Final

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)

Great Tolmount 3D Seismic Survey

Polarcus

October 2017

CONTENTS

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 the proposed 3D seismic survey (hereafter termed "the survey") to be undertaken by Polarcus over the Tolmount area in the Southern North Sea. BEIS is the competent authority for applications submitted under the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (S.I. 2001/1754) (As Amended).

1.2 Polarcus ("the applicant" hereafter), has submitted an application to BEIS for consent under the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (As Amended) to undertake a 3D seismic survey in the Tolmount area which lies within the Southern North Sea candidate Special Area of Conservation (cSAC) and adjacent to other European designated sites.

HABITATS REGULATIONS ASSESSMENT

1.3 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 species and habitats by protecting them from adverse effects of plans and projects.

1.4 The Habitats and Birds Directives provide for the designation of sites for the protection of habitats and species of European importance. These sites are called Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) and are collectively termed European sites, which form part of a network of protected sites across Europe.

1.5 Possible SACs (pSAC) and Candidate SACs (cSACs) and potential SPAs (pSPAs) are afforded the same levels of protection by UK Government as if they were designated. Sites designated under the Ramsar Convention are also afforded the same protection as a designated site.

1.6 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 Conservation Objectives. Such a plan or project may only be agreed after ascertaining that it will not adversely affect the integrity of a European site unless there are imperative reasons of overriding public interest for carrying out the plan or project. Draft sites, i.e. those that have not been subject to any formal consultation, are not subject to the Appropriate Assessment process.

1.7 The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended) transpose the Directives into UK law for activities consented under the

Petroleum Act 1998. The Offshore Petroleum Activities (Conservation of Habitats) (Amendment) Regulations 2007 extend certain provisions of the 2001 regulations.

1.8 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*.

1.9 The proposed 3D seismic survey may affect qualifying sites and so an Appropriate Assessment is required. This HRA is undertaken in accordance with Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora ("the Habitats Directive") and Council Directive 2009/147/EC on the Conservation of Wild Birds ("the Birds Directive") to satisfy the Appropriate Assessment requirement.

1.10 Under the Convention on Wetlands, signed in Ramsar, Iran (1971) sites regularly supporting 20,000 waterbirds and/or support 1% of the individuals in the population of one species or subspecies of water bird, receive specific designation known as Ramsar designation. Under UK guidance Ramsar sites are, as a matter of policy, afforded the same protection as European designations SPAs and SACs (ODPM 2005).

1.11 The conclusions of this HRA have been informed by the analysis and information contained in the Environmental Assessment submitted by the applicant in support of the application for consent and a Strategic HRA for oil and gas activities in the Southern North Sea cSAC undertaken by BEIS. So far as is possible, the key information in these documents is summarised and referenced here, but not duplicated.

2 SURVEY DESCRIPTION

2.1 The following is a brief summary of the proposed seismic survey, further details may be found in the application (Polarcus 2017a, b).

2.2 The proposed regional survey will be undertaken across the Great Tolmount area located in the Southern North Sea (Figure 1). The survey area is 1,330 km^2, with a wider operating area, that includes line turns, of 4,170 km^2. The nearest point to the coastline is 22 km.

2.3 The survey is scheduled to take place between October and December 2017 and is expected to last 56 days, of which there will 36 working days in the field (Polarcus 2017a).

2.4 The proposed survey will be undertaken by a seismic survey vessel towing ten 6,000 m streamers at a speed of approximately 5 knots. The width of each survey line is 625 m. A total of 130 survey lines will be sailed with the airguns firing at intervals of every 4 seconds at 9.375 m apart. The average length of each line is 32.6 km and will take approximately 4 hrs to complete (Polarcus 2017a,b).

2.5 The turning at the end of each line will take approximately 140 minutes during which the airguns will be fired during the run-in to the line and at the run-out at the end of each line. This is estimated to add approximately 3 km at each of the line and within the operational area (Polarcus 2017a,b). The airguns will be switched off between the end of the run-out and the start of the run-in of each line.

2.6 Prior to the start of each new line a 'soft-start' will be undertaken as per the JNCC guidance (JNCC 2017b).

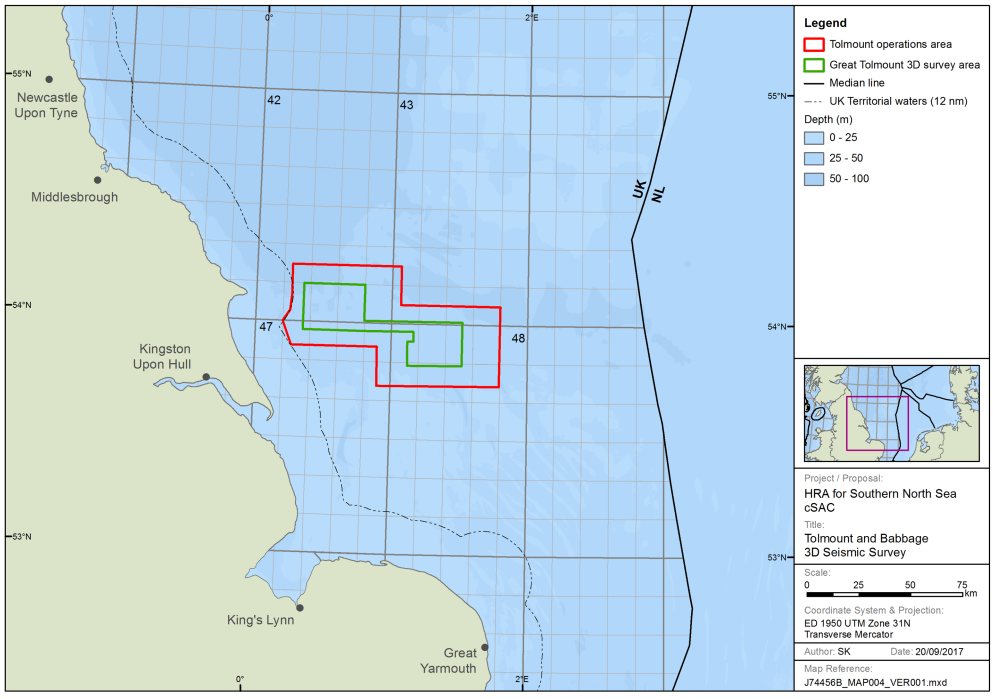

Figure 1: Location of the proposed Great Tolmount 3D seismic (Source Polarcus 2017b).

2.7 The specifications for the seismic array as presented in the application are presented in Table 1.

2.8 The peak Sound Pressure Level (SPL) is 230 dB re 1 µPa at 1 m.

Table 1: Seismic array parameters.

Array Parameter	Value
No. of airguns	22
Total volume (cu. In).	2,495
Sound pressure - dB re 1 µPa (0-p)	230
Sound exposure level - dB re 1 μPa^2s	198
Peak frequency (Hz)	unknown
Pulse rate (Seconds)	4
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 a number of 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 outwith designated sites. Based on the information presented within the application and the results from the noise modelling undertaken in support of the application two SACs: the Southern North Sea cSAC and Humber Estuary SAC and Ramsar have been identified as having qualifying species at risk of a likely significant effect from the proposed survey (Figure 2).

3.2 The sites' qualifying interests relevant to this HRA are:

- Humber Estuary SAC and Ramsar,
- Southern North Sea cSAC.

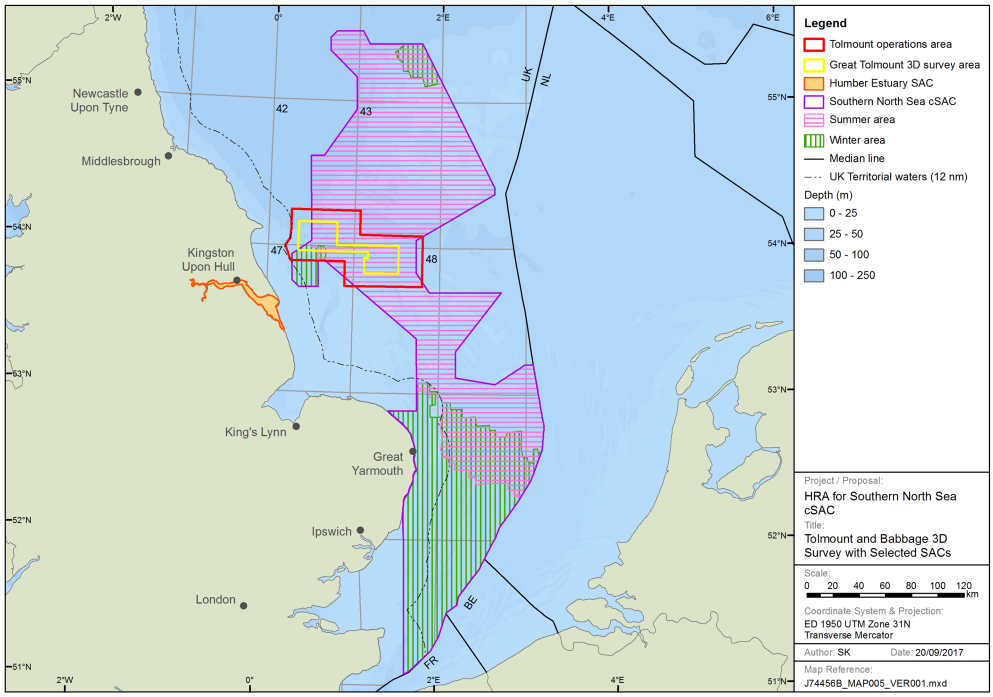

Figure 2: Location of proposed Greater Tolmount seismic survey and relevant designated sites.

4 SCOPE OF THE ASSESSMENT

4.1 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,
- Fish species.

Harbour porpoise

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

- Southern North Sea cSAC

4.3 The harbour porpoise is the smallest and most abundant cetacean species in UK waters. They occur widely across shelf waters predominantly either individually or in small groups but larger aggregations have been reported (Defra 2015), with group sizes varying with season (Clark 2005).

4.4 Although harbour porpoise have a very broad distribution across the UKCS, 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 area of sandy gravel being preferred and this may be linked to prey availability (Clark 2005).

4.5 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 and occurring off the east coasts of England and Scotland (Sveegaard 2011).

4.6 Swimming speeds vary with the highest recorded swimming speeds being 4.3 m/s (Otani *et al.* 2000). Mean recorded swim speeds have been reported as being 1.4 m/s (SNH 2016). 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).

4.7 Harbour porpoise are opportunistic feeders, foraging close to the seabed or near the sea surface, preying on a wide range of fish species including, herring, cod, whiting and sandeels, and their prey will vary during and between seasons (Santos and Pierce 2003). Studies undertaken in Denmark indicate that their local distribution may be correlated with prey availability (Sveegaard 2011).

4.8 Harbour porpoise live for a maximum of between 15 – 20 years. Females become sexually mature at around three to four years old (Lockyer 2003). 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).

4.9 Data from ESAS and other databases indicate harbour porpoise are widespread across the North Sea and adjacent waters (Reid *et al*. 2003) (Figure 3). Recent evidence indicates that there may have been a southward shift in the distribution of harbour porpoise from occurring predominantly around eastern Scotland and the northern North Sea to the southern North Sea since the early 1990's (Figure 4) (Hammond *et al*. 2013, 2017).

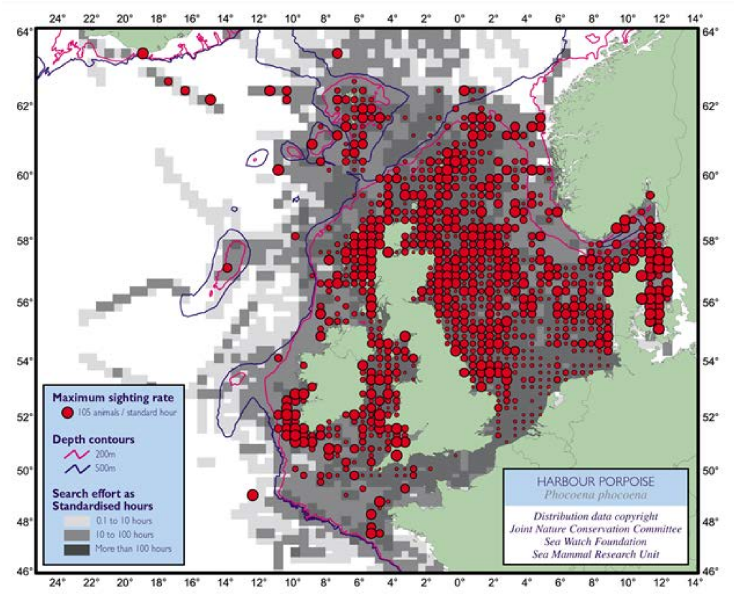

Figure 3: Harbour porpoise distribution in the North Sea and adjacent waters (Source: Reid *et al.* 2003).

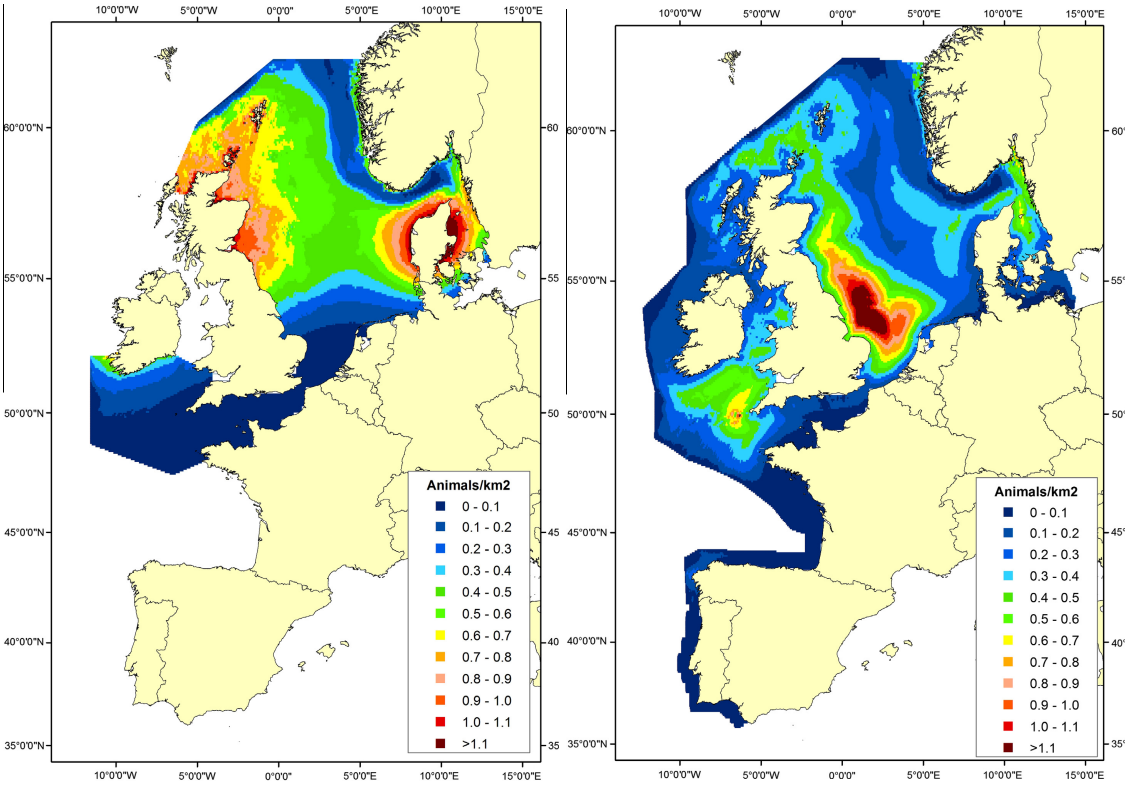

Figure a. Figure b.

Figure 4: a) Predicted surface density for harbour porpoise in 1994. b) Predicted surface density for harbour porpoise in 2005 (Source Hammond *et al.* 2013).

4.10 The latest Small Cetaceans Abundance in the North Sea (SCANS) survey estimated a total harbour porpoise population of 466,569 (95% CL 345,306 – 630,417) individuals based on results from surface density models (Hammond *et al*., 2017).

4.11 The population within the cSAC is based on earlier SCANS II data and is estimated to be 18,500 individuals (98% CI 11,864 – 28,899) (JNCC 2017a). Although this estimate is recognised to be based on data from a single survey collected during a single month and the harbour porpoise population within the cSAC will vary across seasons and years. Based on the estimated population of 18,500 individuals the site holds an estimated 17.5% of the North Sea Management Unit harbour porpoise population of 227,298 individuals (JNCC 2017a).

4.12 Harbour porpoise densities vary seasonally and across the site. In the central and northern area the highest densities occur during the summer period with modelled harbour porpoise densities greater than 3.0 per km^2 occurring widely across the southern North Sea (Figure 5a). 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 cSAC (Figure 5b) (Heinänen & Skov 2015).

4.13 Elsewhere in the southern North Sea, including areas within and encompassing the cSAC, lower densities of harbour porpoise have been reported. Densities reported from SCANS III surveys are from between 0.888 ind/km^2 (SCANS block O) and 0.607 ind/km^2 (SCANS block L) (Hammond *et al* 2013). Data obtained from surveys undertaken at proposed offshore wind farms located within the cSAC indicate densities vary across the site and across seasons. Mean densities reported range from 0.04 ind/km^2 at Triton Knoll offshore wind farm to 2.54 ind/km^2 within the Hornsea subzone 1 offshore wind farm (Table 2).

4.14 Mean densities recorded from other studies are below the peak density of 3.0 ind/km^2 used in this assessment.

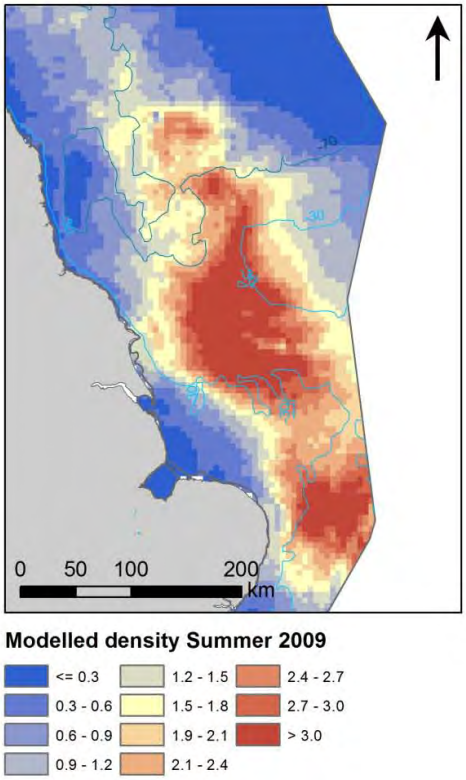

Figure a.

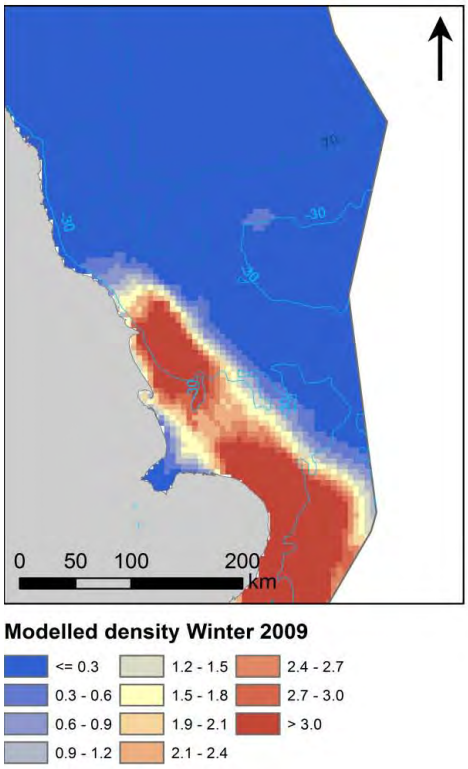

Figure b.

Figure 5: 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 & Skov 2015).

Table 2: Mean densities of harbour porpoise reported within the Southern North Sea cSAC.

Location	Harbour porpoise mean density (ind/km^2)	Source
SCANS III block L	0.607	Hammond *et al*. (2013)
SCANS III block O	0.888	Hammond *et al*. (2013)
Hornsea Zone + 10 km buffer	1.72	SMartWind (2015)
Hornsea subzone 1 + 4 km buffer	2.54	SMartWind (2013)
Hornsea subzone 2 + 4 km	1.88	SMartwind (2015)
Triton Knoll	0.46	Sparling (2011)
Dogger Bank Zone	0.66/0.75	Forewind (2013)
East Anglia One	0.19	EAOWL (2012)
East Anglia Three	0.18	EAOWL (2015)

4.15 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.

4.16 Porpoises are generally considered to be 'high frequency' specialists with a relatively poor ability to detect lower frequency sounds (Southall *et al.* 2007). 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. This is within the frequency range of 130 to 140 kHz that harbour porpoise echolocate (Miller and Wahlberg 2013).

4.17 Their ability to detect sound below 16 kHz or above 140 kHz falls sharply (Kastelein *et al.* 2012, 2015, Southall *et al*. 2007).

4.18 Harbour porpoise are therefore most sensitive to sound sources between 16 to 140 kHz and, although audible, they are unlikely to be sensitive to sound either above or below those frequencies.

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

Grey seal (*Halichoerus grypus*)

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

- Humber Estuary SAC.

4.21 Grey seals occur widely around the waters off eastern England with the majority of 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 (Jones *et al.* 2013) The latest counts within the SAC recorded 3,766 grey seals, giving an estimated population of 15,757 (95% CI 13,167 – 19,614) individuals (SCOS 2016).

4.22 Their distribution offshore comprises predominantly of short-range return trips from haul-out sites to local foraging areas (Figure 6). 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). Recent tagging study data indicates that grey seals from Donna Nook forage across a broad area and are not restricted to localised patches (SCOS 2016). Offshore, grey seals prefer shallower waters in areas of increasing sand and decreasing levels of gravel (Jones *et al*. 2015).

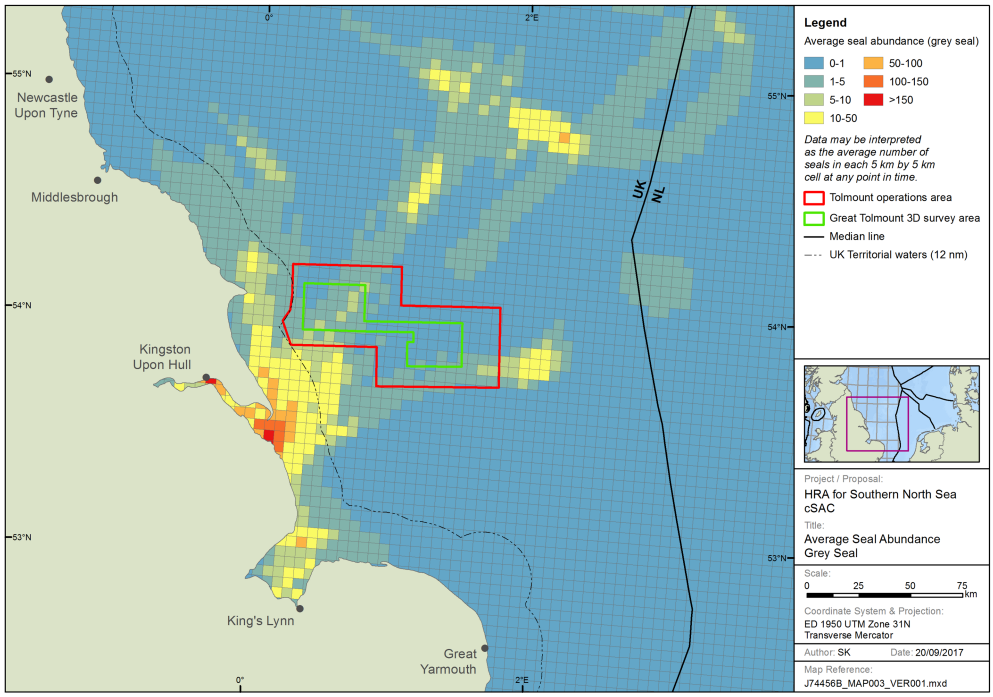

Figure 6: Distribution of grey seals in waters off Eastern England.

4.23 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).

4.24 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).

4.25 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.

Seabirds

4.26 It is recognised that the noise from the proposed survey could affect seabirds that dive below the sea surface when foraging and also their prey within and outwith designated

sites. There is also a risk of disturbance to seabirds from the physical presence of the seismic survey vessel.

4.27 The survey is planned to occur in offshore waters during the non-breeding season, during which time it is not possible to determine whether any birds potentially disturbed originate from an SPA and if so, which SPA. Densities of seabirds in the proposed survey area will be highly variable depending on both the location and the period during which the survey will be undertaken. BEIS note that the proposed survey will be undertaken from October onwards and therefore be outwith the breeding period for seabirds and at a time when seabirds will have dispersed or migrated away from their breeding colonies.

4.28 Seabirds that feed on or near the sea surface, e.g. fulmar, Gulls and Terns are at very low risk of any impact from underwater noise. Any periods below the sea surface are of relatively short duration and the risk of an impact occurring is very low.

4.29 Noise modelling undertaken for previous seismic surveys on seabirds that forage below the sea surface, indicates that the area within which there is the potential of a physical impact is very localised and extends no further than 42 metres from the airguns for any species that remain below the sea surface for periods of up to 2 minutes. For species that are below the sea surface for less than 30 seconds the potential extent of physical impact is less than 20 m from an airgun (OGA 2016).

4.30 The physical presence of the seismic vessel will cause displacement of seabirds on the sea surface in advance of the vessel and a significant majority of them will move away from the approaching vessel. Consequently, there is a very low risk of any seabird occurring within the range at which physical injury is predicted to occur.

4.31 There are no data available to assess potential area of disturbance to seabirds below the sea surface. However, birds that are disturbed will be able to remain on the sea surface and therefore avoid any noise related disturbance. Some species, e.g. red-throated diver, may also be displaced by the presence of the seismic vessel.

4.32 Consequently, it is concluded that there is a very low risk of any impact and there will not be a likely significant effect on any seabird from any SPA Consequently, no designated SPA sites have been identified as being at risk of an adverse effect and no assessment is made on the potential impacts on seabirds from any designated site.

Lamprey

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

4.34 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.

4.35 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).

4.36 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. However, they will likely occur within the area of the seismic survey during their migration to and from the estuaries.

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

5 POTENTIAL IMPACTS

5.1 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.

Marine Mammals

5.2 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) and OSPAR (2009).

5.3 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.

5.4 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. Other factors potentially affecting 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

5.5 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, Nedwell & Harland 2007). Damage to soft organs and tissues can occur when the peak pressure level is greater than 220 dB re. 1 µPa.

Physical injury

5.6 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*. 2007, OSPAR 2009).

Behavioural Change

5.7 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.

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

Secondary Effects

5.9 There is potential for impacts on prey species to affect marine mammals and seabirds, in particular possible impacts of noise on fish species.

6 Noise Modelling

6.1 To assess the potential impacts the applicant has undertaken noise modelling using outputs derived from a Gundalf airgun model and a cylindrical spreading propagation model (Polarcus 2017b). It is noted that the propagation model used by the applicant does not take into consideration water depth or seabed substrate and does take into consideration the directionality of the propagated sound. These factors can have a significant influence on the extent sound propagates.

6.2 The results are presented within the application as Sound Pressure Level (SPL and un-weighted Sound Exposure Level (SEL). No weighted SEL outputs are provided.

6.3 The assessment supporting the application is based on the Southall *et al.* (2007) thresholds which are now widely considered to have been superseded by the revised thresholds produced by NOAA (NMFS 2016). These thresholds are based on more recent data indicating that harbour porpoise may be more sensitive to sound than had previously been supposed.

6.4 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.

6.5 The results from the modelling undertaken by the applicant indicate that there will not be any risk of the onset of PTS to any marine mammal within 500 m of the array.

6.6 The results from the modelling indicate that there is a risk of disturbance to a marine mammal within an area of 17.78 km^2, based on an unweighted disturbance threshold of 160 dB re: 1 µPa $_{(rms)}$.

6.7 There has been no assessment made on the potential impacts from the proposed seismic survey to the prey species of marine mammals.

6.8 In order to undertake the HRA further, information from existing noise modelling has been used to support this 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.

6.9 Noise modelling has previously been undertaken for BEIS in order to assess the potential impacts to harbour porpoise from a seismic survey within the Southern North Sea cSAC (Genesis 2017, unpublished). The modelling was undertaken at three locations within the cSAC and was based on a 3,000 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. Maximum SPL of 261 dB *re* 1 μPa^2s $_{(0\text{-peak})}$.

6.10 The modelling took into account the directionality of the sound produced by an airgun and by doing so provides a more realistic estimate of the area potentially impacted.

6.11 The modelling was based on a larger airgun array than the proposed Great Tolmount seismic survey with a higher maximum SPL of 261 dB *re* 1 μPa^2s $_{(0\text{-peak})}$, compared with 230 dB *re* 1 μPa^2s $_{(0\text{-peak})}$ (Table 1). Therefore, the likely extent of any potential impacts on harbour porpoise within the cSAC will likely be greater than those predicted in the application.

6.12 Noise modelling to assess potential impacts to grey seals from seismic surveys has not previously been undertaken in the area of the proposed survey. However,

modelling has been undertaken on grey seals at three locations in nearshore waters around north-east Scotland, Orkney and Shetland (OGA 2016). Whilst it is recognised that a direct comparison cannot be made due to the different geographic location, the previous modelling was based on a 5,000 cu. in. airgun array with a maximum SPL of 259 dB *re* 1 μPa^2s $_{(0\text{-peak})}$ and therefore, the airgun array and SPL are greater than those that will be used in the proposed survey.

6.13 The results of the noise modelling for harbour porpoise are presented in Table 3 and for grey seal in Table 4.

Potential impacts on harbour porpoise

6.14 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 470 m from the airguns (Table 3). Depending on the modelling and the thresholds used. There is potential for TTS to occur out to 22,200 m based on the latest NOAA thresholds.

6.15 There is potential for levels of noise at which disturbance could occur to extend 35 km from the airguns and encompass an area of between 17.8 km^2 and up to 275 km^2

Potential area of impact on grey seals

6.16 The results from the modelling indicate that noise levels that have the potential to cause the onset of auditory injury (PTS) to seals will not occur. There is potential for the onset of TTS to occur out to 4,249 m.

6.17 Depending on the location and the disturbance threshold used, there is potential for levels of noise at which disturbance could occur to extend 32 km from the airguns and encompass an area of between 47.3 km^2 and 1,541 km^2 (Table 4).

Table 3: Harbour porpoise estimated distance and area of physical injury and disturbance.

Harbour porpoise			
Polarcus	Southall Threshold	Distance @ 500 m	Maximum area (km^2)
PTS	230 dB re 1muPa (peak)	0	0
	198 re 1muPa^2-s (Mxx)	0	0
Disturbance	160 dB re: 1 µPa (rms)	-	17.8
BEIS	NOAA Threshold	Distance @ 1 m	Maximum area (km^2)
PTS	202 dB re 1muPa (peak)	275	0.24
	M-weighted 155 re 1 µPa^{2}s	470 (0 – 6,600)	0.69
TTS	224 dB re 1muPa (peak)	690	-
	M-weighted 140 re 1 µPa^{2}s	22,200 (12,600 – 35,700)	-
Disturbance	160 dB re: 1 µPa (rms)	34,900	275

Note:

Figures for Polarcus obtained from Table 16 of the application.

Disturbance thresholds are based on Southall *et al*. (2007).

BEIS modelling for PTS and TTS based on M-weighted cumulative SEL assuming a soft-start and swimming speed by harbour porpoise of 2 m/s. Minimum and maximum distances are presented in brackets

Area of TTS disturbance not available as not calculated in original modelling.

No TTS assessment included in the application.

Table 4: Grey seal estimated areas of physical injury and disturbance

Grey seal			
Polarcus	Southall Threshold	Distance @ 500 m	Maximum area (km^2)
PTS	218 dB re 1muPa (peak)	0	0
	186 re 1muPa^2-s (Mxx)	0	0
Disturbance	150 dB re: 1 µPa (rms)	-	47.3
OGA	Southall Threshold	Distance @ 1 m	Maximum area (km^2)
PTS	218 dB re 1muPa (peak)	65	0.012
	M-weighted 186 re 1 µPa^{2}s	99	0.031
TTS	212 dB re 1muPa (peak)	159	0.079
	M-weighted 171 re 1 µPa^{2}s	4,249	56.7
Disturbance	150 dB re: 1 µPa (rms)	32,000	1,541

Note:

The OGA (Oil and Gas Authority) noise result is based on modelling undertaken at three separate locations previously modelled and the worst-case has been selected.

Noise modelling by OGA was based on a model with limited directionality capability. Subsequent developments to the model have shown that this causes a far wider area of disturbance than if directionality is included.

No TTS assessment included in the application.

Fish

6.18 No noise modelling specifically to assess the potential impacts on fish has been undertaken by the applicant. Results from previous modelling on fish within the North Sea indicate that noise levels that have the potential to cause mortality to fish species with swim bladders could occur from between 275 m and 302 m depending on the location. For fish without swim bladders, e.g. lampreys, mortality could occur from between 120 m and 140 m from the seismic survey (Table 5) (OGA 2016).

Table 5: Maximum distances at which mortality 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**
1	302	140	302
2	275	120	275
3	302	137	302

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

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

6.19 There are no data available to assess potential area of disturbance to fish species.

7 CONSERVATION OBJECTIVES

7.1 Conservation objectives outline the desired state for any European site, in terms of the interest features for which it has been designated. If these interest 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 integrity 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 There are no set thresholds at which impacts on site integrity are considered to be adverse. This is a matter for interpretation on a site-by-site basis, depending on the designated feature and nature, scale and significance of the impact. Conservation Objectives have been used by the BEIS to consider whether the proposed survey has the potential for having an adverse effect on a site's integrity, either alone or in-combination.

7.3 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 2016).

7.4 The Conservation Objectives for harbour porpoise are 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 prey base.

Southern North Sea cSAC Conservation Objectives

To avoid deterioration of the habitats of the harbour porpoise or significant disturbance to the harbour porpoise, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to maintaining Favourable Conservation Status for the UK harbour porpoise.

To ensure for harbour porpoise that, subject to natural change, the following attributes are maintained or restored in the long term:

1. *The species is a viable component of the site*
2. *There is no significant disturbance of the species*
3. *The supporting habitats and processes relevant to harbour porpoises and their prey are maintained*

Source JNCC 2016

7.5 Harbour porpoises are considered to be a 'viable component' of the site if they are able to survive and live successfully within it. Killing, injuring or significantly disturbing harbour porpoise have the potential to affect species viability within the site (JNCC 2016).

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

7.7 Within the draft Conservation Objectives '*no significant disturbance of the species'* is described as '*any disturbance should not lead to the exclusion of harbour porpoise from a significant portion of the site for a significant period of time'*. Although there is no definition within the draft Conservation Objectives of what is a significant portion or significant period. The aim is to ensure that the site '*contributes, as best it can, to maintaining the Favourable Conservation Status of the wider harbour porpoise population. As such, how the impacts within the site translate into effects on the North Sea Management Unit population are of greatest concern'* (JNCC 2016).

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

7.9 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 2017a).

7.10 Although there are no set thresholds at which impacts on site integrity are considered to be adverse and significant, draft thresholds to assess and manage the effects of noise on site integrity have been proposed by Statutory Nature Conservation Bodies (SNCBs) (JNCC 2017 c). These draft thresholds proposed by the SNCBs have not been adopted by the competent authorities as all management approaches will be continuously reviewed. The thresholds have therefore been noted within this assessment for completion and to provide additional context only.

7.11 The proposed SNCB approach is that:

- '*Ultimately, the purpose of the cSACs is to contribute to maintaining FCS for harbour porpoise and in order to do this, the site's integrity needs to be maintained in line with the site's Conservation Objectives.*
- *Noise disturbance within a cSAC from a plan/project individually or in combination will not exclude harbour porpoises from a maximum of 20% of the relevant area of the cSAC for a period of 1 day. And,*
- *Over a season, the noise disturbance within a cSAC from a plan/project individually or in combination per day will not exclude harbour porpoises from an average of 10% of the relevant area of the cSAC.*'

7.12 The potential extent of noise levels causing disturbance that would reach the proposed thresholds (and therefore impact on the integrity of the site) are presented in Table 6. The results indicate that should a sound source alone or in-combination cause disturbance for one day out to between 29.1 km and 41.5 km for one day, there is a risk of impacting site integrity. Over the course of a season the extent of potential

disturbance should not extend beyond 29.3 km during the summer and 20.8 km in the winter.

Table 6: Estimated extent sound levels capable of causing disturbance occur in order to impact on site integrity.

Site	Estimated Area (km^2)	1 day threshold		Seasonal threshold	
		20% of area (km^2)	Extent of disturbance to meet threshold (km)	10% of area (km^2)	Extent of disturbance to meet threshold (km)
'summer' area April - September	27,088	5,418	41.5	2,708	29.3
'winter' area October – March	13,366	2,673	29.1	1,366	20.8
Extent of disturbance assumes circular sound propagation occurs within the area.					

7.13 The Humber Estuary SAC Conservation Objectives are:

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 2014

7.14 The Humber Estuary SAC conservation objectives are self-explanatory and are considered at the assessment stage later in this document.

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

8 IN-COMBINATION IMPACTS

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

8.2 The in-combination assessment includes plans or projects that are:

- 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.

8.3 For the purposes of this assessment, on-going impacts from current activities have not been included within the in-combination assessment where the influence of the projects upon a receptor, that may also be predicted to be significantly affected by the development, is considered to be captured within the baseline. For some on-going activities, e.g. fishing, shipping, aggregate extraction and dredging disposal it is technically not possible to determine what the baseline conditions would be without the influence the impacts from these on-going activities have on the current marine mammal populations or their prey.

Renewable energy

8.4 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.

8.5 There are forty offshore wind farms wholly within or within 26 km of the cSAC, including two in Belgian and one Dutch waters.

8.6 Within the Southern North Sea cSAC there are 11 offshore wind farms: Three are operating, two are under construction and six have been consented but are not yet under construction. In addition there are a further 29 offshore wind farms that either planned, consented or constructed that lie within 26 km of the cSAC.

8.7 It is recognised that during construction, piling will likely occur at all wind farm locations and that, if undertaken simultaneously as the proposed seismic survey there is the potential to cause an adverse effect in-combination.

8.8 Of the potential 40 offshore wind farms that could be considered in an in-combination assessment none are predicted to be undertaking piling activities at the same time as the proposed seismic survey will be undertaken. The application stipulates that this has been confirmed with the relevant wind farm companies. Consequently, no in-

combination assessment impacts are predicted to occur and no further assessment has been undertaken.

Aggregate extraction and dredging activity

8.9 Existing localised aggregate dredging occurs primarily in the southern half of the cSAC, along the east coast. In 2015 there were 13 production licenses in this area covering an area of 152.89 km^2. A total of 5.98 million tonnes of construction aggregate was extracted from the sites in the Outer Thames and East coast areas, 90% of which came from an area of 11.5 km^2 (TCE 2015, 2016).

8.10 There are a number of licenced areas where there is currently no dredging activity, but where there is potential for future operations within the cSAC.

8.11 Although there are some aggregate extraction sites to the south of the proposed survey area. They are outwith the cSAC and there are no plans for aggregate extraction or dredging activities to be undertaken within the predicted area of potential impact during the period of the proposed seismic survey.

Oil and gas activity

8.12 There is long history of oil and gas activities within the boundaries of the Southern North Sea cSAC. Since 1965, when the first well was spudded, there has been extensive oil and gas development with a total of 42 platforms installed within the site, of which 39 are currently active. In addition to these installations, a total of 4,067 km of pipelines and umbilicals have also been laid in the area (UKOilandgasdata.com 2015).

8.13 Seismic surveys have regularly been undertaken within the cSAC over the last 50 years, with a total of 65 surveys undertaken within the cSAC between 2005 and 2014. The majority of surveys during this period took place in the northern half of the cSAC, where the most recent oil and gas activity has occurred.

8.14 BEIS are aware of three planned oil and gas related surveys that could impact on the cSAC (Table 7).

8.15 BEIS are not aware of any other exploration, construction or decommissioning activities within the area during the period the proposed survey will be undertaken that could cause an in-combination effect. However, on-going routine operational activities will be undertaken within the cSAC.

8.16 BEIS have not been informed, nor are aware, of any other geophysical surveys planned to be undertaken within or adjacent to the sites during the proposed survey period.

Table 7: Proposed oil and gas surveys that have potential for in-combination impact.

Survey	Operator	Type of survey	Start date	End date	Duration (days)	distance from SAC (km)
Wollaston wellhead debris clearance survey	Perenco	SBP, MS, MBE, SSS	20/1/17	31/12/17	1	2
Geophysical site survey	IOG North Sea Ltd	SS, SBP, SSS, MBES	01/09/17	30/11/17	49	0
Sub-bottom profiler survey	Perenco	SBP, MBES, SBP	18/12/17	31/12/17	7	12
SS = Seismic Survey, SBP = Sub-bottom profiler, MBE = Multi-beam Echosounder, SSS = Sidescan sonar, MS = Magnetic survey.						

8.17 All three surveys are capable of causing levels of sound that could cause injury or disturbance to harbour porpoise.

8.18 Previous modelling has shown that of the equipment proposed to be used by the proposed oil and gas surveys, 2D seismic surveys and sub-bottom profilers have the potential to cause an impact on harbour porpoise.

8.19 Based on modelling undertaken for the use of a 'chirper' sub-bottom profiler within the cSAC, it has been estimated that the onset of physical injury to harbour porpoise would not extend beyond 32 m from the sound source and physical disturbance to no further than 235 m (Genesis 2017). The sub-bottom profilers proposed to be used in the surveys are 'pingers', which have a lower level of impact than 'chirpers'. Consequently, the risk of any in-combination impact on harbour porpoise from sub-bottom profilers is very low.

8.20 The IOG North Sea Ltd geophysical site survey to be undertaken over a period of 49 days between 01/09/17 and 30/11/17 includes the use of 2D airgun array with a source level noise estimated to be 216 dB re: 1µPa^2 –s (IOG 2017).

8.21 The site surveys will be undertaken around five installations located in the southern winter area of the SAC (Figure 8). Each survey around each platform will be 1 km^2 and the overall survey period will last for an estimated 5.5 days.

8.22 Natural England have advised '*that due to the scale and duration of the proposed pipeline survey the proposal is unlikely to have a significant effect on designated or proposed sites of nature conservation importance'.* However, it was noted that no in-combination assessment had been undertaken and that this should be carried out.

8.23 The location, duration and type of surveys indicate that there is little or no potential for an in-combination impact on harbour porpoise within the cSAC from any of the proposed surveys, with the exception of the IOG 2D seismic survey. The potential in-

combination impacts between the IOG seismic survey and the Tolmount survey are therefore considered further in Section 10.

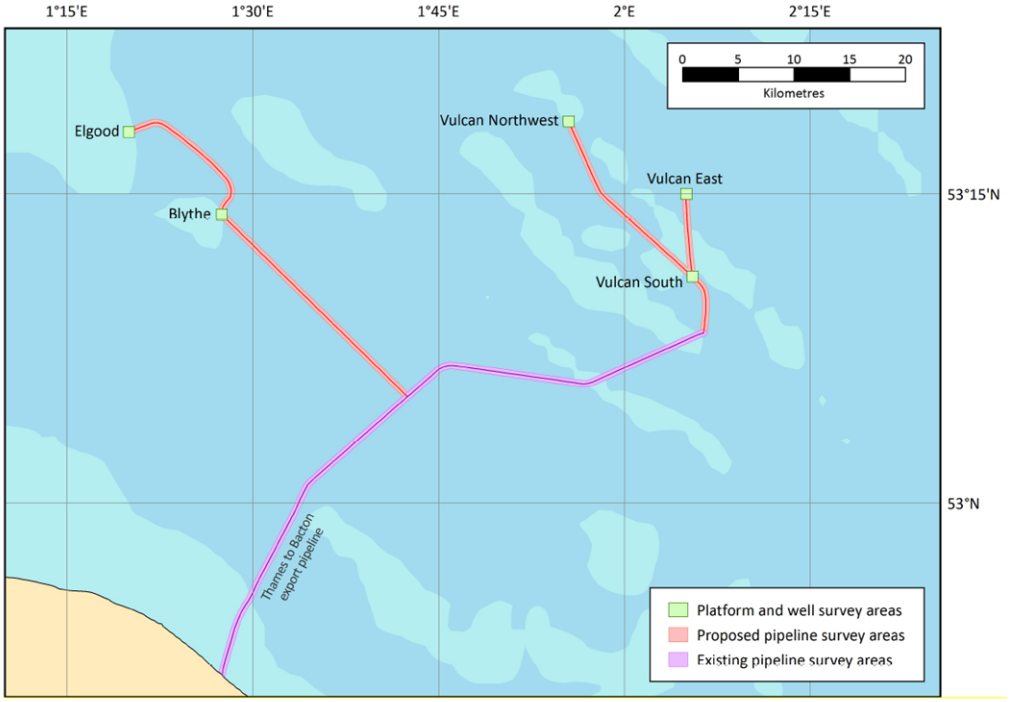

Figure 7: Location of proposed 2D seismic surveys between September and November 2017.

In-combination conclusion

8.24 Following consideration of all known developments that may cause a likely significant effect, BEIS considers that there are no plans or projects likely to cause an in-combination likely significant effect. However on-going routine activities such as shipping and fishing will be being undertaken for the duration of the proposed seismic 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 This section addresses this first step of the HRA, for which BEIS has considered the potential impacts of the survey both alone and in combination with other plans and projects on each of the interest features of the relevant European sites to determine whether or not there will be a likely significant effect.

Harbour porpoise

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

9.4 Harbour porpoise are a qualifying species for the Southern North Sea cSAC. They are known to occur throughout the site, with particular concentrations in the northern 'winter' area over which the proposed seismic survey overlaps Noise modelling undertaken indicates that there is potential for disturbance or displacement effects to occur 34.9 km from the airguns (Figure 8, Table 3).

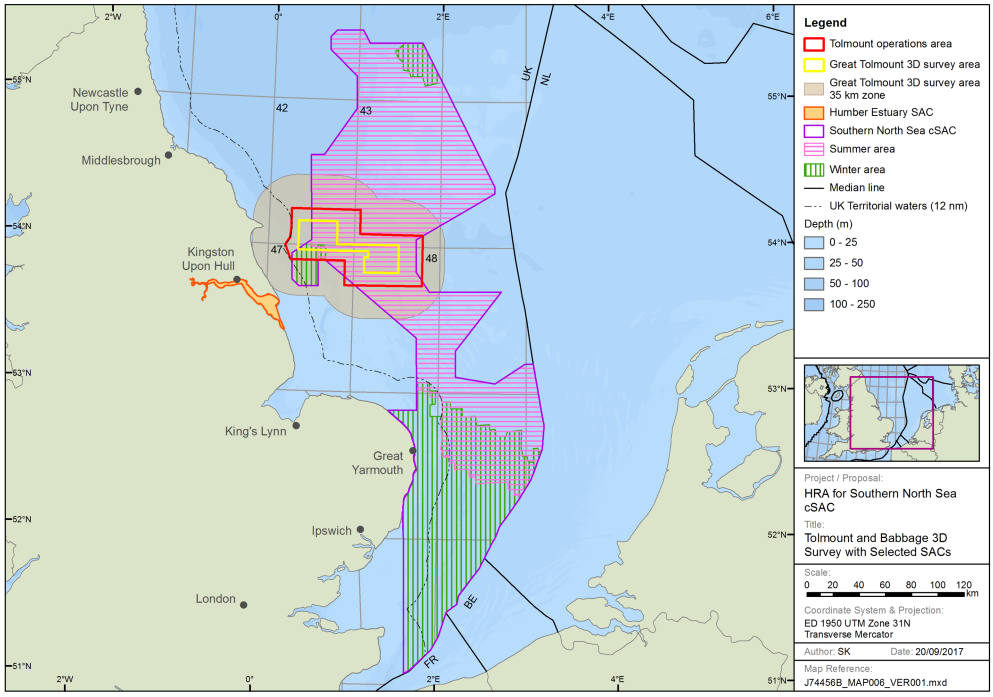

Figure 8: Estimated maximum area of disturbance from proposed seismic survey.

Grey seal

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

9.6 Grey seals are a qualifying species at the Humber Estuary SAC. They are known to routinely forage within 100 km from their haul out sites and although will occur further offshore they do so less frequently. Noise modelling undertaken indicates that there is

potential for disturbance or displacement effects to occur 32 km from the airguns (Figure 8, Table 4).

9.7 The proposed survey will occur within 32 km of the SAC and based on the results from noise modelling and known behaviour of grey seals it is concluded that there is potential for a likely significant effect on grey seals from Humber Estuary SAC.

Habitats

9.8 Habitats listed in the SAC citations (Appendix A) 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.

Fish

9.9 The Sea lamprey and River lamprey are qualifying species for the Humber Estuary SAC. There is also potential for noise to impact on the prey species of harbour porpoise and seals from or within designated sites.

9.10 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 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 are able to detect sound within the 100 Hz to 2 kHz range, those without swim bladders are unlikely to detect sound above 400 Hz (Popper 2014).

9.11 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 5). The area of impact within which physical injury could occur is therefore relatively very small. However, the area within which disturbance could occur may be substantially greater. Modelling undertaken for piling operations at the Hornsea Two offshore wind farm within the cSAC indicate a general behavioural response may occur out 25 km for 'hearing specialists' (DONG 2015). Although the sound profile from piling is different from that of a seismic survey it does indicate the potential extent of disturbance to fish beyond the area of physical injury.

9.12 Results from the noise modelling indicate that the there is potential for an impact on sea lamprey and river lamprey to within 140 m of the seismic survey. Based on the distance the seismic surveys from the SAC and the low risk of any lamprey occurring in the survey area it is concluded that there will not be a Likely Significant Effect on sea lamprey or river lamprey from the proposed survey.

Likely significant effects test - conclusions

9.13 Based on the information presented within the application relating to the proposed activities and the noise modelling undertaken 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 cSAC: *Harbour porpoise*
- Humber Estuary SAC: *Grey seal.*

9.14 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 2000).

10.2 The following section assesses 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. No other projects have been identified as have the potential to cause an in-combination likely significant effect and therefore no in-combination adverse effects are predicted to occur.

Southern North Sea cSAC

Harbour porpoise

10.3 For the purposes of this assessment noise modelling results undertaken based on a larger seismic survey with a higher SPL have been used (Genesis 2017, unpublished). These provide a more precautionary approach to the assessment than based on the modelling results presented in the application.

Physical Injury

10.4 Sound modelling undertaken to support the Appropriate Assessment indicates that, based on the M-weighted SEL threshold, there is potential for sound levels from seismic surveys to cause the onset of PTS to harbour porpoise out to 470 m from the sound source (Table 3).

10.5 The peak harbour porpoise density across the site is estimated to be >3 per km^2 (Table 2) (Heinänen and Skov 2015). Based on this peak density and the worst-case scenario of PTS occurring out to 470 m of the survey, an estimated two harbour porpoise could be affected at the start of a seismic survey.

10.6 The North Sea Management Unit harbour porpoise population is 227,298 individuals and therefore the worst-case scenario of two harbour porpoise being impacted is <0.01% of the Management Unit population.

10.7 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 2017b). Consequently, the risk of any harbour porpoise being impacted by sound from seismic airguns at levels of capable of causing the onset of PTS is extremely low.

10.8 The impacts from TTS are temporary with hearing thresholds recovering relatively rapidly following cessation of the noise. Studies have shown that TTS can recover within 4 and 96 minutes but may take up to 24 hours depending on the sound source, exposure level and duration (Kastelein *et al.* 2012; 2014). Consequently, any auditory injury arising from TTS will cease very shortly after the airguns stop operating or when the harbour porpoise relocate away from the sound source.

10.9 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 survey initially commences, there is a very low risk of physical injury to any harbour porpoise.

10.10 There is a low risk of harbour porpoise being physically impacted by seismic surveys. In the extremely unlikely event of PTS, this would only affect a very small proportion of the relevant population and any physical effects caused by TTS would be of short duration.

Disturbance

10.11 The area of potential disturbance of harbour porpoise varies depending on the location of the survey (Table 3). The greatest extent any noise likely to cause disturbance is estimated to propagate out to 34.9 km from the airguns and cover an area of 275 km^2. Assuming that disturbance occurs entirely within the cSAC, then approximately 0.7% of the cSAC could be affected by the proposed seismic survey.

10.12 Based on a peak site density of 3.0 ind/km^2 an estimated 825 harbour porpoise could be disturbed by a seismic survey. This is equivalent to 0.4% of the North Sea Management Unit harbour porpoise population being disturbed at any one time. A seismic vessel will transit across an area and therefore over the duration of a survey

the total number of harbour porpoises disturbed will be greater. However, the disturbance effects are transient and once the vessel has moved away from an area there is, in effect, no disturbance on those porpoises previously affected.

10.13 The application states that the seismic survey will be travelling at 5.0 knots (9.2 km/h) (Polarcus 2017a). Noise capable of causing disturbance may occur out to 34.9 km from the airguns. As a vessel undertakes a survey, disturbance in any area will last less than 9 hours in any one location. Once the vessel has left the area, sound levels will reduce to background levels.

10.14 Studies undertaken in the Moray Firth during 10 days of 2D seismic surveys using a 470 cu in airgun with peak-to-peak 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 are predicted to be temporary, with porpoises returning to the area impacted within 24 hrs.

10.15 A single seismic survey operating within the cSAC will potentially affect 0.7% of the cSAC for less than 9 hours, after which harbour porpoise are predicted to return to the area within 24 hrs.

10.16 The cSAC identifies two seasonal components: a 'summer' area from between April and September covering an area of approximately 36,951 km^2 and 'winter' area from between October and March covering an area approximately 13,366 km^2. The vast majority of the 'winter' area is located in the southern part of the cSAC. However, there is a relatively small 'winter' area estimated to be 635 km^2 that partially overlaps the proposed survey area (Figure 9).

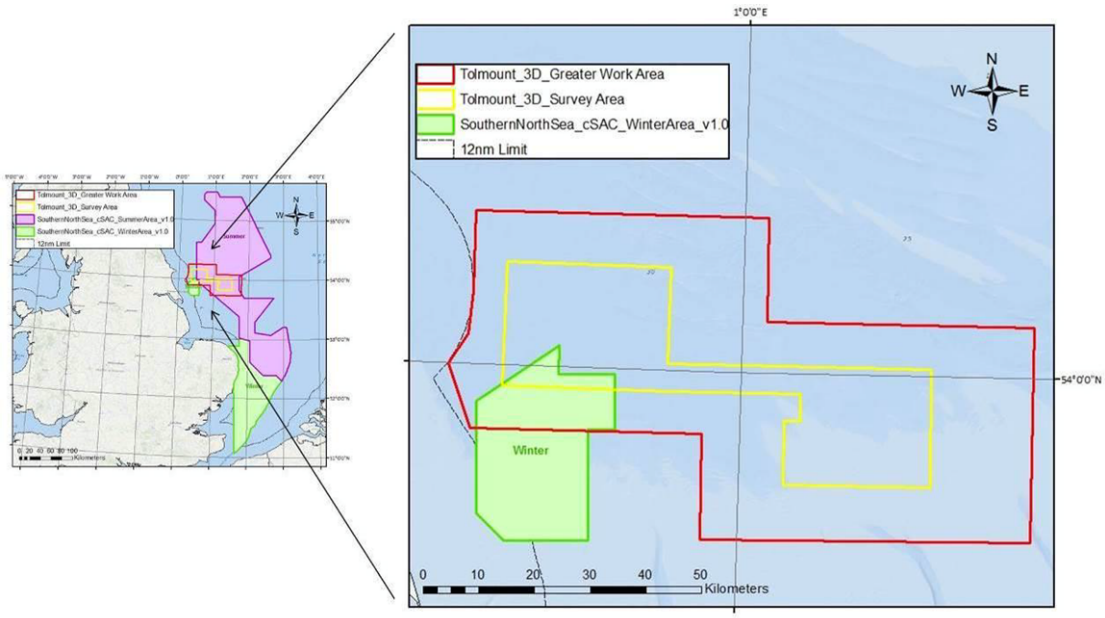

Figure 9: The proposed seismic survey area and an identified as a 'winter' area for harbour porpoise within the cSAC (Source Polarcus 2017b).

10.17 The estimated extent of a seismic survey within the SAC and its two seasonal components are presented in Table 8. Surveys undertaken within the smaller 'winter' area will have a proportionally larger effect compared with the site as a whole, with an estimated 1.4% of the wider 'winter' area being affected.

Table 8: Estimated extent of disturbance on harbour porpoise from proposed seismic survey within the SAC.

:Site	*Area (km^2)*	*Area of disturbance (km^2)*	*% of SAC impacted*
cSAC	36,951	275	0.7
'summer' area April - September	27,088	275	1.0
'winter' area October - March	13,366	190	1.4

10.18 The proposed survey's Greater Working Area overlaps approximately 29% of the cSAC northern 'winter' area, within which 207 km of survey transects will be undertaken (Figure 10). An estimated 26 hours of survey will be undertaken within the northern 'winter' area (Polarcus 2017b).

10.19 Sound from the proposed seismic survey outwith the cSAC's northern 'winter' area will also impact on harbour porpoise within the area itself (Figure 8). This has not been considered within the application and therefore it is not possible to calculate the total extent or duration noise from the proposed seismic survey may have on harbour porpoise within the northern 'winter' area. For the purposes of this assessment it is assumed that a significant proportion of the northern 'winter' area will be impacted at any one time.

10.20 Data obtained by marine mammal observers during seismic surveys show a significant decrease in the number of harbour porpoise detections when airguns are operating, indicating that harbour porpoise are displaced from an area during a seismic survey (Stone 2015). However, there is not total displacement during a survey, with the median closest distance harbour porpoises being detected increasing from approximately 750 m when no airguns are operating to 1,200 m when the airguns are operating (Stone 2015). Therefore, harbour porpoise will still occur within the cSAC, including the northern 'winter' area during the period the survey is being undertaken.

10.21 Although, the effects on harbour porpoises from displacement are unknown, displaced harbour porpoise will relocate elsewhere. Studies have shown an increase in the number of porpoise occurring in areas beyond the area of disturbance during seismic surveys (Pirotta *et al.* 2014).

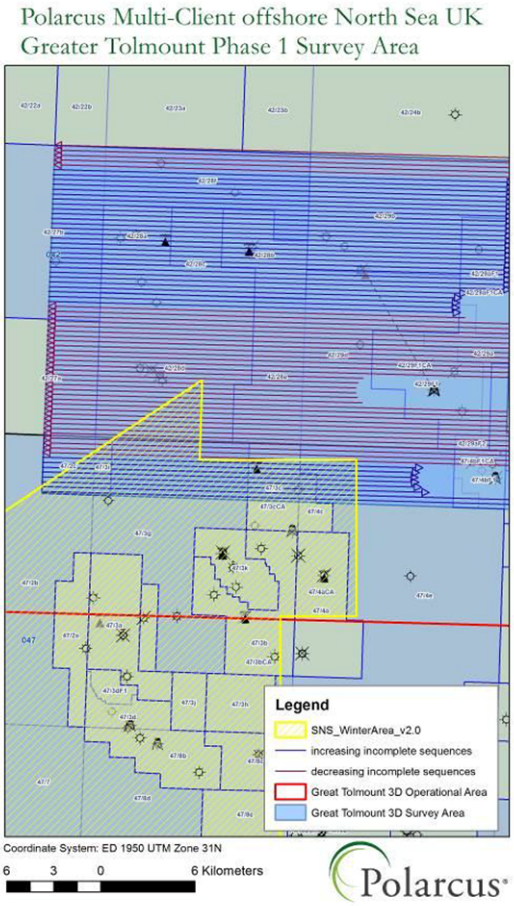

Figure 10: Proposed seismic survey lines within the northern 'winter' area of the cSAC (Source: Polarcus 2017).

10.22 There is potential for harbour porpoise to incur an energetic cost by swimming away from the proposed survey. Studies have indicated that harbour porpoise may be displaced out to 10 km from a seismic survey (Thompson *et al.* 2013, Pirotta *et al.* 2014), which is a relatively small distance compared with their usual foraging range and is not predicted to cause an energetic cost that would be detrimental to an individual harbour porpoise. Harbour porpoise occur widely across the cSAC and the North Sea and is therefore not restrained by limited habitat preferences. Harbour porpoise are known to forage widely and prey on a wide selection of fish species (Sveegaard 2011); they are therefore adaptable and, if displaced, capable of relocating to new areas.

10.23 There is a high degree of certainty that harbour porpoise will be disturbed and potentially displaced by the proposed seismic survey. However, the impacts will be temporary and there is a high degree of certainty that harbour porpoise will return to the area during the survey period and only a short time after the vessel has passed through.

In-combination

10.24 There is recognised to be the potential for an in-combination impact between the proposed Great Tolmount survey and the IOG 2D seismic site survey.

10.25 No noise modelling has been undertaken within the IOG application. However, noise modelling undertaken elsewhere for similar type of 2D seismic surveys elsewhere in the UK indicate that sound arising from airguns will not cause the onset of injury to harbour porpoise within 500 m of the sound source and strong avoidance behaviour may occur out to 5 km with lower level of disturbance out to 21 km (PA Resources 2010). Studies undertaken during the period the seismic survey was being undertaken indicated decreasing levels of displacement of harbour porpoise from a 2D site survey occurred out to approximately 10 km (Thompson *et al.* 2013, Pirotta *et al.* 2014).

10.26 Due to the directionality of seismic survey sound sources it is not realistic to assume that sound will propagate in an evenly circular way from the sound source. It is therefore not possible to accurately estimate the area of impact arising from the proposed IOG seismic survey.

10.27 There is no overlap in the sound sources between the proposed surveys with the IOG survey occurring in the southern area of the SAC (Figure 7) and the Great Tolmount seismic survey in the 'northern' winter area (Figure 2). Harbour porpoise will be disturbed by both surveys. However, the five proposed IOG surveys will each last an estimated 1.1 days each with an unspecified break between the end of one survey and the start of another. There will be limited if any overlap in sound levels capable of causing disturbance between the five separate site survey locations.

10.28 Evidence from studies indicate that once seismic surveys cease or move away from an area harbour porpoise will return within a day and therefore any displacement is short-term and temporary (Pirotta *et al.* 2014). Therefore, within any one site survey location the impact on harbour porpoise is estimated to last no more than two days (one day of survey and one day of 'return').

10.29 Although there is potential for an in-combination impact on harbour porpoise from the two surveys, the location of the surveys ensure that no individual harbour porpoise will be impacted by both surveys. The duration of impacts will be limited with harbour porpoise returning to the area within 24 hrs of the surveys being completed.

Conclusions

10.30 The potential impacts from the proposed Greater Tolmount seismic survey within the Southern North Sea cSAC may, based on a worse-case scenario, cause physical injury to <0.01% of the North Sea Management Unit harbour porpoise population. There is a risk of the survey to cause TTS in harbour porpoises but this is predicted to

be a very short-term effect. Disturbance over a wider area could occur and, at any one time, up to 0.4% of North Sea Management Unit harbour porpoise population could be affected. The extent and duration of survey is such that any disturbance effects will impact on 0.7% of the cSAC as a whole. The survey will likely impact across the northern 'winter' area. However, should it occur, any displacement caused by disturbance will be temporary and porpoises will relocate to other areas during the period the seismic survey is being undertaken. Porpoises will occur in the area shortly after the survey vessel has passed thorough.

10.31 Impacts on prey species will occur and fish may relocate away from the area during the period the seismic survey is being undertaken. It is predicted that the impacts on fish will be temporary and fish will return to the area once the survey vessel passed through.

10.32 The seismic survey will not impact on the supporting habitats and processes relevant to harbour porpoises.

10.33 There is potential for an in-combination impact with a 2D seismic site survey over the same period. The location of the proposed 2D site survey indicate that there will be no overlapping impacts with the proposed Great Tolmount survey. Previous noise modelling has indicated that the onset of physical injury to harbour porpoise will not occur beyond 500 m of the sound source but there will be displacement and disturbance to other harbour porpoise within the cSAC. The extent of any impact is estimated to be less than 10 km from the sound source and the duration of each survey is 1.1 days, totalling 5.5 days. Any impacts form disturbance or displacement will be short-term and temporary.

10.34 It is concluded that based on the best available information and results from the sound modelling that the proposed survey alone and in-combination will not have an adverse effect upon the integrity of the Southern North Sea cSAC.

Humber Estuary SAC

Grey seal

10.35 It is considered, based on the information presented in the application, that grey seals from Humber Estuary SAC are at risk of being impacted by noise arising from the proposed survey.

Physical Injury

10.36 Results from noise modelling presented within the application indicate that there is a risk of physical injury in the form of PTS within 99 m of sound source (Table 4).

10.37 The potential area within which the onset of PTS is predicted to occur is very localised and covers an area of 0.031 km^2. However, a standard mitigation measure, which the

applicant has already committed to undertake is the presence of a Marine Mammal Observer (MMO) during the survey, which will ensure that the risk of any grey seals being present within 99 m of the vessel when the airguns commence firing is very low.

Disturbance and Displacement

10.38 For the purposes of this assessment it is assumed, based on the outputs from the noise modelling, that all grey seals within the SAC and wider area have the potential to be impacted.

10.39 When undertaking surveys the vessel will be travelling 5 knots (9.6 km/h). Noise capable of causing disturbance is predicted to occur out to 32 km from the survey vessel. Consequently, as the vessel transits along a seismic transect, disturbance in any one area will last approximately 8 hours based on the maximum area noise likely to cause disturbance is predicted to occur and the vessel travelling at its slowest operating speed. Once the vessel has left the area, noise levels will reduce to ambient background levels.

10.40 There is potential for repeated levels of noise capable of causing 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.

10.41 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.

10.42 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 seals recorded when air guns were operating compared to when they were not. 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 2 hours of the cessation of piling the distribution of seals returns to pre-piling scenarios (Russell *et al.* 2016).

10.43 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). Soft start is a standard mitigation measure under the JNCC guidelines (2017b). Geological survey consent is conditional upon the applicant adhering to these guidelines.

10.44 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.

In-combination

10.45 No other projects have been identified as having the potential to cause an in-combination capable of causing an adverse effect on grey seals.

Conclusion

10.46 It is predicted that there is a very low risk of any physical injuries to grey seals arising from the proposed seismic survey. Whilst any grey seals within the SAC and the wider area 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 eight hours at any one point and the impacts will be temporary and predicted to be of relatively short duration.

10.47 The duration and effect of any impact on grey seals is predicted to be temporary and although 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.

10.48 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.

10.49 Based on the best available information and results from the noise modelling presented in the application, BEIS is satisfied that the proposed survey (either alone or in combination with known relevant plans and projects) will not have an adverse effect upon the integrity of the Humber Estuary SAC with respect to grey seals.

11 PROPOSED MITIGATION MEASURES

11.1 All seismic surveys relating to oil and gas activities require consent from the competent authority. Every permit issued has, as a condition, a requirement for mitigation measures to be complied with in order to reduce the risk of physical injury to marine mammals.

11.2 The applicant has committed to adhere to the JNCC guidelines *Guidelines for minimising the risk of disturbance and injury to marine mammals from seismic surveys* (JNCC, 2017b).

11.3 The applicant has provided details of the proposed mitigation measures that will be in place for the duration of the survey (Polarcus 2017b). These will include:

- Use of marine mammal observers (MMOs) to detect marine mammals within a "mitigation zone" of 500 m and potentially recommend a delay to seismic operations.
- MMOs will carry out a 30 minute pre-data acquisition survey of the mitigation zone and, if an animal is detected, the soft-start of the seismic airguns should be delayed until their passage, or the transit of the vessel, results in the marine mammals being more than 500 m away from the source.
- If there are cetaceans within 500 m (measured from the centre of the array) then the start of the seismic airguns will be delayed until the cetaceans have moved away (at least 20 minutes) following last sighting.
- Soft-start of airgun activation, whereby there is an incremental increase in power over at least 20 minutes. This is believed to allow any marine mammals to move away from the sound source and reduce the likelihood of exposing the animal to sounds which can cause injury.
- Use of passive acoustic monitoring (PAM) to detect the presence of marine mammals by listening for their calls. This can be a useful supplement to visual monitoring during periods of poor visibility but is only effective for species that regularly vocalise.

12 APPROPRIATE ASSESSMENT CONCLUSIONS

12.1 BEIS has carefully considered all of the information provided by the applicant. BEIS considers that the proposed seismic survey has the potential to have a likely significant effect on two European sites when considered either alone or in combination with other plans and projects.

12.2 The sites are:

- Southern North Sea cSAC,
- Humber Estuary SAC.

12.3 BEIS is confident that, with mitigation measures, there will be no adverse effect on the integrity of either of these sites.

12.4 Mitigation for the survey will be secured and delivered through the consent to carry out a geological survey under the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended).

12.5 BEIS has undertaken an Appropriate Assessment in respect of those European sites' Conservation Objectives to determine whether the project, either alone or in combination with other plans and projects, will result in an adverse effect upon the sites' integrity.

12.6 BEIS has determined that the proposed survey will not have an adverse effect upon the sites' integrity either alone or in combination with other plans or projects. BEIS has undertaken a robust assessment using all of the information available.

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