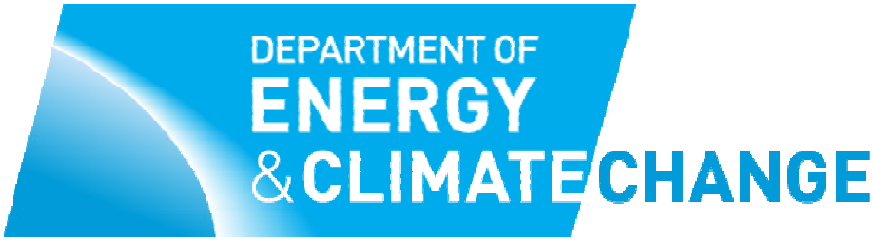


Offshore Oil & Gas Licensing

25th Seaward Round

Southern North Sea
Blocks 42/27d, 42/27e, 43/13b, 43/14a, 43/15c, 43/17, 43/18, 43/19b, 43/20d, 43/23, 44/7, 44/8, 44/9, 44/11b, 44/12b, 44/16d, 44/19f, 48/8c, 48/22, 48/23a, 48/29b, 49/7, 49/8b and 49/13

Phase 2 Screening/
Appropriate Assessment

February 2010

CONTENTS

1 INTRODUCTION

1.1 Background and purpose

On 20th February 2008, the Secretary of State for Energy and Climate Change (through the Department of Energy and Climate Change (DECC)) (then as the Secretary of State for Business, Enterprise and Regulatory Reform, BERR) invited applications for licences in the 25th Seaward Licensing Round.

To comply with obligations under the *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (as amended) (OPAR 2001), in summer 2008, the Secretary of State undertook a screening assessment to determine whether the award of any of the Blocks applied for would be likely to have a significant effect on a relevant European conservation site, either individually or in combination with other plans or projects (DECC 2008).

In so doing, the test set out by the European Court of Justice in the ***Waddenzee*** case (Case C-127/02) was applied, as follows:

> Any plan or project not directly connected with or necessary to the management of a site must be subject to an Appropriate Assessment if it cannot be excluded, on the basis of objective information, that it will have a significant effect on that site, either individually or in combination with other plans or projects.
>
> Where a plan or project not directly connected with or necessary to the management of the site is likely to undermine the site's conservation objectives, it must be considered likely to have a significant effect on that site. The assessment of that risk must be made in the light, inter alia, of the characteristics and specific environmental conditions of the site concerned by such a plan or project.

An initial screening assessment (including consultation with the statutory agencies/bodies), identified 46 Blocks as requiring further assessment prior to decisions on whether to grant licences. Because of the wide distribution of these Blocks around the UKCS, the second phase of screening and, where necessary, the Appropriate Assessments (AA) in respect of each potential licence award, are contained in four regional reports as follows:

- Southern North Sea
- Eastern Irish Sea
- Outer Moray Firth
- West of Orkney and the Wyville Thomson Ridge/Darwin Mounds area.

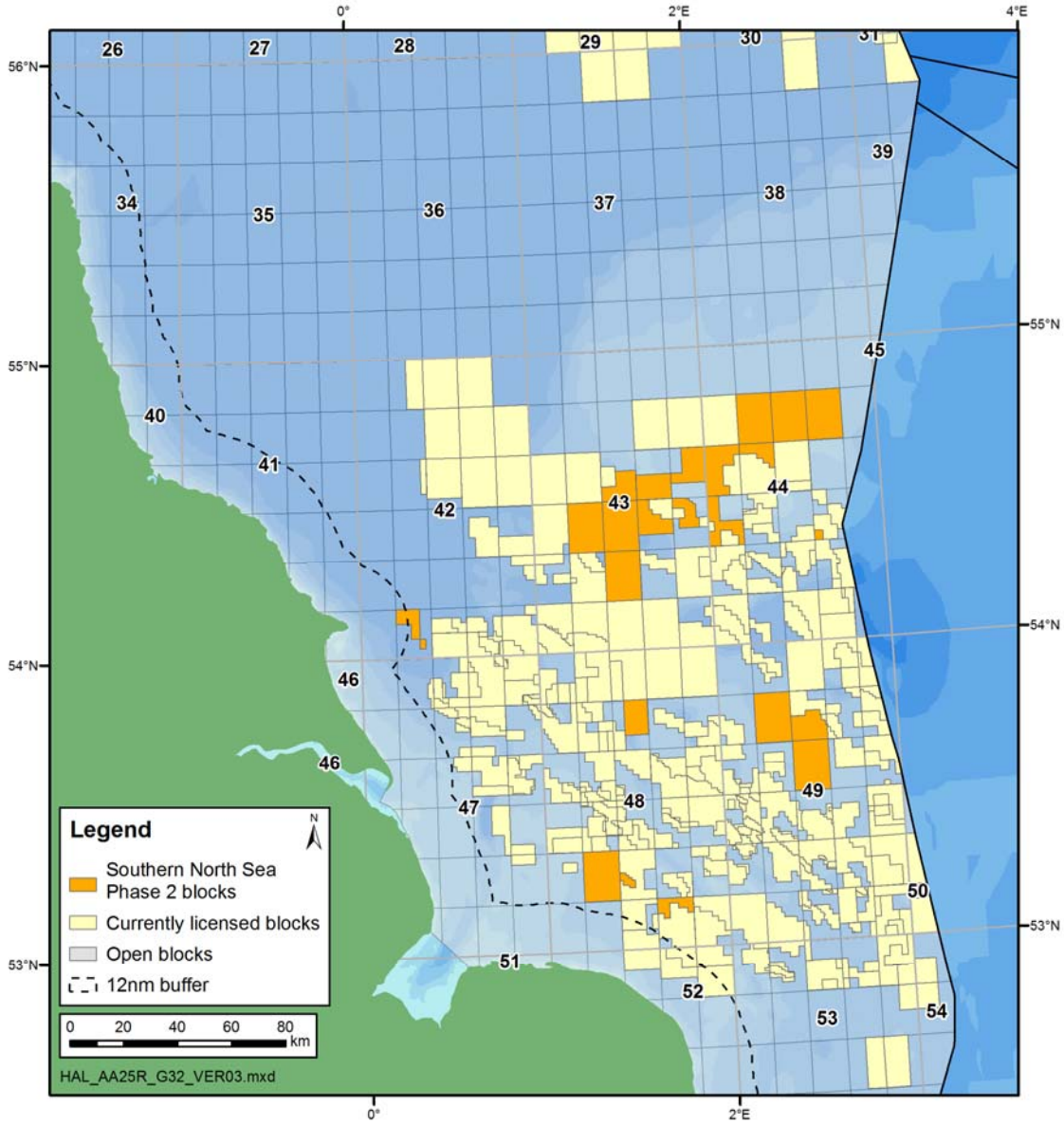
This report documents the further assessment in relation to 24 Blocks in the southern North Sea (see Section 1.2).

1.2 Southern North Sea Blocks

The southern North Sea Blocks applied for in the 25th Round and considered in this document are listed below and shown in dark orange in Figure 1.1 overleaf.

42/27d	43/15c	43/20d	44/9	44/19f	48/29b
42/27e	43/17	43/23	44/11b	48/8c	49/7
43/13b	43/18	44/7	44/12b	48/22	49/8b
43/14a	43/19b	44/8	44/16d	48/23a	49/13

Figure 1.1 – Location of southern North Sea Blocks



2 LICENSING AND ACTIVITY

2.1 Licensing

The exclusive rights to search for, bore for and get petroleum in Great Britain, the territorial sea adjacent to the United Kingdom and on the UK Continental Shelf (UKCS) are vested in the Crown and the *Petroleum Act 1998* gives the Secretary of State, the power to grant licences to explore for and exploit such petroleum. A Seaward Production Licence grants exclusive rights to the holders "to search and bore for, and get, petroleum" in the area covered by the licence, which may be the whole or part of a specified Block or a group of Blocks.

There are three types of Seaward Production Licences:

- **Traditional Production Licences** are the standard type of Seaward Production Licences and run for three successive periods or Terms. Each licence expires automatically at the end of each Term, unless the Licensee has made enough progress to earn the chance to move into the next Term. The Initial Term lasts for four years and the licence will only continue into a Second Term of four years if the agreed Work Programme has been completed and if 50% of the acreage has been relinquished. The licence will only continue into a Third Term of 18 years if a development plan has been approved, and all the acreage outside that development has been relinquished.

- **Frontier Production Licences** are a variation of the Traditional Production Licence with four Terms rather than three. A Frontier Production Licence has a longer exploration phase (six years as opposed to four) with the objective of allowing companies to screen larger areas, during a three year Initial Term so they can look for a wider range of prospects. At the end of the Initial Term, the Licensee must relinquish 75% of the licensed acreage. The Second Term lasts three years at the end of which (i.e. when the licence is six years old), the exploration Work Programme must have been completed and the Licensee must relinquish, 50% of what is left (i.e. leaving one eighth of the original licensed area). In this sense, the end of a Frontier Licence's Second Term corresponds to the end of a Traditional Licence's Initial Term.

- In the 21st Offshore Oil and Gas Licensing Round (2002) the then Department of Trade and Industry introduced **Promote Licences**. The general concept of the Promote Licence is that the Licensee is given two years after award to attract the technical, environmental and financial capacity to complete an agreed Work Programme. In effect, DECC will defer (not waive) its financial, technical and environmental checks until the preset Check Point. Promote Licensees are not allowed to carry out field operations until they have met the full competence criteria. The way this is implemented is that each Promote Licence carries a "Drill-or-Drop" Initial Term Work Programme. The licence will therefore expire after two years if the Licensee has not made a firm commitment to DECC to complete the Work Programme (e.g. to drill a well). By the same point, it must also have satisfied DECC of its technical, environmental and financial capacity to do so.

- The terms and conditions of the licences to be granted in this Licensing Round are contained in the *Petroleum Licensing (Production) (Seaward Areas) Regulations 2008* (SI 2008/225).

It is noted that the environmental management capacity and track record of applicants is explicitly examined by DECC, by way of written submissions and interviews, before licences are awarded.

2.2 Activity

As part of the licence application process, applicant companies provide DECC with details of work programmes they propose in the first term to further the understanding or exploration of the Blocks(s) in question. These work programmes are considered with a range of other factors in DECC's decision on whether to license the Blocks and to whom. There are three levels of drilling commitment:

- A **Firm Drilling Commitment** is a commitment to the Secretary of State to drill a well. Applicants are required to make firm drilling commitments on the basis that, if there were no such commitment, the Secretary of State could not be certain that potential licensees would make full use of their licences. However, the fact that a licensee has been awarded a licence on the basis of a "firm commitment" to undertake a specific activity should not be taken as meaning that the licensee will actually be able to carry out that activity. This will depend upon the outcome of all relevant environmental assessments.

- A **Contingent Drilling Commitment** is also a commitment to the Secretary of State to drill a well, but it includes specific provision for DECC to waive the commitment in light of further technical information.

- A **Drill-or-Drop (D/D) Drilling Commitment** is conditional with the proviso, discussed above, that the licence is relinquished if a well is not drilled.

Note that Drill-or-Drop and Contingent work programmes (subject to further studies by the Licensees) will probably only result in an actual well being drilled in less than 50% of the cases.

It is made clear in the application guidance that a Production Licence does not allow a Licensee to carry out all petroleum-related activities from then on. Field activities, such as seismic survey or drilling, are subject to further individual controls by DECC, and a licensee also remains subject to controls by other bodies such as the Health and Safety Executive. It is the licensee's responsibility to be aware of, and comply with, all regulatory controls and legal requirements.

The approach used here has been to take the proposed activity for a given Block as being the maximum of any application for that Block, and to assume that all activity takes place as a result of the structuring of licences. The licence types and estimates of work commitments for the Blocks derived by DECC from the range of applications received are as follows:

- 42/27d & 42/27e - (Promote)
- 43/13b - D/D well (Traditional)
- 43/14a & 43/15c (part) - D/D well (Traditional)
- 43/17 (split) & 43/18 (split) - one firm well (Traditional)
- 43/17 (split), 43/18 (split) & 43/19b - obtain and reprocess 3D seismic, one firm well (Traditional)
- 43/20d (part) - D/D well (Traditional)
- 43/23 - obtain & reprocess 3D seismic, D/D well (Traditional)
- 44/7, 44/8 & 44/9 - D/D well (Promote)
- 44/11b (split) & 44/12b (split) - D/D well (Traditional)
- 44/11b (split) & 44/16d (part) - D/D well (Traditional)
- 44/19f - D/D well (Traditional)

- 48/8c - one contingent well (Traditional)
- 48/22 (split) & 48/23a - one firm well (Traditional)
- 48/22 (split) - shoot 3D seismic, obtain & reprocess 3D seismic, one firm well (Traditional)
- 48/22 - D/D well (Traditional)
- 48/29b - obtain 2D seismic, D/D well (Traditional)
- 49/7, 49/8b & 49/13 - obtain & reprocess 3D seismic, D/D well (Promote)

On past experience, less activity actually takes place than is bid at the licence application stage. A proportion of Blocks awarded may be relinquished without any field activities occurring.

Activity after the initial term is much harder to predict, as this depends on the results of the initial phase, which is, by definition, exploratory. Typically less than half the wells drilled reveal hydrocarbons, and of that half, less than half again will yield an amount significant enough to warrant development. Depending on the expected size of finds, there may be further drilling to appraise the hydrocarbons (appraisal wells). Discoveries that are developed may require further drilling, wellhead infrastructure, pipelines and possibly production facilities such as platforms, although most recent developments are tiebacks to existing production facilities rather than stand alone developments.

The extent and timescale of development, if any, which may ultimately result from the licensing of these Blocks is therefore uncertain.

3 RELEVANT NATURA 2000 SITES

Relevant Natura 2000 sites (also referred to as 'European Sites') considered in this screening/assessment include Special Areas of Conservation (SACs) and Special Protection Areas (SPAs), whose location in relation to the 24 Blocks (see Section 1.2 above) which have been applied for, indicate the possibility of interactions.

Guidance on selection of relevant Natura 2000 sites is given by Planning Policy Statement 9 (PPS9) which states that: "*The Habitats Regulations do not provide statutory protection for potential Special Protection Areas (pSPAs) or to candidate Special Areas of Conservation (cSACs) before they have been agreed with the European Commission. For the purposes of considering development proposals affecting them, as a matter of policy, the Government wishes pSPAs and cSACs included in a list sent to the European Commission, to be considered in the same way as if they had already been classified or designated*" (ODPM 2005a).

In accordance with Government policy (as set out in PPS9 and above), the relevant sites considered in this screening/assessment include classified and potential SPAs, designated and candidate SACs and Sites of Community Importance (SCIs)[1]. The relevant sites include:

- Coastal and marine Natura 2000 sites along the east coast of England from the Northumbria coast to the Deben Estuary
- Offshore Natura 2000 sites in the southern North Sea
- Riverine SACs within the area for migratory fish.

Guidance in relation to sites which have not yet been submitted to the European Commission is given by Circular 06/2005 (ODPM 2005b) which states that: "*Prior to its submission to the European Commission as a cSAC, a proposed SAC (pSAC) is subject to wide consultation. At that stage it is not a European site and the Habitats Regulations do not apply as a matter of law or as a matter of policy. Nevertheless, planning authorities should take note of this potential designation in their consideration of any planning applications that may affect the site.*" See Sections 4 and 10 for such sites.

In Dutch and German offshore waters, several SACs have been identified and are sufficiently progressed in the designation process to be considered as relevant sites in the context of AA.

Summaries of sites, together with their features of interest, and location maps are given in Appendix A (Maps A.1 to A.3 and Tables A.1 to A.4).

[1] Sites of Community Importance (SCIs) are more advanced in designation than cSACs in that they have been adopted by the European Commission but not yet formally designated by the government of the relevant country.

4 PHASE 2 SCREENING

The Phase 2 screening assessed the potential implications for Natura 2000 sites of the award of licences for the 24 UKCS Blocks listed in Section 1.2 in the 25th Licensing Round. The award of such licences may or may not give rise to subsequent development activity, the implications of which have been considered in this screening in so far as possible. Where relevant, such future activities will themselves be subject to the screening procedure and tests under the Habitats Directive.

An earlier initial screening assessment identified these Blocks as requiring further screening and potentially AA prior to licences being granted (DECC 2008). This is due to the potential for a significant effect on listed habitats or species from a consideration of the geographic location of the Blocks in relation to the sites, and the general characteristics of habitat and species present.

For all other southern North Sea Phase 2 Blocks, no new information has become available which would alter the conclusions of the November 2008 screening. Therefore, it is considered that the following 5 Blocks require AA: 42/27d, 42/27e, 48/22, 48/23a and 48/29b.

Nineteen Blocks (43/13b, 43/14a, 43/15c, 43/17, 43/18, 43/19b, 43/20d, 43/23, 44/7, 44/8, 44/9, 44/11b, 44/12b, 44/16d, 44/19f, 48/8c, 49/7, 49/8b and 49/13) considered in the initial screening were identified as requiring further screening due to their location in relation to the boundary of the Dogger Bank dSAC and North Norfolk Sandbanks and Saturn Reef pSAC (see Figure 3.3), and the consequent potential for physical effects. The Dogger Bank dSAC has yet to undergo public consultation for possible SAC designation within the UK and so has not been submitted to the European Commission as a cSAC. The possible designation of the North Norfolk Sandbanks and Saturn Reef pSAC underwent public consultation within the UK in 2008, but the site has yet to be submitted to the European Commission. Although AA is therefore not required for these sites, Paragraph 6 of Circular 06/2005 states that planning authorities should take note of such potential designation in their consideration of any planning applications that may affect such sites. The Secretary of State has taken note of these sites in relation to the potential licensing of the Blocks above and a consideration of these is included.

5 ASSESSMENT OF THE EFFECTS OF THE PLAN OR PROJECT ON SITE INTEGRITY

5.1 Process

In carrying out this AA so as to determine whether it is possible to grant licences in accordance with Regulation 5(1) of OPAR 2001 (as amended), DECC:

- Considered, on the basis of the precautionary principle, whether it could be concluded that the integrity of relevant European Sites would not be affected. This impact prediction involved a consideration of the cumulative and in-combination effects.

- Examined, in relation to elements of the plan where it was not possible to conclude that the integrity of relevant sites would not be affected, whether appropriate mitigation measures could be designed which cancelled or minimised any potential adverse effects identified.

- Produced a draft AA Report for consultation with its statutory advisors.

- Will consider whether, in the light of comments received, it is possible to go ahead with the plan.

In considering the above, DECC used the tests in line with the ruling of the ECJ in the *Waddenzee* case (Case C-127/02), namely that:

- Prior to the grant of any licence all activities which may be carried out following the grant of such a licence, and which by themselves or in combination with other activities can affect the site's conservation objectives, are identified in the light of the best scientific knowledge in the field.

- A licence can only be granted if DECC has made certain that the activities to be carried out under such a licence will not adversely affect the integrity of that site. That is the case where no reasonable scientific doubt remains as to the absence of such effects.

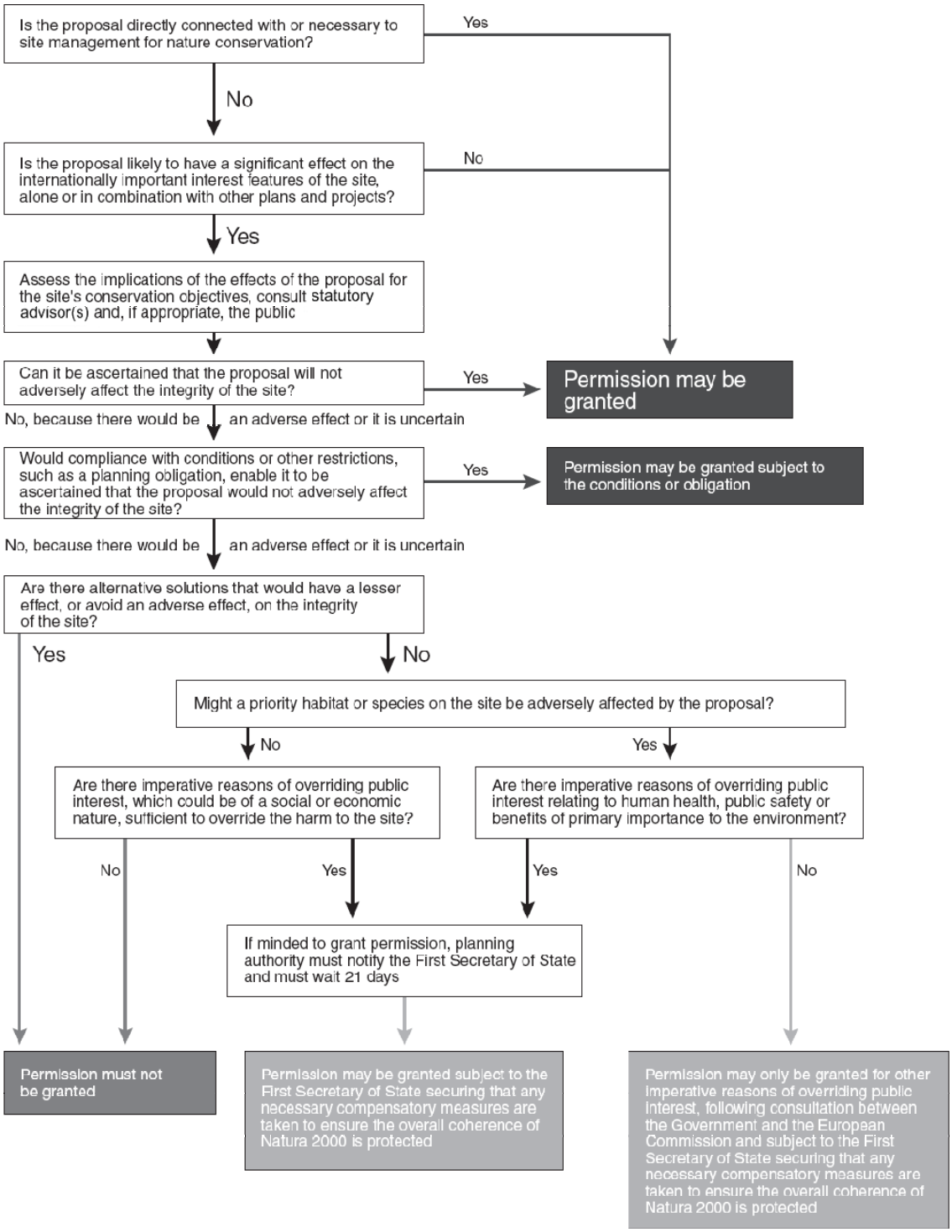
A flowchart summarising the process is shown in Figure 5.1.

Site integrity

Site integrity is defined by the ODPM Circular 06/2005 to accompany PPS9 (ODPM 2005b) as follows: "The integrity of a site is the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified." As clarified by Section 4.6.3 of the EC Guidance (2000), the integrity of a site relates to the site's conservation objectives. These objectives are assigned at the time of designation to ensure that the site continues, in the long-term, to make an appropriate contribution to achieving favourable conservation status for the qualifying interest features. For example, it is possible that a plan or project will adversely affect the integrity of a site only in a visual sense or only habitat types or species other than those listed in Annex I or Annex II. In such cases, the effects do not amount to an adverse effect for purposes of Article 6(3), provided that the coherence of the network is not affected. The AA must therefore conclude whether the proposed activity adversely affects the integrity of the site, in the light of its conservation objectives. For sites

where the potential for adverse affects has been identified, their conservation objectives are listed in full within Appendix C.

Figure 5.1 - Summary of procedures under the Habitats Directive for consideration of plans or projects affecting Natura 2000 sites



Note: 'Statutory advisor(s)' refers to the relevant statutory Government advisor(s) on nature conservation issues. Source: After ODPM (2005b).

5.2 Assessment

The approach to ascertaining the absence or otherwise of adverse effects on the integrity of a European Site is set out in Section 5.1 above. This assessment has been undertaken in accordance with the European Commission Guidance (EC 2000), and with reference to various other guidance and reports including the Habitats Regulations guidance notes (e.g. SEERAD 2000), the Planning and Policy Statement note 9 (ODPM 2005a & b) and English Nature Research Reports, No 704 (Hoskin & Tyldesley 2006).

Appendix A lists and summarises the relevant European Sites as defined in Section 3. Appendix B then presents the results of a screening exercise of these sites to identify the potential effects of activities that could follow the licensing of Blocks 42/27d, 42/27e, 48/22, 48/23a and 48/29b. Where potential effects are identified, more detailed information on the relevant sites is provided in Appendix C.

Detailed assessments are made in Sections 6-9 of the implications for the integrity of the relevant European Sites and their qualifying features and species, were a licence for any of the five southern North Sea Blocks to be granted. The assessment is based on an indication of the potential work programme for the block and likely hydrocarbon resources if present, along with the characteristics of the relevant sites as described in the Appendices. As noted in Section 2.2, the potential work programme is taken as the maximum of any application for that Block; however, on past experience, less activity actually takes place than is bid at the licence application stage. Activities which may be carried out following the grant of a licence, and which by themselves or in combination with other activities can affect the conservation objectives of relevant European Sites, are discussed under the following broad headings:

- Oil spills (including all liquid phase hydrocarbons)
- Physical disturbance and other effects (e.g. pipeline trenching, marine discharges)
- Underwater noise (in particular, seismic surveys)
- In-combination effects (e.g. cumulative and synergistic and secondary/indirect effects).

Use has been made of advice prepared by the conservation agencies under the various Habitats Regulations, since this typically includes advice on operations that may cause deterioration or disturbance to relevant features or species. The Regulation 33 Advice includes an activities/factors matrix derived from MarLIN (www.marlin.ac.uk) where applicable. Several of the “probable” effects highlighted in the MarLIN matrices are not inevitable consequences of oil and gas exploration and production, since through the regulatory EIA and permitting processes they are mitigated by timing, siting or technology requirements (or a combination of one or more of these). There is an expectation that these options would be evaluated in the environmental assessments required as part of activity consenting.

6 CONSIDERATION OF POTENTIAL EFFECTS FROM OIL SPILLS ON RELEVANT SITES

6.1 Overview of spill effects and context

The potential for oil spills associated with exploration and production, the consequences of accidental spillages, and the prevention, mitigation and response measures implemented have been assessed and reviewed in successive SEAs covering the UKCS area under consideration in the 25th Round, including the recent Offshore Energy SEA. Previous SEAs have concluded that in relation to existing exposure to risk as a result of shipping, the incremental risk associated with exploration and production (E&P) is moderate or low.

A large number of site- and activity-specific risk assessments have also been carried out as a component of Environmental Assessments and under the relevant legislation implementing the International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC) (see the *Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 1998*).

Direct mortality of seabirds in the event of oil spill is highly relevant in the context of coastal breeding site classified as SPAs (and possible SPA extensions). Waterbird vulnerability to surface pollution has been quantified for each month on a block-by-block basis by JNCC in terms of the Offshore Vulnerability Index (OVI).

For activities in proximity to sensitive shorelines, the Department's guidance (DTI 2002) requires that the risk of shoreline contamination be determined through an appropriate risk assessment, and operators with oil spill scenarios that could impact the shoreline must have access to appropriate oil spill response resources suitable for shoreline clean-up operations. These resources should be capable of mobilising to prioritised locations within the estimated beaching time established through oil spill modelling under worst case conditions (normally a 30 knot onshore wind).

The following section provides a high-level overview of risks, regulation, contingency planning and response capabilities; followed by an assessment of risks presented to relevant European Sites by activities resulting from the proposed licensing of the Blocks 42/27d, 42/27e, 48/22, 48/23a and 48/29b in the 25th Round. As risks tend to be generic between sites, these have been categorised based on ecological sensitivity and an evaluation of spill probability and severity.

6.2 Spill risk

Risk assessment, under the terms of OPRC, includes considerations of probability and consequence, generally comprising an evaluation of: historical spill scenarios and frequency, fate of spilled oil, trajectory of any surface slick, and potential ecological effects. These considerations are discussed below.

Historical spill scenarios and frequency

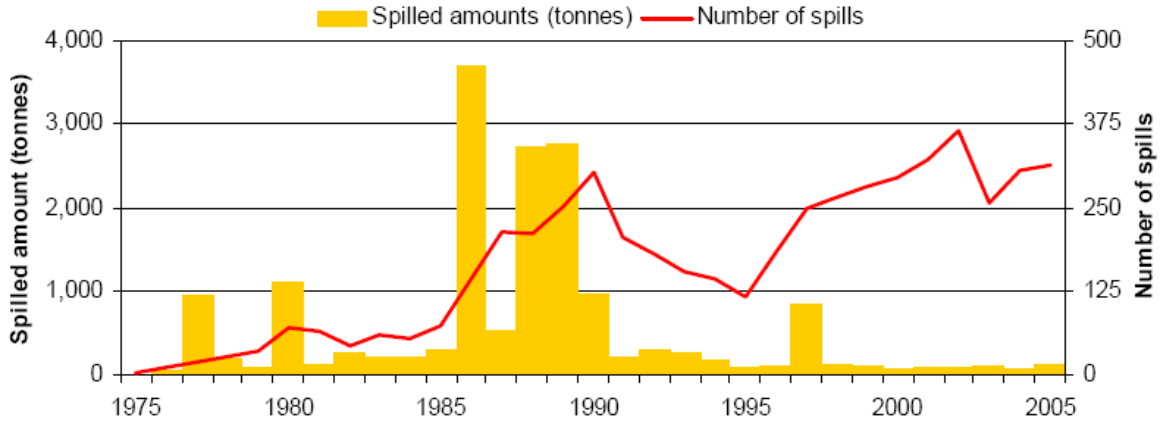
Hydrocarbon spills have been reported from exploration and production facilities on the UKCS since 1974 under PON1 (formerly under CSON7). Well control incidents (i.e. "blowouts" involving uncontrolled flow of fluids from a wellbore or wellhead) have been too infrequent on the UKCS for a meaningful analysis of frequency based on historic UKCS

data. The only significant blowouts on the UKCS to date have been from West Vanguard (1985) and Ocean Odyssey (1988), both involving gas.

The major types of spill from mobile drilling rigs have been organic phase drilling fluids (and base oil), diesel and crude oil. Topsides couplings, valves and tank overflows; and infield flowlines and risers are the most frequent sources of spills from production operations, with most spills being <1 tonne. A large proportion of reported oil spills in recent years (since about 1990) have resulted from process upsets (leading to excess oil in produced water).

Analysis of statistics of oil spills from the oil and gas industry (UKOOA 2006) showed that from 1975 to 2005, for every million tonnes of oil equivalents (TOE) produced on the UKCS, an average of 0.94 spills occurred, and with those the discharge of 3.06 tonnes of oil. An increasing trend in the number of reported spills occurred over the period 1975-1990 followed by a downward trend from 1991-1995 and an upward trend thereafter (see Figure 6.1). The latter trend reflects a lower level of overall production with an increasing number of smaller fields (UKOOA 2006).

Figure 6.1 - Number and volume of reported oil spills from UKCS oil and gas installations over the period 1975-2005



Source: UKOOA (2006)

Over the period 1975-2005, 46% of all oil spills were of crude oil, 18% diesel, 8% hydraulic oil, 4% oily water, 2% condensate and 8% of unknown type. The relative number of diesel, condensate and hydraulic oil spills has increased over the past 10 years. A shift can also be observed towards smaller oil spill volumes over the years. In the period 1975-1981, most spills were between 1 and 10 tonnes; between 2000 and 2005, most spills were between 1 and 100kg. This indicates that the oil spill risk (a function of likelihood and spill size) of the offshore oil and gas industry has reduced over the years. This trend is even clearer when the data are normalised against the number of fields in production (UKOOA 2006).

An annual review of reported oil and chemical spills in the UKCS – covering both vessels and offshore installations – is made on behalf of the Maritime and Coastguard Agency (MCA) by the Advisory Committee on Protection of the Sea (e.g. ACOPS 2008). This includes all spills reported by POLREP reports by the MCA and PON1 reports to DECC. A total of 280 accidental discharges were attributed to oil and gas installations during 2007; this figure is the same as the mean annual total over the period 2000-2006. Of these 280 discharges, 65% were fuel, lubrication or hydraulic oils; additionally, of the 276 discharges with volume information, 95% were less than 455 litres. A total of 42 discharges of 2 tonnes or more originating from offshore oil and gas installations were reported during 2007; the

vast majority of these consisted of non-oil chemicals and hydraulic fluids, with only 6.62 tonnes of crude, 3.67 tonnes of diesel and 51.86 tonnes of OBM spilled (ACOPS 2008).

Since the mid-1990s, the reported number of spills has increased, consistent with more rigorous reporting of very minor incidents (e.g. the smallest reported spill in 2003 was 0.0001 litres). However, the underlying trend in spill quantity (excluding specifically-identified large spills) suggests a consistent annual average of around 100 tonnes. In comparison, oil discharged with produced water from the UKCS in 2006 totalled 4,356 tonnes.

Historic major spill events from UKCS production facilities include the 1986 Claymore pipeline leak (estimated 3,000 tonnes), 1988 Piper Alpha explosion (1,000 tonnes), 1996 Captain spill (685 tonnes) and 2000 Hutton TLP spill (450 tonnes). Although potentially significant at a local scale, these volumes are minor when compared to other inputs of oil to the marine environment, such as riverine inputs (OSPAR 2000).

Trajectory and fate of spilled oil

The main oil weathering processes following a surface oil spill are spreading, evaporation, dispersion, emulsification, dissolution, oxidation, sedimentation and biodegradation. The anticipated reservoir hydrocarbon type in the southern North Sea Blocks is gas, therefore spills of crude oil are not considered a risk. Diesel spills generally evaporate and disperse without the need for intervention. A major diesel spill of *ca.* 1000 tonnes would disperse naturally in about 8 hours and travel some 24km under extreme conditions of a constant unidirectional 30 knot wind.

Coincident with these weathering processes, surface and dispersed oil will be transported as a result of tidal (and other) currents, wind and wave action. Although strong winds can come from any direction and in any season, the predominant winds in the UK are from the southwest which for the southern North Sea Blocks would push spilled oil away from the coast. To support environmental assessments of individual drilling or development of gas projects, modelling is usually carried out for diesel oil releases. Representative modelling cases from various parts of the UKCS have been reviewed by successive SEAs.

Potential ecological effects

The most vulnerable components of the ecosystem to oil spills in offshore and coastal environments are seabirds and marine mammals, due to their close association with the sea surface. Seabirds are affected by oil pollution in several ways, including oiling of plumage resulting in the loss of insulating properties and the ingestion of oil during preening. Pollution of the sea by oil, predominantly from merchant shipping, can be a major cause of seabird mortality. Although locally important numbers of birds have been killed on the UKCS directly by oil spills from tankers, for example common scoter off Milford Haven following the Sea Empress spill in 1996, population recovery has generally been rapid. Chronic pollution resulting from illegal dumping or tank washing probably has a greater chronic impact on seabirds than accidental spills from shipping casualties.

The Offshore Vulnerability Index (OVI) developed by JNCC (Williams *et al*. 1994) is used to assess the vulnerability of bird species to surface pollution; it considers four factors:

- the amount of time spent on the water
- total biogeographical population
- reliance on the marine environment
- potential rate of population recovery

Vulnerability scores for offshore areas are determined by combining the density of each species of bird present with its vulnerability index score. Of the species commonly present offshore in UK offshore waters, gannet, skuas and auk species may be considered to be most vulnerable to oil pollution due to a combination of heavy reliance on the marine environment, low breeding output with a long period of immaturity before breeding, and the regional presence of a large percentage of the biogeographic population. In contrast, the aerial habits of the fulmar and gulls, together with large populations and widespread distribution, reduce vulnerability of these species.

As the major breeding areas for most wildfowl and wader species are outside the UK (in the high Arctic for many species), population dynamics are largely controlled by factors including breeding success (largely related to short-term climate fluctuations, but also habitat loss and degradation) and migration losses. Other significant factors include lemming abundance on Arctic breeding grounds (e.g. white-fronted goose). Variability in movements of wintering birds, associated with winter weather conditions in continental Europe, can also have a major influence on annual trends in UK numbers, as can variability in the staging stops of passage migrants.

Oil spill risks to marine mammals have been reviewed by successive SEAs and their supporting technical reports (e.g. Hammond *et al*. 2008, Murphy *et al*. 2008).

Generally, marine mammals are considered to be less vulnerable than seabirds to fouling by oil, but they are at risk from hydrocarbons and other chemicals that may evaporate from the surface of an oil slick at sea within the first few days. Symptoms from acute exposure to volatile hydrocarbons include irritation to the eyes and lungs, lethargy, poor coordination and difficulty with breathing. Individuals may then drown as a result of these symptoms.

Grey and harbour seals come ashore regularly throughout the year between foraging trips and additionally spend significantly more time ashore during the moulting period (February-April in grey seals and August-September in common seals) and particularly the pupping season (October-December in grey seals and June-July in common seals). Animals most at risk from oil coming ashore on seal haulout sites and breeding colonies are neonatal pups, which rely on their prenatal fur and metabolic activity to achieve thermal balance during their first few weeks of life, and are therefore more susceptible than adults to external oil contamination.

Coastal otter populations are also vulnerable to fouling by oil, should it reach nearshore habitats. They are closely associated with the sea surface and reliant upon fur, rather than blubber, for insulation.

Benthic habitats and species may be sensitive to deposition of oil associated with sedimentation, although based on hydrocarbon types present or used in operations, together with the distance offshore, this is unlikely to be significant in the southern North Sea. However, evidence from the Florida barge spill (Buzzards Bay, Massachusetts, September 1969, in which 700m^3 of diesel fuel were released) suggests that in certain circumstances, contamination from oil spills could be long-term. Monitoring immediately following the spill suggested rapid recovery (reviewed by Teal & Howarth 1984), while subsequent studies (sampling in 1989) indicated that substantial biodegradation of aromatic hydrocarbons in saltmarsh sediments had occurred (Teal *et al.* 1992). However, thirty years after the spill, significant oil residues remain in deep anoxic and sulphate-depleted layers of local salt marsh sediments (Reddy *et al*. 2002, Peacock *et al*. 2005). The ecological consequences of this residual contamination are unclear, although there is potential for remobilisation of sediment-bound contaminants through bioturbation or storm events (in which case, aerobic biodegradation would be expected to be rapid).

Those coastal and marine Annex I habitats which are most sensitive to oil spills are identified in Table 6.1, below. Generally, sheltered habitats of lower exposure to wave energy are considered most vulnerable; oil may persist for long periods in such environments.

6.3 Implications for relevant European Sites

Relevant sites have been screened in Appendix B and all sites where the potential for effects were identified are listed in detail in Appendix C. The identification of potential effects from oil spills on specific European Sites considers the following factors:

- The ecological sensitivity of the qualifying feature(s) to oil spills
- Oil spill probability and severity (taking into account distance from blocks under offer, and probable hydrocarbon type)

Special Areas of Conservation

The ecological sensitivity of the qualifying features of relevant sites to oil spills varies. Several Annex I habitats and Annex II species are not considered to be particularly vulnerable and are not considered further in this assessment; these include:

- **Submerged reefs and sandbanks** – not generally vulnerable to surface oil pollution, except possibly following application of chemical dispersants (generally not permitted in waters shallower than 20m).
- **Lagoons, dunes** – sites above Mean High Water Springs not generally vulnerable to surface oil pollution, except possibly to wind-blown oil or evaporated hydrocarbons.
- **Sea cliffs, sea caves** – generally not considered sensitive due to wave reflection and rapid recovery (e.g. Gundlach & Hayes 1978).
- **Migratory fish** – not generally vulnerable to surface oil pollution due to the absence or paucity of time spent at the water's surface.
- **Terrestrial and freshwater aquatic species** – generally not considered vulnerable to surface oil pollution as not utilising marine or estuarine environments. Includes: narrow-mouthed whorl snail (*Vertigo angustior*), freshwater pearl mussel (*Margaritifera margaritifera*), and non-coastal otter populations (*Lutra lutra*).

Table 6.1 provides information on those categories of Annex I habitats and Annex II species which are potentially vulnerable to oil spills. Those sites where the potential for effects from diesel oil spills has been identified (see Appendix B) are listed. Due to the limited distance which may be travelled by spilled diesel oil and the nature of adjacent habitats, the potential for oil spill effects are considered to relate only to spills from Block 48/22. Note: several sites are represented in more than one risk category.

Table 6.1 - Annex I habitat types and Annex II species potentially vulnerable to oil spills

Mudflats and sandflats
Particularly vulnerable in sheltered areas where wave energy is low. The biological communities associated with these sites are related to the degree of sheltering and subsequent sediment type; sheltered sites with fine, muddy sediments may support a high diversity and abundance of invertebrates and waterfowl. **Sites potentially at risk:** The Wash and North Norfolk Coast SAC
Estuaries

Complexes of several subtidal and intertidal habitats with varying freshwater influence. The sediments of estuaries support various biological communities, while the water column provides an important habitat for free-living species, such as fish, and juvenile stages of benthic plants and animals. Estuaries often contain several different Annex I habitats. **Sites potentially at risk:** None
Saltmarshes
Comprise intertidal mud and sandflats colonised by vegetation due to protection from strong wave action. Pioneering saltmarsh vegetation exists where tidal flooding is frequent, with progression to more diverse, stable communities in upper reaches where tidal flooding is less frequent. Upper reaches can be valuable for plants, invertebrates and wintering or breeding waterfowl. **Sites potentially at risk:** The Wash and North Norfolk Coast SAC, North Norfolk Coast SAC
Inlets and Bays
Large indentations of the coast, and generally more sheltered from wave action than the open coast. They are relatively shallow, with water depth rarely exceeding 30m, and support a variety of subtidal and intertidal habitats and associated biological communities. **Sites potentially at risk:** The Wash and North Norfolk Coast SAC
Harbour porpoise
Sites comprise a variety of marine habitats utilised by harbour porpoise (*Phocena phocena*) for foraging and other activities, with extensive areas beyond the site boundary also utilised. Vulnerable to oil spills due to their dependence on the sea surface for breathing. **Sites potentially at risk:** Doggersbank cSAC
Seals
Designated sites comprise coastal habitats (beaches, estuaries, sandflats and rocky shores) supporting important breeding colonies of common seals (*Phoca vitulina*) and/or grey seals (*Halichoerus grypus*). Seals spend considerable periods of time at these sites during the breeding season and during the moult. Seals forage for prey in surrounding waters and also travel considerable distances beyond the boundaries of sites (particularly grey seals). **Sites potentially at risk:** The Wash and North Norfolk Coast SAC, Doggersbank cSAC
Coastal otters
Sites contain shallow, inshore coastal areas utilised by important populations of otter (*Lutra lutra*) for feeding. **Sites potentially at risk:** The Wash and North Norfolk Coast SAC, North Norfolk Coast SAC

Special Protection Areas

Table 6.2 provides information on those SPA types which are potentially vulnerable to oil spills. Those sites where the potential for effects from diesel oil spills has been identified (see Appendix B) are listed. Due to the limited distance which may be travelled by spilled diesel oil, the potential for oil spill effects relate to a limited number of Blocks only; these are listed alongside the relevant site. Note: several sites are represented in more than one risk category.

Table 6.2 - SPA types potentially vulnerable to oil spills

Cliff-breeding seabird colonies
Designated for colonial breeding seabirds (including auks, fulmar, kittiwake, cormorant, and gannet) which nest either on, or generally associated with sea cliffs. Birds extensively utilise adjacent coastal waters for a variety of activities, and also forage beyond site boundaries.

Sites potentially at risk (relevant Block): Flamborough Head and Bempton Cliffs SPA (42/27d)
Petrel, tern, skua or gull breeding populations
Designated for breeding seabirds, which generally forage over sea areas adjacent to (or in some cases at considerable distance from) breeding sites. **Sites potentially at risk (relevant Block):** North Norfolk Coast SPA (48/22), the Wash SPA (48/22)
Red-throated diver breeding populations utilising coastal waters
Inland sites designated for breeding red-throated diver (*Gavia stellata*) which forage in neighbouring coastal waters. **Sites potentially at risk (relevant Block):** None
Open coastline supporting wintering waders and seaduck
Contain coastal and intertidal habitats which support a variety of wintering waders and seaduck, often in large aggregations. The birds feed on wetlands and the surrounding shallow waters. **Sites potentially at risk (relevant Block):** North Norfolk Coast SPA (48/22), the Wash SPA (48/22)
Firths, lochs and estuaries supporting wintering waterfowl
Contain enclosed and semi-enclosed coastal and intertidal habitats (particularly wetlands) supporting a variety of wintering waterfowl and waders, often in large aggregations. Some species (e.g. seaducks) feed beyond the boundaries of sites. **Sites potentially at risk (relevant Block):** North Norfolk Coast SPA (48/22), the Wash SPA (48/22)

6.4 Regulation, contingency planning and response capabilities

Spill prevention and mitigation measures are implemented for offshore exploration and production inter alia through the *Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation) Regulations 1998* and the *Offshore Installations (Emergency Pollution Control) Regulations 2002*. The required measures include spill prevention and containment measures, risk assessment and contingency planning.

Offshore, primary responsibility for oil spill response lies with the relevant Operator, although the Secretary of State's Representative may intervene if necessary. The Maritime and Coastguard Agency is responsible for a National Contingency Plan and maintains four Emergency Towing Vessels stationed around the UK, which remain on standby at sea. In addition, the MCA maintains a contractual arrangement for provision of aerial spraying and surveillance, with aircraft based at Coventry and Inverness. Within two days, aircraft can deliver sufficient dispersant to treat a 16,000 tonne spill within 50 miles of the coast anywhere around the UK. DECC is a partner in this arrangement and undertakes regular aerial surveillance of offshore installations. MCA holds 1,400 tonnes of dispersant stockpiled in 14 locations around the UK, in addition to counter-pollution equipment (booms, adsorbents etc.) which can be mobilised within 2-12 hours depending on incident location.

Similar response capabilities, providing a tiered response capability, must be available to Operators prior to commencing drilling or production activities. These provisions are made under various long-term commercial contracts with specialist contractors, supplemented where necessary (e.g. for remote locations) with additional stockpiles. Site-specific Oil Spill Contingency Plans must also be submitted to DECC for approval prior to operations. Additional conditions can be imposed by DECC, through block-specific licence conditions (i.e. "Essential Elements").

6.5 Conclusions

Individual European Sites have been categorised in terms of potential vulnerability, based on location and known hydrocarbon prospectivity (gas) of proposed licence blocks and therefore the nature and magnitude of credible risks. Two categories of vulnerability were identified:

- Some sites are considered to be at low risk with the potential for impacts from significant spills of diesel or lube oil.
- Many sites are considered not to be at risk of oil spills associated with activities in proposed blocks, due to location and sensitivity of features.

The incremental risk associated with activities resulting from the proposed licensing (i.e. additional to existing risk; primarily associated with shipping and other maritime activities) is very low. This results from the combination of low probability and low severity (since most spills would be relatively small and of diesel oil). The activities which could reasonably be expected to follow from the proposed licensing would not have a significant effect on the existing risks associated with other activities.

Following licensing, specific activities considered to present a risk to European Sites would be evaluated by DECC under mandatory contingency planning and Appropriate Assessment procedures. In all cases, rigorous spill prevention, response and other mitigation measures are implemented for offshore exploration and production.

Oil spills can have potentially adverse effects, and are controlled in direct proportion to this by a legal framework that minimises their occurrence, provides for contingency planning, response and clean up, and which enables prosecutions. It is not possible to say that in spite of the regulatory controls and other preventative measures, an oil spill will never occur as a result of 25th Round licensing in the southern North Sea; however, as oil spills are not intended activities, a risk-based assessment is appropriate.

Given the availability of mitigation measures, DECC considers that exploration and production activities that could follow the licensing of Blocks 42/27d, 42/27e, 48/22, 48/23a and 48/29b, in so far as they may cause oil spills, will not adversely affect the integrity of European Sites.

7 CONSIDERATION OF SITES AND POTENTIAL PHYSICAL AND OTHER EFFECTS

7.1 Introduction

Several activities associated with oil and gas exploration and production can lead to physical disturbance, damage, alteration or contamination of seabed habitats and geomorphological features, with consequent effects on benthic communities. The prime potential sources of effect are summarised below, followed by a consideration of the foreseeable effects on European Sites assessed to be at potential risk.

7.2 Physical damage at the seabed

The main sources of physical disturbance of the seabed from oil and gas activities are:

- **Anchoring of semi-submersible rigs**. Semi-submersible rigs use anchors to hold position, typically between 8 and 12 in number at a radius depending on the water depth, and cause seabed disturbance from the anchors and chain or cables, and in cohesive sediments, leave 'anchor mounds' after their retrieval. NB: such rigs are typically not used in the southern North Sea water depths.

- **Placement of jack-up rigs**. Jack-up rigs, normally used in shallower water, leave three or four depressions from the feet of the rig (the spud cans) around 15-20m in diameter. In locations with an uneven seabed, material such as grout bags may be placed on the seabed to stabilise the rig feet.

- **Drilling of wells and wellhead removal**. The surface hole sections of exploration wells are typically drilled riserless, producing a localised (and transient) pile of surface-hole cuttings around the surface conductor. After installation of the surface casing (which will result in a small quantity of excess cement returns being deposited on the seabed), the blowout preventer (BOP) is positioned on the wellhead housing. These operations (and associated activities such as ROV operations) may result in physical disturbance of the immediate vicinity (a few metres) of the wellhead. When an exploration well is abandoned, the conductor and casing are plugged with cement and cut below the mudline (sediment surface) using a mechanical cutting tool deployed from the rig and the wellhead assembly is removed. The seabed "footprint" of the well is therefore removed.

- **Production platform jacket installation**. Limited physical footprint similar to a drilling rig, but present on site for longer period. Physical disturbance associated with platform removal during decommissioning is comparable to that of installation.

- **Subsea template and manifold installation**. Limited physical footprint at seabed, smaller than a drilling rig, but present on site for longer period. Physical disturbance associated with subsea template and manifold removal during decommissioning is comparable to that of installation.

- **Pipeline, flowline and umbilical installation, trenching and potentially, placement of rock armour**. Anticipated hydrocarbons are gas and given the location of the Blocks applied for, it is anticipated that new field developments will be 'tied back' to existing infrastructure. Large pipes (greater than 16" diameter) do not have to be trenched according to a general industry agreement as they will not be moved by fishing gear, but

they may still need to be trenched for reasons of temperature loss or upheaval buckling (due to buoyancy). Trenches may require several passes before they are of the required depth, or it may be impossible to achieve the required depth due to obstructions, in which case rock is usually placed on the pipeline (rock dump) to protect and stabilise it.

Other than wellhead removal, which is considered below, I would argue that the potential physical effects of decommissioning are all sufficiently similar to those associated with other E&P activities that the discussions here are enough. There is, I suppose, the removal of colonised hard substrate to consider, but this is a return to more natural seabed conditions so can't really be described as damage.

Oil and gas SEAs have compared the physical disturbance effects of oilfield activities to those of fishing and natural events in shallow water (e.g. storm wave action), and concluded that oilfield effects are typically minor on a regional scale. It is generally accepted that the principal source of human physical disturbance of the seabed and seabed features is bottom trawl fishing. Trawl scarring is a major cause of concern with regard to conservation of shelf and slope habitats and species (e.g. Witbaard & Klein 1993, de Groot and Lindeboom 1994, Kaiser *et al*. 2002a, Kaiser *et al*. 2002b, Gage *et al*. 2005). On the basis that seabed disturbance is qualitatively similar to the effects of severe storms, sand and gravel habitat recovery from the processes of anchor scarring, anchor mounds and cable scrape is likely to be relatively rapid (1-5 years) in most shallower and exposed (as opposed to sheltered) areas.

The broad distribution of large scale biotopes of conservation importance is relatively well understood in the southern North Sea. Within the boundaries of designated and potential SACs the occurrence of habitats of interest is usually known with greater precision. The routine sources of potential physical damage are controlled by a range of statutory measures including Consent to Locate, PON15B, Environmental Statement, Pipeline Works Authorisation and, where relevant, AA. Based on the results of the assessments including AA, DECC may require additional mitigation measures to avoid or minimise any adverse effects, or where this is not possible, refuse consent.

7.3 Marine discharges

As described in previous oil and gas SEAs, marine discharges from exploration and production activities include produced water, sewage, cooling water, drainage, drilling wastes and surplus water based mud (WBM), which in turn may contain a range of hydrocarbons in dissolved and suspended droplet form, various production and utility chemicals, metal ions or salts (including Low Specific Activity radionuclides). In addition to these mainly platform-derived discharges, a range of discharges is associated with operation of subsea infrastructure (hydraulic fluids), pipeline testing and commissioning (treated seawater), and support vessels (sewage, cooling and drainage waters). Discharges from offshore oil and gas facilities have been subject to increasingly stringent regulatory controls over recent decades, and oil concentrations in the major streams (drilling wastes and produced water) have been substantially reduced or eliminated. The effects of marine discharges are judged to be negligible in the context of proposed licensing and the Natura 2000 sites in the area and are not considered further here. They would also be considered in detail in project-specific Environmental Statements, AAs (where necessary) and chemical risk assessments under existing permitting procedures.

7.4 Other effects

Through the transport and discharge of vessel ballast waters (and associated sediment), and to a lesser extent fouling organisms on vessel/rig hulls, non-native species may be introduced to the marine environment. Should these introduced species survive and form established breeding populations, they can exert a variety of negative effects on the environment. These include: displacing native species by preying on them or out-competing them for resources such as prey and habitat; irreversible genetic pollution through hybridisation with native species; increased occurrence of toxic algal blooms. The economic repercussions of these ecological effects can also be very significant. In response to these risks, a number of technical and procedural measures have been proposed (such as the use of ultraviolet radiation to treat ballast water) or introduced such as a mid-ocean exchange of ballast water (the most common mitigation against introductions of non-native species). International management of ballast waters is addressed by the International Maritime Organisation (IMO) through the International Convention for the Control and Management of Ships Ballast Water & Sediments, which was ratified in 30 States in 2005. The Convention includes Regulations with specified technical standards and requirements (IMO Globallast website).

The potential effects of light on birds have been raised in connection with offshore oil and gas activities over a number of years (e.g. Weise *et al*. 2001). As part of navigation and worker safety, oilfield installations and associated vessels are lit at night and the lights, together with any flared gas, will be visible at distance (some 10-12nm in good visibility). However, in view of the distance of the Blocks from coastal SPAs it is concluded that light effects will not affect site integrity.

Physical disturbance of seaduck and other waterbird flocks by vessel and aircraft traffic associated with hydrocarbon exploration and production is possible, particularly in SPAs established for shy species. Such disturbance can result in repeated disruption of bird feeding, loafing and roosting. As with light, it is considered this source of potential effect will not result in significant effects at Natura 2000 sites because of the location of the SPAs and pSPAs relative to the Blocks applied for.

7.5 Implications for relevant European Sites

The screening process (Appendix B) did not identify the potential for physical disturbance, discharge effects or light effects in any relevant sites. Additionally, any potentially damaging activities that could following licensing of Blocks 42/27d, 42/27e, 48/22, 48/23a and 48/29b would be subject to statutory risk assessment, mitigation and permitting measures, which would include assessment of the potential effects on the integrity of Natura 2000 sites.

7.6 Conclusions

All blocks under consideration in the southern North Sea are at least several kilometres offshore and remote from Natura 2000 sites. Any adverse effects that could occur from consequent activities will therefore not influence site integrity. It is unlikely that any new terminals would be built as a result of developments following 25th Round Licensing. While new pipelines could conceivably come ashore at existing terminals, either through or near to coastal SACs and SPAs, there are well proven methods to prevent significant impacts. There is a legal framework, via e.g. EIA regulations and those implementing the Habitats Directive, to ensure that there are no adverse effects on Natura 2000 sites.

Taking into account the information presented above and in the Appendices, it is concluded that activities arising from the licensing of Blocks 42/27d, 42/27e, 48/22, 48/23a and 48/29b will not cause an adverse effect on the integrity of the European Sites.

8 CONSIDERATION OF SITES AND POTENTIAL ACOUSTIC EFFECTS

8.1 Overview of effects of acoustic disturbance

Of all marine organisms, marine mammals are regarded as the most sensitive to acoustic disturbance. This is due to their use of acoustics for echolocation and vocal communication, and their possession of large, gas filled organs which are sensitive to rapid pressure changes. Most concern in relation to seismic noise disturbance has been related to cetacean species. However, some pinnipeds are known to vocalise at low frequencies (100-300Hz) (Richardson *et al*. 1995), suggesting that they have good low frequency hearing and are therefore sensitive to acoustic disturbance. Otters in coastal habitats may also experience acoustic disturbance from seismic exploration or piling. However, they generally occupy shallow, inshore areas where the propagation of seismic noise is very limited.

Many species of fish are highly sensitive to sound and vibration (review in MMS 2004). Exposure to high sound pressure levels has been shown to cause long-term (>2 months) damage to sensory cells in fish ears (Hastings *et al*. 1996, McCauley *et al*. 2003). Other reported effects include threshold shifts (hearing loss), stress responses and other behaviour alterations (review in Popper *et al*. 2003). A number of field studies have observed displacement of fish and reduced catch rates, suggested to be attributable to behavioural responses to seismic exploration (e.g. Skalski *et al*. 1992, Engås *et al*. 1996, Hassel *et al*. 2004, Slotte *et al*. 2004). While lamprey are the only qualifying fish species of relevant European Sites in the southern North Sea area, numerous fish species present in the region provide important components of the diet of qualifying species of other relevant European Sites, such as common seal *Phoca vitulina*, grey seal *Halichoerus grypus* and several seabird species.

There are currently no UK Natura 2000 sites with mobile marine invertebrates as qualifying features. However, as with fish, invertebrates such as crabs and squid may form an important component of the diet of qualifying species of relevant European Sites, for example grey seal. The study of effects of seismic noise on invertebrates is limited, and it has been suggested that no reliable conclusions can be made that negative effects exist or not (Moriyasu *et al.* 2004). Recent studies into the effects of seismic exploration on crustaceans have shown no significant long term effects on physiology, behaviour or catch rates (Christian *et al*. 2003, DFO 2004, Parry & Gason 2006). Due to their well developed nervous system, cephalopods such as squid may be more sensitive to seismic noise than other invertebrates; however, evidence for effects of seismic noise on them is very limited (review in Moriyasu *et al*. 2004).

Direct effects on seabirds because of seismic exploration noise could occur through physical damage, or through disturbance of normal behaviour. Diving seabirds (e.g. auks) may be most at risk of acute trauma. The physical vulnerability of seabirds to sound pressure is unknown, although McCauley (1994) inferred from vocalisation ranges that the threshold of perception for low frequency seismic in some species (penguins) would be high, hence only at short ranges would individuals be adversely affected. Mortality of seabirds has not been observed during extensive seismic operations in the North Sea and elsewhere. A study has investigated seabird abundance in Hudson Strait (Atlantic seaboard of Canada) during seismic surveys over three years (Stemp 1985). Comparing periods of shooting and non-shooting, no significant difference was observed in abundance of fulmar, kittiwake and thick-billed murre (Brünnich's guillemot).

Airborne noise, for example from helicopter overflights, could potentially disturb birds in coastal SPAs, although in the context of other military and civilian aircraft activities the anticipated level of E&P related noise is insignificant. In specific cases of concern, mitigation through routeing restrictions would be implemented.

8.2 Noise sources and propagation

Compared to the noise derived from seismic surveys and piling, noise from other oil and gas activities is relatively minor; previous DECC SEAs have assessed noise in some detail, and the following discussion is focussed on seismic noise as the primary concern. The potential for significant effect is therefore largely related to the anticipated type, extent and duration of seismic survey associated with proposed licensing. The range over which noise propagates (and effects may result) varies with water depth, density stratification, substrate and other factors, and is therefore area-specific.

Seismic survey

With the exception of explosives and modern military sonar (and possibly windfarm monopile piling), airgun arrays used for seismic surveys are the highest energy man made sound sources in the sea; broadband peak-to-peak (p-p) source levels of 248-259dB re 1µPa are typical of large arrays (Richardson *et al*. 1995). Airgun noise is impulsive (i.e. non-continuous), with a typical duty cycle of 0.3% (i.e. one 25ms pulse every 10s) and slow rise time (in comparison to explosive noise). These characteristics complicate both the measurement of seismic noise "dose" and the assessment of biological effects (many of which have been studied in relation to continuous noise). Most of the energy produced by airguns is below 200Hz, although some high frequency noise may also be emitted (Goold 1996). Peak frequencies of seismic arrays are generally around 100Hz; source levels at higher frequencies are low relative to that at the peak frequency but are still loud in absolute terms and relative to background levels.

Current levels of seismic survey in the UKCS are around 20-30 surveys per year, which has been the case for the past few years. This has declined from 75 surveys in 1997 (DECC database of PON14 closeout submissions).

The offshore energy SEA process has reviewed general aspects of noise propagation. Most environmental assessments of noise disturbance in deeper water use simple spherical propagation models to predict sound pressure levels at varying distances from source. However, additional signal modification and attenuation may result from a combination of reflection from sub-surface geological boundaries, sub-surface transmission loss due to frictional dissipation and heat; and scattering within the water column and sub-surface due to reflection, refraction and diffraction in the propagating medium. In shallow water, reflection of high frequency signals from the seabed results in approximately cylindrical propagation and therefore higher received spectrum levels than for spherically propagated low frequency signals (which penetrate the seabed).

In general, as distance from the array increases, higher frequencies are attenuated more rapidly and beyond a few kilometres, the main contribution is in the 2kHz region. Finally beyond around 12km it will be the main low-frequency pulse of around 250Hz that has the main contribution. However, local propagation effects may have significant influence: for example frequency dependence due to destructive interference also forms an important part of the weakening of a noise signal. Simple models of geometric transmission loss may therefore be unreliable in relatively shallow water; in areas of complex seabed topography and acoustic reflectivity; where vertical density stratification is present in deep water; and

where the noise does not originate from a point source. In the St George's Channel, Goold and Fish (1998) recorded 8kHz sounds above background levels at a range of 8km from the source, even in a high noise environment.

Other activities

Available measurements indicate that drilling activities produce mainly low-frequency continuous noise from several separate sources on the drilling unit (Richardson *et al*. 1995, Lawson *et al*. 2001). The primary sources of noise are various types of rotating machinery, with noise transmitted from a semi-submersible rig to the water column through submerged parts of the drilling unit hull, risers and mooring cables, and (to a much smaller extent) across the air-water interface. Noise transmission from jack-up rigs used in shallower water is less because of limited coupling with the water column. Under some circumstances, cavitation of thruster propellers is a further appreciable noise source, as may be the use of explosive cutting methods (e.g. for conductor removal).

Measured farfield sound pressure of around 170dB re 1µPa, in the frequency range 10-2000Hz (Davis *et al.* 1991) is probably typical of drilling from a semi-submersible rig and is of the same order and dominant frequency range as that from large merchant vessels (e.g. McCauley 1994). Drilling noise has also been monitored west of Shetland, in the vicinity of the Foinaven and Schiehallion developments (Swift & Thompson 2000). High and variable levels of noise were initially believed to result from drilling related activity on two semi-submersible rigs operating in the area. However, subsequent analysis found more direct correlation between the use of thrusters and anchor handlers, during rig moves, and high levels of noise (Swift & Thompson 2000). Further measurements of drilling and pipelay noise in the North Sea have been sponsored by the industry (Nedwell & Needham 2001, Nedwell *et al*. 2001, Nedwell *et al*. 2002). Drilling duration may range from a few weeks for an exploration well, to years in the case of a large development programme.

Pipelay operations will result mainly in continuous noise (associated with rotating machinery), with relatively little impulse or percussive noise in comparison to many other marine construction activities. The overall source levels resulting from pipelay operations on the UKCS have not been measured, however, near-field cumulative sound levels associated with pipelay for the Clair field development were predicted to be a maximum of 177dB (Lawson *et al*. 2001), with a duration of weeks or months.

Although there is little published data, noise emission from production platforms is thought to be qualitatively similar to that from ships, and is produced mainly by rotating machinery (turbines, generators, compressors) (Richardson *et al*. 1995).

A further source of noise associated with all stages of the offshore oil industry is helicopter overflights. There is relatively little quantitative information on the transmission of helicopter airborne noise to the marine environment (Richardson *et al*. 1995). Measurements of an airsea rescue helicopter over the Shannon estuary (Berrow *et al*. 2002) indicated that due to the large impedance mismatch when sound travels from air to water, the penetration of airborne sound energy from the rotor blades was largely reflected from the surface of the water with only a small fraction of the sound energy coupled into the water.

8.2.1 Effects thresholds

Richardson *et al.* (1995) defined a series of zones of noise influence on marine mammals, which have been generally adopted by SEAs and EAs undertaken in relation to previous Licensing Rounds. Similarly, data on marine mammal responses have been exhaustively reviewed (e.g. Richardson *et al*. 1995, Gordon *et al*. 1998, Lawson *et al*. 2001, Simmonds *et*

al. 2003, Nowacek *et al*. 2007, Weilgart 2007, Southall *et al*. 2007). Four zones are recognised which will generally occur at increasing sound level: (1) the zone of audibility; (2) zone of responsiveness; (3) zone of masking; (4) zone of hearing loss, discomfort or injury. Potential acute effects include physical damage, noise-induced hearing loss (temporary and permanent threshold shifts, TTS and PTS respectively) and short-term behavioural responses. Postulated chronic effects (for which evidence is almost entirely absent) include long term behavioural responses, exclusion, and indirect effects. The most likely physical/physiological effects are generally considered to be shifts in hearing thresholds and auditory damage.

Injury and behavioural criteria

The Offshore Energy SEA (DECC 2009) reviewed recent data and recommendations for injury and behavioural criteria for noise assessment in marine mammals. The difficult issue of determining when noise causes biologically significant effects in marine mammals has been addressed by NRC (2005). This clarifies the term biologically significant in the context of the US Marine Mammal Protection Act (MMPA), which considers two levels of harassment – level A and level B harassment; in turn specified by National Marine Fisheries Service (NMFS) criteria as noise pressure thresholds of 180 and 160 dB re 1 µPa rms respectively. These values were derived by the High Energy Seismic Survey (HESS) team panel of experts convened in 1999 to assess noise exposure criteria for marine mammals exposed to seismic pulses. The consensus was that, given the best available data at that time, exposure to airgun pulses with received levels above 180dB re 1 µPa (averaged over the pulse duration) was "likely to have the potential to cause serious behavioural, physiological, and hearing effects." The panel noted the potential for ± 10dB variability around the 180dB re 1 µPa level, depending on species, and that more information was needed.

The NMFS has continued to use a "do not exceed" exposure criterion of 180dB re 1 µPa for mysticetes and (recently) all odontocetes exposed to sequences of pulsed sounds, and a 190dB re 1 µPa criterion for pinnipeds exposed to such sounds. Behavioural disturbance criteria for pulsed sounds have typically been set at an SPL value of 160dB re 1 µPa, based mainly on the earlier observations of mysticetes reacting to airgun pulses. However, the relevance of the 160dB re 1 µPa disturbance criterion for odontocetes and pinnipeds exposed to pulsed sounds is not at all well-established. Although these criteria have been applied in various regulatory actions (principally in the U.S.) for more than a decade, they remain controversial, have not been applied consistently in the U.S., and have not been widely accepted elsewhere (Southall *et al*. 2007). Southall *et al*. (2007) have recently proposed injury criteria composed both of unweighted peak pressures and M-weighted sound exposure levels which are an expression for the total energy of a sound wave. The M-weighted function also takes the known or derived species-specific audiogram into account. For three functional hearing categories of cetaceans, proposed injury criteria are an unweighted 230dB re 1µPa p-p for all types of sounds and an M-weighted sound exposure level of 198 or 215dB re 1 $\mu Pa^2 \cdot s$ for pulsed and non-pulsed sounds respectively. For pinnipeds, the respective criteria are 218dB 1µPa p-p for all types of sound and 186 (pulsed) or 203 (non-pulse) dB re 1 $\mu Pa^2 \cdot s$ (M-weighted). These proposals are based on the level at which a single exposure is estimated to cause onset of permanent hearing loss (PTS), by extrapolating from available data for TTS.

Southall *et al*. (2007) concluded that developing behavioural criteria was challenging, in part due to the difficulty in distinguishing a significant behavioural response from an insignificant, momentary alteration in behaviour. Consequently, they recommended that onset of significant behavioural disturbance resulting from a single pulse is taken to occur at the lowest level of noise exposure that has a measurable transient effect on hearing (i.e. TTS-onset). These criteria for single pulses are an unweighted 224dB re 1µPa p-p and an M-

weighted sound exposure level of 183dB re 1 $\mu Pa^2 \cdot s$ for three functional hearing categories of cetaceans, and 212dB re 1μPa (p-p) and 171dB re 1 $\mu Pa^2 \cdot s$ (M-weighted) for pinnipeds.

For multiple pulse and non-pulse (i.e. continuous) sources, they were unable to derive explicit and broadly applicable numerical threshold values for delineating behavioural disturbance. A scoring paradigm was used to numerically rank, in terms of severity, behavioural responses observed in either field or laboratory conditions. However, due to various statistical and methodological problems, much of this data was not considered to provide sufficient scientific credence for establishment of exposure criteria. Southall *et al*. (2007) noted the importance of contextual variables in determining behavioural response; together with the presence or absence of acoustic similarities between the anthropogenic sound and biologically relevant natural signals (e.g. calls of conspecifics, predators, prey). They suggest that the concept of a context-based approach to deriving noise exposure criteria for behavioural responses will be necessary.

Based on NMFS and Southall *et al*.'s (2007) proposed criteria relating to pinnipeds and single pulsed sounds from a typical seismic survey, the range exceeding the injury criteria (onset of PTS) would extend to approximately 9m (p-p) from source, and for significant behavioural disturbance (onset of TTS) approximately 22m (p-p) from source.

Seismic array / propagation characteristics	
Source Level	250 dB
array loss (horizontal directivity)	18 dB
propagation loss factor (logarithmic)	15 dB
Effect threshold	
Southall criteria	
single pulse PTS onset, pinnipeds	218 dB
single pulse TTS onset, pinnipeds	212 dB
NMFS A (18dB corr to p-p)	198 dB
NMFS B (18dB corr to p-p)	178 dB
Lucke (porpoise TTS)	184 dB
Required transmission loss (TL)[1]	
PTS single pulse range TL	14 dB
TTS single pulse range TL	20 dB
NMFS A (18dB corr to p-p)	34 dB
NMFS B (18dB corr to p-p)	54 dB
Lucke (porpoise TTS)	48 dB
Required range[2]	
PTS single pulse range	9 m
TTS single pulse range	22 m
NMFS A (18dB corr to p-p)	185 m
NMFS B (18dB corr to p-p)	4.0 km
Lucke (porpoise TTS)	1.6 km

1 TL = SL-array loss-effect threshold
2 Range = 10^(TL/propagation loss factor)

These ranges represent a tiny proportion of the marine areas used by seals associated with European Sites in the Southern North Sea; therefore, disturbance effects beyond site boundaries are not expected to have consequent effects on site integrity.

Popper *et al*. (2006) suggested interim criteria for injury of fish exposed to pile driving operations, although note that the majority of the evidence base for such criteria is derived from studies of seismic and explosive noise sources. A peak sound pressure level of 208dB re 1µPa for single pulses is proposed. This is supported by the findings of Popper *et al*. (2005) who showed that TTS onset (physiological fatigue and not damage) in three species of fish exposed to seismic air-gun pulses occurred within the range of 205-210dB re 1 µPa (p-p). Popper *et al*. (2006) considered available data as too sparse to set clear-cut science-based criteria for behavioural disturbance of fish or auditory masking from pile driving.

8.3 Implications for relevant European Sites

As discussed above, it is considered that marine mammals and migratory fish are the only qualifying species which may potentially be affected (in terms of conservation status) by acoustic disturbance. The screening process (Appendix B) identified the potential for acoustic disturbance in the following sites:

The Wash and North Norfolk Coast SAC

(Primary Annex II species: common seal *Phoca vitulina*; non-primary Annex II species: otter *Lutra lutra*)

The Wash is the largest embayment in the UK. Its extensive intertidal flats combined with those of the adjacent North Norfolk coast provide ideal breeding and haul-out conditions for common seal. This site is the largest colony of common seals in the UK, with some 7% of the total UK population. Their overall condition has been assessed as unfavourable (declining) due to a decline in the moult population[2].

Derived from aerial surveys of breeding colonies, the minimum number[3] of common seals in the Wash in 2007 was estimated as 2,162 (SCOS 2008); counts in previous recent years were 1,695 (2006), 2,124 (2005) and 2,167 (2004) (Lonergan *et al*. 2007). While a high degree of uncertainty surrounds any apparent population trends, SCOS (2008) describe the common seal population of the east coast of England as a whole over the period 2004-2007 as having undergone recent decline. Following the 1988 phocine distemper virus (PDV) epidemic, the population along the east coast of England (mainly in the Wash) was reduced by 52%. Numbers then slowly increased to approximately pre-1988 epidemic levels before a second PDV epidemic in 2002 resulted in a 22% decline in the Wash (Thomsen *et al*. 2005). Counts in the Wash and eastern England have failed to recover since the epidemic; however, adjacent European colonies which have experienced rapid growth since 2002. Major declines have also now been documented in most populations around Scotland, with declines of up to 50% in Orkney and Shetland since 2000. A targeted research programme has been established including increased monitoring to confirm the magnitude and geographical extent of the declines (SCOS 2008).

[2] The Wash and North Norfolk Coast European Marine Site Draft Condition Assessment, September 2008.
http://www.esfjc.co.uk/ems/pages/EMS%20condition%20assessment%20summary.pdf

[3] Numbers are counts of hauled-out seals from aerial surveys and provide a minimum population estimate, likely to represent approximately 60-70% of the total population.

Recent studies of foraging at sea by common seals have been funded by SNH and the Department (Sharples *et al*. 2005, 2008). These indicate high site fidelity to haul-out sites, but ranging over substantial distances at sea. Common seals hauling out in the Wash forage widely throughout coastal and offshore waters of the English southern North Sea from the North Yorkshire to Sussex coasts. Animals tended to make repeated trips of relatively long distance and duration. With all but one of 24 tagged seals travelling repeatedly to between 75 and 120km offshore and as far as 220km to assumed foraging patches. Foraging trips averaged 8.3 days in duration, and animals were fairly site faithful to the areas in which they foraged (Sharples *et al*. 2008).

Simple calculations of sound propagation can be made to estimate the likely maximum received sound levels at the boundaries of relevant European Sites should a typical seismic survey occur in any one of the Blocks applied for; the results of these are presented in Table 8.1. Most environmental assessments of noise disturbance use simple spherical propagation models of the form SPL = SL – 20log(R), where SL = source level, R = source-receiver range, to predict sound pressure levels (SPL) at varying distances from source. Cylindrical spreading, SPL = SL – 10log(R), is usually assumed in shallow water, depth < R. However, several workers have measured or modelled additional signal modification and attenuation due to a combination of reflection from sub-surface geological boundaries, sub-surface transmission loss due to frictional dissipation and heat; and scattering within the water column and sub-surface due to reflection, refraction and diffraction in the propagating medium (see SEA 4 Environmental Report). In shallow water, reflection of high frequency signals from the seabed results in approximately cylindrical propagation and therefore higher received spectrum levels than for spherically propagated low frequency signals (which penetrate the seabed). Attenuation of signal with distance is frequency dependent, with stronger attenuation of higher frequencies with increasing distance from the source. Frequency dependence due to destructive interference also forms an important part of the weakening of a noise signal.

Propagation has been measured for sounds from pile-driving as well as sounds from operating wind turbines (Madsen *et al*. 2006. For the transient impact sounds from pile-driving, the available data suggest that transmission losses are close to spherical spreading (in the range 11log(R) to 35log(R) up to ranges of more than 1km. Similarly, quantitative modelling of seismic noise propagation in Queen Charlotte Basin, Canada (MacGillivray & Chapman 2005) predicted that received noise levels would be lowest in those areas of the basin with shallow bathymetry due to scattering and absorption of sound at the seabed.

In the case of the Wash and North Norfolk Coast SAC, the minimum direct linear range from the SAC boundary to the nearest Block (48/22) is approximately 14km, giving a propagation loss (assuming 15logR) of around 62dB, or a received sound level of 168dB re 1μPa p-p for a typical seismic survey. This level is considerably lower than the injury criteria proposed by Southall *et al.* (2007) in pinnipeds for both pulsed and non-pulsed sounds, and also below those proposed for the onset of TTS (postulated as significant behavioural disturbance) for pulsed sounds.

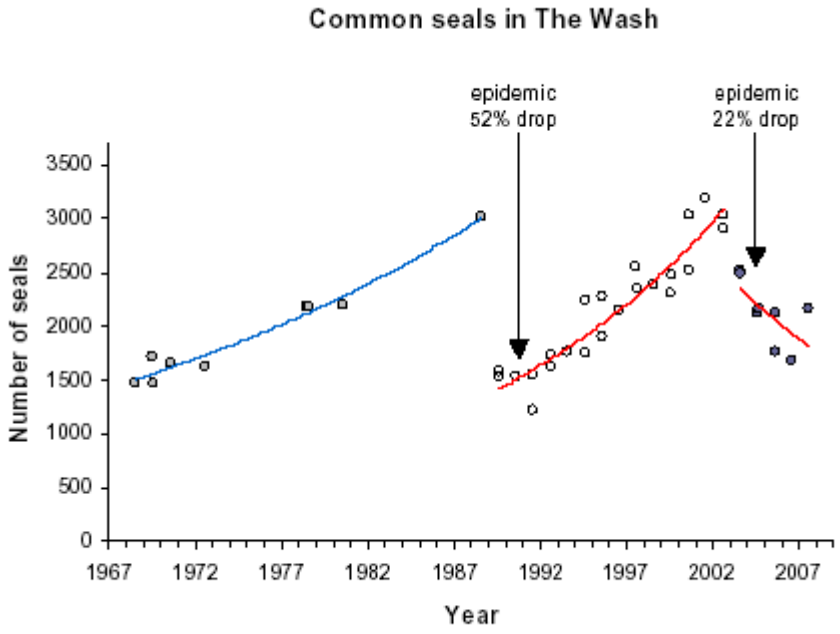
Table 8.1 - Estimated received sound levels in relevant European Sites associated with a typical seismic survey

Block	The Wash and North Norfolk Coast SAC		Humber Estuary SCI	
	Minimum distance (km)	Received sound level (dB re 1μPa peak-to-peak)	Minimum distance (km)	Received sound level (dB re 1μPa peak-to-peak)
42/27d	102	155	50	160
42/27e	105	155	53	159
48/22	14	168	65	158

48/23a	27	164	79	157
48/29b	32	162	94	155

Notes: Assumes a source level of 250dB re 1μPa peak-to-peak, a correction factor of -20dB to compensate for horizontal array effects, and a propagation loss of 15log(R). Figures are rounded to the nearest whole number.

Seismic survey occurring in the proposed licence Blocks will be audible to seals over a large area of the southern North Sea off the east coast of England characterised by moderate marine usage by foraging common seals associated with the Wash and North Norfolk Coast SAC and smaller adjacent haul-out sites. Seismic survey occurring in Blocks 48/22, 48/23a and 48/29b is also likely to be audible to seals in some parts of the SAC itself. The exact effects which this may have are unknown, although available evidence suggests that significant effects at a population level are unlikely. This conclusion is based on population monitoring of the Wash population over 40 years, during which time seismic survey activity in the southern North Sea has been considerable (see e.g. SEA 3 Environmental Report Figure 10.2). As noted above, inter-annual and longer-term population trends have varied, with known factors including recovery from historic hunting (in the Wash until 1970) and persecution, and periodic mass mortalities associated with disease (recorded in Britain since at least 1813; Harwood & Hall 1990). No cause has yet been identified for the apparently widespread current decline in the moult population (SCOS 2008) although attention has been focused on general health/pollutant burdens, and on competition with other predators notably grey seals. The geographical distribution of this trend does not appear to be related to sources of significant anthropogenic noise.



Source: SCOS (2008)

Noise levels suggested to cause auditory damage in phocids are rapidly attenuated with distance from source, and would therefore not propagate into the SAC and have very limited potential for spatial overlap with seals foraging beyond the boundary of the SAC. Furthermore, distances over which hearing damage may occur are well within the effective range of the mitigation measures which would be employed to minimise disturbance to marine mammals. Additionally, any future seismic survey plans would be subject to an extensive source- and site-specific assessment of the potential for adverse effects, including AA.

If significant ecological effects on prey species were to occur, even at considerable distances from the Wash and North Norfolk Coast SAC, these may influence the breeding population of the site. However, noise levels suggested to cause injury to fish (the primary prey species of seals) would not extend beyond a few tens of metres around the noise source. The range over which non-injurious disturbance effects on fish might occur is not possible to define, although available evidence suggests that the extent of any such disturbance of prey species is highly unlikely to have significant effects on relevant qualifying species at a population level.

Otters in coastal habitats may also experience acoustic disturbance from seismic exploration or construction piling. However, as they generally occupy shallow, inshore areas where the propagation of seismic noise is very limited, and the Blocks in question are well offshore, effects are not predicted.

Noise levels associated with other activities potentially resulting from the 25th Licensing Round such as a drilling, vessel movements, pipe-laying operations, are of a considerably lower magnitude than those resulting from seismic survey, and are not expected to have significant effects on relevant qualifying species at a population level.

Humber Estuary SCI

(Non-primary Annex II species: grey seal *Phoca vitulina*, sea lamprey *Petromyzon marinus*, river lamprey *Lampetra fluviatilis*)

The intertidal flats at Donna Nook, at the mouth of the Humber Estuary on the north Lincolnshire coast, provide an important habitat for grey seals. During the autumn, the site supports considerable numbers of breeding seals. Pup production at Donna Nook (along with Blakeney Point and Horsey on the Norfolk coast) in 2007 was estimated as 1,620, of which approximately 1,200 were born at Donna Nook. This represents a 14% increase on 2006; pup production at Donna Nook has been increasing at approximately 14-16% every 5 years since 1992 (SCOS 2008). Throughout the rest of the year, the intertidal flats also provide an important habitat for grey seals to haul out or rest, particularly during the spring moult.

Extensive information on the distribution of British grey seals at sea is available from models of habitat preference derived from satellite telemetry data (McConnell *et al.* 1999, Matthiopoulos *et al*. 2004, Murphy *et al*. 2008). At sea, movements range from short-range return trips from haul-out sites to local foraging areas, to extended journeys between distant haul-out sites. Foraging trips from haul-out sites usually last between two and five days, with seals targeting localised areas generally within 50km of haul-out sites; these areas are typically characterized by a gravel/sand seabed sediment, the preferred burrowing habitat of sandeels, an important component of grey seal diet.

While of relatively low density at a national level, models show grey seal foraging to be widely distributed off the Lincolnshire, Yorkshire and north Norfolk coasts; marine usage appears greater to the north off the Northumberland coast and over the Dogger Bank. However, it is noted that models are based on counts of seals at haul-out sites from 1996-1997; populations of grey seals have increased considerably in the Donna Nook and north Norfolk area since that time, whereas numbers on the Farnes have remained more stable. Therefore, models may underestimate grey seal foraging activity from Donna Nook and north Norfolk relative to adjacent areas to the north.

Table 8.1 shows that in the case of the Humber Estuary SAC, the minimum direct linear range from the SAC boundary to the nearest Block (42/27d) is approximately 50km, giving a propagation loss (assuming 15logR) of around 70dB, or a received sound level of 160dB re 1 μPa p-p for a typical seismic survey. This level is considerably lower than the injury criteria proposed by Southall *et al*. (2007) in pinnipeds for both pulsed and non-pulsed sounds, and also below those proposed for the onset of TTS (postulated as significant behavioural disturbance) for pulsed sounds. With regard to fish, these levels are considerably lower than the levels found by Popper *et al*. (2005) to induce TTS in several fish species.

Seismic survey occurring in the proposed licence Blocks will be audible to seals over a large area of the southern North Sea off the east coast of England, characterised by low-moderate marine usage by foraging grey seals associated with the Humber Estuary SCI and smaller colonies on the Norfolk coast. Marine usage is greatest in the northern part of this region; therefore, seismic survey occurring in Blocks 42/27d and 42/27e will be of greater audibility to grey seals relative to Blocks 48/22, 48/23a and 48/29b. The exact effects which this may have are unknown, although available evidence suggests that significant effects at a population level are unlikely; grey seal populations at Donna Nook and elsewhere around the UK have shown a consistent increasing trend. It is unlikely that seismic survey would be audible to seals within the SCI itself.

Simple calculations of sound propagation can be made to estimate the likely maximum received sound levels at the boundaries of relevant European Sites should a typical seismic survey occur in any one of the Blocks applied for; the results of these are presented in Table 8.1. In the case of the Humber Estuary SAC, the minimum direct linear range from the SAC boundary to the nearest Block (42/27d) is approximately 50km, giving a propagation loss (assuming 15logR) of around 70dB, or a received sound level of 160dB re 1μPa p-p for a typical seismic survey. This level is considerably lower than the injury criteria proposed by Southall *et al.* (2007) in pinnipeds for both pulsed and non-pulsed sounds, and also below those proposed for the onset of TTS (postulated as significant behavioural disturbance) for pulsed sounds. With regard to fish, these levels are considerably lower than the levels found by Popper *et al*. (2005) to induce TTS in several fish species.

Seismic survey occurring in the proposed licence Blocks will be audible to seals over a large area of the southern North Sea off the east coast of England, characterised by low-moderate marine usage by foraging grey seals associated with the Humber Estuary SCI and smaller colonies on the Norfolk coast. Marine usage is greatest in the northern part of this region; therefore, seismic survey occurring in Blocks 42/27d and 42/27e will be of greater audibility to grey seals relative to Blocks 48/22, 48/23a and 48/29b. The exact effects which this may have are unknown, although available evidence suggests that significant effects at a population level are unlikely. It is unlikely that seismic survey would be audible to seals within the SCI itself.

Noise levels suggested to cause auditory damage in phocids are rapidly attenuated with distance from source. For example, based on Southall *et al*.'s (2007) proposed criteria relating to pinnipeds and single pulsed sounds from a typical seismic survey, the range exceeding the injury criteria (onset of PTS) would extend to approximately 10m (p-p) or 1.5km (M-weighted) from source, and for significant behavioural disturbance (onset of TTS) approximately 20m (p-p) or 9km (M-weighted) from source. These ranges do not overlap with the SAC and represent a tiny proportion of the marine areas used by seals associated with European Sites; therefore, disturbance effects beyond site boundaries are not expected to have consequent effects on site integrity. Furthermore, distances over which hearing damage may occur are well within the effective range of the mitigation measures which would be employed to minimise disturbance to marine mammals. Additionally, any future

seismic survey plans would be subject to an extensive source- and site-specific assessment of the potential for adverse effects, including AA.

If significant ecological effects on prey species were to occur, even at considerable distances from the Wash and North Norfolk Coast SAC, these may influence the breeding population of the site. However, noise levels suggested to cause injury to fish (the primary prey species of seals) would not extend beyond a few tens of metres around the noise source. The range over which non-injurious disturbance effects on fish might occur is not possible to define, although available evidence suggests that the extent of any such disturbance of prey species is highly unlikely to have significant effects on relevant qualifying species at a population level.

Qualifying fish species present include the migratory river lamprey and sea lamprey. Sea lamprey inhabit both shallow coastal and deep offshore waters, but migrate into fresh water to spawn. Young river lamprey use the estuarine water of the Humber as a nursery before migrating upstream to freshwater to spawn in the River Derwent and Ouse. Significant propagation of underwater noise into shallow enclosed and semi-enclosed bays and estuaries is not expected, therefore the potential for effects is restricted to sea lamprey occupying marine areas. Considering the low densities of sea lamprey which can be expected in offshore areas, their lack of a swim bladder, and the aforementioned limited range of significant effects of seismic survey on fish, significant effects on qualifying fish species at a population level are unlikely. Furthermore, the potential for impact can be mitigated through timing of seismic survey to avoid the period of lamprey entry into the rivers and consequently significant effects on this qualifying feature can be avoided.

Noise levels associated with other activities potentially resulting from the 25th Licensing Round such as a drilling, vessel movements, pipe-laying operations, are of a considerably lower magnitude than those resulting from seismic survey, and are not expected to have significant effects on relevant qualifying species at a population level.

Riverine SACs

The potential for acoustic disturbance effects was identified for the River Derwent SAC due to presence of migratory lamprey species as qualifying features, which utilise waters of the Humber Estuary as a nursery area (river lamprey) or occupy adjacent coastal and offshore marine areas for part of their life cycle (sea lamprey). Noise associated with activities following licensing of the southern North Sea Blocks will not propagate into the River Derwent SAC and for associated qualifying species occurring beyond the SAC boundaries, as discussed above, significant effects on qualifying fish species at a population level are unlikely.

Adjacent waters SACs

The potential for acoustic disturbance effects was identified for the Doggerbank SAC due to presence of harbour porpoise and harbour seal as qualifying Annex II species, and for the Doggersbank cSAC and the Klaverbank cSAC where harbour porpoise, grey seal and harbour seal are qualifying Annex II species (see Appendix A3). Distances from the closest Blocks applied for and calculations of received sound levels for a given source level are given below.

Table 8.2 - Estimated received sound levels in European Sites in adjacent waters associated with a typical seismic survey

SAC	Closest Block	Minimum distance (km)	Received sound level (dB re 1μPa peak-to-peak)
Doggerbank SAC (Germany)	44/9	105	155
Doggersbank cSAC (Netherlands)	44/9 & 44/19f	7.5	172
Klaverbank cSAC (Netherlands)	44/19f	18	166

Notes: Assumes a source level of 250dB re 1μPa peak-to-peak, a correction factor of -20dB to compensate for horizontal array effects, and a propagation loss of 15log(R). Figures are rounded to the nearest whole number.

Based on Southall *et al*.'s (2007) proposed criteria relating to pinnipeds and single pulsed sounds from a typical seismic survey, the range exceeding the injury criteria (onset of PTS) would extend to approximately 10m (p-p) or 1.5km (M-weighted) from source, and for significant behavioural disturbance (onset of TTS) approximately 20m (p-p) or 9km (M-weighted) from source. These ranges represent a tiny proportion of the marine areas used by seals associated with European Sites; therefore, disturbance effects beyond site boundaries are not expected to have consequent effects on site integrity either through direct effects or on prey.

Simple noise propagation calculations suggest maximum received sound levels at the site boundaries of between 155 and 172 dB re 1μPa p-p for a typical seismic survey occurring in the closest Block (see Table 8.2). These levels are considerably lower than the injury criteria proposed by Southall *et al*. (2007) in cetaceans for both pulsed and non-pulsed sounds, and also below those proposed for the onset of TTS (postulated as significant behavioural disturbance) for pulsed sounds; therefore effects on the integrity of these sites is not predicted.

8.4 Regulation and mitigation

Both planning and operational controls cover acoustic disturbance resulting from activities on the UKCS, specifically including geophysical surveying and pile-driving. Application for consent to conduct seismic and other geophysical surveys is made using *Petroleum Operations Notice No 14* (PON14) supported by an Environmental Narrative to enable an accurate assessment of the environmental effects of the survey. Consultations with Government Departments and other interested parties are conducted prior to issuing consent, and JNCC may request additional risk assessment, specify timing or other constraints, or advise against consent. Any proposed activity with a potentially significant acoustic impact within a designated SAC or SPA would also be subject to the requirement for Appropriate Assessment.

The major operational control and mitigation over seismic surveys in the UK are through JNCC's *Guidelines for minimising the risk of disturbance and injury to marine mammals from seismic surveys* (June 2009 revision to reflect the *Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007* as amended). It is a condition of consents issued under Regulation 4 of the *Petroleum Activities (Conservation of Habitats) Regulations 2001* (& 2007 Amendments) for oil and gas related seismic surveys that the JNCC Seismic Guidelines are followed.

The guidelines require visual monitoring of the area by a dedicated Marine Mammal Observer (MMO) prior to seismic testing to determine if cetaceans are in the vicinity, and a

slow and progressive build-up of sound to enable animals to move away from the source. Passive Acoustic Monitoring (PAM) may also be required. Seismic operators are required, as part of the application process, to justify that their proposed activity is not likely to cause a disturbance etc. under the *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (as amended) and *Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007* (as amended). This assessment should consider all operational activities including shooting during hours of darkness or in poor visibility.

In their latest guidelines, JNCC (2009) advise that operators adopt mitigation measures which are appropriate to minimise the risk of an injury or disturbance offence[4] and stipulate, whenever possible, the implementation of several best practice measure, including:

- only commence seismic activities during the hours of daylight when visual mitigation by MMOs is possible.
- only commence seismic activities during the hours of darkness, or low visibility (including unsuitable sea state for visual mitigation), if an effective PAM system is used. In areas of particular importance for marine mammals, a PAM system should be used during day, night and other poor visibility seismic shooting.
- plan surveys so that the timing will reduce the likelihood of encounters with marine mammals.
- provide trained MMOs to implement the JNCC guidelines.
- use the lowest practicable power levels to achieve the geophysical objectives of the survey.
- seek methods to reduce and/or baffle unnecessary high frequency noise produced by airguns (along with other acoustic energy sources).

8.5 Conclusions

As all blocks under consideration are at least several kilometres from the boundaries of SPAs, direct significant effects on SPAs were not considered possible. Indirect mechanisms of effect, for example through disturbance of prey species, were also considered with the conclusion that these will not have an adverse effect on integrity (i.e. on population viability of qualifying bird species).

Significant effects arising from acoustic disturbance were only considered possible for SACs with marine mammals and fish as a primary or secondary feature. Although seismic survey, drilling and other oil industry noise is detectable by marine mammals, waterbirds and their prey, there is no evidence that such noise presents a risk to the viability of populations in UK waters and specifically not within designated Natura 2000 sites. This would require direct mortality, behavioural response with implications for reproductive success (e.g. disturbance at fixed breeding locations) or reduced long-term ecological viability (e.g. sustained displacement from foraging grounds). In the localised areas of Natura 2000 sites designated for marine mammals, acoustic disturbance from seismic survey activity resulting from proposed licensing would be intermittent and there is no evidence that cumulative effects of previous survey effort have been adverse. Despite considerable scientific effort, no causal link, or reasonable concern in relation to population viability has been found.

Modelling of seismic noise propagation for licensed Blocks in the southern North Sea has generally concluded that effects on the Wash and North Norfolk Coast SAC and Humber Estuary SCI will not be significant. In the case of the Blocks under consideration here, calculations considering the direct linear range to the SAC boundaries and the source level

[4] Defined under Regulation 39 1(a) and 1(b) (respectively) of the *Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007* (as amended)

of a typical seismic survey suggest that received noise levels within all SACs will fall below relevant effects criteria as defined by Southall *et al*. (2007).

Taking into account the information presented above and in the Appendices, it is concluded that activities which could arise from the proposed licensing of Blocks 42/27d, 42/27e, 48/22, 48/23a and 48/29b will not cause an adverse effect on the integrity of the European Sites.

9 IN-COMBINATION EFFECTS

Seismic survey and other noise producing activities that might follow the proposed licensing are anticipated to be widely separated in space and time. Therefore, any acoustic disturbance to marine mammals causing displacement from foraging areas will be short-term and infrequent. SMRU (2007) note that "The effects of repeated surveys are not known, but insignificant transient effects may become important if potentially disturbing activities are repeated and/or intensified". As noted in Section 8.2, the number of seismic surveys is substantially less than historic peaks and as a result significant in-combination effects with gas activities in existing licensed blocks are not foreseen.

Other noise producing activities which are likely to occur within the southern North Sea include those associated with the development of marine renewable energy. Offshore wind energy is expected to undergo large-scale development off the east coast of England and wider southern North Sea over the next decade. In addition to the four constructed offshore wind farms in UK waters of the southern North Sea, consent has been granted to a further 2.5GW of offshore wind energy in the region to be distributed at various sites in the outer Thames area and Greater Wash region (off North Norfolk, Lincolnshire and east Yorkshire). A limited number of these are currently under construction, with works expected to begin at several more in the near future. Additionally, planning applications are under consideration for another 1.5GW with applications expected in 2009 for a further 1.7GW.

In addition to the wind farm developments noted above, following the Offshore Energy SEA, The Crown Estate have entered two Round 3 zonal development agreements for the generation of up to 9 and 4 GW of offshore wind energy respectively. One area lies on the Dogger Bank, approximately overlapping the northern half of the Dogger Bank dSAC; another extends east from approximately 36km east of Flamborough Head to the median line; while the third lies east of Norfolk and Suffolk immediately south of the North Norfolk Sandbanks pSAC. However, the consenting of developments in this area will be subject to detailed project-specific EIA and Habitats Regulations Assessments. The development of offshore wind energy is also taking place in other North Sea nations, with plans for several large developments close to the UK median line, although these will similarly subject to EIA and Habitats Regulations Assessments.

There is currently no infrastructure deployed in the region associated with the extraction of wave and tidal energy, and none is envisaged in the immediate future.

While the operation, maintenance and decommissioning of marine renewable energy developments will introduce noise into the marine environment, these are typically of low intensity. The greatest noise levels arise during the construction phase, and it is these which have the greatest potential for acoustic disturbance effects (see Faber Maunsell & Metoc 2007, DECC 2009). Pile-driving of mono-pile foundations is the principal source of construction noise, which will be qualitatively similar to pile-driving noise resulting from harbour works, bridge construction and oil and gas platform installation. Mono-pile foundations are the most commonly used for offshore windfarm developments at present. In relation to offshore pile-driving, standard conditions on consents for Round 2 offshore wind farms include various protocols to minimise the potential for acoustic disturbance of marine life, including the use of soft start, MMOs and PAM.

Uncertainty exists over the types of foundations which will be utilised by Round 3 developments; a precautionary approach assumes significant use of mono-piles (as assumed in the Offshore Energy SEA), although further development of noise-reduction

measures and alternative foundation types such as jacket, tripod, or gravity bases is anticipated. For future developments, additional measures are likely to be required in areas where EIA suggests that high cetacean densities or site fidelity may occur; these may include technical measures such as pile sleeves (see Nehls *et al*. 2007). The "Statutory nature conservation agency protocol for minimising the risk of disturbance and injury to marine mammals from piling noise" (JNCC 2009) outlines a protocol for the mitigation of potential underwater noise impacts arising from pile driving during offshore wind farm construction.

In addition to those activities which may follow licensing of the southern North Sea Blocks under consideration and future marine renewable energy development, there are a variety of other existing (e.g. gas production, wind turbine deployments, fishing, shipping, military exercise areas, aggregate extraction) and planned (e.g. gas exploration and production) noise-producing activities in overlapping or adjacent areas. Despite this, DECC is not aware of any projects or activities which are likely to cause cumulative or synergistic effects that when taken in-combination with the activities discussed above would adversely affect the integrity of the relevant European Sites. This is due to the presence of effective regulatory mechanisms in place to ensure that operators, DECC and other relevant consenting authorities take such considerations into account during activity permitting. In respect of oil and gas activities and other developments with the potential to affect Natura 2000 sites, these mechanisms also include project specific Habitats Regulations Assessments.

It is noted that the Offshore Energy SEA recommended that operational criteria should be established to limit the cumulative pulse noise "dose" (resulting from seismic survey and offshore pile-driving) within specified areas, which included: areas adjacent to the Farne Islands and Donna Nook (grey seal); the Wash, outer Wash and off the Humber (harbour seal); and, offshore areas of the southern North Sea (harbour porpoise) (DECC 2009).

Potential incremental, cumulative, synergistic and secondary effects from a range of operations, discharges, emissions (including noise), and accidents were considered in the Offshore Energy SEA (DECC 2009; see also OSPAR 2000). Available evidence (see UKBenthos database and OSPAR 2000) for the southern North Sea indicates that past oil and gas activity and discharges has not lead to adverse impacts on the integrity of European sites in the area. The current controls on terrestrial and marine industrial activities, including oil and gas operations that could follow licensing, can be expected to prevent significant in-combination effects affecting relevant European sites.

It is concluded that the in-combination of effects from activities arising from the licensing of Blocks 42/27d, 42/27e, 48/22, 48/23a and 48/29b with those from existing and planned activities in the southern North Sea will not cause an adverse effect on the integrity of the relevant European Sites.

10 CONSIDERATION OF SITES NOT YET SUBMITTED TO THE EC

Annex 1 habitats within the North Norfolk Sandbanks pSAC and Dogger Bank dSAC are sandbanks which are slightly covered by sea water all the times, and *Sabellaria spinulosa* biogenic reefs (North Norfolk Sandbanks). Consideration of vulnerability of these features to oil spills, physical damage and contamination is given below.

The North Norfolk Sandbanks pSAC and Dogger Bank dSAC include existing gas fields and several blocks have been applied for within the indicative boundaries of these sites. Consequently the sites may be affected by a variety of activities, including rig/installation placement and pipelaying, which can result in direct physical damage by abrasion, changes in suspended sediment disturbance and deposits of rock. In view of the large area covered by these sites, the risk of physical loss by removal is remote and subject to assessment and potential mitigation. While local effects are foreseeable, activities that might follow a 25th Licensing Round would modify an extremely small area of these potential European Sites and rapid recovery of such effects has been observed in many similar circumstances. Risks to overall site integrity from gas exploration and production activities would be prevented (mitigated) by the existing legal framework for the respective activities, which includes AA where necessary. It is concluded that activities arising from the proposed 25th Licence Round will not result in an adverse effect on the integrity of the Annex 1 habitat within the North Norfolk Sandbanks pSAC and Dogger Bank dSAC or compromise the integrity of the sites.

Contamination by introduction of synthetic and/or non-synthetic compounds has been noted as a potential threat to the sites. However, current rules effectively mean that only water based drill muds (WBM) would be discharged either on rock cuttings or as excess mud. Around 95% of the constituents of a typical WBM are naturally-occurring (and defined by OSPAR as posing little or no risk to the environment) while remaining chemicals would have low toxicity and bioaccumulation potential. There are strict regulatory controls over the use and discharge of offshore chemicals and toxic or enrichment effects are not envisaged. Dispersion of mud and cuttings is influenced by various factors. The range of cuttings particle size results in a significant variation in settling velocity, and a consequent gradient in the size distribution of settled cuttings, with coarser material close to the discharge location and finer material very widely dispersed away from the location. Extensive monitoring of the ecological effects of discharged WBM cuttings has been carried out in the North and Irish Seas (and internationally) and the consensus view is that any effects are subtle, very localised and transient. In view of the shallow water depths and energetic hydrography of the area the sites are believed to be tolerant of sediment disturbance and discharges of drilling solids. Such materials are an insignificant contribution to the regional sediment budget and do not, in general, accumulate in particular areas.

Oil spills can have potentially adverse effects on the marine environment, and are controlled in direct proportion to this by a legal framework that minimises their occurrence, provides for contingency planning, response and clean up, and which enables prosecutions. It is not credible to conclude that in spite of the regulatory controls, an oil spill will never occur as a result of 25th Round licensing. However, the potential risks of oil spills are mitigated in the southern North Sea by the nature of the hydrocarbons present in those areas (natural gas and condensate), which like diesel fuel, rapidly undergo natural evaporation/dispersion when spilled[5]. Taking into account the risks, controls and mitigating factors, it is concluded that oil

[5] In addition, natural evaporation/dispersion would be expected to have taken place before a slick would approach European Sites on or adjacent to the coast.

spills arising from the proposed 25th Licence Round will not result in an adverse effect on the integrity of these sites.

In conclusion, planning and environmental permitting arrangements covering drilling, pipeline route and development provide effective mechanisms to ensure that these activities do not adversely affect the integrity of the North Norfolk Sandbanks pSAC and Dogger Bank dSAC.

11 OVERALL CONCLUSION

Taking account of all the matters discussed, the Secretary of State is able to grant consent to the plan/programme (as defined) under the Habitats Directive and award the licences covering Blocks 43/13b, 43/14a, 43/15c, 43/17, 43/18, 43/19b, 43/20d, 43/23, 44/7, 44/8, 44/9, 44/11b, 44/12b, 44/16d, 44/19f, 48/8c, 49/7, 49/8b and 49/13 (screened out in Section 4), as well as Blocks 42/27d, 42/27e, 48/22, 48/23a and 48/29b (considered further in Sections 6-9). This is because there is certainty, within the meaning of the ECJ Judgment in the ***Waddenzee*** case, that implementation of the plan will not adversely affect the integrity of relevant European Sites, taking account of the mitigation measures that can be imposed through existing permitting mechanisms on the planning and conduct of activities.

These mitigation measures are incorporated in respect of habitat, diadromous fish, bird and marine mammal interest features through the range of legislation and guidance (see https://www.og.decc.gov.uk/environment/environ_leg_index.htm and https://www.og.decc.gov.uk/regulation/pons/index.htm) which apply to developer activities which could follow plan adoption. These mitigation measures include, where necessary, project-specific Appropriate Assessments based on detailed project proposals which would be undertaken by the competent authority before the granting of a permit/consent. The competent authority needs to be satisfied that the proposed activity will not result in adverse effects on integrity of European/Ramsar sites.

Even where a site/interest feature has been screened out in the plan level assessment, or where a conclusion of no adverse effect on integrity has been reached at plan level, project level assessment will be necessary if, for example, new European/Ramsar sites have been designated after the plan level assessment; new information emerges about the nature and sensitivities of interest features within sites, new information emerges about effects including in-combination effects; or if plan level assumptions have not been met at the project level.

12 REFERENCES

ACOPS (2008). Annual survey of reported discharges attributed to vessels and offshore oil and gas installations operating in the United Kingdom Pollution Control Zone 2007. ACOPS (Advisory Committee on Protection of the Sea) Report to the Maritime and Coastguard Agency, London, 41pp plus appendices.

Berrow S, Holmes B & Goold J (2002). The distribution and intensity of ambient and point source noises in the Shannon estuary. Final report to the Heritage Council. http://www.shannondolphins.ie/downloads/Berrow_SourceNoisesShannonEstuary.pdf

Blackwell SB, Lawson JW & Williams MT (2004). Tolerance by ringed seals (*Phoca hispida*) to impact pipe-driving and construction sounds at an oil production island. *Journal of the Acoustical Society of America* **115**: 2346-2357.

Christian JR, Mathieu A, Thompson DH, White D & Buchanan RA (2003). Effect of seismic energy on snow crab (*Chionoecetes opilio*) 7th November 2003. Environmental Research Funds Report No. 144, Calgary, 106pp

Davis RA, Richardson WW, Thiele L, Dietz R & Johansen P (1991). State of the Arctic Environment report on underwater noise. Arctic Center Publications 2, Finland special issue. *The State of The Arctic Environment Reports*: 154-269.

De Groot SJ & Lindeboom HJ (1994). Environmental impact of bottom gear on benthic fauna in relation to natural resources management and protection of the North Sea. NIOZ Rapport 1994-11, Texel, The Netherlands.

DECC (2008). 25th Seaward Round Block Screening Assessment, November 2008. Department of Energy and Climate Change, 65pp.

DECC (2009). Offshore Energy Strategic Environmental Assessment, Environmental Report. Department of Energy and Climate Change, UK, 307pp plus appendices. http://www.offshore-sea.org.uk/site/scripts/book_info.php?consultationID=16&bookID=11

DFO (2004). Potential impacts of seismic energy on snow crab. DFO (Fisheries and Ocean Canada) Canadian Science Advisory Secretariat. Habitat Status Report 2004/003

EC (1999). Interpretation Manual of European Union habitats. Version EUR 15/2. European Commission (DG Environment), Brussels, 121pp.

EC (2000) Managing NATURA 2000 Sites. The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC, 69pp.

EC (2001). Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites. Methodological Guidance on the provisions of Article 6(3) and 6(4) of the 'Habitats Directive' 92/43/EEC, November 2001, 76pp.

Engås A, Løkkeborg S, Ona E & Soldal AV (1996). Effects of seismic shooting on local abundance and catch rates of cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*). *Canadian Journal of Fisheries and Aquatic Sciences* **53**: 2238-2249.

Faber Maunsell & Metoc (2007). Marine renewables Strategic Environmental Assessment (SEA). Report to The Scottish Government. Faber Maunsell & Metoc, UK.

Gage JD, Roberts JM, Hartley JP & Humphery JD (2005). Potential impacts of deep-sea trawling on the benthic ecosystem along the northern European continental margin: a review. In: PW Barnes & JP Thomas Eds. *Benthic habitats and the effects of fishing*. American Fisheries Society, Symposium 41, Bethesda, Maryland. pp. 503-517.

Goold JC & Fish PJ (1998). Broadband spectra of seismic survey air-gun emissions, with reference to dolphin auditory thresholds. *Journal of Acoustical Society of America* **103**: April 1998

Goold JC (1996). Acoustic assessment of populations of common dolphin, *Delphinus delphis*, in conjunction with seismic surveying. *Journal of the Marine Biological Association of the UK* **76**: 811-820.

Gordon JCD, Gillespie D, Potter J, Frantzis A, Simmonds M & Swift R (1998). The effects of seismic surveys on marine mammals. In: ML Tasker & C Weir Eds. *Proceedings of the Seismic and Marine Mammals Workshop*, 23-25 June 1998, London.

Gundlach ER & Hayes MO (1978). Vulnerability of coastal environments to oil spill impacts. *Marine Technology Society Journal* **12**: 18-27.

Hammond PS, Gordon JCD, Grellier K, Hall AJ, Northridge SP, Thompson D & Harwood J (2001). Background information on marine mammals relevant to SEA 2. Report to the DTI from the Sea Mammal Research Unit, University of St. Andrews, UK, 70pp.

Hammond PS, Gordon JCD, Grellier K, Hall AJ, Northridge SP, Thompson D & Harwood J. (2002). Background information on marine mammals relevant to Strategic Environmental Assessments 2 and 3. Report to the DTI from the Sea Mammal Research Unit, University of St. Andrews, UK, 60pp. plus appendices.

Harris RE, Miller GW & Richardson WJ (2001). Seal responses to airgun sounds during summer seismic surveys in the Alaskan Beaufort Sea. *Marine Mammal Science* **17**: 795-812.

Hassel A, Knutsen T, Dalen J, Skaar, K, Løkkeborg S, Misund OA, Øivind Ø, Fonn M & Haugland EK (2004). Influence of seismic shooting on the lesser sandeel (*Ammodytes marinus*). *ICES Journal of Marine Science* **61**: 1165-1173.

Hastings MC, Popper AN, Finneran JJ & Lanford PJ (1996). Effect of low frequency underwater sound on hair cells of the inner ear and lateral line of the teleost fish *Astronotus ocellatus*. *Journal of the Acoustical Society of America* **99**: 1759-1766.

Hoskin R and Tyldesley D (2006). How the scale of effects on internationally designated nature conservation sites in Britain has been considered in decision making: A review of authoritative decisions. English Nature Research Reports, No 704.

IMO (International Maritime Organisation) GloBallast website (accessed March 2009) http://globallast.imo.org/

JNCC (2009). Annex A - JNCC guidelines for minimising the risk of disturbance and injury to marine mammals from seismic surveys. June 2009. Joint Nature Conservation Committee, Aberdeen, UK, 15pp.

JNCC (Joint Nature Conservation Committee) website (accessed August 2009) http://www.jncc.gov.uk/

Kaiser MJ, Collie JS, Hall SJ, Jennings S & Poiner IR (2002a). Impacts of fishing gear on marine benthic habitats. In: M Sinclair & G Valdimarsson Eds. *Responsible fisheries in the marine ecosystem*. CABI Publishing, Wallingford, pp.197-217.

Kaiser MJ, Collie JS, Hall SJ, Jennings S & Poiner IR (2002b). Modification of marine habitats by trawling activities: prognosis and solutions. *Fish and Fisheries* **3**: 114-133.

Kastak D & Schusterman RJ (1996). Temporary threshold shift in a harbour seal (*Phoca vitulina*). *Journal of the Acoustical Society of America* **100**: 1905-1908.

Kastak D, Schusterman RJ, Southall BL & Reichmuth CJ (1999). Underwater temporary threshold shift induced by octave-band noise in three species of pinnipeds. *Journal of the Acoustical Society of America* **106**: 1142-1148.

Ketten DR (2001). Marine mammal auditory systems: a summary of audiometric and anatomical data and its implications for underwater acoustic impacts. Woods Hole Oceanographic Institution Harvard Medical School.
http://www.solcomhouse.com/auditory.htm

Knudsen FR, Enger PS & Sand O (1994). Avoidance responses to low frequency sound in downstream migrating Atlantic salmon smolt, *Salmo salar*. *Journal of Fish Biology* **45**: 227-233.

Lawson JW, Malme CI & Richardson WJ (2001). Assessment of noise issues relevant to marine mammals near the BP Clair Development. Report to BP from LGL Ltd., Environmental Research Associates and Engineering and Science Services.

Lonergan M, Duck CD, Thompson D, Mackey BL, Cunningham L & Boyd IL (2007). Using sparse survey data to investigate the declining abundance of British harbour seals. *Journal of Zoology* **271**: 261-269.

Matthiopoulos J, McConnell B, Duck C & Fedack M (2004). Using satellite telemetry and aerial counts to estimate space use by grey seals around the British Isles. *Journal of Applied Ecology* **41**: 476-491.

McCauley RD (1994). Seismic surveys. In, Swan, JM, Neff, JM and Young, PC (Eds) Environmental implications of offshore oil and gas developments in Australia. The findings of an independent scientific review. Australian Petroleum Exploration Association, Sydney, NSW. 696pp.

McCauley RD, Fewtrell J & Popper AN (2003). High intensity anthropogenic sound damages fish ears. *Journal of the Acoustical Society of America* **113**: 638-642.

MMS (2004). Geological and geophysical exploration for mineral resources on the Gulf of Mexico Outer Continental Shelf. Final programmatic environmental assessment. Report no. MMS 2004-054. Report to the U.S. Department of the Interior Minerals Management Service, New Orleans, 487pp.
http://www.ocsbbs.com/2004-054.pdf

Moriyasu M, Allain R, Benhalima K & Claytor R (2004). Effects of seismic and marine noise on invertebrates: A literature review. Canadian Science Advisory Secretariat. Research Document 2004/126.

Murphy S, Gordon JCD, McConnell B, Matthiopoulos J, Isojunno S & Hammond PS (2008). Background information on marine mammals for Offshore Strategic Environmental Assessment. Report to the Department of Energy and Climate Change. SMRU Limited, St. Andrews, Scotland, UK, 130pp.

Nedwell J (2005). The dBht(Species); a metric for estimating the behavioural effects of noise on marine species. Proceedings of Underwater Noise Measurement Seminar 13 October 2005, National Physical Laboratory, Teddington.

Nedwell JR & Needham K (2001). Measurement of drill rig noise. Subacoustech Ltd. Report No. 452R0102.

Nedwell JR, Edwards B & Needham K (2002). Noise measurements during pipeline laying operations around the Shetland Islands for the Magnus EOR project. Subacoustech Ltd. Report No. 473R0212.

Nedwell JR, Needham K & Edwards B (2001). Report on measurements of underwater noise from the Jack Bates Drill Rig. Subacoustech Ltd. Report No. 462R0202.

Nehls G, Betke K, Eckelmann S & Ros M (2007). Assessment and costs of potential engineering solutions for the mitigation of the impacts of underwater noise arising from the construction of offshore windfarms. Report to COWRIE Ltd. BioConsult SH report, Husum, Germany, 47pp.

Nowacek DP, Thorne LH, Johnston DW & Tyack PL (2007). Responses of cetaceans to anthropogenic noise. *Mammal Review* **37**: 81-115.

ODPM (2005a). Planning Policy Statement 9: Biodiversity and Geological Conservation. Office of the Deputy Prime Minister, UK, 13pp.

ODPM (2005b). Government circular: Biodiversity and geological conservation - statutory obligations and their impact within the planning system. ODPM Circular 06/2005. Office of the Deputy Prime Minister, UK, 88pp.

OGP & IAGC (International Association of Oil & Gas Producers & International Association of Geophysical Contractors) (2004). Seismic surveys and marine mammals. Joint OGP/IAGC position paper. Houston & London, 12pp.
http://www.anp.gov.br/guias_r8/sismica_r8/Bibliografia/IAGC-OGP%202004%20-%20Joint%20Position%20Paper%20-%20Marine%20Mammals.pdf

OSPAR (2000). Quality Status Report 2000. OSPAR Commission, London.
http://www.ospar.org/eng/html/qsr2000/QSR2000welcome3.htm

Parry GD & Gason A (2006). The effect of seismic surveys on catch rates of rock lobsters in western Victoria, Australia. *Fisheries Research* **79**: 272-284.

Peacock EE, Nelson RK, Solow AR, Warren JD, Baker JL, & Reddy CM (2005). The West Falmouth oil spill: 100 kg of oil persists in marsh sediments. *Environmental Forensics* **6**:273-281.

Popper AN, Fewtrell J, Smith ME & McCauley RD (2003). Anthropogenic sound: Effects on the behavior and physiology of fishes. *Marine Technology Society Journal* **37**: 35-40.

Popper AN, Smith ME, Cott PA, Hanna BW, MacGillivray AO, Austin ME & Mann DA (2005). Effects of exposure to seismic airgun use on hearing of three fish species. *Journal of the Acoustical Society of America* **117**: 3958-3971.

Popper AN, Carlson TJ, Hawkins AD, Southall BJ & Gentry RL (2006). Interim Criteria for Injury of Fish Exposed to Pile Driving Operations: A White Paper. Report to the Fisheries Hydroacoustic Working Group, California Department of Transportation, USA, 15pp.

Reddy CM, Eglinton TI, Hounshell A, White HK, Xu L, Gaines RB & Frysinger GS (2002). The West Falmouth oil spill after thirty years: the persistence of petroleum hydrocarbons in marsh sediments. *Environmental Science and Technology* **36**: 4754 -4760.

Richardson WJ, Greene CR Jr, Malme CI & Thomson DH (1995). *Marine Mammals and Noise.* Academic Press, San Diego, US, 576pp.

Richardson WJ, Greene CR, Hickie JP & Davis RA (1983). Effects of offshore petroleum operations on cold water marine mammals: a literature review. Report prepared for the American Petroleum Institute. API Report No. 4370. Washington, D.C.

SCOS (2007). Scientific advice on matters related to the management of seal populations: 2007. Special Committee on Seals, 93pp.
http://smub.st-and.ac.uk/CurrentResearch.htm/SCOS2003/SCOS%2003_v7.pdf

SCOS (2008). Scientific advice on matters related to the management of seal populations: 2008. Special Committee on Seals, 99pp.
http://www.smru.st-andrews.ac.uk/documents/SCOS_2008_v1.pdf

SEERAD (2000). Nature conservation: implementation in Scotland of EC directives on the conservation of natural habitats and of wild flora and fauna and the conservation of wild birds ("the Habitats and Birds Directives"). June 2000. Revised guidance updating Scottish Office circular no. 6/199.

Sharples RJ, Cunningham L & Hammond PS (2005). Distribution and movement of harbour seals around the UK. Briefing paper by the Sea Mammal Research Unit (SMRU), Gatty Marine Laboratory, University of St Andrews, for the Special Committee on Seals (SCOS) report: Scientific advice on matters related to the management of seal populations, pp.66-69. http://www.scotland.gov.uk/Resource/Doc/921/0020956.pdf

Sharples RJ, Matthiopoulos J & Hammond PS (2008). Distribution and movements of harbour seals around the coast of Britain. Report to the Department of Energy and Climate Change (DECC). Sea Mammal Research Unit, St. Andrews, UK, 65pp.

Simmonds M, Dolman S & Weilgart L (2003). Oceans of Noise. A Whale and Dolphin Conservation Society Science Report.

Skalski JR, Pearson WH & Malme CI (1992). Effects of sounds from a geophysical survey device on catch-per-unit-effort in a hook-and-line fishery for rockfish (*Sebastes* spp.). *Canadian Journal of Fisheries and Aquatic Science* **49**: 1343-1356.

Slotte A, Hansen K, Dalen J & Ona E (2004). Acoustic mapping of pelagic fish distribution and abundance in relation to a seismic shooting area off the Norwegian west coast. *Fisheries Research* **67**: 143-150.

SMRU (2007). Potential impact of oil and gas exploration and development on SACs for bottlenose dolphins and other marine mammals in the Moray Firth and Cardigan Bay/Pembrokeshire. Report to the DTI. Sea Mammal Research Unit, University of St Andrews, Scotland, 13pp.

Southall BL, Bowles AE, Ellison WT, Finneran JJ, Gentry RL, Greene Jr. CR, Kastak D, Ketten DR, Miller JH, Nachtigall PE, Richardson WJ, Thomas JA & Tyack PL (2007). Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals 33: 411-522.

Stemp R (1985). Observations on the effects of seismic exploration on seabirds. In: Greene GD, Engelhardt FR & Paterson RJ (Eds) *Proceedings of the Workshop on Effects of Explosives Use in the Marine Environment*. Jan 29-31, 1985, Halifax, Canada.

Stone CJ & Tasker ML (2006). The effects of seismic airguns on cetaceans in UK waters. *Journal of Cetacean Research and Management* **8**: 255-263.

Stone CJ (2003). The effects of seismic activity on marine mammals in UK waters, 1998-2000. JNCC Report no. 323. Joint Nature Conservation Committee, Peterborough.

Swift RJ & Thompson PM (2000). Identifying potential sources of industrial noise in the Foinaven and Schiehallion region. Report prepared for BP Amoco Exploration, UK Operations, Farburn Industrial Estate, Dyce, Aberdeen, Scotland.

Teal JM & Howarth RW (1984). Oil spill studies: a review of ecological effects. *Environmental Management* **8**: 27-43

Teal JM, Farrington JW, Burns KA, Stegeman JJ, Tripp BW, Woodin B & Phinney C (1992). The West Falmouth oil spill after 20 years: fate of fuel oil compounds and effects on animals. *Marine Pollution Bulletin* **24**: 607-614.

Thompson D, Sjoberg M, Bryant ME, Lovell P & Bjorge A (1998). Behavioural and physiological responses of harbour (*Phoca vitulina*) and grey (*Halichoerus grypus*) seals to seismic surveys. Report the European Commission of BROMMAD Project.

UKOOA (2006). Report on the analysis of DTI UKCS Oil Spill Data from the period 1975-2005. Report to the UK Offshore Operators Association. TINA Consultants. 32pp.

Weilgart LS (2007). The impacts of anthropogenic ocean noise on cetaceans and implications for management. *Canadian Journal of Zoology* **85**: 1091-1116.

Wiese FK, Montevecchi WA, Davoren GK, Huettmann F, Diamond AW & Linke J (2001). Seabirds at risk around offshore oil platforms in the North-west Atlantic. *Marine Pollution Bulletin* **42**: 1285-1290.

Williams JM, Tasker ML, Carter IC & Webb A (1994). Method for assessing seabird vulnerability to surface pollutants. *Ibis* **137**: 147-152.

Witbaard R & Klein R (1993). A method to estimate the bottom trawl intensity independently from fisheries itself by using internal molluscan growth lines. *ICES CM 1993* **K:16**, 8pp.

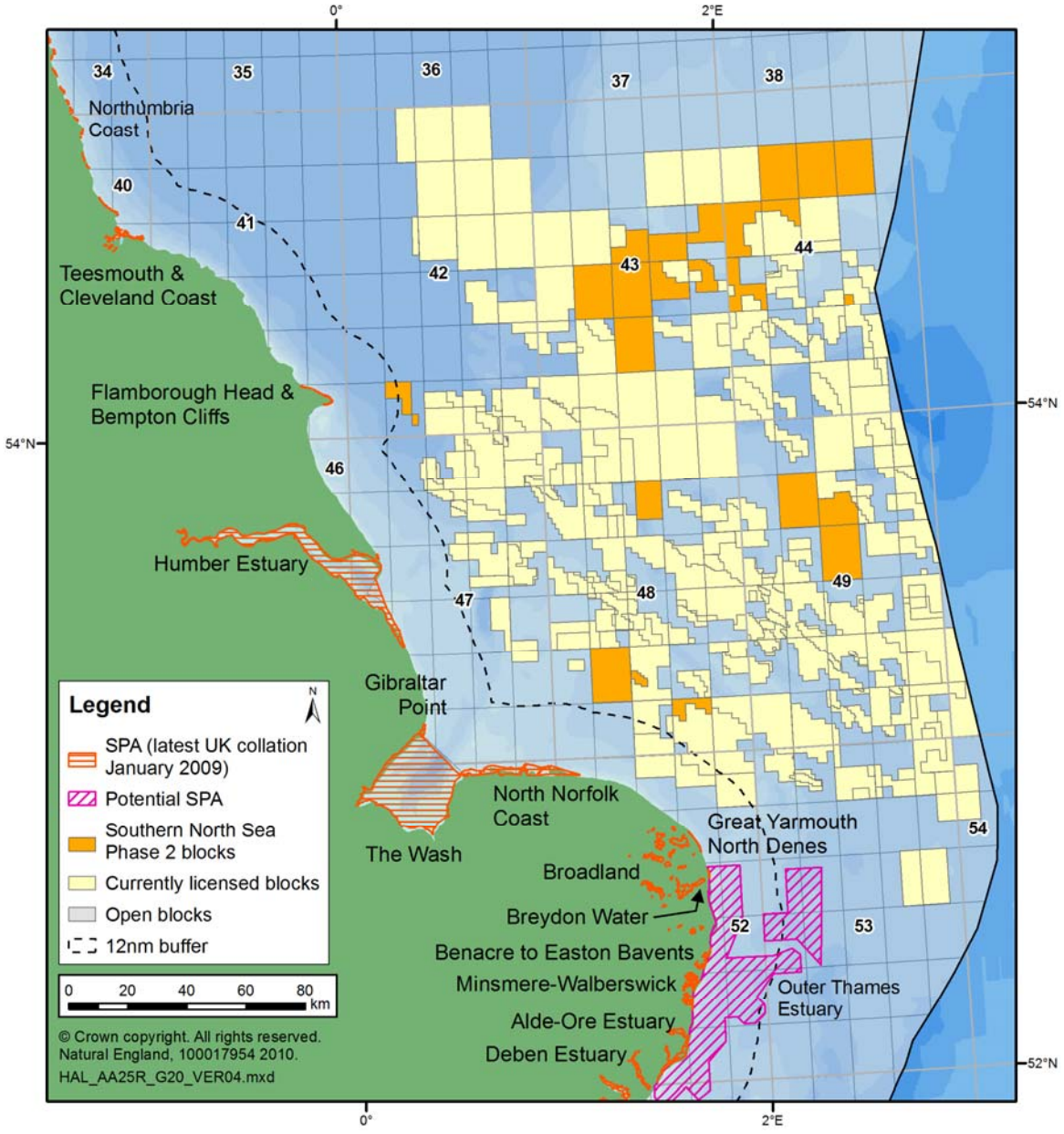
APPENDIX A - THE SITES

The migratory and/or Annex I bird species for which SPAs are selected in the UK are listed in Box A.1, and the SPAs from Northumbria to Suffolk and their qualifying features are given in Table A.1 and their locations shown in the Map A.1.

Abbreviations for the Annex 1 habitats used in SAC site summaries (Tables A.2, A.3 and A.4 and Maps A.2 and A.3) are listed in Box A.2.

A1 Coastal and Marine Special Protection Areas

Map A.1 – Location of Special Protection Areas



Box A.1 - Migratory and/or Annex I bird species for which SPAs are selected in the UK

Divers and grebes
Red-throated diver *Gavia stellata*
Black-throated diver *Gavia arctica*
Little grebe *Tachybaptus ruficollis*
Great crested grebe *Podiceps cristatus*
Slavonian grebe *Podiceps auritus*

Seabirds
Fulmar *Fulmarus glacialis*
Manx shearwater *Puffinus puffinus*
Storm petrel *Hydrobates pelagicus*
Leach's petrel *Oceanodroma leucorhoa*
Gannet *Morus bassanus*
Cormorant *Phalacrocorax carbo carbo*
Shag *Phalacrocorax aristotelis*
Guillemot *Uria aalge*
Razorbill *Alca torda*
Puffin *Fratercula arctica*

Gulls, terns and skuas
Arctic skua *Stercorarius parasiticus*
Great skua *Catharacta skua*
Mediterranean gull *Larus melanocephalus*
Black-headed gull *Larus ridibundus*
Common gull *Larus canus*
Lesser black-backed gull *Larus fuscus*
Herring gull *Larus argentatus*
Great black-backed gull *Larus marinus*
Kittiwake *Rissa tridactyla*
Sandwich tern *Sterna sandvicensis*
Roseate tern *Sterna dougallii*
Common tern *Sterna hirundo*
Arctic tern *Sterna paradisaea*
Little tern *Sterna albifrons*

Crakes and rails
Spotted crake *Porzana porzana*
Corncrake *Crex crex*
Coot *Fulica atra*

Birds of prey and owls
Honey buzzard *Pernis apivorus*
Red kite *Milvus milvus*
Marsh harrier *Circus aeruginosus*
Hen harrier *Circus cyaneus*
Golden eagle *Aquila chrysaetos*
Osprey *Pandion haliaetus*
Merlin *Falco columbarius*
Peregrine *Falco peregrinus*
Short-eared owl *Asio flammeus*

Other bird species
Capercaillie *Tetrao urogallus*
Nightjar *Caprimulgus europaeus*
Woodlark *Lullula arborea*
Fair Isle wren *Troglodytes troglodytes fridariensis*
Aquatic warbler *Acrocephalus paludicola*
Dartford warbler *Sylvia undata*
Chough *Pyrrhocorax pyrrhocorax*
Scottish crossbill *Loxia scotica*

Waders
Oystercatcher *Haematopus ostralegus*
Avocet *Recurvirostra avosetta*
Stone Curlew *Burhinus oedicnemus*
Ringed Plover *Charadrius hiaticula*
Dotterel *Charadrius morinellus*
Golden Plover *Pluvialis apricaria*
Grey Plover *Pluvialis squatarola*
Lapwing *Vanellus vanellus*
Knot *Calidris canutus*
Sanderling *Calidris alba*
Purple Sandpiper *Calidris maritima*
Dunlin *Calidris alpina alpina*
Ruff *Philomachus pugnax*
Snipe *Gallinago gallinago*
Black-tailed Godwit *Limosa limosa* (breeding)
Black-tailed Godwit *Limosa limosa islandica* (non-breeding)
Bar-tailed Godwit *Limosa lapponica*
Whimbrel *Numenius phaeopus*
Curlew *Numenius arquata*
Redshank *Tringa totanus*
Greenshank *Tringa nebularia*
Wood Sandpiper *Tringa glareola*
Turnstone *Arenaria interpres*
Red-necked Phalarope *Phalaropus lobatus*

Waterfowl
Bewick's swan *Cygnus columbianus bewickii*
Whooper swan *Cygnus cygnus*
Bean goose *Anser fabalis*
Pink-footed goose *Anser brachyrhynchus*
Russian white-fronted goose *Anser albifrons albifrons*
Greenland white-fronted goose *Anser albifrons flavirostris*
Icelandic greylag goose *Anser anser*
Greenland barnacle goose *Branta leucopsis*
Svalbard barnacle goose *Branta leucopsis*
Dark-bellied brent goose *Branta bernicla bernicla*
Canadian light-bellied brent goose *Branta bernicla hrota*
Svalbard light-bellied brent goose *Branta bernicla hrota*
Shelduck *Tadorna tadorna*
Wigeon *Anas penelope*
Gadwall *Anas strepera*
Teal *Anas crecca*
Mallard *Anas platyrhynchos*
Pintail *Anas acuta*
Shoveler *Anas clypeata*
Pochard *Aythya ferina*
Tufted duck *Aythya fuligula*
Scaup *Aythya marila*
Eider *Somateria mollissima*
Long-tailed duck *Clangula hyemalis*
Common scoter *Melanitta nigra*
Velvet scoter *Melanitta fusca*
Goldeneye *Bucephala clangula*
Red-breasted merganser *Mergus serrator*
Goosander *Mergus merganser*

Table A.1 - SPAs from Northumbria to Suffolk and their Qualifying Features

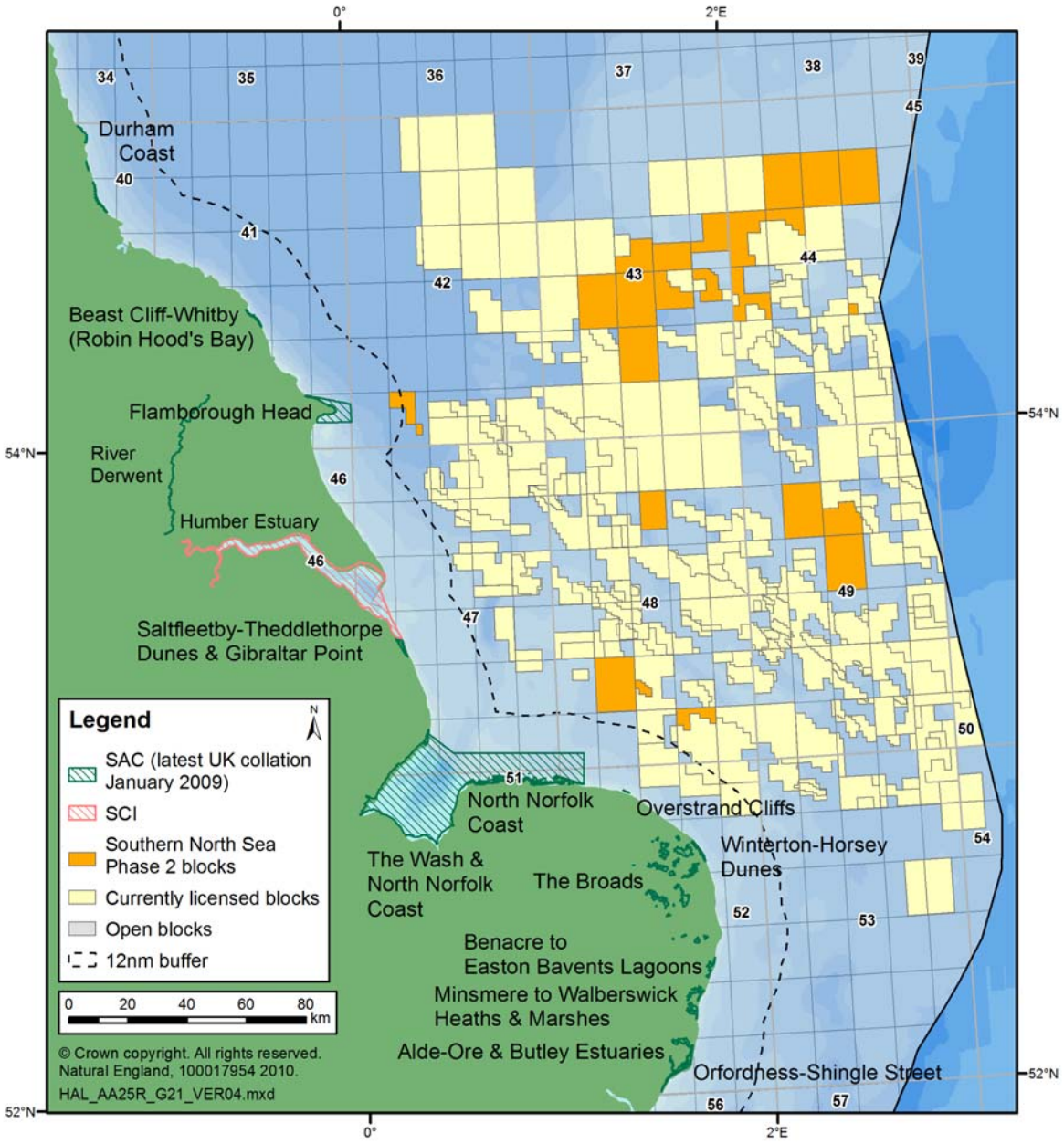
Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages[6]
NORTHEAST ENGLAND				
Northumbria Coast SPA	1107.98	Breeding: Little tern	Over winter: Purple sandpiper Turnstone	N/A
Coquet Island SPA	22.28	Breeding: Arctic tern Common tern Roseate tern Sandwich tern	Breeding: Puffin	Breeding: Seabirds
Teesmouth and Cleveland Coast SPA	1247.31	Breeding: Little tern On passage: Sandwich tern	On passage: Ringed plover Over winter: Knot Redshank	Over winter: Waterfowl
YORKSHIRE AND HUMBER				
Flamborough Head and Bempton Cliffs SPA	212.17	N/A	Breeding: Kittiwake	Breeding: Seabirds
Humber Flats, Marshes and Coast (Phases 1 and 2) SPA	15202.53	Breeding: Little tern Marsh harrier Over winter: Bar-tailed godwit Bittern Golden plover Hen harrier	On passage: Redshank Sanderling Over winter: Dunlin Knot Redshank Shelduck	Over winter: Waterfowl
LINCOLNSHIRE, NORFOLK and SUFFOLK				
Gibraltar Point SPA	414.09	Breeding: Little tern Over winter: Bar-tailed godwit	Over winter: Grey plover Knot	Over winter: Waterfowl
The Wash SPA	62211.66	Breeding: Common tern Little tern Marsh harrier Over winter: Avocet Bar-tailed godwit Golden plover Whooper swan	On passage: Ringed plover Sanderling Over winter: Black-tailed godwit Curlew Dark-bellied brent goose Dunlin Grey plover Knot Oystercatcher Pink-footed goose Pintail Redshank Shelduck Turnstone	Over winter: Waterfowl

[6] - A seabird assemblage of international importance. The area regularly supports at least 20,000 seabirds. Or
- A wetland of international importance. The area regularly supports at least 20,000 waterfowl.

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages[6]
North Norfolk Coast SPA	7886.79	Breeding: Avocet Bittern Common tern Little tern Marsh harrier Mediterranean gull Roseate tern Sandwich tern Over winter: Avocet Bar-tailed godwit Bittern Golden plover Hen harrier Ruff	Breeding: Redshank Ringed plover On passage: Ringed plover Over winter: Dark-bellied brent goose Knot Pink-footed goose Pintail Redshank Wigeon	Over winter: Waterfowl
Broadland SPA	5462.4	Breeding: Bittern Marsh harrier Over winter: Bewick's swan Bittern Ruff Whooper swan	Over winter: Gadwall Pink-footed goose Shoveler	Over winter: Waterfowl
Great Yarmouth North Denes SPA	149.19	Breeding: Little tern	N/A	N/A
Breydon Water SPA	1202.94	Breeding: Common tern Over winter: Avocet Bewick's swan Golden plover	N/A	Over winter: Waterfowl
Benacre to Easton Bavents SPA	516.83	Breeding: Bittern Little tern Marsh harrier Over winter: Bittern	N/A	N/A
Minsmere-Walberswick SPA	2018.92	Breeding: Avocet Bittern Little tern Marsh harrier Nightjar Woodlark Over winter: Avocet Bittern Hen harrier	N/A	N/A
Alde-Ore Estuary SPA	2416.87	Breeding: Avocet Little tern Marsh harrier Sandwich tern Over winter: Avocet	Breeding: Lesser black-backed gull Over winter: Redshank	Breeding: Seabirds Over winter: Waterfowl
Deben Estuary SPA	978.93	Over winter: Avocet	N/A	N/A
Outer Thames Estuary pSPA	393,734.18	Over winter: Red-throated diver	N/A	N/A

A2 Coastal and Marine Special Areas of Conservation

Map A.2 - Location of coastal and marine Special Areas of Conservation



Note: See Map A3 for draft SACs which cross into offshore waters.

Box A.2 - Annex 1 Habitat Abbreviations Used in Site Summaries

Annex I Habitat (abbreviated)	Annex I Habitat(s) (full description)
Bogs	Active raised bogs * Priority feature Blanket bogs * Priority feature Degraded raised bogs still capable of natural regeneration

Annex I Habitat (abbreviated)	Annex I Habitat(s) (full description)
	Depressions on peat substrates of the *Rhynchosporion* Transition mires and quaking bogs
Coastal dunes	Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) Coastal dunes with *Juniperus* spp. Decalcified fixed dunes with *Empetrum nigrum* Dunes with *Hippophae rhamnoides* Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*) Embryonic shifting dunes Fixed dunes with herbaceous vegetation (`grey dunes`) * Priority feature Humid dune slacks Shifting dunes along the shoreline with *Ammophila arenaria* (`white dunes`)
Coastal lagoons	Coastal lagoons *Priority feature
Estuaries	Estuaries
Fens	Alkaline fens Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* * Priority feature Petrifying springs with tufa formation (*Cratoneurion*) * Priority feature
Forest	Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) * Priority feature Old sessile oak woods with *Quercus robur* on sandy plains
Grasslands	Alpine and subalpine calcareous grasslands Calaminarian grasslands of the *Violetalia calaminariae* Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) Semi-natural dry grasslands and scrubland facies: on calcareous substrates (*Festuco-Brometalia*) (important orchid sites) * Priority feature Species-rich *Nardus* grassland, on siliceous substrates in mountain areas (and submountain areas in continental Europe) * Priority feature
Heaths	Alpine and Boreal heaths European dry heaths Northern Atlantic wet heaths with *Erica tetralix*
Inlets and bays	Large shallow inlets and bays
Limestone pavements	Limestone pavements * Priority feature
Machairs	Machairs
Mudflats and sandflats	Mudflats and sandflats not covered by seawater at low tide
Reefs	Reefs
Rocky slopes	Calcareous rocky slopes with chasmophytic vegetation
Running freshwater	Water courses of plain to montane levels with the *Ranunculion fluitantis*

Annex I Habitat (abbreviated)	Annex I Habitat(s) (full description)
	and *Callitricho-Batrachion* vegetation
Salt marshes and salt meadows	Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*) *Salicornia* and other annuals colonising mud and sand *Spartina* swards (*Spartinion maritimae*)
Sandbanks	Sandbanks which are slightly covered by sea water all the time
Scree	Calcareous and calcshist screes of the montane to alpine levels (*Thlaspietea rotundifolii*) Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*)
Scrub (mattoral)	*Juniperus communis* formations on heaths or calcareous grasslands
Sea caves	Submerged or partially submerged sea caves
Sea cliffs	Vegetated sea cliffs of the Atlantic and Baltic coasts
Standing freshwater	Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. Natural dystrophic lakes and ponds Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*
Vegetation of drift lines	Annual vegetation of drift lines
Vegetation of stony banks	Perennial vegetation of stony banks

Table A.2 - SACs from Northumbria to Suffolk and their Qualifying Features

Note: See Table A3 for draft SACs which cross into offshore waters.

Site Name	Area (ha)	Annex 1 Habitat Primary	Annex 1 Habitat Qualifying	Annex II Species Primary	Annex II Species Qualifying
NORTHEAST ENGLAND					
Durham Coast SAC	393.63	Sea cliffs	N/A	N/A	N/A
YORKSHIRE AND THE HUMBER					
Beast Cliff-Whitby (Robin Hood's Bay) SAC	260.2	Sea cliffs	N/A	N/A	N/A
Flamborough Head SAC	6311.96	Reefs Sea cliffs Sea caves	N/A	N/A	N/A
Humber Estuary cSAC	36657.15	Estuaries Mudflats and sandflats	Sandbanks Salt marshes and salt meadows Coastal lagoons Coastal dunes	N/A	River lamprey *Lampetra fluviatilis* Sea lamprey *Petromyzon marinus* Grey seal *Halichoerus grypus*

Site Name	Area (ha)	Annex 1 Habitat Primary	Annex 1 Habitat Qualifying	Annex II Species Primary	Annex II Species Qualifying
LINCOLNSHIRE, NORFOLK AND SUFFOLK					
Saltfleetby - Theddlethorpe Dunes and Gibraltar Point SAC	960.2	Coastal dunes	Coastal dunes	N/A	N/A
The Wash and North Norfolk Coast SAC	107761.28	Sandbanks Mudflats and sandflats Inlets and bays Reefs Salt marshes and salt meadows	Coastal lagoons	Common seal *Phoca vitulina*	Otter *Lutra lutra*
North Norfolk Coast SAC	3207.37	Coastal lagoons Vegetation of stony banks Salt marshes and salt meadows Coastal dunes			Otter *Lutra lutra* Petalwort *Petalophyllum ralfsii*
Overstrand Cliffs SAC	30.02	Sea cliffs	N/A	N/A	N/A
The Broads SAC	5865.6	Standing freshwater Bog Fens Forests	Grasslands	Desmoulin`s whorl snail *Vertigo moulinsiana* Fen orchid *Liparis loeselii*	Otter *Lutra lutra*
Winterton-Horsey Dunes SAC	425.94	Coastal dunes	Coastal dunes	N/A	N/A
Benacre to Easton Bavents Lagoons SAC	366.93	Coastal lagoons	N/A	N/A	N/A
Minsmere to Walberswick Heaths and Marshes SAC	1265.52	Vegetation of drift lines Heath	Vegetation of stony banks	N/A	N/A
Alde, Ore and Butley Estuaries SAC	1561.53	Estuaries	Mudflats and sandflats Salt marshes and salt meadows	N/A	N/A
Orfordness-Shingle Street SAC	901.19	Coastal lagoons Vegetation of drift lines Vegetation of stony banks	N/A	N/A	N/A

A3 Offshore Special Areas of Conservation

Map A.3 – Location of offshore Special Areas of Conservation

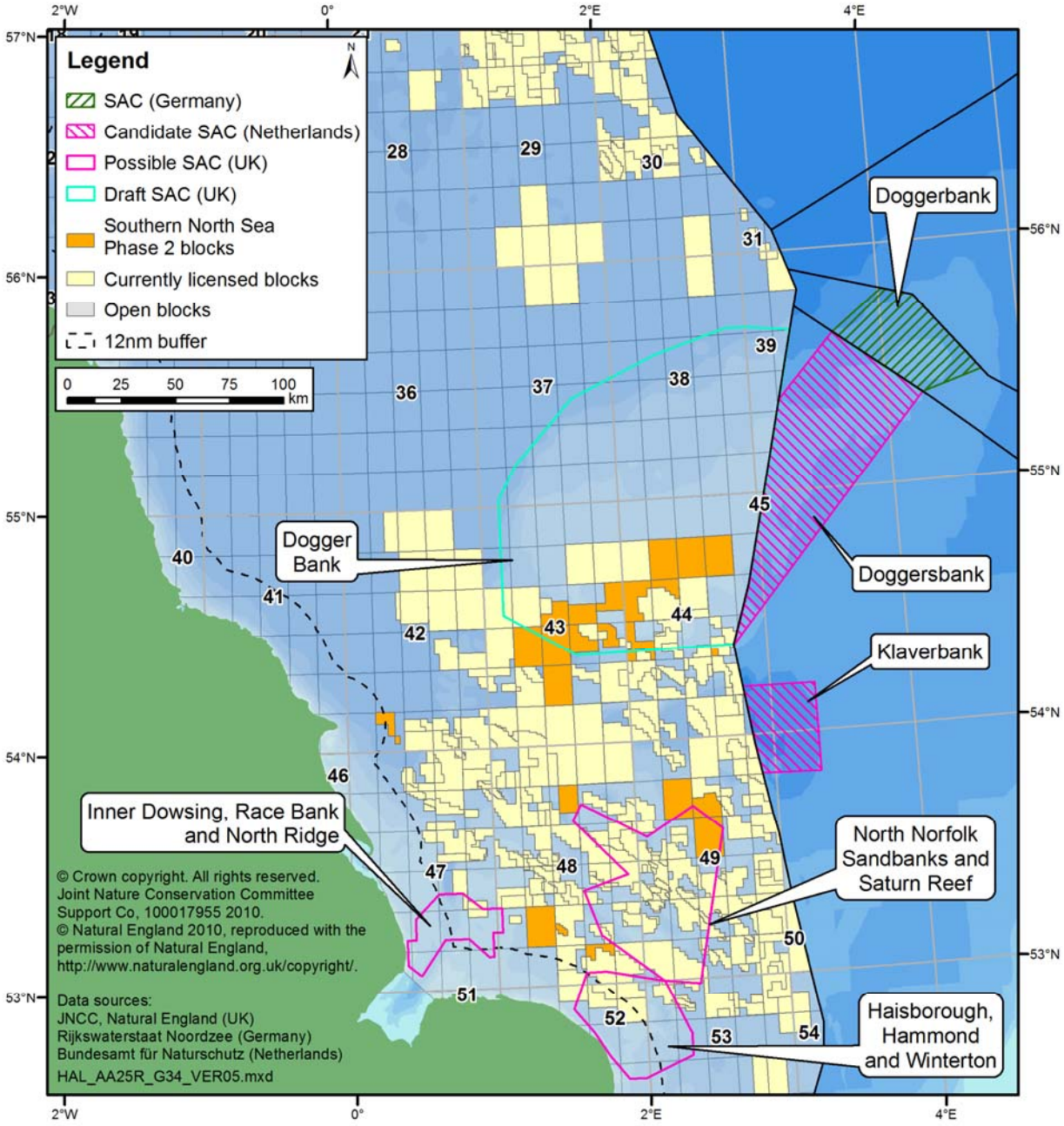


Table A.3 - Offshore SACs in the Southern North Sea and their Qualifying Features

Site Name	Area (ha)	Annex I Habitat	Annex II Species
Doggerbank SAC (Germany)	169,895	Sandbanks	Harbour porpoise *Phocoena phocoena* Harbour seal *Phoca vitulina*
Doggersbank cSAC (Netherlands)	471,772	Sandbanks	Harbour porpoise *Phocoena phocoena* Harbour seal *Phoca vitulina* Grey seal *Halichoerus grypus*

Site Name	Area (ha)	Annex I Habitat	Annex II Species
Klaverbank cSAC (Netherlands)	123,764	Reefs	Harbour porpoise *Phocoena phocoena* Harbour seal *Phoca vitulina* Grey seal *Halichoerus grypus*
Dogger Bank dSAC	1,505,712	Sandbanks	N/A
North Norfolk Sandbanks and Saturn Reef pSAC	360,341	Sandbanks Reefs (biogenic *Sabellaria spinulosa*)	N/A
Inner Dowsing, Race Bank and North Ridge dSAC	90,606.49	Sandbanks Reefs	N/A
Haisborough, Hammond and Winterton dSAC	184,694.86	Sandbanks	N/A

A4 Riverine Special Areas of Conservation

In addition to the mapped SACs, the following riverine SACs designated for migratory fish and/or the freshwater pearl mussel are also considered.

Table A.4 - Relevant riverine SACs designated for migratory fish and/or the freshwater pearl mussel

Site Name	Freshwater pearl mussel *Margaritifera margaritifera*	Migratory fish[1]
River Derwent	-	SL, RL

[1] *SL - Sea lamprey Petromyzon marinus, RL - River lamprey Lampetra fluviatilis, AS - Atlantic salmon Salmo salar*

APPENDIX B – SCREENING TABLES FOR IDENTIFICATION OF POTENTIAL EFFECTS ON THE SITES

B1 Coastal and marine Special Protection Areas

Site name	Features present[1]			Vulnerability to effects[2]				Consideration
	Breeding	Wintering	Passage	Oil spills	Physical Disturbance	Acoustic Disturbance	In-combination	
NORTHEAST ENGLAND								
Northumbria Coast	✓	✓	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.
Coquet Island	✓	-	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.
Teesmouth and Cleveland Coast	✓	✓	✓	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.
YORKSHIRE AND THE HUMBER								
Flamborough Head and Bempton Cliffs	✓	-	-	✓	-	-	-	Site integrity would not be affected by emissions or discharges from routine operations. In the unlikely event of a major diesel oil spill from Block 42/27d, weathered spilled diesel oil could theoretically affect the features present, although mitigation would be possible. Such mitigation measures would be defined by subsequent Habitats Regulations Assessment once project plans are known.
Humber Flats, Marshes and Coast (Phases 1 and 2)	✓	✓	✓	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.
LINCOLNSHIRE, NORFOLK AND SUFFOLK								
Gibraltar Point	✓	✓	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by

Site name	Features present[1]			Vulnerability to effects[2]				Consideration
	Breeding	Wintering	Passage	Oil spills	Physical Disturbance	Acoustic Disturbance	In-combination	
								emissions or discharges from routine operations or accidental spills.
The Wash	✓	✓	✓	✓	-	-	-	Site is remote from blocks and its integrity would not be directly affected by emissions or discharges from routine operations or accidental spills. However, its ecology is intimately linked with the adjacent North Norfolk Coast SPA, where the potential for effects have been identified (see below). In the unlikely event of a major diesel oil spill from Block 48/22, weathered spilled diesel oil could theoretically affect the qualifying features (over-wintering waterfowl and breeding terns) when foraging in adjacent areas beyond the site boundaries. However, mitigation would be possible.
North Norfolk Coast	✓	✓	✓	✓	-	-	-	Site integrity would not be affected by emissions or discharges from routine operations. In the unlikely event of a major diesel oil spill from Block 48/22, weathered spilled diesel oil could theoretically affect the features present, although mitigation would be possible. Such mitigation measures would be defined by subsequent Habitats Regulations Assessment once project plans are known.
Broadland	✓	✓	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.
Great Yarmouth and North Denes	✓	-	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.
Breydon Water	✓	✓	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.
Benacre to Easton Bavents	✓	✓	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental

Site name	Features present[1]			Vulnerability to effects[2]				Consideration
	Breeding	Wintering	Passage	Oil spills	Physical Disturbance	Acoustic Disturbance	In-combination	
								spills.
Minsmere-Walberswick	✓	✓	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.
Alde-Ore Estuary	✓	✓	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.
Deben Estuary	-	✓	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.
Outer Thames	-	✓	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.

Notes: 1 ✓ denotes feature present; 2 ✓ denotes vulnerability to effect

B2 Coastal and marine Special Areas of Conservation

Site name	Features present[1]		Effects[2]				Consideration
	Habitats	Species	Oil spills[3]	Physical Disturbance	Acoustic Disturbance	In-combination	
NORTHEAST ENGLAND							
Durham Coast	✓	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.
YORKSHIRE AND THE HUMBER							
Beast Cliff-Whitby (Robin Hood'sBay)	✓	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.
Flamborough Head	✓	-	-	-	-	-	Due to nature of feature(s) present, site integrity would not be affected by emissions or discharges from routine operations or accidental spills.
Humber Estuary	✓	✓	-	-	✓	✓	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills. Certain activities (i.e. seismic survey) may cause temporary acoustic disturbance to the species features (grey seal and migratory fish), although effects on site integrity are unlikely. It is noted that this site could potentially be influenced by offshore wind energy developments off the east coast of England.
LINCOLNSHIRE, NORFOLK AND SUFFOLK							
Saltfleetby - Theddlethorpe Dunes and Gibraltar Point	✓	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.
The Wash and North Norfolk Coast	✓	✓	✓	-	✓	✓	Site integrity would not be affected by emissions or discharges from routine operations. Certain activities (i.e. seismic survey) may cause temporary acoustic disturbance to the species features (common seal and otter), although effects on site integrity are unlikely. In the unlikely event of a major diesel oil spill from Block 48/22, weathered spilled diesel oil could theoretically affect several habitat and species features, although mitigation would be possible. Such mitigation

Site name	Features present[1]		Effects[2]				Consideration
	Habitats	Species	Oil spills[3]	Physical Disturbance	Acoustic Disturbance	In-combination	
							measures would be defined by subsequent Habitats Regulations Assessment once project plans are known. It is noted that this site could potentially be influenced by offshore wind energy developments off the east coast of England.
North Norfolk Coast	✓	✓	✓	-	-	-	Site integrity would not be affected by emissions or discharges from routine operations. In the unlikely event of a major diesel oil spill from Block 48/22, weathered spilled diesel oil could theoretically affect several habitat and species features, although mitigation would be possible. Such mitigation measures would be defined by subsequent Habitats Regulations Assessment once project plans are known.
Overstrand Cliffs	✓	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.
The Broads	✓	✓	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.
Winterton-Horsey Dunes	✓	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.
Benacre to Easton Bavents Lagoons	✓	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.
Minsmere to Walberswick Heaths and Marshes	✓	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.
Alde, Ore and Butley Estuaries	✓	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.
Orfordness-Shingle Street	✓	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.

Notes: [1] ✓denotes feature present; [2] ✓denotes vulnerability to effect; [3] including diesel and/or lube oil

B3 Offshore Special Areas of Conservation

Site name	Features present[1]		Effects[2]				Consideration
	Habitats	Species	Oil spills[3]	Physical Disturbance	Acoustic Disturbance	In-combination	
Doggerbank SAC	✓	✓	-	-	✓	✓	Site is remote from blocks (some 25km from UK median line) and its integrity would not be affected by emissions or discharges from routine operations or accidental spills. Certain activities (i.e. seismic survey) may be detectable within site boundaries.
Doggersbank cSAC	✓	✓	✓	-	✓	✓	Site abuts the UK median line but is several kilometres from the blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills. Seismic survey noise may be detectable within site boundaries.
Klaverbank cSAC	✓	✓	-	-	✓	✓	Site abuts the UK median line but is several kilometres from the blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills. Seismic survey noise may be detectable within site boundaries.
Dogger Bank dSAC	✓	N/A	✓	✓	-	✓	Site boundary and qualifying features not yet defined, several blocks are located in indicative boundary; although mitigation of effects is possible. Such mitigation measures would be defined by subsequent Habitats Regulations Assessment once project plans are known.
North Norfolk Sandbanks and Saturn Reef pSAC	✓	N/A	✓	✓	-	✓	Several blocks are located within site boundary; although mitigation of effects is possible.
Inner Dowsing, Race Bank and North Ridge	✓	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.
Haisborough, Hammond and Winterton	✓	-	-	-	-	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills.

Notes: [1] ✓denotes feature present; [2] ✓denotes vulnerability to effect; [3] including diesel and/or lube oil

B4 Riverine Special Areas of Conservation

Site name	Features present[1]		Effects[2]				Consideration
	Habitats	Species	Oil spills[3]	Physical Disturbance	Acoustic Disturbance	In-combination	
River Derwent	✓	✓	-	-	✓	-	Site is remote from blocks and its integrity would not be affected by emissions or discharges from routine operations or accidental spills. Certain activities (i.e. seismic survey) may cause temporary acoustic disturbance to the species features (river and sea lamprey) outside of the site boundaries, although mitigation would be possible. Such mitigation measures would be defined by subsequent Habitats Regulations Assessment once project plans are known.

Notes: [1] ✓denotes feature present; [2] ✓denotes vulnerability to effect; [3] including diesel and/or lube oil

APPENDIX C – DETAILED INFORMATION ON NATURA 2000 SITES WHERE THE POTENTIAL FOR EFFECTS HAVE BEEN IDENTIFIED

C1 Coastal and marine Special Protection Areas

Site Name: Flamborough Head and Bempton Cliffs SPA	
Location	Grid Ref: TA233723 (central point) Latitude 54º 07'55"N Longitude 00º 06'48"W
Area (ha)	212.17
Summary	Flamborough Head is located on the east coast of Yorkshire. The cliffs project into the North Sea, rising to 135 m at Bempton, exposing a wide section of chalk strata. The cliff-top vegetation comprises maritime grassland species alongside species more typical of chalk grassland. The site supports large numbers of breeding seabirds including kittiwake *Rissa tridactyla* and auks, as well as the only mainland-breeding colony of gannet *Morus bassanus* in the UK. The seabirds feed and raft in the waters around the cliffs, outside the SPA, as well as feeding more distantly in the North Sea. The intertidal chalk platforms are also used as roosting sites, particularly at low water and notably by juvenile kittiwakes.
Qualifying features for which the site is designated:	
Under Article 4.2 of the Directive (79/409/EEC) by supporting populations of European importance of the following migratory species: **During the breeding season:** Kittiwake *Rissa tridactyla*, 83,370 pairs representing at least 2.6% of the Eastern Atlantic breeding population (as of 1987). ***Under Article 4.2 of the Directive (79/409/EEC) by regularly supporting at least 20,000 seabirds Assemblage qualification: A seabird assemblage of international importance.*** During the breeding season, the area regularly supports 305,784 individual seabirds including: Puffin *Fratercula arctica*, razorbill *Alca torda*, guillemot *Uria aalge*, herring gull *Larus argentatus*, gannet *Morus bassanus*, kittiwake *Rissa tridactyla*.	
Conservation objectives:	
To avoid deterioration of the habitats of the qualifying species (listed above) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and to ensure for the qualifying species that the following are maintained in the long term: • Population of the species as a viable component of the site • Distribution of the species within site • Distribution and extent of habitats supporting the species • Structure, function and supporting processes of habitats supporting the species • No significant disturbance of the species	

Site Name: North Norfolk Coast SPA	
Location	Grid Ref: TF745446 (central point) Latitude 52º 58'13"N Longitude 00º 35'55"E
Area (ha)	7886.79
Summary	The North Norfolk Coast SPA encompasses much of the northern coastline of Norfolk in eastern England. It is a low-lying barrier coast that includes a great variety of coastal habitats. The main habitats, found along the whole coastline, include extensive intertidal sand and mudflats, saltmarshes, shingle and sand dunes, together with areas of freshwater grazing marsh and reedbed, which has developed in front of rising land. The site contains some of the best examples of saltmarsh in Europe. The great diversity of high-quality freshwater, intertidal and marine habitats results in very large numbers of waterbirds occurring throughout the year. In summer, the site holds large breeding populations of waders, four species of terns, bittern and wetland raptors such as marsh harrier. In winter, the coast is used by very large numbers of geese, seaducks, other ducks and waders. The coast is also of major importance for staging waterbirds in the spring and autumn migration periods. Breeding terns, particularly sandwich tern, and wintering seaducks regularly feed outside the SPA in adjacent coastal waters. To the west, the coastal habitats of North Norfolk Coast SPA are continuous with the Wash SPA, with which area the ecology of this site is intimately linked.
Qualifying features for which the site is designated:	

Under Article 4.1 of the Directive (79/409/EEC) by supporting populations of European importance of the following species listed on Annex I of the Directive:

During the breeding season:
Avocet *Recurvirostra avosetta*, 177 pairs representing at least 30.0% of the breeding population in Great Britain (Count as at 1998)

Bittern *Botaurus stellaris*, 3 individuals representing at least 15.0% of the breeding population in Great Britain (Count as at 1998)

Common tern *Sterna hirundo*, 460 pairs representing at least 3.7% of the breeding population in Great Britain (Count as at 1996)

Little tern *Sterna albifrons*, 377 pairs representing at least 15.7% of the breeding population in Great Britain (5 year mean 1994-1998)

Marsh harrier *Circus aeruginosus*, 14 pairs representing at least 8.8% of the breeding population in Great Britain (Count as at 1995)

Mediterranean gull *Larus melanocephalus*, 2 pairs representing at least 20.0% of the breeding population in Great Britain (Count as at 1996)

Roseate tern *Sterna dougallii*, 2 pairs representing at least 3.3% of the breeding population in Great Britain (5 year mean 1994-1998)

Sandwich tern *Sterna sandvicensis*, 3,457 pairs representing at least 24.7% of the breeding population in Great Britain (5 year mean 1994-1998)

Over winter:
Avocet *Recurvirostra avosetta*, 153 individuals representing at least 12.0% of the wintering population in Great Britain (Count as at 1997/8)

Bar-tailed godwit *Limosa lapponica*, 1,236 individuals representing at least 2.3% of the wintering population in Great Britain (5 year peak mean 1991/2 - 1995/6)

Bittern *Botaurus stellaris*, 5 individuals representing at least 5.0% of the wintering population in Great Britain (5 year peak mean 1993/4 - 1998/9)

Golden plover *Pluvialis apricaria*, 2,667 individuals representing at least 1.1% of the wintering population in Great Britain (5 year peak mean 1991/2 - 1995/6)

Hen harrier *Circus cyaneus*, 16 individuals representing at least 2.1% of the wintering population in Great Britain

Site Name: North Norfolk Coast SPA

(5 year mean 1993/4-1997/8)

Ruff *Philomachus pugnax*, 54 individuals representing at least 7.7% of the wintering population in Great Britain (5 year peak mean 1993/4 - 1998/9)

This site also qualifies under Article 4.2 of the Directive (79/409/EEC) by supporting populations of European importance of the following migratory species:

During the breeding season:
Redshank *Tringa totanus*, 700 pairs representing at least 1.2% of the breeding Eastern Atlantic - wintering population (Count as at 1998)

Ringed plover *Charadrius hiaticula*, 220 pairs representing at least 1.4% of the breeding Europe/Northern Africa - wintering population (Count as at 1998)

On passage:
Ringed plover *Charadrius hiaticula*, 1,256 individuals representing at least 2.5% of the Europe/Northern Africa - wintering population (5 year peak mean 1994/5 - 1998/9)

Over winter:
Dark-bellied brent goose *Branta bernicla bernicla*, 11,512 individuals representing at least 3.8% of the wintering Western Siberia/Western Europe population (5 year peak mean 1991/2 - 1995/6)

Knot *Calidris canutus*, 10,801 individuals representing at least 3.1% of the wintering Northeastern Canada/Greenland/Iceland/Northwestern Europe population (5 year peak mean 1991/2 - 1995/6)

Pink-footed goose *Anser brachyrhynchus*, 23,802 individuals representing at least 10.6% of the wintering Eastern Greenland/Iceland/UK population (5 year peak mean 1991/2 - 1995/6)

Pintail *Anas acuta*, 1,139 individuals representing at least 1.9% of the wintering Northwestern Europe population (5 year peak mean 1991/2 - 1995/6)

Redshank *Tringa totanus*, 2,998 individuals representing at least 2.0% of the wintering Eastern Atlantic - wintering population (5 year peak mean 1993/4 - 1997/8)

Wigeon *Anas penelope*, 14,039 individuals representing at least 1.1% of the wintering Western Siberia/Northwestern/Northeastern Europe population (5 year peak mean 1991/2 - 1995/6)

Under Article 4.2 of the Directive (79/409/EEC) by regularly supporting at least 20,000 waterfowl Assemblage qualification: A wetland of international importance.

Over winter, the area regularly supports 91,249 individual waterfowl (5 year peak mean 1991/2 - 1995/6) including: shelduck *Tadorna tadorna*, avocet *Recurvirostra avosetta*, golden plover *Pluvialis apricaria*, ruff *Philomachus pugnax*, bar-tailed godwit *Limosa lapponica*, pink-footed goose *Anser brachyrhynchus*, dark-bellied brent goose *Branta bernicla bernicla*, wigeon *Anas penelope*, pintail *Anas acuta*, knot *Calidris canutus*, redshank *Tringa totanus*, bittern *Botaurus stellaris*, white-fronted goose *Anser albifrons albifrons*, dunlin *Calidris alpina alpina*, gadwall *Anas strepera*, teal *Anas crecca*, shoveler *Anas clypeata*, common scoter *Melanitta nigra*, velvet scoter *Melanitta fusca*, oystercatcher *Haematopus ostralegus*, ringed plover *Charadrius hiaticula*, grey plover *Pluvialis squatarola*, lapwing *Vanellus vanellus*, sanderling *Calidris alba*, cormorant *Phalacrocorax carbo*.

Conservation objectives:

To avoid deterioration of the habitats of the qualifying species (listed above) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and to ensure for the qualifying species that the following are maintained in the long term:

- Population of the species as a viable component of the site
- Distribution of the species within site
- Distribution and extent of habitats supporting the species
- Structure, function and supporting processes of habitats supporting the species
- No significant disturbance of the species

Site Name: The Wash SPA	
Location	Grid Ref: TF537403 (central point) Latitude 52º 56'16"N Longitude 00º 17'12"E
Area (ha)	62211.66
Summary	The Wash is the largest estuarine system in the UK. It is fed by the rivers Witham, Welland, Nene and Great Ouse that drain much of the east Midlands of England. The Wash comprises very extensive saltmarshes, major intertidal banks of sand and mud, shallow waters and deep channels. The eastern end of the site includes low chalk cliffs at Hunstanton. In addition, on the eastern side, the gravel pits at Snettisham are an important high-tide roost for waders. The intertidal flats have a rich invertebrate fauna and colonising beds of glasswort which are important food sources for the large numbers of waterbirds dependent on the site. The sheltered nature of the Wash creates suitable breeding conditions for shellfish, principally mussel, cockle and shrimps. These are important food sources for some waterbirds such as oystercatchers. The Wash is of outstanding importance for a large number of geese, ducks and waders, both in spring and autumn migration periods, as well as through the winter. The SPA is especially notable for supporting a very large proportion (over half) of the total population of Canada/Greenland breeding knot. In summer, the Wash is an important breeding area for terns and as a feeding area for marsh harrier that breed just outside the SPA. To the north, the coastal habitats of the Wash are continuous with Gibraltar Point SPA, whilst to the east the Wash adjoins the North Norfolk Coast SPA.

Qualifying features for which the site is designated:

Under Article 4.1 of the Directive (79/409/EEC) by supporting populations of European importance of the following species listed on Annex I of the Directive:

During the breeding season:
Common tern *Sterna hirundo*, 152 pairs representing at least 1.2% of the breeding population in Great Britain (Count as at 1993)

Little tern *Sterna albifrons*, 33 pairs representing at least 1.4% of the breeding population in Great Britain (5 year mean 1992-1996)

Marsh harrier *Circus aeruginosus*, 15 pairs representing at least 9.4% of the breeding population in Great Britain (Count as at 1995)

Over winter:
Avocet *Recurvirostra avosetta*, 110 individuals representing at least 8.7% of the wintering population in Great Britain (5 year peak mean 1991/2 - 1995/6)

Bar-tailed godwit *Limosa lapponica*, 11,250 individuals representing at least 21.2% of the wintering population in Great Britain (5 year peak mean 1991/2 - 1995/6)

Golden plover *Pluvialis apricaria*, 11,037 individuals representing at least 4.4% of the wintering population in Great Britain (5 year peak mean 1991/2 - 1995/6)

Whooper swan *Cygnus cygnus,* 68 individuals representing at least 1.2% of the wintering population in Great Britain (5 year peak mean 1991/2 - 1995/6)

This site also qualifies under Article 4.2 of the Directive (79/409/EEC) by supporting populations of European importance of the following migratory species:

On passage:
Ringed plover *Charadrius hiaticula*, 1,185 individuals representing at least 2.4% of the Europe/Northern Africa - wintering population (5 year peak mean 1991/2 - 1995/6)

Sanderling *Calidris alba*, 1,854 individuals representing at least 1.9% of the Eastern Atlantic/Western & Southern Africa - wintering population (2 year mean Aug 1994 - 1995)

Over winter:
Black-tailed godwit *Limosa limosa islandica*, 859 individuals representing at least 1.2% of the wintering Iceland - breeding population (5 year peak mean 1991/2 - 1995/6)

Site Name: The Wash SPA
Curlew *Numenius arquata*, 3,835 individuals representing at least 1.1% of the wintering Europe - breeding population (5 year peak mean 1991/2 - 1995/6) Dark-bellied brent goose *Branta bernicla bernicla*, 22,248 individuals representing at least 7.4% of the wintering Western Siberia/Western Europe population (5 year peak mean 1991/2 - 1995/6) Dunlin *Calidris alpina alpina*, 35,620 individuals representing at least 2.5% of the wintering Northern Siberia/Europe/Western Africa population (5 year peak mean 1991/2 - 1995/6) Grey plover *Pluvialis squatarola*, 9,708 individuals representing at least 6.5% of the wintering Eastern Atlantic - wintering population (5 year peak mean 1991/2 - 1995/6) Knot *Calidris canutus*, 186,892 individuals representing at least 53.4% of the wintering Northeastern Canada/Greenland/Iceland/Northwestern Europe population (5 year peak mean 1991/2 - 1995/6) Oystercatcher *Haematopus ostralegus*, 25,651 individuals representing at least 2.9% of the wintering Europe & Northern/Western Africa population (5 year peak mean 1991/2 - 1995/6) Pink-footed goose *Anser brachyrhynchus*, 33,265 individuals representing at least 14.8% of the wintering Eastern Greenland/Iceland/UK population (5 year peak mean 1991/2 - 1995/6) Pintail *Anas acuta*, 923 individuals representing at least 1.5% of the wintering Northwestern Europe population (5 year peak mean 1991/2 - 1995/6) Redshank *Tringa totanus*, 2,953 individuals representing at least 2.0% of the wintering Eastern Atlantic - wintering population (5 year peak mean 1991/2 - 1995/6) Shelduck *Tadorna tadorna*, 15,981 individuals representing at least 5.3% of the wintering Northwestern Europe population (5 year peak mean 1991/2 - 1995/6) Turnstone *Arenaria interpres*, 717 individuals representing at least 1.0% of the wintering Western Palearctic - wintering population (5 year peak mean 1991/2 - 1995/6)
Under Article 4.2 of the Directive (79/409/EEC) by regularly supporting at least 20,000 waterfowl Assemblage qualification: A wetland of international importance. Over winter, the area regularly supports 400,273 individual waterfowl (5 year peak mean 1991/2 - 1995/6) including: black-tailed godwit *Limosa limosa islandica*, avocet *Recurvirostra avosetta*, golden plover *Pluvialis apricaria*, bar-tailed godwit *Limosa lapponica*, pink-footed goose *Anser brachyrhynchus*, dark-bellied brent goose *Branta bernicla bernicla*, shelduck *Tadorna tadorna*, pintail *Anas acuta*, oystercatcher *Haematopus ostralegus*, grey plover *Pluvialis squatarola*, whooper swan *Cygnus cygnus,* dunlin *Calidris alpina alpina*, sanderling *Calidris alba*, curlew *Numenius arquata*, redshank *Tringa totanus*, turnstone *Arenaria interpres*, little grebe *Tachybaptus ruficollis*, cormorant *Phalacrocorax carbo*, white-fronted goose *Anser albifrons albifrons,* wigeon *Anas penelope*, mallard *Anas platyrhynchos*, ringed plover *Charadrius hiaticula*, lapwing *Vanellus vanellus*, knot *Calidris canutus*, whimbrel *Numenius phaeopus*.
Conservation objectives:
To avoid deterioration of the habitats of the qualifying species (listed above) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and to ensure for the qualifying species that the following are maintained in the long term: • Population of the species as a viable component of the site • Distribution of the species within site • Distribution and extent of habitats supporting the species • Structure, function and supporting processes of habitats supporting the species • No significant disturbance of the species

C2 Coastal and marine Special Areas of Conservation

Site Name: Humber Estuary SCI	
Location	Grid Ref: SE838110 (central point) Latitude 53º 35'21"N Longitude 00º 44'05"W
Area (ha)	36657.15
Summary	The Humber is the second-largest coastal plain estuary in the UK, and the largest coastal plain estuary on the east coast of Britain. It is a muddy, macro-tidal estuary, fed by the Rivers Ouse, Trent and Hull, Ancholme and Graveney. Suspended sediment concentrations are high, and are derived from a variety of sources, including marine sediments and eroding boulder clay along the Holderness coast. This is the northernmost of the English east coast estuaries whose structure and function is intimately linked with soft eroding shorelines. As salinity declines upstream, reedbeds and brackish saltmarsh communities fringe the estuary. This section of the estuary is also noteworthy for extensive mud and sand bars, which in places form semi-permanent islands. Significant fish species present include the migratory river lamprey and sea lamprey, which breed in the River Derwent, a tributary of the River Ouse. Donna Nook, on the south shore at the mouth of the estuary, is used by grey seals as a breeding colony and haul-out site.
Qualifying features for which the site is designated:	
Annex 1 Habitat Primary features: Estuaries, mudflats and sandflats not covered by seawater at low tide Secondary features: Sandbanks which are slightly covered by seawater all the time, coastal lagoons, *Salicornia* and other annuals colonising mud and sand, Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*), embryonic shifting dunes, shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes'), fixed dunes with herbaceous vegetation ('grey dunes'), dunes with *Hippophae rhamnoides* ***Annex 2 Species*** Primary features: None Secondary features: Sea lamprey *Petromyzon marinus*, river lamprey *Lampetra fluvitilis*, grey seal *Halichoerus grypus*	
Conservation objectives:	
For Annex I Habitats To avoid deterioration of the qualifying habitats (listed above), thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for the qualifying interest. To ensure for the qualifying habitats that the following are maintained in the long term: • Extent of the habitats on site • Distribution of the habitats within site • Structure and function of the habitats • Processes supporting the habitats • Distribution of typical species of the habitats • Viability of typical species as components of the habitats • No significant disturbance of typical species of the habitats	
For Annex II Species To avoid deterioration of the habitats of the qualifying species (listed above) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for the qualifying interest. To ensure for the qualifying species that the following are established then maintained in the long term: • Population of the species as a viable component of the site • Distribution of the species within the site • Distribution and extent of habitats supporting the species • Structure, function and supporting processes of habitats supporting the species • No significant disturbance of the species	

Site Name: River Derwent SAC	
Location	Grid Ref: SE704474 (central point) Latitude 53º 55'03"N Longitude 00º 55'40"W
Area (ha)	411.23
Summary	The Derwent is one example of river lamprey populations which inhabit the many rivers flowing into the Humber estuary in eastern England. Only the lower reaches of the Derwent are designated, reflecting the spawning distribution of the species in the Derwent system. Larvae spend several years in silt beds before metamorphosing and migrating downstream into estuaries to feed on fish for 1-2 years before returning to freshwater to spawn.
Qualifying features for which the site is designated:	
Annex 1 Habitat Primary features: None Secondary features: Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation ***Annex 2 Species*** Primary features: River lamprey *Lampetra fluvitilis* Secondary features: Sea lamprey *Petromyzon marinus*, bullhead *Cuttus gobio*, otter *Lutra lutra*	
Conservation objectives:	
For Annex I Habitats To avoid deterioration of the qualifying habitats (listed above), thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for the qualifying interest. To ensure for the qualifying habitats that the following are maintained in the long term: • Extent of the habitats on site • Distribution of the habitats within site • Structure and function of the habitats • Processes supporting the habitats • Distribution of typical species of the habitats • Viability of typical species as components of the habitats • No significant disturbance of typical species of the habitats	
For Annex II Species To avoid deterioration of the habitats of the qualifying species (listed above) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for the qualifying interest. To ensure for the qualifying species that the following are established then maintained in the long term: • Population of the species as a viable component of the site • Distribution of the species within the site • Distribution and extent of habitats supporting the species • Structure, function and supporting processes of habitats supporting the species • No significant disturbance of the species	

Site Name: The Wash and North Norfolk Coast SAC	
Location	Grid Ref: TF558403 (central point) Latitude 52º 56'13"N Longitude 00º 19'05"E
Area (ha)	107761.28
Summary	The Wash is the largest embayment in the UK with extensive areas of subtidal mixed sediment. In the tide-swept approaches to the Wash, the relatively common tube-dwelling polychaete worm *Sabellaria spinulosa* forms areas of biogenic reef. The site includes one of the largest expanses of sublittoral sandbanks and the second-largest area of intertidal flats in the UK. These habitats support important invertebrate communities; benthic communities on sandflats in the deeper, central part of the Wash are particularly diverse. The embayment supports a variety of mobile species, including a range of fish and common seal, with the subtidal sandbanks also providing important nursery grounds for young commercial fish species. Extensive saltmarsh habitats are also present, fringed by important areas of Mediterranean and thermo-Atlantic vegetation.

Qualifying features for which the site is designated:

Annex 1 Habitat
Primary features: Sandbanks which are slightly covered by sea water all the time, mudflats and sandflats not covered by seawater at low tide, large shallow inlets and bays, reefs, *Salicornia* and other annuals colonising mud and sand, Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*), Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*)
Secondary features: Coastal lagoons

Annex 2 Species
Primary features: Common seal *Phoca vitulina*
Secondary features: Otter *Lutra lutra*

Conservation objectives:

For Annex I Habitats
To avoid deterioration of the qualifying habitats (listed above), thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for the qualifying interest. To ensure for the qualifying habitats that the following are maintained in the long term:

- Extent of the habitats on site
- Distribution of the habitats within site
- Structure and function of the habitats
- Processes supporting the habitats
- Distribution of typical species of the habitats
- Viability of typical species as components of the habitats
- No significant disturbance of typical species of the habitats

For Annex II Species
To avoid deterioration of the habitats of the qualifying species (listed above) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for the qualifying interest. To ensure for the qualifying species that the following are established then maintained in the long term:

- Population of the species as a viable component of the site
- Distribution of the species within the site
- Distribution and extent of habitats supporting the species
- Structure, function and supporting processes of habitats supporting the species
- No significant disturbance of the species

Site Name: North Norfolk Coast SAC	
Location	Grid Ref: TF752445 (central point) Latitude 52º 58'08"N Longitude 00º 36'38"E
Area (ha)	3207.37
Summary	An extensive and varied area of coastal habitats, predominately consisting of dunes, beaches, machair, shingle, sea cliffs and islets. Other habitats include lagoons, saltmarshes and other intertidal habitats. The site, together with the Wash and North Norfolk Coast SAC, comprises the only area in the UK where all the more typically Mediterranean species that characterise Mediterranean and thermo-Atlantic halophilous scrubs occur together. It also includes some of the best examples of transitions between shingle and saltmarsh. The site is one of two sites representing embryonic shifting dunes in the east of England, and is of exceptional length and quality (14% of national total). It also contains 8% of the estimated total area of shifting dunes with *Ammophila arenaria* in Britain
Qualifying features for which the site is designated:	
Annex 1 Habitat Primary features: Coastal lagoons, perennial vegetation of stony banks, Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*), embryonic shifting dunes, shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes'), fixed dunes with herbaceous vegetation ('grey dunes'), humid dune slacks Secondary features: None ***Annex 2 Species*** Primary features: None Secondary features: Otter *Lutra lutra*, petalwort *Petalophyllum ralfsii*	
Conservation objectives:	
For Annex I Habitats To avoid deterioration of the qualifying habitats (listed above), thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for the qualifying interest. To ensure for the qualifying habitats that the following are maintained in the long term: • Extent of the habitats on site • Distribution of the habitats within site • Structure and function of the habitats • Processes supporting the habitats • Distribution of typical species of the habitats • Viability of typical species as components of the habitats • No significant disturbance of typical species of the habitats	
For Annex II Species To avoid deterioration of the habitats of the qualifying species (listed above) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for the qualifying interest. To ensure for the qualifying species that the following are established then maintained in the long term: • Population of the species as a viable component of the site • Distribution of the species within the site • Distribution and extent of habitats supporting the species • Structure, function and supporting processes of habitats supporting the species • No significant disturbance of the species	