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).

ION MNSH Phase 2B Seismic Survey September 2021

Issued September 2021
Rev 2.0

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1 INTRODUCTION

1.1 This is a record of the Habitats Regulations Assessment (HRA) undertaken by the Department for Business Energy and Industrial Strategy (BEIS) in respect of a planned seismic survey to be undertaken by GX Technology EAME Ltd / GX Technology Corporation (hereafter referred to as 'ION').

1.2 This HRA covers a planned 3D seismic survey in Quadrants 36 - 38 and 42 - 44 off the east coast of England. The planned activities are presented in the application to carry out a marine survey GS/1292/0 (Version 1) and associated environmental assessment submitted to BEIS on 6 August 2021 (ION 2021a,b).

1.3 BEIS is the competent authority for applications submitted under the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (S.I. 2001/1754) (As Amended) (referred to as the Offshore Habitats Regulations).

1.4 BEIS recognises that there is potential for activities to impact on sites designated under the European Habitats 92/43/EC and Birds Directives 209/147 EC. Consequently, as the competent authority, BEIS has undertaken an assessment to determine whether the potential impacts from the proposed seismic survey as identified in the application may cause likely significant or adverse effects to the qualifying features of designated sites and thereby affect the integrity of the sites.

1.5 As part of the assessment, potential in-combination impacts from future plans or projects within the designated sites have been assessed to determine whether there is potential for likely significant or adverse effects on the integrity of the sites. The in-combination assessment may include potential future activities that are not the subject of any currently submitted projects or plans. By doing so it does not pre-empt the requirement to undertake HRA when future licence applications are submitted. It does not pre-determine any decision regarding future programmes or projects. However, where possible, it does provide a strategic overview of potential in-combination impacts from forecast activities.

1.6 This document presents the finding of the assessment undertaken by BEIS.

Habitats Regulations Assessment

1.7 Council Directive 92/43/EC 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 survival of certain habitats and species by protecting them from the adverse effects of plans and projects.

1.8 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 extended certain provisions of the 2001 regulations.

1.9 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*.

1.10 The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 make changes to three statutory instruments including the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (the Offshore Habitats Regulations), which is relevant to this assessment. The 2019 regulations ensure that the protection provided under the existing regulations, including the 2001 regulations remain as they were prior to the UK's exit of the EU. This includes the continued protection of designated sites along with their qualifying features and the requirement for a competent authority to undertake an assessment of any plans or projects that could impact on the sites or their features.

1.11 The Conservation of Habitats and Species Regulations 2017 (as amended) and The Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended) provide for the designation of sites for the protection of habitats and species of national importance; these sites are called Special Areas of Conservation (SACs). For the protection of birds, these sites are called Special Protection Areas (SPAs). Collectively, all existing and future SACs and SPAs form a national site network[1].

1.12 Possible SACs (pSACs), candidate SACs (cSACs) and potential SPAs (pSPAs) are afforded the same levels of protection by the UK Government as sites that have already been designated. Sites designated under the Ramsar Convention are also afforded the same level of protection as a designated site.

1.13 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/National Site unless there are imperative reasons of overriding public interest for carrying out the plan or project.

[1] Prior to 1 January 2021 national sites were referred to as European sites.

2 SURVEY DESCRIPTION

2.1 The following is a summary of the proposed ION MNSH Phase 2B 3D seismic survey, further details may be found within the application (ION 2021a,b).

2.2 The proposed regional survey will be undertaken across the Southern North Sea in quadrants 37, 38, 42, 43 and 44 off the east coast of England. The planned survey is located within UKCS Blocks 37/26 - 37/30, 38/26 - 38/30, 42/4, 42/5, 42/9, 42/10, 42/14, 42/15, 42/19, 42/20 43/1 – 43/20, 44/1 – 44/9 and 44/11 – 44/19. The Greater Working Area covers approximately 10,565 km^2, with the Survey Area covering 2,407 km^2 (Figure 1) (ION 2021a).

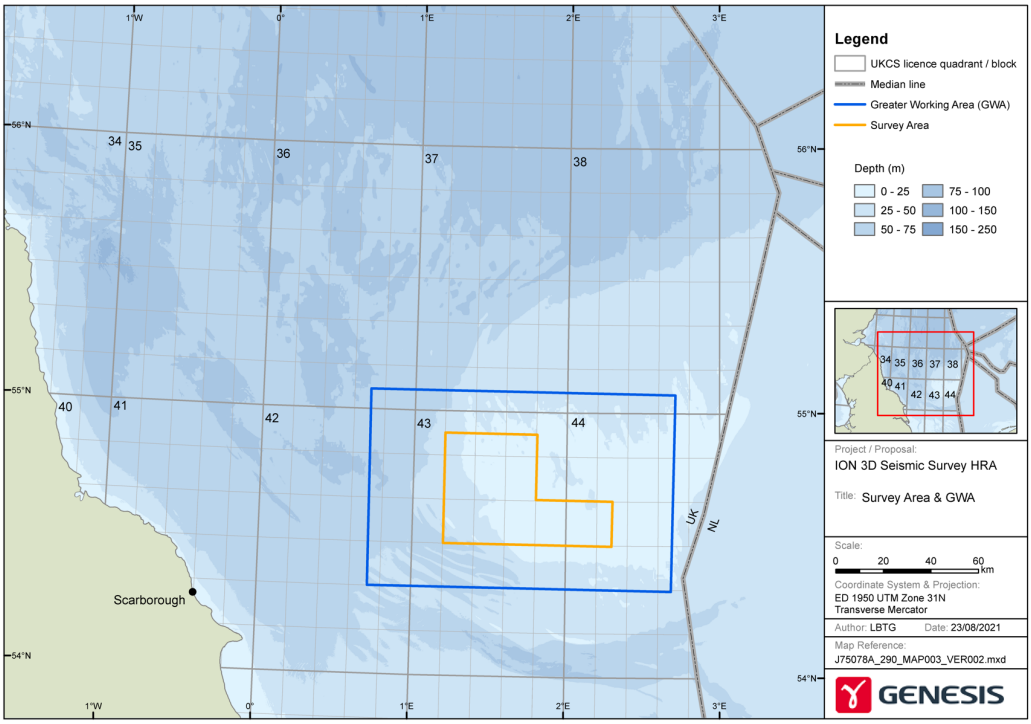


Figure 1: Location of the proposed ION MNSH Phase 2B 2021 3D seismic showing Survey and Greater Working areas in the North Sea.

2.3 The survey is scheduled to take place between 10 September and 15 November 2021 and expected to last up to 51 days (ION 2021a).

2.4 The proposed survey will be undertaken by a seismic survey vessel (*Akademik Nemchinov*) towing four 6,000 m streamers at a speed of between 4.5 and 5 knots (8.3 - 9.3 km/h). The width of each towed survey array will be approximately 350 m and each surveyed line will be 200 m apart (ION 2021a,b). The total volume of airguns operated will be 3,390 cu. in. and be fired at intervals of every 7.3 seconds (ION 2021b).

2.5 The total Greater Working Area is 10,565 km^2, although the Survey Area (the area within which airguns will be operating) is 2,407 km^2 (ION 2021a). The maximum length of any single line within the Southern North Sea SAC is 71 km (ION 2021b). The total length of survey line wholly within the Southern North Sea SAC is not presented in the application but a total survey area of 2,407 km^2 will be within the SAC.

2.6 The spacing between each surveyed line is 200 m but due to the configuration of the survey the gap between consecutive lines will be between 7.8 km and 9 km, i.e. the survey follows a pattern of a 'race-track' with the vessel undertaking a wide turn at the end of each line and commences the next line up to 9 km from the previous one. Following completion of the second line the vessel returns to within 200 m of the original line and commences the next line. This survey pattern is continued throughout the survey.

2.7 The airguns will be switched off at the end of each survey line and prior to the commencement of using any airguns a 'soft-start' will be undertaken as per the JNCC guidance (JNCC 2017a). Each line turn occurs within the Greater Working Area and will take between 3.0 and 3.5 hrs during which the airguns will not be operating.

2.8 A summary of the proposed survey specifications is presented in Table 1.

Table 1: Survey parameters.

Survey Parameter	Application
Start date and End date	10 September – 15 November 2021
Total duration of survey (days)	51
Greater Working Area (km^2)	10,565
Survey Area (km^2) [1]	2,407
No. of survey turns	100
Line spacing (m)	200
Consecutive line gap (m)	7,800 – 9,000
Line Direction	270^o – 90^o
Longest survey line (km)	71
Greater Working Area in SAC (km^2)	8,362
Survey Area in SAC (km^2)	2,407
Length of line in SAC (km)	3,734 (including run-outs (sail line kms where the source is active)
Longest single survey line in SAC (km)	71

1 – The area within which airguns will be operated.

2.9 The specifications for the seismic array, as presented in the application, are presented in Table 2. The peak Sound Pressure Level (SPL) for the 3,390 cu. in. airgun array is 254 dB re 1 µPa $_{(0\text{-}P)}$ at 1 m (ION 2021a, b).

Table 2: Proposed seismic array parameters (Source: ION 2021a,b).

Array Parameter	Array Option
Arrays x sub-arrays	2 x 2
Total volume (cu. In).	3,390
Sound pressure - dB re 1 µPa (0-p)	254
Sound exposure level - dB re 1 μPa^2s	232
Pulse rate (Seconds)	7.3
Towed depth (m)	6
Vessel speed (knots)	5

3 DESIGNATED SITES

3.1 The proposed seismic survey is being undertaken in waters within or adjacent to several European designated 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 out with 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, six SACs have been identified as having qualifying species at risk of a likely significant effect from the proposed survey (Figure 2).

3.3 The survey will be undertaken during the post-breeding and non-breeding period for seabirds. Although there will be seabirds within the Survey Area which could be disturbed by both the physical presence of the vessel and noise from the airguns, neither the number of birds present nor their origin are known, with birds likely to be present from many UK and non-UK colonies. The nearest SPA to the proposed survey is the Flamborough and Filey Coast SPA which is 54 km from the nearest Greater Working Area boundary. Following breeding there will few birds present at the colony with birds from this and other colonies dispersing widely into the North Sea and further afield.

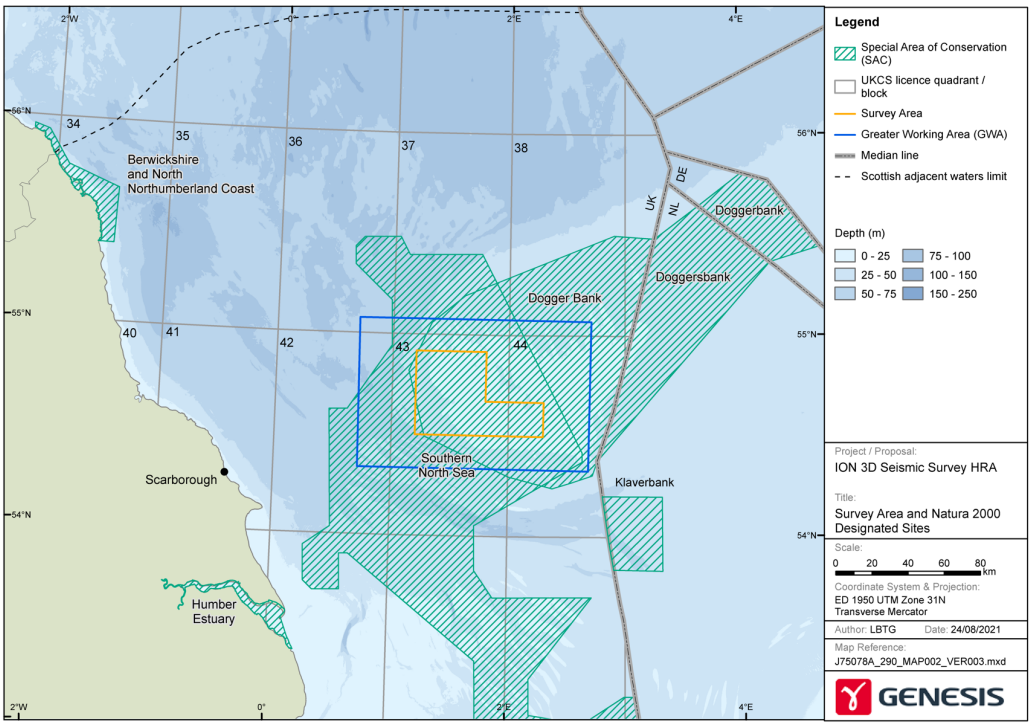


Figure 2: Location of proposed ION MNSH Phase B survey and relevant designated sites.

3.4 The qualifying sites and species relevant to this HRA:

- Southern North Sea SAC (Harbour porpoise),
- Humber Estuary SAC (Grey seal, Sea lamprey, River lamprey),
- Berwickshire and North Northumberland Coast SAC (Grey seal),
- Doggersbank SAC – Dutch sector (Harbour porpoise, Grey seal, Common seal),
- Klaverbank SAC – Dutch sector (harbour porpoise, grey seal, Harbour seal),
- Dogger Bank SAC – German sector (Harbour porpoise, Common seal),

3.5 Sites identified as having qualifying features that could be impacted by the proposed survey and their distance from both the Greater Working and Survey areas are presented in Table 3.

Table 3: Designated sites identified as having qualifying features that could be impacted by the proposed survey.

Designated site	Distance from Greater Working Area (km)	Distance from Survey Area (km)	Qualifying features
Southern North Sea SAC	0	0	Harbour porpoise
Humber Estuary SAC	87.6	unknown	Grey seal, Sea lamprey, River lamprey
Berwickshire and North Northumberland Coast SAC	142.5	unknown	Grey seal
Doggersbank SAC (Dutch sector)	5.1	32.8	Harbour porpoise, Grey seal, Harbour seal
Klaverbank SAC (Dutch sector)	7.7	38.9	Harbour porpoise, Grey seal, Harbour seal
Dogger Bank SAC (German sector)	30.2	138.3	Harbour porpoise, Harbour seal

3.6 The proposed Greater Working Area overlaps 8,362 km^2 of the Southern North Sea SAC, equivalent to 22.6% of the site as a whole. There is no spatial overlap with other designated sites that have qualifying species that could be impacted by the seismic survey. However, the qualifying species from the other designated sites listed above could occur within the Greater Working and Survey Areas or be impacted by noise within the designated site.

3.7 The Greater Working Area overlaps a total of 7,425 km^2 of the Dogger Bank SAC (UK sector). However, the site is designated for habitat features that will not be impacted by the proposed seismic survey.

Qualifying features

3.8 Based on the information presented within the application it has been determined that the HRA should consider alone and in-combination the potential direct and indirect impacts on:

- Harbour porpoise,
- Grey seal,
- Harbour seal,
- Sea lamprey and River lamprey,
- Fish (prey) species.

Harbour porpoise

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

- Southern North Sea SAC,
- Doggersbank SAC (Dutch sector),
- Klaverbank SAC (Dutch sector),
- Dogger Bank (German sector) SAC.

3.10 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. 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).

3.11 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 (Figure 3) (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).

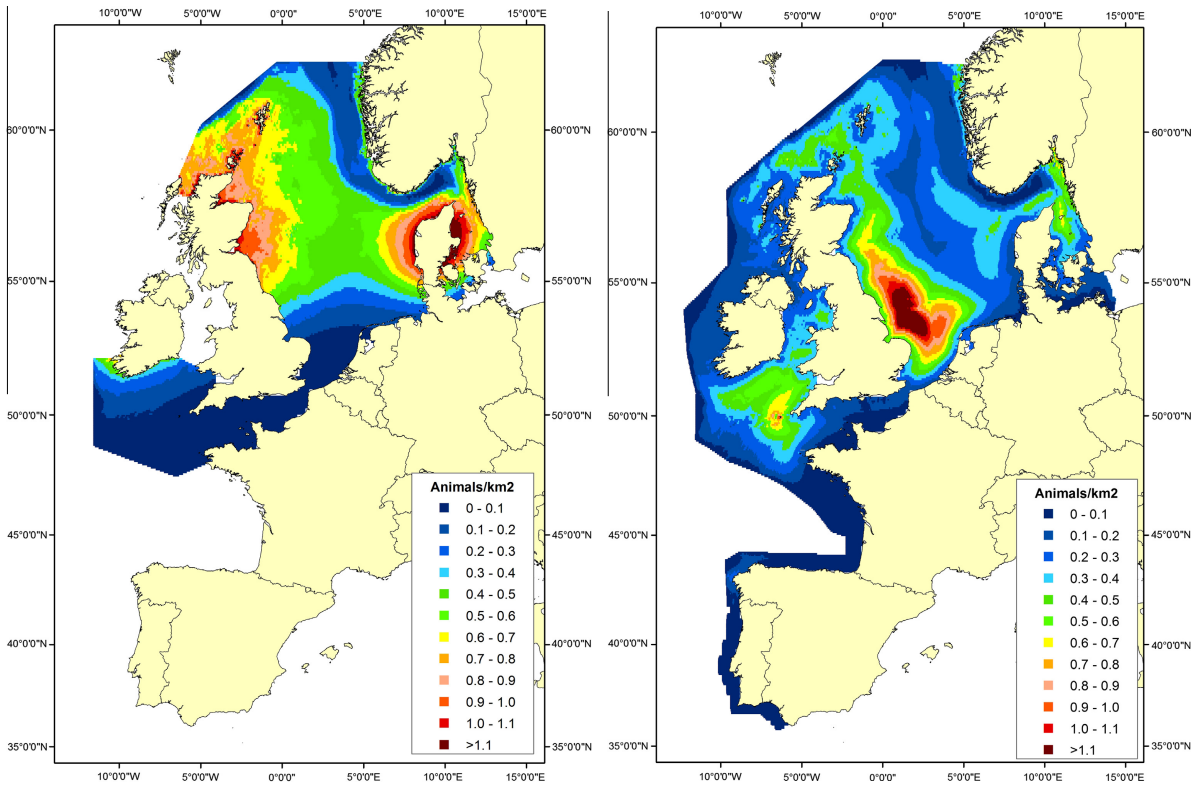


Figure a. Figure b.

Figure 3: a) Predicted surface density for harbour porpoise in 1994. b) Predicted surface density for harbour porpoise in 2005 (Source Hammond *et al.* 2013).

3.12 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).

3.13 There are three Management Units identified for harbour porpoise in the north-east Atlantic, of which, the Southern North Sea SAC, the Doggersbank SAC, Klaverbank SAC and the German Dogger Bank SAC lie within the North Sea Management Unit. The harbour porpoise population within the North Sea Management Unit was originally estimated to be 227,298 (CI 176,360 – 292,948) individuals (IAMMWG 2015). However, following the revision of the regional SCANS harbour porpoise population, the population of harbour porpoise within the North Sea Management Unit has also been revised and is now estimated to be 346,601 (CI 289,498 – 419,967) individuals (IAMMWG 2021). This population estimate has been used for the purposes of this assessment.

3.14 The Southern North Sea SAC selection assessment document estimates that the site holds 18,500 harbour porpoise (98% C.I. 11,864 – 28,899) (JNCC 2017b; 2019a), which was 8.1% of

the North Sea Management Unit population at the time the estimate was made (Hammond *et al*. 2013, IAMMWG 2015). Based on the latest North Sea Management Unit population estimate the harbour porpoise population within the SAC may be 28,075 individuals. However, it is recognised that the harbour porpoise population within the SAC will vary across seasons and years.

3.15 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 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 sites 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.

3.16 Densities of harbour porpoise within the Doggersbank SAC also vary seasonally with highest reported densities of 1.029 ind./km^2 recorded during March and lower densities of 0.396 ind./km^2 and 0.391 ind./km^2 recorded in July and October respectively (Geelhoed *et al*. 2013).

3.17 Based on data in the JCP database highest densities in the central and northern area of the Southern North Sea SAC occur during the summer period with modelled harbour porpoise densities greater than 3.0 per km^2 occurring widely (Figure 4a). 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 (Figure 4b) (Heinänen and Skov 2015). A winter survey undertaken across the Central North Sea in November 2011 reported an average density across the whole surveyed area of 0.63 ind./km^2 (Cucknell *et al*. 2016).

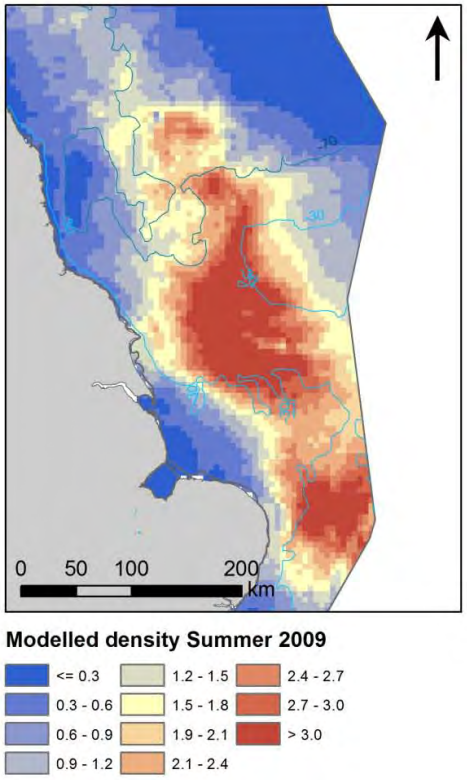


Figure a.

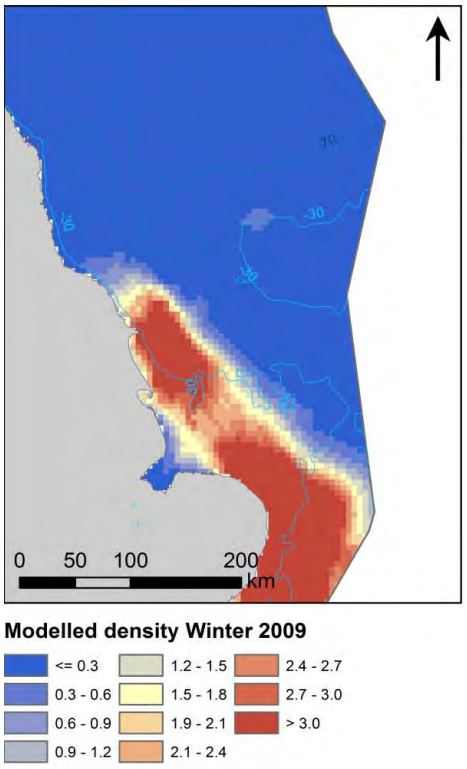


Figure b.

Figure 4: a) Estimated summer densities of harbour porpoise in the southern North Sea. b) Estimated winter densities of harbour porpoise in the southern North Sea. (Source: Heinänen and Skov 2015).

3.18 Surveys undertaken across the southern North Sea, including areas within and encompassing the Southern North Sea SAC, have reported lower densities of harbour porpoise than modelled estimates. 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 and the Doggersbank SAC, in 2011 recorded a density of 1.88 ind./km^2 (Gilles *et al.* 2012). Data obtained from surveys undertaken at proposed offshore wind farms located within or adjacent to the Southern North Sea 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).

3.19 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. Individuals tagged in Danish waters were recorded off the east coasts of England and Scotland (Sveegaard 2011).

3.20 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).

3.21 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).

3.22 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.

3.23 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).

3.24 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).

3.25 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.

3.26 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).

3.27 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.

3.28 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).

Grey seal

3.29 The grey seal (*Halichoerus grypus*) is an Annex II qualifying species for the:

- Humber Estuary SAC,
- Berwickshire and North Northumberland Coast SAC,
- Klaverbank SAC (Dutch sector),
- Doggersbank SAC.

3.30 Grey seals occur widely around the waters off eastern England with most activity in the nearshore waters to the south of the Humber Estuary, at Donna Nook, where a grey seal colony is located within the Humber Estuary SAC (Russell *et al*. 2017). The latest counts within the Humber

Estuary SAC recorded 5,625 grey seals, giving an estimated population of 23,512[2] (SCOS 2020). The latest count for the Berwickshire and North Northumberland Coast SAC is 6,427 individuals (SCOS 2020) and therefore an estimated population of 26,864 individuals.

3.31 Their distribution offshore comprises predominantly of short-range return trips from haul-out sites to local foraging areas (Figure 5). However, longer movements between distant haul-out sites also regularly occur. Foraging trips from haul-out sites usually last between one and thirty days with most trips within 100 km of the haul out site, although they can go further and individuals often make repeated trips to the same region offshore (SMRU 2004, SCOS 2015, Russell 2016). Tagging study data indicates that grey seals from Donna Nook forage across a broad area and are not restricted to localised patches and their distribution has changed since 2005 with more regular foraging now occurring further offshore (SCOS 2016, Russell 2016). Offshore, grey seals prefer shallower waters in areas of increasing sand and decreasing levels of gravel (Jones *et al*. 2015, Russell 2016).

3.32 Densities of grey seals across the area vary, with highest densities located to the south and nearer shore. Within the Survey Area densities are relatively low and are less than 2.0 ind/km^2 (Figure 5). Densities of grey seals recorded at the Dogger Bank offshore wind farms (Creyke Beck A and B, Teesside A and B), across which the proposed survey will be undertaken, reported highest peak density of 0.93 ind./km^2 at Creyke Beck A, with peak densities across the wind farm zone as a whole of 0.25 ind./km^2 (Forewind 2013).

[2] An estimated 23.9% of all grey seals are at haul-out sites at the time of the monitoring surveys. Consequently, a scalar multiplier of 4.18 is used to provide a population estimate (SCOS 2016).

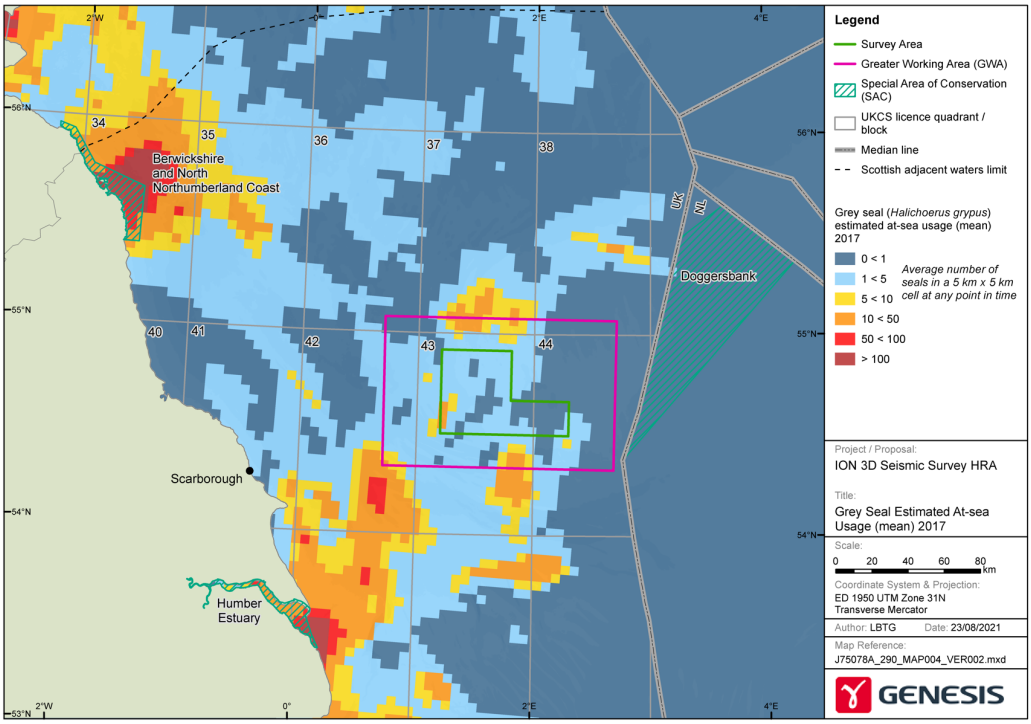


Figure 5: Distribution of grey seals in waters off Eastern England and proposed survey area.

3.33 Grey seals breed in the region between late October and December when they will spend a greater proportion of time onshore compared with other times of year. Following pupping the females will remain onshore for approximately two weeks (SCOS 2015). Grey seals moult between December and April during which time they spend a greater proportion of their time at their haul out sites (SCOS 2015). Grey seals forage on a range of fish species with sandeels, gadoids, flatfish and cephalopods being dominant prey items (SMRU 2011, Pierce *et al.* 1991).

3.34 Sound arising from the proposed seismic survey has the potential to significantly affect grey seals due to permanent or temporary physical hearing damage and or displacement and disturbance. Consequently, the proposed survey could affect grey seals or their prey outwith designated sites.

Harbour seal

3.35 The harbour seal (*Phoca vitulina*) is an Annex II qualifying species for the:

- Doggersbank SAC,
- Klaverbank SAC (Dutch sector),
- Dogger Bank SAC (German sector).

3.36 Harbour seals occur widely around the waters off eastern England and in Dutch waters with most activity in the nearshore waters (Figure 6 and Figure 7). Harbour seals occur in sheltered bays,

inlets and enclosed estuaries and foraging trips are not as extensive as those of grey seals, remaining largely in nearshore waters. Breeding in the region takes place between June and July and pups are nursed for a few weeks. During this period harbour seals will remain predominantly within nearshore waters.

3.37 Tracking studies undertaken on harbour seals in the UK indicate that they occur primarily in nearshore waters but can travel up to between 50 km and 100 km offshore Figure 6. Tracking of 229 harbour seals in Dutch waters between 2007 and 2015 showed that nearly all movements were within 100 km of the coast and between April and October over 90% of movements were less than 60 km (Figure 7). Longer movements offshore occurred primarily between December and March (Aarts *et al*. 2016). Similarly, in Danish waters, between May and August nearly all harbour seals are close to their breeding sites with adults in particular remaining in the proximity of their breeding sites throughout the year. Non-adult harbour seals have been shown to range more widely, particularly between December and April (Dietz *et al*. 2013).

3.38 Harbour seals are opportunistic feeders preying on a wide range of fish species including sandeels, gadoids, flatfish, scorpion fish, sandy benthic fish, pelagic fish and cephalopods (SCOS 2015).

3.39 Sound arising from the proposed seismic survey has the potential to effect harbour seals due to displacement or disturbance. Consequently, the proposed survey could affect harbour seals or their prey.

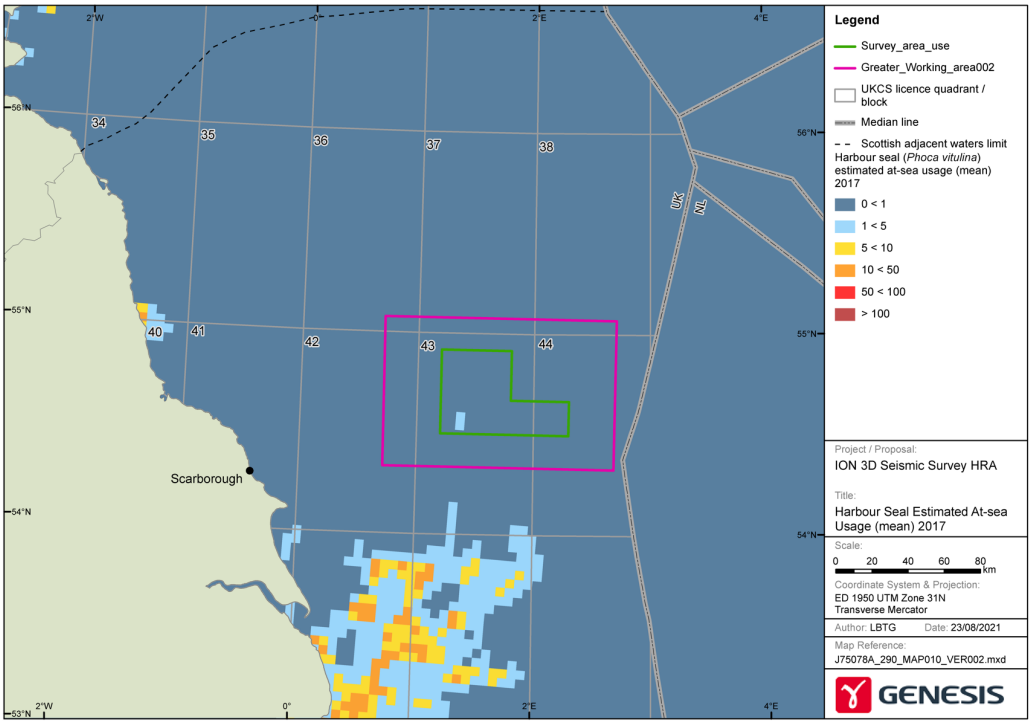


Figure 6: Distribution of harbour seals in waters off Eastern England and proposed survey area.

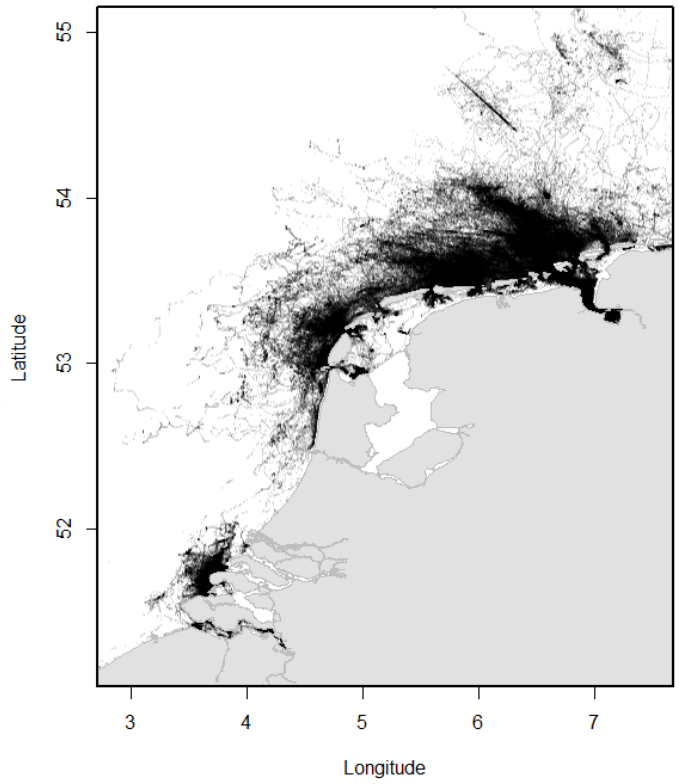


Figure 7: Distribution of tagged harbour seals in Dutch waters (Source: Aarts *et al*. 2016).

Lamprey (Sea lamprey, River lamprey)

3.40 Sea lamprey (*Petromyzon marinus*) and River lamprey (*Lampetra fluviatilis*) are qualifying features of the Humber Estuary SAC.

3.41 Sea lamprey spend their adult life in the sea or estuaries but spawn and spend the juvenile part of their life cycle in fresh water rivers. Adult sea lamprey migrate from the sea to the rivers during late spring and the young (ammococetes) return to the sea from September onwards.

3.42 River lampreys occur in coastal waters, estuaries and rivers. After one to two years in estuaries river lampreys stop feeding in the autumn and move upstream from the river mouth between October and December (Maitland 2003).

3.43 Very little is known about the distribution of lampreys offshore but being parasitic, lampreys will occur wherever their host goes. They have a broad range of host species including marine mammals, basking sharks and other fish species so could occur over a very wide geographical area.

3.44 Sea lampreys have poor hearing ability. Studies indicate that sea lamprey respond to sound at frequencies of between 20 Hz and 100 Hz (Lenhardt and Sismour 1995) and show low sensitivity to low frequency sounds (Maes *et al*. 2004).

Prey species

3.45 Fish are not qualifying species for the Southern North Sea SAC nor, aside from lampreys, are they qualifying features of the other designated sites subject to this assessment. However, potential impacts on fish that are prey for harbour porpoise and seabirds could affect the integrity of the sites by reducing their prey base (JNCC and NE 2019).

3.46 Sandeels are one of the main prey items for harbour porpoise, grey seals and seabirds and are also an important prey species for predatory fish such as whiting, cod and haddock, some of which may also be prey for harbour porpoise and seals (Greenstreet *et al*. 2006).

3.47 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).

3.48 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).

3.49 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).

3.50 Both harbour porpoise and grey seals, along with seabirds, 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).

3.51 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.

3.52 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).

3.53 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).

3.54 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

3.55 This HRA draws on several information sources relating to the proposed project and the site designation which should be read in conjunction with this report including,

- ION (2021a). Application to carry out a Marine Survey. Application GS/1292/0 (Version 1). GX Technology EAME Ltd. 6 August 2021.
- ION (2021b). MNSH Phase 2B 3D seismic survey 2021 UKCS Southern North Sea. Environmental Assessment justification. ION Geophysical Corporation. August 2021.
- Natura 2000 – Standard Data Form. Site: UK0030395. Southern North Sea. JNCC (2019b).
- Guidance for assessing the significance of noise disturbance against Conservation Objectives of harbour porpoise SACs. (England, Wales & Northern Ireland). JNCC (2020a).

- Harbour Porpoise (*Phocoena phocoena*) possible Special Area of Conservation: Southern North Sea. Draft Conservation Objectives and Advice on Activities. JNCC and NE (2019).
- A potential approach to assessing the significance of disturbance against conservation objectives of the harbour porpoise cSACs. Version 3.0. Discussion document JNCC (2017c).
- Noise assessment and management in harbour porpoise SACs. Briefing note: Use of thresholds to assess and manage the effects of noise on site integrity. JNCC. (2017d).

3.56 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 and the physical presence of the vessel. 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), OSPAR (2009) and Erbe *et al*. (2018).

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. Pinnipeds (seals) are potentially more sensitive to low frequency sounds than cetaceans and harbour porpoise may be more sensitive to relatively high frequencies. 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.

Lampreys

4.10 There is no information on the potential impacts sound from an airgun may have on Lamprey. However, they do not have any specialist hearing structures, they lack otolith organs and swim bladders and are likely to have poor hearing sensitivity. Therefore, behavioural or physiological effects are only likely to occur when they are very close to a powerful sound source (Franco *et al*. 2011).

Secondary Effects

4.11 There is potential for impacts on prey species to indirectly affect marine mammals and seabirds, 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 (ION 2021b).

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 seismic airguns during the proposed survey on marine mammals.

5.3 The modelling indicates that, based on the cumulative SEL metric, there is risk of PTS to harbour porpoise out to 24 – 25 m from the use of the 3,290 cu in airgun array. This is reduced to a radius of 8 m or less when a soft-start is undertaken (ION 2021b).

5.4 The onset of PTS in pinnipeds only arises within 64 m and 67 m of the airgun when a 3,390 cu. in. airgun arrays are operated without a soft-start. This is reduced to 10 m when a soft-start is undertaken. For all other airgun options PTS is not predicted to occur (ION 2021b).

5.5 The results from the modelling indicate that there is a risk of behavioural effects, e.g. mild disturbance to a harbour porpoise from within an area of 655 m^2 based on a 3,390 cu. in. airgun, (ION 2021b)[3].

5.6 Injury to fish is expected to arise between 26 m and 46 m depending on species group and behavioural impacts out to 603 m depending on the airgun array (ION 2020a).

5.7 To undertake the HRA further information from existing noise modelling has been used to support the assessment. A comparison between the results from the modelling undertaken within the application and existing noise modelling results provides a greater degree of confidence in the conclusions drawn in this HRA.

5.8 Noise modelling has been undertaken for BEIS to assess the potential impacts to harbour porpoise from a seismic survey within the Southern North Sea SAC (BEIS *in prep.,* 2020). The modelling was undertaken at three locations within the SAC and was based on a 3,220 cu. in. airgun array, comprising four sub-arrays each with eight individual airguns ranging in volume of between 40 cu in and 150 cu. in. The maximum SPL was 261 dB *re* 1 μPa^2s $_{(0\text{-peak})}$. The modelling undertaken previously by BEIS was therefore based on a smaller airgun array than that proposed for the ION survey and but a higher maximum SPL of 261 compared with 254 dB *re* 1 μPa^2s $_{(0\text{-peak})}$ from the 3,390 cu. in. airgun option in the ION application. The results from both sets of noise modelling for harbour porpoise are presented in Table 4.

5.9 There are differences in the modelling results which are, in part, due to the differences in the airgun arrays used for the two sets of models. Evidence from studies undertaken on the impacts

[3] The applicant defines disturbance as 'strong' disturbance where there will physical displacement at 165 dB re 1 µPa (SPL pk-pk) and 'mild' disturbance at levels of 145 dB re 1 µPa2s (SEL single pulse).

to harbour porpoise from seismic airguns indicate disturbance to harbour porpoise can occur out to 12 km from an airgun array (Sarnocińska *et al*. 2020). Consequently, for the purposes of this assessment the results from the BEIS noise modelling have been used.

Table 4: Harbour porpoise estimated areas of physical injury and disturbance.

Harbour porpoise	ION (3,390 cu. in. airgun)		BEIS (3,220 cu. in. airgun)	
	Distance (m)	Maximum area (km^2)	Distance (m)	Maximum area (km^2)
PTS (no soft-start)	25	0.002	-	-
PTS (with soft-start)	0	0	320	0.32
Disturbance	1,100	3.8	7,800	301

PTS SEL Threshold weighted 155 re 1 μPa^2s.
'mild' disturbance - 145 dB re 1 $\mu Pa_{(rms)}$.

5.10 Noise modelling to assess potential impacts to grey seals from seismic surveys has not previously been undertaken by BEIS in the proposed survey area. However, modelling has been undertaken on grey seals at three locations in nearshore waters around north-east Scotland, Orkney and Shetland (OGA 2016). The modelling results are not directly comparable due to the different geographic location and that the previous modelling was based on a 5,000 cu. in. airgun array with a maximum SPL of 259 dB *re* 1 $\mu Pa^2s_{(0\text{-peak})}$ compared to 255 dB *re* 1 $\mu Pa^2s_{(0\text{-peak})}$. Consequently, a larger area of potential impact might be predicted by the modelling previously undertaken for BEIS.

5.11 The results from the two sets of noise modelling undertaken for grey seal are presented Table 5. Although the results from the BEIS modelling may be greater than that predicted from a smaller airgun array as is being used for this survey. The use of the BEIS modelling results have been used for the purposes of this assessment but may be overly precautionary.

Table 5: Grey and harbour seal estimated areas of physical injury and disturbance.

Pinnipeds	ION (3,390 cu. in. airgun)		BEIS (5,000 cu. in. airgun)	
	Distance (m)	Maximum area (km^2)	Distance (m)	Maximum area (km^2)
PTS (no soft-start)	67	0.014	-	-
PTS (with soft-start)	10	0.0003	99	0.031
Disturbance	726	0.53	17,000	383

PTS SEL Threshold weighted 185 re 1 μPa^2s.
'mild' disturbance - 160 dB re 1 $\mu Pa_{(rms)}$.

Potential impacts on harbour porpoise

5.12 The results from the modelling indicate that noise levels that have the potential to cause the onset of auditory injury (PTS) to harbour porpoise occur out to between 0 and 320 m from the airguns (Table 4).

5.13 There is potential for levels of noise at which disturbance could occur to extend from between 0.65 km and 7.8 km from the airguns and encompass an area of between 1.32 km^2 and 383 km^2 (Table 4).

Potential area of impact on grey and harbour seals

5.14 The results from the modelling indicate that noise levels that have the potential to cause the onset of auditory injury (PTS) to seals will occur between 10 m and 99 m from the airguns (Table 5).

5.15 There is potential for levels of noise at which disturbance could occur to extend between 0.73 km and 17.0 km from the airguns and encompass an area of between 1.66 km^2 and 383 km^2 (Table 5).

Potential impacts on fish

5.16 Results from the noise modelling undertaken by the applicant for the application and previously by BEIS are presented in Table 6. Noise levels that have the potential to cause mortality to fish species with swim bladders could occur from between 46 m and 302 m. For fish without swim bladders, e.g. Lampreys, mortality could occur from between 31 m and 140 m from the seismic survey (OGA 2016, ION 2021b).

Table 6: Maximum distances at which mortality and disturbance to fish, eggs and larvae could occur.

Location	Distance (m)			
	Fish: swim bladder involved in hearing [-1] Allis shad Twaite Shad,	**Fish: no swim bladder [-2]** Sea Lamprey, River lamprey Plaice, lemon sole	**Eggs and Larvae** All species	**Disturbance** All species
ION	46	31	46	603
BEIS	302	140	302	-

1 - 213 Unweighted peak SPL (dB re 1 µPa)

2 - 207 Unweighted peak SPL (dB re 1 µPa)

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 Southern North Sea SAC (JNCC 2017c,d; JNCC 2020a). 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 7 (JNCC 2020a). Relevant to this assessment is the EDR for seismic surveys which is 12 km. This is based on recent evidence indicating that harbour porpoise can be displaced up to 12 km from seismic survey (Sarnocińska *et al*. 2020).

6.3 The use of a 26 km EDR has been used for pile-driving and the detonation of unexploded ordnance (UXO) and 5 km for the geophysical surveys when considered in the in-combination assessment. For the purposes of this assessment a 15 km EDR has been used for UXO with bubble curtains, this follows the EDR proposed for pile-driving with noise abatement.

Table 7: Precautionary Effective Deterrent Ranges (EDR) (Source: JNCC 2020a).

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 to what diameter a pin-pile should be is provided in published advice (JNCC 2020a).

6.4 The SNCBs recognise that future data may require the suitability of the EDR to be reconsidered if it is found to be inappropriate (JNCC 2017d).

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 (JNCC and NE 2019).

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 can 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 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*' (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 2017b; 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 2017c,d; JNCC and NE 2019, JNCC 2020a). 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 Southern North Sea 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 2020a).

7.15 The potential extent of noise causing disturbance that would meet these proposed thresholds and therefore impact on the integrity of the site is presented in Table 8. The results indicate that should the impact occur wholly inside the Southern North Sea 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 10% of the SAC, i.e. 3,695 km^2; equivalent to a radius of noise of 29.3 km and in the 'winter' the area should not extend over an area of more than 1,269 km^2, equivalent to a radius of 20.1 km.

Table 8: Estimated extent sound levels capable of causing displacement disturbance occur 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	1,269	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 proposed SNCB threshold approach for the Southern North Sea SAC.

7.19 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. The threshold approach proposed by the SNCBs has not been fully adopted by all the competent authorities. However, the thresholds have been noted within the assessment as a high-level management tool to limit the spatial distribution of noise from offshore activities within a large offshore SAC, such as the Southern North Sea SAC.

7.20 The HRA has been carried out in light of best scientific knowledge with reference to the Conservation Objectives of the Southern North Sea SAC and the potential impacts on the integrity of the site (EC 2018).

The Humber Estuary SAC

7.21 The Humber Estuary SAC was designated as a SAC in 2009. The site comprises a number of habitat types including sandbanks, mudflats and coastal lagoons and river lamprey, sea lamprey and grey seal are qualifying species for the site (Natural England 2018).

Humber Estuary SAC Conservation Objectives

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- The extent and distribution of qualifying natural habitats and habitats of qualifying species,
- The structure and function (including typical species) of qualifying natural habitats,
- The structure and function of the habitats of qualifying species,
- The supporting processes on which qualifying natural habitats and habitats of qualifying species rely,
- The populations of qualifying species, and,
- The distribution of qualifying species within the site.

Source: Natural England 2018a

Berwickshire and North Northumberland Coast SAC

7.22 The Berwickshire and North Northumberland Coast SAC was designated as a SAC in 2005. The site covers an area of 652 km^2 and comprises a number of habitats primarily of marine areas, sea inlets, tidal rivers, estuaries mudflats sand flats and lagoons. Grey seal is a qualifying species and the site supports 2.5% of the annual pup production (JNCC 2020b).

7.23 The Berwickshire and North Northumberland Coast SAC Conservation Objectives are the same as those for the Humber Estuary SAC.

Doggersbank SAC

7.24 The Doggersbank SAC lies within Dutch waters encompassing an area of 4,735 km^2. The site became a SAC in 2016. Qualifying species for the site include harbour porpoise, grey and harbour seals (Jak *et al.* 2009).

Doggersbank SAC Conservation Objectives

- Maintain the distribution, extent and quality of habitat for the purposes of maintaining the population.
- Maintain the extent and quality of habitat in order to maintain the population.

Source: Jak et al. 2009

Klaverbank SAC

7.25 The Klaverbank SAC lies within Dutch waters encompassing an area of 1,539 km^2. The site became a SAC in June 2016. Qualifying species for the site include harbour porpoise, grey and harbour seals (Jak *et al.* 2009). The conservation objectives for the site are the same as those for Doggersbank SAC

Dogger Bank (German sector) SAC

7.26 The Dogger Bank (German sector) SAC lies within German waters encompassing an area of 1,698 km^2. The site became a SAC in 2010. Qualifying species for the site include harbour porpoise and harbour seal (BfN 2010).

Dogger Bank (German sector) SAC Conservation Objectives

• Maintain and restore the site's specific ecological functions, biodiversity and natural hydrodynamics and morphodynamics.

• Maintain at and restore to favourable conservation status habitat type 1110 (sandbanks which are slightly covered by sea water all the time) together with its typical and endangered species and ecological communities.

• Maintain at and restore to favourable conservation status the following Habitats Directive species and their natural habitats: harbour porpoise and common seal.

Source: BfN. 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,

- 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

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 20 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 2017c, JNCC 2020a). (Table 9 and Figure 8). Two wind farms (Triton Knoll and Hornsea Two) are currently undertaking offshore construction. 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 Belgium, the SeaMade wind farms: Mermaid and Seastar are under construction. However, all the monopile foundations have been installed.

Table 9: 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	Offshore construction started
Westermost Rough	Operating
Round 3	
Creyke Beck A	Onshore construction started
Creyke Beck B	Onshore construction started
East Anglia One	Operating
East Anglia Two	Application submitted
East Anglia Three	Consented
Hornsea Project One	Operating
Hornsea Project Two	Offshore construction started
Hornsea Project Three	Consented
Norfolk Vanguard	Application submitted
Teesside A (Sofia)	Consented
Teesside B	Onshore construction started
Belgium	
SeaMade (Mermaind and Seastar)	Offshore construction started
Netherlands	
Borssele I and II	Operating
Borssele III and IV	Operating

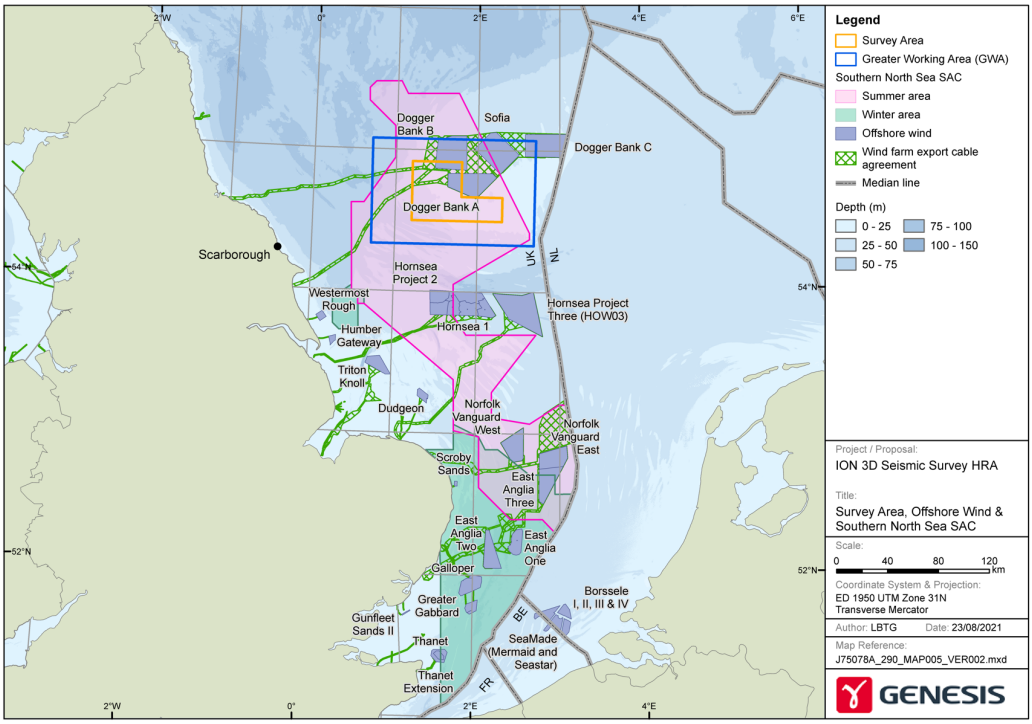


Figure 8: Offshore wind farms located within 26 km of the Southern North Sea SAC.

8.6 It is recognised that during construction, pile-driving will likely occur and that, if undertaken simultaneously as the proposed ION seismic survey, there is the potential to cause an adverse effect in-combination. Of the offshore wind farms that are relevant to the in-combination assessment the Hornsea Two offshore wind farm could be pile-driving during the period of the proposed seismic survey in 2021 (Ørsted 2020). The Triton Knoll offshore wind farm has completed installing the foundations and therefore no further pile-driving is anticipated.

8.7 Other offshore wind farm activities that could cause an impact on qualifying features include the clearance of UXO and geophysical surveys. An application has been submitted to the Marine Management Organisation to undertake the clearance of up to 25 items of UXO at the Dogger Bank A and Dogger Bank B wind farms, including export cable routes, between May and December 2021 (DBWF 2021, MMO 2021a). BEIS has been informed that the UXO clearance at both wind farms has been completed with no UXO requiring to be cleared. Consequently there is no in-combination impact from the UXO clearance activities.

8.8 No consent is required by the offshore wind farm industry for undertaking geophysical surveys. Consequently, there is limited information available regarding potential geophysical surveys that could cause an in-combination impact. However, the Supporting Environmental Information submitted by Dogger Bank Wind Farm in support of UXO clearance undertaken at Dogger Bank A and Dogger Bank B wind farms, reported up to six geophysical surveys to be undertaken at

Dogger Bank A, B and C, Sofia and at Hornsea Three and Hornsea Four during 2021. There is little or no published information on when, where or how the six proposed geophysical surveys will be undertaken. However, published Notice to Mariners indicate that the surveys undertaken at Dogger Bank B and C were completed by 1 June. The status of the remaining possible geophysical surveys is unknown.

8.9 A further survey using a sub-bottom profiler (Applied Acoustics DuraSpark (x2) Sparker) is planned to be undertaken at Dogger Bank South wind farm area during September. It is planned to last nine to ten days covering two locations 4 km^2 and 4.5 km^2 (MMO 2021b).

Cable laying

8.10 The Viking Link project is a high voltage direct current (HVDC) electrical interconnector between Denmark and the UK. The 762 km long cable will be laid between Jutland in Denmark and Bicker Fen in Lincolnshire and crosses the Southern North Sea SAC (NGVL 2018a). Four items of unexploded ordnance were identified along the cable route within 26 km of the Southern North Sea SAC boundary, of which one was in the SAC; these were to be cleared in 2020. No other UXO clearance activities are associated with this project are known of (NGVL 2018b, NGVL 2019, MMO 2020).

Aggregate and dredging

8.11 Existing localised aggregate dredging occurs primarily in the southern half of the Southern North Sea SAC, along the east coast (Figure 9). 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.

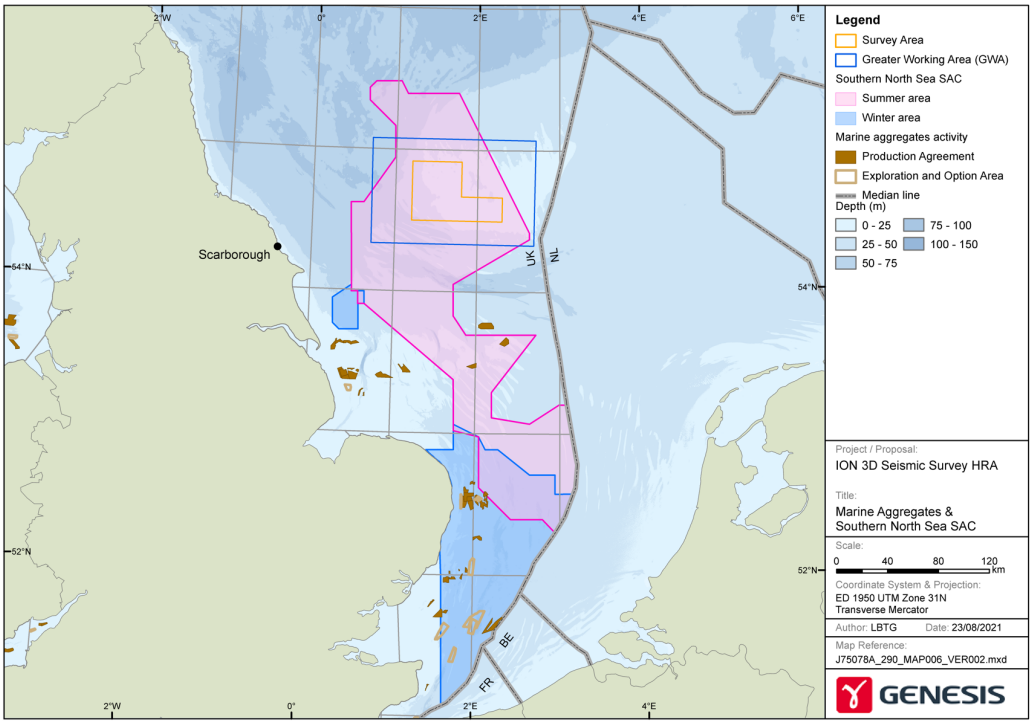


Figure 9: Existing marine aggregate activities in the Southern North Sea SAC.

8.12 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).

8.13 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 Southern North Sea SAC may be impacted by noise arising from dredging activities.

Oil and gas

8.14 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 in the 'summer' area of the site (Figure 10) (OGA NDR 2020).

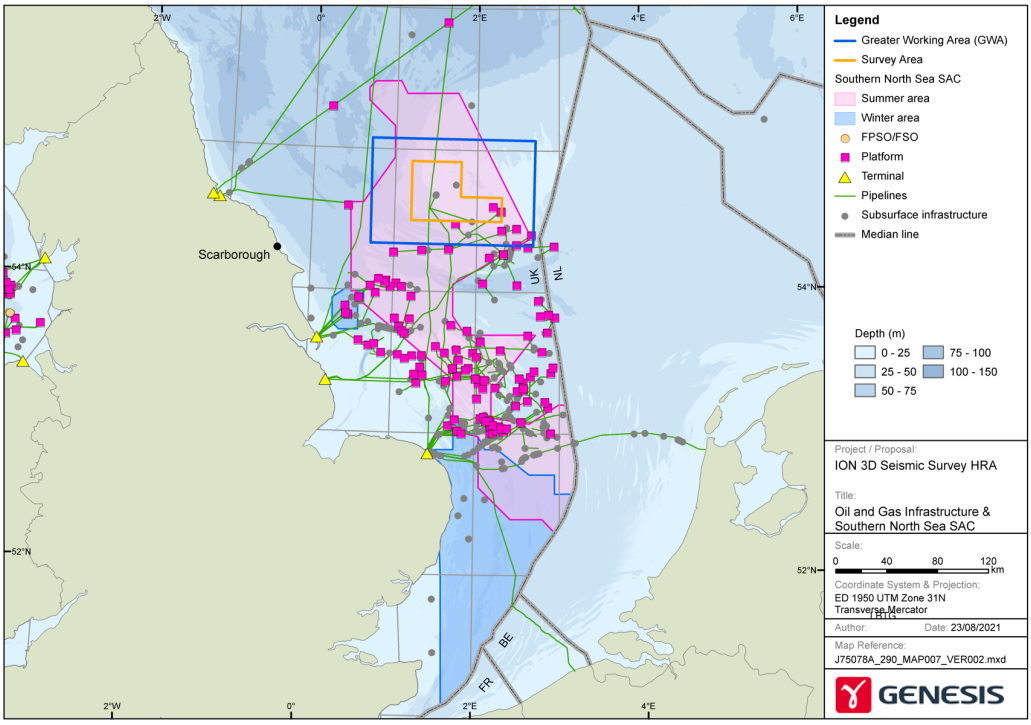


Figure 10: Existing oil and gas infrastructure within the Southern North Sea SAC and proposed survey area.

8.15 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.

8.16 BEIS are aware of a number of planned oil and gas related activities within the area during the period the proposed survey will be undertaken that could cause an in-combination effect (Table 10).

8.17 The proposed operations include drilling activities. Noise from drilling activities is largely dependent on the type of drilling platform being used. Jack-up rigs are the most frequently used drilling platform in the Southern North Sea and produce the lowest levels of sound. Studies in Danish waters reported sound source levels of 148 re 1µPa-m $_{(rms)}$ from drilling activities undertaken from a fixed platform (Bach *et al.* 2010). The level of sound arising from drilling is relatively low and occurs predominantly at a low frequency and is a continuous sound source (Greene 1987; McCauley 1998; Nedwell and Edwards 2004). Sound arising from drilling is outwith the main hearing frequencies for harbour porpoise.

8.18 Studies using Passive Acoustic Monitoring (PAM) at platforms located on the Dogger Bank did not record any decrease in harbour porpoise activity at the platforms when drilling was being undertaken and indicated that harbour porpoises appeared to use oil and gas platforms as feeding refuges (Todd *et al.* 2007, Todd *et al*. 2009). Similar results have been reported from studies undertaken at two platforms in Danish waters (Bach *et al*. 2010).

8.19 The placement of oil and gas infrastructure will be undertaken using vessels and is not predicted to cause any significant increase in the level of vessel activity within the Southern North Sea SAC above which currently occurs within the site.

Table 10: Planned oil and gas activities within or adjacent to the SAC that could cause an in-combination impact.

Applicant	Licence Reference No.	Licence Block(s)	Start and End Dates	Planned Activity
Shell	DR/2081/0	48/20	15 April 2021 – 31 December 2021	Drilling at Galleon field.
Chrysaor	CL/1150/0	49/17	26 February 2021 – 30 September 2021	Location of mobile drilling unit.
Chrysaor	GS/1263/2	48/10	6 August 2021 – 31 August 2021	Geophysical Survey (Sub-bottom Profiler CHIRP Survey)
Geoex	GS/1199/0	multiple	10 June – 30 Sept 2021	Marine Survey (2D)
BP	GS/1252/2	multiple	24 June – 24 September 2021	Geophysical Survey (Sub-bottom Profiler Pinger Survey, Magnetic Survey (e.g. Electromagnetic Survey))
ION	GS/1163/0	multiple	1 April 2021 – 31 October 2021	3D seismic survey

MBES = Multi-beam Echosounder, SSS = Side-scan Sonar.

8.20 Chrysaor have submitted an application (GS/1263/2) to undertake debris clearance and bathymetry geophysical surveys at three installations that are each subject to ongoing decommissioning. Two of the installations: Tethys TN and Kelvin TM, lie within the Southern North Sea SAC. The third installation (Saturn ND) lies outwith but adjacent to the site. The surveys comprise the use of single and multi-beam echosounders, sub-bottom profiler, mini-airgun, side-scan sonar and a magnetometer. Each Survey Area around an installation is 1 km^2, with a Greater Working Area of 9 km^2. Each survey is estimated to last one day and all three will be undertaken by 31 August 2021 (Chrysaor 2021, Humber Energy 2021).

8.21 The Geoex geophysical survey (GS/1190/0) covers a wide area of the central and northern North Sea, of which 64 km of survey line was within the Southern North Sea SAC (EPI 2021; BEIS 2021a). The survey was originally planned to start in April 2021 but was delayed until June 2021 and is to be completed by 30 September 2021. The two survey lines that will impact on the

Southern North Sea have been completed and no further impacts from this survey will occur within the site.

8.22 The BP geophysical survey (GS/1252/2) is a pipeline route survey comprising the collection of data along three lines each 100 m apart, running the length of the pipeline route. The survey will entail the use of a sub-bottom profiler, side-scan sonar and magnetometer. A total length of 69 km of the survey will occur within the Southern North Sea SAC. The survey is to be undertaken over a period of 70 days commencing no earlier than 24 June and ending on 24 September 2021 (BP 2021a, b). BP has confirmed that works entailing the use of the side-scan sonar have been completed and therefore will not overlap with the proposed MNSH seismic survey (BP 2021c).

8.23 An application to undertake a regional 3D seismic survey was submitted by ION to BEIS in December 2020. The survey is located within UKCS Blocks 35/21 - 35/25, 35/27 - 35/30, 36/ 16 – 36/30, 37/16 – 37/30, 38/16, 38/17, 38/18, 38/21,38/22, 38/23, 38/26, 38/27, 38/28, 41/1 – 41/10, 42/1 - 42/8, 43/1 – 43/7 and 44/1. The Greater Working Area covers approximately 21,344 km^2, with the Survey Area covering 12,627 km^2. A total of 2,718 km^2 occurs within the Southern North Sea SAC. The survey comprises the towing of between eight and ten 9,500 m streamers at a speed of between 4.5 knots (8.3 km/h) and 5 knots (9.3 km/h). The width of each towed survey array is approximately 1,125 m and each surveyed line is 563 m apart. The total volume of airguns operated is 3,390 cu. in. and are fired at intervals of every 5.4 or 7.2 seconds. (ION 2020a,b). Following the completion of an HRA, the survey was approved in April 2021 (BEIS 2021b).

Shipping

8.24 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 (Heinänen and Skov 2015). 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).

8.25 The level of vessel activity across the ‘summer’ and ‘winter’ areas of the SAC differs (Figure 11). 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.

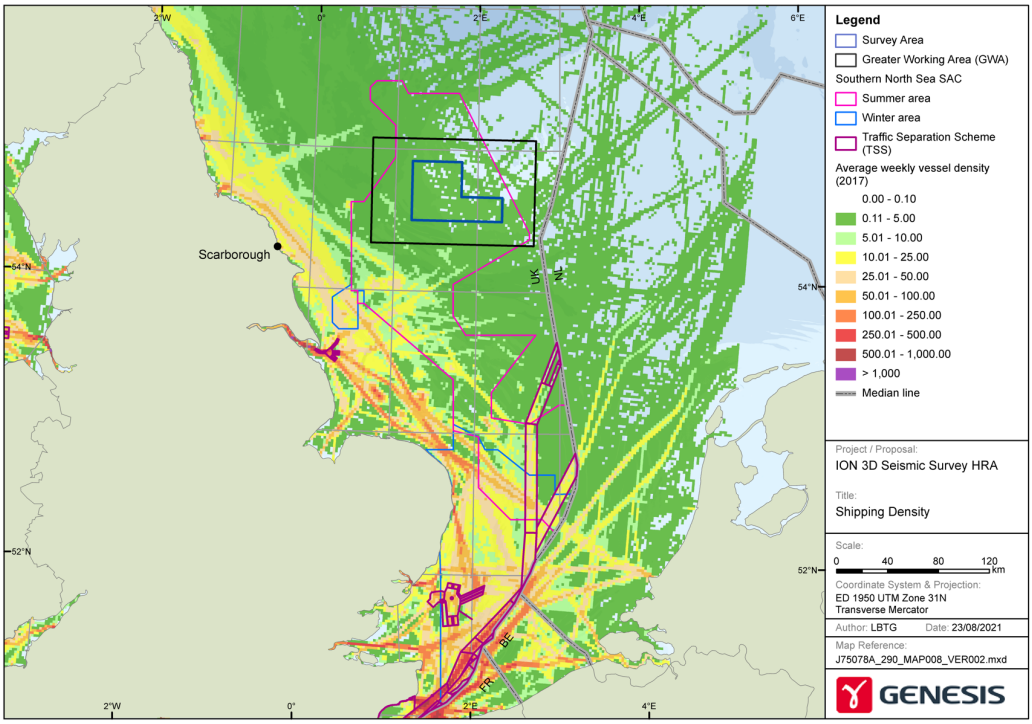


Figure 11: Shipping density within the SAC during 2017.

Fishing activity

8.26 Fishing occurs widely across the southern North Sea and has also been on-going in the area for many hundreds of years. Most 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 12) (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.

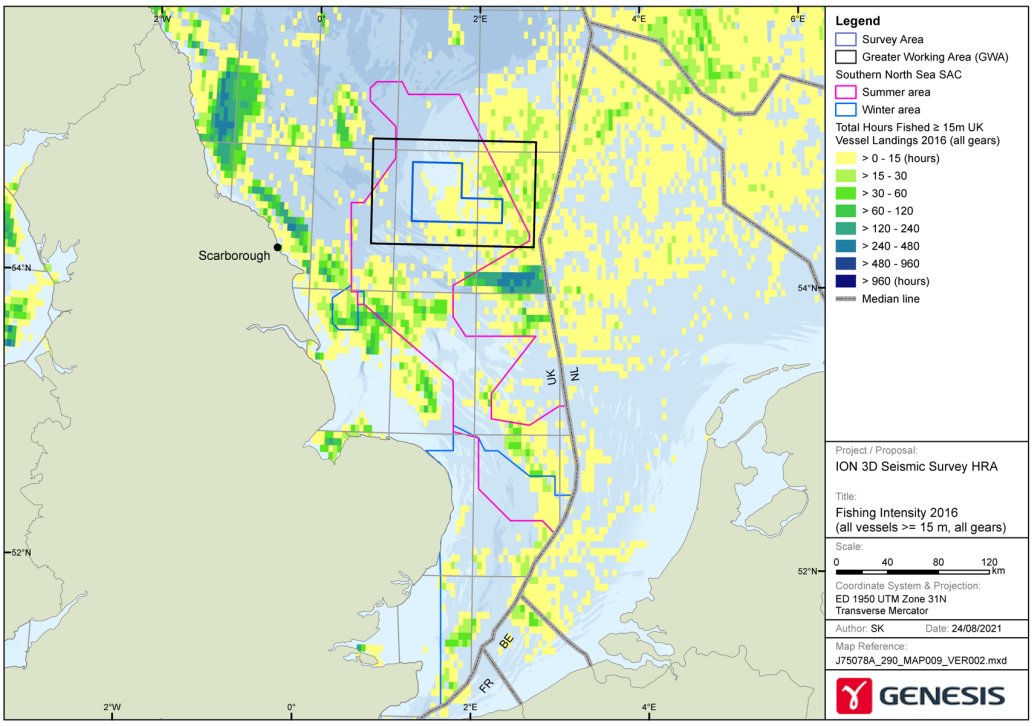


Figure 12: Fishing intensity across the SAC during 2016 by UK registered vessels

8.27 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).

8.28 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 Serea 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.

Noise modelling predicts that the proposed seismic survey 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

8.29 Following consideration of all known developments that may 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:

- Construction pile-driving at Hornsea Two offshore wind farm,
- BP Geophysical survey,
- Geoex Seismic Geophysical Survey,
- ION 3D Seismic Geophysical Survey,
- Geophysical Survey at Dogger Bank A offshore wind farm,
- Geophysical Survey at Sofia offshore wind farm,
- Geophysical Survey at Hornsea Three offshore wind farm,
- Geophysical Survey at Hornsea Four offshore wind farm,
- Geophysical Survey at Dogger Bank South offshore wind farm,
- Chrysaor Energy Geophysical Survey.

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 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 proposed survey both alone and in combination with other plans and projects on each of the interest features of the relevant National Sites to determine whether there will be a likely significant effect.

Harbour porpoise

9.4 Harbour porpoise are a qualifying species for the Southern North Sea SAC, Doggersbank SAC, Klaverbank SAC and the Dogger Bank SAC (German Sector).

9.5 Within the Southern North Sea SAC harbour porpoise are known to occur throughout the site, with particular concentrations in the northern 'summer' area over which the proposed seismic survey overlaps. Noise modelling undertaken indicates that there is potential for auditory injury to occur within 320 m of the sound source and disturbance or displacement effects to occur 7.8 km from the airguns and extend over an area of 301 km^2 (Table 4).

9.6 The Doggersbank SAC is 5.1 km from the Greater Working area and 32.8 km from the proposed Survey Area and therefore beyond the range noise from which the seismic survey is predicted to cause disturbance. Consequently, the proposed seismic survey will not cause a likely significant effect on harbour porpoise within the Doggersbank SAC.

9.7 The Klaverbank SAC is 7.7 km from the Greater Working Area and 38.9 km from the proposed Survey Area and therefore beyond the range noise from which the seismic survey is predicted to cause disturbance. Consequently, the proposed seismic survey will not cause a likely significant effect on harbour porpoise within the Klaverbank SAC

9.8 The Dogger Bank (German sector) SAC lies 32 km from the closest boundary of the proposed surveys Greater Working Area and 138.3 km from the Survey Area. This is beyond the range at which disturbance from the seismic survey is predicted to impact on harbour porpoise and therefore harbour porpoise within the SAC will not be impacted and the proposed seismic survey will not cause a likely significant effect.

9.9 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 seismic survey within or adjacent to the Southern North Sea SAC; the potential impacts on harbour porpoise are therefore considered further in the Appropriate Assessment.

9.10 There is predicted to be no impact that will cause a likely significant effect on harbour porpoise from the proposed survey in the Doggersbank SAC, Klaverbank SAC and Dogger Bank (German sector) SAC. No further assessment is required on these sites.

Grey seal

9.11 Results from noise modelling indicate that there is potential for levels of noise to cause physical injury or disturbance and displacement to grey seals.

9.12 Grey seals are a qualifying species at the Berwickshire and North Northumberland Coast SAC, the Humber Estuary SAC, Klaversbank SAC and Doggersbank SAC.

9.13 Grey seal are known to routinely forage within 100 km from their haul out sites and although they occur further offshore they do so less frequently. Noise modelling undertaken indicates that there is potential for auditory injury to arise within 99 m of the sound source. The potential extent of disturbance could extend to 17 km and encompass an area of 333 km^2 (based on worst-case modelling outputs) (Table 5).

9.14 Based on the results from noise modelling, the known offshore distribution of grey seals (Figure 5) and their behaviour, it is concluded that there is potential for a likely significant effect on grey seals from the Humber Estuary SAC and the Berwickshire and North Northumberland Coast SAC; the potential impacts on grey seal are therefore considered further in the Appropriate Assessment.

9.15 The Doggersbank SAC is 32.8 km from the Survey Area and the Klaversbank is 38.9 km from the Survey Area and therefore both sites are beyond the range noise from the seismic survey is predicted to cause disturbance within the site (Table 5). Consequently, the proposed seismic survey will not cause a likely significant effect on grey seals in the Doggersbank SAC or Klaversbank SAC.

Harbour Seal

9.16 Results from noise modelling indicate that there is potential for levels of noise to cause physical injury or disturbance and displacement to harbour seals.

9.17 Harbour seals are a qualifying species for the Doggersbank SAC, Klaversbank SAC and the Dogger Bank (German sector) SAC.

9.18 Noise modelling undertaken indicates that there is potential for auditory injury to arise within 99 m of the sound source and levels of noise capable of causing disturbance could extend to 17 km and encompass an area of 383 km^2 (based on combined worst-case modelling outputs) (Table 5).

9.19 Tracking of harbour seals in UK and Dutch waters indicate that they do not routinely travel further than 60 km from their haul out sites from between April and October. Therefore, densities of harbour seal within the SAC are predicted to be relatively very low.

9.20 The Doggersbank SAC is 32.8 km from the Survey Area and the Klaversbank is 38.9 km away. The Dogger Bank (German sector) SAC lies 138.3 km from the Survey Area. Consequently, noise from the proposed seismic survey is not predicted to cause disturbance to harbour seals within the SACs for which they are a qualifying feature.

9.21 Based on the results from noise modelling and known behaviour of harbour seals it is concluded that there will not be a likely significant effect on harbour seals within the Doggersbank SAC, Klaversbank SAC or the Dogger Bank (German sector) SAC.

Sea Lamprey and River Lamprey

9.22 The Sea lamprey and River lamprey are qualifying species for the Humber Estuary SAC, which lies 87.6 km from the nearest boundary to the Greater Working Area. There is also potential for noise to impact on the prey species of harbour porpoise and seals from or within designated sites.

9.23 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 include prey species for harbour porpoise and seals, such as herring, are recognised to be hearing specialists. Those without, e.g. sandeels, are considered to have a relatively low sensitivity to noise. Most fish with swim bladders can detect sound within the 100 Hz to 2 kHz range, those without swim bladders are unlikely to detect sound above 400 Hz (Popper *et al*. 2014).

9.24 Results from the noise modelling indicate that noise levels capable of causing lethal effects on fish with swim bladders could occur out to 302 m from the airgun and for fish without swim

bladders impacts could occur to 140 m (Table 6). The area of impact within which physical injury could occur is therefore relatively very small.

9.25 Based on the distance of the seismic survey is from the SAC, the low risk of any Lamprey occurring in the Survey Area along with their relatively poor hearing ability and low sensitivity to noise, it is concluded that there will not be a likely significant effect on sea lamprey or river lamprey from the proposed survey.

Habitats

9.26 Habitats listed in the SAC citations will not be impacted by the proposed seismic survey and are not considered to be at risk of a likely significant effect. They are therefore not considered further in this Appropriate Assessment.

Likely significant effects test - conclusions

9.27 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,
- Humber Estuary SAC: Grey seal,
- Berwickshire and North Northumberland Coast SAC: Grey seal.

9.28 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 seismic survey 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 2018).

10.2 The following sections assess whether there will be an adverse effect on any of the European sites identified as having qualifying species for which no likely significant effect could not be ruled out from the project alone and in-combination.

10.3 A dual approach based on outputs from two sets of noise modelling and supported by the use of EDR has been used for harbour porpoise in order to determine whether an adverse effect on the integrity of the Southern North Sea SAC will occur. There are no EDRs for other species of marine mammal and therefore noise modelling results have been used to support the assessment on grey seals.

10.4 The assessment of the potential impacts from the seismic survey is based on the combined results from noise modelling undertaken by the applicant and by BEIS. 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 A second approach to the assessment has also been undertaken based on recommendations by the JNCC and NE. 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 potential for sound levels to cause the onset of PTS to harbour porpoise out to 320 m of the sound source (Table 4).

10.7 The peak harbour porpoise density across the SAC is estimated to be >3 per km^2 (Figure 4) (Heinänen and Skov 2015). Based on this peak density and the worst-case scenario of PTS occurring out to 320 m of the survey, an estimated one harbour porpoise could be affected at the start of the seismic survey.

10.8 The North Sea Management Unit harbour porpoise population is estimated to be 346,601 individuals and therefore the worst-case scenario of one harbour porpoise being impacted is <0.0001% of the Management Unit population.

10.9 The estimated area of potential impact from PTS is within 500 m of the airgun array and therefore within the radius which, if marine mammals are detected during a pre-shooting search, the commencement of the firing of the airguns must be delayed by a minimum of 20 minutes, as per the JNCC guidance (JNCC 2017a). Harbour porpoise will avoid the area of potential injury and move away from the seismic survey vessel as it approaches. Consequently, apart from when the operation of the airgun initially commences, there is a very low risk of physical injury to any harbour porpoise. In the extremely unlikely event the onset of PTS does occur, it would only affect a very small proportion of the relevant population.

Disturbance

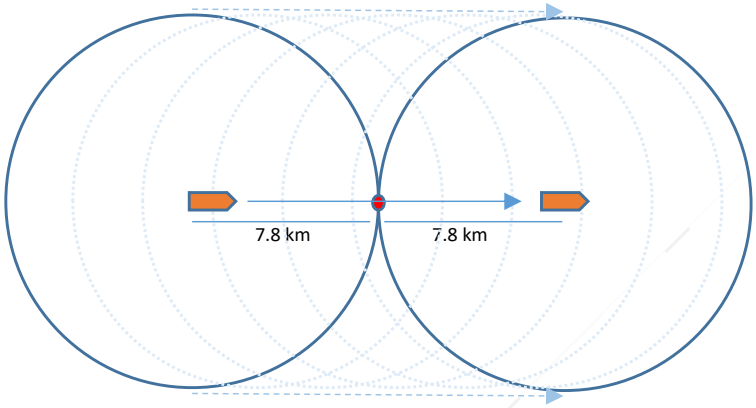
10.10 The largest distance any noise likely to cause disturbance is estimated to propagate out to is 7.8 km from the airguns, covering an area of 301 km^2 (Table 4). If disturbance occurs entirely within the SAC, then approximately 0.8% of the SAC as a whole and 1.1% of the 'summer' area could be affected by the proposed seismic survey at any one time.

10.11 Based on a peak site density of 3.0 ind./km^2 an estimated 903 harbour porpoise could be disturbed by a seismic survey. This is equivalent to 0.3% of the North Sea Management Unit harbour porpoise population being disturbed.

10.12 A seismic vessel will transit across an area and over the duration of a survey the total number of harbour porpoises disturbed will be greater. The application states that the seismic survey will be travelling at 5 knots (9.26 km/h) (ION 2021a,b). As the vessel undertakes a survey, disturbance in any area will last no more than 1 hr and 42 minutes in any one location (Figure 13). Once the vessel has left the area, sound levels will reduce to background levels. The disturbance effects are therefore transient and once the vessel has moved away from an area there is, in effect, no disturbance on those porpoises previously impacted.

10.13 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 seismic surveys will be temporary, with porpoises predicted to return to the area impacted within 24 hrs.



● = Location of harbour porpoise in order for maximum duration of disturbance to occur.

Maximum extent of disturbance from seismic survey at 145 dB re 1 µPa at 1 m – 7.8 km.

Total distance – 15.6 km.

Vessel speed – 9.26 km/h.

Total duration of disturbance impact = 1.7 hrs (1 hr and 42 mins).

Figure 13: Diagram showing potential maximum duration of disturbance to harbour porpoise from seismic survey.

Threshold Approach

10.14 The JNCC have advised that the assessment for harbour porpoise within the SAC should be undertaken by the proposed threshold approach whereby disturbance should not exceed 20% of the SAC 'summer' or 'winter' areas over the course of one day (the daily threshold) and on average 10% of an area over the course of a single season (the seasonal threshold) (see Section 7).

Daily Threshold

10.15 To calculate whether the daily threshold of 20% of the seasonal area is impacted an accurate estimate of the level of activity within the seasonal area of the SAC is required to calculate the likely area impacted each day.

A total of 8,362 km^2 of the Greater Working Area is within the Southern North Sea SAC and therefore overlaps 22.6% of the SAC as a whole and 30.9% of the 'summer' area. However, airguns will only be operating within the Survey Area and, aside from the period when soft-start is undertaken, the airguns will not be operating in the wider Greater Working Area. The area of seismic survey to be undertaken within the Survey Area and within the SAC is 2,407 km^2 (ION 2021b). The Survey Area overlaps with 6.5% of the SAC as a whole and 8.9% of the 'summer' area.

10.16 Noise arising from the proposed seismic survey will be transient as the vessel moves along the pre-determined survey lines. The extent of displacement (deterrence) over the period of one day will therefore be greater than if the survey was stationary.

10.17 When undertaking the seismic survey, the vessel will be travelling at a maximum speed of 5 knots (9.26 km/h) (ION 2021a,b)[4]. Consequently, the maximum length of line that could, in theory, be surveyed over the course of a single day is 222 km. Assuming a 12 km EDR, the total area impacted over the course of 24 hrs would be 5,780 km^2 (Figure 14). This presumes that airguns are operating continuously throughout a 24 hr period. This is an unrealistic scenario as there will be breaks of approximately 3.0 hrs in airgun operations at the end of each line as the vessel turns before commencing the next line (ION 2021a,b); consequently, airguns will not be operating throughout a 24 hr period.

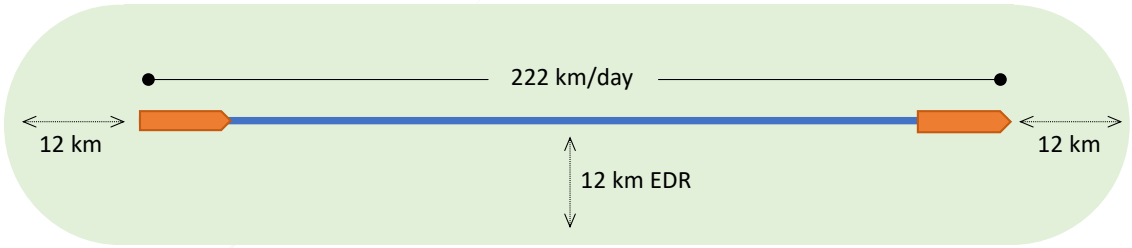


Figure 14: Worst-case theoretical area of impact from a seismic survey travelling at 5 knots, using 12 km EDR.

10.18 Based on the configuration of the planned survey route, the length of the longest survey line is 71 km, all of which is within the SAC. Each consecutive line will be a maximum of 9 km apart and line turns will take between 3 and 3.5 hrs (ION 2021b). It is therefore possible that the survey will undertake two complete survey lines during any one 24 hr period, each 9 km apart. Theoretically a third survey line may also be started but will last no longer than 2.5 hrs within the course of a single day and be located 200 m from the first survey line. Consequently, it will have

[4] Note the application (ION 2021b) states the vessel speed to be both 4.5 knots and 5 knots. For the purposes of this assessment the more precautionary vessel speed of 5 knots has been used. If the vessel travels at 4.5 knots a smaller area of the SAC will be impacted each day.

negligible additional impact on the area impacted in any one day (Figure 15). Noise occurring at the end of each survey line will propagate into the SAC beyond the boundary of the Survey Area.

10.19 The maximum area within the SAC that will be impacted per day is estimated to be 3,135 km^2 [5] [6]. This is equivalent to impacting 8.5% of the SAC as a whole and 11.6% of the 'summer' area per day. Consequently, the daily threshold will not be exceeded by the proposed seismic survey on its own.

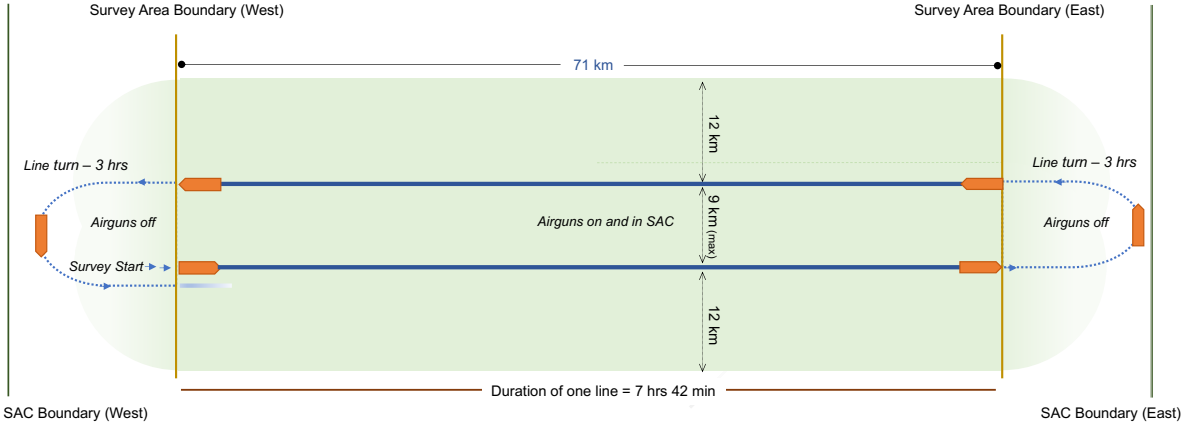


Figure 15: Maximum area of impact over a 24 hr period from proposed ION seismic survey within the Southern North Sea SAC.

Seasonal Threshold

10.20 The survey was planned to commence on 1 September 2021, although the start date will be no earlier than 10 September. The survey will be completed by 15 November 2021 and be undertaken over a period of 51 days. Consequently, the survey will occur over a period of no more than 21 days of the summer period between 10 September and 30 September. There will be no impacts occurring within the 'winter' area of the SAC.

10.21 To assess the seasonal spatial overlap, it is presumed that the survey will start no earlier than 10 September 2021 and that once the survey commences it will be undertaken for 24 hrs each day without a break (except for line turns), for the remaining summer period. The whole of the survey is within the SAC and the seasonal impact is based on the maximum daily area of impact of 3,135 km^2. This is precautionary as it is unlikely that the survey will be operating continuously

[5] Calculation based on an area of potential impact within the Survey Area of 2,343 km^2 (71 km x 33 km) and a rectangular area of impact of 396 km^2 (12 km x 33 km) beyond each end of the Survey Area boundary. This is precautionary as impacts within the SAC but beyond the Survey Area are semi-elliptical and therefore impact over a relatively smaller area than calculated.

[6] Note that this figure is lower than 5,248 km^2 assessed within the application, where the applicant has assessed the impacts based on each consecutive survey line being greater than 12 km apart and therefore impacting the maximum theoretical area. However, the applicant also states that the maximum spacing between consecutive lines will be 9 km and therefore the total area impacted per day is reduced. If consecutive line spacing is greater than 9 km apart further assessment will be required to account for the larger area of potential impact.

throughout September and may not start until 10 September and the maximum area of impact is unlikely to arise every day throughout the month.

10.22 Based on the maximum daily impact occurring throughout the survey period the seasonal threshold is 1.3% of the SAC and therefore the seasonal threshold is not exceeded by the proposed survey (Table 11).

Table 11: Estimated extent of seasonal disturbance on harbour porpoise from proposed ION MNSH Phase 2B seismic survey within the SAC.

SAC area	Area impacted per day (km^2)	Daily Threshold (%)	Estimated duration of impact (days)	Seasonal Threshold (%)
Worst-case (Maximum daily impact - 30 days in summer period)				
'summer'	3,135	11.6	21	1.3

Conclusion

10.23 Results from noise modelling indicate that no more than one harbour porpoise is at risk of physical injury from noise arising from the airguns. With proposed mitigation discussed in Section 12 there is a very low risk of any harbour porpoise being injured.

10.24 There is a risk of harbour porpoise being displaced or disturbed by the proposed seismic survey. Noise modelling indicates that up to 903 harbour porpoise may be disturbed at any one time; this is 0.3% of the North Sea Management Unit population and therefore below the predicted level of disturbance that could cause a population level effect. 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 approximately 24 hrs.

10.25 The results from the threshold approach indicate that up to 11.6% of the 'summer' area may be impacted each day and 1.3% of the seasonal threshold. The daily and seasonal thresholds are not exceeded.

10.26 The proposed survey 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.

10.27 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.

Berwickshire and North Northumberland Coast SAC and Humber Estuary SAC

Grey seal

10.28 It is considered, based on the known distribution of grey seals and information presented in the application, that grey seals from Berwickshire and North Northumberland Coast SAC and the Humber Estuary SAC are at risk of being impacted by noise arising from the proposed survey.

10.29 Densities of grey seal across the proposed seismic survey Greater Working Area range from <1 individual per 5 km^2 to <50 individuals per 5 km^2, i.e. between <0.04 and 2.0 individuals per km^2 (Figure 5)[7]. Over the majority of the Survey Area densities of grey seals are relatively low with the densities being predominantly between 0 and 5 individuals per 5 km^2 (0 – 0.2 ind./km^2).

Physical Injury

10.30 Results from noise modelling presented within the application indicate that there is a risk of physical injury in the form of PTS within 10 m of the sound source, if a soft start is undertaken (Table 5). Additional modelling carried out for previous assessments indicates that this could extend to 99 m (although this is based on modelling results from not within the Survey Area).

10.31 The potential area within which the onset of PTS is predicted to occur is very localised and covers an area of no more than 0.031 km^2 and is likely to be less. The presence of a Marine Mammal Observers (MMO) during the survey will ensure that the risk of any grey seals being present within the area at which the onset of PTS is predicted to occur is very low.

Disturbance and Displacement

10.32 When undertaking surveys the vessel will be travelling at a maximum speed of 5 knots (9.26 km/h). Noise capable of causing disturbance is predicted to occur out to no more than either 0.7 km or 17 km (depending on modelled outputs) from the survey vessel (Table 5). Consequently, as the vessel transits along a seismic transect, disturbance in any one area will last no more than two hours based on the maximum area of noise likely to cause disturbance is predicted to occur. Once the vessel has left the area, noise levels will reduce to ambient background levels.

10.33 The Berwickshire and North Northumberland Coast SAC lies 142.5 km from the Greater Working Area and the Humber Estuary SAC lies 87.6 km away. Approximately 98% of the Survey Area has densities of below 0.2 ind./km^2, although it is recognised that higher densities over the Dogger Bank could be impacted by noise. On an average estimated density of 0.2 ind./km^2 (See Figure 5) being disturbed across the proposed Survey Area an estimated 77 grey seals could be

[7] Note: the applicant has assessed the potential impact on grey seals based on a peak density within the Greater Working Area of 1.08 ind./km^2 (ION 2021b). Tracking studies indicate considerably lower densities across the Survey Area and much of the Greater Working Area, where the airguns will be switched off (Figure 5). Based on the results of the tracking studies an average density of 0.2 ind./km^2 has been used to assess the potential number of seals impacted across the whole of the Survey Area for the duration of the survey.

disturbed at any one time and across the whole of the Survey Area a total of 481 grey seals may be disturbed [8].

10.34 The estimated grey seal population for the Berwickshire and North Northumberland Coast SAC is 26,865 individuals, consequently, if all the grey seals estimated to be disturbed are from this SAC 2.0% of the SAC population may be disturbed during the whole survey within the Survey Area.

10.35 The estimated grey seal population for the Humber Estuary SAC is 23,512 individuals, consequently, if all the grey seals impacted are from this SAC 1.83% of the SAC may be disturbed during the whole survey period within the Survey Area.

10.36 Note that it is extremely unlikely that all grey seals disturbed are from the one SAC and that it is highly probable that grey seals within the Survey Area originate from a number of sites located along the east coast and therefore all the predicted impacts will not be impacting upon a single site. An estimated 0.9% of the combined Humber Estuary SAC and North Northumberland Coast SAC population of 50,376 individuals could be disturbed.

10.37 There is potential for repeated levels of noise capable of causing both displacement or disturbance to occur as the survey vessel undertakes the survey along pre-determined survey lines within the area. The duration of any potential impact depends on the total length of seismic survey line occurring within the area and the speed of the vessel.

10.38 It is likely that grey seals receiving levels of sound capable of causing disturbance will avoid the area. However, the duration of the impact for individual seals will be relatively short as the seismic vessel will move outwith the area and the seals are capable of temporarily relocating to areas away from the sound source.

10.39 Studies undertaken on seals indicate that they are not significantly impacted by seismic surveys. Harris *et al*. (2001) reported no significant difference in the number of ringed and bearded seals recorded when 1,320 cu. in. air guns with a sound source of 230 dB dB re 1 µPa (0-p) were operating compared to when they were not. However, the increase in the median distance at which they were observed from 144 m to 234 m was significant, indicating that seals did move away from the vessel when the airguns were operating. Other studies have indicated a level of displacement and potential increase in haul out behaviour when airguns have been operating but have also shown that the behaviour of seals quickly return to normal once the airguns have ceased operating (Thompson *et al.* 1998). Similar results have been reported from studies undertaken on harbour seals impacted by piling activities, where it has been shown that displacement effects can occur out to 25 km from the sound source but within two hours of the cessation of piling the distribution of seals returns to pre-piling scenarios (Russell *et al.* 2016).

[8] Calculated based on a mean density of 0.2 ind./km^2 across 2,407 km^2 of Survey Area.

10.40 The potential impacts on individual grey seals will vary, depending on individuals' sensitivities and habituation to noise. Furthermore, studies suggest that the response to noise may depend on whether the sound is sudden and causes a startle response or is more gradual and allows habituation to occur and therefore avoids a startle response. Where sound levels are increased more gradually, i.e. by soft-start, a reduced level of displacement is likely (Götz and Janik 2011).

10.41 The impacts from the proposed seismic survey may cause temporary displacement or disturbance behaviour that could reduce the ability of grey seals to forage. Grey seals are opportunistic feeders and can, if prey availability changes, adapt to foraging on alternative prey. Noise modelling indicates a relatively localised effect on potential prey species but in the unlikely event that grey seals are unable to forage in the wider area then they will be able to survive the short period of time during which the survey will be causing an impact without food, surviving off their existing fat reserves.

Conclusion

10.42 It is predicted that there is a very low risk of any physical injuries to grey seals arising from the proposed seismic survey. However, grey seals from the Berwickshire and North Northumberland Coast SAC and the Humber Estuary SAC are at risk of being displaced or disturbed. Displaced grey seals will relocate to other areas and are predicted to return shortly after the sound levels are below that at which displacement occurs. Disturbance to grey seals may occur but results from noise modelling indicate that sound levels capable of causing disturbance will occur for less than two hours at any one point and evidence from other studies indicate that the impacts from disturbance will be temporary and predicted to be of relatively short duration.

10.43 The duration and effect of any impact on grey seals is predicted to be temporary and although the proposed survey will cause a level of displacement and disturbance, it will not cause any direct or indirect mortality to grey seals and therefore will not impact on the population or effect its ability to maintain itself in the long-term.

10.44 The proposed survey 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.

10.45 Based on the best available information and supported by results from noise modelling, BEIS is satisfied that the proposed survey alone will not have an adverse effect upon the integrity of the Berwickshire and North Northumberland Coast SAC or the Humber Estuary SAC with respect to grey seals.

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 ION MNSG Phase 2B seismic survey.

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

- Construction pile-driving at Hornsea Two offshore wind farm,
- Geophysical Survey at Dogger Bank South offshore wind farm,
- ION UKCS 3D Seismic Geophysical Survey,
- BP Geophysical survey,
- Geophysical Survey at Dogger Bank A offshore wind farm,
- Geophysical Survey at Sofia offshore wind farm,
- Geophysical Survey at Hornsea Three offshore wind farm,
- Geophysical Survey at Hornsea Four offshore wind farm,
- *Geoex Seismic Geophysical Survey,*
- *Geophysical Survey at Dogger Bank B offshore wind farm,*
- *Geophysical Survey at Dogger Bank C offshore wind farm,*
- *Chrysaor geophysical survey.*

11.3 There is considerable uncertainty on the status of the geophysical surveys at Dogger Bank A, Sofia, Hornsea Three and Hornsea Four and these may have been completed or not undertaken.

11.4 Projects in italics have completed activities and therefore will not contribute to the level of impact occurring at the same time as the proposed ION MNSH Phase 2B survey, i.e. do not contribute to the daily threshold. However, the activities occurred during the 'summer' period and therefore they do contribute to the overall seasonal impact and therefore are included as part of this in-combination impact assessment.

Hornsea Project Two Pile driving

The Hornsea Two offshore wind farm is located within Subzone 2 of the Round 3 Offshore Wind Farm Zone; Zone 4: Hornsea. At its closest point Hornsea Two lies 89 km from shore and covers an area of 462 km^2; of which 298 km^2 of the wind farm site lies within the SAC. In addition to the wind farm area an export cable route crosses the SAC. It is estimated that 36 km of the cable route is within the SAC (Figure 8).

11.5 Ørsted will be installing turbine foundations throughout 2021, although the exact timing of the activities are unknown. A total 165 turbines are to be installed.

11.6 For the purposes of this assessment noise modelling undertaken by BEIS for the Review of Consents within the Southern North Sea SAC has been used. The modelling results are based on the use of a 3,000 kJ hammer at Hornsea Two wind farm.

11.7 The results from the modelling (based on a weighted SEL) indicate that the onset of PTS could occur out to 1,534 m and encompass an area of 7.38 km^2. Levels of noise predicted to cause disturbance (based on unweighted SEL) could occur out to 29.5 km and cover an area of 2,794 km^2.

11.8 Based on the results from noise modelling and a peak density of 2.22 ind./km^2 an estimated 16 harbour porpoise are at risk of PTS from the pile-driving and 2,119 harbour porpoise may be disturbed or displaced, of which 1,982 may be within the SAC (BEIS 2020).

11.9 However, the use of an acoustic deterrent device will be operated during all pile-driving activities and this will significantly reduce the risk of any harbour porpoise occurring within the range at which the onset of PTS is predicted to arise.

11.10 Noise modelling undertaken for Hornsea Two and presented in the application indicates that the onset of PTS in grey seals would occur within 500 m of pile-driving and displacement would occur no further than 2 km and extend over an area of 12.57 km^2. The estimated number of grey seal predicted to be displaced by pile-driving is no more than 25 individuals (SMart Wind 2015).

11.11 The results of the assessment based on a 26 km EDR for pile-driving turbine foundations indicate that up to 1,976 km^2 of the 'summer' area of SAC may be impacted. Turbines installed outwith the SAC or nearer the SAC boundary will have a smaller EDR overlapping the SAC. Consequently, an assessment based on all turbines impacting a maximum area within the SAC is an unrealistic worst-case.

11.12 As a worst-case, noise from pile-driving at Hornsea Two could cause displacement of harbour porpoise over 5.3% of the SAC as a whole and 7.3% of the 'summer' area. There will be no impacts on the 'winter' area. Based on the worst-case scenario, the seasonal average is estimated to be 6.7% of the 'summer' area (BEIS 2020).

11.13 A realistic worst-case scenario for assessing the seasonal impact is based on the average area impacted by pile-driving each of the 165 turbine foundations over the course of a single season. Based on a realistic worst-case scenario the seasonal threshold is 4.7% (Ørsted 2020).

Table 12: Estimated extent of seasonal disturbance on harbour porpoise from proposed pile-driving at Hornsea 2 offshore wind farm within the SAC.

SAC area	Maximum area of SAC impacted per day (km^2)	Mean Daily Threshold (%)	Estimated duration of impact (days) [1]	Seasonal Threshold (%)
Turbine foundation installation – Unrealistic worst-case				
'summer'	1,976	7.3	167	6.7
Turbine foundation installation – Realistic worst-case				
'summer'	1,401	5.2	167	4.7

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

Dogger Bank A and Dogger Bank B offshore wind farm UXO clearance

11.14 Clearance of unexploded ordnance within both Dogger Bank A and Dogger Bank B offshore wind farms and along the export cable route was planned to be undertaken over a six week period between May and December 2021 (DBWF 2021). A geophysical survey has been undertaken to determine the presence of UXO within the survey area and BEIS have been informed that no UXO was identified and none has been cleared. Consequently, there is no in-combination impact arising from these activities.

Wind farm geophysical surveys

11.15 Geophysical surveys for the offshore wind farm industry are not regulated and require a voluntary notification of the proposed activities to be submitted to the MMO. Consequently, there is little or no information available regarding the potential five geophysical surveys that are to be undertaken within the Southern North Sea SAC during 2021.

11.16 Within the DBWF (2021) environmental information supporting the application for the proposed UXO clearance the applicant has considered the potential impacts from three of the geophysical surveys that they propose to be undertaking during 2021, namely those at Dogger A, B and C offshore wind farms and included an assessment for the proposed geophysical survey at Sofia offshore wind farm. No information on the proposed geophysical surveys at Hornsea Three or Hornsea Four are available and therefore no assessment can be undertaken for these two potential activities.

11.17 The estimated number of harbour porpoise is based on a 5 km radius of impact, as per the recommended EDR. With a site specific density of 0.71 ind./km^2 an estimated 56 harbour porpoise may be disturbed at any given time for each of the four proposed geophysical surveys for which there is some information.

11.18 The reported calculated daily area of potential disturbance within the SAC for all four surveys is 256 km^2. Consequently, each survey could impact on the 0.9% of the daily threshold and

between 0.5% and <0.01% of the seasonal threshold. (Table 13). The surveys undertaken at Dogger Bank B and Dogger Bank C have been completed and therefore their impacts will not affect the in-combination daily impact but will contribute to the seasonal impact. The status of the other surveys is uncertain, although they may have been completed as their reported end date was 31 August 2021 (DBWF 2021).

Table 13: Estimated extent of daily and seasonal disturbance on harbour porpoise from proposed geophysical surveys at Dogger and Sofia offshore wind farms within the SAC.

SAC area	Area of SAC impacted per day (km^2)	Daily Threshold (%)	Estimated duration of impact (days)	Seasonal Threshold (%)
Dogger A geophysical survey				
'summer'	256	0.9	111	0.5
Dogger B geophysical survey				
'summer'	256	0.9	111	0.5
Dogger C geophysical survey (export cable only)				
'summer'	256	0.9	1	<0.01
Sofia geophysical survey (export cable only)				
'summer'	256	0.9	1	<0.01

11.19 The estimated number of grey seal to be impacted by each of the geophysical surveys is estimated to be 16 individuals (DBWF 2021).

11.20 The MMO have been notified of a planned geophysical survey to be undertaken at the Dogger Bank South round 4 offshore wind farm. The survey will last up to ten days during September and survey two locations covering an area of 4 km^2 and 4.5 km^2, a combined total survey area of 8.5 square kilometres (MMO 2021b). The EDR for geophysical equipment, e.g. sub-bottom profilers, is 5 km (JNCC 2020a). Consequently, it is predicted that noise will extend 5 km beyond the boundaries of the geophysical survey areas. The shape of the proposed survey areas is unknown but for the purposes of this assessment presumed to be broadly 2 km x 2 km and therefore the overall area of noise, including the 5 km EDR, is estimated to be 144 km^2 at each location.

11.21 Based on the maximum densities of 3.0 ind./km^2 an estimated 432 harbour porpoise may be disturbed [9].

11.22 Based on the above assumptions the estimated worst-case daily threshold is 0.5% and the seasonal threshold is 0.03% (Table 14).

[9] There is no site specific density for harbour porpoise at the Dogger Bank South offshore wind farm site and therefore a worst-case maximum harbour porpoise density has been used for the purposes of this assessment.

Table 14: Estimated extent of daily and seasonal disturbance on harbour porpoise from proposed Dogger Bank South geophysical survey within the SAC.

SAC area	Area impacted per day (km^2)	Daily Threshold (%)	Estimated duration of impact (days) [1]	Seasonal Threshold (%)
Worst-case (Maximum daily impact - 10 days in summer period)				
'summer'	144	0.5	10	0.03

11.23 The density of grey seals within the proposed survey area is unknown. For the purposes of this assessment a mean offshore density of 0.2 ind./km^2 has been used (Figure 5). On this assumption an estimated 29 grey seal could be disturbed at each of the two areas surveyed.

Oil and gas industry activities

11.24 There are three oil and gas related activities that could have the potential to cause an in-combination impact.

ION 3D Seismic Geophysical Survey,

11.25 The ION 3D seismic survey commenced in April 2021 and is due to be completed by 31 October 2021 and expected to last up to 165 days (ION 2020b).

11.26 The total Greater Working Area for the survey is 21,344 km^2, although the Survey Area (the area within which airguns will be operating) is 12,627 km^2 (ION 2020a). The total length of survey line wholly within the SAC is estimated to be a maximum of 4,816 km, with a maximum length of any single line within the SAC of 73.3 km (Figure 16).

11.27 Based on the results of noise modelling, a harbour porpoise peak density of 3.0 ind./km^2 and the worst-case scenario of PTS occurring out to 320 m of the survey, an estimated one harbour porpoise could be affected at the start of the seismic survey (BEIS 2021b).

11.28 The largest distance any noise likely to cause disturbance from the ION 3D UKCS 3D seismic survey is estimated to propagate out to is 7.8 km from the airguns and cover an area of 301 km^2.

11.29 Based on a peak site density of 3.0 ind./km^2 an estimated 903 harbour porpoise could be disturbed by the seismic survey. This is equivalent to 0.3% of the North Sea Management Unit harbour porpoise population being disturbed (BEIS 2021b).

11.30 The maximum area within the SAC that will be impacted per day is estimated to be 1,759 km^2. This is equivalent to impacting 4.7% of the SAC as a whole and 6.5% of the 'summer' area per day (BEIS 2021b).

11.31 Based on the daily average impact the seasonal threshold would be 2.1% of the SAC and therefore the seasonal threshold is not exceeded by the proposed survey (BEIS 2021b).

11.32

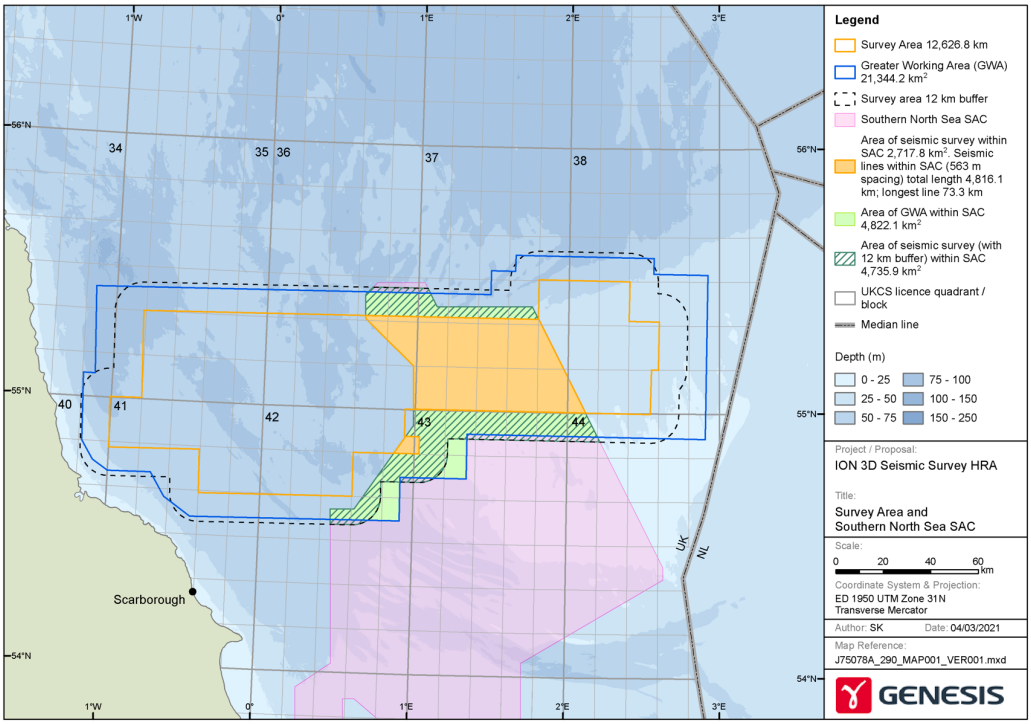


Figure 16: Area of ION UKCS 3D seismic survey within the Southern North Sea SAC.

Table 15: Estimated extent of seasonal disturbance on harbour porpoise from the ION UKCS 3D seismic survey within the Southern North Sea SAC.

SAC area	Area impacted per day (km²)	Daily Threshold (%)	Estimated duration of impact (days)	Seasonal Threshold (%)
Worst-case (Maximum daily impact - 156 days in summer period)				
'summer'	1,759	6.5	153	5.4
Realistic worst-case (Mean daily impact 156 days in summer period)				
'summer'	700	2.6	153	2.1

BP Geophysical survey,

11.33 An application to undertake a pipeline route survey over period of 70 days between 24 June and 24 September 2021 has been made by BP (BP 2021a). 37 km of the proposed Humber route and 32 km of the proposed Teesside route are within the Southern North Sea SAC (BP 2021b). Consequently, a total of 69 km of survey line will be within the SAC.

11.34 Noise modelling undertaken to support the application indicate that there is potential for PTS to arise in harbour porpoise within 91 m of the sound source based on a cumulative SEL metric.

11.35 Disturbance could arise out to 288 m from the sound source impacting an area of 0.26 km^2 at any one time (BP 2021b). Based on a maximum harbour porpoise density of 3 ind./km^2 an estimated one harbour porpoise could be disturbed by the proposed pipeline route geophysical survey at any one time.

11.36 The maximum area within the SAC that could be impacted is estimated to be 690 km^2 [10]. This is equivalent to 2.5% of the Southern North Sea SAC 'summer' area. The applicant anticipates that the survey work within the SAC will take 1.5 days to complete. Therefore, the maximum daily impact is predicted to be 460 km^2; 1.7% of the daily threshold (Table 16).

11.37 The seasonal threshold is calculated based on their being two days of survey impacting the SAC during September 2021 and is between 0.01 and 0.02% of the seasonal threshold (Table 16).

11.38 The density of grey seals along the survey route varies, with a peak density of between 10 and 50 individuals per 25 km^2 (0.25 – 2.0 ind./km^2) occurring nearer the coastal waters (Figure 5). Nose modelling undertaken by the applicant indicates that disturbance to grey seals could occur to no further than 163 m from the sound source and impact an area of 0.08 km2 (BP 2021b). Consequently, less than one grey seal is predicted to be affected at any one time from the proposed survey.

Table 16: Estimated extent of seasonal disturbance on harbour porpoise from the proposed BP pipeline route geophysical survey within the Southern North Sea SAC.

SAC area	Area impacted per day (km^2)	Daily Threshold (%)	Estimated duration of impact (days)	Seasonal Threshold (%)
Worst-case (Maximum daily impact - 1 day in summer period)				
'summer'	690	2.5	1	0.01
Realistic worst-case (impact over 1.5 days in summer period)				
'summer'	460	1.7	2	0.02

Multi-client Geophysical Survey

11.39 On 17 March 2021 Filial AV Geoex applied to undertake a 2D multi-client Geophysical Survey in the North Sea and Norwegian Sea between June and September 2021. The survey is expected to last no longer than 120 days, with 62 days occurring in UK waters (EPI 2021). BEIS undertook an HRA prior to a consent decision (BEIS 2021a).

[10] Calculation based on 69 km of survey line within the SAC and a 5 km EDR. All survey data collected in one day. Note, this is slightly higher than the figure presented in the application of 664 km^2 (BP 2021b).

11.40 The results of the HRA undertaken indicated that up to 1,704 km^2 of the SAC, 6.3% of the 'summer' area, could be impacted by noise from the survey. The seasonal impact was estimated to be 0.1% (Table 17).

11.41 The survey has completed all activities that could cause an impact within the Southern North Sea SAC and therefore there will be no in-combination impacts with respect to the daily threshold but there is an in-combination seasonal impact.

Table 17: Estimated extent of daily and seasonal disturbance on harbour porpoise from proposed Geoex seismic survey within the SAC.

SAC area	Area impacted per day (km^2)	Daily Threshold (%)	Estimated duration of impact (days) [1]	Seasonal Threshold (%)
Worst-case (Maximum daily impact - 2 days in summer period)				
'summer'	1,704	6.3	4	0.1

1 – This accounts for two days 'recovery time' following cessation of the seismic survey.

Chrysaor Geophysical Survey

11.42 Geophysical surveys at the Tethys TN and Kelvin TM, lie within the Southern North Sea SAC. Each Survey Area around each installation is 1 km^2, with a Greater Working Area of 9 km^2. The total duration of the surveys within the SAC is estimated to be two days and be completed by 31 August 2021 (Chrysaor 2021, Harbour Energy 2021).

11.43 Noise modelling undertaken to support the application indicate that there is potential for PTS to arise in harbour porpoise within 385 m of the mini-airgun based on a cumulative SEL metric (Harbour Energy 2021).

11.44 Disturbance from the proposed use of a mini-airgun is predicted to occur out to 795 m from the sound source impacting an area of 1.98 km^2 at any one time (Harbour Energy 2021). Based on a maximum harbour porpoise density of 3 ind./km^2 an estimated six harbour porpoise could be disturbed by the proposed geophysical survey at any one time.

11.45 The EDR for mini airguns is not specified in the SNCB guidance. For the purposes of this assessment a 5 km EDR has been used, similar to that proposed for geophysical survey equipment, e.g. sub-bottom profilers (JNCC 2020a). Consequently it is predicted that noise will extend 5 km beyond the boundaries of the geophysical survey areas. The shape of the proposed survey areas are 1 km x 1 km and therefore the overall area of noise, including the 5 km EDR, is estimated to be 121 km^2 at each location each day; in total 242 km^2 over two days.

11.46 Based on the above the estimated worst-case daily threshold is 0.4% and the seasonal threshold is 0.004% (Table 18).

Table 18: Estimated extent of daily and seasonal disturbance on harbour porpoise from the Chrysaor geophysical surveys within the Southern North Sea SAC.

SAC area	Area impacted per day (km^2)	Daily Threshold (%)	Estimated duration of impact (days) [1]	Seasonal Threshold (%)
Worst-case (Maximum daily impact - 10 days in summer period)				
'summer'	121	0.4	2	0.004

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

Noise modelling

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

Physical Injury

11.48 Based on the results from the noise modelling between 0 and 19 harbour porpoise could be at risk of PTS from proposed activities affecting the Southern North Sea SAC (Table 19). The level of noise arising from sub-bottom profilers used during geophysical surveys is below the thresholds at which the onset of PTS is predicted to arise. Consequently, it is predicted that as a worst-case no more than 19 harbour porpoise are at risk of the onset of PTS from proposed activities within the Southern North Sea SAC. It is estimated that up to 0.005% of the North Sea Management Unit harbour porpoise population could be impacted. With the proposed mitigation measures in place for pile-driving at Hornsea Two and the seismic surveys it is predicted that no harbour porpoise will be impacted by PTS.

Table 19: Estimated number of harbour porpoise at risk of the onset of PTS from proposed activities in the Southern North Sea SAC.

Activity	Harbour porpoise PTS
ION MNSH Phase 2B Seismic Survey	0 – 1
Hornsea Two Pile-driving	0 – 16
Dogger Bank Geophysical Surveys	0
Dogger Bank South Geophysical Survey	0
ION UKCS 3D Seismic Survey	0 – 1
BP Pipeline Route Geophysical Survey	0
Chrysaor Geophysical Survey	0 – 1
Total	**0 – 19**

Disturbance

11.49 The number of harbour porpoise predicted to be disturbed by planned activities within the Southern North Sea SAC at any one time is 4,476 individuals (Table 20)

11.50 The estimated number of harbour porpoise that may be disturbed is equivalent to 1.3% of the North Sea Management Unit population. This is within the levels at which a population level of effect is predicted not to arise based on the ASCOBANS thresholds (See Para. 10.4).

Table 20: Estimated number of harbour porpoise at risk of disturbance from proposed activities in the Southern North Sea SAC.

Activity	Harbour porpoise PTS
ION MNSH Phase 2B Seismic Survey	903
Hornsea Two Pile-driving	2,119
ION UKCS 3D Seismic Survey	903
Dogger Bank A Geophysical survey	56
Sofia Geophysical survey	56
Dogger Bank South	432
BP Pipeline Route Geophysical Survey	1
Chrysaor Geophysical Survey	6
Total	**4,476**

In-combination threshold approach

11.51 Based on the worst-case scenario without any mitigation, the daily threshold could be exceeded, in September with up to 27.7% of the 'summer' area of the SAC potentially impacted (Table 21). This is above the maximum daily threshold, recommended by the Nature Conservation Bodies, that could cause an adverse effect on the integrity of the site.

11.52 The probability of having the maximum theoretical area of impact arising from all activities on the same day is so small (approximately 1 in 1,350). It is therefore safe to conclude that the daily threshold based on the unrealistic worst-case maximum area of impact from all seven projects will not arise.

11.53 An assessment based on the average area of SAC impacted each day and the use of noise limiting mitigation provides a more probable daily threshold. Table 21 presents the daily threshold based on the average area of SAC impacted each day from the consented ION UKCS 3D seismic survey and from pile-driving at Hornsea Two. The geophysical surveys undertaken at Dogger Bank A and Sofia offshore wind farms are presumed to have been completed by the end of

August based on the available information and therefore are not contributing to the daily threshold during September. Under this more probable scenario the daily threshold is 19.9% and therefore the daily threshold is not predicted to be exceeded, although it is very close to the daily threshold of 20%.

11.54 Based on a realistic worst-case scenario (with mitigation) the in-combination impacts across the season will be 9.37% of the 'summer' area (Table 22). Consequently, the seasonal threshold is not exceeded, although it is very close to the seasonal threshold of 10%.

11.55 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 (Table 23)[11]. Any changes in any of the Projects' schedules or scopes of work could affect the threshold based assessment.

[11] Note Table 23 presents the confidence that activities will be undertaken on the basis that they have or will be consented. For those Projects that have not been consented this is a presumption made for the purposes of this HRA only, required to address potential in-combination impacts. It does not in any way fetter any future HRA conclusions or consent decisions.

Table 21: Unrealistic and realistic worst-case in-combination daily threshold (%).

Activity	September 2021	
	Unrealistic Worst-case	Realistic worst-case
ION MNSH Phase 2B Seismic Survey	11.6	11.6
Hornsea Two Pile-driving	7.3	5.2
ION UKCS 3D Seismic Survey	6.5	2.6
Dogger Bank A Geophysical Survey [1]	0.9	0.0
Sofia Geophysical Survey [1]	0.9	0.0
Dogger Bank South Geophysical Survey	0.5	0.5
BP Pipeline Route Geophysical Survey [2]	0	0
Total %	**27.7**	**19.9**

[1] Both surveys were due to commence in April 2021 and therefore should have been completed by the end of August. They are included in the unrealistic worst-case scenario as their completion has not been confirmed.

[2] The use of a sub-bottom profiler has been completed and therefore there are no activities that contribute to the daily threshold.

Table 22: Seasonal thresholds in-combination

Activity	Worst-case Seasonal threshold	Realistic-worst-case Seasonal threshold
ION MNSH Phase 2B Seismic Survey	1.3	1.3
Hornsea Two Pile-driving	6.7	4.7
ION UKCS 3D Seismic Survey	5.4	2.2
Geoex Seismic Survey	0.1	0.1
Dogger Bank A Geophysical survey	0.5	0.5
Dogger Bank B Geophysical survey	0.5	0.5
Dogger Bank C Geophysical survey	0.01	0.01
Sofia Geophysical survey	0.01	0.01
Dogger Bank South Geophysical Survey	0.03	0.03
BP Pipeline Route Geophysical Survey	0.02	0.02
Chrysaor Geophysical Survey	0.004	0.004
Total %	**14.57**	**9.37**

Table 23: Confidence in extent and duration of potential impacts from planned activities within or adjacent to the Southern North Sea SAC in September 2021.

Project	Confidence	Comment
ION MNSH Phase 2B Seismic Survey	Very High	Very High to High confidence activities will be undertaken during September 2021. Very High to High confidence on when activities will be undertaken within the SAC. Very High level of confidence that the survey will be undertaken along known pre-determined survey lines. High level of confidence from published evidence on the extent and duration of impacts.
Hornsea Two pile-driving	Very High	Very High confidence activities will be undertaken during summer 2021. Very High confidence on when activities will be undertaken within the SAC. High level of confidence in the area of SAC that could be impacted. High level of confidence from published evidence on the extent and duration of impacts.
ION UKCS 3D Seismic Survey	Very High	Very High confidence activities will be undertaken during summer 2021. High confidence on when activities will be undertaken within the SAC. Very High level of confidence that the survey will be undertaken along known pre-determined survey lines. High level of confidence from published evidence on the extent and duration of impacts.
Dogger Bank A, B, C and Sofia geophysical surveys	Low	Very High confidence activities will be undertaken during summer 2021. Low confidence of when activities have or will be undertaken and completed. Low confidence on what activities will be undertaken within the SAC. Moderate level of confidence from published evidence on the extent and duration of impacts.
Dogger Bank South Geophysical Survey	Moderate	Very High to High confidence activities will be undertaken during September 2021. Moderate confidence on the extent and duration of activities will be undertaken within the SAC. Moderate level of certainty from published evidence on the extent and duration of impacts.
BP Pipeline Route Geophysical Survey	High	Very High certainty activities will not be undertaken during September 2021. High certainty on what activities will be undertaken within the SAC. Moderate level of confidence from published evidence on the extent and duration of impacts.

In-combination assessment Southern North Sea SAC conclusions

11.56 Results from noise modelling indicate that up to 18 harbour porpoise could be at risk of physical injury in the form of PTS from known planned activities within or adjacent to the SAC. This is 0.0015% of the Management Unit population and therefore below the level of 1.7% at which a population level effect is predicted to occur. Mitigation measures in place for all activities capable of causing the onset of PTS will reduce the risk of any harbour porpoise being impacted.

11.57 The estimated number of harbour porpoise that could be disturbed is 4,470 individuals. This is below the 1.7% at which population level effects are predicted to occur.

11.58 The results from the threshold approach indicate that if all activities impact over the maximum possible area on the same the day the daily threshold will be exceeded. However, the probability of this occurring is small. Under the more probable scenario the daily threshold will be 19.9% and therefore will not be exceeded. The aim of the noise management is to keep below the thresholds as much as possible and even under the more probable scenario there is a level of precaution, in that it presumes all activities will occur on the same day.

11.59 Based on the best available information and supported by results from noise modelling and the threshold approach, BEIS is satisfied that the proposed ION MNSH Phase 2 seismic survey in-combination with other plans will not have an adverse effect upon the integrity of the Southern North Sea SAC with respect to harbour porpoise.

In-combination assessment on Humber Estuary SAC and Berwickshire and North Northumberland Coast SAC: Grey seals

11.60 There is potential for an in-combination impact on grey seals from the proposed ION MNSH Phase 2B seismic survey, pile-driving being undertaken at Hornsea Two offshore wind farm, the on-going ION UKCS 3D seismic survey and wind farm related geophysical surveys at Dogger A, B, C, Sofia and Dogger Bank South.

11.61 The assessment for the proposed ION MNSH Phase 2B seismic survey on its own concludes that there will be a very low risk of any grey seals within the range at which the onset of PTS is predicted to occur (Table 5 and Para. 10.31). Consequently, there will be no in-combination impact on grey seals with respect to physical injury.

11.62 There is potential for in-combination impacts arising from displacement or disturbance. It is estimated that 318 grey seals could be disturbed or displaced from in-combination impacts at any one time (Table 24). A potential disturbance of up to 318 grey seals is equivalent to 1.18% of the Berwickshire and North Northumberland Coast SAC and 1.36% of the Humber Estuary SAC grey seal population.

11.63 It is not realistic to presume that all the grey seals impacted by the proposed activities are all derived from a single SAC population and the proportion of the grey seal population from both SACs potentially disturbed is estimated to be 0.6%. For reasons presented in Section 10, it is predicted that any disturbance or displacement of grey seals will be temporary and not cause a population level effect.

Table 24: Estimated number of grey seals at risk of disturbance from proposed activities.

Activity	Disturbance
ION MNSH Phase 2B Seismic	77
Hornsea Pile-driving	25
ION UKCS 3D Seismic Survey	139
Dogger B Geophysical survey	16
Dogger C Geophysical survey	16
Sofia Geophysical survey	16
Dogger Bank South Geophysical Survey	29
Total	**318**

In-combination assessment Berwickshire and North Northumberland Coast SAC and Humber Estuary SAC conclusions

11.64 Results from noise modelling indicate that there is a very low risk of any physical injury, in the form of PTS, to grey seals from the proposed ION MNSH Phase 2B seismic survey and therefore there is no in-combination impact with other plans or programmes.

11.65 There is potential for an in-combination impact from the proposed seismic survey and other activities to cause displacement or disturbance. It is estimated that 0.6% of the grey seal combined SAC populations could be disturbed by planned activities. However, any displacement or disturbance impacts will be temporary with seals capable of relocating away from an area without causing a population level effect.

11.66 Based on the best available information and supported by results from noise modelling, BEIS is satisfied that the proposed ION MNSH Phase 2B survey in-combination with other plans or projects will not have an adverse effect upon the integrity of the Berwickshire and North Northumberland Coast SAC nor the Humber Estuary SAC with respect to grey seal.

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 ION have committed to following the JNCC guidelines for *minimising the risk of injury to marine mammals from geophysical surveys* (JNCC 2017a, ION 2021b). Mitigation measures that will be required to be adhered to include:

- The use of two dedicated Marine Mammal Observers.
- The use of Passive Acoustic Monitoring (PAM).
- Where practical, the pre-shooting search and soft start should be timed to occur during daylight hours/good visibility. When not possible, a PAM system must be used for pre-shooting searches and soft starts that occur during periods of low visibility/hours of darkness.
- Observations must be undertaken for at least 60 minutes prior to the soft-start and there must 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.
- A minimum of 20 minutes soft-start undertaken every time the air-guns are switched on.
- Airguns must be switched off at the end of each line and in the event that the survey is suspended for more than 10 minutes, a 30 minute pre-shoot search and 20 minute soft-start must be undertaken.
- At the end of the survey, a report (indicating the BEIS reference number) must be sent to JNCC.

12.3 Furthermore, to reduce the risk of simultaneous operations occurring within the SAC, a condition attached to the consent will require the applicant to establish and maintain close contact with all operators currently (or planning) to undertake work within the SAC that contribute to the daily thresholds.

13 CONCLUSIONS

13.1 The Secretary of State has carefully considered all of the information available in order to undertake a Habitats Regulations Assessment. He considers the proposed ION MNSH Phase 2B 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, Berwickshire and North Northumberland Coast SAC and Humber Estuary SAC.

13.2 The Secretary of State has undertaken an Appropriate Assessment in respect of the sites' 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.

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

13.4 Having considered all of the information available to him the Secretary of State has concluded that the proposed ION MNSH Phase 2B seismic survey will not have an adverse effect on the integrity of any of the designated sites either alone or in-combination with other plans or projects.

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