Department of Trade and Industry

Appropriate Assessment

with regard to

24th Offshore Oil and Gas Licensing Round

January 2007

Department of Trade and Industry
Energy Development Unit
Offshore Environment and Decommissioning

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FIGURES

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1 SUMMARY

On 16th March 2006, the Secretary of State for Trade and Industry invited applications for Licences in the 24th Seaward Licensing Round. Applications for Traditional Seaward, Frontier Seaward and Promote Licences were invited. The draft plan to hold a 24th Seaward Licensing Round had previously been subject to a Strategic Environmental Assessment (SEA), the sixth in a series undertaken by the DTI since 1999. The SEA Environmental Report includes *inter alia* detailed consideration of the status of the natural environment and potential effects of the range of activities which could follow licensing, including on conservation sites. The SEA Environmental Report was subject to a 3 month public consultation period, and a post-consultation report summarising and responding to feedback received has been produced as an input to DTI licensing decisions.

This assessment is made in order to satisfy the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended), which apply to offshore oil and gas activities in territorial waters and on the UK Continental Shelf (UKCS). This legislation implements the requirements of the Habitats Directive (92/43/EEC) and Wild Birds Directive (79/409/EEC) and creates a network of protected areas (Natura 2000 network). For simplicity, these Directives are hereafter referred to only as the 'Habitats Directive'. Under Article 6 of the Habitats Directive, an appropriate assessment has been undertaken to assess whether exploration licences issued under the 24th Round will have any adverse effects on the integrity of Natura 2000 sites also referred to as 'European Sites'. It is noted that the offshore regulations only apply to petroleum related activities, and Defra has consulted on proposed Offshore Marine Conservation Regulations that will extend provisions to other activities.

The Petroleum Act 1998 vests exclusive right of searching and boring for and getting petroleum within Great Britain and the territorial sea adjacent to the United Kingdom in the Crown and allows the Secretary of State for Trade and Industry, to grant licences to explore for and exploit these resources and those on the UK Continental Shelf (UKCS). Offshore licensing for oil and gas exploration and production commenced in 1964 and has progressed through a series of Seaward Licensing Rounds. The award of block licences confers no automatic right to conduct any offshore activities, which are subject to a range of statutory permitting and consenting requirements, including where relevant, activity specific appropriate assessment. This assessment has been undertaken in accordance with the European Commission Guidance (EC 2000), and with reference to various guidance and reports including the Habitat regulations guidance note (EN, 1997), the Planning and Policy Statement note 9 (PPS9, 2005) and English Nature Research Reports, No 704 (2006).

This AA is based on blocks applied for in the 24th Seaward Licensing Round **excluding blocks 17/3, 106/30, 107/21 and 107/22**[1]. It is a plan-level AA since details of specific projects cannot be defined at this stage in plan implementation. It considers, in the light of the conservation objectives of each relevant European Site, those activities that could follow block licensing which are likely to have a significant effect on European Sites, either individually or in combination with other activities. (see Section 3.3 for the list of blocks assessed in this AA). Where the assessment identified a potential for adverse effects on the integrity of European Site(s), the need and potential for mitigation measures to obviate or minimise the adverse effects were considered in reaching a conclusion.

Taking into account impact predictions, the mitigation measures available (where relevant) and evidence from other sites, the Secretary of State is able to grant consent to the plan (as defined) under the Habitats Directive and award the relevant licences because:

- significant effects on a European Site, either individually or in combination with other plans or projects, can be excluded from the outset (e.g. where the blocks are located far away from any European Sites); or
- for the other blocks, there is certainty, within the meaning of the ECJ Judgment in the *Waddenzee* case, that the plan will not adversely affect the integrity of relevant European Sites, taking account of the mitigation measures that can be imposed before any activity starts.

[1] These four blocks are variously located in the Inner Moray Firth and Cardigan Bay; these will be subject to a separate AA before decisions on licensing them are taken.

2 INTRODUCTION AND BACKGROUND

2.1 Introduction

On 16th March 2006, the Secretary of State for Trade and Industry invited applications for Licences in the 24th Seaward Licensing Round. Applications for Traditional Seaward, Frontier Seaward and Promote Licences were invited (see Section 3.1 for further description of these types of licences). This appropriate assessment (AA) has been undertaken as required by national regulations to assess whether licences issued as part of the 24th Round will have any adverse effects on the integrity of Natura 2000 sites.

2.2 Background

The Habitats Directive requires, amongst other things, that Member States afford protection for certain species and habitats through the designation of Special Areas of Conservation (SAC) and Special Protection Areas (SPA) respectively. Collectively these Special Areas are known as “Natura 2000” sites, “European Sites” or of the “Natura 2000” network.

Article 6(3) of the Habitats Directive, first sentence, requires that “Any plan or project not directly connected with or necessary to the management of [a Natura 2000] site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site’s conservation objectives.” Article 6(3), second sentence says that “In the light of the conclusions of the assessment of the implications for the [Natura 2000] site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the [Natura 2000] site concerned …”.

This requirement is implemented in the UK in relation to offshore oil and gas activities by the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended).

It is noted that Defra has consulted on the proposed Offshore Marine Conservation Regulations which will enable the designation of sites offshore and extend provisions to other activities.

The AA has been undertaken in accordance with the European Commission’s Methodological Guidance (EC 2000), the Habitat regulations guidance note (EN, 1997) and also the Planning and Policy Statement, note 9 (PPS9, 2005) and with reference to the Judgments of the European Court of Justice (ECJ) in Cases C-127/02 (the “Waddenzee” case) and C-6/04 (Commission v. United Kingdom), and English Nature Research Reports, No 704. (2006).

This assessment considers European Sites that are at any stage of designation or recommendation. The Natura 2000 network is a developing one, under current government policy, and as set out in paragraph 6 of Planning Policy Statement 9 (PPS 9) ‘Biodiversity and Geological Conservation’, potential sites in the process of being recommended formally to government are treated as engaging the Habitats Directive. Therefore, such sites are to be considered as any fully designated Natura 2000 site insofar as there is sufficient information on the feature(s) and boundaries of the site.

2.3 Need for Appropriate Assessment

The European Commission Guidance on Article 6 (EC 2000) notes that “A likelihood of significant effects may arise not only from plans or projects located within a protected site but also from plans or projects located outside a protected site.” For this reason, it is important that Member States, both in their legislation and in their practice, allow for the Article 6(3) safeguards being applied to development pressures which are external to a Natura 2000 site but which are likely to have significant effects on it.

Analyses, consultations and discussions of environmental sensitivities have taken place prior to this assessment, in consideration of the conservation features in and adjacent to the areas of potential licensing. It has been ascertained to the satisfaction of the DTI that an AA is required in respect of certain aspects of the proposed Licensing Round.

3 APPROPRIATE ASSESSMENT PROCESS AND SCOPE

3.1 Process

The whole AA process has been conducted on the following basis.

1. Screening stage

In complying with its obligations under Article 6(3), first sentence, the Department has applied the test set out by the European Court of Justice in the *Waddenzee* case (Case C-127/02). This test is that a plan or project not directly connected with or necessary to the management of a site must be subject to an AA 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. In considering whether significant effects were likely to occur, the precautionary principle was applied. In considering whether the Round required an AA the Department:

- Identified all blocks potentially included in the draft plan.

  In this case taken to be all those blocks (excluding blocks 17/3, 106/30, 107/21 and 107/22) for which applications were made as part of the 24th Licensing Round.

- Identified the relevant Natura 2000 sites in the area of the draft plan or likely to be affected by it.[2]

  Relevant Natura 2000 sites considered included designated, candidate, possible, and draft coastal, marine and offshore SACs and SPAs whose location in relation to the blocks which have been applied for indicate the possibility of interactions.

- Considered the potential oil and gas activities that could follow adoption of the draft plan and in particular the potential sources of significant effects on Natura 2000 sites.

  This included both a generic consideration of oilfield activities and block specific consideration based on DTI assessment of prospectivity and indications of potential activity levels based on block applications – see Section 3.4

- Identified those Natura 2000 sites where no significant effects from the draft plan were likely, for example, because of distance or the features or natural history of the species for which the site is designated are not at risk. These sites are not considered further in this AA.

2. Appropriate Assessment stage

In carrying out this AA so as to determine whether it was possible to authorise the plan under Article 6(3), second sentence, the Department:

- Considered whether, on the basis of the precautionary principle it could be concluded that the integrity of relevant European Sites would not be affected by the plan. 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.

[2] EC 2000

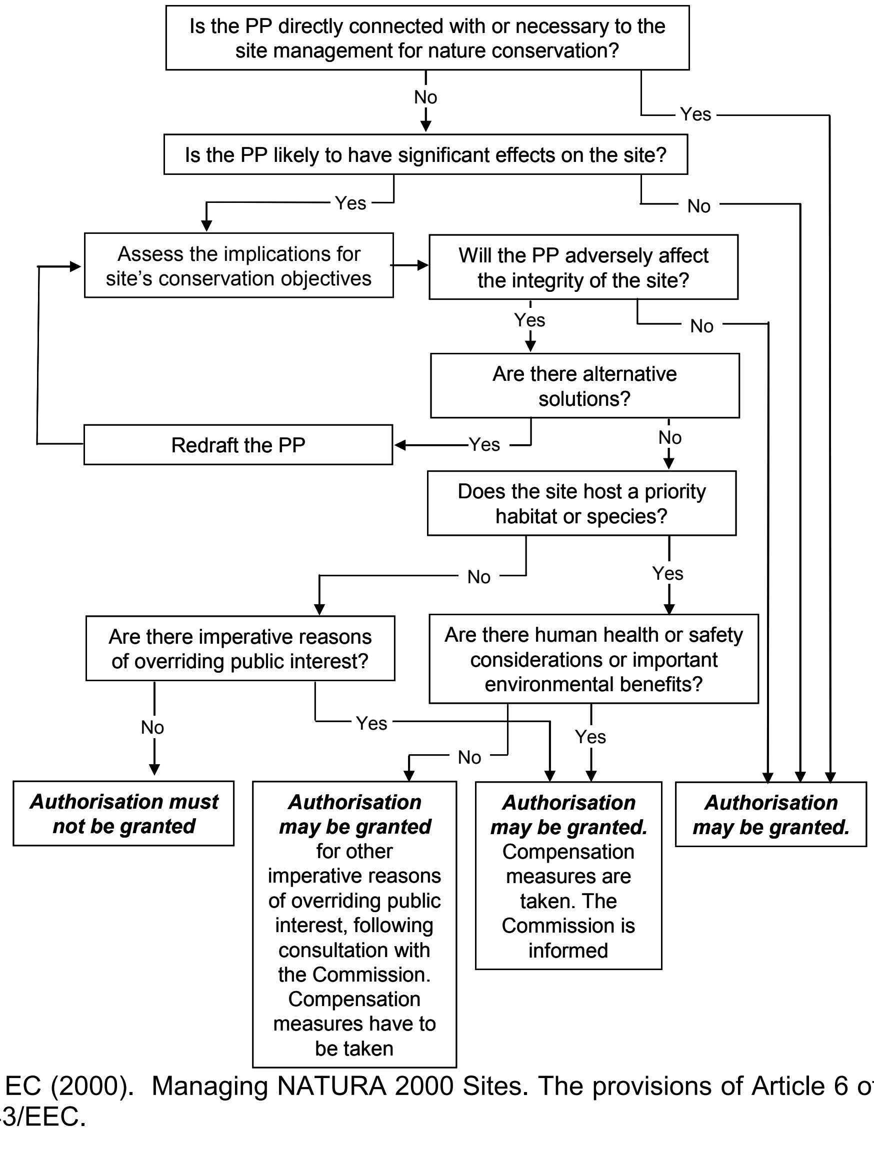
- Produced a draft AA Report and consulted with its statutory advisors and the public.

- Considered whether, in the light of comments received, it was possible to go ahead with the plan.

  In considering this, the Department applied the test set out by the ECJ in the *Waddenzee* case, namely that a competent authority can authorise a plan or project "only if [it has] made certain that it 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 3.1 where "PP" is plan or programme.

Figure 3.1 Summary of Procedures under the Habitats Directive for Consideration of Plans or Projects Affecting Natura 2000 Sites



Source: After EC (2000). Managing NATURA 2000 Sites. The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC.

3.1.1 Site Integrity

Section 4.6.3 of the EC Guidance (2000) states "It is clear from the context and from the purpose of the directive that the 'integrity of the site' relates to the site's conservation objectives. 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. English Nature (1997) states that this is whether the plan or project would adversely affect the "coherence of the site's ecological structure and function, across its whole area, or the habitats, complex of habitats and/or populations of species for which the site is or will be classified" (PPG 9 box C10). An adverse effect on integrity is likely to be one which prevents the site from making the same contribution to favourable conservation status for the relevant feature as it did at the time of its designation (English Nature, 1997).

3.2 Relevant blocks

Offshore blocks for which applications have been made during the 24th Seaward Licensing Round and considered in this AA are listed below and shown on Figures 3.2 and 3.3. Note, a number have been licensed previously. This AA does not include four blocks which have also been applied for and are variously located in the Inner Moray Firth and Cardigan Bay; these will be subject to a separate AA before decisions on licensing them are taken.

2/3	14/21b	21/1b	22/27c
3/5	14/22b	21/29d	22/28c
19/6	14/24a	21/2b	23/16g
28/8	14/26c	21/3d	23/27b
28/9	14/27b	21/3e	28/10b
18/10	14/30a	21/7a	28/15
16/11	15/20c	211/1	28/19
29/11	15/23c	211/17	28/20
12/12	15/24a	211/2	28/24
12/13	15/25d	211/3	28/25
12/29	15/25f	213/10	28/30
10/1b	15/28a	213/14	28/3b
109/5	15/29d	213/15	28/5c
110/1	15/29e	213/9	29/1d
110/10	16/16	214/12	29/21
110/12	16/18c	214/13	29/22
110/13c	16/1a	214/14	29/26
110/14b	16/3f	214/15	29/27
110/15b	16/6c	214/19	29/28
110/18	16/8c	214/2	29/29
110/19	2/4b	214/20	29/4g
110/23	20/20	214/3	29/6b
110/3b	204/16	214/4b	3/10c
110/4	204/17	214/5b	3/11c
110/5	204/21	214/6	3/29c
110/7b	204/22	214/7	3/30b
110/8b	204/27	214/8	3/6b
110/9b	204/28	214/9b	3/8f
112/30	204/29	216/28	30/19b
113/26b	205/12	216/30	30/20b
113/27b	205/13	217/21	30/25a
113/29c	205/16b	217/22	30/2b
113/30	205/17	217/26	30/3b
13/14	206/3	22/11b	34/30
13/15	206/4	22/12b	35/26
13/20	208/11	22/13b	36/10
13/21d	208/16	22/16b	37/12
13/24d	208/26	22/1b	37/13
13/30c	21/13b	22/23c	37/2
14/16	21/16b	22/24c	37/26
14/17	21/17	22/25c	37/27
14/18c	21/18b	22/25d	37/28

37/29	43/1	47/18	49/22b
37/3	43/10	47/20a	49/24b
37/30	43/19c	47/22	49/25b
37/4	43/2	47/23	49/28c
37/6	43/24c	47/6	50/21
37/7	43/3	47/7	52/3
38/20	43/30c	47/9d	52/4b
38/25	43/4	48/12e	52/5b
38/29	43/5	48/13c	53/3b
38/30	43/9	48/17d	53/4e
39/16	44/1	48/17e	53/4f
39/21	44/13	48/18d	56/13
39/26	44/14	48/23b	56/14
4/26b	44/15	48/24d	56/19
40/5	44/2	48/27	56/20
41/1	44/21e	48/28b	9/12d
41/10b	44/27c	48/29b	9/12e
42/18	44/3	48/30b	9/4b
42/27b	44/5	48/9d	9/9e
42/2b	44/6	49/10c	9/9f
42/3	47/13b	49/14a	
42/4	47/14c	49/20c	

3.3 The Natura 2000 Sites

Sites were first screened for inclusion/exclusion in the initial assessment with respect to their location to the blocks which are the subject of licence applications and in terms of the foreseeable possibility of interactions.

The initial list of sites for further consideration includes (see also Figures 3.2 and 3.3):

- Coastal and marine Natura 2000 sites (SPAs and SACs) along the east coast of Great Britain from Shetland to Kent
- Coastal and marine Natura 2000 sites (SPAs and SACs) along the west coast from Islay to Pembrokeshire
- Coastal and marine Natura 2000 sites (SPAs and SACs) along the coast of Northern Ireland
- Offshore Natura 2000 sites in the Southern North Sea
- Offshore Natura 2000 sites in the Central North Sea
- Offshore Natura 2000 sites at the Wyville Thomson Ridge and Darwin Mounds

The sites together with their features of interest are summarised in Tables A1 to A5 in Appendix A together with more detailed location maps (Figures A1 to A8).

It was determined on further consideration that no interaction with 24th Round activities could be foreseen for a number of these sites because of the nature of the qualifying features, distance from blocks applied for and nature and scale of potential activities and these were not considered further.

Where a potential for a significant effect on a listed habitat or species was considered reasonably foreseeable from consideration of the geographic location of the sites, and the general characteristics of habitat and species present these were considered further as summarised in Appendices B to D. Whether such an impact represents an adverse effect on site integrity is then considered in detail as appropriate. For the above sites, the impacts that are considered in the AA are judged under the broad categories of:

- oil spills (including all liquid phase hydrocarbons);
- physical disturbance (e.g. trenching and placing deposits on the seabed)
- underwater noise (in particular, seismic surveys);

This AA is assessing the potential implications for European Sites of the proposed 24th Licence Round rather than considering the implications of specific individual projects. The award of licences under the 24th Round which is the subject of this AA may or may not give rise to subsequent development activity, the implications of which have been considered in this AA in so far as possible. Where relevant such future activities, will themselves be subject to the screening procedure and tests under the Habitats Directive which have been used to guide this AA.

If the Secretary of State cannot be certain on the basis of the precautionary principle that the integrity of a European Site will not be affected by the plan the Secretary of State must consider whether appropriate mitigation measures will cancel or minimise the adverse effects. This could be by means of conditions in the appropriate consents that are being applied for at the time. Where necessary, the subsequent stages of the Habitats Directive will be applied as necessary and its obligations will be discharged, which may mean withholding consent. It is emphasised that any Licence issued from the 24th Licence Round does not give blanket permission to any or all of the projects that may flow from it, and it does not diminish the required assessment of environmental impacts for separate projects.

Consequently, the aim of this assessment is to consider an outcome from the licensing that is reasonably foreseeable in terms of environmental impact, whilst taking into account the precautionary principle. In almost all circumstances this is equivalent to considering a reasonably foreseeable maximum degree of activity. Licences are awarded when judged against a number of criteria, including the amount of activity proposed. Once the licence has been awarded, it is possible for the Operator to undertake less or more activity depending upon a number of factors including results from early exploration.

The approach in this assessment has been to take the proposed activity for a given block as being the maximum of any application for that block, and assume that all activity takes place. This more than satisfies the test of being reasonably foreseeable, and the environmental impacts of these activities are pessimistic. The 24th Seaward Licensing Round is for exploration for hydrocarbons with production being contingent on what is found during the exploration phase. It is impossible to state what future exploration will reveal. As and when specific activities and development projects are proposed, they will each be subject to regulatory assessment including the relevant tests under the Habitats Directive enabled by UK regulations. The outcome of such assessments includes the potential for consent to be withheld if it cannot be demonstrated that there will not be adverse effects on the integrity of a European Site.

Figure 3.2 Map showing Blocks assessed in this AA and relevant Special Areas of Conservation

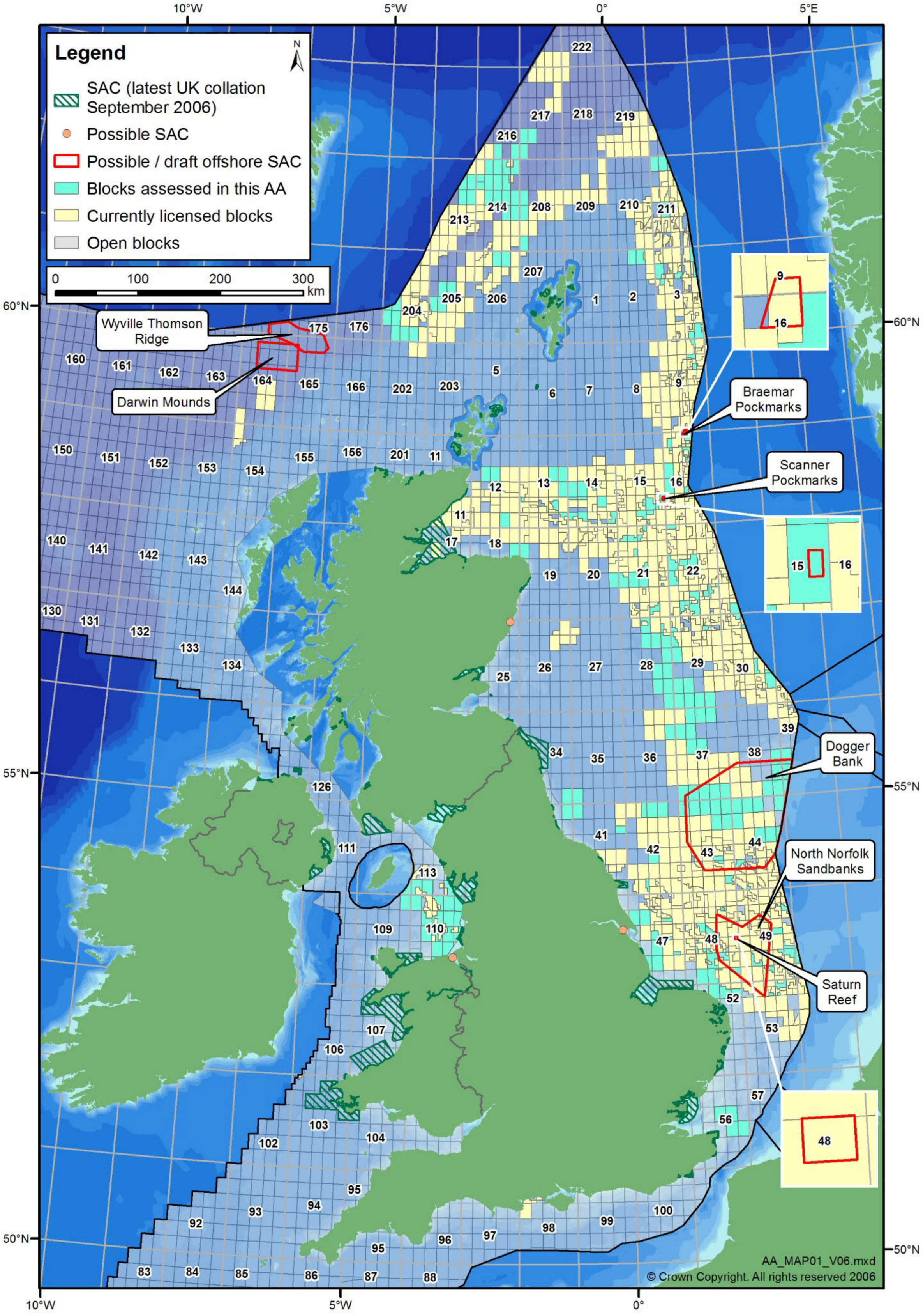
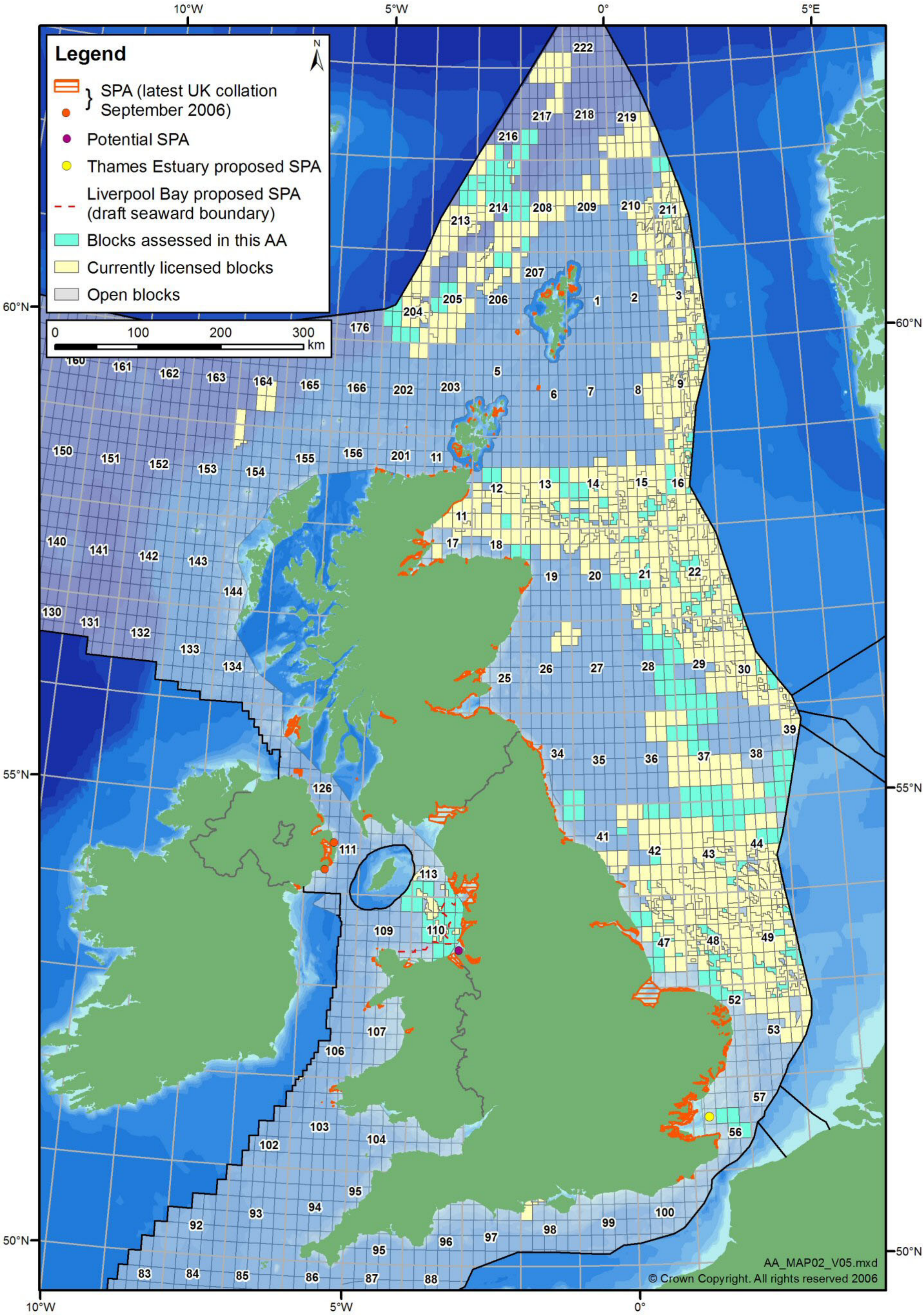


Figure 3.3 Map showing Blocks assessed in this AA and relevant Special Protection Areas



4 DESCRIPTION OF THE PLAN

4.1 The licensing regime

The Petroleum Act 1998 vests exclusive right of searching and boring for and getting petroleum[3] within Great Britain and the territorial sea adjacent to the United Kingdom in the Crown and allows the Secretary of State for Trade and Industry, to grant licences on behalf of Her Majesty to explore for and exploit these resources and those on the UK Continental Shelf (UKCS). The main type of offshore Licence is the Seaward Production Licence. Offshore licensing for oil and gas exploration and production commenced in 1964 and has progressed through a series of Seaward Licensing Rounds. A Seaward Production Licence may cover the whole or part of a specified block or a group of blocks. A Licence grants exclusive rights to the holders "to search and bore for, and get, petroleum" in the area covered by the licence. A Licence does not confer any exemption from other legal/regulatory/fiscal requirements.

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 two 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 four 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 Round (2002) the DTI 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, DTI 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 DTI to complete the Work Programme (e.g. to drill a well). By the same point, it must also have satisfied DTI of its technical, environmental and financial capacity to do so.

The terms and conditions of the Licences are set out in the Petroleum Licensing (Exploration and Production) (Seaward and Landward Areas) Regulations Order 2004 (2004/352), as amended by the Petroleum Licensing (Exploration and Production) (Seaward and Landward Areas) (Amendment) Regulations Order 2006 (2006/784).

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[3] That is mineral oil or related hydrocarbon and natural gas

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

4.2 Work programmes

As part of the licence application process, applicant companies provide the DTI with details of work programmes they propose to further the understanding or exploration of the blocks(s) in question. These work programmes are considered with a range of other factors in the DTI's decision on whether to license the blocks and to whom. Although the approach in this assessment has been to take the proposed activity for a given block as being the maximum of any application for that block, and assume that all activity takes place as a result of the structuring of licences, it is possible to foresee what activity may potentially occur in the next four years, as this information is contained within the licence applications. On past experience, less activity actually takes place than is bid at the licence application stage. Activity after the initial four years is much harder to predict, as this depends on the results of the initial phase, which is, by definition, exploratory. A proportion of blocks awarded will be relinquished without any field activities occurring.

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 the DTI 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

It is made clear in the application guidance that a Production Licence does not grant carte blanche 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 the DTI, and a licensee 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.

4.3 First four-year exploration phase

The proposed work programmes for the first four-year period is detailed in the licence applications. For some activities, such as seismic survey noise and oil spills, the impacts can occur some distance from the licensed blocks and the degree of activity is not necessarily proportional to the size or number of blocks in an area. Therefore, it is appropriate to consider the impacts in a generic way. For the case of direct physical disturbance, the licence blocks being applied for are relevant, although there may still be pipelines that cross unlicensed blocks should any significant development ensue after the initial four-year exploratory period.

Based on previous experience, and for the purpose of the assessment, an estimate of the likely outcome from the 24th Round licence applications has been made. Note that Drill or Drop work programmes (subject to further studies by Licence holders) will probably only result in an actual well being drilled in less than 50% of the cases. Contingent wells are treated as firmer than Drill or Drop (perhaps 50 - 75%). The estimates of work commitments for Blocks or groups of Blocks derived by the DTI from the range of applications received are as follows:

For the North Sea:

- 15/25d - Firm well
- 16/3f - Drill or Drop (D/D)
- 18/10 & 19/6 - 1 Licence (L) with 1 D/D across both blocks. Request is for northerly parts of blocks only
- 47/22 & 47/23 (split block) - 1 L with 1 D/D
- 47/23 (split block), 47/13b & 47/18 - 1 L with 1 D/D
- 56/13, 14, 19 & 20 - 1 L with 1 D/D

For the Irish Sea:

- 109/5 & 112/30 - 1 L with 1 D/D
- 110/1 - D/D
- 110/3b - D/D
- 110/4 &110/9b (split block) - 1 L with 1 D/D
- 110/5 - D/D with probable 100km new shoot 2D seismic
- 110/7b & 110/12 - 1 L with 1 D/D
- 110/8b - 1 firm well, 170 km^2 new shoot 3D seismic
- 110/9b (split block) & 110/14b (split block) - 1 L with 1 D/D
- 110/10 - D/D
- 110/13c (split block) - D/D
- 110/13c (split block) & 110/14b (split block) - 1 L with 1 firm well
- 110/15b - D/D
- 110/18, 110/19 & 110/23 - 1 L with 1 Contingent well probably drilled from land
- 113/26b & 113/27b (split block) - 1 L with 1 D/D or firm
- 113/27b (split block) - 2 firm wells, 170 km^2 new shoot 3D seismic
- 113/29c & 113/30 - 1 L with 1 D/D

D/D = Drill or Drop, L = Licence

4.4 Subsequent development

Experience from previous licensing rounds indicate that it is typical for less than half the wells drilled to reveal hydrocarbons, and of that half, less than half again will yield an amount significant enough to be considered on a list of potential developments. Depending on the expected size of finds, there may be further drilling to appraise the hydrocarbons (appraisal wells). Potential developments are then considered against current assets, current plans and a list of other discoveries. Discoveries that are developed will 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.

Therefore, the extent and timescale of development which may ultimately result from the 24th Round Licensing is uncertain. Consequently, this assessment is generic in terms of the quantitative extent of development (e.g. numbers of platforms, lengths of pipelines) considered

4.5 Licences applied for

Figures 3.1 and 3.2 show the UKCS along with blocks for which licence applications have been made during the 24th Round in the context of existing licensed blocks and SACs and SPAs respectively.

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

5.1 Approach

The approach to ascertaining the absence or otherwise of adverse effects on the integrity of a European Site is set out in section 3.1 above.

Appendix A lists, maps and summarises the European Sites potentially affected by activities that could follow 24th Licensing Round. In Appendices B - E assessments are made of the implications of the 24th Round Licensing for European Sites and their qualifying features and species. The assessment is based on the actual blocks applied for, an indication of potential work programmes for each and likely hydrocarbon resources if present. Following an initial screening exercise, the assessment has been restricted to those sources of impact judged to have the potential to affect European Sites, specifically, oil spills, physical and other effects, and acoustic effects. The following sections summarise the outcomes of the assessment.

Use has been made to Regulation 33 Advice prepared by the Country Agencies, since this typically includes advice on operations that may cause deterioration or disturbance to relevant features or species. The Regulation 33 Advice also includes an activities/factors matrix derived from Marlin (www.marlin.ac.uk). However, it is noted that several of the “probable” effects highlighted in the matrices are not inevitable consequences of oil and gas exploration and production since they can be mitigated through timing, siting or technology (or a combination of these). There is an expectation that these options would be evaluated in the environmental assessments required as part of activity consenting.

5.2 Conclusions for European Sites vulnerable to oil spills

Coastal European Sites may be vulnerable to oil spills.

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 credible to conclude that in spite of the regulatory controls, an oil spill will never occur as a result of 24th Round licensing. However, the potential risks of oil spills are mitigated in the southern North Sea and most of Liverpool Bay by the nature of the hydrocarbons present in those areas (natural gas), or in the case of the majority of blocks being applied for where oil is expected to be found by the distance offshore which allows for natural dispersion before a slick would approach a European Site. Appendix B2 and B3 describe oil spill risk and mitigative measures in detail. Taking into account that information, it is concluded that oil spills arising from the proposed 24th Licence Round will not result in an adverse effect on the integrity of the European Sites

5.3 Conclusions for European Sites vulnerable to physical and other damage

5.3.1 North Norfolk Sandbanks and Dogger Bank dSACs

The North Norfolk Sandbanks and Dogger Bank dSACs include areas where there are existing gas fields and several blocks have been applied for within the boundaries of the dSACs. Consequently the sites may be affected by a variety of activities including pipelaying activities via direct physical disturbance and deposits of rock. While local effects are foreseeable, activities that might follow a 24th Licensing Round would modify an extremely small area of these European Sites and have a minimal effect upon them, and rapid recovery has been observed in many similar circumstances. In any case, risks to overall site integrity from major projects would be prevented from materialising (mitigated) by the existing legal framework for the respective activities.

Taking into account the information presented in Appendix C, it is concluded that activities arising from the proposed 24th Licence Round will not result in an adverse effect on the integrity of the Annex I habitat, sandbanks which are slightly covered by sea water all the times, or compromise the integrity of the European Sites.

5.3.2 Scanner and Braemar Pockmarks dSACs

Pockmark SACs may be affected by direct physical damage, physical disturbance and interruption of the gas or fluid flow on which they depend. Specific mitigation measures are needed to ensure the conservation objectives for the sites are not compromised by activities that may follow a 24th Licensing Round, in particular controls on anchoring to avoid physical damage and on well location and trajectory to prevent interruption of the flow of shallow gas supplying and maintaining the features. Existing detailed well planning and environmental permitting arrangements are regarded as providing effective mechanisms to identify features and to ensure protection of surface and subsurface components essential to the continued maintenance of the structures in favourable condition.

Taking into account the information presented in Appendix C it is concluded that properly controlled through the appropriate use of mitigation measures, the activities arising from the proposed 24th Licence Round will not cause an adverse effect on the integrity of these European Sites.

5.3.3 Coastal Sites impinged on by blocks applied for

Coastal European Sites are potentially vulnerable to physical damage from drilling rig placement, drilling, installation construction, pipelaying and pipeline maintenance activities. While exploration or production activities could take place in or near to coastal SACs and SPAs, there are well proven methods to prevent impacts. There is a legal framework, via the necessary activity consents and Environmental Impact Assessment (EIA) regulations, to ensure that correct project timing, design and mitigation is employed so that the integrity of European Sites is not adversely affected.

Taking into account the information presented in Appendix C it is concluded that properly controlled (through the existing regulatory mechanisms), the activities that could follow from the proposed 24th Licence Round will not cause an adverse effect on the integrity of the European Sites considered in this AA.

5.3.4 Coastal Sites not impinged on by blocks applied for

Coastal European Sites are potentially vulnerable to physical damage from pipelaying and pipeline maintenance activities. It is not reasonably foreseeable that any new terminals would be built as a result of developments following the 24th 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 impacts. There is a legal framework, via the necessary pipeline consents and EIA regulations, to ensure that correct project design and mitigation is employed so that the integrity of European Sites is not adversely affected.

Taking into account the information presented in Appendix C, it is concluded that activities arising from the proposed 24th Licence Round will not cause an adverse effect on the integrity of the European Sites.

5.4 Conclusions for European Sites vulnerable to acoustic disturbance

While it is clear that seismic survey noise may be detectable by marine mammals, there is no evidence that noise arising from seismic surveys presents a risk to the viability of populations in UK waters; and specifically not within designated European 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); such effects have never been documented. In the localised areas of European Sites designated for marine mammals, acoustic disturbance associated with seismic is 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 (see assessment in Appendix D).

A number of simple analyses on common noise sources have shown that seismic noise is well within the range of noises to which bottlenose dolphin and harbour porpoise are frequently exposed. Several studies note disturbance reactions in those species as a result of exposure to vessels and high frequency devices such as net pingers, which appear to have greater potential to interfere with cetaceans (e.g. because the noise is continuous or because it is tonal rather than 'white noise'). Although hydrocarbon production platforms are sources of semi-continuous noise, they have not been observed to result in adverse effects on marine mammal occurrence in the vicinity of an installation.

In-combination effects from seismic surveys are not considered to be any greater than in-isolation effects; seismic surveys are deliberately not undertaken in the presence of other noise sources (such as piling or net pingers) that would compromise the acoustic signals.

The conclusions for seismic noise are similarly valid for piling noise.

Taking into account the information presented in Appendix D, it is concluded that activities arising from the proposed 24th Licence Round will not cause an adverse effect on the integrity of the European Sites.

5.5 In-combination effects

Although there are existing (e.g. oil and gas production, fishing, wildlife watching cruises) and planned (e.g. oil and gas exploration and production, wind farm development) activities in or adjacent to the 24th Round areas the DTI is not aware of any projects 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. In any case, there are effective regulatory mechanisms in place to ensure that operators and the DTI take such considerations into account during activity permitting. These mechanisms generally allow for public participation in the process, and this will be strengthened by regulations amending the offshore EIA regime which are due to come into force later this year. In respect of oil and gas activities and other developments, these mechanisms also include project specific AA.

6 OVERALL CONCLUSION ON IMPACT

Taking account of all the matters discussed, the Secretary of State is able to grant consent to the plan (as defined) under the Habitats Directive and award the relevant licences because either:

- significant effects on a European Site, either individually or in combination with other plans or projects, can be excluded from the outset (e.g. where the blocks are located far away from any European Sites); or

- for the other blocks, there is certainty, within the meaning of the ECJ Judgment in the *Waddenzee* case, that the plan will not adversely affect the integrity of relevant European Sites, taking account of the mitigation measures that can be imposed before any activity starts.

7 CONSULTATIONS AND CORRESPONDENCE

7.1 Consultations to date

Consultations have been undertaken with a range of bodies. Of most relevance to this assessment are the consultations with conservation bodies that relate to the features of the European Site.

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APPENDIX A – THE DESIGNATED SITES

A1 Introduction

The following maps and tables show the locations of potentially relevant European sites and describe their qualifying features.

A2 Coastal and Marine Special Protection Areas

Figure A.1 Location of SPAs - Shetland to the Tay

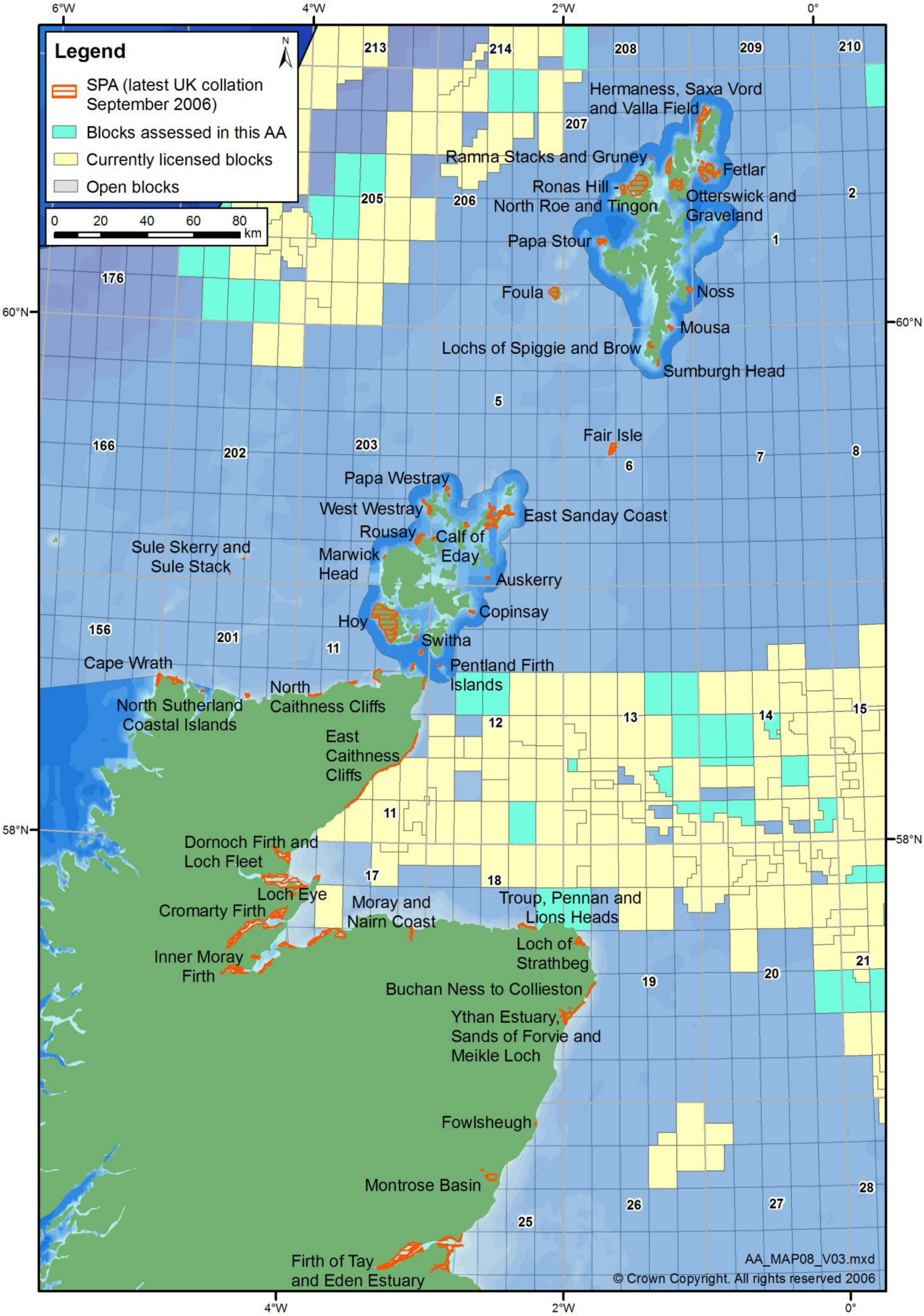


Figure A.2 Location of SPAs - Forth to Teesmouth and Islay to Pembrokeshire

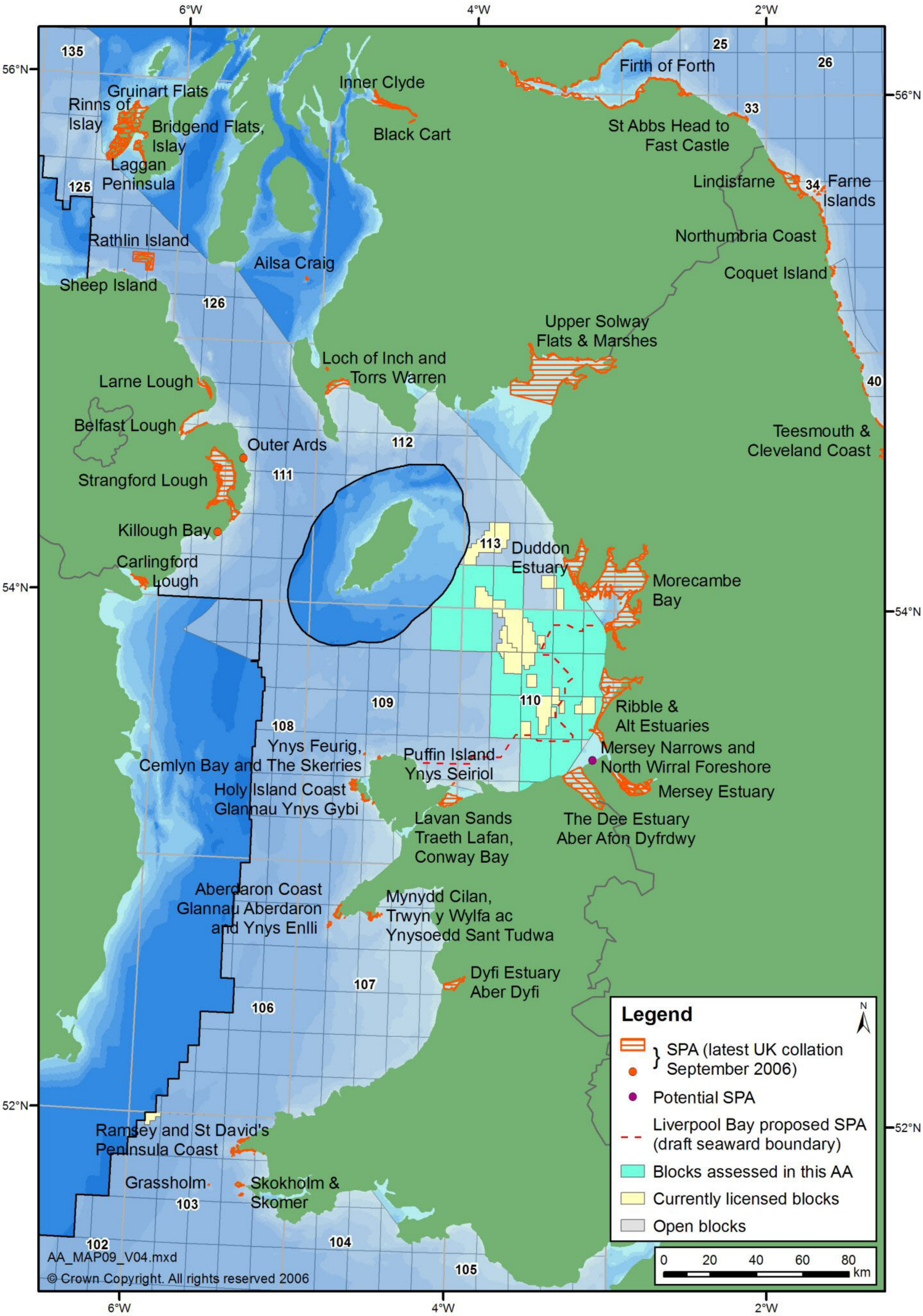


Figure A.3 Location of SPAs – Northumbria to Kent

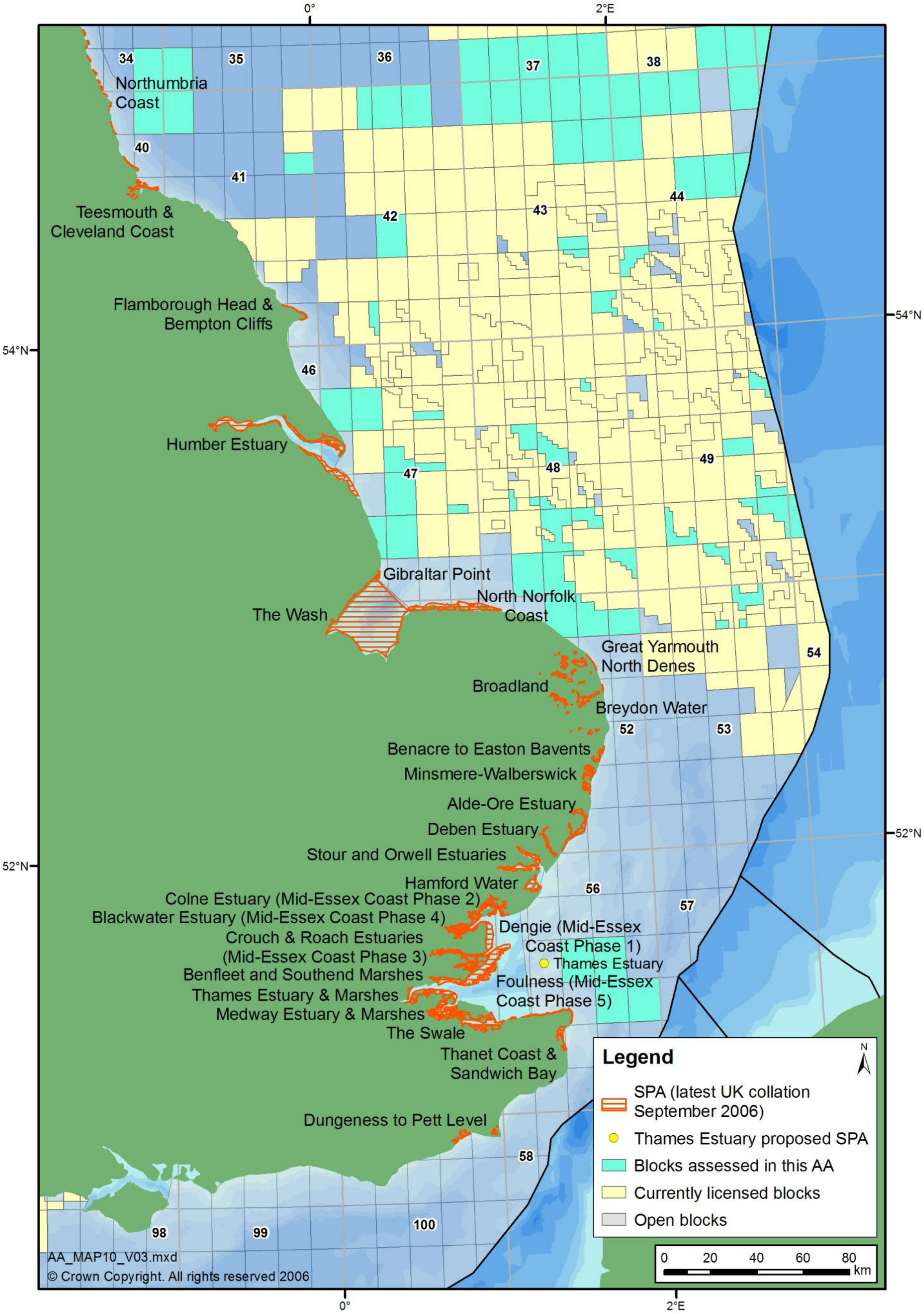


Table A.1 East Coast SPAs from Shetland to Kent and their Qualifying Features

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages[4]
SHETLAND				
Sumburgh Head SPA	39.04	Breeding: Arctic tern *Sterna paradisaea*	N/A	Breeding: Seabirds
Lochs of Spiggie and Brow SPA	141.48	Over winter: Whooper swan *Cygnus cygnus*	N/A	N/A
Foula SPA	1323.31	Breeding: Arctic tern *Sterna paradisaea* Leach's Storm-petrel *Oceanodroma leucorhoa* Red-throated diver *Gavia stellata*	Breeding: Great Skua *Catharacta skua* Guillemot *Uria aalge* Puffin *Fratercula arctica* Shag *Phalacrocorax aristotelis*	Breeding: Seabirds
Papa Stour SPA	569.03	Breeding: Arctic tern *Sterna paradisaea*	Breeding: Ringed plover *Charadrius hiaticula*	N/A
Ronas Hill-North Roe and Tingon SPA	5470.2	Breeding: Merlin *Falco columbarius* Red-throated diver *Gavia stellata*	N/A	N/A
Ramna Stacks and Gruney SPA	11.59	Breeding: Leach's storm-petrel *Oceanodroma leucorhoa*	N/A	N/A
Otterswick and Graveland SPA	2241.41	Breeding: Red-throated diver *Gavia stellata*	N/A	N/A
Hermaness, Saxa Vord and Valla Field SPA	1037.3	Breeding: Red-throated diver *Gavia stellata*	Breeding: Gannet *Morus bassanus* Great skua *Catharacta skua* Puffin *Fratercula arctica*	Breeding: Seabirds
Fetlar SPA	2594.91	Breeding: Arctic tern *Sterna paradisaea* Red-necked phalarope *Phalaropus lobatus*	Breeding: Dunlin *Calidris alpina schinzii* Great skua *Catharacta skua* Whimbrel *Numenius phaeopus*	Breeding: Seabirds

[4] - 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[4]
Noss SPA	343.82	N/A	Breeding: Gannet *Morus bassanus* Great skua *Catharacta skua* Guillemot *Uria aalge*	Breeding: Seabirds
Mousa SPA	197.98	Breeding: Arctic tern *Sterna paradisaea* Storm petrel *Hydrobates pelagicus*	N/A	N/A
Fair Isle SPA	561.27	Breeding: Arctic tern *Sterna paradisaea* Fair Isle wren *Troglodytes troglodytes fridariensis*	Breeding: Guillemot *Uria aalge*	Breeding: Seabird
ORKNEY				
Pentland Firth Islands SPA	170.51	Breeding: Arctic tern *Sterna paradisaea*	N/A	N/A
Switha SPA	57.39	Over winter: Barnacle goose *Branta leucopsis*	N/A	N/A
Hoy SPA	9499.7	Breeding: Peregrine *Falco peregrinus* Red-throated diver *Gavia stellata*	Breeding: Great skua *Catharacta skua*	Breeding: Seabirds
Marwick Head SPA	8.7	N/A	Breeding: Guillemot *Uria aalge*	Breeding: Seabirds
Rousay SPA	633.41	Breeding: Arctic tern *Sterna paradisaea*	N/A	Breeding: Seabirds
West Westray SPA	350.62	Breeding: Arctic tern *Sterna paradisaea*	Breeding: Guillemot *Uria aalge*	Breeding: Seabirds
Papa Westray (North Hill and Holm) SPA	245.71	Breeding: Arctic tern *Sterna paradisaea*	Breeding: Arctic skua *Stercorarius parasiticus*	N/A
Calf of Eday SPA	238.03	N/A	N/A	Breeding: Seabirds
East Sanday Coast SPA	1515.23	Over winter: Bar-tailed godwit *Limosa lapponica*	Over winter: Purple sandpiper *Calidris maritima* Turnstone *Arenaria interpres*	N/A
Auskerry SPA	101.97	Breeding: Arctic tern *Sterna paradisaea* Storm petrel *Hydrobates pelagicus*	N/A	N/A

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages[4]
Copinsay SPA	125.42	N/A	N/A	Breeding: Seabirds
Sule Skerry and Sule Stack SPA	18.9	Breeding: Leach's storm petrel *Oceanodroma leucorhoa* Storm petrel *Hydrobates pelagicus*	Breeding: Gannet *Morus bassanus* Puffin *Fratercula arctica*	Breeding: Seabird
NORTH COAST OF SCOTLAND				
Cape Wrath SPA	1019.18	N/A	N/A	Breeding: Seabirds
North Sutherland Coastal Islands SPA	221.11	Over winter: Barnacle goose *Branta leucopsis*	N/A	N/A
North Caithness Cliffs SPA	557.73	Breeding: Peregrine *Falco peregrinus*	Breeding: Guillemot *Uria aalge*	Breeding: Seabirds
MORAY FIRTH AND ABERDEENSHIRE				
East Caithness Cliffs SPA	442.62	Breeding: Peregrine *Falco peregrinus*	Breeding: Guillemot *Uria aalge* Kittiwake *Rissa tridactyla* Razorbill *Alca torda* Herring Gull *Larus argentatus* Shag *Phalacrocorax aristotelis*	Breeding: Seabirds
Dornoch Firth and Loch Fleet SPA	7836.33	Breeding: Osprey *Pandion haliaetus* Over winter: Bar-tailed godwit *Limosa lapponica*	Over winter: Greylag goose *Anser anser* Wigeon *Anas penelope*	Over winter: Waterfowl
Loch Eye SPA	205.14	Over winter: Whooper swan *Cygnus cygnus*	Over winter: Greylag goose *Anser anser*	N/A
Cromarty Firth SPA	3766.24	Breeding: Common tern *Sterna hirundo* Osprey *Pandion haliaetus* Over winter: Bar-tailed godwit *Limosa lapponica* Whooper swan *Cygnus cygnus*	Over winter: Greylag goose *Anser anser*	Over winter: Waterfowl

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages[4]
Inner Moray Firth SPA	2339.23	Breeding: Common tern *Sterna hirundo* Osprey *Pandion haliaetus* Over winter: Bar-tailed godwit *Limosa lapponica*	Over winter: Greylag goose *Anser anser* Red-breasted merganser *Mergus serrator* Redshank *Tringa totanus* Scaup *Aythya marila*	Over winter: Waterfowl
Moray and Nairn Coast SPA	2410.25	Breeding: Osprey *Pandion haliaetus* Over winter: Bar-tailed godwit *Limosa lapponica*	Over winter: Greylag goose *Anser anser* Pink-footed goose *Anser brachyrhynchus* Redshank *Tringa totanus*	Over winter: Waterfowl
Troup, Pennan and Lion's Heads SPA	174.22	N/A	Breeding: Guillemot *Uria aalge*	Breeding: Seabirds
Loch of Strathbeg SPA	615.94	Breeding: Sandwich tern *Sterna sandvicensis* Over winter: Barnacle goose *Branta leucopsis* Whooper swan *Cygnus cygnus*	Over winter: Greylag goose *Anser anser* Pink-footed goose *Anser brachyrhynchus*	Over winter: Waterfowl
Buchan Ness to Collieston Coast SPA	208.62	N/A	N/A	Breeding: Seabirds
Ythan Estuary, Sands of Forvie and Meikle Loch SPA	1016.24	Breeding: Common tern *Sterna hirundo* Little tern *Sterna albifrons* Sandwich tern *Sterna sandvicensis*	Over winter: Pink-footed goose *Anser brachyrhynchus*	Over winter: Waterfowl
Fowlsheugh SPA	10.15	N/A	Breeding: Guillemot *Uria aalge* Kittiwake *Rissa tridactyla*	Breeding: Seabirds
SOUTH OF ABERDEENSHIRE TO BORDERS				
Montrose Basin SPA	984.61	N/A	Over winter: Greylag goose *Anser anser* Knot *Calidris canutus* Pink-footed goose *Anser brachyrhynchus* Redshank *Tringa totanus*	Over winter: Waterfowl

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages[4]
Firth of Tay and Eden Estuary SPA	6923.29	Breeding: Little tern *Sterna albifrons* Marsh harrier *Circus aeruginosus* Over winter: Bar-tailed godwit *Limosa lapponica*	Over winter: Greylag goose *Anser anser* Pink-footed goose *Anser brachyrhynchus* Redshank *Tringa totanus*	Over winter: Waterfowl
Firth of Forth Islands SPA	105.06	Breeding: Arctic tern *Sterna paradisaea* Common tern *Sterna hirundo* Roseate tern *Sterna dougallii* Sandwich tern *Sterna sandvicensis*	Breeding: Gannet *Morus bassanus* Lesser black-backed Gull *Larus fuscus* Puffin *Fratercula arctica* Shag *Phalacrocorax aristotelis*	Breeding: Seabirds
Firth of Forth SPA	tbc	On passage: Sandwich tern *Sterna sandvicensis* Over winter: Bar-tailed godwit *Limosa lapponica* Golden plover *Pluvialis apricaria* Red-throated diver *Gavia stellata* Slavonian grebe *Podiceps auritus*	Over winter: Knot *Calidris canutus* Pink-footed goose *Anser brachyrhynchus* Redshank *Tringa totanus* Shelduck *Tadorna tadorna* Turnstone *Arenaria interpres*	Over winter: Waterfowl
St. Abb's Head to Fast Castle SPA	247.85	N/A	N/A	Breeding: Seabirds
NORTH EAST ENGLAND				
Lindisfarne SPA	3679.22	Breeding: Little tern *Sterna albifrons* Over winter: Bar-tailed godwit *Limosa lapponica* Golden plover *Pluvialis apricaria* Whooper swan *Cygnus cygnus*	On passage: Ringed plover *Charadrius hiaticula* Over winter: Grey plover *Pluvialis squatarola* Greylag goose *Anser anser* Knot *Calidris canutus* Light-bellied Brent goose *Branta bernicla hrota* Wigeon *Anas penelope*	Over winter: Waterfowl

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages[4]
Farne Islands SPA	101.86	Breeding: Arctic tern *Sterna paradisaea* Common tern *Sterna hirundo* Roseate tern *Sterna dougallii* Sandwich tern *Sterna sandvicensis*	Breeding: Guillemot *Uria aalge* Puffin *Fratercula arctica*	Breeding: Seabirds
Northumbria Coast SPA	1107.98	Breeding: Little tern *Sterna albifrons*	Over winter: Purple sandpiper *Calidris maritima* Turnstone *Arenaria interpres*	N/A
Coquet Island SPA	22.28	Breeding: Arctic tern *Sterna paradisaea* Common tern *Sterna hirundo* Roseate tern *Sterna dougallii* Sandwich tern *Sterna sandvicensis*	Breeding: Puffin *Fratercula arctica*	Breeding: Seabirds
Teesmouth and Cleveland Coast SPA	1247.31	Breeding: Little tern *Sterna albifrons* On passage: Sandwich tern *Sterna sandvicensis*	On passage: Ringed plover *Charadrius hiaticula* Over winter: Knot *Calidris canutus* Redshank *Tringa totanus*	Over winter: Waterfowl
YORKSHIRE AND HUMBER				
Flamborough Head and Bempton Cliffs SPA	212.17	N/A	Breeding: Kittiwake *Rissa tridactyla*	Breeding: Seabirds
Humber Flats, Marshes and Coast (Phases 1 and 2) SPA	15202.53	Breeding: Little tern *Sterna albifrons* Marsh harrier *Circus aeruginosus* Over winter: Bar-tailed godwit *Limosa lapponica* Bittern *Botaurus stellaris* Golden plover *Pluvialis apricaria* Hen harrier *Circus cyaneus*	On passage: Redshank *Tringa totanus* Sanderling *Calidris alba* Over winter: Dunlin *Calidris alpina alpina* Knot *Calidris canutus* Redshank *Tringa totanus* Shelduck *Tadorna tadorna*	Over winter: Waterfowl

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages[4]
LINCOLNSHIRE, NORFOLK and SUFFOLK				
Gibraltar Point SPA	414.09	Breeding: Little tern *Sterna albifrons* Over winter: Bar-tailed godwit *Limosa lapponica*	Over winter: Grey plover *Pluvialis squatarola* Knot *Calidris canutus*	Over winter: Waterfowl
The Wash SPA	62211.66	Breeding: Common tern *Sterna hirundo* Little tern *Sterna albifrons* Marsh harrier *Circus aeruginosus* Over winter: Avocet *Recurvirostra avosetta* Bar-tailed godwit *Limosa lapponica* Golden plover *Pluvialis apricaria* Whooper swan *Cygnus cygnus*	On passage: Ringed plover *Charadrius hiaticula* Sanderling *Calidris alba* Over winter: Black-tailed godwit *Limosa limosa islandica* Curlew *Numenius arquata* Dark-bellied Brent goose *Branta bernicla bernicla* Dunlin *Calidris alpina alpina* Grey plover *Pluvialis squatarola* Knot *Calidris canutus* Oystercatcher *Haematopus ostralegus* Pink-footed goose *Anser brachyrhynchus* Pintail *Anas acuta* Redshank *Tringa totanus* Shelduck *Tadorna tadorna* Turnstone *Arenaria interpres*	Over winter: Waterfowl

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages[4]
North Norfolk Coast SPA	7886.79	Breeding: Avocet *Recurvirostra avosetta* Bittern *Botaurus stellaris* Common tern *Sterna hirundo* Little tern *Sterna albifrons* Marsh harrier *Circus aeruginosus* Mediterranean gull *Larus melanocephalus* Roseate tern *Sterna dougallii* Sandwich tern *Sterna sandvicensis* Over winter: Avocet *Recurvirostra avosetta* Bar-tailed godwit *Limosa lapponica* Bittern *Botaurus stellaris* Golden plover *Pluvialis apricaria* Hen harrier *Circus cyaneus* Ruff *Philomachus pugnax*	Breeding: Redshank *Tringa totanus* Ringed plover *Charadrius hiaticula* On passage: Ringed plover *Charadrius hiaticula* Over winter: Dark-bellied Brent goose *Branta bernicla bernicla* Knot *Calidris canutus* Pink-footed goose *Anser brachyrhynchus* Pintail *Anas acuta* Redshank *Tringa totanus* Wigeon *Anas penelope*	Over winter: Waterfowl
Broadland SPA	5462.4	Breeding: Bittern *Botaurus stellaris* Marsh harrier *Circus aeruginosus* Over winter: Bewick's swan *Cygnus columbianus bewickii* Bittern *Botaurus stellaris* Ruff *Philomachus pugnax* Whooper swan *Cygnus cygnus*	Over winter: Gadwall *Anas strepera* Pink-footed goose *Anser brachyrhynchus* Shoveler *Anas clypeata*	Over winter: Waterfowl
Great Yarmouth North Denes SPA	149.19	Breeding: Little tern *Sterna albifrons*	N/A	N/A

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages[4]
Breydon Water SPA	1202.94	Breeding: Common tern *Sterna hirundo* Over winter: Avocet *Recurvirostra avosetta* Bewick's swan *Cygnus columbianus bewickii* Golden plover *Pluvialis apricaria*	N/A	Over winter: Waterfowl
Benacre to Easton Bavents SPA	516.83	Breeding: Bittern *Botaurus stellaris* Little tern *Sterna albifrons* Marsh harrier *Circus aeruginosus* Over winter: Bittern *Botaurus stellaris*	N/A	N/A
Minsmere-Walberswick SPA	2018.92	Breeding: Avocet *Recurvirostra avosetta* Bittern *Botaurus stellaris* Little tern *Sterna albifrons* Marsh harrier *Circus aeruginosus* Nightjar *Caprimulgus europaeus* Woodlark *Lullula arborea* Over winter: Avocet *Recurvirostra avosetta* Bittern *Botaurus stellaris* Hen harrier *Circus cyaneus*	N/A	N/A

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages[4]
Alde-Ore Estuary SPA	2416.87	Breeding: Avocet *Recurvirostra avosetta* Little tern *Sterna albifrons* Marsh harrier *Circus aeruginosus* Sandwich tern *Sterna sandvicensis* Over winter: Avocet *Recurvirostra avosetta*	Breeding: Lesser black-backed gull *Larus fuscus* Over winter: Redshank *Tringa totanus*	Breeding: Seabirds Over winter: Waterfowl
Deben Estuary SPA	978.93	Over winter: Avocet *Recurvirostra avosetta*	N/A	N/A
Stour and Orwell Estuaries SPA	3323.62	Over winter: Hen harrier *Circus cyaneus*	Over winter: Black-tailed godwit *Limosa limosa islandica* Dunlin *Calidris alpina alpina* Grey plover *Pluvialis squatarola* Pintail *Anas acuta* Redshank *Tringa totanus* Ringed plover *Charadrius hiaticula* Shelduck *Tadorna tadorna* Turnstone *Arenaria interpres*	Over winter: Waterfowl
ESSEX AND KENT				
Hamford Water SPA	2187.21	Breeding: Little tern *Sterna albifrons* Over winter: Avocet *Recurvirostra avosetta* Golden plover *Pluvialis apricaria* Ruff *Philomachus pugnax*	On passage: Ringed plover *Charadrius hiaticula* Over winter: Black-tailed godwit *Limosa limosa islandica* Dark-bellied Brent goose *Branta bernicla bernicla* Grey plover *Pluvialis squatarola* Ringed plover *Charadrius hiaticula* Teal *Anas crecca*	Over winter: Waterfowl

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages[4]
Colne Estuary (Mid-Essex Coast Phase 2) SPA	2701.43	Breeding: Little tern *Sterna albifrons* Over winter: Avocet *Recurvirostra avosetta* Golden plover *Pluvialis apricaria* Hen harrier *Circus cyaneus*	Over winter: Dark-bellied Brent goose *Branta bernicla bernicla* Redshank *Tringa totanus*	Over winter: Waterfowl
Blackwater Estuary (Mid-Essex Coast Phase 4) SPA	4395.15	Breeding: Little tern *Sterna albifrons* Over winter: Avocet *Recurvirostra avosetta* Golden plover *Pluvialis apricaria* Hen harrier *Circus cyaneus* Ruff *Philomachus pugnax*	On passage: Ringed plover *Charadrius hiaticula* Over winter: Black-tailed Godwit *Limosa limosa islandica* Dark-bellied Brent goose *Branta bernicla bernicla* Dunlin *Calidris alpina alpina* Grey plover *Pluvialis squatarola* Redshank *Tringa totanus* Ringed plover *Charadrius hiaticula* Shelduck *Tadorna tadorna*	Over winter: Waterfowl
Crouch and Roach Estuaries (Mid-Essex Coast Phase 3) SPA	1735.58	N/A	Over winter: Dark-bellied Brent goose *Branta bernicla bernicla*	N/A
Dengie (Mid-Essex Coast Phase 1) SPA	3127.23	Over winter: Bar-tailed godwit *Limosa lapponica* Hen harrier *Circus cyaneus*	Over winter: Grey plover *Pluvialis squatarola* Knot *Calidris canutus*	Over winter: Waterfowl
Benfleet and Southend Marshes SPA	2251.31	N/A	On passage: Ringed plover *Charadrius hiaticula* Over winter: Dark-bellied Brent goose *Branta bernicla bernicla* Grey plover *Pluvialis squatarola* Knot *Calidris canutus*	Over winter: Waterfowl

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages[4]
Foulness (Mid-Essex Coast Phase 5) SPA	10968.9	Breeding: Avocet *Recurvirostra avosetta* Common tern *Sterna hirundo* Little Tern *Sterna albifrons* Sandwich tern *Sterna sandvicensis* Over winter: Avocet *Recurvirostra avosetta* Bar-tailed godwit *Limosa lapponica* Golden plover *Pluvialis apricaria* Hen harrier *Circus cyaneus*	On passage: Redshank *Tringa totanus* Over winter: Dark-bellied Brent goose *Branta bernicla bernicla* Grey plover Pluvialis squatarola Knot *Calidris canutus* Oystercatcher *Haematopus ostralegus*	Over winter: Waterfowl
Thames Estuary and Marshes SPA	4838.94	Over winter: Avocet *Recurvirostra avosetta* Hen harrier *Circus cyaneus*	On passage: Ringed plover *Charadrius hiaticula* Over winter: Ringed plover *Charadrius hiaticula*	Over winter: Waterfowl
The Greater Thames Estuary pSPA	TBC	Red-throated diver *Gavia stellata*, black-throated Diver *Gavia arctica*	N/A	N/A
Medway Estuary and Marshes SPA	4684.36	Breeding: Avocet *Recurvirostra avosetta* Little Tern *Sterna albifrons* Over winter: Avocet *Recurvirostra avosetta*	On passage: Ringed plover *Charadrius hiaticula* Over winter: Black-tailed godwit *Limosa limosa islandica* Dark-bellied Brent goose *Branta bernicla bernicla* Dunlin *Calidris alpina alpina* Grey plover *Pluvialis squatarola* Pintail *Anas acuta* Redshank *Tringa totanus* Ringed plover *Charadrius hiaticula* Shelduck *Tadorna tadorna*	Over winter: Waterfowl

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages[4]
The Swale SPA	6514.71	Breeding: Avocet *Recurvirostra avosetta* Marsh harrier *Circus aeruginosus* Mediterranean gull *Larus melanocephalus* Over winter: Avocet *Recurvirostra avosetta* Bar-tailed godwit *Limosa lapponica* Golden plover *Pluvialis apricaria* Hen harrier *Circus cyaneus*	On passage: Ringed plover *Charadrius hiaticula* Over winter: Black-tailed godwit *Limosa limosa islandica* Grey plover *Pluvialis squatarola* Knot *Calidris canutus* Pintail *Anas acuta* Redshank *Tringa totanus* Shoveler *Anas clypeata*	Over winter: Waterfowl
Thanet Coast and Sandwich Bay SPA	1870.16	N/A	Over winter: Turnstone *Arenaria interpres*	N/A
Dungeness to Pett Level SPA	1474.04	Breeding: Common tern *Sterna hirundo* Little tern *Sterna albifrons* Mediterranean gull *Larus melanocephalus* On passage: Aquatic warbler *Acrocephalus paludicola* Over winter: Bewick's swan *Cygnus columbianus bewickii*	Over winter: Shoveler *Anas clypeata*	N/A

Table A.2 West Coast SPAs from Islay to Pembrokeshire and their Qualifying Features

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages
ISLAY TO KINTYRE				
Gruinart Flats, Islay SPA	3261.32	Over winter: Barnacle goose *Branta leucopsis* Greenland white-fronted goose *Anser albifrons flavirostris*	N/A	N/A

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages
Rinns of Islay SPA	9407.46	Breeding: Chough *Pyrrhocorax pyrrhocorax* Corncrake *Crex crex* Hen harrier *Circus cyaneus* On passage: Whooper swan *Cygnus cygnus* Over winter: Chough *Pyrrhocorax pyrrhocorax* Greenland white-fronted goose *Anser albifrons flavirostris*	Breeding: Common scoter *Melanitta nigra*	N/A
Bridgend Flats, Islay SPA	331.16	Over winter: Barnacle goose *Branta leucopsis*	N/A	N/A
Laggan, Islay SPA	1230.02	Over winter: Barnacle goose *Branta leucopsis* Greenland white-fronted goose *Anser albifrons flavirostris*	N/A	N/A
NORTH NORTHERN IRELAND				
Rathlin Island SPA	3344.62	Breeding: Peregrine *Falco peregrinus*	Breeding: Guillemot *Uria aalge* Razorbill *Alca torda*	Breeding: Seabird
Sheep Island SPA	3.5	Breeding: Cormorant *Phalacrocorax carbo*	N/A	N/A
EAST NORTHERN IRELAND				
Larne Lough SPA	395.94	Breeding: Common tern *Sterna hirundo* Roseate tern *Sterna dougallii* Sandwich tern *Sterna sandvicensis*	Over winter: Light-bellied Brent goose *Branta bernicula hrota*	N/A
Belfast Lough SPA	432.14	Over winter: Bar-tailed godwit *Limosa lapponica*	Redshank *Tringa totanus* Turnstone *Arenaria interpres*	Over winter: Waterfowl
Outer Ards SPA	1410.41	Breeding: Arctic tern *Sterna paradisaea* Over winter: Golden plover *Pluvialis apricaria*	Over winter: Light-bellied Brent goose *Branta bernicula hrota* Ringed plover *Charadrius hiaticula* Turnstone *Arenaria interpres*	N/A

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages
Strangford Lough SPA	15580.79	Breeding: Arctic tern *Sterna paradisaea* Common tern *Sterna hirundo* Sandwich tern *Sterna sandvicensis* Over winter: Bar-tailed godwit *Limosa lapponica* Golden plover *Pluvialis apricaria*	Over winter: Knot *Calidris canutus* Light-bellied Brent goose *Branta bernicula hrota* Redshank *Tringa totanus* Shelduck *Tadorna tadorna*	Over winter: Waterfowl
Killough Bay SPA	104.23	N/A	Over winter: Light-bellied Brent goose *Branta bernicula hrota*	N/A
Carlingford Lough SPA	827.12	Breeding: Common tern *Sterna hirundo* Sandwich tern *Sterna sandvicensis*	Over winter: Light-bellied Brent goose *Branta bernicula hrota*	N/A
SOUTHWEST SCOTLAND				
Black Cart SPA	56.3	Over winter: Whooper swan *Cygnus cygnus*	N/A	N/A
Inner Clyde Estuary SPA	1826.02	N/A	Over winter: Redshank *Tringa totanus*	N/A
Ailsa Craig SPA	99.94	N/A	Breeding: Gannet *Morus bassanus* Lesser black-backed gull *Larus fuscus*	Breeding: Seabird
Loch of Inch & Torrs Warren SPA	2111.04	Over winter: Greenland white-fronted goose *Anser albifrons flavirostris* Hen harrier *Circus cyaneus*	N/A	N/A

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages
Upper Solway Flats and Marshes SPA	30706.26	Over winter: Bar-tailed godwit *Limosa lapponica* Barnacle goose *Branta leucopsis* Golden plover *Pluvialis apricaria* Whooper swan *Cygnus cygnus*	On passage: Ringed plover *Charadrius hiaticula* Over winter: Curlew *Numenius arquata* Dunlin *Calidris alpina alpina* Knot *Calidris canutus* Oystercatcher *Haematopus ostralegus* Pink-footed goose *Anser brachyrhynchus* Pintail *Anas acuta* Redshank *Tringa totanus*	Over winter: Waterfowl
NORTHWEST ENGLAND				
Duddon Estuary SPA	6806.3	Breeding: Sandwich tern *Sterna sandvicensis*	On passage: Ringed plover *Charadrius hiaticula* Sanderling *Calidris alba* Over winter: Knot *Calidris canutus* Pintail *Anas acuta* Redshank *Tringa totanus*	Over winter: Waterfowl

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages
Morecambe Bay SPA	37404.6	Breeding: Little tern *Sterna albifrons* Sandwich tern *Sterna sandvicensis* Over winter: Bar-tailed godwit *Limosa lapponica* Golden plover *Pluvialis apricaria*	Breeding season: Lesser black-backed gull *Larus fuscus* Herring gull *Larus argentatus* On passage: Ringed plover *Charadrius hiaticula* Sanderling *Calidris alba* Over winter: Curlew *Numenius arquata* Dunlin *Calidris alpina alpina* Grey plover *Pluvialis squatarola* Knot *Calidris canutus* Oystercatcher *Haematopus ostralegus* Pink-footed goose *Anser brachyrhynchus* Pintail *Anas acuta* Redshank *Tringa totanus* Shelduck *Tadorna tadorna* Turnstone *Arenaria interpres*	Breeding: Seabird Over winter: Waterfowl

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages
Ribble and Alt Estuaries SPA	12361.13	Breeding: Common tern *Sterna hirundo* Ruff *Philomachus pugnax* Over winter: Bar-tailed godwit *Limosa lapponica* Berwick's swan *Cygnus columbianus bewickii* Golden plover *Pluvialis apricaria* Whooper swan *Cygnus cygnus*	Breeding: Lesser black-backed gull *Larus fuscus* On passage: Ringed plover *Charadrius hiaticula* Sanderling *Calidris alba* Over winter: Black-tailed godwit *Limosa limosa islandica* Dunlin *Calidris alpina alpina* Grey plover *Pluvialis squatarola* Knot *Calidris canutus* Oystercatcher *Haematopus ostralegus* Pink-footed goose *Anser brachyrhynchus* Pintail *Anas acuta* Redshank *Tringa totanus* Sanderling *Calidris alba* Shelduck *Tadorna tadorna* Teal *Anas crecca* Widgeon *Anas penelope*	Breeding: Seabird Over winter: Waterfowl
Mersey Narrows and North Wirral Foreshore pSPA	2089.41	N/A	Over winter: Redshank *Tringa totanus* Turnstone *Arenaria interpres*	Over winter: Waterfowl

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages
Mersey Estuary SPA	5033.14	Over winter: Golden plover *Pluvialis apricaria*	On passage: Redshank *Tringa totanus* Ringed plover *Charadrius hiaticula* Over winter: Dunlin *Calidris alpina alpina* Pintail *Anas acuta* Redshank *Tringa totanus* Shelduck *Tadorna tadorna* Teal *Anas crecca*	Over winter: Waterfowl
Liverpool Bay pSPA	197,504	Red-throated diver *Gavia stellata*	Migratory Species: Common scoter *Melanitta nigra,*	N/A
Dee Estuary SPA	13076.29	Breeding: Common tern *Sterna hirundo* Little tern *Sterna albifrons* On passage: Sandwich tern *Sterna sandvicensis* Over winter: Bar-tailed godwit *Limosa lapponica*	On passage: Redshank *Tringa totanus* Over winter: Black-tailed godwit *Limosa limosa islandica* Curlew *Numenius arquata* Dunlin *Calidris alpina alpina* Grey plover *Pluvialis squatarola* Knot *Calidris canutus* Oystercatcher *Haematopus ostralegus* Pintail *Anas acuta* Redshank *Tringa totanus* Shelduck *Tadorna tadorna* Teal *Anas crecca*	Over winter: Waterfowl
NORTH AND WEST WALES				
Traeth Lafan / Lavan Sands, Conway Bay SPA	2642.98	N/A	Over winter: Oystercatcher *Haematopus ostralegus*	N/A
Ynys Seiriol / Puffin Island SPA	31.21	N/A	Breeding: Cormorant *Phalacrocorax carbo*	N/A

Site Name	Area (ha)	Article 4.1 Species	Article 4.2 Migratory species	Article 4.2 Assemblages
Ynys Feurig, Cemlyn Bay and The Skerries SPA	85.66	Breeding: Arctic tern *Sterna paradisaea* Common tern *Sterna hirundo* Roseate tern *Sterna dougallii* Sandwich tern *Sterna sandvicensis*	N/A	N/A
Glannau Ynys Gybi/Holy Island Coast SPA	352.59	Breeding: Chough *Pyrrhocorax pyrrhocorax* Over winter: Chough *Pyrrhocorax pyrrhocorax*	N/A	N/A
Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA	505.03	Breeding: Chough *Pyrrhocorax pyrrhocorax* Over winter: Chough *Pyrrhocorax pyrrhocorax*	Breeding: Manx shearwater *Puffinus puffinus*	N/A
Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal SPA	373.55	Breeding: Chough *Pyrrhocorax pyrrhocorax* Over winter: Chough *Pyrrhocorax pyrrhocorax*	N/A	N/A
Dyfi Estuary/Aber Dyfi SPA	2048.11	Over winter: Greenland white-fronted goose *Anser albifrons flavirostris*	N/A	N/A
Ramsey, St. David's Peninsula Coast SPA	845.63	Breeding: Chough *Pyrrhocorax pyrrhocorax* Over winter: Chough *Pyrrhocorax pyrrhocorax*	N/A	N/A
Grassholm SPA	10.72	N/A	Breeding: Gannet *Morus bassanus*	N/A
Skokholm and Skomer SPA	427.71	Breeding: Chough *Pyrrhocorax pyrrhocorax* Short-eared owl *Asio flammeus* Storm petrel *Hydrobates pelagicus*	Breeding: Lesser black-backed gull *Larus fuscus* Manx shearwater *Puffinus puffinus* Puffin *Fratercula arctica*	Breeding: Seabird

A3 Coastal and Marine Special Areas of Conservation

Figure A.4 Location of SACs - Shetland to the Tay

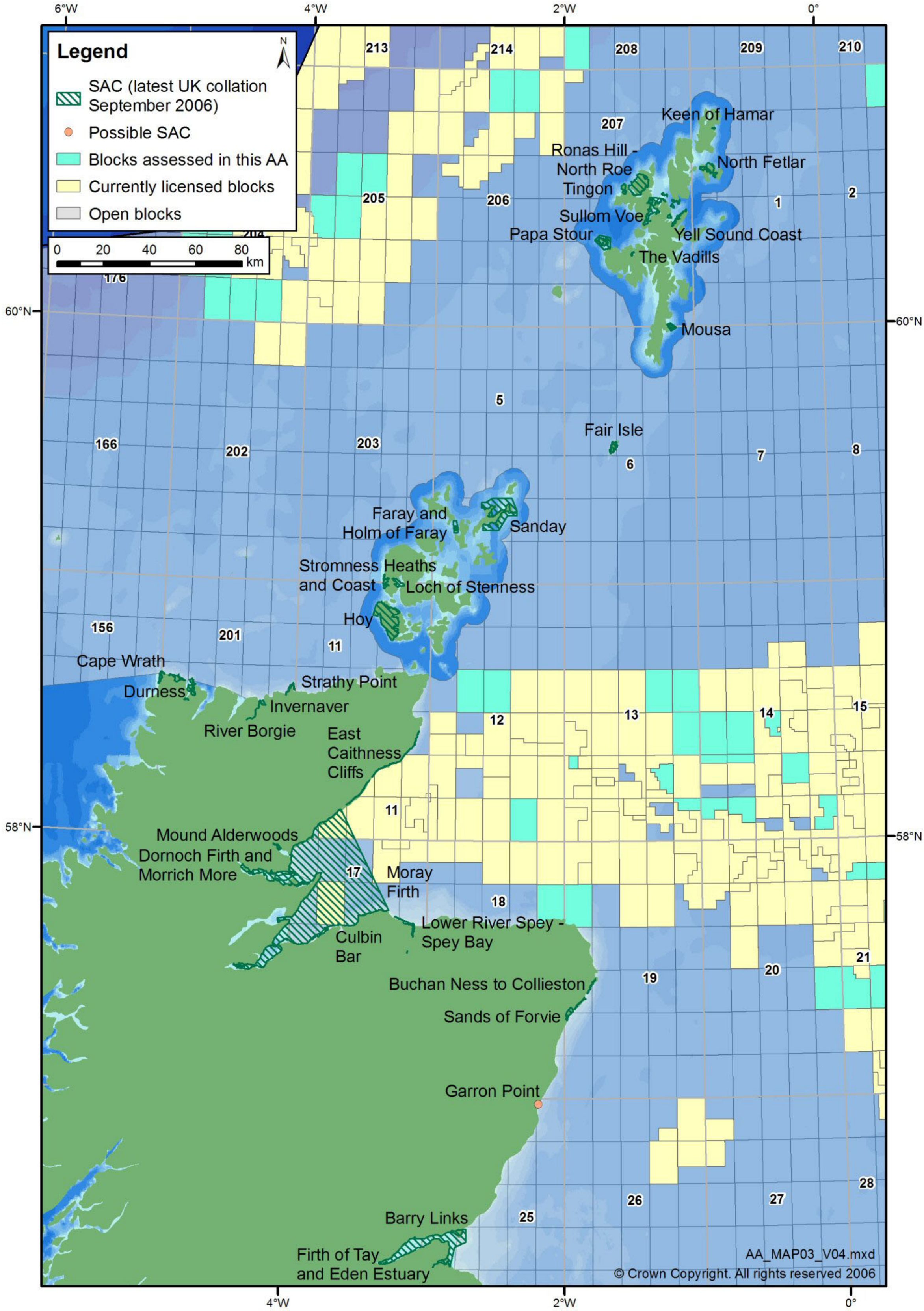


Figure A.5 Location of SACs - Forth to Teesmouth and Islay to Pembrokeshire

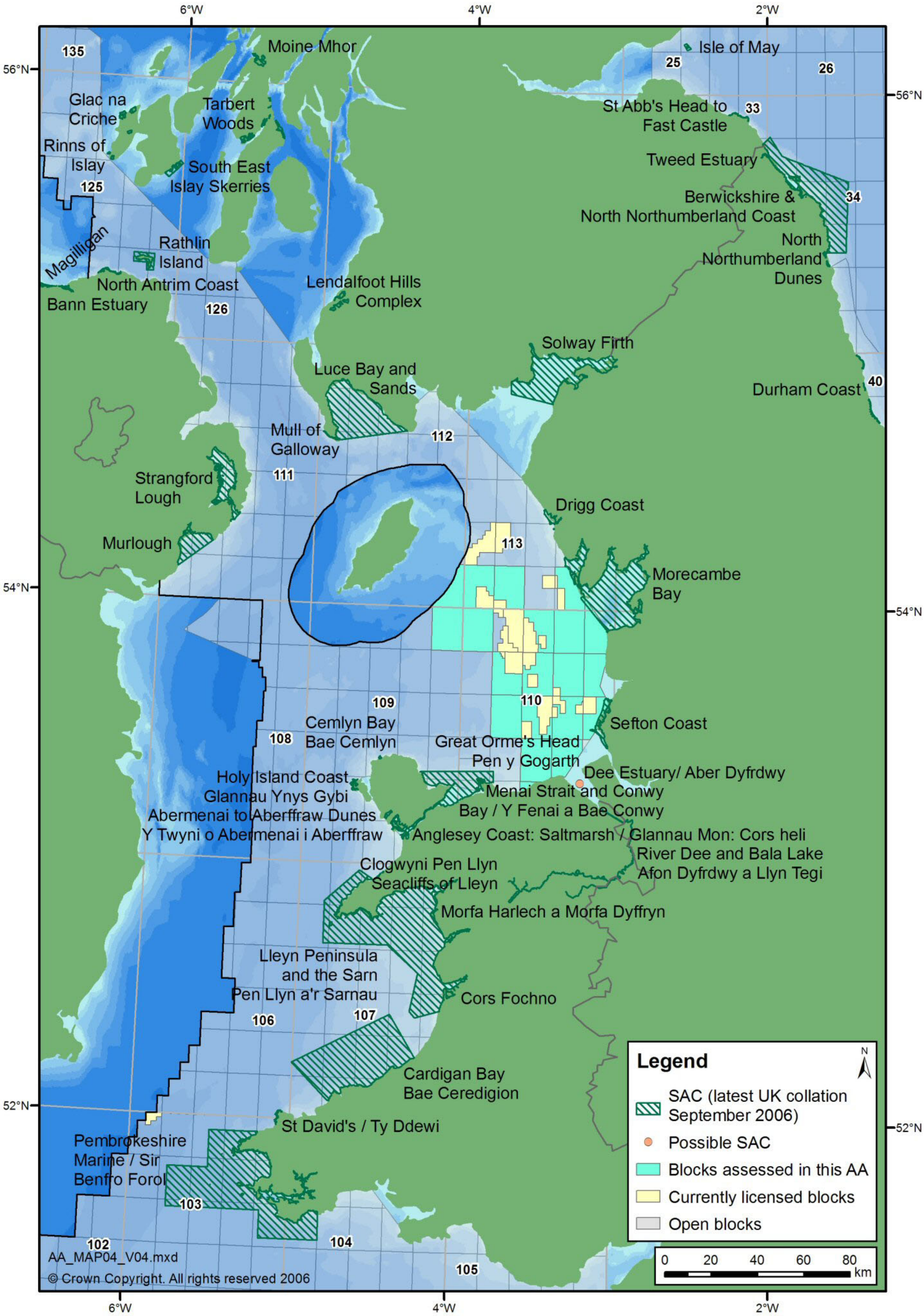


Figure A.6 Location of SACs – Durham to Kent

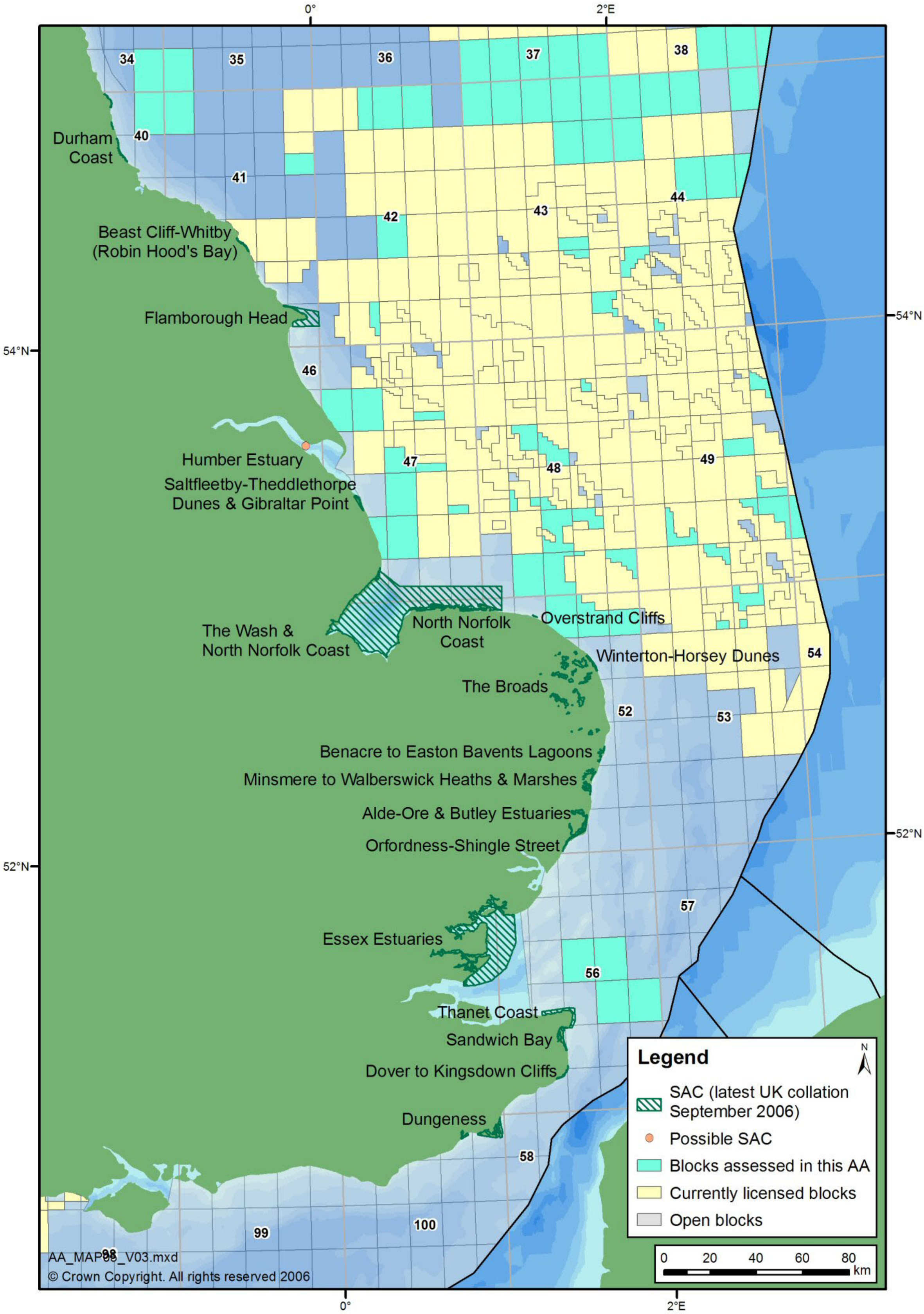


Table A.3 East Coast SACs from Shetland to Kent and their Qualifying Features

Site Name	Area (ha)	Annex 1 Habitat Primary	Annex 1 Habitat Qualifying	Annex II Species Primary	Annex II Species Qualifying
SHETLAND					
The Vadills SAC	62.43	Coastal lagoons	N/A	N/A	N/A
Papa Stour SAC	2076.69	Reefs Sea caves	N/A	N/A	N/A
Tingon SAC	569.3	Bogs	Standing freshwater	N/A	N/A
Ronas Hill-North Roe SAC	4900.9	Standing freshwater Heath Bogs	Heath Scree	N/A	N/A
Sullom Voe SAC	2698.55	Inlets and bays	Coastal lagoons Reefs	N/A	N/A
Yell Sound Coast SAC	1540.55	N/A	N/A	Otter *Lutra lutra* Common seal *Phoca vitulina*	N/A
Keen of Hamar SAC	38.52	Grasslands Scree	Heath	N/A	N/A
North Fetlar SAC	1581.93	Heath Fens	N/A	N/A	N/A
Mousa SAC	530.6	N/A	Reefs Sea caves	Common seal *Phoca vitulina*	N/A
Fair Isle SAC	561.27	Sea cliffs	Heaths	N/A	N/A
ORKNEY					
Hoy SAC	9499.7	Sea cliffs Standing freshwater Heath Bog	Heath Fens Rocky slopes	N/A	N/A
Loch of Stenness SAC	791.87	Coastal lagoons	N/A	N/A	N/A
Stromness Heaths and Coasts SAC	635.78	Sea cliffs Heath	Fens	N/A	N/A
Faray and Holm of Faray SAC	785.68	N/A	N/A	Grey seal *Halichoerus grypus*	N/A
Sanday SAC	10971.65	Reefs	Sandbanks Mudflats and sandflats	Common seal *Phoca vitulina*	N/A
NORTH COAST OF SCOTLAND					
Cape Wrath SAC	1018.18	Sea cliffs	N/A	N/A	N/A

Site Name	Area (ha)	Annex 1 Habitat Primary	Annex 1 Habitat Qualifying	Annex II Species Primary	Annex II Species Qualifying
Durness SAC	1212.74	Coastal dunes Standing freshwater Grasslands Limestone pavements	Coastal dunes Heath Grasslands Fens	N/A	Otter *Lutra lutra*
Invernaver SAC	294.54	Coastal dunes Heath Grasslands	Coastal dunes Fens	N/A	N/A
River Borgie SAC	32.72	N/A	N/A	Freshwater pearl mussel *Margaritifera margaritifera*	Atlantic salmon *Salmo salar* Otter *Lutra lutra*
Strathy Point SAC	203.58	Sea cliffs	N/A	N/A	N/A
MORAY FIRTH AND ABERDEENSHIRE					
East Caithness Cliffs SAC	442.64	Sea cliffs	N/A	N/A	N/A
Mound Alderwoods SAC	297.33	Forests	N/A	N/A	N/A
Moray Firth SAC	151341.67	N/A	Sandbanks	Bottlenose dolphin *Tursiops truncatus*	N/A
Dornoch Firth and Morrich More SAC	8700.53	Estuaries Mudflats and sandflats Saltmarsh and saltmeadows Salt meadows Coastal dunes	Sandbanks Reefs	Otter *Lutra lutra* Common seal *Phoca vitulina*	N/A
Culbin Bar SAC	612.88	Vegetation of stony banks	Salt meadows Coastal dunes	N/A	N/A
Lower River Spey - Spey Bay SAC	652.6	Vegetation of stony banks Forests	N/A	N/A	N/A
Buchan Ness to Collieston SAC	207.52	Sea cliffs	N/A	N/A	N/A
Sands of Forvie SAC	734.05	Coastal dunes	N/A	N/A	N/A
SOUTH OF ABERDEENSHIRE TO THE BORDERS					
Garron Point cSAC	15.58	N/A	N/A	Narrow-mouthed whorl snail *Vertigo angustior*	N/A
Barry Links SAC	789.67	Coastal dunes	N/A	N/A	N/A
Firth of Tay and Eden Estuary SAC	15412.53	Estuaries	Sandbanks Mudflats and sandflats	Common seal *Phoca vitulina*	N/A

Site Name	Area (ha)	Annex 1 Habitat Primary	Annex 1 Habitat Qualifying	Annex II Species Primary	Annex II Species Qualifying
Isle of May SAC	356.75	N/A	Reefs	Grey seal *Halichoerus grypus*	N/A
St. Abb's Head to Fast Castle SAC	127.52	Sea cliffs	N/A	N/A	N/A
NORTH EAST ENGLAND					
Berwickshire and North Northumberland Coast SAC	65045.5	Mudflats and sandflats Inlets and Bays Reefs Submerged or partially submerged sea caves	N/A	Grey seal *Halichoerus grypus*	N/A
Tweed Estuary SAC	155.93	Estuaries Mudflats and sandflats	N/A	N/A	Sea lamprey *Petromyzon marinus* River lamprey *Lampetra fluviatilis*
North Northumberland Dunes SAC	1147.56	Coastal dunes		Petalwort *Petalophyllum ralfsii*	
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 pSAC	39492.89	Priority not assigned Estuaries Coastal lagoons Salt marshes and salt meadows *Salicornia* and other annuals colonising mud and sand Mudflats and sandflats Sandbanks		Priority not assigned River lamprey *Lampetra fluviatilis* Sea lamprey *Petromyzon marinus*	
LINCOLNSHIRE, NORFOLK AND SUFFOLK					
Saltfleetby - Theddlethorpe Dunes and Gibraltar Point SAC	960.2	Coastal dunes	Coastal dunes	N/A	N/A

Site Name	Area (ha)	Annex 1 Habitat Primary	Annex 1 Habitat Qualifying	Annex II Species Primary	Annex II Species Qualifying
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
ESSEX AND KENT					
Essex Estuaries SAC	46140.82	Estuaries Mudflats and sandflats Salt marshes and salt meadows	Sandbanks	N/A	N/A
Thanet Coast SAC	2803.84	Reefs Sea caves	N/A	N/A	N/A

Site Name	Area (ha)	Annex 1 Habitat Primary	Annex 1 Habitat Qualifying	Annex II Species Primary	Annex II Species Qualifying
Sandwich Bay SAC	1137.87	Coastal dunes	Coastal dunes	N/A	N/A
Dover to Kingsdown Cliffs SAC	183.85	Sea cliffs	Grasslands	N/A	N/A
Dungeness SAC	3223.56	Vegetation of drift lines Vegetation of stony banks	N/A	Great crested newt *Triturus cristatus*	N/A

Table A.4 West Coast SACs from Islay to Pembrokeshire and their Qualifying Features

Site Name	Area (ha)	Annex 1 Habitat Primary	Annex 1 Habitat Qualifying	Annex II Species Primary	Annex II Species Qualifying
ISLAY TO KINTYRE					
Moine Mhor SAC	1150.41	Bogs	Mudflats and sandflats Salt marshes and salt meadows Forests	N/A	Marsh fritillary butterfly *Euphydryas* (*Eurodryas, Hypodryas*) *aurinia* Otter *Lutra lutra*
Glac na Criche SAC	265.33	Bogs	Sea cliffs Heaths	N/A	Marsh fritillary butterfly *Euphydryas* (*Eurodryas, Hypodryas*) *aurinia*
Rinns of Islay SAC	1149.7	N/A	N/A	Marsh fritillary butterfly *Euphydryas* (*Eurodryas, Hypodryas*) *aurinia*	N/A
South-East Islay Skerries SAC	1498.3	N/A	N/A	Common seal *Phoca vitulina*	N/A
Tayvallich Juniper and Coast SAC	1213.47	Scrub (matorral)	N/A	Marsh fritillary butterfly *Euphydryas* (*Eurodryas, Hypodryas*) *aurinia*	Otter *Lutra lutra*
Tarbert Woods SAC	1595.97	Forests	N/A	N/A	N/A
NORTH NORTHERN IRELAND					
Magilligan SAC	1058.22	Coastal dunes	Coastal dunes	N/A	Marsh fritillary butterfly *Euphydryas* (*Eurodryas, Hypodryas*) *aurinia* Petalwort *Petalophyllum ralfsii*
Bann Estuary SAC	347.94	Coastal dunes	Salt marshes and salt meadows Coastal dunes	N/A	N/A
Rathlin Island SAC	3344.62	Reefs	Sandbanks	N/A	N/A

Site Name	Area (ha)	Annex 1 Habitat Primary	Annex 1 Habitat Qualifying	Annex II Species Primary	Annex II Species Qualifying
		Sea cliffs Sea caves	Vegetation of drift lines		
North Antrim Coast SAC	314.59	Sea cliffs	Vegetation of drift lines Salt marshes and salt meadows Coastal dunes Grasslands	Narrow-mouthed whorl snail *Vertigo angustior*	N/A
EAST NORTHERN IRELAND					
Strangford Lough SAC	15398.54	Mudflats and sandflats Coastal lagoons Inlets and bays Reefs	Vegetation of drift lines Vegetation of stony banks Salt marshes and salt meadows	N/A	Common seal *Phoca vitulina*
Murlough SAC	11902.03	Coastal dunes	Sandbanks Mudflats and sandflats Salt marshes and salt meadows Coastal dunes	Marsh fritillary butterfly *Euphydryas* (*Eurodryas, Hypodryas*) *aurinia*	Common seal *Phoca vitulina*
SOUTHWEST SCOTLAND					
Lendalfoot Hills Complex SAC	1309.71	Grassland Fens	Heaths Grasslands Bogs	N/A	N/A
Mull of Galloway SAC	136.39	Sea cliffs	N/A	N/A	N/A
Luce Bay and Sands SAC	48759.28	Inlets and bays Coastal dunes	Sandbanks Mudflats and sandflats Reefs	N/A	Great crested newt *Triturus cristatus*
Solway Firth SAC	43636.72	Sandbanks Estuaries Mudflats and sandflats Salt marshes and salt meadows	Reefs Vegetation of stony banks Coastal dunes	Sea lamprey *Petromyzon marinus* River lamprey *Lampetra fluviatilis*	N/A
NORTHWEST ENGLAND					
Drigg Coast SAC	1397.44	Estuaries Coastal dunes	Mudflats and sandflats Salt marshes and salt meadows Coastal dunes	N/A	N/A

Site Name	Area (ha)	Annex 1 Habitat Primary	Annex 1 Habitat Qualifying	Annex II Species Primary	Annex II Species Qualifying
Morecambe Bay SAC	61506.22	Estuaries Mudflats and sandflats Inlets and bays Vegetation of stony banks Salt marshes and salt meadows Coastal dunes	Sandbanks Coastal lagoons Reefs Coastal dunes	Great crested newt *Triturus cristatus*	N/A
Sefton Coast SAC	4563.97	Coastal dunes	Coastal dunes	Petalwort *Petalophyllum ralfsii*	Great crested newt *Triturus cristatus*
Dee Estuary pSAC	14,000ha (approximately)		Estuary Mudflats and sandflats Salt marshes and salt meadows, vegetation of drift lines		River lamprey *Lampetra fluviatilis* Sea lamprey *Petromyzon marinus*
River Dee and Bala Lake SAC	1308.93	Running freshwater	N/A	Atlantic salmon *Salmo salar* Floating water-plantain *Luronium natans*	Sea lamprey *Petromyzon marinus* Brook lamprey *Lampetra planeri* River lamprey *Lampetra fluviatilis* Bullhead *Cottus gobio* Otter *Lutra lutra*
NORTH AND WEST WALES					
Great Orme's Head / Pen y Gogarth SAC	302.63	Heaths Grasslands	Sea cliffs	N/A	N/A
Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC	26482.67	Sandbanks Mudflats and sandflats Reefs	Inlets and bays Sea caves	N/A	N/A
Bae Cemlyn/Cemlyn Bay SAC	43.43	Coastal lagoons	Vegetation of stony banks	N/A	N/A
Glannau Ynys Gybi/Holy Island Coast SAC	464.27	Sea cliffs Heaths	Heaths	N/A	N/A
Glannau Môn: Cors heli/Anglesey Coast: Saltmarsh SAC	1058	Salt marshes and salt meadows	Estuaries Mudflats and sandflats	N/A	N/A
Y Twyni o Abermenai i	1871.03	Coastal dunes	Standing freshwater	Petalwort *Petalophyllum*	N/A

Site Name	Area (ha)	Annex 1 Habitat Primary	Annex 1 Habitat Qualifying	Annex II Species Primary	Annex II Species Qualifying
Aberffraw/Abermenai to Aberffraw Dunes SAC				*ralfsii* Shore dock *Rumex rupestris*	
Clogwyni Pen Llyn/Seacliffs of Lleyn SAC	1048.4	Sea cliffs	N/A	N/A	N/A
Pen Llyn a`r Sarnau/Lleyn Peninsula and the Sarnau SAC	146023.48	Sandbanks Estuaries Coastal lagoons Inlets and bays Reefs	Mudflats and sandflats Salt marshes and salt meadows Sea caves	N/A	Bottlenose dolphin *Tursiops truncatus* Otter *Lutra lutra* Grey Seal *Halichoerus grypus*
Morfa Harlech a Morfa Dyffryn SAC	1062.57	Coastal dunes	N/A	Petalwort *Petalphyllum ralfsii*	N/A
Cors Fochno SAC	652.71	Bogs	Bogs	N/A	N/A
Cardigan Bay/Bae Ceredigion SAC	95860.36	N/A	Sandbanks Reefs Sea caves	Bottlenose dolphin *Tursiops truncatus*	Sea lamprey *Petromyzon marinus* River lamprey *Lampetra fluviatilis* Grey Seal *Halichoerus grypus*
St David's/Ty Ddewi SAC	935.47	Sea cliffs Heaths	N/A	Floating water-plantain *Luronium natans*	N/A
Pembrokeshire Marine/Sir Benfro Forol SAC	138069.45	Estuaries Inlets and bays Reefs	Sandbanks Mudflats and sandflats Lagoons Salt marshes and salt meadows Sea caves	Grey Seal *Halichoerus grypus* Shore dock *Rumex rupestris*	Sea lamprey *Petromyzon marinus* River lamprey *Lampetra fluviatilis* Allis shad *Alosa alosa* Twaite shad *Alosa fallax* Otter *Lutra lutra*

A4 Offshore Special Areas of Conservation

Figure A.7 Location of offshore SACs in the Central North Sea

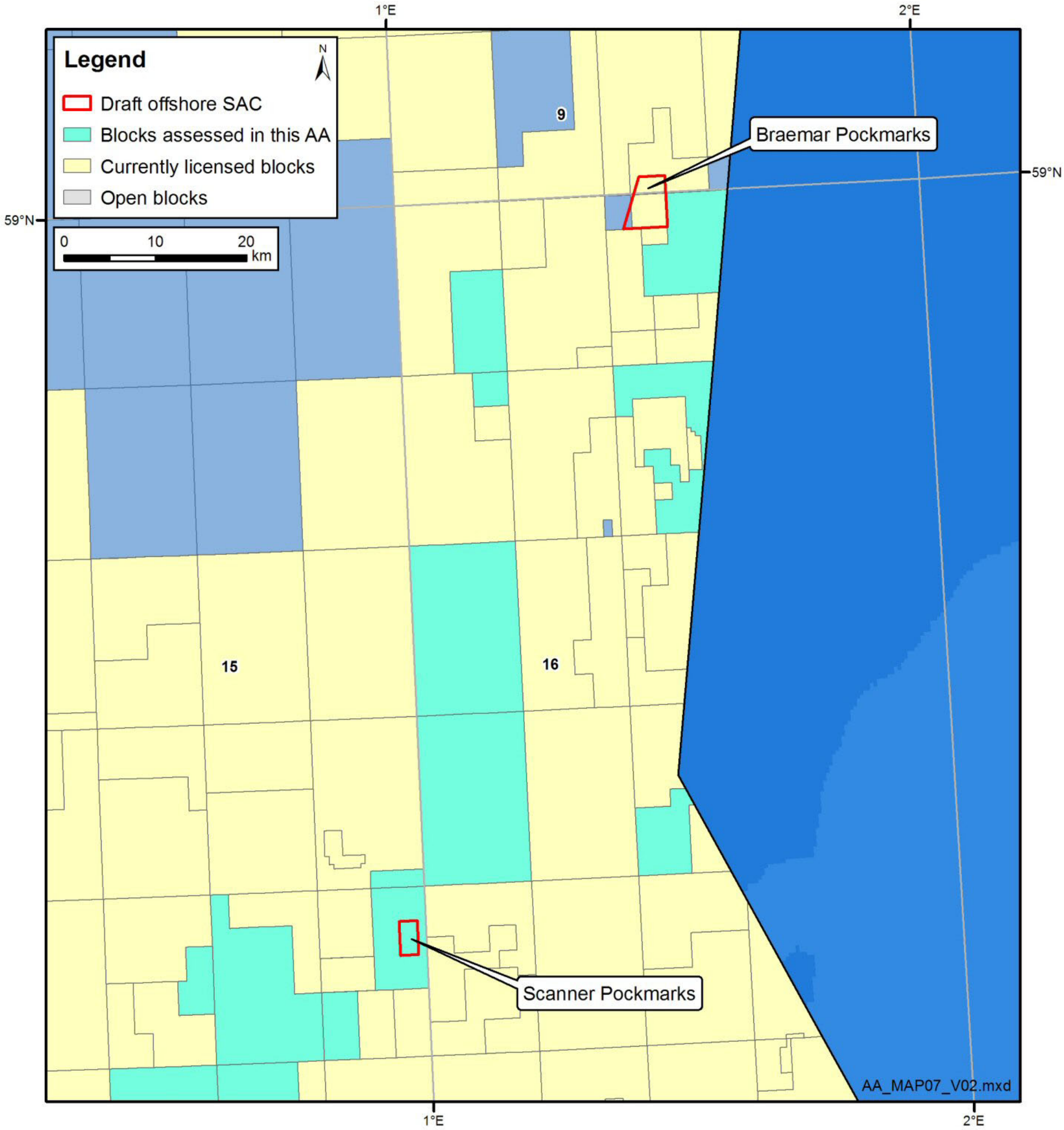


Figure A.8 Location of offshore SACs in the Southern North Sea

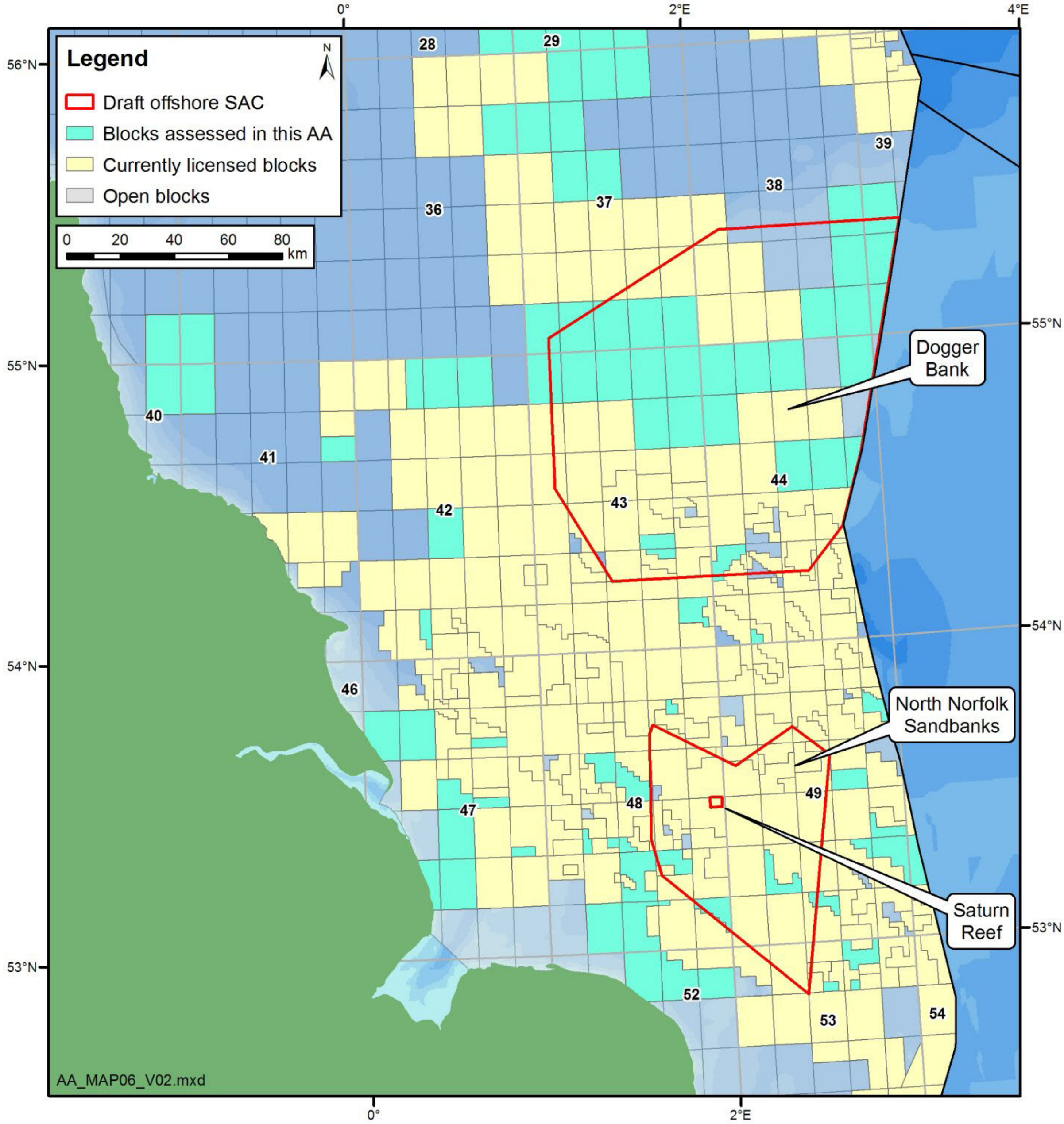


Table A.5 Offshore SACs and their Qualifying Features

Site Name	Area (ha)	Annex I Habitat Qualifying	Annex II Species Qualifying
Darwin Mounds[5] pSAC	152900	Reefs (biogenic *Lophelia pertusa*)	N/A
Wyville Thompson Ridge dSAC[3]	153324	Reefs	N/A

[5] For location of these 2 sites see Figure 3.2

Site Name	Area (ha)	Annex I Habitat Qualifying	Annex II Species Qualifying
Braemar Pockmarks dSAC	2134	Submarine structures made by leaking gases	N/A
Scanner Pockmark dSAC	724.9	Submarine structures made by leaking gases	N/A
Dogger Bank dSAC	1340527	Sandbanks	N/A
North Norfolk Sandbanks and Saturn Reef dSAC	432651.4	Sandbanks Reefs (biogenic *Sabellaria spinulosa*)	N/A

In addition to the sites listed in Table A.5, an area of reef (bedrock and stony), often referred to as the Irish Sea Mounds, has been identified in the northwest Irish Sea. The potential conservation value of this site has been acknowledged by the JNCC (Johnston *et al*. 2004), however, a proposed area for SAC designation has not yet been submitted.

A5 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 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

Annex I Habitat (abbreviated)	Annex I Habitat(s) (full description)
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
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* 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

APPENDIX B – CONSIDERATION OF SITES AND POTENTIAL EFFECTS FROM OIL SPILLS

B1 Overview of effect and context (frequency and severity, coastal vs offshore)

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 reviewed in successive SEAs covering the UKCS areas under consideration in the 24th Round. In part, this is because oil spills are probably the issue of greatest public concern in relation to the offshore oil and gas industry (although evidence indicates this is a perceived risk, as opposed to objective risk). SEAs 1 to 6 have concluded, for successive parts of the UKCS, 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)).

Direct mortality of seabirds in the event of oil spill is clearly highly relevant in the context of designated coastal breeding site SPAs (and possible SPA extensions). In relation to nearshore areas designated as SPAs due to concentrations of waterbirds, vulnerability to surface pollution has been quantified by JNCC in terms of the Offshore Vulnerability Index (OVI). Additional analyses have been carried out in some areas; for example, analysis of seasonal importance of sub-areas of the Irish Sea, in terms of abundance of divers, grebes and seaduck, was carried out as part of supporting studies for SEA 6 (Barton & Pollock 2005)

For activities in proximity to sensitive shorelines, the DTI 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 European Sites by activities resulting from the proposed 24th 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.

B2 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** – 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 has been undertaken by UKOOA (2002). This suggested that the best indicator of oil spill frequency was volume of production (rather than number of installations, number of fields or type of installation, although these all have an influence). From 1975 and 2001, between zero and 2.3 spills occurred each year per million tonnes of oil produced (or oil-equivalent, in the case of gas/condensate production).

An annual review of reported oil and chemical spills in UK waters – covering both vessels and offshore installations – is made on behalf of the Maritime and Coastguard Agency by the Advisory Committee on Protection of the Sea (e.g. ACOPS 2004). Across the whole review area, 21 discharges of 2 tonnes or more were reported during 2003 including 15 attributed to offshore oil and gas installations (ACOPS 2004). DTI data for UKCS offshore installations in 2003 include 375 reported spillages, totalling 83 tonnes. Over the preceding decade, 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 that an annual average around 100 tonnes has been consistently achieved. In comparison, oil discharged with produced water from the UKCS in 2003 totalled 5190 tonnes.

Historic major spill events from UKCS production facilities include the Claymore pipeline leak in 1986 (estimated 3,000 tonnes), Piper Alpha explosion, 1988 (1,000 tonnes), Captain spill, 1996 (685 tonnes) and Hutton TLP spill, 2000 (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).

- **Fate of spilled oil** – the main oil weathering processes following a surface oil spill are evaporation, dispersion, emulsification, dissolution, oxidation, sedimentation and biodegradation. The majority of the anticipated reservoir hydrocarbons in the Irish Sea and Southern North Sea (SNS) are gas, with a limited content of condensate. A dry gas blowout would not result in significant deposition of liquid hydrocarbons to the sea surface, and there have been no large condensate spills on the UKCS resulting from exploration and appraisal (E&A) drilling in a comparable reservoir. Model predictions are that even a large condensate spill would evaporate and disperse relatively quickly; similarly 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

- **Trajectory of any surface slick** – Coincident with these weathering processes, surface and dispersed oil will be transported as a result of tidal (and other) currents, wind and wave action. To support environmental assessments of individual drilling or development projects, modelling is usually carried out for a major crude oil release, corresponding to a blowout, and for smaller diesel or fuel oil releases, which are expected to be less persistent. Representative modelling cases from various parts of the UKCS have been reviewed by successive SEAs.

- **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 and loss of insulating properties, and 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 and used to assess the vulnerability of bird species to surface pollution considers four factors:
  - the amount of time spent on the water,
  - total biogeographical population,
  - reliance on the marine environment,

- potential rate of population recovery (Williams *et al.* 1994).

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 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.

Generally, marine mammals are 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. Grey and common 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. Animals most at risk from oil coming ashore on seal haul-out sites and breeding colonies are neonatal pups, which are therefore more susceptible than adults to external oil contamination.

Benthic habitats and species may also be sensitive to deposition of oil associated with sedimentation, or following chemical dispersion. The proportion of a surface spill that is deposited to the seabed might be expected to increase as a result of high turbulence and suspended solids concentrations in the water column, both associated with storm conditions in shallow water. Studies of macrobenthic infauna following the Braer spill (Kingston et al. 1995), which occurred under such conditions, found no significant changes in benthic community structure, as characterised by species richness, individual abundance and diversity, which could be related to the areas of seabed affected by the spill. This may have been because Braer oil was of such low toxicity as to significantly disrupt benthic community structure, or because the sampling programme was carried out too soon after the spill to enable the full effects of its impact to be detected. In recognition of this, DTI has conducted further sampling of the study area, ten years after the spill event, results from which have indicated a substantial decline in sediment hydrocarbon concentrations.

In contrast, long-term evidence from the Florida barge spill (Buzzards Bay, Massachusetts, September 1969, in which 175,000 gallons (700m3) of diesel fuel were released) suggests that some contamination effects of oil spills could be “indefinite”. 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).

B3 Regulation, contingency planning and response capabilities

Spill prevention and mitigation measures are implemented for offshore exploration and production through The Offshore Petroleum Production and Pipe-lines (Assessment of Environmental Effects) Regulations 1999 and The Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation) Regulations 1998. 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 (MCA) 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. The DTI 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 DTI for approval prior to operations. Additional conditions can be imposed by DTI, through block-specific licence conditions (i.e. "Essential Elements")

B4 SPA/SAC qualifying species and sites

For the purposes of this assessment, European Sites have been categorised based on ecological sensitivity and an evaluation of spill probability and severity (taking into account distance from blocks under offer, and probably hydrocarbon type). This classification is by necessity a simplification of available information, but serves to provide a basis for the high level assessment required at this stage of the licensing process. Potential effects of specific E&P activities would be risk assessed under the controlling legislation outlined above.

A number of Annex I habitats have been excluded from the following assessment, on the basis of vulnerability:

- submerged reefs & sandbanks – not generally vulnerable to surface oil pollution, except possibly following application of chemical dispersants (generally not permitting 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)

NB several sites are represented in more than one risk category; only sites with species or habitats considered to be potentially at risk from oil spills are listed. Sites listed are clockwise from Cape Wrath.

In each list, sites considered to be vulnerable to crude oil spills (as a result of relative proximity to known oil reserves) are coloured red; sites vulnerable only to bunker or lube oil spills (proximity to known gas reserves) are coloured green; sites not considered to be vulnerable to spills originating from blocks under offer (excluding exceptional circumstances) are coloured black.

B5 Cliff-breeding seabird colonies with possible SPA extensions

These sites are designated for colonial breeding seabirds (including auks, fulmar, kittiwake, cormorant, and gannet) which nest either on, or generally associated with sea cliffs.

Sumburgh Head SPA, Foula SPA, Hermaness, Saxa Vord and Valla Field SPA, Noss SPA, Fair Isle SPA, Marwick Head SPA, West Westray SPA, Calf of Eday SPA, Copinsay SPA, Sule Skerry and Sule Stack SPA, North Caithness Cliffs SPA, East Caithness Cliffs SPA, Troup, Pennan and Lion's Heads SPA, Buchan Ness to

Collieston Coast SPA, Fowlsheugh SPA, Firth of Forth Islands SPA, St. Abb's Head to Fast Castle SPA, Farne Islands SPA, Coquet Island SPA, Flamborough Head and Bempton Cliffs SPA

Grassholm SPA, Ynys Seiriol / Puffin Island SPA, Ailsa Craig SPA, Sheep Island SPA, Rathlin Island SPA

B6 Petrel, tern, skua or gull breeding populations with possible SPA extensions

These sites are designated for breeding seabirds, which generally forage over sea areas adjacent to (or in some cases at considerable distance from) breeding sites.

Papa Stour SPA, Ramna Stacks and Gruney SPA, Fetlar SPA, Noss SPA, Mousa SPA, Fair Isle SPA, Pentland Firth Islands SPA, Hoy SPA, Rousay SPA, West Westray SPA, Papa Westray (North Hill and Holm) SPA, Auskerry SPA, Sule Skerry and Sule Stack SPA, Cromarty Firth SPA, Inner Moray Firth SPA, Loch of Strathbeg SPA, Ythan Estuary, Sands of Forvie and Meikle Loch SPA, Lindisfarne SPA, Farne Islands SPA, Northumbria Coast SPA, Coquet Island SPA, Teesmouth and Cleveland Coast SPA, Gibraltar Point SPA, The Wash SPA, North Norfolk Coast SPA, Great Yarmouth North Denes SPA, Breydon Water SPA, Alde-Ore Estuary SPA, Dungeness to Pett Level SPA

Skokholm and Skomer SPA, Aberdaron Coast and Bardsey Island SPA, Ynys Feurig, Cemlyn Bay and The Skerries SPA, Dee Estuary SPA, Ribble and Alt Estuaries SPA, Morecambe Bay SPA, Duddon Estuary SPA, Carlingford Lough SPA, Strangford Lough SPA, Outer Ards SPA, Larne Lough SPA

B7 Open coastline supporting wintering waders and seaduck

These sites 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.

East Sanday Coast SPA, Moray and Nairn Coast SPA, Firth of Forth SPA, Lindisfarne SPA, Northumbria Coast SPA, Teesmouth and Cleveland Coast SPA, Liverpool Bay pSPA, Gibraltar Point SPA, The Wash SPA, North Norfolk Coast SPA, Thanet Coast and Sandwich Bay SPA

Traeth Lafan / Lavan Sands, Conway Bay SPA

B8 Enclosed firth, loch or estuary supporting wintering waterfowl

These sites contain semi-enclosed coastal and intertidal habitats (particularly wetlands) supporting a variety of wintering waterfowl and waders, often in large aggregations. Some species (e.g. sea-ducks) feed beyond the boundaries of sites.

Dornoch Firth and Loch Fleet SPA, Cromarty Firth SPA, Inner Moray Firth SPA, Ythan Estuary, Sands of Forvie and Meikle Loch SPA, Montrose Basin SPA, Firth of Tay and Eden Estuary SPA, Humber Flats, Marshes and Coast (Phases 1 and 2) SPA, Alde-Ore Estuary SPA, Deben Estuary SPA, Stour and Orwell Estuaries SPA, Colne Estuary (Mid-Essex Coast Phase 2) SPA, Blackwater Estuary (Mid-Essex Coast Phase 4) SPA, Crouch and Roach Estuaries (Mid-Essex Coast Phase 3) SPA, Dengie (Mid-Essex Coast Phase 1) SPA, Benfleet and Southend Marshes SPA, Foulness (Mid-Essex Coast Phase 5) SPA, Thames Estuary and Marshes SPA, The Greater Thames Estuary pSPA, Medway Estuary and Marshes SPA, The Swale SPA

Dyfi Estuary/ Aber Dyfi SPA, Dee Estuary SPA, Mersey Estuary SPA, Mersey Narrows and North Wirral Foreshore pSPA, Ribble and Alt Estuaries SPA, Morecambe Bay SPA, Duddon Estuary SPA, Upper Solway Flats and Marshes SPA, Inner Clyde Estuary SPA, Carlingford Lough SPA, Killough Bay SPA, Strangford Lough SPA, Outer Ards SPA, Belfast Lough SPA, Larne Lough SPA, Bridgend Flats, Islay SPA, Gruinart Flats,

B9 Mudflats and sandflats

These sites are estuaries and other coastal areas with intertidal sandflats and mudflats and/or permanently submerged shallow sandbanks. 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.

Dornoch Firth and Morrich More SAC, Firth of Tay and Eden Estuary SAC, Berwickshire and North Northumberland Coast SAC, Tweed Estuary SAC, Dee Estuary pSAC, The Wash and North Norfolk Coast SAC, Alde, Ore and Butley Estuaries SAC, Essex Estuaries SAC

Menai Strait and Conwy Bay SAC, Morecambe Bay SAC, Solway Firth SAC, Strangford Lough SAC

B10 Estuaries

These sites are 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.

Tweed Estuary SAC, Alde, Ore and Butley Estuaries SAC, Essex Estuaries SAC

Pembrokeshire Marine SAC, Lleyn Peninsula and the Sarnau SAC, Dee Estuary pSAC, Morecambe Bay SAC, Drigg Coast SAC, Solway Firth SAC

B11 Saltmarshes

These sites 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.

The Wash and North Norfolk Coast SAC, North Norfolk Coast SAC, Essex Estuaries SAC

Anglesey Coast: Saltmarsh SAC, Dee Estuary pSAC, Morecambe Bay SAC, Solway Firth SAC

B12 Inlets and bays

These sites are 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.

Sullom Voe SAC, The Wash and North Norfolk Coast SAC

Pembrokeshire Marine SAC, Lleyn Peninsula and the Sarnau SAC, Morecambe Bay SAC, Luce Bay and Sands SAC, Strangford Lough SAC

B13 Bottlenose dolphins

These sites are utilised by populations of bottlenose dolphins.

Moray Firth SAC, Pen Llyn a`r Sarnau/Lleyn Peninsula and the Sarnau SAC, Cardigan Bay/Bae Ceredigion SAC

B14 Seal breeding sites

These sites comprise coastal habitats (beaches, estuaries, sandflats and rocky shores) with important breeding colonies of seals (common and/or grey seals). Seals forage for prey in surrounding waters and may also travel considerable distances beyond the boundaries of sites (particularly grey seals).

Yell Sound Coast SAC, Mousa SAC, Faray and Holm of Faray SAC, Sanday SAC, Dornoch Firth and Morrich More SAC, Firth of Tay and Eden Estuary SAC, Isle of May SAC, Berwickshire and North Northumberland Coast SAC, The Wash and North Norfolk Coast SAC

B15 Coastal otter sites

These sites are shallow, inshore coastal areas utilised by important populations of otter *Lutra lutra* for feeding.

Yell Sound Coast SAC, Durness SAC

B16 Conclusion

Individual European Sites have been categorised in terms of potential vulnerability, based on location and known hydrocarbon prospectivity of blocks on offer in the 24th Round and therefore the nature and magnitude of credible risks. Three categories of vulnerability were identified:

1. Around the North Sea coast from Shetland to approximately Flamborough Head, a number of cliff-breeding seabird SPAs; together with petrel, tern, skua and gull breeding colony SPAs and possible extensions and several open coastline sites supporting wintering waders are considered potentially vulnerable to crude oil spills from blocks in existing developed parts of the North Sea UKCS.

2. A larger number of sites south of Flamborough Head and west of the Great Britain mainland are considered to be at very low risk with the potential only for impacts from minor spills of fuel and other oils (because reservoir prospectivity is for gas)

3. Many sites are considered not to be at risk of oil spills associated with proposed 24th Round licensing, due to location.

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). (The overall risks of a major crude oil spill, which would require catastrophic loss of well control, are quantitatively and qualitatively comparable to those considered ALARP (As Low As Reasonably Practicable) under the relevant health and safety regulations.) 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 the Department 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.

Given the availability of mitigation measures, the Department considers that E&P activities in so far as they may cause oil spills, will not adversely affect the integrity of European Sites.

APPENDIX C – CONSIDERATION OF SITES AND POTENTIAL PHYSICAL AND OTHER EFFECTS

C1 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 draft, possible and designated SACs assessed to be at potential risk.

C2 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.

- 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 14m 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 would be 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. Since it is not currently viable to export gas by pressurised tanker, virtually all new field developments will need to be ‘tied back’ to existing offshore infrastructure. In the unlikely instance of a major new field being discovered, a new pipeline to one of the existing east coast of England terminals may be laid. By far the most common means of exporting gas is via existing facilities and pipelines, as this involves a minimum of pipework, although the infrastructure that is physically nearest is not always suitable due to availability of capacity, incompatible gas pressures etc.

  There are four licence applications that are variously within, overlapping or abutting the North Norfolk Sandbanks dSAC. If there was a significant find in these blocks that led to a tieback, the pipeline would probably be up to 20-30km given the availability of infrastructure nearby.

- Subsea template and manifold installation - limited physical footprint at seabed, smaller than a drilling rig, but present on site for longer period

- Pipeline, flowline and umbilical installation, trenching and potentially, placement of rock armour - a typical pipelaying project includes the following operations:
  - Pipeline route survey(s);

- Pre-sweep operations to minimise pipe spanning;
- Trenching, either involving a plough or a jetting rig;
- Pipelaying;
- Backfilling of the original sediments;
- Rock dumping to stabilise sections of pipe that are insufficiently buried.
- Testing and commissioning.

Pre-sweep operations involve making the pipeline route reasonably level. In many circumstances it is not required, but where the seabed is rapidly varying in level, it can be necessary to dredge through raised areas (e.g. sandbanks) and deposit fill into depressions. Without this, pipes may suffer 'spanning', where sections are unsupported, which puts the integrity of the pipe at risk and increases the chances of entanglement with fishing gear and anchors.

There are many variations on this. 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.

Pipes may be laid by the trenching rig i.e. the rig straddles the pipe and the pipe is immediately lowered into the trench, or a trench could be left open for hours or days before the pipe is laid in it. Experience in some locations in the SNS has been that trench 'levees', intended for backfill, have been washed away before the pipe could be laid, requiring significant rock dump to achieve an overburden.

Vessels are required for surveying, pre-sweep dredging, trenching, pipelaying, backfilling, rock dumping and post-lay surveying (depending on what operations are undertaken). It may be that a single vessel performs multiple operations, e.g. trenching, pipelaying and backfilling may be done by the pipelay vessel. The pipelay vessel must steer an accurate route, and it will either be anchored by multiple anchors on either side (anchor handling) or it will be located by dynamic positioning (DP). In the case of anchor handling, anchors are picked up from the rear of the vessel by anchor handling tugs and dropped in front of the vessel as it moves forward. These anchors disturb the seabed and the anchor chains can also disturb the seabed in the vicinity of the anchor where the catenary swings over the seabed. Floats may be used in some circumstances to lift the anchor chain off the seabed but this significantly reduces the tension that can be created. This means that the lateral distance at which they can be deployed is smaller, and they are not safe to use in bad weather. DP vessels use multiple thrusters and a geographical positioning system to maintain course. These powerful thrusters are a significant source of marine noise. It is possible that the turbulence created could disturb sediments in shallow water although no data on this has been found.

If pipes are buoyant (e.g. many gas pipelines), they may be trenched and backfilled/rock dumped to counter buoyancy or alternatively a concrete weight coating may be required. In some circumstances where the pipe does not float, pipes may be laid in a trench but not backfilled, relying on the natural deposition processes to restore a level seabed.

Trenching equipment either displaces sediments physically using a plough, creating two 'levees' either side of the trench, or a jetting system fitted to a 'sword' is used to liquidise the sediments and break up aggregations, which are then sucked away and either discharged immediately in the vicinity or are stored on the vessel for dumping at another location. Both systems rely on a rig of 150-200 tonnes which sits on skids on the seabed and is towed by a vessel. Trenching and backfilling equipment disturbs the seabed. Creating the trench is obviously intentional but there will be a zone either side of the trench that is also disturbed. Including the skids of the trencher, the width of seabed directly affected is around 10-12m. Both methods create a plume of suspended solids.

Material excavated by a trencher may be returned as backfill by means of a backfill plough. The backfill plough sweeps a wider area of seabed than the trencher and, including its runners which compress the seabed, it modifies a width of around 24m of seabed.

Rock dump (or rock placement) is used either to fill in depressions prior to placing a pipe or to cover a pipe once laid. The DTI's decommissioning guidelines assume that rock dump will not be removed from the seabed (DTI, 2006). Rates of rock dump may be 5,000 m^3 per kilometre of pipeline, which would cause cover around 11-12m width along the pipeline. Typically, the 'rocks' used comprise an inner layer of 5mm ('pea') gravel covered by an armour layer of cobbles in the order of 5-10kg each. The armour layer is designed to resist the range of bottom currents in the area, i.e. the rock dump is not expected ever to move from its location. If the pipeline is lifted on decommissioning, the rock dump may be displaced and the pea gravel may migrate, but guidelines for decommissioning pipelines are still in preparation and there is no OSPAR requirement to remove pipelines or rock dump.

Benthic communities along rock dump areas will differ significantly from surrounding communities, given the stability and shelter afforded by the rock in contrast to the prevailing sandy sediments. It is plausible that the rock will provide a suitable substrate for the development of *S. spinulosa* reef in some areas. This is, however, speculation, and there is little published information on rock dump ecology.

Assuming that suspended sediment plumes from pipelaying are similar to (or less severe than) dredging plumes, and considering the suggestions of Elliot et al. (1998), plumes from pipelaying have the potential to:

- reduce light penetration and hence primary production
- modify the surface sediment composition
- smother the benthos and clog feeding or respiration apparatus
- create a disturbed benthic community, reduce diversity, (although in the short term there may be an increase in species richness possibly due to making resources and niches available) introduce contaminants into the water column and affect larval recruitment

Elliot *et al.* (1998) also note that impacts from dredging plumes may be small in areas of high tidal currents, and quotes Poiner and Kennedy (1984) as an example where a dredge plume produced low levels of suspended sediment and did not appear to smother the benthos. It emphasises that subtidal sandbanks are the result of relatively high-energy conditions and as such they will be naturally disturbed by large changes in the hydrographic conditions e.g. storms. The ability of the community to recover from sediment disturbance is high because of the predominantly mobile nature of the component species. Therefore the influx of material such as dredge spoil should be accommodated.

Newell *et al.* (2004) noted that trailer dredging over an area of mixed substrate in the English Channel had no impact on community composition of macrofauna within the dredge site. In the same area, Hitchcock and Bell (2004) reported that the physical impact of dredging on the seabed was limited to a zone approximately 300m downtide of the dredged area. No suppression of benthic community structure was recorded beyond 100m from the dredge site. Species variety, population density, biomass and body size of macrofauna was enhanced for 2 km in each direction along the axis of the tidal streams.

Newell *et al.* (2004), quoting other sources, estimated the nature and rate of recolonisation processes in marine deposits following cessation of dredging in the English Channel. Recovery of species diversity to within 70-80% of that in the surrounding deposits was generally achieved within 100 days. Recovery of population density was achieved within 175 days. In contrast, restoration of biomass following growth of the individual colonising species was incomplete even 18 months after cessation of dredging. These data for the time taken for restoration of the biomass agree with those in the literature where recovery of biomass after initial recolonisation by the macrofauna of sands and gravels has been reported to take 2-3 years.

MMS (1999) quote various sources and report that recolonisation takes 1-3 years in areas of strong currents and up to 5-10 years in areas of low current velocity. Longer recovery times are reported for sands and gravels where an initial recovery phase in the first 12 months is followed by a period of several years before pre-extraction population structure is attained.

DTI 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 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 broadscale distribution of biotopes of conservation importance is relatively well understood. Within the boundaries of designated and dSACs 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 were relevant AA. Based on the results of the assessments including AA DTI may require additional mitigation measures to cancel or minimise any adverse effects, or where this is not possible, refuse consent.

C3 Marine discharges

As described in previous DTI 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). The effects of the majority of these are judged to be negligible in the context of 24th Round blocks and Natura 2000 sites and are not considered further here. They would also be considered in detail in project specific AAs, Environmental Statements and chemical risk assessments under existing permitting procedures.

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.

OSPAR Recommendation 2001/1 for the Management of Produced Water from Offshore Installations provides for a reduction in the discharge of oil in produced water and also includes a presumption against the discharge to sea of produced water from new developments.

Drilling wastes are a major component of the total waste streams from offshore exploration and production, with typically around 1,000 tonnes of cuttings resulting from an exploration or development well. Water-based mud cuttings are discharged at, or relatively close to, sea surface during “closed drilling”, whereas surface hole cuttings will be discharged at seabed during “open-hole” drilling. Use of oil-based mud systems, for example in highly deviated sections or in water reactive shale sections, would require the onshore disposal or reinjection of the waste materials.

Mud systems used in surface hole drilling for exploration wells are usually simple (seawater with occasional viscous gel sweeps) and would not result in significant contamination of sediments. However, the composition of closed drilling discharges likely to result from exploration, appraisal and development drilling (and to a lesser extent from well maintenance activities) is more complex, and will include cuttings (i.e. rock in varying degrees of consolidation and in a range of particle sizes), barite or other naturally occurring dense minerals, salts (sodium and potassium chloride), bentonite, and a range of mud additives in much smaller quantities. Water-based mud additives perform a number of functions, but are predominantly polymeric organic substances and inorganic salts with low toxicity and bioaccumulation potential.

Operational chemicals/substances for use in the UKCS have to be notified and tested under the Offshore Chemical Notification Scheme (OCNS), administered by the Department of Trade and Industry using scientific and environmental advice from CEFAS (the Centre for Environment, Fisheries and Aquaculture Science) and the Fisheries Research Services (FRS) Marine Laboratory, Aberdeen. Information required on the OCNS list include a ranking for each chemical (Hazard Quotient (HQ) values or OCNS group) and an indication of whether they would have a adverse environmental effect (Risk Quotient or RQ values). HQ values are generated the CHARM (Chemical Hazard Assessment & Risk Management) model and provide an indication of the potential hazard. Chemicals are ranked according to their worst-case HQ (Gold (HQ = >0-<1); Silver (>=1-<30); White (>=30-<100); Blue (>=100-<300); Orange (>=300-<1000), and Purple (>=1000). Where HQ values cannot be generated using CHARM, chemicals continue to be ranked according to their revised OCNS group (A, B, C, D and E), with Group E representing the least potential hazard. Group Z indicates those chemicals with zero discharge.

A permit application for the use and discharge of chemicals is required by *The Offshore Chemicals Regulations 2002* and is required to be submitted to the DTI in advance of the commencement of drilling.

In addition to mud on cuttings, surplus water-based mud may be discharged at the sea surface during or following drilling operations. Due to its density, a proportion of the particulate component of the mud (including barite) may settle in the vicinity of the discharge point.

The discharge of surface hole cuttings at the seabed is likely to produce a discrete transient pile of cuttings surrounding the conductor. Although this may be disturbed by emplacement of and removal of the wellhead assembly, a small pile is likely to remain for a period following well abandonment or suspension. The duration over which this pile persists will be dependant on the tidal and other currents of the area. This material will consist of shallow formation cuttings and will be very similar to surficial sediments in composition and characteristics. Most of the chemical additives typically used in the drilling of the surface sections are categorised by OSPAR as PLONOR (**P**ose **L**ittle **O**r **NO R**isk to the marine environment) or inorganic and have the lowest Hazard Quotient (Gold or OCNS Group E).

The discharge of cement and component chemicals, some 100-120 tonnes per well, is likely both as direct annular returns at seabed and at surface following displacement of excess cement from the wellbore. Cement returns to seabed surface are routinely monitored by ROV so pumping of cement can be stopped when returns appear at the seabed. The majority of the cement and cement chemicals have either PLONOR status or have Gold Band CHARM HQs and adverse effects have not been reported.

Beyond the zone of physical smothering immediately around the wellhead, ecological effects of surface hole cuttings discharge are considered to be negligible.

A major insoluble component of WBM discharges, which will accumulate in sediments, is barite (barium sulphate). Barite has been widely shown to accumulate in sediments following drilling (reviewed by Hartley 1996). Barium sulphate is of low bioavailability and toxicity to benthic organisms. Other metals, present mainly as salts, in drilling wastes may originate from formation cuttings, from impurities in barite and other mud components, or from other sources such as pipe dopes.

When WBM is used to drill the lower hole sections of the well, a proportion is normally discharged either on cuttings, or as excess mud if the required technical properties of the fluid cannot be maintained e.g. through dilution with water. The great majority (approximately 95% by weight) of the constituents of most WBM would be expected to be included in the OSPAR PLONOR list.

Four main types of environmental effect are associated with the discharge of WBM and cuttings drilled with WBM:

- Plume formation and turbidity, mainly associated with silt and clay particles which do not settle rapidly through the water column
- Settlement of particulates on the seabed, potentially causing physical smothering and changes to substrate characteristics
- Organic enrichment and subsequent oxygen depletion associated with enhanced aerobic microbial activity in surface sediments
- Direct toxicity effects in the water column and affected seabed

In general, none of the above has proved to be significant following extensive use and discharge of WBM in the North and Irish Seas. The chemical formulation of WBM avoids or minimises the inclusion of toxic components, and the materials used in greatest quantities (barite and bentonite) are of negligible toxicity (barium sulphate is of low bioavailability and toxicity to benthic organisms e.g. Starczak *et al*. 1992).

Organic additives to WBM perform a number of functions, but are predominantly polymeric substances and glycols with low toxicity and bioaccumulation potential (DTI 2003). A large proportion of organic components is likely to dissociate from cuttings and discharged mud in the water column, and can be expected to biodegrade with no observable environmental effects.

Dispersion of mud and cuttings is influenced by various factors, including particle size distribution and density, vertical and horizontal turbulence, current flows, and water depth. In deep water, 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, generally at undetectable loading. The typical conclusion of cuttings dispersion reports is that the particulate concentrations at the seabed would be negligible (and insignificant in the context of naturally occurring particulates) at distances of more than a few hundred metres from a wellhead.

Although the presence of drilling material at the seabed close to the drilling location (<500m) is often detectable, there is a substantial body of evidence available from North and Irish Sea monitoring studies, e.g. Daan and Mulder (1996) and Rees (1994), and laboratory studies, e.g. Neff *et al*. (1989) that indicates little or no detectable effects of WBM discharges in shelf water depths. In contrast to the general picture of limited effects of WBM discharges, Cranford and Gordon (1992) reported low tolerance of dilute bentonite clay suspensions in scallops (*Placopecten magellanicus*). Cranford *et al*. (1999) found that used WBM and its major constituents, bentonite and barite caused effects on the growth, reproductive success and survival of *Placopecten*, which were attributed to chronic toxicity and physical disturbance. It may be that *Placopecten* is especially sensitive to drill muds (or fine sediments in general) or that in the field WBM discharges rapidly disperse to below effective concentrations.

Most studies of ecological effects of drilling wastes have involved soft-sediment species and habitats. Studies of the effects of water based mud discharges from 3 production platforms in 130-210m water depth off California found significant reductions at some stations in the mean abundance of 4 of 22 hard bottom taxa investigated using photographic quadrats (Hyland *et al*. 1994). These effects were attributed to the physical effects of particulate loading, namely disruption of feeding or respiration, or the burial of settled larvae.

C4 Other effects

The actual or potential introduction of non-native species through vessel movements is an issue of major concern. Through the transport and discharge of vessel ballast waters (and associated sediment), and to a lesser extent fouling organisms on vessel/rig hulls, large numbers of non-native species may be introduced to the marine environment. Should these introduced species survive and form an established breeding population, 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 be very significant. In response to this, 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 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 will be visible at distance (some 10-12 nm in good visibility). The attractive effect of lights on seabirds in cloudy nights is enhanced by fog, haze and drizzle (Weise *et al*. 2001). The lights on installations and vessels are primarily non-flashing so the behavioural effects noted by Bruderer *et al*. (1999) in response to a strong searchlight being switched on and off are not anticipated.

Plan level considerations of this potential source of effect on Natura 2000 sites are that the likely number of developments following block licensing is expected to be limited, with most being subsea tiebacks to existing infrastructure and that mitigation is possible. For example, potential effects can be mitigated through the control or avoidance of well test and routine flaring during production, and timing controls can be used since drilling and construction are temporary activities. It is therefore concluded that adverse effects from light are not expected.

Physical disturbance of seaduck and other waterbird flocks by vessel and aircraft traffic associated with oil and gas exploration and production are possible, particularly in SPAs established for shy species such as common scoter. Such disturbance can result in repeated disruption of bird feeding, loafing and roosting. As with light, this source of potential effect is considered unlikely to result in significant effects at Natura 2000 sites because of the projected limited scale and nature of developments and because mitigation is possible which would be identified during activity specific assessment and permitting processes. Available mitigation measures include strict use of existing shipping and aircraft routes, timing controls on temporary activities to avoid sensitive periods. It is therefore concluded that adverse effects from physical disturbance are not expected.

C5 North Norfolk sandbanks and Saturn *Sabellaria spinulosa* reef dSAC

The draft dossier for the Offshore Special Area of Conservation: North Norfolk Sandbanks and Saturn Reef (Version 2 JNCC 2006) notes that in the pursuit of the conservation objectives for the ‘Reefs’ interest feature, the competent authorities for this area may be advised to manage human activities within their remit such that they do not result in deterioration or disturbance of this biogenic reef through any of the following:

i) Physical damage by abrasion or changes in suspended sediment (e.g. bottom trawling)

ii) Biological disturbance by selective extraction of species (e.g. commercial fishing)

In pursuit of the conservation objectives for the ‘Sandbanks’ interest feature, the competent authorities for this area may be advised to manage human activities within their remit such that they do not result in deterioration or disturbance of the ‘Sandbanks which are slightly covered by seawater all the time’ through any of the following:

i) Physical loss by removal (e.g. installation of petroleum industry infrastructure)

ii) Physical damage by abrasion or selective extraction (e.g. bottom trawling, aggregates extraction, cable/pipeline laying)

iii) Toxic contamination by introduction of synthetic and/or non-synthetic compounds (e.g. hydrocarbon extraction)

Sandbanks are defined by the Interpretation Manual of European Habitats as "Sublittoral sandbanks, permanently submerged. Water depth is seldom more than 20 m below chart datum, and they may be non-vegetated sandbanks or sandbanks with vegetation belonging to the Zosteretum marinae and Cymodoceion nodosae" (EC, 1999).

In general, shallow sandy sediments are typically colonised by a burrowing fauna of worms, crustaceans, bivalve molluscs and echinoderms. Mobile epifauna at the surface of the sandbank may include shrimps, gastropod molluscs, crabs and fish. Sand-eels *Ammodytes* spp., an important prey species for birds, seals and fish, live in sandy sediments. Where coarse stable material, such as shells, stones or maerl is present on the sediment surface, species of foliose seaweeds, hydroids, bryozoans and ascidians may form distinctive communities. Shallow sandy sediments are often important nursery areas for fish, and feeding grounds for seabirds (especially puffins *Fratercula arctica*, guillemots *Uria aalge* and razorbills *Alca torda*) and sea-duck (e.g. common scoter *Melanitta nigra*) (JNCC, 2003).

SEA 2 summarised much of the available data on sandbank development in the southern North Sea, and a proportion of the area considered is now the North Norfolk Sandbanks dSAC. Models for sandbank development include spiral water circulation with convergence over the crestline; lateral migration; and stratigraphic evolution associated with submergence of coastal sand bodies. Detailed hydrography and sediment transport have been studied on the Leman and Well Banks and on the Broken Bank. From analysis of historic bathymetric charts, some of the more offshore Norfolk Banks have elongated towards the northwest, the direction of net regional sand transport. The evidence for bank migration perpendicular to their long axis is, however, more equivocal. These offshore banks are markedly asymmetrical in cross-section with their steeper flanks oriented towards the northeast suggestive of migration in that direction. It has been suggested that opposing movement of sand streams may magnify localised irregularities into a complex "S" shaped bank surrounding a pair of ebb and flow channels (as in banks of the Haisborough Tail - Winterton Ridge system), with subsequent erosion of the bank apices leaving a line of *en echelon* banks. The internal structure within some of the offshore banks is evidence of northeastward migration, although it is uncertain whether migration still occurs at the present time.

Sandbanks within the SEA 2 area were investigated by a survey programme, commissioned by DTI in June-July 2001, which included high-resolution multibeam bathymetry, photography of sediment features and epifauna and seabed sampling. Both active sandbanks, maintained by the modern tidal current regime, and moribund sandbanks, formed at periods of lower sea level, are found in the SNS.

The North Norfolk coast has been seen as the source for the continuing development of the Norfolk sandbank sequence. At present the sequence starts with the relatively nearshore Haisborough Sand, and extends north-eastwards as far as the Indefatigable Banks and beyond, into a similar parallel sequence of unnamed banks (HR Wallingford, 2003). A model is suggested where the sandbanks northeast of the Leman Bank are the sorted remnants of the Weichselian ice front sediments that they closely parallel. The two inshore groups of sandbanks (Haisborough Sand, Hammond Knolls, Hewitt Ridges and Smiths Knoll; Cross Sand, Scroby Sand, Caister Sand and associated banks) were (and are in the case of the second group) associated with the erosion and retreat of a northeast facing cliffed shoreline. Their differing aspects to the modern coast could be due to the varying aspect of the coast as retreat took place. There is some evidence for suspension transport across the Norfolk Banks in a north-easterly direction.

The North Norfolk Banks dSAC represents the most extensive examples of linear sandbanks with sand sediment in UK waters (JNCC, 2003). Large sandwaves are present on the inner banks, with size decreasing with increased distance from shore. SEA 2 data show that the community is characterised by heart urchin *Echinocardium cordatum*, bivalve *Fabulina fabula* and sandeels (DTI, 2001). Despite large amounts of gas exploration and production activity around the banks, development is largely off the slopes and ridges of the banks. The seabed around Leman, Ower and Inner banks has few gas installations. The Broken and Swarte banks and the inner two Indefatigable banks are more heavily built around with the outer Indefatigable banks again having less infrastructure around them. Fishing pressure is moderate to low (JNCC, 2003).

Saturn Reef dSAC

Saturn Reef is an extensive area of *Sabellaria spinulosa* reef and surrounding sandbank covering an area of 1,641ha. It is located in approximately 20m of water on a small sandbank between Swarte and Broken banks within the larger North Norfolk Sandbanks complex. The density of *S. spinulosa* reef varies across the site from dense coverage (90%) in the centre to more sparse patches (<10%) on the outer edges. Images of the reef show it to rise to *ca*. 30cm above the surrounding seabed.

S. spinulosa is a small, tube-building polychaete worm, and the tube structures can form sub-tidal reefs where dense aggregations of worms exist. The following description draws heavily on work of Holt *et al*. (1998) for the UK Marine SACs Project. *S. spinulosa* in reef form is not well studied, and in some cases inferences are drawn from research on the related inshore species *S. alveolata*.

The existence of well developed, stable *S. spinulosa* reefs has only recently been demonstrated conclusively. In coastal waters, the only certain UK occurrence seems to be in the mouth of the Wash, where reefs raised up to 30cm proud of the seabed extend for hundreds of metres, both within and outside the Wash and North Norfolk Coast SAC. Similar communities may occur in the Bristol Channel, although this is uncertain. Less stable, often annual 'crusts' or clumps seem to be much more widespread in turbid sublittoral areas. Holt *et al*. (1998) state that in the North East Atlantic, *S. spinulosa* has a widespread distribution around the British Isles, and is also present in the Mediterranean Sea. However, it is limited to areas with elevated concentrations of suspended sediment.

S. spinulosa forms crusts and occasionally well developed, raised reefs sublittorally in turbid waters from a few metres to at least 40m or so. The best reefs probably form on sandy sediments with some hard substrata. *S. spinulosa* does not seem to penetrate into low salinity areas. Thin crusts appear to be moderately fragile and are quite easily broken up by storms or physical impacts.

S. spinulosa seems in many cases to be annual, but on more stable reefs the animals seem to be able to live for a few years. Spawning probably occurs largely over winter and settlement in early spring. Settlement is stimulated by the presence of *S. spinulosa* tubes, but not as strongly as in *S. alveolata*. The commercially valuable pink shrimp *Pandalus montagui* seems to have a strong association with *S. spinulosa* reefs. Associated communities on reef areas may be richer than surrounding areas.

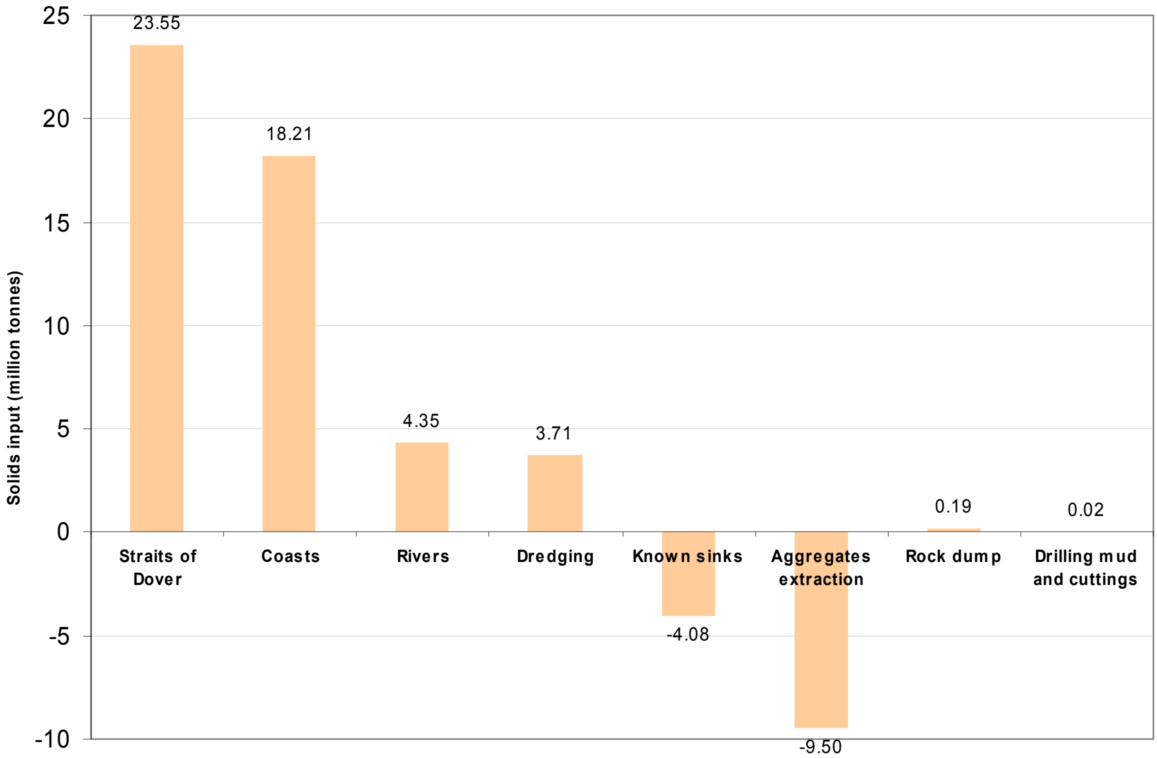
S. spinulosa appears to be generally tolerant of changes in water quality and overall they do not seem to show any special sensitivity to chemical contaminants. Holt *et al*. (1998) believed that it seemed likely that damage to *Sabellaria* spp. adjacent to the sediment plumes from dredging would not be particularly high.

The fragility of substantial reefs is unclear. Reefs are broken up sufficiently easily to be sampled by a $0.1m^2$ Day grab. Crusts of *S. spinulosa* on cobble and boulders off the Northumberland and North Yorkshire coasts often break up during winter storms. Elsewhere they appear to be more permanent features, probably related to the stability of the physical environment in which they are found. Rees and Dare (1993), reviewing other papers, concluded that colonies were robust to all but the severest weather, that they were vulnerable to bottom fishing gear and that they were unable to rebuild their tubes once dislodged from them.

S. alveolata often suffers from burial as a result of large movements of sand, which it can tolerate for periods of days or even weeks, although this severely hampers its growth. Longer term burial is fatal. Colonies can die back for many years as a result of cold winters. In many parts of its range it seems to compete for space with mussels *Mytilus edulis*, interactions with which are not fully understood. There is little knowledge of sensitivity to natural events of *S. spinulosa* reefs. Interactions with brittle stars *Ophiothrix fragilis*, which can reduce recruitment and growth of *S. spinulosa*, may be important.

The introduction of drilling wastes and sediment disturbed by pipelaying etc into the SNS should be put into the context of the other sedimentary processes. There is a large input of material from cliff and beach erosion, from rivers and from the offshore dumping of material dredged from estuaries. There is also a major input of material from the English Channel through the Dover Straits. A certain amount of material is also deposited in sinks such as in the Wash. Estimates of annual inputs are very difficult to make and may vary greatly from year to year, especially as much sediment movement is associated with major storms. A contemporary estimate of inputs, drawing on many data sources, is given in HR Wallingford (2002) and the average annual estimates are presented in Figure E.3. It should be noted that several inputs and outputs have not been estimated but may also be significant, e.g. the general movement of sediment from the Central North Sea southwards, and the general movement of sediment from the SNS eastwards towards the German Bight and the Baltic.

Figure C.1 Known sources and sinks of SNS solids (annual quantities)



Source: HR Wallingford (2003); EEMS returns (2002); TSO (2003); PWA applications 2001-2004.

From the perspective of large-scale physical processes, the contributions of material from the oil and gas industry can be considered negligible when compared to the millions of tonnes eroded, deposited and transported annually by natural processes. The effect of the 24^{th} Round Licensing that would be in addition to pre-existing conditions would be smaller still. Small-scale effects, such as habitat alteration where rock is dumped, would occur, and it is conceivable that some engineering operations, such as pipelaying would have the potential to affect larger areas. However, the North Norfolk sandbanks and Saturn *Sabellaria spinulosa* reef dSAC covers an area of approximately 4327km^2 and is known to experience significant natural disturbance of surface sediments during storms. All potential drilling and major construction works (should commercial discoveries be made) are already subject to regulatory EIA and AA (where relevant) and these are viewed as providing the mechanisms for adequate controls to mitigate any adverse effects to site integrity.

Summary

- The sandbank features of the North Norfolk Sandbanks dSAC are maintained by the circulation of water and sediment over the whole SNS and also the Central North Sea and English Channel.

- Gas exploration and production activities have been ongoing for many years and formed part of the character of the site at the time of recommendation for designation.
- Drilling solids from the oil and gas industry are a vanishingly small contribution to the regional sediment budget and do not, in general, accumulate in particular areas.
- Biogenic reefs formed by *Sabellaria* are known within and outside the dSAC boundaries. These reefs are vulnerable to physical damage from rig/platform placement and pipeline installation. While potential impacts are foreseeable, existing environmental assessment and permitting/regulatory mechanisms are regarded as effective in ensuring that site specific information is obtained and factored into development planning so that they do not adversely affect the integrity of the dSAC.
- It is believed that structures on the seabed, depressions caused by drilling rigs and rock dump (and other deposits for stabilisation) give rise to very local changes in seabed character, with recovery periods sometimes in the tens of years. The extent of such existing impacts, however, is an extremely small proportion of the site area, and for the development that might ensue from the 24th Round Licensing, the extent is an order of magnitude smaller. It is firmly believed that there would be no discernible impact on the large scale currents or sediment processes that maintain the features of interest, and it is concluded that there would be no adverse effect on site integrity.
- There are strict regulatory controls over the use an discharge of offshore chemicals and toxic and enrichment effects are not envisaged
- It is conceivable that certain 'pre-sweep' dredging and infill has the potential, in extreme cases, of altering the currents around or across an individual sandbank feature in such a way that might alter its future development and thereby alter the character of the sandbank habitat. It is not clear whether such an alteration would be adverse in terms of the quality of habitat, but it cannot be ruled out. On the basis of the precautionary principle, the Department will require the use of mitigation measures under the EIA and AA regimes to prevent adverse effects on the integrity of the site. This may result in restrictions on the types of construction techniques permitted, requirement to avoid specific areas or refusal of consent.

C6 Dogger Bank dSAC

The draft dossier for the Offshore Special Area of Conservation: Dogger Bank (Version 2 JNCC 2006) notes that in pursuit of the conservation objectives for Sandbanks, the competent authorities for the Dogger Bank site may be advised to manage human activities within their remit such that they do not result in deterioration or disturbance through any of the following:

i) Physical loss by removal (e.g. installation of petroleum industry infrastructure)

ii) Physical damage by abrasion or selective extraction (e.g. bottom trawling, aggregates extraction, cable/pipeline laying)

iii) Toxic contamination by introduction of synthetic and/or non-synthetic compounds (e.g. hydrocarbon extraction)

iv) Biological disturbance by selective extraction of species (e.g. bottom trawling)

The Dogger Bank is a large and isolated positive topographic feature located in the central North Sea, ~100km off England's north-east coast and marks a hydrographic and biogeographic division between the southern and central North Sea. This elongate sandbank (aligned ENE to WSW) is a moraine which covers an area of 13,405km^2. At its shallowest point in the south-west, it is less than 20m deep, standing >18m higher than the surrounding seabed (Gubbay *et al.*, 2002).

The Dogger Bank is the most extensive sandy mound in UK waters and, depending on how the extent of the bank is judged, extends into Dutch, Danish and German waters. It is representative of moderately mobile clean sand habitat with a community characterised by amphipods *Bathyporeia spp*., bivalve *Fabulina fabula* and a variety of polychaete species (DTI, 2001). Despite partial degradation due to bottom trawling activity and some permanent oil and gas infrastructure the prospect of maintaining the structure is good and restoration of some communities may be possible (JNCC, 2003). Fishing pressure is generally moderate to low, although some small areas may be trawled several times a year.

The Dogger Bank is largely composed of a core of glacial and glaciomarine sediments built up during the Devensian, and possibly deposited along the eastern edge of an ice sheet located in the western North Sea (Gubbay *et al.*, 2002). The core of the bank is mantled by a layer of Holocene sand, ranging from ~1m thickness near the summit of the bank to 10m or more around the flanks. As the sea level rose, the Dogger Bank became an island and was probably not completely covered by water until ~7,500 years ago. The presence of freshwater and salt marsh peat beds and clays containing intertidal molluscs are evidence of former coastal environments around the margins of the bank at this time.

Extensive areas of gravelly sand and small patches of sandy gravel and gravel are present. The coarse sediments are probably the result of intensified wave action in the shallower waters (Gubbay *et al.*, 2002). Samples taken for SEA 2 consisted of mixed sediments, pebbles and shell fragments with sparse encrusting epifauna, typical of much of the Dogger Bank. From some sites, a medium sand substratum prevailed.

The hydrographic regime over the Dogger Bank is complex. This is a function of Atlantic water from the north meeting the residual currents from the Straits of Dover to the south. Tidal current velocities over the bank are reduced and eddies are likely to be formed, adding to the reduction of current velocity and increasing sedimentation over the bank. Most of the water column over the Dogger Bank and the North Sea to the south of it remains mixed all year round.

Some 31 blocks have been applied for within the boundaries of the Dogger Bank dSAC although there do not currently appear to be any proposed field activities. The considerations of foreseeable effects given above for the North Norfolk Sandbanks dSAC would apply equally to the Dogger Bank dSAC. The draft conservation objectives for the site are for the environmental and ecological processes of the sandbank to be maintained in favourable condition, including the extent, distribution, diversity and characteristic species composition of the sandy sediment communities representative of a gravelly sand environment in the southern North Sea.

Summary

- The Dogger Bank dSAC occupies a substantial area much of which is subject to natural physical disturbance. There is also evidence dating back nearly 100 years of variability in fauna over time.
- Gas exploration and some production activities in the south of the area have been ongoing for many years and formed part of the character of the site at the time of recommendation for designation.
- Drilling solids from the oil and gas industry are a vanishingly small contribution to the regional sediment budget and do not, in general, accumulate in particular areas.
- The dSAC is potentially susceptible to impacts from pipeline construction. There is limited existing infrastructure in the area indicating that most new developments in the area (if any) will require export infrastructure either to shore or to tie in to existing systems to the south.
- In view of the energetic hydrography of the area the site is believed to be tolerant of sediment disturbance and discharges of drilling solids.
- There are strict regulatory controls over the use an discharge of offshore chemicals and toxic and enrichment effects are not envisaged
- Drilling, pipeline route and development planning and environmental permitting arrangements provide effective mechanisms to ensure that these activities do not adversely affect the integrity of the dSAC.

C7 Pockmark SACs

The draft dossiers for the Offshore Special Area of Conservation: Scanner Pockmark and the Offshore Special Area of Conservation: Braemar Pockmarks (Versions 2 JNCC 2006) note that the competent authorities for these pockmark areas would be advised to manage human activities within their remit such that they do not result directly or indirectly in the deterioration or disturbance of the carbonate structures through any of the following:

i) Physical loss by removal or smothering (e.g. installation of petroleum industry infrastructure)

ii) Physical damage by changes in suspended sediment, abrasion or selective extraction (e.g. bottom trawling, installation of petroleum industry infrastructure or petroleum extraction);

iii) Toxic contamination by introduction of synthetic and/or non-synthetic compounds (e.g. hydrocarbon extraction);

iv) Biological disturbance by selective extraction of species (e.g. commercial fishing).

Two dSACs for pockmark features are within the footprint of the blocks applied for in the 24th Licensing Round, the Braemar and the Scanner Pockmark dSACs. Pockmarks could be affected by 3 aspects of drilling exploration activity; firstly by direct physical disturbance from drilling apparatus or anchors and their associated chains and cables, secondly by deposition of drilling solids and finally by interruption of the flow of sub-seabed gas or fluids which maintain the pockmark and the distinctive aspects of its biological functioning.

Pockmarks vary widely in terms of size, depth, density of occurrence in an area, rate and periodicity of gas/fluid seepage, presence of cemented rock (methane-derived authigenic carbonate) and chemosynthetic biological activity. The active pockmarks in the Braemar and the Scanner dSACs are medium to large in size. The draft conservation objectives for both sites are to maintain the submarine structures made by leaking gases in favourable condition, including the natural environmental and ecological processes, and the extent, distribution, diversity and characteristic species composition of the biological communities present.

Physical damage to these features (and other pockmarks) from anchoring is unlikely since they would be routinely identified during geophysical survey (e.g. rig site or pipeline route survey) and avoided as they present anchoring or drilling hazards. In addition, the application of the Conservation of Habitats regulations would trigger an AA screening or full AA by the DTI as part of drilling activity consenting, which allows for mitigation measures to be required if necessary.

It is not conceivable that these pockmarks would be adversely affected by pipelaying operations or platform or subsea facility installation. This is because the depressions present construction difficulties and hazards which would be identified at the planning stage and avoided. But even if an operator was prepared to construct a pipeline across such a feature existing permitting safeguards (including PON15B, Environmental Statement, Pipeline Works Authorisation and where relevant AA) exist to avoid such an impact.

A further potential drilling impact relates to the deposition of mud and cuttings. Tophole cuttings from drilling can be discounted since these accumulate immediately around the well and as considered earlier wells and rigs would not be located in a pockmark feature.

In contrast, cuttings discharged near the sea surface will spread widely through dilution and dispersion during their passage through the water column. Using typical settling velocities of quartz particles, the settling velocity of 10µm particles, approximately the mid-range of mud/cuttings discharges, is around 0.1mm/s. In 100-150m of relatively quiescent water (typical of the Scanner/Braemar pockmarks), such particles would settle in 350 hours, i.e. 15 days (30 tidal cycles). In practice, some of the particles will tend to settle faster due to the greater density of barite compared to quartz and due to 'density currents' caused by the mass downward movement of a dense discharge. Against this, the natural turbulence of the sea along with tidal and residual currents will keep a proportion of the particles in suspension. It is considered reasonable to assume that the suspended solids plume from a drilling discharge will last for several days and move considerably in this time.

de Haas et al. (1997) studied recent natural sedimentation rates in the North Sea. In a broad region surrounding the Braemar and Scanner Pockmarks dSACs, sediment deposition of 5-9cm/100 years was identified, suggesting natural sedimentation of <1mm/year. While the deposition rates of drill cuttings are rarely measured in practice, typical modelled cuttings deposition suggests that deposition is typically less than 1mm beyond 1km in the direction of the tide, and around 300m in the direction of the residual current (and sometimes much less than this). Deposition rates at the pockmarks are therefore expected to be much less than 1mm. This would be of the same order of magnitude as the annual natural deposition rate or less.

It is generally believed that the formation of pockmarks is caused by the expulsion of gas or water through seabed sediments (e.g. Whiticar & Werner 1981, Hovland et al. 1984, Harrington 1985). In an SEA 2 technical report, Dando (2001) revealed that gas seepage rates from several North Sea pockmarks were insufficient to keep the base of the features free of sediment, and that sediment was most probably removed by periodic explosive releases of gas. In other words, active pockmarks may experience periodic massive gas expulsions, accompanied by a cloud of winnowed sediment. The SEA 2 Pockmark report quotes McQuillin *et al*. (1979) in identifying water column targets seen on deep-towed boomer and side scan sonar records as sediment clouds, lifted into the water by gas escape. Over a period of about eight hours they were seen to settle back to the seabed. Judd (1994) reported a similar sediment cloud seen close to the Witch's Hole on 1977 data. This evidence suggests that gas escape events of sufficient magnitude to lift considerable volumes of sediment into the water occur at the present day. It is reasonable to assume, therefore, that active pockmarks are robust when exposed to high suspended solids concentrations and short-term sediment deposition.

Based on evidence of buried pockmarks in sediments, Dando (2001) also stated that pockmarks will become buried where there is a net sediment deposition and where there are insufficient cycles of gas expulsion to preserve the pockmark. For example, in an area where there is say 1mm per year of natural sedimentation, the addition of, say, 0.5mm of cuttings can be likened to the effect an acceleration of the rate of burial by six months.

The final potential source of impact on pockmarks is interruption of the flow of sub-seabed gas or fluids needed to maintain the pockmark and the distinctive aspects of its biological functioning. This potential risk to the Scanner pockmark was considered in detail by Holmes & Stoker (2005) who concluded that any future drilling in close proximity must not be allowed to disturb the shallow gas reservoir apparently feeding the pockmark or the fault believed to be acting as a conduit for gas transferring from depth to the overlying gas charged sediments. Particular care was advocated to prevent loss of gas from the Crenulate Reflector in the area. Whilst this presents a risk, such shallow gas charged sediments also present a significant risk to the rig and well and are routinely identified during rig site surveys. Such areas are avoided during detailed well planning. Existing environmental assessment and permitting, and well design review mechanisms are regarded as effective in ensuring the attainment of the conservation objectives for these dSACs.

In-combination effects which could adversely affect the pockmarks have not been identified.

Summary

- Pockmark features (i.e. methane-derived authigenic carbonate accumulations) are very localised and are susceptible to direct physical interference. Drill rig and other anchoring have the potential to physically damage the site features although this can be avoided through mitigation. The Department will require that rig and other mooring analyses demonstrate avoidance of interaction with these features or alternative positioning methods will be required.
- Pockmarks are not susceptible to impacts from seismic surveys.
- From observations within pockmarks and what is known about the dynamic nature of active pockmarks drilling discharges that occur some distance (more than 1 kilometre) from the feature would not be expected to adversely the affect integrity of the site features.
- Future drilling in close proximity to Pockmark SACs must not be allowed to disturb the shallow gas reservoir apparently feeding the pockmark or the fault believed to be acting as a conduit for gas transferring from depth to the overlying gas charged sediments. The operator will need to demonstrate a considered and precautionary approach to well planning and design.
- Detailed well/development planning and environmental permitting arrangements provide effective mechanisms to ensure protection of surface and subsurface components essential to the continued maintenance of the structures in favourable condition. On the basis of the precautionary principle, the Department will require the use of mitigation measures under the EIA and AA regimes to prevent adverse effects on the integrity of the site. The Department will place controls on anchoring to avoid physical damage, on well location and trajectory to prevent

interruption of the flow of shallow gas supplying and maintaining the features, and on drilling discharges to prevent smothering from cuttings deposition. The Department will also place controls on new pipeline routes and lay methods to avoid interaction with site features.

C8 Moray Firth SAC

The Moray Firth SAC is primarily known for resident bottlenose dolphins but “sandbanks which are slightly covered by sea water all the time” are also listed as a primary qualifying feature under Annex 1. The sandbanks in question are in the inner Moray Firth and the nearest block applied for in the 24th Licensing Round and included in this AA is some 60km distant. Consequently no foreseeable interaction with this feature of the European Site is envisaged.

C9 Wyville Thomson Ridge dSAC and Darwin Mounds pSAC

These two European Sites are some 65 and 100km to the west of the closest blocks applied for in the 24th Round. In view of prevailing wind and current direction (from the south-west) no interaction is foreseen with the sites and they are not considered further.

C10 Morecambe Bay SAC

The Morecambe Bay SAC is the second largest embayment in the UK and encompasses a large area of intertidal mudflats and sandbanks which are exposed by a large tidal range. The conservation objectives for the site are “Subject to natural change, maintain the qualifying habitats and species in favourable conditions”. Several blocks have been applied for in the 24th Round which abut the western boundary of the site. Proposed work programmes include new seismic survey and a drill or drop well. The only potential interaction with the site from anticipated routine activities (as opposed to accidents which are considered elsewhere in this AA) in the blocks is the spread of drilling mud and cuttings particulates. This material could result in a physical and a chemical footprint. However, in view of the tidal range, size of the site, nature of the natural sediments of the area and likely nature and scale of discharges, no adverse effect on site integrity is foreseen. The locations of potential drilling sites are not currently known but if close to the site an AA could be triggered during the permitting process. This would provide a further opportunity to assess potential implications of a specific proposed activity, to identify any additional mitigation if necessary and, in the light of the foregoing, to consider whether the activity should be authorised.

C11 Sefton Coast SAC

A block has been applied for in the 24th Round which borders the SAC. However, the primary and qualifying features and species for the site are terrestrial and no interaction with potential activities is foreseen. Should a commercial discovery be made, export via existing Liverpool Bay infrastructure is anticipated rather than a new pipeline to shore.

APPENDIX D – CONSIDERATION OF SITES AND POTENTIAL ACOUSTIC EFFECTS

D1 Overview of effects of acoustic disturbance

Compared to the noise derived from seismic surveys, noise from other oil and gas activities is relatively minor; sequential DTI 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.

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 (seals, sea lions and walruses) 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, where present in coastal habitats, may also experience acoustic disturbance through seismic exploration. However, they generally occupy shallow, inshore areas where the propagation of seismic noise is very limited. Acoustic disturbance of pinnipeds from aircraft is also a matter of concern.

In Appendix A3, Atlantic salmon (*Salmo salar*), several species of lamprey, and three other species of fish are identified as primary or qualifying Annex II species amongst seven different SACs. The majority of these fish are anadromous, and occupy estuaries and coastal waters for part of their life cycle.

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). Specific to Atlantic salmon, Knudsen *et al*. (1994) showed that a source of intense low frequency sound (10Hz) within a river acted as an acoustic barrier to young salmon, with fish being displaced to an area where the intense sound was absent.

There are currently no UK Natura 2000 sites with marine invertebrates as qualifying features. However, invertebrates such as crabs and squid may form an important component of the diet of qualifying Annex II species, for example bottlenose dolphin *Tursiops truncatus*.

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 these animals 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 routing restrictions would be implemented.

D2 Noise sources and propagation

With the exception of explosives and modern military sonar, airgun arrays used for seismic surveys are the highest energy man made sound sources in the sea; broadband source levels of 248-259 dB 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% and slow rise time (in comparison to explosive noise). Most of the energy produced by airguns is below 200 Hz, although some high frequency noise may also be emitted (Goold 1996, Gordon and Moscrop 1998). 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 (DTI database of PON14 closeout submissions). There is no evidence to suggest that the 24th Round Licensing would cause a significant increase in activity, and it is less likely still that it would cause a return to historic levels.

A proportion of the wells anticipated following 24th Round Licensing may be assessed using Vertical Seismic Profiling (VSP), which typically involves a short duration, low intensity source when compared to 2D or 3D reflection surveys.

The DTI SEA process has reviewed general aspects of noise propagation. Most environmental assessments of noise disturbance in deep 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 (see SEA 4). 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 8 kHz sounds above background levels at a range of 8km from the source, even in a high noise environment.

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. Under some circumstances, cavitation of thruster propellers is a further appreciable noise source.

Drilling noise has 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).

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).

Acoustic disturbance of pinnipeds from aircraft is also a matter of concern. Animals which are hauled out for pupping or moulting are probably the most susceptible to such disturbance (Richardson *et al*. 1995). Richardson *et al*. (1983) provide a review of effects of aircraft on pinnipeds. Overflying aircraft may cause seals to temporarily vacate pupping beaches, which could result in separation of mothers and pups. In open water, seals generally dive when an aircraft passes overhead at low altitude. Low flying helicopters have been observed to be disturbing in certain circumstances.

D3 Effects thresholds in marine mammals

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). 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) and short-term behavioural responses. Postulated chronic effects (for which evidence is almost entirely absent) including 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.

Australian seismic guidelines (Environment Australia 2001) consider that “sounds heard by whales of over approximately 140 dB in feeding, breeding or resting areas may be considered likely to significantly disturb whales that are present. Sounds heard by whales of over 150 dB in other areas, such as migratory paths, may significantly disturb whales that are in the area.”. In contrast to this behavioural consideration, the National Marine Fisheries Service (NMFS) criterion for onset of Level A harassment resulting from seismic noise, under the US Marine Mammal Protection Act (180 dB re 1 μPa rms) and for Level B harassment (160 dB) were determined in relation to the likelihood of auditory threshold shifts (MMS 2004).

Most research effort has concentrated on large whales and Richardson *et al*. (1995) commented on an almost total lack of studies on effects of geophysical surveys on delphinid species. Using recorded airgun pulses from a 2D seismic survey with a 2,120 cubic inch airgun array, measured as power spectral density and re-calculated using a weighting method for comparison with a dolphin audiogram obtained using pure tone bursts, Goold (1996) and Goold & Fish (1998) concluded firstly that common dolphins were able to tolerate seismic pulses at a distance of 1 km from the array; and secondly that received levels at this distance were equivalent to a SPL of 133 dB re 1 μPa rms at 20 kHz.

Ketten (2001) concludes, from a comprehensive review, that a signal intensity of 140 dB that is also 80-90 dB over the individual threshold at each frequency is required for significant threshold shifts, i.e. a blanket figure of overall noise level is not appropriate. Typically, dolphins take avoidance action >90 dBht (Nedwell, 2005) (dBht is a species-specific parameter used to estimate perceivable level of sound). The zone around a seismic vessel where sound levels are >90 dBht is relatively small, perhaps a radius of 1.5km around the centre of the array, although (as noted above) local propagation effects make this sort of small-scale prediction imprecise. This would correlate with observed reactions taking place within 1-2km, although avoidance cannot be entirely instinctive, as dolphins are observed moving towards seismic vessels within this range, particularly after airguns have been firing for some time (Stone 2003).

Little is known of the acoustic abilities and sensitivities of beaked and pilot whales, although these species almost certainly use echolocation clicks spanning the sonic and low ultrasonic frequency range (MMS 2004). Hooker and Whitehead (1998) report echolocation clicks from diving bottlenose whales over the Gully submarine canyon on the Scotian Shelf; while clicks and frequency modulated whistles have been reported from beaked whales, with frequencies ranging between 300 Hz and 40 kHz (see review in MMS 2004). It is therefore assumed that beaked whales have good auditory capabilities over this frequency range, and will be susceptible to a similar range of disturbance and physiological effects to those observed in other cetacean species. In recent years, concerns in relation to beaked whales have also been associated with the use of military sonars, following a number of mass stranding events and the postulation of potential mechanisms of physical trauma in deep-diving marine mammals (Tepley 2001, Jepson *et al*. 2003, Piantadosi & Thalmann 2004, Fernández *et al*. 2004, Moore & Early 2004). To date, these mechanisms including formation of gas bubbles (and resulting decompression sickness or "bends"), either due to a behavioural response or directly induced by sound, have not been associated with geophysical surveys.

Behavioural responses to anthropogenic noise have generally been studied by visual or acoustic monitoring of abundance. Visual monitoring of cetaceans during seismic surveys has been carried out for several years throughout the UKCS. Stone (2003) carried out a detailed statistical analysis of 1,652 sightings during 201 seismic surveys, representing 44,451 hours of observational effort. Sighting rates of white-sided dolphins, white-beaked dolphins, *Lagenorhynchus* spp., all small odontocetes combined and all cetaceans combined were found to be significantly lower during periods of shooting on surveys with large airgun arrays. In general, small odontocetes showed the strongest avoidance response to seismic activity, with baleen whales and killer whales showing some localised avoidance, pilot whales showing few effects and sperm whales showing no observed effects.

In terrestrial mammals, exposure to loud sounds can lead to temporary threshold shifts (TTS), permanent threshold shifts (PTS) and non-auditory tissue damage, which may be fatal. For continuous sound sources, the intensity of the signal relative to the hearing threshold at that frequency, and the duration of the exposure can both affect the timing of the onset of TTS and PTS. For impulsive sounds, the intensity, pulse duration, pulse repetition rate and duration of exposure can all affect the timing and extent of TTS and PTS. With the absence of reliable information on the levels of sound likely to cause hearing damage in most marine mammal species, it has been common practice to transfer human Damage Risk Criteria (DRC) to other mammals. Richardson *et al*. (1995) predict that at low frequencies (<500 Hz) TTS would occur at around 165-180 dB re 1μPa@1m in phocids and at around 180-210 dB re 1μPa@1m in small odontocetes.

These represent the DRC estimates for exposure to continuous noise. For impulsive, intermittent sounds, e.g. airgun firing, the sound levels may be significantly higher, and will depend on the length and number of pulses received. Richardson *et al* (1995) estimated the DRC for 100 pulses to be 138 dB above absolute hearing threshold. This would be approximately 208 dB for a harbour seal and would be higher for small odontocetes. Such levels could be encountered directly below, or within 100m horizontal distance, from a large commercial airgun array.

Harris *et al*. (2001) studied the occurrence and behaviour of seals (predominantly ringed seals *Phoca hispida*) during a near-shore seismic survey off the coast of northern Alaska. Near identical sightings rates occurred during periods of no airguns firing, one airgun, and a full array (8-11 120in^3 airguns), although during full array shooting, seals showed partial avoidance of a zone within a 150m radius of the vessel. Despite this, most seals remained close enough to a seismic line to be exposed to received levels exceeding 190db re 1μPa (rms) when diving.

Blackwell *et al*. (2004) observed ringed seal behaviour on ice and in the water surrounding an oil production facility (63-3000m) during pipe-driving operations. Mean underwater sound levels were 157dB re 1μPa at 63m, and <180dB re 1μPa at all distances. Seals exhibited little or no reaction to noise, and were observed swimming in open water as close to 46m from the facility throughout pipe-driving operations. It was suggested that the seals around this facility were habituated to industrial sounds.

TTS has been induced, experimentally, in three pinniped species, harbour seal, northern elephant seal and Californian sea lions (Kastak & Schusterman 1996, Kastak *et al* 1999). All three species showed a similar TTS of 4.6-4.9 dB, after 20-22 minutes of exposure at 65-70 dB above threshold level in the frequency range 0.1-2 kHz. Both harbour and grey seals showed short term avoidance behaviour during controlled exposure experiments with small airguns (Thompson *et al.* 1998). In both cases seals abandoned foraging sites and swam away from airguns but returned to forage in the same areas on subsequent days. Models of grey seal habitat preference supported by satellite telemetry data suggest that foraging movements are on two geographical scales: long and distant trips from one haul-out site to another; and local repeated trips to discrete offshore areas. Foraging destinations at sea are typically localized areas characterized by a gravel/sand seabed sediment; the preferred burrowing habitat of sandeels, an important component of grey seal diet. Recent studies of foraging at sea by common seals have been funded by SNH and DTI (Sharples *et al* 2005). These indicate high site fidelity to haul-out sites, but ranging over substantial distances at sea; for example, seals tagged in The Wash travelled repeatedly to between 75 and 120 km offshore and as far as 220 km to assumed foraging patches. All but one of the seals tagged, which used a haul-out site 60 km north of The Wash, remained faithful to the haul-out site at which they were captured. The implications for both common and grey seals are that ecological effects at considerable distances from a designated SAC may influence the breeding population of the site.

However, long-term population trends in both grey and common seals are generally positive: the grey seal population in the northeast Atlantic has been increasing at around 6% annually since the 1960's and its current size is estimated at around 130,000-140,000 individuals. The common seal population along the east coast of England (mainly in The Wash) was reduced by 52% following the 1988 phocine distemper virus (PDV) epidemic. The population was affected by a recurrence of the PDV epidemic in August 2002. The mean 2004 count for The Wash (2146) was 14.6% lower than the mean 2003 count (2513) and 28% lower than the mean pre-epidemic 2002 count (2976).

Other effects of sound in marine mammals have been postulated, including triggering the onset of Decompression Sickness (DCS) either through behavioural modification or direct physical activation of microbubbles (see above). Possibly more meaningful in relation to Annex IV of the Directive than to an Article 6(3) Appropriate Assessment [of specific sites], concerns have been raised that the cumulative effect of sequential seismic surveys could act as a barrier to marine mammal migration. For example, in relation to the Atlantic Margin area, Gordon *et al*. (1998) considered that sound fields from planned seismic surveys in 1997, assuming a spherical propagation model and a threshold intensity of 160dB re 1 µPa, would form a "virtually unbroken barrier to any marine mammal wishing to move north-south along the shelf edge". Available evidence (largely based on acoustic monitoring, Clark & Charif 1998, Swift *et al* 2002) does not suggest that broadscale marine mammal distribution patterns have been influenced by seismic activity to date. Nevertheless, there is little doubt that successive seismic surveys could have a cumulative effect on animal distribution and movements as a result of repetitive behavioural disturbance.

D4 SAC qualifying species and sites

As discussed above, it is considered that marine mammals are the only qualifying species which may potentially be affected (in terms of conservation status) by acoustic disturbance. The following sites are designated in relation to marine mammals:

Yell Sound SAC

(Primary Annex II species otter, common seal)
Blocks 2/3, 2/4b, 3/6b are approximately 90-110km distant; blocks 206/3, 206/4, 208/26, 214/14, 214/15, 214/19 are approximately 65-120 km distant.

Yell Sound Coast in the Shetland Islands is the most northerly UK site selected for common seal. The rocky shores and uninhabited islands and skerries within Yell Sound support a colony representing over 1% of the UK population. The Yell Sound area is also believed to support more than 2% of the entire GB otter population. The site consists of a complex of islands and coastline, selected to include the areas of highest otter density. The adjacent marine areas have extensive algal beds, which are used by otters for foraging.

The SAC is potentially within the phocid audible range of seismic surveys in several blocks which may be licensed west and east of Shetland; however, received sound will be low frequency and close to ambient levels; and it is not considered that activities which may follow proposed licensing will adversely affect the integrity of the SAC. Similarly for otters, which are probably less sensitive to the low frequencies which may propagate over this range.

Mousa SAC

(Primary Annex II species common seal)
Blocks 3/29c, 3/30b, 9/4b are >160km distant

The exposed rocky island of Mousa, off the east coast of Shetland Mainland, supports just over 1% of the UK population of common seal. The large rocky tidal pools on the island are frequently used by the seals for pupping, breeding and moulting, and provide shelter from the exposed conditions on the open coast.

The SAC is considered to be outside the phocid audible range (ca. 130dB, 125km) of seismic surveys in blocks on offer east of Shetland and it is not considered that activities which may follow proposed licensing will adversely affect the integrity of the SAC.

Faray and Holm of Faray SAC

(Primary Annex II species grey seal); Sanday SAC (primary Annex II species common seal)
Blocks 12/12 and 12/13 are 65-70 km distant

The two uninhabited islands of Faray and Holm of Faray, in the northern part of Orkney, support the second-largest grey seal breeding colony in the UK, contributing around 9% of annual UK pup production.

Sanday supports the largest group of common seal at any discrete site in Scotland, representing over 4% of the UK population. Nearshore kelp beds that surround Sanday are important foraging areas for the seals, and the colony is linked to a very large surrounding population in the Orkney archipelago.

The SAC is potentially within the audible range to phocids of seismic surveys in two blocks which may be licensed east of the Pentland Firth; however, received sound will be low frequency and close to ambient levels and it is not considered that activities which may follow proposed licensing will adversely affect the integrity of the SAC.

Dornoch Firth and Morrich More SAC

(Primary Annex II species otter, common seal)
Block 12/29 is approximately 80km distant

The Dornoch Firth supports a significant proportion of the inner Moray Firth population of the common seal. The seals are the most northerly population to utilise sandbanks and represent almost 2% of the UK population. The site also supports a good population of otters.

The SAC is potentially within the audible range to phocids of seismic surveys in block 12/29, although the licence application has no commitment to additional seismic coverage. Regulatory mitigation measures are considered necessary to provide appropriate control over survey timing, source level and operational measures to minimise the duration of acoustic disturbance; in addition, a specific AA would be required for any seismic survey in this block. Subject to appropriate mitigation, it is not considered that activities which may follow proposed licensing will adversely affect the integrity of the SAC.

Moray Firth SAC

(Primary Annex II species: bottlenose dolphin)
Blocks 12/12, 12/13, 12/29, 18/10, 19/6 are within potential range of effect (noise from seismic survey).

The bottlenose dolphin population within the SAC is relatively well-studied, although it is noted that photo-identification studies outside the SAC indicate mobility of this 'resident' dolphin population on a timescale similar to that of the implementation of the Directive (Wilson *et al*. 2004). Consequently, conservation status of the population may be influenced by anthropogenic activities outside the scope of Appropriate Assessments specific to the site under Article 6(3). However, under the existing site designation, significant acoustic disturbance, resulting from the use of a multiple airgun array seismic source within the SAC boundary may be considered as a potential adverse effect on the integrity of the SAC.

The combined 18/10 & 19/6 block applications are considered likely to involve one D/D well each (if successful, these may involve VSP). There is no firm commitment to additional seismic coverage.

Spatial and temporal variations in bottlenose dolphin abundance within (and adjacent to) the SAC have been assessed by Wilson *et al*. (1997) and Hastie *et al*. (2003), who conclude that sightings are very clearly concentrated in three deep, narrow channels subject to tidal flows, namely at Sutors, Chanonry and Kessock. At this range, ≈60km from the closest block applied for (12/29), significant effects at a population level would not be expected to result from seismic survey, drilling, VSP or production noise and it is not considered that these activities which may follow proposed licensing will adversely affect the integrity of the SAC.

Drilling in the outer Moray Firth blocks under consideration (12/12, 12/13, 12/29, 18/10, 19/6) and development in the event of a viable discoveries, would potentially result in noise disturbance in combination with production (and wind turbine generation) at the existing Beatrice installations. In view of the individual scale of acoustic sources, it is not considered that in combination effects of activities which may follow proposed licensing will adversely affect the integrity of the SAC.

Firth of Tay and Eden Estuary SAC

(Primary Annex II species common seal); Isle of May SAC (primary Annex II species grey seal)
Blocks 28/3b, 28/5c, 28/15, 28/19, 28/20, 28/24, 28/25, 28/30 are >200km distant

The Firth of Tay SAC supports a nationally important breeding colony of common seal, part of the east coast population of common seals that typically utilise sandbanks. Around 600 adults haul-out at the site to rest, pup and moult, representing around 2% of the UK population of this species.

The Isle of May, lying at the entrance to the Firth of Forth, supports the largest east coast breeding colony of grey seals in Scotland and the fourth-largest breeding colony in the UK, contributing approximately 4.5% of annual UK pup production.

Both SACs are considered to be outside the audible range to phocids (*ca.* 130dB, 125km) of seismic surveys in blocks on offer in the central North Sea and consequently it is not considered that activities which may follow proposed licensing will adversely affect the integrity of the SAC.

Berwickshire and North Northumberland Coast SAC

Blocks 34/30, 35/26, 40/5, 41/1 are 65-110 km distant

This is an extensive and diverse stretch of coastline in north-east England and south-east Scotland. The north-east England coastal section is representative of grey seal breeding colonies in the south-east of its breeding range in the UK. It is the most south-easterly site selected for this species, and supports around 2.5% of annual UK pup production.

The SAC is potentially within the audible range to phocids of seismic surveys in four relatively nearshore blocks which may be licensed east of Teesmouth. However, received sound will be low frequency and close to ambient levels; and it is not considered that activities which may follow proposed licensing will adversely affect the integrity of the SAC.

The Wash and North Norfolk Coast SAC

(Primary Annex II species common seal; qualifying Annex II species otter)
Blocks 47/22 and 47/23 are approximately 5-6 km of the SAC northern boundary; block 48/27 is within 5km of the SAC eastern boundary

The Wash, on the east coast of England, is the largest embayment in the UK. The extensive intertidal flats here and on the North Norfolk Coast provide ideal conditions for common seal breeding and hauling-out. This site is the largest colony of common seals in the UK, with some 7% of the total UK population.

Blocks 47/22 and 47/23 are both the subject of D/D well offers with no firm commitment to additional seismic coverage. Although these blocks, together with block 48/27, are close to the SAC boundaries, significant effects at breeding and haul-out sites within the SAC would not be expected to result from drilling and production noise. Additional seismic coverage, or VSP associated with these blocks could have significant effects, especially during the breeding (June-July) and moulting (August-September seasons. Regulatory mitigation measures are considered necessary to provide appropriate control over survey timing, source level and operational measures to minimise the duration of acoustic disturbance; in addition, a specific AA would be required for any seismic survey in these three blocks.. Subject to appropriate mitigation, it is not considered that activities which may follow proposed licensing will adversely affect the integrity of the SAC.

Pembrokeshire Marine/Sir Benfro Forol SAC

(Primary Annex II species grey seal; qualifying Annex II species otter)
Blocks applied for in Liverpool Bay are remote from the SAC

Pembrokeshire in south-west Wales is representative of grey seal colonies in the south-western part of the breeding range in the UK. It is the largest breeding colony on the west coast south of the Solway Firth, representing over 2% of annual UK pup production.

Potential activities in Liverpool Bay blocks applied for are not anticipated to adversely affect the integrity of the Pembrokeshire Marine SAC.

Cardigan Bay SAC

(Primary Annex II species bottlenose dolphin; qualifying Annex II species grey seal)
Blocks applied for in Liverpool Bay are remote from the SAC

The bottlenose dolphin population of Cardigan Bay off the west coast of Wales has been estimated to consist of around 125 individuals. The dolphins appear to use the inshore waters of Cardigan Bay for both feeding and reproduction, and in the summer months calves and juveniles are often observed with adult individuals or groups.

Although some animals are present near-shore in every month of the year, sightings rates increase through the summer, peaking in July-August, with a low between October and April. A long-term land-based study (1989-96) at New Quay in Cardigan Bay, West Wales, found that 92% of all sightings occurred between April and November, with 48% between June and August; sightings rates were lowest in March and highest in July (Bristow & Rees 2001). Further coastal observations of bottlenose dolphin within the Cardigan Bay SAC have been made by Pierpoint & Allan (2006), who noted that sighting rates were higher at Mwnt, Ynys Lochtyn and New Quay Harbour. In accordance with previous reports, female dolphins with calves were recorded more frequently at Mwnt than elsewhere; the high level of occurrence (> 50% of watches in which dolphins were present) suggested site fidelity by females with calves through the summer months.

Potential activities in Liverpool Bay blocks applied for are not anticipated to adversely affect the integrity of the Cardigan Bay SAC.

Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarns

(Qualifying Annex II species bottlenose dolphin, otter, grey seal)
Blocks applied for in Liverpool Bay are at least 100 km from the SAC

Lleyn Peninsula and the Sarns on the north-west coast of Wales is designated primarily for a range of marine habitats (Annex I), with three species of marine mammal cited as qualifying species.

Potential activities in Liverpool Bay blocks applied for are not anticipated to adversely affect the integrity of the Lleyn Peninsula and the Sarns SAC.

Strangford Lough SAC, Murlough SAC

(Qualifying Annex II species common seal)
Blocks 109/15 and 112/30 are approximately 94km from the Strangford Lough SAC boundary; blocks 110/1 and 113/26b are approximately 105km distant.

Strangford Lough SAC is designated primarily for a range of marine habitats (Annex I) while Murlough SAC is designated primarily for dune habitats (Annex I). Common seal is cited as a qualifying species for both sites.

Several blocks which may be licensed in the Irish Sea are expected to have new 2D or 3D seismic surveys, with others likely to be subject to D/D or contingent well commitments. Although both sites are within the linear distance considered to represent the audible range to phocids (ca. 130dB, 125km) of seismic surveys, the Isle of Man presents a physical barrier to acoustic propagation and it is not considered that activities which may follow proposed licensing will adversely affect the integrity of the SAC.

Other sites

Durness SAC, River Borgie SAC, Moine Mhor SAC, Tayvallich Juniper and Coast SAC, River Dee and Bala Lake SAC, North Norfolk Coast SAC, The Broads SAC all have otter cited as a qualifying Annex II species. The Scottish sites, although some include maritime habitats (dunes, raised bog), are at considerable distances (>300km) from offered blocks; while the habitats used by otters within the English SACs are predominantly freshwater and will not be affected by propagated noise from offshore activities. It is not considered that activities which may follow proposed licensing will adversely affect the integrity of these SACs.

In combination effects

Seismic survey and other noise producing activities that might follow a 24th Licensing Round are anticipated to be widely separated in space and time. As noted above the number of seismic surveys is substantially less than historic peaks and as a result significant in-combination effects with oil and gas activities in existing licensed blocks are not foreseen. Similarly, while significant in-combination effects with noise from other activities such as shipping, fishing, military exercising, marine construction are feasible, they are not viewed as likely to occur in or adjacent to relevant European Sites because of the controls in place on 24th Round and other block activities, including EIA and AA which require other noise sources to be considered during the consenting process.

Mitigation

The major operational control and mitigation over seismic surveys in the UK are implemented through JNCC's Guidelines for minimising acoustic disturbance to marine mammals from seismic surveys (latest revision April 2004). These were originally introduced on a voluntary basis as part of the UK's commitment under ASCOBANS, but have subsequently been required by licence conditions in many areas. Member companies of the UK Offshore Operators Association (UKOOA) are required to comply with these Guidelines in all areas of the UK Continental Shelf. The guidelines list several aspects of operational planning which should be considered in relation to minimising potential disturbance, including timing (particularly to avoid breeding and calving seasons) and planning to use the lowest practicable power levels.

The JNCC guidelines include a requirement for visual monitoring of the area prior to airgun firing to determine if marine mammals are in the vicinity, and a slow and progressive build-up of sound to enable animals to move away from the source. In areas of high sensitivity the guidelines require a competent Marine Mammal Observer (MMO) on the source vessel to carry out visual monitoring (during daylight hours) before and during the survey; two MMOs are required for surveys north of 57° latitude due to the longer daylight hours.

JNCC may also advise the DTI that passive acoustic monitoring (PAM) should be used as a mitigation tool if sensitive species are likely to inhabit the proposed survey location.

Finally, as part of required PON14 activity permitting the DTI requires an environmental assessment to accompany application for offshore seismic surveys. Consideration of such applications includes the DTI conservation advisers and may result in additional mitigation being required and may trigger a specific AA. Seismic surveys wholly within territorial waters were previously not necessarily subject to the PON14 regulatory approval mechanism (see SEA 6 recommendations). To resolve this, the Offshore Petroleum Activities (Conservation of Habitats) (Amendment) Regulations 2007 have been made. These regulations amend the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 which implement the Habitats Directives.