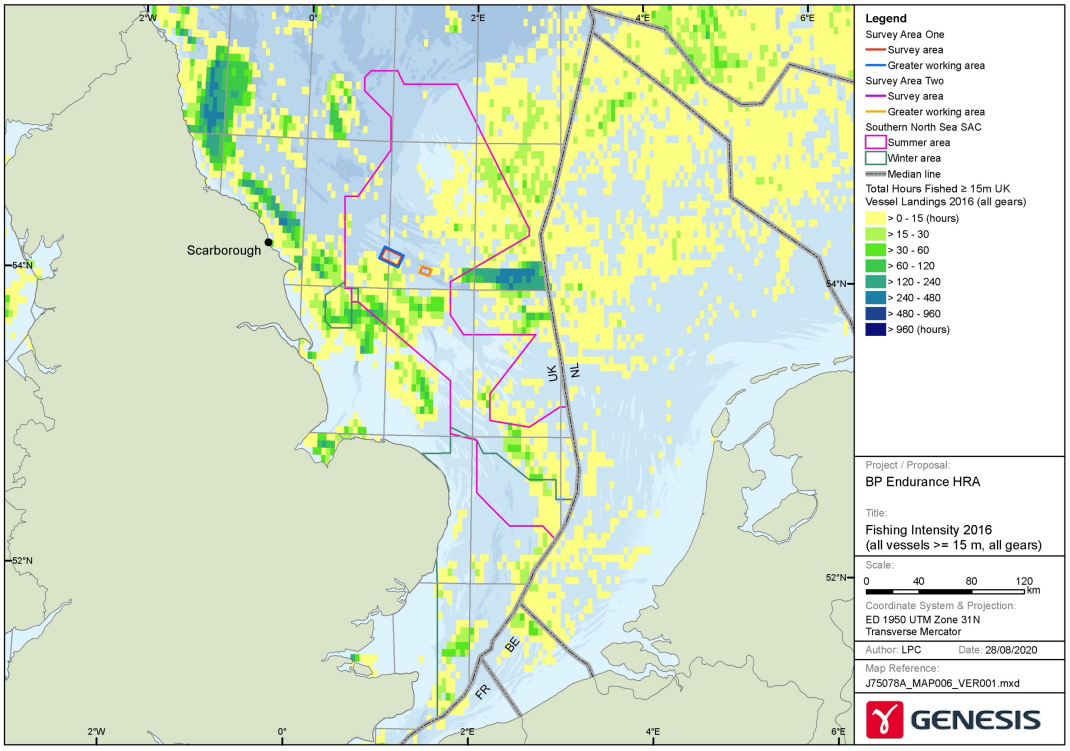


Figure 8: Fishing intensity across the SAC during 2016 by UK registered vessels.

8.23 There is a high risk of an impact from bycatch associated with the fishing industry to harbour porpoise across the North Sea, i.e. there is good evidence of a significant impact. There is a medium risk of an impact from removal of prey (JNCC and NE 2019).

8.24 The bycatch of harbour porpoise in fishing gear is reported to be one of the most significant anthropogenic pressures impacting on the harbour porpoise population (JNCC and NE 2019). It is estimated that between 1,235 and 1,990 harbour porpoise die each year in the North Sea due to bycatch, predominantly in gill nets (ICES 2016, Mitchell *et al*. 2018, OSPAR 2017). This is approximately 0.6% of the North Sea Management Unit population.

8.25 Noise modelling predicts, that the proposed surveys will not cause any direct mortality to any harbour porpoise and therefore there will be no in-combination impact between fishing and the survey.

In-combination conclusion

8.26 Following consideration of all known developments that could cause a likely significant effect, BEIS considers that there are plans or projects likely to cause an in-combination likely significant effect. The activities likely to cause an in-combination impact considered within this HRA are:

- UXO clearance at Sofia offshore wind farm,
- UXO clearance at Hornsea Two offshore wind farm,
- Construction pile-driving at Dogger Bank A offshore wind farm.

9 LIKELY SIGNIFICANT EFFECTS TEST

9.1 Regulation 5 of the 2001 Regulations requires the Competent Authority to consider whether a development will have a likely significant effect on a European site, either alone or in combination with other plans or projects. A likely significant effect is, in this context, any effect that may be reasonably predicted as a consequence of a plan or project that may affect the Conservation Objectives of the features for which the site was designated but excluding trivial or inconsequential effects. An Appropriate Assessment is required if a plan or project is likely to have a significant effect on a European site, either alone or in combination with other plans or projects. A judgement of likely significant effect in no way pre-supposes a judgement of adverse effect on site integrity.

9.2 There are no recognised criteria as to what can be considered to be trivial or inconsequential impacts. Where predicted impacts are relatively very small compared to either the population of the management unit or the area of the site or the duration of the impact, it was determined that the impact would not cause a likely significant effect.

9.3 This section addresses this first step of the HRA, for which BEIS has considered the potential impacts of the survey both alone and in combination with other plans and projects on each of the interest features of the relevant European sites to determine whether or not there will be a likely significant effect.

Harbour porpoise

9.4 Harbour porpoise are a qualifying species for the Southern North Sea SAC.

9.5 Within the Southern North Sea SAC harbour porpoise are known to occur throughout the site, with concentrations in the northern 'summer' area over which the proposed surveys overlap. Noise modelling undertaken indicates that there is no potential for auditory injury to occur but disturbance or displacement effects could occur out to 8.9 km and extend, during the course of the survey, over an area of 3,400 km^2 (Table 2).

9.6 Based on the predicted extent of potential impacts, it is concluded that there is potential for a likely significant effect on harbour porpoise from the proposed survey within or adjacent to the Southern North Sea SAC; the potential impacts on harbour porpoise are therefore considered further in the Appropriate Assessment.

Likely significant effects test - conclusions

9.7 Based on the information presented within the application relating to the proposed activities and the advice received during consultation it is concluded that it is not possible to exclude a likely significant effect on the following designated sites and qualifying species:

- Southern North Sea SAC: Harbour porpoise,

9.8 For all other designated sites and associated qualifying habitats or species it is concluded that there will not be a likely significant effect from the proposed surveys either alone or in-combination with other plans or projects.

10 APPROPRIATE ASSESSMENT

10.1 An Appropriate Assessment is triggered when the competent authority, in this case the Secretary of State, determines that a plan or project is likely to have a significant effect on a European site. Guidance issued by the European Commission states that the purpose of an Appropriate Assessment is to determine whether adverse effects on the integrity of the site can be ruled out as a result of the plan or project, either alone or in-combination with other plans and projects, in view of the site's conservation objectives (EC 2000).

10.2 The following sections assess whether there will be an adverse effect on the Southern North Sea SAC from the project alone and in-combination.

10.3 A dual approach based on outputs from noise modelling and supported by the use of EDR has been used in order to determine whether an adverse effect on the integrity of the Southern North Sea SAC will occur.

10.4 The assessment of the potential impacts from the seismic survey is based on the results from noise modelling undertaken by the applicant. This approach takes into account project specific factors that can affect the level of sound produced and its propagation within the water column. From this it is possible to estimate the number of harbour porpoise that may be affected and the overall duration of the potential impacts. Based on the study published by ASCOBANS (2015) an annual reduction in the population of 1.7% could cause a population level decline (Para. 7.11). However, a similar level of impact from disturbance is predicted to not cause a population level of decline.

10.5 Following advice received a second approach to the assessment has also been undertaken based on recommendations by the JNCC. This approach is based on the use of a generic EDR for all seismic survey activities irrespective of their location and airgun size. Following published evidence and advice received from the JNCC, for the purposes of this assessment a 12 km EDR has been used for the seismic survey. The extent and duration of the survey is then measured against thresholds above which an adverse effect on site integrity could arise, as described in Section 6.

Southern North Sea SAC (Harbour porpoise)

Physical Injury

10.6 Noise modelling undertaken indicates that, based on the weighted SEL threshold, there is no potential for sound levels to cause the onset of PTS to harbour porpoise (Section 5).

Disturbance

10.7 The largest distance any noise likely to cause disturbance is estimated to propagate out to is 8.9 km from the airguns, covering an area of 1,720 km^2 over a 24 hr period (Table 2). Assuming

that the disturbance occurs entirely within the SAC, then approximately 4.6% of the SAC as a whole and 6.4% of the 'summer' area could be affected by the proposed seismic survey over a period of 24 hrs.

10.8 Based on a peak site density of 3.0 ind./km^2 an estimated 5,160 harbour porpoise could be disturbed by the proposed survey over 24 hrs. This is equivalent to 1.5% of the North Sea Management Unit harbour porpoise population being disturbed. This estimate is based on the highest density of porpoises modelled within the SAC and not from survey data which has reported lower densities within the SAC (See Para. 3.14).

10.9 Based on the latest densities recorded during the SCANS surveys of 0.888 ind./km^2 the estimated number of porpoise disturbed each day is 1,527 individuals; 0.44% of the North Sea Management Unit population.

10.10 Over the duration of the survey the total area predicted to be disturbed is 3,400 km^2 (Table 2). Based on the maximum density an estimated 10,200 harbour porpoise may be disturbed, equivalent to 2.9% of the North Sea Management Unit population.

10.11 The estimated number of harbour porpoise that could be disturbed over the duration of the survey based on the latest SCANS density estimate of 0.888 km^2 is 3,019 individuals; 0.87% of the North Sea Management Unit population.

10.12 Studies undertaken in the Danish sector of the Central North Sea reported disturbance out to 12 km from a 3,570 cu. in. airgun, although the duration of the disturbance is not reported (Sarnocińska *et al*. 2020). Similar studies undertaken in the Moray Firth using a 470 cu in airgun with source levels estimated to be 242–253 dB re 1 µPa @ 1 m $_{(peak\ to\ peak)}$, reported a decrease in the relative densities of harbour porpoises within 10 km of the airgun and an increase in densities at greater distances. However, porpoises continued to occur at sites within the impacted area during the seismic survey and there was a decline in the level of displacement over the ten day period that surveys were undertaken, indicating an increasing level of acclimation during the surveys. Once the surveys had ceased the number of detections returned to baseline levels within a day (Thompson *et al.* 2013, Pirotta *et al.* 2014). Therefore, any displacement effects caused by the proposed surveys are predicted to be temporary, with porpoises returning to the area impacted within approximately 24 hrs.

Threshold Approach

10.13 The JNCC have advised that the assessment for harbour porpoise within the SAC should be undertaken by the threshold approach, whereby disturbance should not exceed 20% of the SAC 'summer' or 'winter' areas on any one day and on average 10% of an area over the course of a single season (see Section 7). To calculate the extent of noise within the SAC using the threshold approach the extent of disturbance from a moving sound source over the course of 24 hrs and

the season is required. This assessment has been undertaken by the applicant as part of their application and used by BEIS as part of this HRA (BP 2022a,b).

10.14 The JNCC have advised BEIS that the EDR to be used for this assessment should be 12 km, this is in line with their current guidance on EDR (JNCC 2020).

Daily Threshold

10.15 In order to calculate whether the daily threshold of 20% of the seasonal area is impacted an accurate estimate of the level of activity within the SAC is required.

10.16 The applicant has stated that when undertaking the surveys the vessel will be travelling at no greater than 4.5 knots (8.4 km/h) and that airguns will be operating for no more than 21 hours during any 24 hour period. Airguns will be operating for approximately 175 km of survey line each day (BP 2021a,b).

10.17 Assuming a 12 km EDR, the total area impacted over the course of 24 hrs could be 4,652 km^2 (Figure 9). This presumes that airguns are operating continuously for 21 hours out of a 24 hour period and that there is a single surveyed line located wholly within the SAC. This is not the case and the applicant has confirmed that the longest line to be surveyed is 75 km, of which 60 km is within the SAC and that each consecutive survey line will be no more than 5 km from the previous line surveyed (BP 2022a,c).

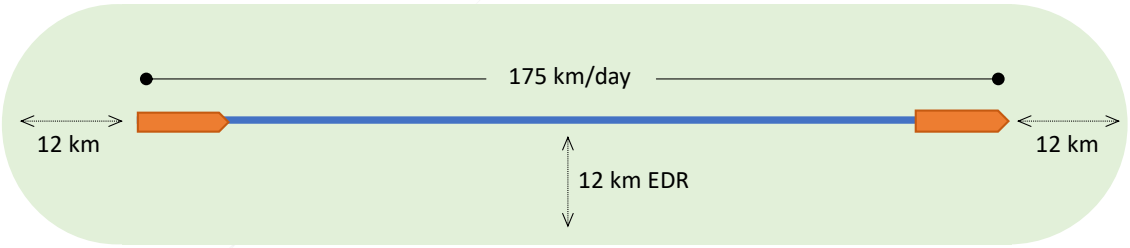


Figure 9: Worst-case theoretical area of impact from a 4D Test Line survey travelling at 4.5 knots using 10 km EDR.

10.18 On the basis of the information provided by the applicant and the advice received from the JNCC the maximum area of impact within the SAC from the proposed survey based on a maximum line spacing of 5 km is estimated to be 2,190 km^2 (Figure 10 and Appendix A). This is equivalent to 8.1% of the 'summer' area.

10.19 The variation request is to increase the line spacing from 5 km to up to 20 km. On this basis the maximum area of impact within the SAC from the proposed survey based on a maximum line spacing of 20 km is estimated to be 2,775 km^2. This is equivalent to 10.27% of the summer area.

10.20 The daily threshold will not be exceeded by the proposed survey when undertaking surveys with line spacing of less than 20 km.

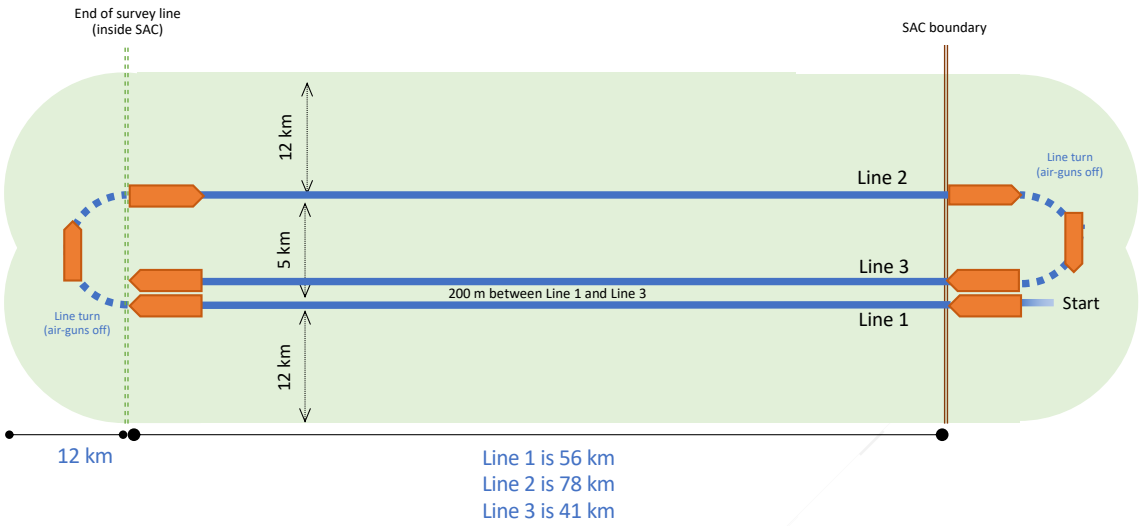


Figure 10: Example of a maximum area impacted over one day from proposed NEP 3D survey (175 km of survey line per day and 5 km spacing between consecutive lines) (Source BP 2022a).

Seasonal Threshold

10.21 The survey is planned to start no earlier than 1 April 2022 and last for no more than 92 days during which airguns will be operational for an estimated 64 days (BP 2021a, 2022a). Consequently, the proposed survey will be undertaken entirely within the summer period of between April and September).

10.22 To assess the seasonal spatial overlap two possible scenarios have been considered.

1. Airguns will be operated over the entire period of the proposed survey of 92 days and impact across the maximum possible extent each day. This is highly precautionary and unrealistic. Although airguns could be operated over more days than the estimated 64 days stated in the application, it is not possible for the maximum area of the SAC to be impacted each day. Due to the way the survey is configured the maximum possible area of disturbance within the SAC will only occur on one day.

2. Airguns will be operated over no more than 64 days and impact across the maximum possible extent each day. This is an unrealistic scenario as it is not possible for the maximum area of the SAC to be impacted each day. Due to the way the survey is configured the maximum possible area of disturbance within the SAC will only occur on one day.

10.23 A two day 'recovery period' is included in each assessment to account for the delay in porpoises returning to an area following displacement and therefore effectively still be deterred from an area of the SAC.

10.24 Based on the maximum daily impacts from each of the survey durations and the two line spacing options the seasonal threshold would be between 2.9% and 5.3%. and therefore the seasonal threshold will not be exceeded (Table 6).

Table 6: Estimated extent of seasonal disturbance on harbour porpoise from proposed NEP 3D seismic survey within the SAC.

SAC area	Area impacted per day (km^2)	Daily Threshold (%)	Estimated duration of impact (days) *	Seasonal Threshold (%)
Maximum line spacing 5 km (original application)				
Scenario 1: Maximum area of daily impact over 92 day period				
'summer'	2,190	8.1	94	4.2
Scenario 2: Maximum area of daily impact over 64 day period				
'summer'	2,190	8.1	66	2.9
Maximum line spacing 20 km (variation)				
Scenario 1: Maximum area of daily impact over 92 day period				
'summer'	2,775	10.3	94	5.3
Scenario 2: Maximum area of daily impact over 64 day period				
'summer'	2,775	10.3	66	3.7

* Includes two day 'recovery period' following completion of the survey.

10.25 There is potential for the prey species of harbour porpoise to be impacted by the proposed surveys. Studies on the impacts to fish from seismic surveys indicate that any disturbance to fish is temporary and localised (Peña *et al*. 2013; Slotte *et al*. 2004; Wardle *et al*. 2001). Should fish be displaced, harbour porpoise will either relocate to areas where prey species are present or remain until the seismic vessel has moved further away and the fish return to the area. Any potential impacts will be very localised and temporary and any effects will be inconsequential.

Conclusion

10.26 Results from noise modelling indicate that no harbour porpoise are at risk of physical injury from noise arising from the proposed survey.

10.27 There is a risk of harbour porpoise being displaced or disturbed by the proposed survey. Noise modelling indicates that between 1,527 and 5,160 harbour porpoise may be disturbed over each day of the survey depending on the density of porpoise in the area. This is between 0.44% and 1.5% of the North Sea Management Unit population. The disturbance will be of short duration as

the vessel transits through the Survey Area. Once the vessel has passed, any changes in behaviour due to disturbance will cease quickly after the vessel has moved away and any porpoises that may have been displaced are predicted to return to the area within 24 hrs.

10.28 The results from the threshold approach indicate that a maximum daily disturbance of 8.1% of the 'summer' area could occur on one day during the survey. The seasonal impact ranges from between 2.9% and 4.2%. The daily and seasonal thresholds are not exceeded.

10.29 The proposed surveys will not affect the supporting habitats and will have a temporary and localised impact on the supporting prey species, e.g. fish. Once the proposed survey has moved away or ceased there will be no effect on the distribution, abundance and population dynamics of the species.

10.30 Based on the best available information and supported by results from noise modelling and the threshold approach, BEIS is satisfied that the proposed survey alone will not have an adverse effect upon the integrity of the Southern North Sea SAC with respect to harbour porpoise.

11 IN-COMBINATION ASSESSMENT

11.1 There is potential for in-combination impacts to arise due to noise from other known or planned activities and the proposed seismic survey.

11.2 Projects identified as having potential to cause an in-combination impact are:

- Dogger Bank A offshore wind farm - Pile-driving,
- Sofia offshore wind farm - UXO clearance,
- Hornsea Two – UXO clearance.

Dogger Bank A Pile-driving

11.3 Offshore construction at the Dogger Bank Offshore wind farm is planned to commence in Q2 2022 (SSE 2022). The exact date when offshore construction may commence is not known but previous applications for UXO clearance have indicated that foundation piling would start in June 2022 (DBWF 2020). In the absence of any further information it is presumed that offshore construction at Dogger Bank A will commence on 1 June 2022. Subsequent to this, BEIS have been informed that pile-driving at Dogger Bank A will not commence before 15 July 2022 and therefore will not be undertaken at the same time as the seismic survey which is due to be completed by the end of June 2022 (BP 2022e).

11.4 For the purposes of this assessment noise modelling undertaken by Dogger Bank Wind Farm for the Dogger Bank A and B offshore wind farms has been used. The modelling is based on the installation of 95 wind turbines at each of the wind farms. Each turbine will have 10 m diameter monopile driven into the seabed using a 4,000 kJ hammer (DBWF 2021).

11.5 The results from the modelling indicate that the onset of PTS could occur out to 1,400 m and encompass an area of 4 km^2. Levels of noise predicted to cause disturbance could occur out to 19 km and cover an area of 890 km^2 (DBWF 2021).

11.6 Based on the results from noise modelling and a peak density of 0.71 ind./km^2 recorded across the Dogger Bank Zone (Forewind 2014), an estimated three harbour porpoise are at risk of PTS from the pile-driving and 632 harbour porpoise may be disturbed or displaced.

11.7 BEIS has previously undertaken an assessment based on the SNCB threshold approach with an EDR of 26 km (BEIS 2020). The results of the assessment based on a 26 km EDR for monopile pile-driving indicated a maximum area of impact within the SAC from a single pile-driving event of 2,124 km^2, impacting 7.9% of the 'summer' area of the SAC and 4.2% of the seasonal threshold (Table 7).

11.8 The seasonal threshold is based on a worst-case and unrealistic maximum impact as it presumes that the maximum daily area of impact will occur across the installation of all 95 turbines. This is

not the case as those located within 26 km of the SAC boundary will impact across a smaller area of the SAC compared to those greater than 26 km within the boundary of the SAC. Consequently, the seasonal threshold will be smaller than 4.2%. However, there is no information available to calculate a realistic scenario based on an average daily impact and therefore this worst-case scenario is used for the purposes of this assessment.

11.9 It is important to note that this is based on the installation of a single foundation over a 24 hr period. It is technically possible, that two monopiles could be installed in one day in which case the area of disturbance would be greater. However, this scenario is considered to be highly unlikely to occur and has not been assessed in this HRA.

Table 7: Estimated extent of daily and seasonal disturbance on harbour porpoise from proposed pile-driving at Dogger Bank A offshore wind farm within the SAC.

SAC area	Area of SAC impacted per day (km^2)	Daily Threshold (%)	Estimated duration of impact (days) [1]	Seasonal Threshold (%)
-Pile driving Dogger Bank A monopiles				
'summer'	2,124	7.9	97	4.2

1 – This accounts for two days 'recovery time' following cessation of pile-driving.

Sofia UXO clearance

11.10 Noise modelling undertaken by SOWL indicates that the onset of PTS in harbour porpoise could occur within 14.6 km from a detonation of a 795 kg charge (SOWL 2021a).

11.11 Assuming circular propagation of noise, in the event that the onset of PTS extends 14.6 km from the source the onset of PTS could occur over an area of 669.6 km^2. The density of harbour porpoise across the Dogger Bank Zone is 0.71 ind./km^2 (Forewind 2014). Based on the site specific density, an estimated 475 harbour porpoise could be at risk of PTS in the event that an 800 kg UXO is detonated at Sofia offshore wind farm. This is 0.13% of the North Sea Management Unit population. However, it is important to note that mitigation measures in place will significantly reduce this potential impact. In particular, the use of low-order disposal and Acoustic Deterrent Devices will greatly reduce the extent of any potential impact and deter harbour porpoise away from the area of greatest risk (SOWLa,c).

11.12 Due to the very short duration noise arising from the detonation of a single item of UXO, there is limited potential for significant disturbance to arise with a startle response predicted to be the most likely behavioural response and limited other disturbance or displacement. However, the use of Acoustic Disturbance Devices (ADD), the purpose of which is to cause enough disturbance so that the harbour porpoise relocate away from an area, will cause disturbance. The extent disturbance is predicted to arise from the use of ADD at Sofia is 7,500 m, covering an area of

176 km^2. On this basis an estimated 125 harbour porpoise could be disturbed at each location that an ADD is used.

11.13 SOWL have undertaken an assessment based on the SNCB threshold approach with an EDR of 5 km when low-order detonation is undertaken and 26 km when high order detonation is carried out (SOWL 2021a).

11.14 When undertaking low-order detonations between one and two detonations could occur each day. Consequently, an area of between 78.5 km^2 and up to a maximum area of 157 km^2 could be impacted each day; between 0.3% and 0.6% of the 'summer' area of the SAC. The seasonal impact arising from detonating 50 items of UXO all using low order detonation is 0.08% (Table 8).

11.15 In the event that high-order detonation is undertaken the maximum area impacted within the SAC each day is between 2,124 km^2 and 3,782 km^2 depending on whether one or two detonations are carried out; equivalent to 7.9% and 14% of the 'summer' area of the SAC. There will be no more than five items of UXO detonated using high-order detonation methods during the whole UXO clearance campaign (SOWL 2021a,b). On this basis the seasonal threshold would be between 0.3% and 0.4% (Table 8).

11.16 The applicant has stated that when conditions are suitable bubble curtains will be used for all high-order detonations. The use of bubble curtains for pile-driving reduces the EDR from 26 km to 15 km (JNCC 2020) and although not stated in the recent guidance a similar level of effect for UXO clearance has been considered for the purposes of this assessment.

11.17 The reduction in the EDR to 15 km reduces the area impacted to between 2.6% and 5.2% of the 'summer' area depending on the number of detonations per day and the seasonal threshold is reduced to between 0.74% and 0.78%.

11.18 The applicant has stated that there will be no more than five items of UXO located within the SAC that will be detonated using high-order detonations and bubble curtains will be used if conditions are suitable (SOWL 2021a,b). All other items will be cleared using low-order detonation. Under this scenario it is estimated that the average seasonal threshold could be between 0.17 and 0.18% (Table 8).

Table 8: Seasonal spatial overlap for Sofia UXO detonations without bubble curtains.

SAC area	Maximum area of SAC impacted (km^2)	Daily Threshold (%)	No. of detonations	Estimated duration of impact (days) [1]	Seasonal Threshold (%)
Low-order detonation - One per day (50 detonations in total)					
'summer'	78.5	0.3	50	52	0.08
Low-order detonation – Two per day (50 detonations in total)					
'summer'	157	0.6	50	27	0.08
High-order detonation - One per day (5 detonations in total)					
'summer'	2,123.7	7.87	5	7	0.3
High-order detonation – Two per day (5 detonations in total)					
'summer'	3,781.7	14.01	5	5	0.4
High-order detonation - One per day (5 detonations with bubble curtains)					
'summer'	706.8	2.6	5	7	0.1
High-order detonation – Two per day (5 detonations with bubble curtains)					
'summer'	1,413.6	5.2	5	5	0.1
High-order and Low-order detonation - One per day (45 Low-order detonations and 5 High-order detonations with bubble curtains)					
'summer'	706.8	0.3/2.6	45 + 5	45+7	0.2
High-order and Low-order detonation – Two per day (45 Low-order detonations and 5 High-order detonations with bubble curtains)					
'summer'	1,413.6	0.6/5.2	45 + 5	25+5	0.2

1 – This includes two days 'recovery time' following cessation of UXO clearance.

11.19 The potential impact from UXO detonations using the threshold approach is unrealistically worst-case:

- It assumes that there will be 50 detonations all of which will be undertaken during the summer period; this figure is speculative and considered to be a maximum.
- The maximum area of impact can only occur on one day. It is therefore unrealistic and self-evidently not possible to have the same maximum level of daily impact over the course of a season.

11.20 The realistic worst-case scenario used for assessing the maximum daily impact arises from a single high-order detonation without the use of bubble curtains. The realistic worst-case for assessing the average seasonal impact is the clearance of 50 items of UXO with no more than five being cleared using high-order detonations but with the use of bubble curtains on all occasions and the remaining 45 items cleared using low-order detonation methods.

Consequently the maximum area of impact per day is 7.87% of the SAC and the average seasonal impact is 0.18%.

Hornsea Two UXO clearance

11.21 Ørsted have a Marine Licence to undertake UXO clearance within the wind farm area and along the export cable route. The licence is for clearance by detonation of up to 100 items of UXO over a two year period: 40 items between July 2019 to 31 December 2019 and 60 items between 1 April 2020 to 31 December 2020. An extension to the Marine Licence has been requested to the end of September 2022 to allow for any, as yet unidentified, UXO to be cleared during 2022 (MMO 2022a,b).

11.22 During 2021 when offshore construction was being undertaken at Hornsea Two no additional items of UXO were cleared (MMO 2022c). It is therefore unlikely that any further UXO will be identified and cleared.

Hornsea Two UXO clearance

11.23 Noise modelling undertaken by Ørsted indicates that the onset of PTS in harbour porpoise could occur within 11.6 km from a detonation of an 800 kg charge (Ørsted 2018a,b).

11.24 Assuming circular propagation of noise, in the event that the onset of PTS extends 11.6 km from the source the onset of PTS could occur over an area of 422.7 km^2. The density of harbour porpoise across the Hornsea Zone plus a 10 km buffer is between 1.72 and 2.22 ind./km^2 (SMart Wind 2015). Based on the higher recorded density, an estimated 425 harbour porpoise are at risk of PTS in the event that an 800 kg UXO is detonated at Hornsea Two. This is 0.13% of the North Sea Management Unit.

11.25 No assessment has been made by Ørsted on the estimated number of harbour porpoise that could be displaced or disturbed by UXO clearance based on noise modelling outputs.

11.26 However, the use of Acoustic Disturbance Devices (ADD), the purpose of which is to cause enough disturbance so that the harbour porpoise relocate away from an area, will cause disturbance. The extent disturbance is predicted to arise from the use of ADD at Hornsea Two is 7,500 m, covering an area of 176 km^2. On this basis an estimated 391 harbour porpoise could be disturbed at each location that an ADD is used.

11.27 The number of UXO that may be required to be cleared is unknown. However, based on the lack of any additional UXO clearance required in 2021 it is presumed that similar results might be expected in 2022. For the purpose of this assessment no more than five items of UXO will be cleared during 2022, with no more than one detonation per day.

11.28 Bubble curtains were successfully deployed for 93.5% of occasions during earlier UXO clearance. For the purposes of this assessment the use of bubble curtain has been included. Advice from the JNCC suggests that Optimus will now be undertaking low-order detonations in

the event that any further UXO is required to be cleared, although details of the variation are not available (JNCC 2022b).

11.29 Based on the use of low-order detonations being undertaken at all future items of UXO the daily area estimated to be impacted is 0.3% of the SAC and the average seasonal impact is 0.01% (Table 9).

Table 9: Seasonal spatial overlap for Hornsea Two UXO detonations without bubble curtains.

SAC area	Maximum area of SAC impacted (km^2)	Daily Threshold (%)	No. of detonations	Estimated duration of impact (days) [1]	Seasonal Threshold (%)
Single UXO detonation per day without bubble curtain					
'summer'	2,124	7.8	5	7	0.3
Single UXO detonation per day with bubble curtain					
'summer'	706.8	2.6	5	7	0.1
Single UXO detonation per day with Low-order detonation					
'summer'	79	0.3	5	7	0.01

1 – This accounts for two days 'recovery time' following cessation of UXO clearance.

In-combination scenarios

11.30 The in-combination assessment has been undertaken using outputs from both noise modelling and the threshold approach. Due to the number of current and planned activities being undertaken within or adjacent to the SAC and the level of uncertainty surrounding them, there are a number of potential in-combination scenarios. This section assesses the potential levels of in-combination impact that could arise.

11.31 The timelines for each of the activities identified as having the potential to cause an in-combination impact are presented in Figure 11. There is potential for the greatest daily impact to occur between June and mid-August when all three activities could be being undertaken. Advice from the applicant is that the seismic survey should be completed by the end of June and that pile-driving at Dogger Bank A is not expected to start until mid-July. Therefore the two activities are not predicted to overlap. However, the permits for both activities do allow for them to be undertaken within the periods shown in Figure 11.

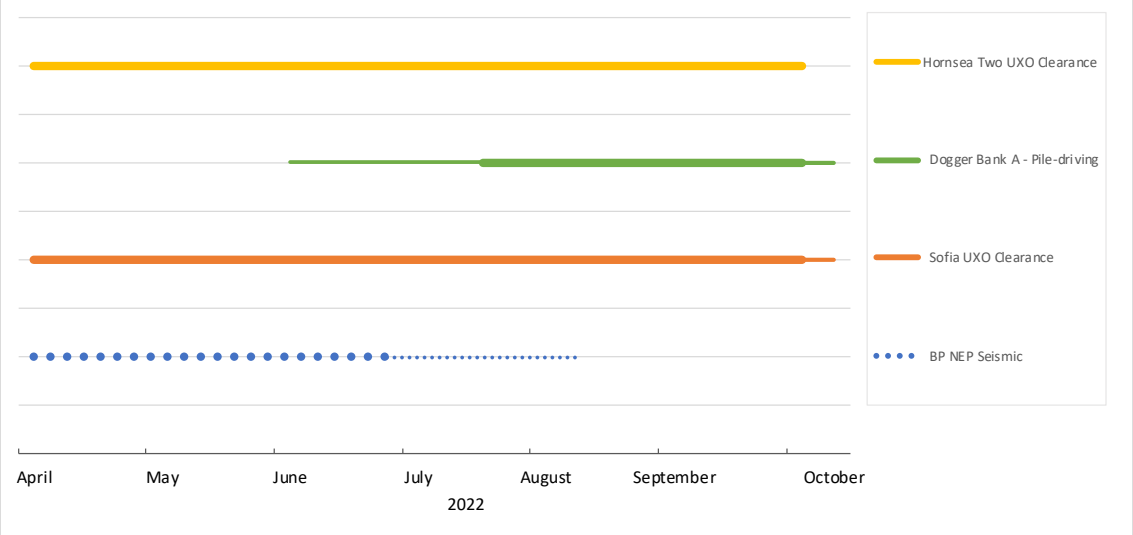


Figure 11: Timeline of activities within the Southern North Sea SAC in 2022 that could have an in-combination impact.

Note: narrow dots/line for Dogger Bank A Pile-driving and the NEP seismic survey are periods when activities are not predicted to occur but are within the timeframe of the consents.

In-combination Impacts on Southern North Sea SAC: Harbour porpoise.

Noise modelling

11.32 This section assesses the potential in-combination impacts based on the results from noise modelling undertaken for each of the applications.

Physical Injury

11.33 Based on the results from noise modelling noise arising from the proposed BP NEP 3D seismic survey will be below that at which the onset of PTS is predicted to occur for harbour porpoise (Section 5). Consequently, the survey will not cause any in-combination impact with respect to physical injury.

Disturbance

11.34 The total number of harbour porpoise predicted to be disturbed by the proposed BP NEP 3D seismic survey is 1,527 individuals (see Para. 10.9). In addition to the proposed survey there could be up to 632 harbour porpoise disturbed by the consented Dogger Bank A wind farm during construction.

11.35 Due to the nature of the sound arising from the detonation of explosives, i.e. a number of single discrete events undertaken over an extended period of time with each blast lasting for a very short duration, harbour porpoise are not predicted to be significantly displaced from an area. Should they occur, any changes in behaviour are predicted to be very short-lived. Existing guidance suggests that disturbance behaviour is not predicted to occur from UXO clearance if undertaken over a short period of time (JNCC 2010).

11.36 The use of an ADD during the clearance of UXO at Sofia is estimated to disturb up to 125 porpoises at each clearance location and up to 391 from the use of ADD at Hornsea Two should any further UXO require clearance.

11.37 In total an estimated 2,675 harbour porpoise could be disturbed by the proposed activities over any 24 hour period. This is 0.8% of the North Sea Management Unit population. The potential impacts from displacement or disturbance will be temporary. If displaced, harbour porpoise will be able to relocate elsewhere and evidence from studies indicate that they will return to the area within 24 hrs of the noise ceasing.

In-combination threshold approach

11.38 There are a number of potential scenarios that could be used for assessing the in-combination impacts using the threshold approach. Four possible scenarios are assessed, they are:

1. Potential worst-case,
2. Realistic worst-case,
3. Likely worst-case,
4. Probable case.

'Potential worst-case'. This scenario is based on:

- The maximum daily length of line and area impacted within the SAC from the proposed BP NEP seismic survey. This is with the revised 20 km spacing between each survey line.
- The maximum area of impact from pile-driving at the Dogger Bank A Offshore Wind Farm.
- There are no more than two high-order UXO detonations per day at maximum distance apart at Sofia offshore wind farm.
- There is no more than one UXO detonation per day at Hornsea Two.
- It presumes UXO is cleared without the use of noise mitigation.

11.39 This scenario is a potential worst-case in that, for it to arise, the maximum area of potential impact from all the projects must occur on the same day. The probability of this occurring is extremely remote. Furthermore, mitigation measures including the high probability that either low order detonation or bubble curtains will be used during all UXO clearance and that agreed conditions ensure that this scenario will not occur (See Section 12).

11.40 Based on the potential worst-case scenario the daily threshold could be exceeded during each month between April 2022 and September 2022 (Table 10). However, there is potential for

extensive overlap between the sound sources which reduces the area of the SAC that could be impacted during any single day.

'**Realistic worst-case'** is based on:

- The maximum daily length of line and area impacted within the SAC from the proposed BP NEP seismic survey. Based on the revised potential for a 20 km spacing between survey lines.
- The maximum area of impact from pile-driving one monopile at the Dogger Bank A.
- One detonation per day from the Sofia offshore wind farm impacting the maximum possible area.
- One detonation per day from the Hornsea Two offshore wind farm impacting the maximum possible area.
- No more than one item of UXO will be cleared with the use of High-order detonation UXO clearance on the same day as Dogger Bank pile-driving.
- Bubble curtains will be used by SOWFL and Hornsea Two when undertaking High-order detonation UXO clearance.

11.41 Under the realistic worst-case all activities have a higher probability of arising on the same day compared to the potential worst-case scenario. The estimated area of impact does not account for the potential area of overlapping noise within the SAC across the three projects. This is therefore the maximum are of potential impact under this scenario.

11.42 Based on a realistic worst-case scenarios the daily thresholds are marginally exceeded.

'Likely worst-case scenario' is based on:

- The maximum daily length of line and area impacted within the SAC from the proposed BP NEP seismic survey. Based on the revised potential for a 20 km spacing between survey lines.
- The maximum area of impact from pile-driving at the Dogger Bank A wind farm.
- Two detonations per day using low order detonation techniques from the Sofia offshore wind farm impacting the maximum possible area.
- No UXO being detonated at Hornsea Two.

11.43 Under the likely worst-case scenario, which is still based on the maximum area of impact by both the proposed seismic survey and pile-driving, the daily threshold of 20% is not exceeded (Table 12).

11.44 **'Probable case'** is based on:

- The maximum daily length of line and area impacted within the SAC from the proposed BP NEP seismic survey. Based on the revised potential for a 20 km spacing between survey lines. The survey being completed before 1 July.
- Pile-driving at Dogger Bank A commencing no earlier than 15 July. The maximum area of impact from pile-driving at the Dogger Bank A wind farm.
- Two detonations per day using low order detonation techniques from the Sofia offshore wind farm impacting the maximum possible area.
- No UXO being detonated at Hornsea Two.

11.45 Under the probable case scenario, which is still based on the maximum area of impact by both the proposed seismic survey and pile-driving, the daily threshold of 20% is not exceeded (Table 13.)

11.46 There is considerable uncertainty over the timing of any of the planned activities during the summer period of 2022. In particular there is limited information available as to when pile-driving will commence at Dogger Bank A. Public sources indicate June but recent advice is that it will not commence until mid-July. No definite date as to when pile-driving will start has been found.

11.47 The aim of the noise management is to keep below the thresholds as much as possible (JNCC 2020) and although there is a theoretical risk of the daily threshold being exceeded under certain scenarios the probability of it occurring is very small.

Table 10: Potential worst-case in-combination daily threshold (%).

Activity	Apr	May	Jun	Jul	Aug	Sept
BP NEP 3D survey [1]	**10.3**	**10.3**	**10.3**	**10.3**	**10.3**	**0**
Dogger Bank A - Pile-driving [2]	0	0	7.9	7.9	7.9	7.9
Sofia UXO detonation (2/day) [3]	14.01	14.01	14.01	14.01	14.01	14.01
Hornsea Two UXO clearance [4]	7.8	7.8	7.8	7.8	7.8	7.8
Total %	**32.1**	**32.1**	**40.0**	**40.0**	**40.0**	**29.7**

1 Based on maximum possible area of impact within the SAC of 2,775 km^2.
2 Based on maximum possible area of impact within the SAC of 2,124 km^2.
3 Based on two high-order detonations at Sofia without noise mitigation maximum possible area of impact within the SAC of 3,782 km^2.
4 Based on one high-order detonation at Hornsea Two without noise mitigation maximum possible area of impact within the SAC of 3,782 km^2.

Table 11: Realistic worst-case in-combination daily threshold (%).

Activity	Apr	May	Jun	Jul	Aug	Sept
BP NEP 3D survey [1]	**10.3**	**10.3**	**10.3**	**10.3**	**10.3**	**0**
Dogger Bank A - Pile-driving [2]	0	0	7.9	7.9	7.9	7.9
Sofia UXO detonation (1/day) [3]	2.6	2.6	2.6	2.6	2.6	2.6
Hornsea Two UXO clearance [3]	2.6	2.6	2.6	2.6	2.6	2.6
Total %	**15.5**	**15.5**	**23.4**	**23.4**	**23.4**	**13.1**

1 Based on maximum possible area of impact within the SAC of 2,775 km^2.
2 Based on maximum possible area of impact within the SAC of 2,124 km^2.
3 Based on one high-order detonation using bubble curtains impacting within the SAC of 707 km^2.

Table 12: Likely worst-case in-combination daily threshold.

Activity	Apr	May	Jun	Jul	Aug	Sept
BP NEP 3D survey [1]	**10.3**	**10.3**	**10.3**	**10.3**	**10.3**	**0**
Dogger Bank A - Pile-driving [2]	0	0	7.9	7.9	7.9	7.9
Sofia UXO detonation (1/day) [3]	0.6	0.6	0.6	0.6	0.6	0.6
Hornsea Two UXO detonation	0	0	0	0	0	0
Total %	**10.9**	**10.9**	**18.8**	**18.8**	**18.8**	**8.5**

1. Based on maximum possible area of impact within the SAC of 2,775 km^2.
2. Based on maximum possible area of impact within the SAC of 2,124 km^2.
3. Based on two low-order detonation impacting within the SAC of 157 km^2.

Table 13: Probable case in-combination daily threshold.

Activity	Apr	May	Jun	Jul	Aug	Sept
BP NEP 3D survey [1]	**10.3**	**10.3**	**10.3**	**0**	**0**	**0**
Dogger Bank A - Pile-driving [2]	0	0	0	7.9	7.9	7.9
Sofia UXO detonation (1/day) [3]	0.6	0.6	0.6	0.6	0.6	0.6
Hornsea Two UXO detonation	0	0	0	0	0	0
Total %	**10.9**	**10.9**	**10.9**	**8.5**	**8.5**	**8.5**

1. Based on maximum possible area of impact within the SAC of 2,190 km^2.
2. Based on maximum possible area of impact within the SAC of 2,124 km^2.
3. Based on two low-order detonation impacting within the SAC of 157 km^2.

11.48 Under the potential worst-case scenario which is based on the survey being undertaken over a continuous period of 92 days (the duration of the licence) the seasonal threshold could be exceeded by 0.2% (Table 14). However, the applicant has undertaken the assessment based on no more than 64 days and under this realistic worst-case scenario the seasonal threshold will not be exceeded.

11.49 To remain below the summer seasonal threshold under the potential worst-case scenario the seismic survey should not exceed 88 days.

Table 14: In-combination seasonal thresholds (%).

Activity	Summer seasonal threshold (%)	
	Potential worst-case	Realistic worst-case
BP NEP 3D seismic survey [1,2]	**5.3**	**3.6**
Dogger Bank A Pile-driving [3]	4.2	4.2
Sofia UXO detonation [4,5]	0.4	0.2
Hornsea Two UXO clearance [6,7]	0.3	0.1
Total	**10.2**	**8.1**

1 Potential worst-case based on maximum area and duration of impact.
2 Realistic worst-case based on maximum area of impact over a predicted duration of survey of 62 days.
3 Based on maximum area and duration of impact.
4 Based on five high-order detonations without a bubble curtain and two detonations per day.
5 Based on no more than 5 UXO items cleared using high-order and 45 items using low-order detonation. All high-order detonations require the use of a bubble curtain. One detonation per day. All detonations impact over maximum possible area within the SAC.
6 Five high-order detonations not using bubble curtains
7 Five high-order detonations all using bubble curtain.

11.50 There are varying levels of confidence in the extent and duration of impacts from each of the activities that could occur within the Southern North Sea SAC which affect the results of this assessment; a summary is presented in Table 15. Any changes in any of the Projects' schedules or scopes of work would affect both the daily and seasonal threshold based assessments.

Table 15: Confidence in extent and duration of potential impacts from planned activities within or adjacent to the Southern North Sea SAC between April and September 2022.

Project	Confidence	Comment
BP NEP 3D seismic	High	High confidence activities will be undertaken during 'summer' 2022. High confidence on when activities will commence. Moderate confidence in the duration of the survey. Very High level of certainty that the survey will be undertaken along known pre-determined survey lines and therefore the exact location of the impacts are known. High - Moderate level of confidence from published evidence on the extent and duration of impacts from airgun arrays.
Dogger Bank A	Moderate	High confidence activities will be undertaken during 'summer' 2022. Low confidence when pile-driving will commence in 2022. Very High level of confidence in the maximum area of SAC that could be impacted. Very low confidence on the average daily impact. High level of confidence from published evidence on the extent and duration of impacts.
Sofia UXO Clearance	High	Very High confidence activities will be undertaken during 'summer' 2022. Very High confidence of regular usage of low or detonations and bubble curtains to mitigate noise impacts. Low confidence on the location and number of UXO required to be detonated. Low confidence on the number of UXO to be cleared per day, but no more than two. Very High confidence no more than five high-order detonations within the Southern North Sea SAC. Low confidence on the extent of displacement from UXO clearance. Limited published evidence supporting the use of either a 26 km EDR without bubble curtains or 15 km EDR with the use of bubble curtains.
Hornsea Two UXO clearance	Low	Very Low confidence any UXO detonations will be undertaken during 'summer' 2022. Very High confidence of regular usage of bubble curtains to mitigate noise impacts. Very low confidence on the location and number of UXO required to be detonated. Low confidence on the number of UXO to be cleared per day. Low confidence on the extent of displacement from UXO clearance. Limited published evidence supporting the use of either a 26 km EDR without bubble curtains or 15 km EDR with the use of bubble curtains.

In-combination assessment Southern North Sea SAC conclusions

11.51 Results from noise modelling indicate that up to 2,675 harbour porpoise could be disturbed by the proposed activities. This is 0.8% of the Management Unit population and therefore below the level of 1.7% at which a population level effect might be predicted to occur.

11.52 The results from the threshold approach indicate that the daily thresholds could be exceeded under the potential worst-case scenario. Under the realistic worst-case and probable case scenarios the daily threshold of 20% of the SAC is not exceeded.

11.53 The seasonal average threshold of 10% of the SAC across the season could be exceeded if survey is undertaken over the maximum possible period. However, it is known that the survey is very likely be completed before 1 July and will not exceed a total of 64 days of seismic survey. Under this scenario the seasonal threshold is not exceeded under a realistic scenario.

11.54 Based on the best available information and supported by results from noise modelling and the threshold approach, BEIS is satisfied that the proposed BP NEP 3D seismic survey in-combination with other plans or projects will not have an adverse effect upon the integrity of the Southern North Sea SAC with respect to harbour porpoise.

12 MITIGATION

12.1 The following section presents a summary of the planned mitigation submitted by the Applicant that will reduce the risk of an adverse effect occurring.

12.2 BP have committed to following the JNCC guidelines for *minimising the risk of injury to marine mammals from geophysical surveys* (JNCC 2017e, BP 2022a). This will include:

- A minimum of 20 minutes soft-start undertaken every time the airguns are switched on.
- Use of JNCC accredited marine mammal observers (MMOs) to conduct watches for marine animals during daylight hours with good visibility. MMOs will monitor during the pre-source start search and soft start phase as a minimum.
- Observations will be undertaken for at least 30 minutes prior to the soft-start and there will be a minimum of a 20 minute delay from the time of the last marine mammal detection within the 500 m mitigation zone and the commencement of the soft-start.
- If the source arrays have been inactive for a period of 10 minutes the MMO will perform a visual inspection of the 500 m mitigation zone. If a mammal is detected within the 500 m mitigation zone, the commencement of the survey will be delayed for at least 20 minutes following last sighting
- Passive Acoustic Monitoring will be undertaken during the pre-source start search and soft start phase during poor visibility periods as a minimum.
- If line changes are anticipated to be longer than 40 minutes in duration, the airgun array will be switched off at the end of the survey line. A full pre-source start search and soft start will be conducted prior to the start of the next survey line.

12.3 BP have also committed to:

- Produce a sound management plan, as part of the project simops plan, covering the planned communication and protocol in relation to other operators with significant sound producing activity in the SAC, in order to mitigate the risk of percentage area of sound emission within the SAC being greater than the established threshold values. Ongoing pre-survey engagements are being held with other operators, including Orsted, RWE and SSE, which will inform this plan, including the frequency of sound management meetings required between operators.
- As a minimum, monthly meetings will be held with all operators conducting activities with notable sound emissions during the spring/summer season. These meetings will involve sharing activity updates between operators and identifying upcoming periods where the SNS

SAC thresholds (JNCC, 2020) are at risk of being exceeded. This is expected to involve the project managers or equivalent of different activities as well as environmental advisors and consent managers, as appropriate.

- During periods where there is an identified risk of the SNS SAC thresholds being exceeded, daily or weekly simops meetings, depending on the variability of activity, will be held with other operators conducting activities planned during that time with sound emissions that contribute to the thresholds being exceeded. These meetings will aim to avoid the SNS SAC thresholds being exceeded, by all operators mutually scheduling or optimizing activity where possible. This is expected to involve representatives on the vessels as well as survey project managers, who can control the day-to-day vessel activities and schedules.
- In addition to structured meetings, contact details will be shared for ad-hoc communication as needed and all relevant operators will be included on the vessel 24-hr lookahead plans, which covers planned upcoming activity.

13 LICENCE CONDITIONS

13.1 This assessment has been undertaken based on the information presented in the application and associated documents (BP 2021, 2022a, b, c and d). Any changes to the information used by the applicant and BEIS to assess the potential impacts from the proposed survey could affect the conclusions of this assessment. It is therefore important that the following are not exceeded when the survey is within the Southern North Sea SAC or within 12 km of the boundary:

1. No more than 175 km of survey line will be undertaken during any one day. By doing so this could increase the daily area of disturbance.
2. The airguns will not be operating for more than 21 hrs in anyone one 24 hr period. By doing so this could increase the daily area of disturbance.
3. All successive survey lines will be no further than 20 km apart. By doing so this could increase the daily area of disturbance.

13.2 In addition to the above to ensure that the daily and seasonal thresholds are not exceeded the following conditions are required:

1. No seismic survey will be undertaken within the Southern North Sea SAC or within 12 km of the boundary of the SAC simultaneously as pile-driving is being undertaken at Dogger Bank A wind farm and high order UXO detonations relating to either or both the Sofia offshore wind farm or the Hornsea Two offshore wind farm are being undertaken. Unless it can be demonstrated that the activities together do not exceed Southern North Sea SAC underwater noise thresholds.
2. Evidence of the agreement with the Dogger Bank A Offshore Wind Farm (RWE), Sofia Offshore Wind Farm (SOWFL) and the Hornsea Two Offshore Wind Farm Project (Orsted) to co-ordinate this must be submitted by BP to BEIS at least one week prior to commencement of any works.
3. Following completion of the survey a close out report must be submitted to BEIS (OPRED) and the JNCC detailing the vessel activity, survey route and survey lines acquired each day. The report should also identify all communications made with the other relevant parties during the survey to ensure that the thresholds were not exceeded.

13.3 The above licence conditions are in line with those required in Marine Licenses granted by the MMO (e.g. MMO 2022d).

14 CONCLUSIONS

14.1 The Secretary of State has carefully considered all of the information available in order to undertake a Habitats Regulations Assessment. He considers the proposed BP NEP 3D seismic survey to have the potential to cause a Likely Significant Effect alone and in-combination with other plans or projects on the qualifying species of the Southern North Sea SAC.

14.2 The Secretary of State has undertaken an Appropriate Assessment in respect of the site's Conservation Objectives to determine whether the project, either alone or in-combination with other plans or projects, will result in an adverse effect on integrity.

14.3 The Secretary of State has undertaken a robust assessment using all of the information available to him.

14.4 Having considered all of the information available to him, the Secretary of State has concluded that, subject to mitigation measures and licence conditions described in this assessment, the proposed BP NEP 3D seismic survey will not have an adverse effect on the integrity of any European designated site either alone or in-combination with other plans or projects

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APPENDIX A: MODELLED DISTURBANCE AREA

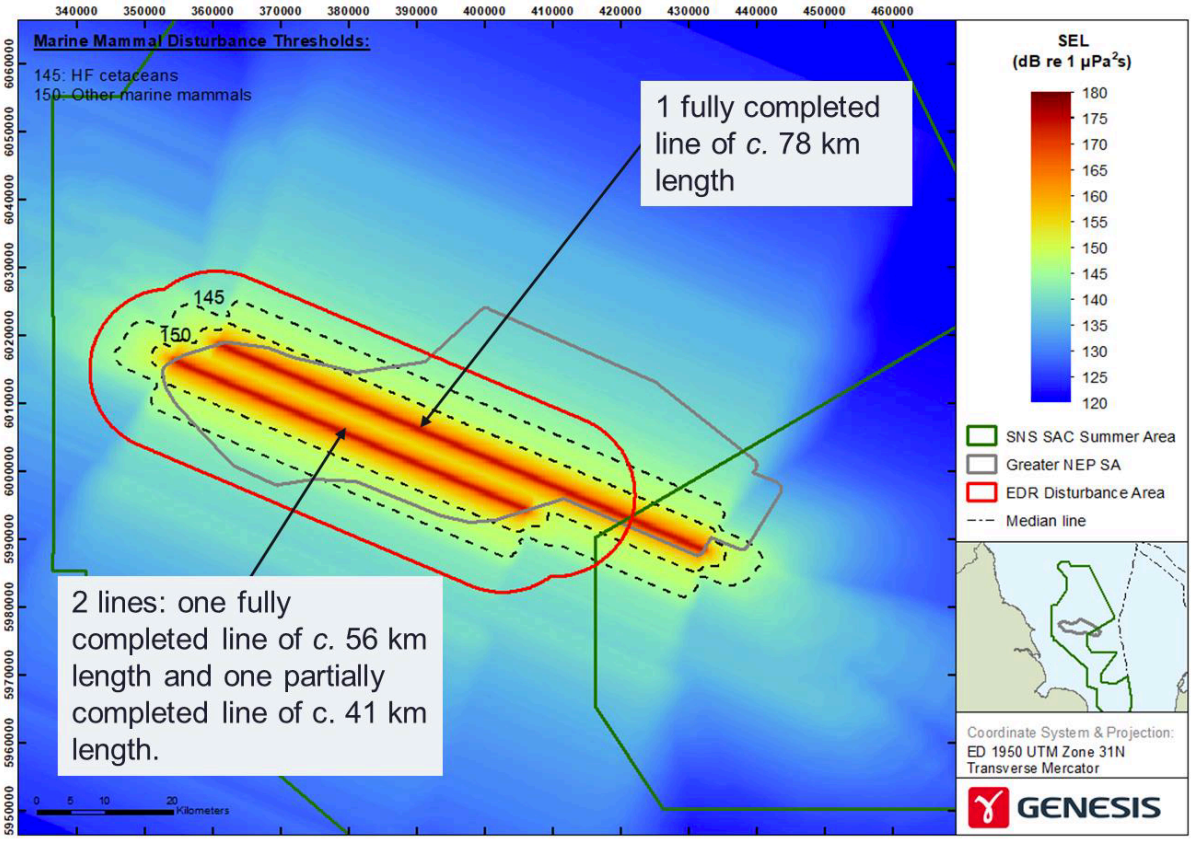
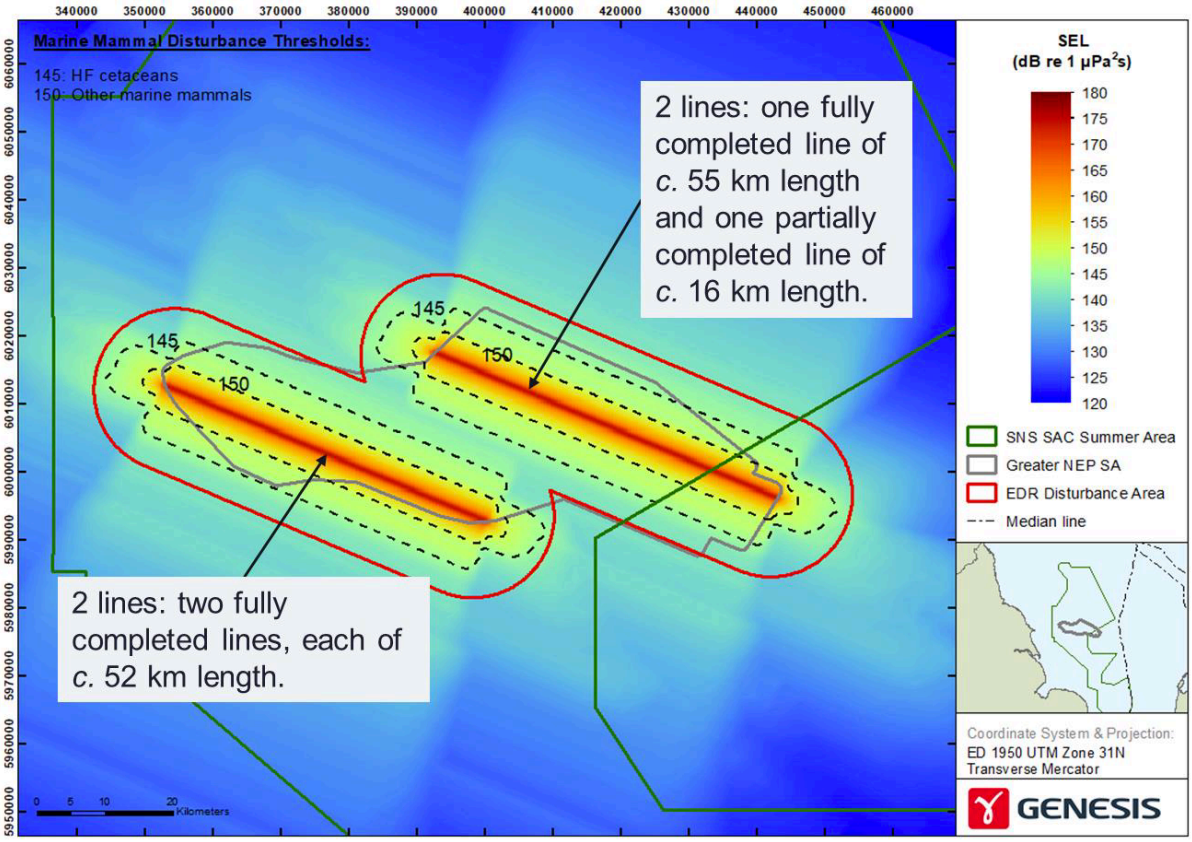


Figure 12: Possible survey lines over a 24 hr period (Scenario 2 in BP 2022a)

Area of potential disturbance (BP 2022a):

- One fully completed lines of *c.* 78 km length.
- One fully completed line of *c.* 56 km length.
- One partially completed line of 41 km length.

Note: the figure from BP (2022a) presents the survey lines extending beyond the boundary of the SAC. Due to the configuration of the survey area (see Figure 2) this scenario is possible wholly within the SAC.



Area of potential disturbance (BP 2022d):

- Two fully completed lines of *c.* 52 km length.
- One fully completed line of *c.* 55 km length.
- One partially completed line of 16 km length.