Department for
Business, Energy
& Industrial Strategy

OFFSHORE OIL & GAS LICENSING 30TH SEAWARD ROUND

Habitats Regulations Assessment

Appropriate Assessment: Southern North Sea

May 2018

Any enquiries regarding this publication should be sent to us at oep@beis.gov.uk.

Contents

1 Introduction 1
1.1 Background and purpose 1
1.2 Relevant Blocks 2
1.3 Relevant Natura 2000 sites 3
1.4 Assessment overview 7
2 Licensing and potential activities 8
2.1 Licensing 8
2.2 Activities that could follow licensing 9
2.3 Existing regulatory requirements and controls 16
3 Appropriate assessment process 21
3.1 Process 21
3.2 Site integrity 21
3.3 Assessment of effects on site integrity 22
4 Evidence base for assessment 23
4.1 Introduction 23
4.2 Physical disturbance and drilling effects 24
4.3 Underwater noise 29
5 Assessment 37
5.1 Assessment of physical disturbance and drilling effects 37
5.2 Assessment of underwater noise effects 56
5.3 In-combination effects 63
6 Overall conclusion 78
7 References 79

1 Introduction

1.1 Background and purpose

The plan/programme covering this and potential future seaward licensing rounds has been subject to a Strategic Environmental Assessment (OESEA3), completed in July 2016. The SEA Environmental Report includes detailed consideration of the status of the natural environment and potential effects of the range of activities which could follow licensing, including potential effects on conservation sites. The SEA Environmental Report was subject to an 8 week public consultation period, and a post-consultation report summarising comments and factual responses was produced as an input to the decision to adopt the plan/programme. This decision has allowed the Oil & Gas Authority (OGA) to progress with further seaward oil and gas licensing rounds. As a result on 25th July 2017, the OGA invited applications for licences regarding 821 Blocks in a 30th Seaward Licensing Round covering mature areas of the UKCS, and applications were received for licences covering 239 Blocks/part Blocks.

The *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (as amended) implement the requirements of Articles 6(3) and 6(4) of the Habitats Directive with respect to oil and gas activities in UK territorial waters and on the UK Continental Shelf. The *Conservation of Offshore Marine Habitats and Species Regulations 2017* cover other relevant activities in offshore waters (i.e. excluding territorial waters). Within territorial waters, the Habitats Directive is transposed into UK law via the *Conservation of Habitats and Species Regulations 2017* in England and Wales, the *Conservation (Natural Habitats, &c.) Regulations 1994* in Scotland (for non-reserved matters), and the *Conservation (Natural Habitats, &c) Regulations (Northern Ireland) 1995* (as amended) in Northern Ireland.

As the petroleum licensing aspects of the plan/programme are not directly connected with or necessary for nature conservation management of European (Natura 2000[1]) sites, to comply with its obligations under the relevant regulations, the Department for Business, Energy and Industrial Strategy[2] (BEIS, formerly the Department of Energy and Climate Change) is undertaking a Habitats Regulations Assessment (HRA). To comply with obligations under the *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (as amended), in winter 2017, the Secretary of State undertook a screening assessment to determine whether the award of any of the Blocks offered would be likely to have a significant effect on a relevant

[1] This includes Special Areas of Conservation (SAC) and Special Protection Areas (SPA), and potential sites for which there is adequate information on which to base an assessment.
[2] Note that while certain licensing and regulatory functions were passed to the OGA (a government company wholly owned by the Secretary of State for BEIS) on 1 October 2016, environmental regulatory functions are retained by BEIS, and are administered by the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED).

site, either individually or in combination[3] with other plans or projects (BEIS 2018). In doing so, the Department has applied the Habitats Directive test[4] (elucidated by the European Court of Justice in the case of Waddenzee (Case C-127/02)[5]) which is:

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

1.2 Relevant Blocks

The screening assessment (including consultation with the statutory conservation agencies/bodies) formed the first stage of the HRA process. The assessment was undertaken in the period within which applications for Blocks were being accepted, and therefore considered all 821 Blocks offered. The screening identified 304 whole or part Blocks as requiring further assessment prior to decisions on whether to grant licences (BEIS 2018). Following the closing date for 30th Seaward Round applications, and the publication of the screening document, those Blocks identified as requiring further assessment were reconsidered against the list of actual applications. It was concluded that further assessment (Appropriate Assessment - AA) was required for 61 of the Blocks applied for. Because of the wide distribution of these Blocks around the UKCS, the AA in respect of each potential licence award, are contained in four regional reports as follows:

- Southern North Sea
- Central North Sea
- West of Shetland
- Irish Sea

[3] Note that "in-combination" and "cumulative" effects have similar meanings, but for the purposes of HRA, and in keeping with the wording of Article 6(3) of the Habitats Directive, "in-combination" is used to describe the potential for such effects throughout. More information on the definitions of "cumulative" and "in-combination" effects are available in MMO (2014a) and Judd *et al.* (2015).

[4] See Article 6(3) of the Habitats Directive.

[5] Also see the Advocate General's Opinion in the recent 'Sweetman' case (Case C-258/11), which confirms those principles set out in the Waddenzee judgement.

1.2.1 Southern North Sea Blocks

The southern North Sea Blocks applied for in the 30th Round and considered in this assessment are listed below in Table 1.1, and are shown in Figure 1.1.

Table 1.1: Blocks requiring further assessment

42/13b	42/14	42/15b	42/17	42/18	42/20a
42/30d	43/2	43/7	43/8	43/10	43/14
43/15	43/16	43/17a	43/23	43/24b	43/26c
44/6	44/7	44/8b	44/9b	44/11d	44/12d
44/12e	47/2d	47/3f	47/7	47/8f	47/10d
47/15c	48/6d	48/8b	48/11c	48/11d	48/12b
48/16	48/17d	48/18b	48/19b	48/20c	48/24a
53/1b	53/13	53/14b	53/8	53/9	

1.3 Relevant Natura 2000 sites

The screening identified the relevant Natura 2000 sites and related Blocks requiring further assessment in the southern North Sea (refer to Appendix B of BEIS 2018). Following a reconsideration of those Blocks and sites screened in against those Blocks applied for, ten Natura 2000 sites in parts of the southern North Sea were identified as requiring further assessment in relation to the 47 Blocks (Table 1.2 and Figure 1.1).

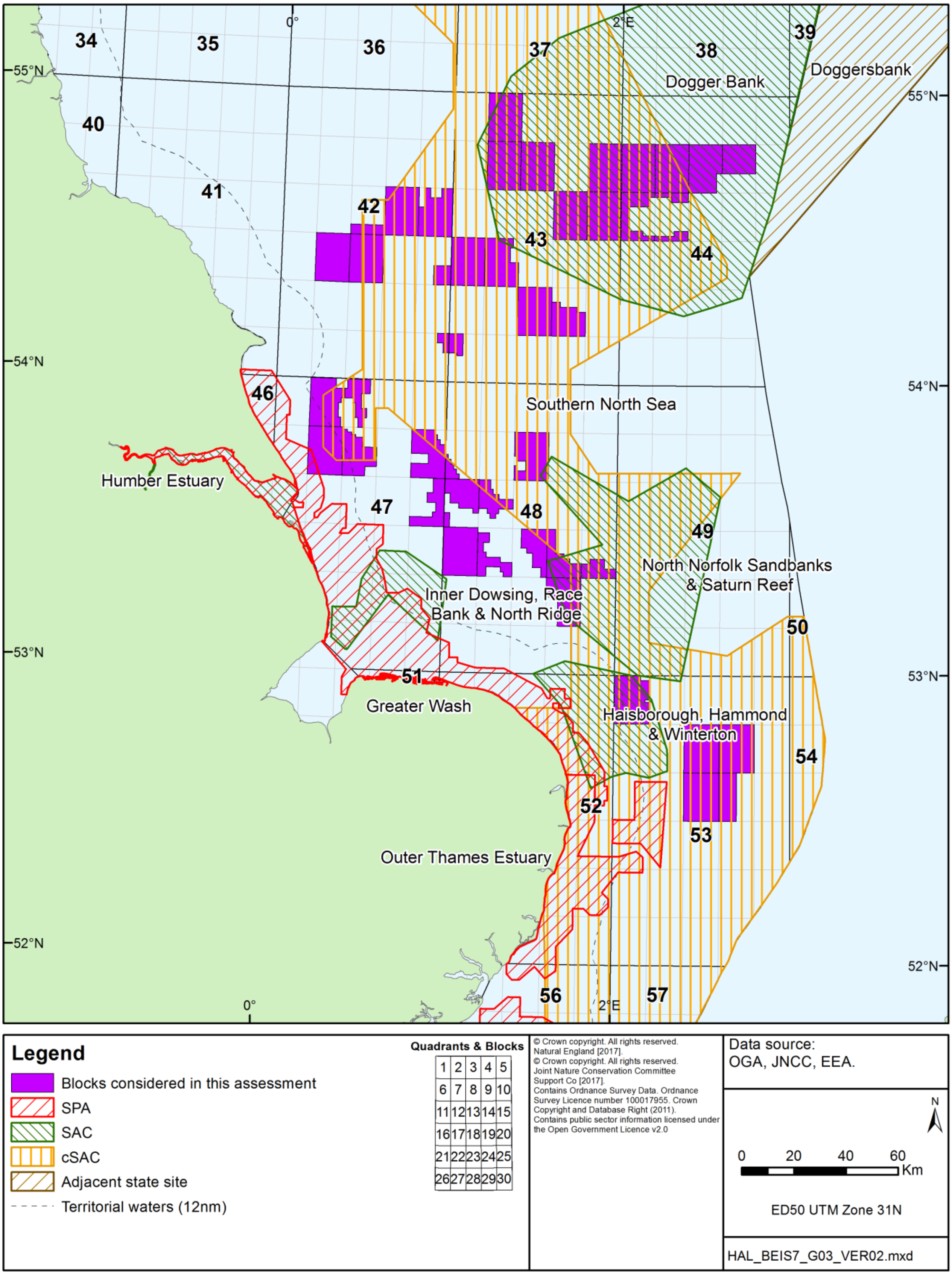
Table 1.2: Relevant sites requiring further assessment

<table>
<tr><th>Relevant site
Features</th><th>Relevant Blocks applied for</th><th>Sources of potential effect</th></tr>
<tr><td colspan="3">SPAs</td></tr>
<tr><td rowspan="2">Humber Estuary SPA
Breeding, on passage and overwintering waders and waterfowl, breeding terns, breeding and overwintering birds of prey. Overwintering waterbird assemblage.</td><td rowspan="2">47/7</td><td>Physical disturbance and drilling: rig siting, drilling discharges, vessel presence and movement</td></tr>
<tr><td>Underwater noise: site survey and well evaluation, conductor piling.</td></tr>
<tr><td rowspan="2">Greater Wash SPA
Overwintering divers, waterfowl and gulls, breeding terns.</td><td>47/2d, 47/7, 47/8f, 47/15c</td><td>Physical disturbance and drilling: rig siting, drilling discharges, vessel presence and movement</td></tr>
<tr><td>47/2d, 47/7, 47/8f, 47/15c, 48/16, 53/1b</td><td>Underwater noise: site survey and well evaluation, conductor piling.</td></tr>
</table>

Relevant site Features	**Relevant Blocks applied for**	**Sources of potential effect**
Outer Thames Estuary SPA Breeding terns, overwintering diver.	53/8, 53/13	Physical disturbance and drilling: rig siting, drilling discharges, vessel presence and movement
		Underwater noise: site survey and well evaluation, conductor piling
SACs		
Southern North Sea cSAC Annex II species: Harbour porpoise	42/13b, 42/14, 42/15b, 42/17, 42/18, 42/20a, 42/30d, 43/2, 43/7, 43/8, 43/10, 43/14, 43/15, 43/16, 43/17a, 43/23, 43/24b, 43/26c, 44/6, 44/7, 44/8b, 44/11d, 44/12d, 44/12e, 47/2d, 47/3f, 47/7, 47/8f, 47/10d, 47/15c, 48/6d, 48/8b, 48/11c, 48/12b, 48/18b, 48/19b, 48/20c, 48/24a, 53/1b, 53/8, 53/9, 53/13, 53/14b	Physical disturbance and drilling: rig siting, drilling discharges, vessel presence and movement
	42/13b, 42/14, 42/15b, 42/17, 42/18, 42/20a, 42/30d, 43/2, 43/7, 43/8, 43/10, 43/14, 43/15, 43/16, 43/17a, 43/23, 43/24b, 43/26c, 44/6, 44/7, 44/8b 44/9b 44/11d, 44/12d, 44/12e, 47/2d, 47/3f, 47/7, 47/8f, 47/10d, 47/15c, 48/6d, 48/8b, 48/11c, 48/11d, 48/12b, 48/16, 48/17d, 48/18b, 48/19b, 48/20c, 48/24a, 53/1b, 53/8, 53/9, 53/13, 53/14b	Underwater noise: site survey and well evaluation, conductor piling
Dogger Bank SAC Annex I habitat: Sandbanks which are slightly covered by sea water all the time	43/2, 43/7, 43/8, 43/10, 43/14, 43/15, 43/16, 43/17a, 43/23, 44/6, 44/7, 44/8b, 44/9b, 44/11d, 44/12d, 44/12e	Physical disturbance and drilling: rig siting, drilling discharges
Doggersbank SAC (Netherlands) Annex I habitat: Sandbanks which are slightly covered by sea water all the time Annex II species: grey seal, harbour seal, harbour porpoise	44/9b	Physical disturbance and drilling: rig siting, drilling discharges, vessel presence and movement
		Underwater noise: site survey and well evaluation, conductor piling
North Norfolk Sandbanks and Saturn Reef SAC Annex I habitats: Sandbanks which are slightly covered by sea water all the time, reefs	48/8b, 48/18b, 48/19b, 48/20c, 48/24a, 53/1b	Physical disturbance and drilling: rig siting, drilling discharges
Humber Estuary SAC Annex I habitats: Estuaries mudflats and sandflats, sandbanks, saltmarsh and salt meadows, coastal lagoons, coastal dunes Annex II species: River lamprey, sea lamprey, grey seal	47/7	Physical disturbance and drilling: rig siting, drilling discharges, vessel presence and movement
		Underwater noise: site survey and well evaluation, conductor piling

Relevant site Features	**Relevant Blocks applied for**	**Sources of potential effect**
Inner Dowsing, Race Bank and North Ridge SAC Annex I habitats: Sandbanks which are slightly covered by sea water all the time, reefs	47/15c, 48/16	Physical disturbance and drilling: rig siting, drilling discharges
Haisborough, Hammond and Winterton SAC Annex I habitats: Sandbanks which are slightly covered by sea water all the time, reefs	53/1b, 53/8, 53/13	Physical disturbance and drilling: rig siting, drilling discharges

Figure 1.1: Blocks and sites relevant to this Appropriate Assessment



1.4 Assessment overview

This document sets out the key assumptions and approach to the AA, the evidence base underpinning the assessment and the assessment of relevant Blocks and sites. The document is organised as follows:

- Overview of the licensing process and nature of the activities that could follow including assumptions used to underpin the AA process (Section 2)
- Description of the approach to ascertaining the absence or otherwise of adverse effects on the integrity of relevant European sites (Section 3)
- Evidence base on the environmental effects of offshore oil and gas activities to inform the assessment (Section 4)
- The assessment of effects on the integrity of relevant sites, including in-combination with other plans or projects (Section 5)
- Overall conclusion (Section 6)

As part of this HRA process, the draft AA document was subject to statutory consultation and has been amended as appropriate in light of comments received. Both the draft and final AA documents are available via the 30th Round Appropriate Assessment webpage of the gov.uk website.

2 Licensing and potential activities

2.1 Licensing

The exclusive rights to search and bore for petroleum in Great Britain, the territorial sea adjacent to the United Kingdom and on the UK continental shelf (UKCS) are vested in the Crown and the *Petroleum Act 1998* (as amended) gives the OGA the power to grant licences to explore for and exploit these resources. Offshore licensing for oil and gas exploration and production commenced in 1964 and progressed through a series of Seaward Licensing Rounds. A Seaward Production Licence grants exclusive rights to the holders "to search and bore for, and get, petroleum" in the area covered by the Licence but does not constitute any form of approval for activities to take place in the Blocks, nor does it confer any exemption from other legal or regulatory requirements. Offshore activities are subject to a range of statutory permitting and consenting requirements, including, where relevant, activity specific AA under Article 6(3) of the Habitats Directive (Directive 92/43/EC).

Several sub-types of Seaward Production Licence were available in previous rounds (Traditional, Frontier and Promote) which have been replaced by the single "Innovate" licence[6]. As per previous licensing structures, the Innovate licence is made up of three terms covering exploration (Initial Term), appraisal and field development planning (Second Term), and development and production (Third Term). The lengths of the first two terms are flexible, but have a maximum duration of 9 and 6 years respectively. The Third Term is granted for 18 years but may be extended if production continues beyond this period. The Innovate licence introduces three Phases to the Initial Term, covering:

- Phase A: geotechnical studies and geophysical data reprocessing (note that the acquisition of new seismic could take place in this phase for the purpose of defining a 3D survey as part of Phase B, but normally this phase will not involve activities in the field)
- Phase B: shooting of new seismic and other geophysical data
- Phase C: exploration and appraisal drilling

Applicants may propose the Phase combination in their submission to the OGA. Phase A and Phase B are optional and may not be appropriate in certain circumstances, but every application must propose a Phase C, except where the applicant does not think any exploration is needed (e.g. in the development of an existing discovery or field re-development) and proposes to go straight to development (i.e. 'straight to Second Term'). The duration of the Initial Term and the Phases within it are agreed between the OGA and the applicant.

[6] *The Petroleum and Offshore Gas Storage and Unloading Licensing (Amendment) Regulations 2017* amend the Model Clauses to be incorporated in Seaward Production Licences so as to implement the Innovate licences to be issued in the 30th Round.

Applicants may choose to spend up to 4 years on a single Phase in the Initial Term, but cannot take more than 9 years to progress to the Second Term. Failure to complete the work agreed in a Phase, or to commit to the next Phase means the licence ceases, unless the term has been extended by the OGA.

Financial viability is considered prior to licence award for applicants proposing to start at Phase A or B, but further technical and financial capacity for Phase C activities would need to be demonstrated before the licence could enter Phase C and drilling could commence. If the applicant proposes to start the licence at Phase C or go straight to the Second Term, the applicant must demonstrate that it has the technical competence to carry out the activities that would be permitted under the licence during that term, and the financial capacity to complete the Work Programme, before the licence is granted. It is noted that the safety and environmental capability and track record of all applicants are considered by the OGA (in consultation with the Offshore Safety Directive Regulator)[7] through written submissions before licences are awarded[8]. Where full details cannot be provided via the written submissions at the application stage, licensees must provide supplementary submissions that address any outstanding environmental and safety requirements before approvals for specific offshore activities such as drilling can be issued.

2.2 Activities that could follow licensing

As part of the licence application process, applicants provide the OGA with details of work programmes they propose in the Initial Term. These work programmes are considered along with a range of other factors by the OGA before arriving at a decision on whether to license the Blocks and to whom. Activities detailed in work programmes may include the purchase, reprocessing or shooting of 2D or 3D seismic data (Phases A and B) and the drilling of wells (Phase C). There are three levels of drilling commitment:

- A Firm Drilling Commitment is a commitment to the OGA to drill a well. Firm drilling commitments are preferred on the basis that, if there were no such commitment, the OGA 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 relevant activity specific environmental assessments.

[7] The Offshore Safety Directive Regulator is the Competent Authority for the purposes of the Offshore Safety Directive comprising of the Department for Business, Energy and Industrial Strategy (BEIS) Offshore Petroleum Regulator for Gas Environment and Decommissioning (OPRED) and the Health and Safety Executive (HSE) working in partnership.

[8] Refer to OGA technical guidance and safety and environmental guidance on applications for the 30th Round at: https://www.ogauthority.co.uk/licensing-consents/licensing-rounds/

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

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

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

The OGA general guidance[9] makes it clear that an award of a Production Licence does not automatically allow a licensee to carry out any offshore petroleum-related activities from then on (this includes those activities outlined in initial work programmes, particularly Phases B and C). Figure 2.2 provides an overview of the plan process associated with the 30th Seaward Licensing Round and the various environmental assessments including HRA. Offshore activities such as seismic survey or drilling are subject to relevant activity specific environmental assessments by BEIS (see Figures 2.3 and 2.4), and there are other regulatory provisions exercised by the Offshore Safety Directive Regulator and bodies such as the Health and Safety Executive. It is the licensee’s responsibility to be aware of, and comply with, all regulatory controls and legal requirements.

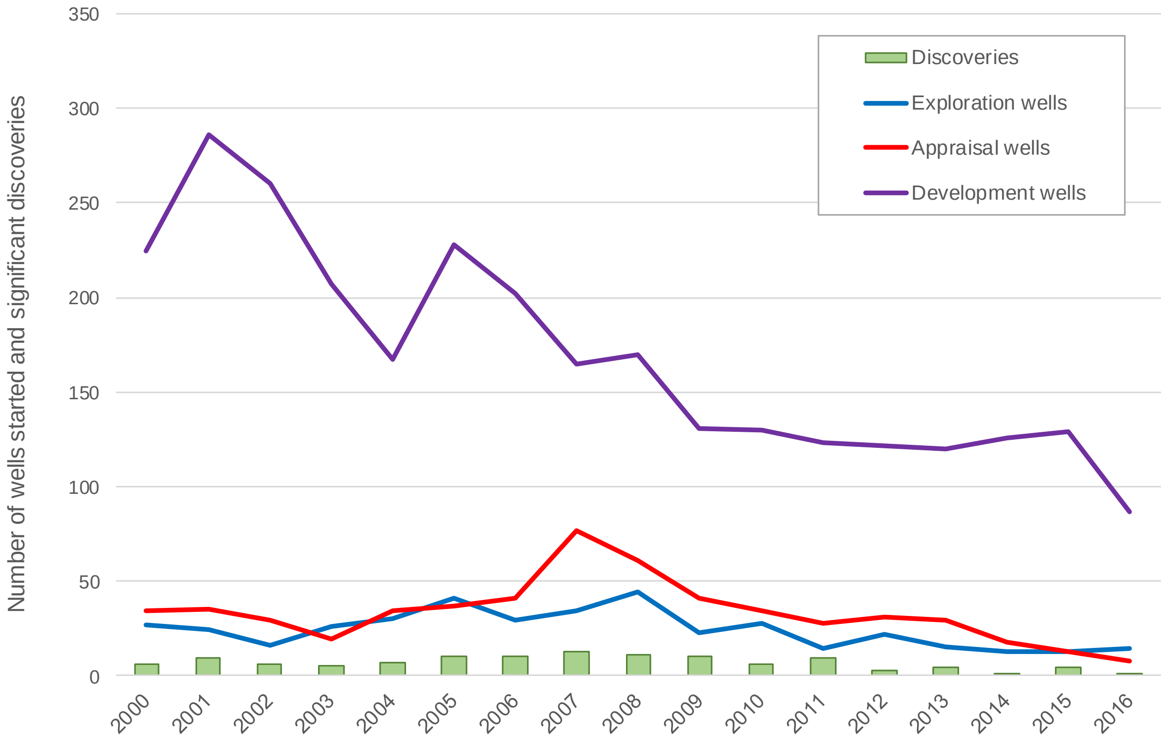
The proposed work programmes for the Initial Term are detailed in the licence applications. For some activities, such as seismic survey, the potential impacts associated with noise could occur some distance from the licensed Blocks and the degree of activity is not necessarily proportional to the size or number of Blocks in an area. In the case of direct physical disturbance, the licence Blocks being applied for are relevant.

2.2.1 Likely scale of activity

On past experience the activity that actually takes place is less than what is included in the work programme at the licence application stage. A proportion of Blocks awarded may be relinquished without any offshore activities occurring. Activity after the Initial Term is much harder to predict, as this depends on the results of the initial phase, which is, by definition, exploratory. Typically less than half the wells drilled reveal hydrocarbons, and of that, less than half will have a potential to progress to development. For example, the OGA analysis of exploration well outcomes from the Moray Firth & Central North Sea between 2003 and 2013 indicated an overall technical success rate of 40% with respect to 150 exploration wells and side-tracks (Mathieu 2015). Depending on the expected size of finds, there may be further drilling to appraise the hydrocarbons (appraisal wells). For context, Figure 2.1 highlights the total number of exploration and appraisal wells started on the UKCS each year since 2000 as well as the number of significant discoveries made (associated with exploration activities).

[9] https://www.ogauthority.co.uk/media/3951/general-guidance.pdf

Figure 2.1: UKCS Exploration, appraisal & development wells, and significant discoveries since 2000



Note: "significant" generally refers to the flow rates that were achieved (or would have been reached) in well tests (15 mmcfgd or 1000 BOPD) and does not indicate commercial potential of the discovery. Source: OGA Drilling Activity (October 2017), Significant Offshore Discoveries (April 2017)

Discoveries that progress to development may require further drilling, installation of infrastructure such as wellheads, pipelines and possibly fixed platform production facilities, although recent developments are mostly tiebacks to existing production facilities rather than stand alone developments. For example, of the 48 current projects identified by the OGA's Project Pathfinder (as of 4th August 2017)[10], 18 are planned as subsea tie-backs to existing infrastructure, 4 involve new stand-alone production platforms and 10 are likely to be developed via Floating Production, Storage and Offloading (FPSO) facilities. The final form of development for many of the remaining projects is not decided, with some undergoing re-evaluation of development options but some are likely to be subsea tie-backs. Figure 2.1 indicates that the number of development wells has declined over time and this pattern is likely to continue. The nature and scale of potential environmental impacts from the drilling of development wells are similar to those of exploration and appraisal wells and thus the screening criteria described in Section 4 are applicable to the potential effects of development well drilling within any of the 30th Round Blocks.

[10] https://itportal.ogauthority.co.uk/eng/fox/path/PATH_REPORTS/pdf

2.2.2 30th Round activities considered by the HRA

The nature, extent and timescale of development, if any, which may ultimately result from the licensing of 30th Round Blocks is uncertain, and therefore it is regarded that at this stage a meaningful assessment of development level activity (e.g. pipelay, placement of jackets, subsea templates or floating installations etc) cannot be made. A small number of 30th Round applications proposed to go straight to the Second Term (i.e. appraisal and field development planning, see above), one of which is relevant to this Appropriate Assessment (Block 43/14). Whilst such an application makes a firm commitment to undertake development level activities, at this stage the nature of any development is not known. This Block is still considered in this assessment, in view of the similarity in the nature and scale of development drilling to that for exploration (see above) and that to progress to this stage, no further exploration (i.e. deep geological seismic survey) is required. Once project plans are in place, subsequent permitting processes relating to exploration, development and decommissioning, would require assessment (including HRA) as appropriate, allowing the opportunity for further mitigation measures to be identified as necessary, and for permits to be refused if necessary. In this way the opinion of the Advocate General in ECJ (European Court of Justice) case C-6/04, on the effects on Natura sites, "*must be assessed at every relevant stage of the procedure to the extent possible on the basis of the precision of the plan. This assessment is to be updated with increasing specificity in subsequent stages of the procedure"* is addressed. Therefore only activities as part of the work programmes associated with the Initial Term and its associated Phases A-C will be considered in this AA (see Table 2.2).

Potential accidental events, including spills, are not considered in the AA as they are not part of the work plan. Measures to prevent accidental events, response plans and potential impacts in the receiving environment would be considered as part of the environmental impact assessment (EIA) process for specific projects that could follow licensing when the location, nature and timing of the proposed activities are available to inform a meaningful assessment of such risks.

The approach used in this assessment has been to take the proposed activity for the Block as being the maximum of any application for that Block, and to assume that all activity takes place. The estimates of work commitments for the relevant Blocks from the applications received by the OGA are shown in Table 2.1.

Table 2.1: Indicative work programmes relevant to Blocks considered in this assessment

Relevant Blocks	Obtain[11] and/or reprocess 2D or 3D seismic data	Shoot 3D seismic	Drill or drop well/contingent well	Second Term
42/13b	✓	-	✓	-
42/14	✓	-	✓	-

[11] To obtain seismic data means purchasing or otherwise getting the use of existing data and does not involve shooting new seismic.

Relevant Blocks	Obtain[11] and/or reprocess 2D or 3D seismic data	Shoot 3D seismic	Drill or drop well/contingent well	Second Term
42/15b	✓	-	✓	-
42/17	✓	-	✓	-
42/18	✓	-	✓	-
42/20a	✓	-	✓	-
42/30d	✓	-	✓	-
43/2	✓	-	✓	-
43/7	✓	-	✓	-
43/8	✓	-	✓	-
43/10	✓	-	✓	-
43/14	-	-	-	✓
43/15	✓	-	✓	-
43/16	✓	-	✓	-
43/17a	✓	-	✓	-
43/23	-	-	✓	-
43/24b	-	-	✓	-
43/26c	✓	-	✓	-
44/6	✓	-	✓	-
44/7	✓	-	✓	-
44/8b	✓	-	✓	-
44/9b	-	-	✓	-
44/11d	✓	-	✓	-
44/12d	✓	-	✓	-
44/12e	✓	-	✓	-
47/2d	✓	-	✓	-
47/3f	✓	-	✓	-
47/7	-	-	✓	-
47/8f	✓	-	✓	-
47/10d	-	-	✓	-
47/15c	-	-	✓	-
48/6d	-	-	✓	-
48/8b	✓	-	✓	-
48/11c	-	-	✓	-
48/11d	-	-	✓	-
48/12b	-	-	✓	-
48/16	✓	-	✓	-
48/17d	✓	-	✓	-
48/18b	-	-	✓	-
48/19b	-	-	✓	-
48/20c	✓	-	✓	-
48/24a	-	-	✓	-
53/1b	✓	-	✓	-
53/13	✓	-	✓	-
53/14b	✓	-	✓	-
53/8	✓	-	✓	-
53/9	✓	-	✓	-

Completion of the work programmes is likely to involve one or more of the activities summarised in Table 2.2. A series of assumptions has been developed on the nature and scale of activities to be assessed based on the evidence base for potential effects presented in Section 4 as well as reviews of exemplar Environmental Statements of relevant activities. Subsequent development activity is contingent on successful exploration and appraisal and may or may not result in the eventual installation of infrastructure. Where relevant, such future activities will themselves be subject to activity specific screening procedures and tests under the Habitats Directive.

Table 2.2: Potential activities and assessment assumptions

Potential activity	Description	Assumptions used for assessment
Initial Term Phase C: Drilling and well evaluation		
Rig tow out & de-mobilisation	Mobile rigs are towed to and from the well site typically by 2-3 anchor handling vessels.	The physical presence of a rig and related tugs during tow in/out is both short (a number of days depending on initial location of rig) and transient.
Rig placement/ anchoring	Jack-up rigs are used in shallower waters (normally <120m) and jacking the rig legs to the seabed supports the drilling deck. Each of the rig legs terminates in a spud-can (base plate) to prevent excessive sinking into the seabed.	It is assumed that jack-up rigs will be three or four-legged rigs with 20m diameter spudcans with an approximate seabed footprint of 0.001km^2 within a radius of *ca*. 50m of the rig centre. For the assessment it is assumed that effects may occur within 500m of a jack-up rig which would take account of any additional rig stabilisation (rock placement) footprint. A short review of 18 Environmental Statements which included drilling operations in the southern North Sea since 2007 (specifically in quadrants 42, 43, 44, 47, 48, 49 and 53) indicated that rig stabilisation was either not considered necessary and/or assessed as a worst case contingency option. Where figures were presented, the spatial scale of potential rock placement operations was estimated at between 0.001-0.004km^2 per rig siting. A BEIS study due to report later this year will compare the rock volumes estimated in operator applications (e.g. drilling application) with those actually used (from close-out returns).
Marine discharges	Typically around 1,000 tonnes of cuttings (primarily rock chippings) result from drilling an exploration well. Water-based mud cuttings are typically discharged at, or relatively close to sea surface during "closed drilling" (i.e. when steel casing in the well bore and a riser to the rig are in place), whereas surface hole cuttings are normally discharged at seabed during "open-hole" drilling. Use of oil based mud systems, for example in highly deviated sections or in drilling water reactive shales, would require onshore disposal or treatment offshore to the required standards prior to discharge.	The footprint of cuttings and other marine discharges, or the distance from source within which smothering or other effects may be considered is generally a few hundred metres. For the assessment it is assumed that effects may occur within 500m of the well location covering an area in the order of 0.8km^2.
Conductor piling	Well surface holes are usually drilled "open-hole" with the conductor subsequently inserted and cemented in place to provide a stable hole through which the lower well sections are	The need to pile conductors is well-specific and is not routine. It is anticipated that a conductor piling event would last between 4-6 hours.

Potential activity	Description	Assumptions used for assessment
	drilled. Where the nature of the seabed sediment and shallow geological formations are such that they would not be stable open-hole (i.e. risking collapse), the conductor may be driven into the sediments. In North Sea exploration wells, the diameter of the conductor pipe is usually 26" or 30" (<1m), which is considerably smaller than the monopiles used for offshore wind farm foundations (>3.5m diameter), and therefore require less hammer energy and generate noise of a considerably lower amplitude. For example, hammer energies to set conductor pipes are in the order of 90-270kJ (see: Matthews 2014, Intermoor website), compared to energies of up to 3,000kJ in the installation of piles at some southern North Sea offshore wind farm sites. Direct measurements of underwater sound generated during conductor piling are limited. Jiang *et al.* (2015) monitored conductor piling operations at a jack-up rig in the central North Sea in 48m water depth and found peak sound pressure levels (L_{pk}) not to exceed 156dB re 1 µPa at 750m (the closest measurement to source) and declining with distance. Peak frequency was around 200Hz, dropping off rapidly above 1kHz; hammering was undertaken at a stable power level of 85 ±5 kJ but the pile diameter was not specified (Jiang *et al.* 2015).	
Rig/vessel presence and movement	On site, the rig is supported by supply and standby vessels, and helicopters are used for personnel transfer.	Supply vessels typically make 2-3 supply trips per week between rig and shore. Helicopter trips to transfer personnel to and from the rig are typically made several times a week. A review of Environmental Statements for exploratory drilling suggests that the rig could be on location for up to 10 weeks.
Rig site survey	Rig site surveys are undertaken to identify seabed and subsurface hazards to drilling, such as wrecks and the presence of shallow gas. The surveys use a range of techniques, including multibeam and side scan sonar, sub-bottom profiler, magnetometer and high-resolution seismic involving a much smaller source (mini-gun or four airgun cluster of 160in^3) and a much shorter hydrophone streamer. Arrays used on site surveys and some VSP operations (see below) typically produce frequencies predominantly up to around 250Hz, with a peak source level of around 235dB re 1µPa @ 1m (Stone 2015). The rig site survey vessel may also be used to characterise seabed habitats, biota and background contamination.	Rig site survey typically covers 2-3km^2. Survey durations are usually of the order of four or five days.
Well evaluation (e.g. Vertical Seismic Profiling)	Sometimes conducted to assist with well evaluation by linking rock strata encountered in drilling to seismic survey data. A seismic source (airgun array, typically with a source size of ~500 in^3 and a maximum of 1,200 in^3,	Vertical Seismic Profiling (VSP) surveys are static and of short duration (one or two days at most).

Potential activity	Description	Assumptions used for assessment
	Stone 2015) is deployed from the rig, and measurements are made using a series of geophones deployed inside the wellbore.	

2.3 Existing regulatory requirements and controls

The AA assumes that the high level controls described below are applied as standard to activities since they are legislative requirements. These are distinct from further mitigation measures which may be identified and employed to avoid likely significant effects on relevant sites (see Sections 5.1.3 and 5.2.3).

2.3.1 Physical disturbance and drilling

There is a mandatory requirement to have sufficient recent and relevant data to characterise the seabed in areas where activities are due to take place (e.g. rig placement)[12]. If required, survey reports must be made available to the relevant statutory bodies on submission of a relevant permit application or Environmental Statement, and the identification of any potential sensitive habitats by such survey (including those under Annex I of the Habitats Directive) may influence BEIS's decision on a project level consent.

Discharges from offshore oil and gas facilities have been subject to increasingly stringent regulatory controls over recent decades (see review in DECC 2016, and related Appendices 2 and 3). As a result, oil and other contaminant concentrations in the major streams (drilling wastes and produced water) have been substantially reduced or eliminated (e.g. the discharge of oil based muds and contaminated cuttings is effectively banned), with discharges of chemicals and oil exceeding permit conditions or any unplanned release, potentially constituting a breach of the permit conditions and an offence. Drilling chemical use and discharge is subject to strict regulatory control through permitting, monitoring and reporting (e.g. the mandatory Environmental Emissions Monitoring System (EEMS) and annual environmental performance reports). The use and discharge of chemicals must be risk assessed as part of the permitting process (e.g. Drilling Operations Application) under the *Offshore Chemicals Regulations 2002* (as amended), and the discharge of chemicals which would be expected to have a significant negative impact would not be permitted.

At the project level, discharges would be considered in detail in project-specific environmental impact assessments, (where necessary through HRAs) and chemical risk assessments under existing permitting procedures.

2.3.2 Underwater noise

Controls are in place to cover all significant noise-generating activities on the UKCS, including geophysical surveying. Seismic surveys (including VSP and high-resolution site surveys), sub-

[12] See BEIS (2017). Guidance notes on the *Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999* (as amended).

bottom profile surveys and shallow drilling activities require an application for consent under the *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (as amended) and cannot proceed without consent. These applications are supported by an EIA, which includes a noise assessment. Applications are made through BEIS's Portal Environmental Tracking System using a standalone Master Application Template (MAT) and Geological Survey Subsidiary Application Template (SAT). Regarding noise thresholds to be used as part of any assessment, applicants are encouraged to seek the advice of relevant SNCB(s) (JNCC 2017b) in addition to referring to European Protected Species (EPS) guidance[13]. Applicants should be aware of recent research development in the field of marine mammal acoustics and the publication in the US of a new set of criteria for injury (NMFS 2016, referred to as NOAA thresholds).

BEIS consults the relevant statutory consultees on the application for advice and a decision on whether to grant consent is only made after careful consideration of their comments. Statutory consultees may request additional information or risk assessment, specific additional conditions to be attached to consent (such as specify timing or other specific mitigation measures), or advise against consent.

It is a condition of consents issued under Regulation 4 of the *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (as amended) for oil and gas related seismic and sub-bottom profile surveys that the JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys (JNCC 2017b) are followed. Where appropriate, EPS disturbance licences may also be required under the *Conservation of Offshore Marine Habitats and Species Regulations 2017*[14]. JNCC (2017b) reaffirms that adherence to the guidelines constitutes best practice and will, in most cases, reduce the risk of deliberate injury to marine mammals to negligible levels. Applicants are expected to make every effort to design a survey that minimises sound generated and consequent likely impacts, and to implement best practice measures described in the guidelines.

In addition, potential disturbance of certain species may be avoided by the seasonal timing of offshore activities. Periods of seasonal concern for individual Blocks on offer have been highlighted (see Section 2 of OGA's Other Regulatory Issues[15] which accompanied the 30th Round offer) which licensees should take account of. Licensees should also be aware that it may influence BEIS's decision whether or not to approve particular activities.

[13] For inshore waters of England, Wales and the UK offshore marine area - JNCC *et al*. (2010); for Scottish inshore waters - Marine Scotland (2014).
[14] Disturbance of European Protected Species (EPS) (i.e. those listed in Annex IV) is a separate consideration under Article 12 of the Habitats Directive, and is not considered in this assessment.
[15] https://www.ogauthority.co.uk/media/4004/other_regulatory_issues.docx

Figure 2.2: Stages of plan level environmental assessment

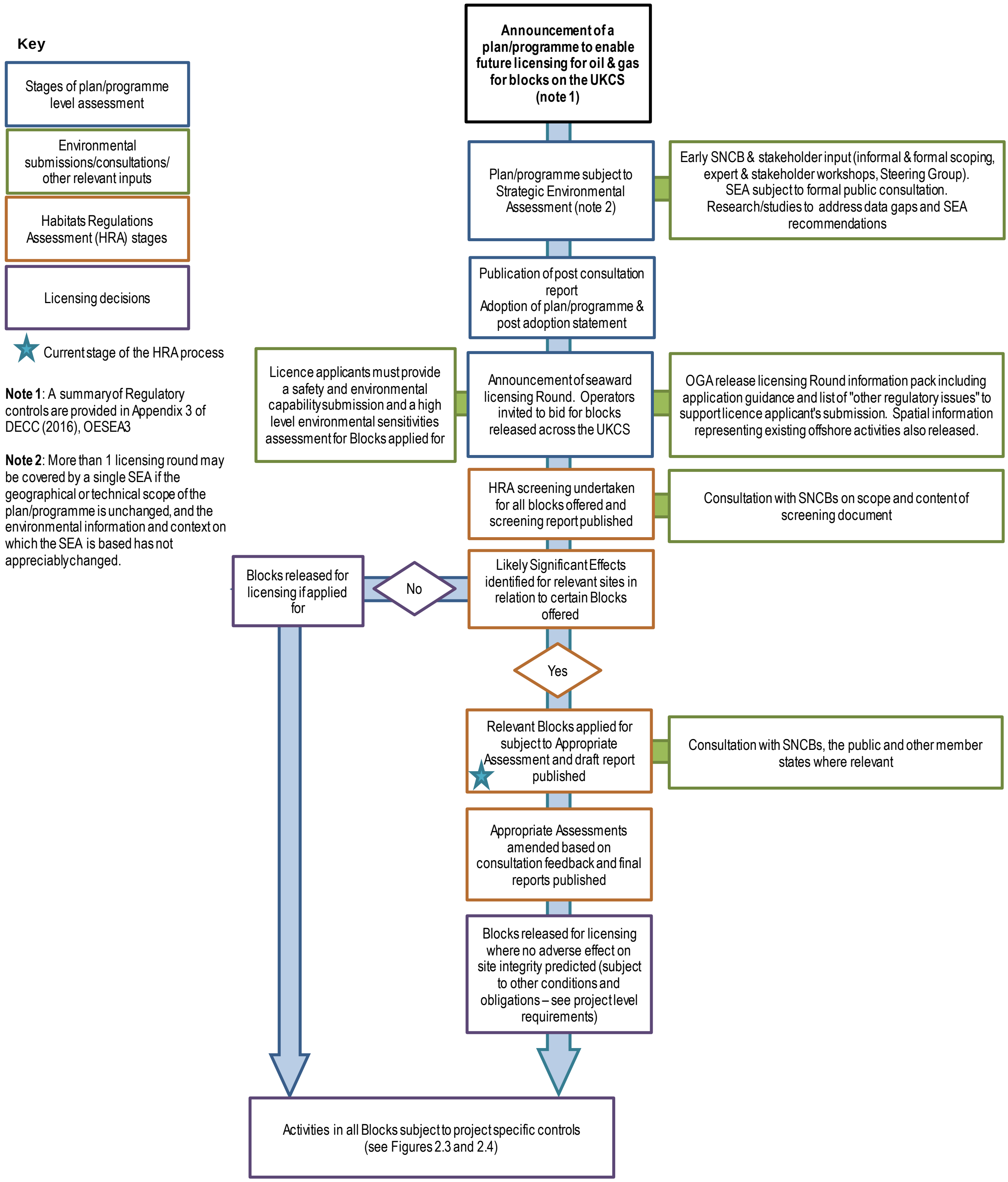
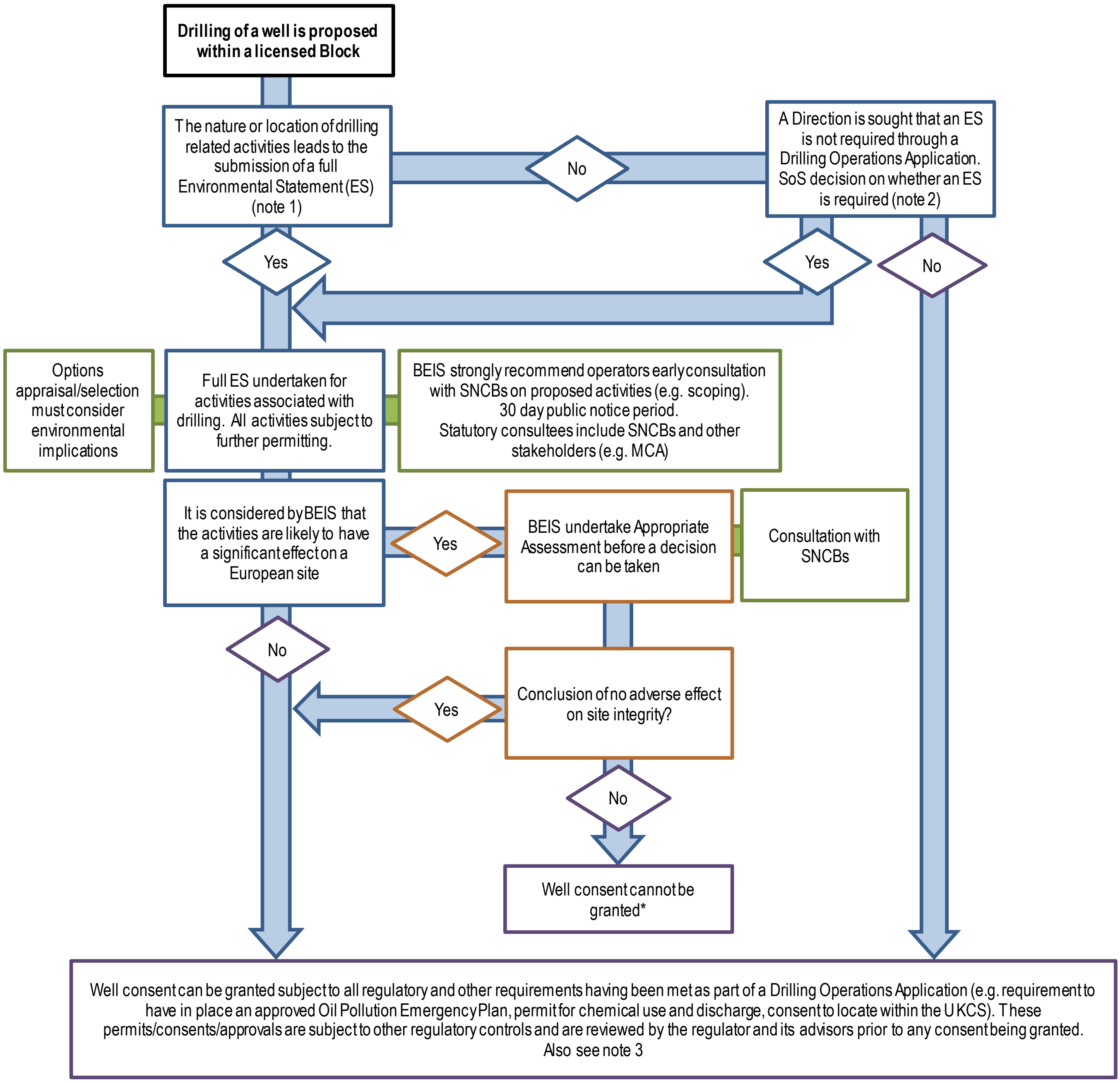


Figure 2.3: High level overview of exploration drilling environmental requirements



Key

- Stages of project permitting
- Environmental submissions/consultations/ other relevant inputs
- Habitats Regulations Assessment (HRA) stages
- Permitting/Consenting decisions

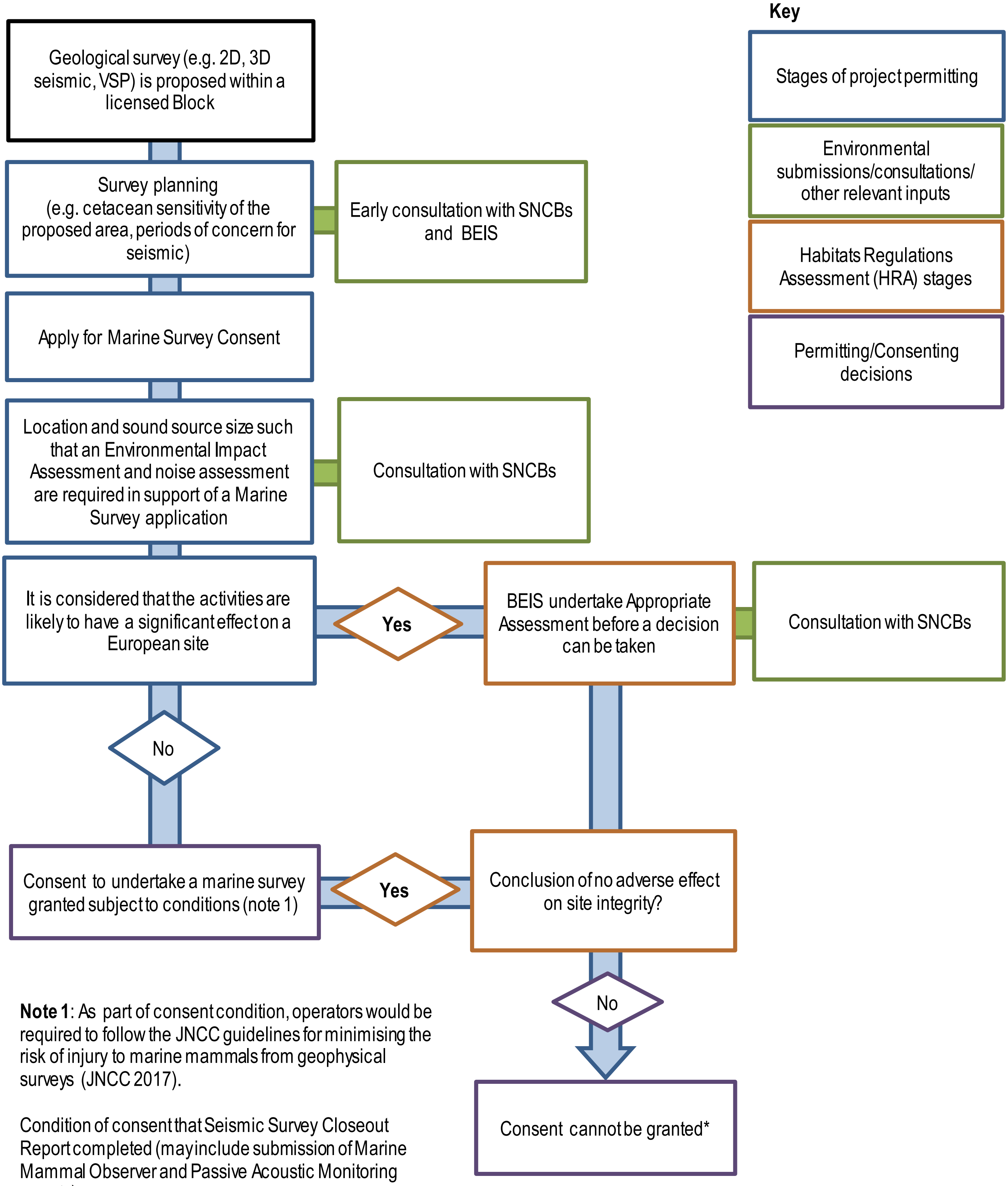
Note 1: See BEIS (2017). The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended) – A Guide. The Offshore Petroleum Regulator for Environment and Decommissioning, 80pp.

Note 2: Early consultation between BEIS and operators is typical to mitigate against Environmental Statement (ES) requirements being identified following the request for a direction

Note 3: In cases where an ES was initially identified as not required, or where an ES has been approved, the requirement to undertake AA may still apply (e.g. due to changes in the nature of the project or the designation of additional European sites)

* Article 6(4) of the Habitats Directive provides a derogation which would allow a plan or project to be approved in limited circumstances even though it would or may have an adverse effect on the integrity of a European site (see: Defra 2012).

Figure 2.4: High level overview of seismic survey environmental requirements



Note 1: As part of consent condition, operators would be required to follow the JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys (JNCC 2017).

Condition of consent that Seismic Survey Closeout Report completed (may include submission of Marine Mammal Observer and Passive Acoustic Monitoring reports)

* Article 6(4) of the Habitats Directive provides a derogation which would allow a plan or project to be approved in limited circumstances even though it would or may have an adverse effect on the integrity of a European site (see: Defra 2012).

3 Appropriate assessment process

3.1 Process

In carrying out this AA so as to determine whether it is possible to agree to the grant of licences in accordance with Regulation 5(1) of *The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (as amended), BEIS has:

- Considered, on the basis of the precautionary principle, whether it could be concluded that the integrity of relevant European Sites would not be affected. This impact prediction involved a consideration of the 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 negated or minimised any potential adverse effects identified.
- Subject to consultation on this document, drawn conclusions on whether or not it can agree to the grant of relevant licences.

In considering the above, BEIS used the clarification of the tests set out in the Habitats Directive in line with the ruling of the ECJ in the ***Waddenzee*** case (Case C-127/02), so that:

- Prior to the grant of any licence all activities which may be carried out following the grant of such a licence, and which by themselves or in combination with other activities can affect the site's conservation objectives, are identified in the light of the best scientific knowledge in the field.
- A licence can only be granted if BEIS has made certain that the activities to be carried out under such a licence will not adversely affect the integrity of that site (i.e. cause deterioration to a qualifying habitat or habitat of qualifying species, and/or undermine the conservation objectives of any given site). That is the case where no reasonable scientific doubt remains as to the absence of such effects.

3.2 Site integrity

The integrity of a site is defined by government policy, in the Commission's guidance and clarified by the courts (Cairngorms judicial review case[16]) as being: *'…the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat,*

[16] World Wild Life Fund & Others, Re application for judicial review of decisions relating to the protection of European Sites at Cairngorm Mountain, by Aviemore and proposals for construction of a funicular railway thereon.

complex of habitats and/or the levels of populations of the species for which it was classified[/designated].' This is consistent with the definitions of favourable conservation status in Article 1 of the Directive (JNCC 2002). As clarified by the European Commission (2000), the integrity of a site relates to the site's conservation objectives. These objectives are assigned at the time of designation to ensure that the site continues, in the long-term, to make an appropriate contribution to achieving favourable conservation status for the qualifying interest features. An adverse effect would be something that impacts the site features, either directly or indirectly, and results in disruption or harm to the ecological structure and functioning of the site and/or affects the ability of the site to meet its 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 with respect to 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) of the Habitats Directive, 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.

3.3 Assessment of effects on site integrity

The assessment has been undertaken in accordance with the European Commission Guidance (EC 2000) and with reference to other guidance, reports and policy, including the Habitats Regulations Guidance Notes (English Nature 1997, Defra 2012, SEERAD 2000), SNH (2015), the National Planning Policy Framework (DCLG 2012), the Marine Policy Statement (HM Government 2011), English Nature report, No. 704 (Hoskin & Tyldesley 2006) and Natural England report NECR205 (Chapman & Tyldesley 2016).

The assessment of effects on site integrity is documented in Section 5. It has been informed by an evidence base on the environmental effects of oil and gas activities on the UKCS and elsewhere (Section 4), and has utilised a number of assumptions on the nature and scale of potential activities that could follow licensing (Table 2.2), along with the characteristics and specific environmental conditions of the relevant sites (see Section 5). Activities which may be carried out following the grant of a licence, and which by themselves or in combination with other activities can affect the conservation objectives of relevant sites are discussed under the following broad headings:

- Physical disturbance and drilling effects (Section 5.1)
- Underwater noise effects (Section 5.2)
- In-combination effects (Section 5.3)

4 Evidence base for assessment

4.1 Introduction

The AAs are informed by an evidence base on the environmental effects of oil and gas activities derived from the scientific literature, relevant Strategic Environmental Assessments (e.g. DECC 2009, 2011 and 2016) and other literature. Recent operator Environmental Statements for offshore exploration and appraisal activities on the UKCS have also been reviewed, providing for example a more specific indication of the range of spatial footprints associated with relevant drilling activities to inform the further consideration of those sites where physical disturbance and drilling effects may be considered likely.

In recent years, significant work has been undertaken in the area of sensitivity assessments and activity/pressure matrices (e.g. Tillin *et al*. 2010, Tillin & Tyler-Walters 2014). Defra (2015) includes an evidence base for the latest pressures-activity matrix produced by JNCC (2013). These are intended to be representative of the types of pressures that act on marine species and habitats from a defined set of activities, based on benchmarks of these pressures where the magnitude, extent or duration is qualified or quantified in some way. This approach underpins advice on operations for a number of the sites included in this assessment (Dogger Bank SAC, North Norfolk Sandbanks and Saturn Reef SAC, Haisborough, Hammond and Winterton SAC and Inner Dowsing, Race Bank and North Ridge SAC). The advice identifies a range of pressures for the sites in relation to oil and gas exploration activity, for which the site features are regarded to be sensitive, not sensitive; or where a sensitivity assessment has not been made, or it is concluded there is insufficient evidence for a sensitivity assessment to be made at the pressure benchmark[17]. Whilst the matrices provided as part of the advice are informative and note relevant pressures associated with hydrocarbon exploration, resultant effects are not inevitable consequences of activity since often they can be mitigated through timing, siting or technology (or a combination of these). The Department expects that these options would be evaluated by the licensees and documented in the environmental assessments required as part of the activity specific consenting regime.

On review of the identified pressures for the relevant sites (e.g. relating to abrasion/disturbance of surface/subsurface substrate, habitat structure and siltation rate changes, introduction of contaminants) and their justifications, it is regarded that the evidence base on the potential effects of oil and gas exploration (e.g. as considered in successive SEAs, and summarised in Section 4.2), comprehensively covers the range of pressures identified in the advice, and is used to underpin the assessment against site specific information.

[17] Note that the advice does not take into account the intensity, frequency or cumulative impacts from activities, and pressure benchmarks are used as reference points to assess sensitivity and are not thresholds that identify a likely significant effect within the meaning of Habitats Regulations (JNCC 2017a)

The following sections provide a summary of the evidence informing the site-specific assessment of effects provided in Section 5. To focus the presentation of relevant information, the sections take account of the environments in which those Blocks and relevant Natura 2000 sites to be subject to further assessment and relevant Natura 2000 sites are located (Table 1.2, Figure 1.1).

4.2 Physical disturbance and drilling effects

The pathways by which exploration activities may have physical disturbance and drilling effects on Natura 2000 sites include:

- Physical damage to benthic habitats caused by the placement of jack-up drilling rig spud cans (see Section 4.2.1)
- Physical loss and change of benthic habitats through rock placement around jack-up legs for rig stabilisation (see Section 4.2.2)
- Physical loss of benthic habitats through the discharge of surface hole cuttings around the well and placement of wellhead assembly (see Section 4.2.2)
- Smothering by settlement of drill cuttings on seabed following discharge near sea surface (see Section 4.2.2)
- Displacement of sensitive receptors by visual/acoustic disturbance from the presence and movement of vessels and aircraft (see Section 4.2.3)

4.2.1 Physical damage to benthic habitats

Jack-up rigs, normally used in shallower water (<120m), leave three or four seabed depressions from the feet of the rig (the spud cans) around 15-20m in diameter. The form of the footprint depends on factors such as the spudcan shape, the soil conditions, the footing penetration and methods of extraction, with the local sedimentary regime affecting the longevity of the footprint (HSE 2004). For example, swathe bathymetry data collected as part of FEPA monitoring of the Kentish Flats wind farm off the Kent coast indicated a set of six regular depressions in the seabed at each of the turbine locations resulting from jack-up operations. Immediately post-construction, a January 2005 survey recorded these depressions as having depths of between 0.5 and 2.0m. By November 2007, these depths had reduced by an average of 0.6m indicating that the depressions were naturally infilling as a result of the mobile sandy sediments present across the area (Vattenfall 2009). In locations with an uneven or soft seabed, material such as grout bags or rocks may be placed on the seabed to stabilise the rig feet, and recoverable mud mats may be used in soft sediment.

Habitat recovery from temporary disturbance will depend primarily on re-mobilisation of sediments by current shear (as reviewed by Newell *et al*. 1998, Foden *et al.* 2009). Subsequent benthic population recovery takes place through a combination of migration, re-distribution and larval settlement. On the basis that seabed disturbance is qualitatively similar to the effects of wave action from severe storms, it is likely that in most of the shallower parts of the UKCS, sand and gravel habitat recovery is likely to be relatively rapid (1-5 years) (van Dalfsen *et al.* 2000, Newell & Woodcock 2013).

4.2.2 Physical loss of benthic habitats and smothering

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. These cuttings are derived from shallow geological formations and a proportion will therefore be similar to surficial sediments in composition and characteristics. The persistence of cuttings discharged at the seabed is largely determined by the potential for it to be redistributed by tidal and other currents. In areas of shallow water (<50m) and strong currents (e.g. southern North Sea), the cuttings are rapidly dispersed (Breuer *et al*. 1999).

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 (seabed sediment surface) using a mechanical cutting tool deployed from the rig and the wellhead assembly is removed. The seabed "footprint" of the well is therefore removed although post-well sediments may vary in the immediate vicinity of the well compared to the surrounding seabed (see for example, Jones *et al*. (2012), although this is only likely to be temporary in the southern North Sea).

In contrast to historic oil based mud discharges[18], effects on seabed fauna of the discharge of cuttings drilled with water based muds (WBM) and of the excess and spent mud itself are usually subtle or undetectable (e.g. Cranmer 1988, Neff *et al.* 1989, Hyland *et al.* 1994, Daan & Mulder 1996, Currie & Isaacs 2005, OSPAR 2009, Bakke *et al*. 2013, DeBlois *et al*. 2014). Considerable data has been gathered from the North Sea and other production areas, indicating that localised physical effects are the dominant mechanism of ecological disturbance where water-based mud and cuttings are discharged. Modelling of WBM cuttings discharges in the southern North Sea for an exploration well in Block 44/19b in *ca*. 27m water depth (Tullow Oil UK 2010), indicated that most of the material would be deposited within 1km of the well location. Cuttings deposition decreased further from the well location with <400mm thickness predicted within the first 4m of the well, falling to ~10mm covering a 140x65m area. Beyond this, cuttings deposition was predicted to be less than 1mm thick. It was thought likely that all the cuttings would become mixed with the natural sediments and eventually disperse due to the strong tidal and wave generated currents in the area.

OSPAR (2009) concluded that the discharge of drill cuttings and water-based fluids may cause some smothering in the near vicinity of the well location. The impacts from such discharges are localised and transient, but may be of concern in areas with sensitive benthic fauna. Field

[18] OSPAR Decision 2000/3 on the Use of Organic-Phase Drilling Fluids (OPF) and the Discharge of OPF-Contaminated Cuttings came into effect in January 2001 and effectively eliminated the discharge of cuttings contaminated with oil based fluids (OBF) greater than 1% by weight on dry cuttings.

experiments on the effects of water-based drill cuttings on benthos by Trannum *et al.* (2011) found after 6 months only minor differences in faunal composition between the controls and those treated with drill cuttings. This corresponds with the results of field studies where complete recovery was recorded within 1-2 years after deposition of water-based drill cuttings (Daan & Mulder 1996, Currie & Isaacs 2005).

Finer particles may be dispersed over greater distances than coarser particles although exposure to WBM cuttings in suspension will in most cases be short-term (Bakke *et al.* 2013). Chemically inert, suspended barite has been shown under laboratory conditions to potentially have a detrimental effect on suspension feeding bivalves. Standard grade barite, the most commonly used weighting agent in WBMs, was found to alter the filtration rates of four bivalve species (*Modiolus modiolus, Dosinia exoleta, Venerupis senegalensis* and *Chlamys varia*) and to damage the gill structure when exposed to 0.5mm, 1.0mm and 2.0mm daily depth equivalent doses (Strachan 2010, Strachan & Kingston 2012). All three barite treatments altered the filtration rates leading to 100% mortality. The horse mussel (*M. modiolus*) was the most tolerant to standard barite with the scallop (*C. varia*) the least tolerant. Fine barite, at a 2mm daily depth equivalent, also altered the filtration rates of all species, but only affected the mortality of *V. senegalensis*, with 60% survival at 28 days. The bulk of WBM constituents (by weight and volume) are on the OSPAR list of substances used and discharged offshore which are considered to Pose Little or No Risk to the Environment (PLONOR). Barite and bentonite are the materials typically used in the greatest quantities in WBMs and are of negligible toxicity. Field studies undertaken by Strachan (2010) showed that the presence of standard grade barite was not acutely toxic to seabed fauna but did alter benthic community structure. When the suspended barite levels used in laboratory studies are translated to field conditions (i.e. distances from the point of discharge) it is clear that any effects will be very local to a particular installation (in the case of oil and gas facilities, well within 500m).

Relevant information on the recovery of benthic habitats to smothering mainly comes from studies of dredge disposal areas (see Newell *at al*. 1998). Recovery following disposal occurs through a mixture of vertical migration of buried fauna, together with sideways migration into the area from the edges, and settlement of new larvae from the plankton. The community recolonising a disturbed area is likely to differ from that which existed prior to construction. Opportunistic species will tend to dominate initially and on occasion, introduced and invasive species may then exploit the disturbed site (Bulleri & Chapman 2010). Harvey *et al.* (1998) suggest that it may take more than two years for a community to return to a closer resemblance of its original state (although if long lived species were present this could be much longer). Shallow water (<20m) habitats in wave or current exposed regimes, with unconsolidated fine grained sediments have a high rate of natural disturbance and the characteristic benthic species are adapted to this. Species tend to be short lived and rapid reproducers and it is generally accepted that they recover from disturbance within months. By contrast a stable sand and gravel habitat in deeper water is believed to take years to recover (see Newell *et al.* 1998, Foden *et al*. 2009).

As noted, there may be a requirement for jack-up rig stabilisation (e.g. rock placement or use of mud mats) depending on local seabed conditions. In soft sediments, rock deposits may cover existing sediments resulting in a physical change of seabed type. The introduction of rock into an area with a seabed of sand and/or gravel can hypothetically provide “stepping stones” which might facilitate biological colonisation including by non-indigenous species by allowing species with short lived larvae to spread to areas where previously they were effectively excluded. On the UK continental shelf such “stepping stones” are already widespread and numerous for example in the form of rock outcrops, glacial dropstones and moraines, relicts of periglacial water flows, accumulations of large mollusc shells, carbonate cemented rock etc., and these are often revealed in rig site and other (e.g. pipeline route) surveys.

4.2.3 Presence and movement of vessels

Blocks may support important numbers of seabirds at certain times of the year including overwintering birds and those foraging from coastal SPAs. Therefore, the presence and/or movement of vessels and aircraft from and within Blocks during exploration and appraisal activities could temporarily disturb foraging seabirds from relevant SPA sites. The anticipated level of airborne noise from helicopter traffic associated with Block activity is likely to be insignificant in the context of existing helicopter, military and civilian aircraft activity levels. Given the mature nature of the southern North Sea basin, helicopter and vessel traffic are very likely to use established routes from existing ports. In view of the seasonal nature of the sensitivity, where relevant it is more appropriate to consider this in project level assessment (e.g. EIA and HRA where necessary), when the location and timing of activities are known.

Physical disturbance of seaduck and other waterbird flocks by vessel and aircraft traffic associated with hydrocarbon exploration and appraisal is possible, particularly in SPAs established for shy species (e.g. common scoter). Such disturbance can result in repeated disruption of bird feeding, loafing and roosting. For example, large flocks of common scoter were observed being put to flight at a distance of 2km from a 35m vessel, though smaller flocks were less sensitive and put to flight at a distance of 1km (Kaiser 2002, also see Schwemmer *et al.* 2011). Larger vessels would be expected to have an even greater disturbance distance (Kaiser *et al.* 2006). With respect to the disturbance and subsequent displacement of seabirds in relation to offshore wind farm (OWF) developments, the Joint SNCB interim displacement advice[19] recommends for most species a standard displacement buffer of 2km with the exception of the species groups of divers and sea ducks. Divers and sea ducks have been assessed as being the most sensitive species groups to offshore development and associated boat and helicopter traffic. Therefore for divers and sea ducks a 4km displacement buffer has been recommended. Whilst displacement effects for divers have been detected at greater distances (e.g. 5-7km, Webb 2016), this relates to the construction and operation of offshore wind farms which have a much larger spatial and temporal footprint than oil and gas exploration activities.

The presence and/or movement of vessels from and within Blocks during exploration and appraisal activities could also potentially disturb marine mammals foraging within or close to

[19] http://jncc.defra.gov.uk/pdf/Joint_SNCB_Interim_Displacement_AdviceNote_2017.pdf

designated or potential SACs for which they are a qualifying feature. Reported responses include avoidance, changes in swimming speed, direction and surfacing patterns, alteration of the intensity and frequency of calls and increases in stress-related hormones (Veirs *et al.* 2016, Rolland *et al.* 2012, Dyndo *et al.* 2015). Harbour porpoises, white-sided dolphins and minke whales have been shown to respond to survey vessels by moving away from them, while white-beaked dolphins have shown attraction (Palka & Hammond 2001). A study on captive harbour porpoises in a semi-natural net-pen complex in a Danish canal, recorded their behaviour while simultaneously measuring underwater noise of vessels passing the enclosure; reaction to noise was defined to occur when a highly stereotyped 'porpoising' behaviour was observed. Porpoising occurred in response to almost 30% of vessel passages; the most likely behavioural trigger were medium- to high- frequency components (0.25–63 kHz octave bands) of vessel noise, while low- frequency components of vessel noise and additional pulses from echosounders could not explain the results (Dyndo *et al*. 2015).

Of primary concern for this AA, is whether vessels linked to operations result in a significant increase to overall local traffic. While harbour porpoises appear to be more sensitive to potential disturbance than bottlenose dolphins, the increase in vessel traffic linked to the proposed plan is expected to be negligible. In UK waters, a modelling study indicated a negative relationship between the number of ships and the presence and abundance of harbour porpoises when shipping intensity exceeded a suggested threshold of approximately 80 ships per day in the North Sea Management Unit (Heinänen & Skov 2015). AIS-derived ship density data from 2015[20] indicates that the approaches to major ports such as in the Humber and Thames regions had estimated shipping densities of up to 500 vessels per week, with the majority of coastal waters (10-25 vessels per week) and offshore waters (<5 vessels per week) supporting much lower densities.

Worldwide, collisions with vessels are a potential source of mortality to marine mammals, primarily cetaceans. Whales are occasionally reported to be struck and killed by ships, especially by fast-moving ferries, but smaller cetacean species and seals can also be impacted by propeller strikes from smaller vessels. In the UK certain areas experience very high densities of commercial and recreational shipping traffic, some of which may also be frequented by large numbers of marine mammals; despite this, relatively few deaths are recorded as results of collisions (Hammond *et al*. 2008). Between 2000 and 2009, only 11 out of 1,100 post-mortems on harbour porpoises and common dolphins identified collision as the cause of death (UKMMAS 2010). Draft advice on operations for the Southern North Sea cSAC[21] indicates that post mortem investigations of harbour porpoise deaths have revealed death caused by trauma (potentially linked with vessel strikes) is not currently considered a significant risk.

Through the transport and discharge of vessel ballast waters (and associated sediment), and to a lesser extent fouling organisms on vessel/rig hulls, non-native species may be introduced

[20] https://data.gov.uk/dataset/vessel-density-grid-2015, also see MMO (2014b)
[21] http://jncc.defra.gov.uk/pdf/SouthernNorthSeaConservationObjectivesAndAdviceOnActivities.pdf

to the marine environment. Should these introduced species survive and form established breeding populations, they can result in negative effects on the environment. These include: displacing native species by preying on them or out-competing them for resources; irreversible genetic pollution through hybridisation with native species, and increased occurrence of harmful algal blooms (as reviewed in Nentwig 2007). The economic repercussions of these ecological effects can also be significant (see IPIECA & OGP 2010, Lush *et al*. 2015, Nentwig 2007). In response to these risks, a number of technical measures have been proposed such as the use of ultraviolet radiation to treat ballast water or procedural measures such as a mid-ocean exchange of ballast water (the most common mitigation against introductions of non-native species). 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 2004, which entered into force in September 2017 and currently has 68 contracting States, representing 75% of world shipping tonnage[22]. The Convention includes Regulations with specified technical standards, procedures and reporting requirements which aim to prevent the spread of harmful aquatic organisms from one region to another (IMO Globallast website[23]). Further oil and gas activity is unlikely to change the risk of the introduction of non-native species as the vessels typically operate in a geographically localised area (rigs currently move between the Irish Sea and North Sea), and the risk from hull fouling is low, given the geographical working region and scraping of hulls for regular inspection.

4.3 Underwater noise

The sources, measurement, propagation, ecological effects and potential mitigation of noise associated with hydrocarbon exploration and production have been extensively reviewed, assessed and updated in each of the successive offshore energy SEAs (see DECC 2009, 2011, 2016).

4.3.1 Noise sources and propagation

Of those oil and gas activities that generate underwater sound, deep geological seismic surveys (2D and 3D) are of primary concern due to the high amplitude, low frequency and impulsive nature of the sound produced over a relatively wide area. As indicated in Section 2.2.2, no new 2D or 3D seismic surveys are proposed within the work programmes of the relevant southern North Sea Blocks applied for in the 30th Round. Consequently, sources of impulsive sound are restricted to the smaller volume air-guns and sub-bottom profilers used in site surveys and well evaluation (i.e. Vertical Seismic Profiling, VSP), and also from occasional conductor-piling during drilling (see Table 2.2). Compared to deep geological survey, these sources tend to generate sound of lower amplitude, are typically complete within several hours on a single day, are conducted from either a fixed point (VSP) or cover a small area (site surveys) and, in the case of some sub-bottom profilers, operate at a higher frequency than air-

[22] http://www.imo.org/en/About/Conventions/StatusOfConventions/Documents/StatusOfTreaties.pdf
[23] http://archive.iwlearn.net/globallast.imo.org/the-bwmc-and-its-guidelines/index.html

guns[24]. Consequently, the overall magnitude and area of risk from sound effects is considerably smaller than in the case of deep geological seismic surveys.

Drilling operations and support vessel traffic are sources of continuous noise (non-impulsive) of comparable amplitude and dominated by low frequencies and of a lower amplitude than deep geological seismic survey. Sound pressure levels of between 120dB re 1µPa in the frequency range 2-1,400Hz (Todd & White 2012) are probably typical of drilling from a jack-up rig, with slightly higher source levels likely from semi-submersible rigs due to greater rig surface area contact with the water column. In general, support and supply vessels (50-100m) are expected to have broadband source levels in the range 165-180dB re 1µPa@1m, with the majority of energy below 1kHz (OSPAR 2009). Additionally, the use of thrusters for dynamic positioning has been reported to result in increased sound generation (>10dB) when compared to the same vessel in transit (Rutenko & Ushchipovskii 2015).

For all sources, there is now a reasonable body of evidence to quantify sound levels associated with these activities and to understand the likely propagation of these sounds within the marine environment, even in more complex coastal locations (DECC 2016).

4.3.2 Potential ecological effects

Potential effects of anthropogenic noise on receptor organisms range widely, from masking of biological communication and small behavioural reactions, to chronic disturbance, physiological injury and mortality. While generally the severity of effects tends to increase with increasing exposure to noise, it is important to draw a distinction between effects from physical (including auditory) injury and those from behavioural disturbance. In addition to direct effects, indirect effects may also occur, for example via effects on prey species, complicating the overall assessment of significant effects. Marine mammals, and in particular the harbour porpoise, are regarded as the most sensitive to acoustic disturbance therefore it is considered appropriate to focus on marine mammals when assessing risk from underwater noise; however, high amplitude impulsive noise also potentially presents a risk to fish and diving birds.

Marine mammals

The risk of physical injury from an activity can be assessed using threshold criteria based on sound levels. For marine mammals, the latest SEA (DECC 2016) reflects the injury thresholds criteria developed by Southall *et al.* (2007), including the subsequent update for harbour porpoises in Lepper *et al*. (2014), based on the work by Lucke *et al.* (2009); since then, recent work carried out by NOAA has updated acoustic thresholds further (NMFS 2016). It is recognised that geophysical surveys (primarily 2D and 3D seismic) have the potential to generate sound that exceeds thresholds of injury, but only within a limited range from source (tens to hundreds of metres); for site surveys and VSP, the range from source over which

[24] It should be noted that airgun (including VSP) and sub-bottom profiling site surveys undertaken in relation to licences issued under the *Petroleum Act 1998* require consent under the *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (as amended), but side-scan sonar and multibeam echosounder surveys only require to be notified to the Regulator (JNCC 2017b).

injury may occur will be even smaller. Within this zone, current mitigation measures as described in JNCC guidelines[25] are thought sufficient in minimising the risk of injury to negligible levels for the marine mammal species of relevance in this AA (harbour porpoise and seals). As JNCC guidelines (see Section 2.3.2) are required to be followed as part of any consent with regard to geophysical surveys across the UKCS, the risk of injury to marine mammals is not considered further.

With respect to disturbance, it has proved much more difficult to establish broadly applicable threshold criteria based on exposure alone; this is largely due to the inherent complexity of animal behaviour where the same sound level is likely to elicit different responses depending on an individual's behavioural context and exposure history. For compliance with the Habitat Directive, the guidance for the Protection of marine European Protected Species from injury and disturbance (JNCC 2010) recommends that 'disturbance' is interpreted as sustained or chronic disruption of behaviour scoring five or more in the Southall *et al*. (2007) behavioural response severity scale[26]. This is to highlight that a disturbance offence is unlikely to occur from sporadic changes in behaviour with negligible consequences on vital rates and population effects (i.e. trivial disturbance). While it is possible to envisage how some behavioural effects may ultimately influence vital rates, evidence is currently limited. The focus of field studies has been on measuring displacement and changes in vocalisation with the assumption that these may influence vital rates mainly via a reduction in foraging opportunities.

Evidence of the effects of seismic surveys on odontocetes and pinnipeds is limited but of note are studies carried out in the Moray Firth observing responses to a 10 day 2D seismic survey (Thompson *et al.* 2013a). The 2D seismic survey took place in September 2011 and exposed a 200km^2 area to noise throughout that period; peak-to-peak source levels generated by the 470 cubic inch airgun array were estimated to be 242-253 dB re 1 µPa at 1m and are therefore representative of the volume of a typical array used in VSP, and larger than that used in rig-site survey. Within 5-10km from the source, received peak-to-peak SPLs were estimated to be between 165 and 172 dB re 1 µPa, with SELs for a single pulse between 145 and 151 dB re 1 µPa^{2}s. A relative decrease in the density of harbour porpoises within 10km of the survey vessel and a relative increase in numbers at distances greater than 10km was reported; however, these effects were short-lived, with porpoise returning to impacted areas within 19 hours after cessation of activities. Overall, it was concluded that while short-term disturbance was induced, the survey did not lead to long-term or broad-scale displacement (Thompson *et al*. 2013a). Further acoustic analyses revealed that for those animals which stayed in proximity to the survey, there was a 15% reduction in buzzing activity associated with foraging or social activity; however, a high level of natural variability in the detection of buzzes was noted prior to survey (Pirotta *et al*. 2014). Passive acoustic monitoring provided evidence of short-term behavioural responses also for bottlenose dolphins, but no measurable effect on the number of dolphins using the Moray Forth SAC could be revealed (Thompson *et al*. 2013b). These

[25] JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys, August 2017 (JNCC 2017).
[26] See Table 4 (p450) of Southall *et al.* (2007) for a full description of response scores.

findings correspond to a 2D seismic survey, with a higher amplitude noise source, longer duration and greater spatial extent than activities within the proposed work programmes of any 30th Licensing Round applications for the southern North Sea Blocks.

As concluded in the recent OESEA3 (DECC 2016), a conservative assessment of the potential for marine mammal disturbance of seismic surveys will assume that firing of airguns will affect individuals within 10km of the source, resulting in changes in distribution and a reduction of foraging activity but the effect is short-lived. The precautionary criterion applied during initial Block screening (15km) is maintained here to identify the Blocks applied for to be considered with respect to likely significant effects in this assessment (see Section 5.2); this is to reflect the degree of uncertainty and the limited direct evidence available and to allow for a greater potential for disturbance when large array sizes are used.

Recent evidence on the response of harbour porpoise to impact piling during wind-farm construction is also relevant since the impulsive character of the sound generated during piling is comparable with that from seismic airguns and for assessing in-combination effects with wind farms currently planned or under construction across the North Sea. Empirical studies during the construction of OWFs in the North and Baltic Seas (Tougaard *et al*. 2009, Cartensen *et al*. 2006, Brandt *et al*. 2011, Dähne *et al.* 2013) have all observed displacement of harbour porpoises in response to pile-driving. The magnitude of the effect (spatial extent and duration) varied between studies as a function of the many factors at play including exposure level, duration of piling and ecological importance of the area. Nonetheless, from the available evidence it has been concluded that impact piling will displace individual harbour porpoises within an area of approximately 20km radius; however, once piling ceases, harbour porpoises are expected to return readily (hours to days) (DECC 2016). Current SNCB advice assumes a distance of 26km as the zone of disturbance for pile-driving (Joint SNCB response to 29th Round draft AA, February 2017). At Horns Rev wind farm, off the Danish North Sea coast, a study using satellite telemetry showed that harbour seals were still transiting the site during periods of piling but no conclusive results could be obtained from analysis of habitat use with regard to a change in response to piling (Tougaard *et al*. 2006). Evidence of a response was obtained by Edrén *et al.* (2010) at a haul-out site 4km away from the Danish Nysted windfarm; during piling, numbers hauling out were reduced by 10-60% but the effect was only of short duration since the overall number of seals increased slightly during the whole construction phase. Russell *et al*. (2016) used telemetry data from 23 harbour seals to investigate potential avoidance of seals to the construction of the Lincs wind farm in The Wash off the east coast of England, including pile-driving of mono-pile foundations. While there was no significant displacement during construction as a whole, seal abundance during piling was significantly reduced up to 25km from the piling activity, with a 19-83% (95% confidence intervals) reduction in usage compared to breaks in piling activity. This displacement was shown to be temporary, with seals returning to their non-piling distribution within two hours of the cessation of piling.

Information on the potential effects of other geophysical surveys (e.g. sub-bottom profilers) is currently very limited and the most recent OESEA (DECC 2016) concluded that effects are negligible but with a high level of uncertainty. Laboratory and field measurements are also taking place on similar equipment as part of a US project. Outputs from these studies will be considered in due course to reduce uncertainty in assessments. With regard to conductor piling, the low hammer energy, narrow diameter of pipes and short duration of piling, combined with limited field measurements of sound propagation from this activity (Jiang *et al*. 2015), suggest a very low potential for significant disturbance of marine mammals.

Noise from vessels and drilling activity is audible to marine mammals but are not of the characteristics sufficient to cause injury. Vessel noise may elicit low-level disturbance effects in marine mammals (e.g. changes in vocalisation rates and dive behaviour)[27]; however, such effects are temporary, of limited spatial extent. Considering the scale of the likely activity associated with the 30th Round licensing (see Table 2.2) relative to existing vessel traffic in the region, they are not considered to result in significant disturbance, i.e. that which may affect vital rates and thus constitute an adverse effect on site integrity.

Fish

Many species of fish are highly sensitive to sound and vibration and broadly applicable sound exposure criteria have recently been published (Popper *et al.* 2014). Studies investigating fish mortality and organ damage from noise generated during seismic surveys are very limited and results are highly variable, from no effect to long-term auditory damage (reviewed in Popper *et al.* 2014). Behavioural responses and effects on fishing success ("catchability") have been reported following seismic surveys (Pearson *et al.* 1992, Skalski *et al.* 1992, Engås *et al.* 1996, Wardle *et al*. 2001). Potential effects on migratory diadromous fish is an area of significant interest for which empirical evidence is still limited, especially as salmonids and eels are sensitive to particle motion (not sound pressure) (Gill & Bartlett 2010). Atlantic salmon *Salmo salar* have been shown through physiological studies to respond to low frequency sounds (below 380Hz), with best hearing at 160Hz (threshold 95 dB re 1 μPa). Hence, their ability to respond to sound pressure is regarded as relatively poor with a narrow frequency span, a limited ability to discriminate between sounds, and a low overall sensitivity (Hawkins & Johnstone 1978, cited by Gill & Bartlett 2010).

In addition to considering direct effects on fish as qualifying features of Natura 2000 sites, fish also form important prey items of seabird, marine mammal and fish qualifying features. Example fish species of known importance to both diving seabirds and marine mammals in the southern North Sea include sandeels, small pelagic species such as herring and sprat, and young gadoids. Sandeels lack a swim bladder, which is considered to be responsible for their observed low sensitivity to underwater noise (Suga *et al*. 2005) and minor, short-term responses to exposure to seismic survey noise (Hassel *et al*. 2004), although data are limited. By contrast, herring are considered hearing specialists, detecting a broader frequency range than many species. Sprat are assumed to have similar sensitivities to herring due to their comparable morphology, although studies on this species are lacking. Observed responses of herring to underwater noise vary; for example, Peña *et al*. (2013) did not observe any changes

[27] Note that in studies of animals in the wild it is difficult to determine the relative contribution of noise and physical presence of vessels in the observed responses, with the latter discussed in Section 4.2.3.

in swimming speed, direction, or school size as a 3D seismic vessel slowly approached schools of feeding herring from a distance of 27km to 2km; conversely, Slotte *et al*. (2004) observed herring and other mesopelagic fish to be distributed at greater depth during periods of seismic shooting than non-shooting, and a reduced density within the survey area. Evidence for and against avoidance of approaching vessels by herring has been reported (e.g. Skaret *et al*. 2005, Vabø *et al*. 2002), with the nature of responses believed to be related to the activity of the school at the time.

Following a review of relevant studies, MMS (2004) consider that the "consensus is that seismic airgun shooting can result in reduced trawl and longline catch of several species when the animals receive levels as low as 160dB". These reduced catches are temporary in nature and likely reflect temporary displacement and/or altered feeding behaviour. No associations of lower-intensity, continuous drilling noise and fishing success have been demonstrated, and large numbers of fish are typically observed around producing installations in the North Sea (e.g. Løkkeborg *et al*. 2002, Fujii 2015) and elsewhere (e.g. Stanley & Wilson 1991).

Diving birds

Direct effects from seismic exploration noise on diving birds could potentially occur through physical damage, or through disturbance of normal behaviour, although evidence for such effects is very limited. Deeper-diving species which spend longer periods of time underwater (e.g. auks) may be most at risk of exposure to high-intensity noise from seismic survey and consequent injury or disturbance, but all species which routinely submerge in pursuit of prey and benthic feeding opportunities (i.e. excluding shallow plunge feeders) may be exposed to anthropogenic noise. A full list of relevant species occurring in the UK is provided in Box 4.1; of these, four species are qualifying features of sites in the southern North Sea region which this AA addresses: red-throated diver, common scoter, goldeneye and scaup.

Very high amplitude low frequency underwater noise may result in acute trauma to diving seabirds, with several studies reporting mortality of diving birds in close proximity (i.e. tens of metres) to underwater explosions (Yelverton *et al*. 1973, Cooper 1982, Stemp 1985, Danil & St Leger 2011). However, mortality of seabirds has not been observed during extensive seismic operations in the North Sea and elsewhere. While seabird responses to approaching vessels are highly variable, flushing disturbance would be expected to displace most diving seabirds from close proximity to seismic airgun arrays, particularly among species more sensitive to visual disturbance such as scoter, divers and cormorant (Garthe & Hüppop 2004 and see Section 4.2.3). Therefore, the potential for acute trauma to diving birds from seismic survey is considered to be very low.

Data relating to the potential behavioural disturbance of diving birds due to underwater noise are very limited. The reported in-air hearing sensitivity for a range of diving duck species, red-throated diver and gannet have been tested for tone bursts between frequencies of 0.5-5.7kHz; results revealed a common region of greatest sensitivity from 1-3kHz, with a sharp reduction in sensitivity >4kHz (Crowell e*t al.* 2015). Similar results were observed for African penguin; tests of in-air hearing showed a region of best sensitivity of 0.6-4kHz, consistent with the vocalisations of this species (Wever *et al*. 1969). Testing on the long-tailed duck underwater showed reliable responses to high intensity stimuli (> 117 dB re 1μPa) from 0.5-2.9kHz

(Crowell 2014). An underwater hearing threshold for cormorant of 70-75 dB re 1µPa rms for tones at tested frequencies of 1-4kHz has been suggested (Hansen *et al*. 2017). The authors argue that this underwater hearing sensitivity, which is broadly comparable to that of seals and small odontocetes at 1-4kHz, is suggestive of the use of auditory cues for foraging and/or orientation and that cormorant, and possibly other species which perform long dives, are sensitive to underwater sound. A study showed that the use of acoustic pingers mounted on the corkline of a gillnet in a salmon fishery, emitting regular impulses of sound at *ca.* 2kHz, was associated with a significant reduction in entanglements of one species of interest, the guillemot, but not rhinoceros auklet (Melvin *et al*. 1999). In a playback experiment on wild African penguins, birds showed strong avoidance behaviour (interpreted as an antipredator response) when exposed to killer whale vocalisations and sweep frequency pulses, both of which were focussed between 0.5-3kHz (Frost *et al*. 1975).

McCauley (1994) inferred from vocalisation ranges that the threshold of perception for low frequency seismic noise in some species (e.g. penguins, considered as a possible proxy for auk species) would be high, hence individuals might be adversely affected only in close proximity to the source. A study 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). More recently, Pichegru *et al*. (2017) used telemetry data from breeding African penguins to document a shift in foraging distribution concurrent with a 2D seismic survey off South Africa. Pre/post shooting, areas of highest use (indicated by the 50% kernel density distribution) bordered the closest boundary of the seismic survey; during shooting, their distribution shifted away from the survey area, with areas of higher use at least 15km distant to the closest survey line. However, insufficient information was provided on the spatio-temporal distribution of seismic shooting or penguin distribution to determine an accurate displacement distance. It was reported that penguins quickly reverted to normal foraging behaviour after cessation of seismic activities, suggesting a relatively short-term influence of seismic activity on these birds' behaviour and/or that of their prey (Pichegru *et al*. 2017).

These data are limited, but the observed regions of greatest hearing sensitivity for cormorants in water and other diving birds in air are above those low frequencies (i.e. <500Hz) which dominate and propagate most widely from geological survey. While there is some evidence of noise-induced changes in the distribution and behaviour of diving birds in response to impulsive underwater noise, these have been temporary and may be a direct disturbance or reflect a change in fish distribution during that period (possibly as a result of seismic activities).

Box 4.1: Migratory and/or Annex I diving bird species occurring in the UK considered potentially vulnerable to underwater noise effects

Divers and grebes	**Diving ducks**
Great northern diver *Gavia immer*	Pochard *Aythya ferina*
Red-throated diver *Gavia stellata*	Tufted duck *Aythya fuligula*
Black-throated diver *Gavia arctica*	**Scaup *Aythya marila***
Little grebe *Tachybaptus ruficollis*	Eider *Somateria mollissima*
Great crested grebe *Podiceps cristatus*	Long-tailed duck *Clangula hyemalis*

Slavonian grebe *Podiceps auritus* **Seabirds** Manx shearwater *Puffinus puffinus* Gannet *Morus bassanus* Cormorant *Phalacrocorax carbo carbo* Shag *Phalacrocorax aristotelis* Guillemot *Uria aalge* Razorbill *Alca torda* Puffin *Fratercula arctica*	**Common scoter *Melanitta nigra*** Velvet scoter *Melanitta fusca* **Goldeneye *Bucephala clangula*** Red-breasted merganser *Mergus serrator* Goosander *Mergus merganser*

*Note: Includes species which are known to engage in pursuit diving or benthic feeding in marine, coastal and estuarine waters at least during part of the year. Species in **bold** are those of relevance to the sites and Blocks considered within this AA.*

5 Assessment

The screening process (BEIS 2018) identified a number of sites where there was the potential for likely significant underwater noise, physical disturbance and/or drilling effects associated with proposed activities that could follow licensing of Blocks offered in the 30th Round. A number of these Blocks have been applied for (see Section 1.2) and the further assessment of licensing of these Blocks on relevant Natura 2000 sites (those shown in Figure 1.1) is given below. This assessment has been informed by the evidence base on the environmental effects of oil and gas activities (Section 4), and the assumed nature and scale of potential activities (Table 2.2).

5.1 Assessment of physical disturbance and drilling effects

5.1.1 Blocks and sites to be assessed

The nature and extent of potential physical disturbance and drilling effects are summarised in Section 4.2. On the basis of this information, in conjunction with the locations of Blocks applied for in the 30th Round and the sites with relevant qualifying features, potential likely significant effects are considered to remain for forty five Blocks (or part Blocks), in respect of ten sites (Figure 5.1) which are described below.

The Humber Estuary SAC/SPA is a muddy, macro-tidal estuary, fed by a number of rivers including the Rivers Ouse, Trent and Hull. Suspended sediment concentrations are high, and are derived from a variety of sources, including marine sediments and eroding boulder clay along the Holderness coast. The extensive mud and sand flats support a range of benthic communities, which in turn are an important feeding resource for birds and fish. Wave exposed sandy shores are found in the outer/open coast areas of the estuary. These change to the more moderately exposed sandy shores and then to sheltered muddy shores within the main body of the estuary and up into the tidal rivers. Significant fish species include river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* which breed in the River Derwent, a tributary of the River Ouse. Grey seals *Halichoerus grypus* come ashore in autumn to form breeding colonies on the sandy shores of the south bank at the mouth of the Humber at Donna Nook, where annual pup production has almost doubled in the past 10 years to approximately 2,000 pups in the 2016 breeding season (SCOS 2016; Lincolnshire Wildlife Trust 2017[28]). Grey seal populations have experienced considerable growth throughout the wider region, with pup production increasing at an average of 15.6% annually among the four largest English North Sea colonies from 2012-2014 (including Donna Nook) (SCOS 2016). Tagging studies show that grey seals use offshore areas (up to 100km from the coast) connected to their haul-out sites by prominent corridors, although density is greatest in coastal waters adjacent to colonies. Models of at-sea distribution estimate high densities of seals (>4

[28] Lincolnshire Wildlife Trust website: http://www.lincstrust.org.uk/donna-nook/weekly-update

per km^2) around the mouth of the Humber Estuary within approximately 15km of the SAC boundary, diffusing to lower densities of generally ≤2 seals per km^2 further from shore (Jones & Russell 2016). The estuary supports important numbers of waterbirds (especially geese, ducks and waders) during migration periods and in winter. In summer, it supports important breeding populations of bittern *Botaurus stellaris*, marsh harrier *Circus aeruginosus*, avocet *Recurvirostra avosetta* and little tern *Sterna albifrons*[29] which may forage in adjacent coastal waters (covered by the Greater Wash SPA below).

The Greater Wash SPA extends from Bridlington Bay in the north, to the boundary of the Outer Thames Estuary SPA in the south. The site is proposed to protect important areas of sea used by waterbirds during the non-breeding period, and for foraging in the breeding season by the qualifying interest features of a number of already classified SPAs: including little tern from the Humber Estuary SPA[30]. The seaward boundary is defined by the area of importance to red-throated diver, and by the foraging area of sandwich tern off the north Norfolk Coast. Red-throated diver are distributed throughout the SPA with 1,511 individuals or 8.9% of the GB wintering population estimated to be present within the site. Higher densities of birds were recorded close inshore, particularly in the area outside The Wash SPA, north of the Humber Estuary, along the eastern part of North Norfolk Coast and in the south of the site where it abuts the Outer Thames Estuary SPA (Lawson *et al.* 2016). See Outer Thames Estuary SPA below for the potential functional importance of sandbanks within the site in supporting red-throated diver prey species. In the northernmost section of the site, off the Holderness coast, seabed habitats primarily comprise coarse sediments, with occasional areas of sand, mud and mixed sediments. The inshore environment is highly dynamic, with large volumes of material being eroded from the shoreline and seabed and transported southwards. Water depth is generally shallow, reaching up to 20m towards the offshore boundary. Subtidal sandbanks occur at the mouth of the Humber Estuary, primarily comprising sand and coarse sediments[31].

The recently enlarged Outer Thames Estuary SPA includes three new areas identified for foraging terns breeding at other (already classified) SPAs on shore; these are parts of the Rivers Yare and Bure, a small riverine section at Minsmere, and both estuarine and marine areas around Foulness. The SPA therefore comprises areas for foraging breeding seabirds and non-breeding waterbirds[32], and supports the largest aggregations of wintering red-throated diver in the UK, 38% of the GB population. Red-throated divers occur throughout the entire area of the Outer Thames Estuary, but at greatest density and with greatest frequency off the coast of Suffolk and over sandbanks in the centre of the estuary and those extending toward the coast of south Essex and part of north Kent. The site contains areas of shallow and

[29] publications.naturalengland.org.uk/file/3302589
[30] The seaward foraging extent relevant to little tern from the Humber Estuary SPA was set to be the generic seaward extent value (2.2km) derived from a series of JNCC little tern surveys at UK colonies between 2009 and 2013.
[31] https://consult.defra.gov.uk/natural-england-marine/greater-wash-potential-special-protection-area-com/supporting_documents/V9%20FINAL%20Greater%20Wash%20Departmental%20Brief%2017%20October%202016%20ready%20for%20consultation.pdf
[32] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/579017/outer-thames-departmental-brief.pdf

deeper water, with high tidal current streams and a range of mobile sediments, including several shallow sandbanks. The sandbanks may have a functional role (as nursery, spawning, or feeding grounds or in providing shelter) in supporting prey species of the red-throated diver (small fish such as gadoids, sprat, herring and sandeel; Guse *et al.* 2009)[33]. Large areas of mud, silt and gravelly sediments form the deeper water channels, the main ones of which form the approach route to the ports of London and as such are continually disturbed by shipping and maintenance dredging. Sand in the form of sandbanks separated by troughs predominates in the remaining areas and the crests of some of the banks are exposed at mean low water. The seabed in the area of the Norfolk and Suffolk coast is of a similar composition to that in the main estuary with large shallow areas of mud, sand, silt and gravely sediments but, in the absence of main port areas within this area, there is consequently less disturbance through shipping or dredging.

The Southern North Sea cSAC has been recognised as an area with predicted persistent high densities of harbour porpoise. The harbour porpoise is protected in European waters under the provisions of Article 12 of the Habitats Directive and within the UK its conservation status is favourable[34]. Individuals in the UK are part of the north east Atlantic population which is mainly considered to be a single 'continuous' population, even though some degree of genetic differentiation has been observed (Andersen *et al.* 1997, 2001, Tolley *et al.* 2001, Fontaine *et al.* 2007). From a management and conservation perspective however, three distinct UK Management Units (MU) have been identified; the North Sea, West Scotland and the Celtic & Irish Seas (IAMMWG 2015). The Southern North Sea cSAC is the largest of the possible SACs proposed for the conservation of harbour porpoise. It was selected primarily on the basis of preferential and prolonged use by harbour porpoises in contrast to other areas of the North Sea, but variability in numbers within the site and across the North Sea (seasonally and between years) is known to be high. For example, a large southerly shift in distribution was reported across the North Sea between 1994 and 2005 when SCANS and SCANS-II surveys took place (Hammond *et al*. 2013). As part of the site identification process, analysis of the observed density of harbour porpoise against different environmental variables (Heinänen & Skov 2015) indicated that the coarseness of the seabed sediment was an important determinant of porpoise density, with porpoises showing a preference for coarser sediments (such as sand/gravel) rather than fine sediments (e.g. mud). Sandeels, which are known prey for harbour porpoises, exhibit a strong association with sandy substrates. The majority of the substrate types within the site are categorised as sublittoral sand and sublittoral coarse sediment. Moderate energy levels at the seabed (including wave and tidal energy) are estimated across the majority of the site[35]. The current draft conservation objectives indicate that the concept of 'site population' may not be appropriate for this species. It highlights the need to assess impacts on the site based on how the proposed activities translate into effects on the relevant MU population. In the case of this AA, it refers to the North Sea MU ranging

[33] http://jncc.defra.gov.uk/PDF/ThamesSPAConsObsVersion3%207%20Mar2013FINAL.pdf
[34] JNCC (2013). Species conservation status reports. Third Report by the United Kingdom under Article 17 of the EU Habitats Directive. Joint Nature Conservation Committee, Peterborough. http://jncc.defra.gov.uk/page-6564 (accessed August 2015).
[35] http://jncc.defra.gov.uk/pdf/SouthernNorthSeaSelectionAssessmentDocument.pdf

from the east coast of the UK to part of Denmark (Skagerrak and northern Kattegat). The abundance of harbour porpoise for the North Sea MU was estimated in 2016 (Hammond *et al.* 2017) as part of SCANS-III (345,000, CV = 0.18), which is similar to the 2005 estimate (335,000 CV = 0.22).

The Dogger Bank SAC was formed by glacial processes before being submerged through sea level rise during the last marine transgression (by *ca*. 8,000 years BP). The southern part of the bank is covered by water seldom deeper than 20m and extends within the SAC in UK waters down to 35-40m deep. The bank structure slopes down to greater than 50m deep in UK, Dutch and German waters and its location in open sea exposes the bank to substantial wave energy preventing the colonisation of the sand by vegetation on the shallower parts of the bank. Large parts of the Dogger Bank are situated above the storm-wave base (Connor *et al.* 2006) and it is estimated that during a storm event, sediment up to medium sand particles can be mobilised in 60m water depth at the northern slope of the Dogger Bank (Klein *et al*. 1999). Models of natural disturbance have estimated that the Dogger Bank is disturbed to 4cm depth at least once every year by tides and waves (Diesing *et al*. 2013). Sediments range from fine sands containing many shell fragments on top of the bank to muddy sands at greater depths supporting invertebrate communities (Diesing *et al*. 2009, Eggleton *et al.* 2017). Sand eels are an important prey resource found at the bank supporting a variety of species including fish, seabirds and cetacean. Occasional, discrete areas of coarser sediments (including pebbles) are dominated by the soft coral *Alcyonium digitatum*, the bryozoan *Alcyonidium diaphanum* and serpulid worms[36].

A profile of the habitat type associated with the Dutch Doggersbank SAC site is not yet available[37] but it is a continuation of the UK Dogger Bank SAC and contains similar habitat types[38]. Grey and harbour seal and harbour porpoise are listed as qualifying features of the Doggersbank SAC, but are not primary reasons for site selection (Van Moorsel 2011). Models based on grey seals (Jones & Russell 2016) and harbour seals tagged in the UK (Jones *et al.* 2017) and Dutch coast (Aarts *et al*. 2016) suggest a low density of both species in the site and surrounding area (i.e. < 0.1 seal per km^2). Data from grey seals tagged on the Dutch coast also suggest limited presence of grey seals in the area compared to coastal waters, although animals do pass through the site when moving between Dutch and UK waters (Brasseur *et al.* 2015). While the sandbank habitats and associated fish communities may provide valuable foraging opportunities for seals, the site is located >180km from the nearest UK and continental landfalls, placing it beyond the 50km (harbour) and 100km (grey) ranges from haul-out sites where the majority of foraging activity occurs (Jones *et al*. 2015). For both species, their abundance in the site was assessed as 0-2% of the national (Dutch) population, although no specific values were available. Harbour porpoise abundance within the site was assessed as 2-15% of the national (Dutch) population, with no specific values available, and modelling studies estimate that the site represents an area of higher harbour porpoise density relative to

[36] http://jncc.defra.gov.uk/page-6508
[37] https://www.noordzeeloket.nl/en/policy/noordzee-natura-2000/gebieden/doggersbank/dogger-bank/habitattype/
[38] http://www.emodnet-seabedhabitats.eu

many other areas in the North Sea. Those further west, in UK waters (i.e. the Southern North Sea cSAC), typically support the highest densities in the region, although the distribution of this highly mobile, wide-ranging species varies (Heinänen & Skov 2015; Gilles *et al.* 2016).

The North Norfolk Sandbanks and Saturn Reef SAC contains the most extensive example of offshore linear ridge sandbanks in UK waters, and encompasses an area where previous seabed surveys identified an extensive biogenic reef created by the ross worm *Sabellaria spinulosa*, called Saturn reef (Jenkins *et al*. 2015). The sandbanks are subject to a range of current strengths which are strongest on the banks closest to shore, and are dominated by sandy sediments (see Parry *et al.* 2015). Whilst the sandbanks are very similar in terms of the biological communities present, increasing species numbers have been recorded on the outermost banks, likely related to the change in hydrodynamic regime with increasing distance from the coast[39]. First discovered in 2002, the Saturn reef covered an area approximately 750m by 500m just to the south of Swarte Bank. More recent surveys failed to identify the extensive areas of *S. spinulosa* reef previously observed but did find reefs in the area which highlights the ephemeral nature of the feature and indicates that favourable conditions for *S. spinulosa* formation occur within the site (see JNCC website and Jenkins *et al*. 2015).

The Inner Dowsing, Race Bank and North Ridge SAC occupies The Wash Approaches. Water depths are mostly shallow (<30m) and the site encompasses a wide range of sandbank types and biogenic reef formed by *Sabellaria spinulosa*. The group of banks within the Wash Approaches are made up of fine to medium sands derived from coastal erosion processes following the last glacial retreat and marine inundation. Inner Dowsing is a sandbank of coarse sand with some areas of gravel to the west of the site, with a distinctive elongate shape maintained by the tidal currents in the area. The Race Bank-North Ridge-Dudgeon Shoal sandbank system is an example of a sinusoidal sandbank that also has a complex pattern of smaller sandbanks associated with it. The tops of the sandbanks are characterised by low diversity communities dominated by polychaete worms and mobile amphipod crustaceans. The trough areas between the sandbanks are composed of mixed and gravelly sands, predominantly as veneers over glacial till. In these areas diverse mosaics of biotopes occur, which are dominated by the ascidian *Molgula* sp. along with a number of nemertean worms and polychaetes. Abundant *S. spinulosa* agglomerations have consistently been recorded and these support attached epifauna such as bryozoans, hydroids, sponges and anemones[40].

The Haisborough, Hammond and Winterton SAC contains a series of sandbanks that run parallel to the coast. The sandy sediments within the site are very mobile in the strong tidal currents of the area, and though large-scale bank migration or movement appears to be slow, there is a level of sediment movement around and across the banks evidenced by megaripple and sandwave formations. Infaunal communities of the sandy bank tops are consequently of low biodiversity, characterised by mobile polychaetes and amphipods which are able to rapidly re-bury themselves into the dynamic sediment environments. Along the flanks of the banks,

[39] http://jncc.defra.gov.uk/page-6537
[40] http://jncc.defra.gov.uk/page-6536

and towards the troughs between the banks the sediments tend to be slightly more stable with gravels exposed in areas. In these regions of the site, infaunal and epifaunal communities are much more diverse. *Sabellaria spinulosa* reefs are located at Haisborough Tail, Haisborough Gat and between Winterton Ridge and Hewett Ridge and arise from the surrounding coarse sandy seabed to heights of between 5cm to 10cm.

5.1.2 Implications for site integrity of relevant sites

The conservation objectives of relevant sites and other relevant information relating to site selection and advice on operations have been considered against indicative Block work programmes (see Section 2.2.1) to determine whether they could adversely affect site integrity. The results are given in Table 5.1 below. In terms of mitigation, all mandatory requirements (as given in Section 2.3.1), are assumed to be in place as a standard for all activities assessed here.

Figure 5.1: Sites and Blocks to be subject to further assessment for physical disturbance and drilling effects

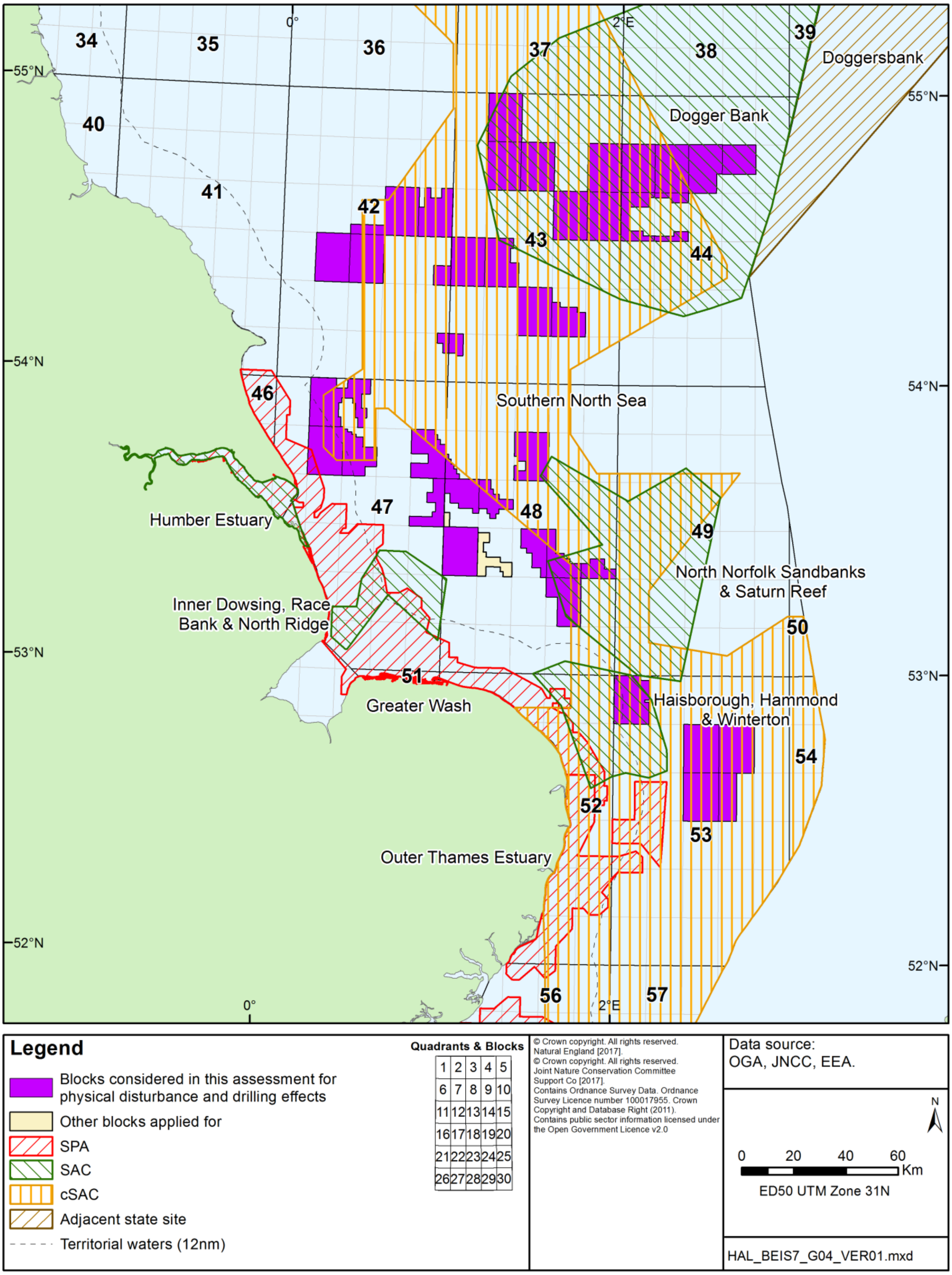


Table 5.1: Consideration of potential physical disturbance and drilling effects and relevant site conservation objectives

Humber Estuary SPA
Site information
Area (ha): 37,630 **Relevant qualifying features:** Breeding, on passage and overwintering waders and waterfowl, breeding terns, breeding and overwintering birds of prey. Overwintering waterbird assemblage. See Natura 2000 standard data form for details of qualifying features[41]. **Conservation objectives:** With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified, and subject to natural change; Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring; • The extent and distribution of the habitats of the qualifying features • The structure and function of the habitats of the qualifying features • The supporting processes on which the habitats of the qualifying features rely • The population of each of the qualifying features, and, • The distribution of the qualifying features within the site.
Relevant Blocks for physical disturbance and drilling effects
47/7
Assessment of effects on site integrity
Rig siting Block 47/7 is 5km from the site boundary and given the assumed distance from a jack-up rig within which effects may occur (500m, see Table 2.2), rig installation will not significantly impact the extent and distribution of the habitats of the qualifying features. **Drilling discharges** It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2) and therefore drilling discharges will not significantly impact the extent and distribution or the structure and function of the habitats of the qualifying features given Block 47/7 is 5km from the site. No adverse effect on site integrity expected. **Rig/vessel presence and movement** The Humber Estuary and adjacent Blocks are currently exposed to very high to high shipping densities[42] with Block 47/7 exposed to an average of 38 vessel movements per week (range 6-108) per 2km grid cell across the Block (2015 MMO data)[43]. The Block is in a mature hydrocarbon basin and helicopters and vessels are expected to use established routes to existing ports. The temporary nature of drilling activities and the limited number of associated supply vessel trips (2-3 per week per rig; Table 2.2) is unlikely to significantly increase the potential for disturbance of qualifying features or impact their distribution within the site. No adverse effect on site integrity expected. **In-combination effects** No intra-plan in-combination effects likely given that Block 47/7 is the only Block applied for of relevance to the site. Section 5.3 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

[41] http://jncc.defra.gov.uk/pdf/SPA/UK9006111.pdf

[43] https://data.gov.uk/dataset/vessel-density-grid-2015

Greater Wash SPA
Site information
Area (ha): 353,577.86 **Relevant qualifying features:** Overwintering divers, waterfowl and gulls, breeding terns. See site citation for details of qualifying features[44]. **Conservation objectives:** With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified, and subject to natural change; Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring; • The extent and distribution of the habitats of the qualifying features • The structure and function of the habitats of the qualifying features • The supporting processes on which the habitats of the qualifying features rely • The population of each of the qualifying features, and, • The distribution of the qualifying features within the site.
Relevant Blocks for physical disturbance and drilling effects
47/2d, 47/7, 47/8f, 47/15c
Assessment of effects on site integrity
Rig siting Blocks 47/2d, 47/8f and 47/15c are a minimum of 7.6km from the site boundary and given the assumed distance from a jack-up rig within which effects may occur (500m, see Table 2.2), rig installation will not significantly impact the extent and distribution of the habitats of the qualifying features. Block 47/7 has significant areas outside the site boundaries in which rig siting would be possible, and therefore interaction with the habitats of the qualifying features could be avoided. If located within the site, the maximum spatial footprint of physical damage associated with jack-up rig siting is small ($0.8km^2$) compared to the large site (covering <0.02%). As indicated in Section 5.1.1, the environment off the Holderness coast is highly dynamic, with large volumes of material eroded from the shoreline and seabed and transported southwards. Recovery from physical damage of the scale associated with rig placement is expected to be rapid. The small scale and temporary nature of the potential physical damage will ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity. **Drilling discharges** It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2). Therefore with respect to Blocks 47/2d, 47/8f and 47/15c, drilling discharges will not significantly impact the extent and distribution or the structure and function of the habitats of the qualifying features. With respect to Block 47/7, there are significant areas outside the site in which drilling discharges would not impact the site. However, if located within the site, the maximum spatial footprint within which smothering by drilling discharges may occur ($0.8km^2$) is small (representing 0.02% of the total site area) and given the dynamic nature of the site, redistribution of drilling discharges and recovery from smothering would be rapid. The small scale and temporary nature of potential smothering, and mandatory mitigation requirements with respect to drilling chemical use and discharge (Section 2.3.1), will ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity. **Rig/vessel presence and movement** Of the qualifying features likely to be present within relevant parts of the site, overwintering red-throated diver and common scoter are highly sensitive to disturbance by ship and helicopter traffic (Garthe & Hüppop 2004). Block 47/7 is the only Block where there is the potential for a rig to be present within the site and there are significant areas outside the site boundaries in which rig siting would be possible. Therefore, the potential for disturbance to affect the distribution of qualifying features is primarily associated with the movement of supply vessels and helicopters across the site to drilling rigs (which may be outside of the site). The relevant Blocks are currently exposed to very high or high shipping densities[45], with an average of 31 vessel movements per week (range 5-108) per 2km grid cell across the Blocks (2015 MMO data[46]). The Blocks are in a mature hydrocarbon basin and helicopters and vessels are expected to use established routes to existing ports. The temporary nature of drilling

[44] http://publications.naturalengland.org.uk/publication/4597871528116224?category=6071598712881152
[45] https://www.ogauthority.co.uk/media/1419/29r_shipping_density_table.pdf
[46] https://data.gov.uk/dataset/vessel-density-grid-2015

activities and limited number of associated supply vessel and helicopter trips (2-3 vessel trips per week per rig; Table 2.2) is unlikely to represent a significant increase in the level of disturbance of sensitive qualifying features. Further mitigation measures are also available (Section 5.1.3) and will be required, where appropriate, to ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity.

In-combination effects
No intra-plan in-combination effects are likely with respect to the spatial footprints associated with rig siting and drilling discharges given that Block 47/7 is the only one that transects the site. There is the potential for in-combination effects associated with the presence and movement of supply vessels and helicopters to rigs within each of the Blocks. However, given the existing high shipping densities and the limited and temporary supply vessel and helicopter traffic, intra-plan effects are not considered likely for the four Blocks. Further mitigation measures are also available (Section 5.1.3), and will be required, where appropriate, to ensure that site conservation objectives are not undermined. Section 5.3 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

Outer Thames Estuary SPA

Site information

Area (ha): 392,451
Relevant qualifying features: Breeding terns, overwintering diver. See Natura 2000 standard data form for details of qualifying features[47].

Conservation objectives:
With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified, and subject to natural change;
Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

- The extent and distribution of the habitats of the qualifying features
- The structure and function of the habitats of the qualifying features
- The supporting processes on which the habitats of the qualifying features rely
- The population of each of the qualifying features, and,
- The distribution of the qualifying features within the site.

Relevant Blocks for physical disturbance and drilling effects

53/8, 53/13

Assessment of effects on site integrity

Rig siting
Blocks 53/8 and 53/13 are a minimum of 6km from the site boundary and given the assumed distance from a jack-up rig within which effects may occur (500m, see Table 2.2), rig installation will not significantly impact the extent and distribution of the habitats of the qualifying features. No adverse effect on site integrity.

Drilling discharges
It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2). Therefore with respect to Blocks 53/8 and 53/13, drilling discharges will not significantly impact the extent and distribution or the structure and function of the habitats of the qualifying features. No adverse effect on site integrity.

Rig/vessel presence and movement
Overwintering red-throated divers are highly sensitive to disturbance by ship and helicopter traffic (Garthe & Hüppop 2004). Given that the Blocks are outside of the site boundaries, the potential for disturbance to impact the distribution of qualifying features is primarily associated with the movement of supply vessels and helicopters to drilling rigs. Blocks 53/13 and 53/8 are exposed to very high and high shipping densities respectively[48], with an average number of 19 vessel movements per week (range 4-54) per 2km grid cell across the relevant Blocks (2015 MMO data[49]). The Block is in a mature hydrocarbon basin and helicopters and vessels are expected to use established routes to existing ports. The temporary nature of drilling activities and limited number of associated supply vessel and helicopter trips (2-3 vessel trips per week per rig; Table 2.2) is unlikely to represent a significant

[47] http://jncc.defra.gov.uk/pdf/SPA/UK9020309.pdf
[48] https://www.ogauthority.co.uk/media/1419/29r_shipping_density_table.pdf
[49] https://data.gov.uk/dataset/vessel-density-grid-2015

increase in the level of disturbance of sensitive qualifying features. However, further mitigation measures are available (Section 5.1.3) and will be required, where appropriate, to ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity.

In-combination effects
No intra-plan in-combination effects are likely with respect to the spatial footprints associated with rig siting and drilling discharges given that both Blocks are outside of the site boundaries. There is the potential for in-combination effects associated with the presence and movement of supply vessels and helicopters to rigs within each of the Blocks. However, given the existing high shipping densities and the limited and temporary supply vessel traffic intra-plan effects are not considered likely for the two Blocks. Section 5.3 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

Southern North Sea cSAC

Site information

Area (ha): 3,695,054
Relevant qualifying features: Harbour porpoise

Conservation objectives:
To avoid deterioration of the habitats of the harbour porpoise or significant disturbance to the harbour porpoise, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to maintaining Favourable Conservation Status (FCS) for the UK harbour porpoise.
To ensure for harbour porpoise that, subject to natural change, the following attributes are maintained or restored in the long term:

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

Relevant Blocks for physical disturbance and drilling effects

42/13b, 42/14, 42/15b, 42/17, 42/18, 42/20a, 42/30d, 43/2, 43/7, 43/8, 43/10, 43/14, 43/15, 43/16, 43/17a, 43/23, 43/24b, 43/26c, 44/6, 44/7, 44/8b, 44/11d, 44/12d, 44/12e, 47/2d, 47/3f, 47/7, 47/8f, 47/10d, 47/15c, 48/6d, 48/8b, 48/11c, 48/12b, 48/18b, 48/19b, 48/20c, 48/24a, 53/1b, 53/8, 53/9, 53/13, 53/14b

Assessment of effects on site integrity

Rig siting
The delineation of the Southern North Sea site was based on the prediction of 'harbour porpoise habitat' within the North Sea (Heinänen & Skov 2015). The analysis indicated a preference for water depths between 30 and 50m throughout the year, and in general, the coarseness of the seabed sediment was important, with porpoises showing a preference for coarser sediments (such as sand/gravel)[50]. Physical damage to benthic habitats through disturbance or abrasion by the placement of spud cans as part of rig installation has the potential to impact on the extent of supporting habitat within the site. It is assumed that physical damage effects occur within 500m of the rig location (Table 2.2) and therefore no adverse effects on site integrity are expected for Block 42/17 which is beyond this distance from the site. A number of Blocks (42/18, 44/17, 46/2, 46/7, 47/10, 47/15, 48/6, 48/11, 48/12, 48/18, 48/19 and 48/24) have significant areas outside the site boundaries in which rig siting would be possible, and therefore interaction with the habitats of the qualifying features could be avoided. With respect to those Blocks that are partly or wholly within the site, the maximum spatial footprint of physical damage associated with jack-up rig siting is small (0.8km^2) compared to the large site (covering 0.002%). Recovery from physical damage in relevant sand/gravel habitats across the relatively shallow and dynamic site (majority of site less than 40m) is expected to be relatively rapid. The small scale and temporary nature of the potential physical damage, and the mobile nature of the qualifying features will ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity.

The requirement for rig stabilisation measures would be determined by site survey of local conditions. In soft sediments, rock placement may cause smothering of existing sediments and a physical change of seabed type. The majority of the substrate types within the site are categorised as sublittoral sand and sublittoral coarse sediment. It is likely that if rock placement is required it would be within 500m of a rig and based on a review of submitted ESs it is estimated this could cover an area of 0.001-0.004km^2 (Table 2.2). Hence, the potential loss of extent of sandy sediment is small compared to the widespread nature of this sediment type across the large site (36,958km^2). Further mitigation measures are available (Section 5.1.3) and will be required, where appropriate to

[50] http://jncc.defra.gov.uk/pdf/SouthernNorthSeaSelectionAssessmentDocument.pdf

ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity.

Drilling discharges
It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2) and therefore no adverse effects on site integrity are expected for Blocks beyond this distance from the site (42/17). With respect to the other Blocks, the maximum spatial footprint within which smothering by drilling discharges may occur (0.8km^2) is small (representing 0.002% of the total site area) and recovery from smothering in relevant sand/gravel habitats across the relatively shallow site (majority of site less than 40m) is expected to be relatively rapid. The small scale and temporary nature of potential smothering and mandatory mitigation requirements with respect to drilling chemical use and discharge (Section 2.3.1) will ensure that site conservation objectives are not undermined.

Rig/vessel presence and movement
Harbour porpoise are considered sensitive to underwater noise from shipping which could make preferred habitats less attractive as a result of disturbance (habitat displacement, area avoidance). There are currently a number of large ports on the east coast which result in large vessel shipping routes throughout the site. Given existing levels of shipping activity over the site and elevated porpoise densities, the temporary nature of drilling activities and limited number of associated supply vessel trips is unlikely to represent a significant increase in the level of disturbance that would lead to the exclusion of harbour porpoise from a significant portion of the site for a significant period of time. Further mitigation measures are also available (Section 5.1.3) and will be required, where appropriate to ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity.

In-combination effects
Intra-plan in-combination effects are possible although spatial footprints associated with rig installation and drilling discharges in the Blocks are localised and temporary, and unlikely to overlap between Blocks either spatially or temporally. The combined spatial footprint within which physical disturbance and drilling effects could occur across the 43 Blocks (17 drill or drop and 2 contingent wells proposed) is estimated at 15.2km^2 (0.04% of the site). However, the temporary nature of the disturbance, the mobile nature of the qualifying feature and mandatory mitigation measures (Section 2.3.1), will ensure that site conservation objectives are not undermined. There is also the potential for in-combination effects associated with the presence and movement of supply vessels and rigs within each of the Blocks. However, drilling operations for the 19 proposed wells are unlikely to coincide either spatially or temporally to such an extent that the level of disturbance would lead to the exclusion of harbour porpoise from a significant portion of the site for a significant period of time. Section 5.3 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

Dogger Bank SAC

Site information

Area (ha): 1,233,115
Relevant qualifying features: Sandbanks which are slightly covered by sea water all the time

Conservation objectives:
For the feature to be in favourable condition thus ensuring site integrity in the long term and contribution to Favourable Conservation Status of Annex 1 sandbanks. This contribution would be achieved by maintaining or restoring, subject to natural change:
- The extent and distribution of the qualifying habitat in the site;
- The structure and function of the qualifying habitat in the site; and
- The supporting processes on which the qualifying habitat relies.

Relevant Blocks for physical disturbance and drilling effects

43/2, 43/7, 43/8, 43/10, 43/14, 43/15, 43/16, 43/17a, 43/23, 44/6, 44/7, 44/8b, 44/9b, 44/11d, 44/12d, 44/12e

Assessment of effects on site integrity

Rig siting
The qualifying feature is sensitive to physical damage through disturbance or abrasion[51] by the placement of spud cans as part of rig siting. Blocks 43/16 and 43/23 are 5.3km and 7.8km respectively from the site boundary and given the assumed distance from a jack-up rig within which effects may occur (500m, see Table 2.2), rig installation will not significantly impact the extent and distribution of the qualifying habitat. Block 43/17a has

[51] http://jncc.defra.gov.uk/docs/DoggerBank_AoO_Workbook_v1_0.xlsx

significant areas outside the site boundaries in which rig siting would be possible, and therefore interaction with the habitats of the qualifying features could be avoided. With respect to the remaining Blocks that are within the site, the maximum spatial footprint of physical damage associated with jack-up rig siting is small (0.8km^2) compared to the large site (covering 0.006%), and its offshore location and relatively shallow depth (15-40m) exposes it to substantial wave energy, particularly during storm events which may cause significant natural disturbance of sediments (see Section 5.1.1). Recovery from physical damage of the scale associated with temporary rig placement is expected to be rapid. The small scale and temporary nature of the potential physical damage and the further mitigation measures available (e.g. rig siting to ensure sensitive seabed surface features are avoided, see Section 5.1.3), will ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity.

There may be a requirement for rig stabilisation depending on local seabed conditions. In soft sediments, rock placement may cover existing sediments resulting in a physical change of seabed type. Sandy sediment dominates the site covering approximately 80% of the seabed. This facies forms mobile sand streaks, which comprise a thin veneer actively being transported across the seabed, with mobile sand ripples and small sand waves forming where the seabed sediment is thicker (Diesing *et al.* 2009). Of note is that coarse sediment patches including pebbles and cobbles are present within the site, most of which are relatively small but a few larger patches are present towards its western and southern edges (Diesing *et al.* 2009). The Supplementary Advice on Conservation Objectives (SACO)[52] indicates that some of the sandbank's extent is currently considered to be lost due to the presence of large-scale and widespread infrastructure associated with offshore oil and gas and renewables cabling activities, which have resulted in changes to the substratum of the site thus requiring a restore objective. However, it is likely that if rock placement is required it would be within 500m of a rig and based on a review of submitted ESs it is estimated this could cover an area of 0.001-0.004km^2 (Table 2.2). Hence, the potential loss of extent of sandy sediment is small compared to the predominance of this sediment type across the large site (12,331km^2). Moreover, further mitigation measures are available which include removable mud mats or anti-scour mats as an alternative to rock placement (Section 5.1.3), and will be required, where appropriate, to ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity. As noted in Section 4.2.3, management of the spread of non-native species from vessels and rigs is being progressed through international measures, and the risk is limited by the operational range of rigs on the UKCS.

Drilling discharges

The qualifying feature is sensitive to siltation rate changes, including smothering from drilling discharges, It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2). Therefore with respect to Blocks 43/16 and 43/23 which are beyond this distance or Block 43/17a which has significant areas outside the site boundaries in which drilling will be possible, drilling discharges will not significantly impact the extent and distribution or the structure and function of the qualifying habitat. With respect to other Blocks within the site, the maximum spatial footprint within which smothering by drilling discharges may occur (0.8km^2) is small (representing 0.006% of the total site area) and given the site's exposure to wave energy, redistribution of drilling discharges and recovery from smothering would be rapid. The small scale and temporary nature of potential smothering, and mandatory mitigation requirements with respect to drilling chemical use and discharge (Section 2.3.1) will ensure that site conservation objectives are not undermined.

In-combination effects

Intra-plan in-combination effects are possible although spatial footprints associated with rig installation and drilling discharges in Blocks 43/2, 43/7, 43/8, 43/10, 43/14, 43/15, 44/6, 44/7, 44/8b, 44/9b, 44/11d, 44/12d and 44/12e (i.e. those Blocks entirely or largely within the site) are localised and temporary, and unlikely to overlap between Blocks either spatially or temporally. Given the indicative work programmes, the combined spatial footprint within which physical disturbance and drilling effects could occur (within 500m of the rig/well location) across the 13 Blocks (7 drill or drop wells proposed) is estimated at 5.6km^2 (0.05% of the site). However, the temporary nature of the disturbance, low to moderate sensitivity of the qualifying feature and available mitigation (Sections 2.3.1 and 5.1.3), will ensure that site conservation objectives are not undermined. Section 5.3 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

Doggersbank SAC (Netherlands)

Site information

Area (ha): 473,500
Relevant qualifying features: Sandbanks, grey seal, harbour seal, harbour porpoise

[52] http://jncc.defra.gov.uk/pdf/DoggerBank_SACO_v1_0.pdf

Conservation objectives: For harbour porpoise, grey seal and harbour seal: Maintain extent and quality of habitat in order to maintain population
Relevant Blocks for physical disturbance and drilling effects
44/9b
Assessment of effects on site integrity
Rig siting Block 44/9b is 9.2km from the site boundary and given the assumed distance from a jack-up rig within which effects may occur (500m, see Table 2.2), rig installation will not significantly impact the extent and quality of the sandbank habitat. Therefore rig siting will not adversely affect site integrity. **Drilling discharges** It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2). Therefore with respect to Block 44/9b, drilling discharges will not significantly impact the extent and quality of the sandbank habitat. Therefore drilling discharges will not adversely affect site integrity. **Rig/vessel presence and movement** Whilst harbour porpoise may be sensitive to vessel traffic, the temporary nature of drilling activities and limited number of associated supply vessel trips is unlikely to represent a significant increase in the level of disturbance given that relevant vessels unlikely to cross the site. Therefore rig/vessel presence and movement will not adversely affect site integrity. **In-combination effects** No intra-plan in-combination effects likely given that Block 44/9b is the only Block applied for of relevance to the site. Section 5.3 provides a consideration of potential Block activities in-combination with other relevant plans and projects.
North Norfolk Sandbanks and Saturn Reef SAC
Site information
Area (ha): 360,341 **Relevant qualifying features:** Sandbanks, reefs **Conservation objectives:** For the features to be in favourable condition thus ensuring site integrity in the long term and contribution to Favourable Conservation Status of Annex I Sandbanks which are slightly covered by sea water all of the time and Annex I Reefs. This contribution would be achieved by maintaining or restoring, subject to natural change: • The extent and distribution of the qualifying habitats in the site; • The structure and function of the qualifying habitats in the site; and • The supporting processes on which the qualifying habitats rely
Relevant Blocks for physical disturbance and drilling effects
48/8b, 48/18b, 48/19b, 48/20c, 48/24a, 53/1b
Assessment of effects on site integrity
Rig siting Both the sandbank and reef qualifying features are sensitive to physical damage through disturbance or abrasion[53] by the placement of spud cans as part of rig siting. The dynamic nature of the site causes regular disturbance to the fauna present and species are likely to be well adapted to fluctuations in suspended sediments. Blocks 48/18b and 53/1b are on the site boundary and given the assumed distance from a jack-up rig within which effects may occur (500m, see Table 2.2), interaction with qualifying habitats could be avoided and rig installation will not significantly impact the extent and distribution of the qualifying habitats. With respect to the other Blocks which are partly or wholly within the site, the maximum spatial footprint of physical damage associated with jack-up rig siting is small (0.8km^2) compared to the large site (covering 0.02%). Recovery from physical damage of the scale associated with rig placement is expected to be rapid given the dynamic nature of the site. Moreover, further mitigation measures are available (e.g. rig siting to ensure sensitive seabed surface features are avoided, see Section 5.1.3), and will be required, where appropriate, to ensure that site conservation objectives are not

[53] http://jncc.defra.gov.uk/docs/NNSSR_AoO_Workbook_v1_0.xlsx

undermined and there is no adverse effect on site integrity.

There may be a requirement for rig stabilisation depending on local seabed conditions. The sandbanks and reefs features are considered sensitive to physical change to another habitat type and the SACO[54] notes that the deposition of material (rock) may lead to a persistent change in substrate which is not suitable habitat for characterising sandbank communities. They advise that activities must look to minimise, as far as is practicable, changes in substratum and the biological assemblages within the site to minimise further impact on feature extent and distribution. As indicated by Parry *et al*. (2015), sandy sediment dominates the site covering approximately 80% of the seabed. Of note is that patches of coarse and mixed sediment including pebbles and cobbles are present within the site (see Section 5.1.1). It is likely that if rock placement is required it would be within 500m of a rig and based on a review of submitted ESs it is estimated this could cover an area of 0.001-0.004km^2 (Table 2.2). Hence, the potential loss of extent of sandy sediment is small compared to the predominance of this sediment type across the large site (3,603.4km^2). Moreover, further mitigation measures are available which include removable mud mats or anti-scour mats as an alternative to rock placement (Section 5.1.3) and will be required, where appropriate, to ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity. As noted in Section 4.2.3, management of the spread of non-native species from vessels and rigs is being progressed through international measures, and the risk is limited by the operational range of rigs on the UKCS.

Drilling discharges
The sandbank and reef qualifying features are sensitive to siltation rate changes including smothering from drilling discharges. The SACO also notes that alteration of surface sediment by drill cuttings may lead to a persistent change in substrate which is not suitable habitat for characterising sandbank communities. Blocks 48/18b and 53/1b are on the site boundary and given the assumption that effects relating to drilling discharges occur within 500m of the well location (Table 2.2), interaction with qualifying habitats could be avoided and drilling discharges will not significantly impact the extent and distribution of the qualifying habitats. With respect to the other Blocks which are partly or wholly within the site, the maximum spatial footprint within which smothering by drilling discharges may occur (0.8km^2) is small (representing 0.02% of the total site area) and given the site's dynamic nature, redistribution of drilling discharges and recovery from smothering would be rapid. The small scale and temporary nature of potential smothering, as well as mandatory mitigation requirements with respect to drilling chemical use and discharge (Section 2.3.1), will ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity.

In-combination effects
Intra-plan in-combination effects are possible although spatial footprints associated with rig installation and drilling discharges in Blocks 48/8b, 48/19b, 48/20c and 48/24a (i.e. those Blocks entirely or partly within the site) are localised and temporary, and unlikely to overlap between Blocks either spatially or temporally. Given the indicative work programmes, the combined spatial footprint within which physical disturbance and drilling effects could occur (within 500m of the rig/well location) across the 4 Blocks (2 drill or drop and 1 contingent well proposed) is estimated at 2.4km^2 (0.07% of the site). However, the localised and temporary nature of the disturbance and available mitigation (Sections 2.3.1 and 5.1.3), will ensure that site conservation objectives are not undermined. Section 5.3 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

Humber Estuary SAC

Site information

Area (ha): 36,657.15
Relevant qualifying features: Estuaries, mudflats and sandflats, sandbanks, saltmarsh and salt meadows, coastal lagoons, coastal dunes, river lamprey, sea lamprey, grey seal

Conservation objectives:
With regard to the natural habitats and/or species for which the site has been designated, and subject to natural change;
Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- The extent and distribution of qualifying natural habitats and habitats of qualifying species
- The structure and function (including typical species) of qualifying natural habitats

[54] http://jncc.defra.gov.uk/pdf/NNSSR_SACO_v1_0.pdf

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

Relevant Blocks for physical disturbance and drilling effects

47/7

Assessment of effects on site integrity

Rig siting
Block 47/7 is 7.2km from the site boundary and given the assumed distance from a jack-up rig within which effects may occur (500m, see Table 2.2), rig installation will not significantly impact the extent and distribution of the qualifying habitats within the site. The Block is an area of high grey seal usage (see Section 5.1.1) and rig siting could impact the extent and distribution of supporting habitat. However, the environment off the Holderness coast is highly dynamic, with large volumes of material eroded from the shoreline and seabed and transported southwards. The maximum spatial footprint of physical damage associated with jack-up rig siting is small ($0.8km^2$) and given the environmental conditions, recovery from physical damage of the scale associated with rig placement is expected to be rapid. The small scale and temporary nature of the potential physical damage will ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity.

Drilling discharges
It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2) and therefore drilling discharges will not significantly impact the extent and distribution or the structure and function of the qualifying habitats given the distance of Block 47/7 from the site. With respect to the high grey seal usage of the Block, the maximum spatial footprint within which smothering by drilling discharges may occur ($0.8km^2$) is small and given the environmental conditions, the redistribution of drilling discharges and recovery from smothering would be rapid and would not impact the extent and distribution or structure and function of supporting habitats. The small scale and temporary nature of the potential physical damage, and mandatory mitigation requirements with respect to drilling chemical use and discharge (Section 2.3.1) will ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity.

Rig/vessel presence and movement
The Humber Estuary and adjacent Blocks are currently exposed to very high to high shipping densities[55]. The temporary nature of drilling activities and the limited number of associated supply vessel and helicopter trips is unlikely to significantly increase the potential for disturbance of qualifying features and impact their distribution within the site. The Block is in a mature hydrocarbon basin and helicopters and vessels are expected to use established routes to existing ports. No adverse effect on site integrity expected.

In-combination effects
No intra-plan in-combination effects likely given that Block 47/7 is the only Block applied for of relevance to the site. Section 5.3 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

Inner Dowsing, Race Bank and North Ridge SAC

Site information

Area (ha): 84,514
Relevant qualifying features: Sandbanks, reefs

Conservation objectives:
The site's conservation objectives apply to the site and the individual species and/or assemblage of species for which the site has been classified.
Ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the Favourable Conservation Status of its qualifying features, by maintaining or restoring:

- the extent and distribution of qualifying natural habitats and habitats of the qualifying species
- the structure and function (including typical species) of qualifying natural habitats
- the structure and function of the habitats of the qualifying species
- the supporting processes on which qualifying natural habitats and the habitats of qualifying species rely

55 https://www.ogauthority.co.uk/media/1419/29r_shipping_density_table.pdf

• the populations of qualifying species • the distribution of qualifying species within the site
Relevant Blocks for physical disturbance and drilling effects
47/15c, 48/16
Assessment of effects on site integrity
Rig siting Blocks 47/15c and 48/16 are 10km and 0.5km respectively from the site boundary and given the assumed distance from a jack-up rig within which effects may occur (500m, see Table 2.2), rig installation will not significantly impact the extent and distribution of the qualifying habitats within the site. No adverse effect on site integrity expected. As noted in Section 4.2.3, management of the spread of non-native species from vessels and rigs is being progressed through international measures, and the risk is limited by the operational range of rigs on the UKCS. **Drilling discharges** It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2) and therefore drilling discharges will not significantly impact the extent and distribution or the structure and function of the qualifying habitats given the distance of Blocks 47/15c and 48/16 from the site. No adverse effect on site integrity expected. **In-combination effects** No intra-plan in-combination effects likely given that Blocks 47/15c and 48/16 are located outside of the site boundaries. Section 5.3 provides a consideration of potential Block activities in-combination with other relevant plans and projects.
Haisborough, Hammond and Winterton SAC
Site information
Area (ha): 146,759 **Relevant qualifying features:** Sandbanks, reefs **Conservation objectives:** The site's conservation objectives apply to the site and the individual species and/or assemblage of species for which the site has been classified. Ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the Favourable Conservation Status of its qualifying features, by maintaining or restoring: • the extent and distribution of qualifying natural habitats and habitats of the qualifying species • the structure and function (including typical species) of qualifying natural habitats • the structure and function of the habitats of the qualifying species • the supporting processes on which qualifying natural habitats and the habitats of qualifying species rely • the populations of qualifying species • the distribution of qualifying species within the site
Relevant Blocks for physical disturbance and drilling effects
53/1b, 53/8, 53/13
Assessment of effects on site integrity
Rig siting Blocks 53/8 and 53/13 are 6.3km from the site boundary and given the assumed distance from a jack-up rig within which effects may occur (500m, see Table 2.2), rig installation will not significantly impact the extent and distribution of the qualifying habitat. With respect to Block 53/1b which is largely within the site, the maximum spatial footprint of physical damage associated with jack-up rig siting is small (0.8km^2) compared to the large site (covering 0.05%). The sandbanks and reefs features are sensitive to abrasion/disturbance on the seabed surface and subsurface. The SACO[56] indicates that pipelines present within the site and fisheries using bottom-towed gear may have impacted the extent and distribution of qualifying natural habitats thus requiring a restore

56 https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK0030369&SiteName=haisborough&SiteNameDisplay=Haisborough%2c+Hammond+and+Winterton+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=

objective. However, recovery from physical damage of the scale associated with rig placement is expected to be rapid given the dynamic nature of the site. Moreover, further mitigation measures are available (e.g. rig siting to ensure sensitive seabed surface features are avoided, see Section 5.1.3) and will be required, where appropriate to ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity.

There may be a requirement for rig stabilisation depending on local seabed conditions. The sandbanks and reefs features are considered sensitive to physical change to another sediment type[57]. However, it is likely that if rock placement is required it would be within 500m of a rig and based on a review of submitted ESs it is estimated this could cover an area of 0.001-0.004km^2 (Table 2.2). Hence, the potential loss of extent of sandy sediment is small. Moreover, further mitigation measures are available which include removable mud mats or anti-scour mats as an alternative to rock placement (Section 5.1.3), and will be required, where appropriate, to ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity. As noted in Section 4.2.3, management of the spread of non-native species from vessels and rigs is being progressed through international measures, and the risk is limited by the operational range of rigs on the UKCS.

Drilling discharges
The reefs and sandbanks features are sensitive to the discharge of drill cuttings and water-based fluids which may cause some smothering in the near vicinity of the well location. However, the impacts from such discharges are localised and transient. It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2) and therefore drilling discharges will not significantly impact the extent and distribution or the structure and function of the qualifying habitats given the distance of Blocks 53/8 and 53/13 from the site. With respect to Block 53/1b which is largely within the site, the maximum spatial footprint within which smothering by drilling discharges may occur (0.8km^2) is small (representing 0.05% of the total site area) and given the dynamic nature of the site, redistribution of drilling discharges and recovery from smothering would be rapid. The small scale and temporary nature of potential smothering, and mandatory mitigation requirements with respect to drilling chemical use and discharge (Section 2.3.1) will ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity.

In-combination effects
No intra-plan in-combination effects are likely with respect to the spatial footprints associated with rig siting and drilling discharges given that Block 53/1b is the only one that transects the site. Section 5.3 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

5.1.3 Further mitigation measures

Further mitigation measures are available which are identified through the EIA process and operator's environmental management and the BEIS permitting processes. These considerations are informed by project specific plans and the nature of the sensitivities identified from detailed seabed information collected in advance of field activities taking place. Site surveys are required to be undertaken before drilling rig placement (for safety and environmental reasons) and the results of such surveys (survey reports) allow for the identification of further mitigation including the re-siting of activities (e.g. wellhead or rig leg positions) to ensure sensitive seabed surface features (such as reefs) are avoided and potential rig stabilisation issues (e.g. from scouring around spud cans, or soft sediment conditions) are minimised. Where rig stabilisation is required, BEIS will expect operators to provide adequate justification for the stabilisation option proposed, minimise the volume of rock deposited[58] or consider utilising systems (e.g. anti-scour mats, mud mats) that can be removed

[57] https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK0030369&SiteName=haisborough&countyCode=&responsiblePerson=&unitId=&SeaArea=&IFCAArea=

[58] This will be informed by a BEIS study currently underway comparing rock volumes estimated in operator applications with those actually used (from returns) which will report later this year.

following drilling. For those Blocks where proposed activities could result in the physical disturbance of overwintering divers or marine mammals by vessels and aircraft traffic, available mitigation measures include strict use of existing shipping and aircraft routes, and timing controls on temporary activities to avoid sensitive periods.

Survey reports are used to underpin operator environmental submissions (e.g. EIAs) and where requested, survey reports are made available to nature conservation bodies during the consultation phases of these assessments[59].

In all instances, consent for project-level activities will not be granted unless the operator can demonstrate that the proposed exploration activities will not have an adverse effect on the integrity of relevant sites. The information provided by operators in their applications must be detailed enough for BEIS (and its advisors) to make a decision on whether the activities could lead to a likely significant effect.

5.1.4 Conclusions

Likely significant effects identified with regards to physical damage to the seabed, drilling discharges and other effects (see Section 5.1.2) when considered along with project level mitigation (Section 5.1.3) and relevant activity permitting (see Sections 2.3.1 and 5.1.3), will not have an adverse effect on the integrity of the Natura 2000 sites considered in this assessment. There is a legal framework through the implementation of the EIA Regulations and the Habitats Directive, to ensure that there are no adverse effects on the integrity of Natura 2000 sites. These would be applied at the project level, at which point there will be sufficient definition to make an assessment of likely significant effects, and for applicants to propose project specific mitigation measures.

Taking into account the information presented above, it is concluded that activities arising from the licensing of those Blocks listed in Table 5.1, in so far as they may generate physical disturbance and drilling effects, will not cause an adverse effect on the integrity of the relevant sites identified. Consent for activities will not be granted unless the operator can demonstrate that the proposed activities which may include the drilling of a number of wells and any related activity including the placement of a drilling rig, will not have an adverse effect on the integrity of relevant sites.

[59] Whether within or outside an SAC, rig site survey typically includes a consideration of the presence of, amongst other sensitivities, Annex I habitats.

5.2 Assessment of underwater noise effects

5.2.1 Blocks and sites to be assessed

The nature and extent of potential underwater noise effects are summarised in Section 4.3. On the basis of this information, in conjunction with the location of Blocks applied for in the 30th Round and the location of sites with relevant qualifying features, potential likely significant effects are considered to remain for 47 Blocks (or part Blocks), in respect of six sites (Figure 5.2). Descriptions of the six sites and their qualifying features, which are also assessed for physical and drilling effects, are provided earlier in Section 5.1.1. Qualifying features of relevance to underwater noise effects are noted below in Table 5.2.

5.2.2 Implications for site integrity of relevant sites

The site conservation objectives and other relevant information relating to site selection and advice on operations has been considered against indicative Block work programmes (see Section 2.2.1) to determine whether they could adversely affect site integrity, i.e. impacts the site features, either directly or indirectly, and result in disruption or harm to the ecological structure and functioning of the site and/or affects the ability of the site to meet its conservation objectives. The results are given in Table 5.2 below. In terms of mitigation, all mandatory requirements (as given in Section 2.3.2) are assumed to be in place as a standard for all activities assessed at this stage.

Importantly, the work programmes do not propose to shoot new 2D or 3D seismic survey within any of the southern North Sea Blocks offered in the 30th Round. Therefore, the assessment is focussed on potential underwater noise impacts associated with rig site survey, VSP and conductor piling (as described in Section 4.3).

Figure 5.2: Sites and Blocks to be subject to further assessment for underwater noise effects

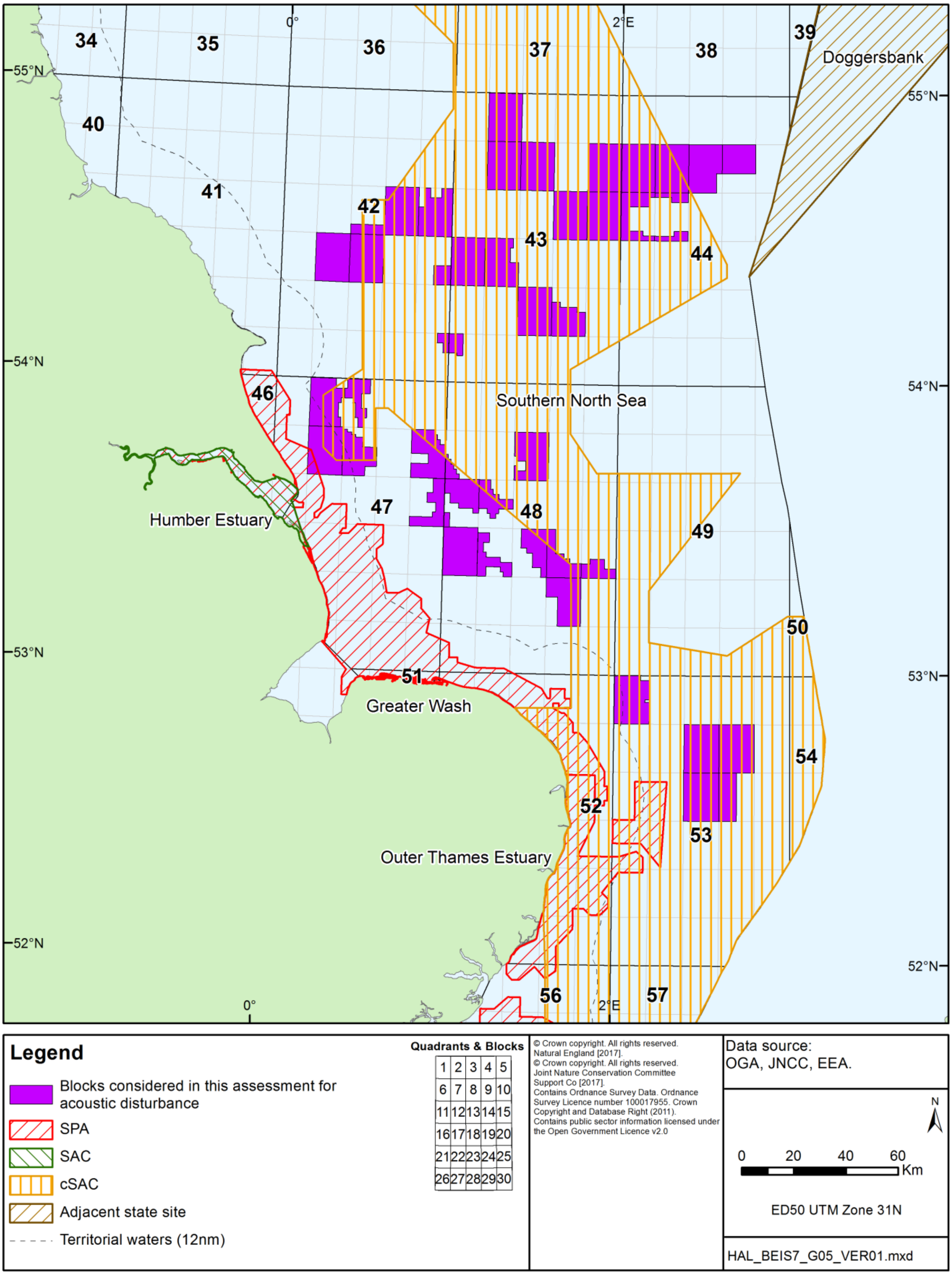


Table 5.2: Consideration of potential underwater noise effects and relevant site conservation objectives

Humber Estuary SPA
Site information
Area (ha): 37,630 **Relevant qualifying features:** Overwintering waterfowl assemblage, including diving ducks: scaup and goldeneye. See further details in Table 5.1 above. **Conservation objectives:** See Table 5.1 above.
Relevant Blocks for underwater noise effects
47/7
Assessment of effects on site integrity
Rig site survey and VSP Block 47/7 lies 5km off the east English coast, and a minimum of 7km north-east of the Humber Estuary SPA, During winter months, the site regularly supports some 150,000 individual waterbirds, comprising 26 species which include two diving ducks: scaup and goldeneye. The winter distributions of these two species are largely limited to estuaries and sheltered coastal waterbodies, such as those encompassed by the boundaries of the SPA, and these species associated with the site are therefore unlikely to be present in the open coastal/offshore waters of Block 47/7. Given the distribution of the scaup and goldeneye qualifying features within the site and adjacent waters relative to the Block, and the amplitude and likely propagation of noise from rig site survey and/or VSP, the likelihood of behavioural disturbance of the qualifying features to underwater noise is considered extremely remote. Should they occur, any such effects will be of limited spatial extent and short duration, and would therefore not represent an adverse effect on site integrity. **Conductor piling** The impulsive underwater noise produced should conductors need to be piled into the seabed is of significantly lower magnitude than that generated in the piling of offshore wind turbine monopile foundations (see Table 2.2). Considering the noise source characteristics, the location of the Block, the short duration of the activity, and the occasional use of this technique to meet technical requirements; when combined with mandatory mitigation measures (Section 2.3.2), disturbance to sensitive features (diving ducks) within the site is considered unlikely and will not result in an adverse effect on site integrity. **In-combination effects** No intra-plan in-combination underwater noise effects are likely given that Block 47/7 is the only Block applied for of relevance to the site. Section 5.3 provides a consideration of potential Block activities in-combination with other relevant plans and projects
Greater Wash SPA
Site information
Area (ha): 353,577.86 **Relevant qualifying features:** Overwintering red-throated diver and common scoter. See further details in Table 5.1 above. **Conservation objectives:** See Table 5.1 above.
Relevant Blocks for underwater noise effects
47/2d, 47/7, 47/8f, 47/15c, 48/16, 53/1b
Assessment of effects on site integrity
Rig site survey and VSP The southwest corner of Block 47/7 overlaps the site; all other Blocks are ≥8km distant to site boundary. While red-throated diver are widespread in the site, surveys suggest that common scoter are concentrated off the mouth of The Wash and a small area around Winterton-on-Sea (Lawson *et al*. 2016), which are all >15km from relevant Blocks. Given the distribution of the relevant qualifying features within the site relative to the Block, and the amplitude and likely propagation of noise from rig site survey and/or VSP, the likelihood of significant behavioural disturbance of the qualifying features or their prey species to underwater noise is considered extremely remote. Should they occur, any such effects will be of limited spatial extent and short duration, and would therefore not represent an adverse effect on site integrity. **Conductor piling** The impulsive underwater noise produced should conductors need to be piled into the seabed is of significantly lower magnitude than that generated in the piling of offshore wind turbine monopile foundations (see Table 2.2).

Considering the noise source characteristics, the location of the majority of the Blocks (and the potential to site rigs away from the site in Block 47/7), the short duration of the activity, and the occasional use of this technique to meet technical requirements; when combined with mandatory mitigation measures (Section 2.3.2), any disturbance to overwintering divers within the site will be highly localised, short-term, and will not result in an adverse effect on site integrity.

In-combination effects
Intra-plan in-combination underwater noise effects are considered highly unlikely given the low potential for effects identified above and that Block 47/7 is the only Block applied for of relevance which partially overlaps the site, with the remaining five Blocks of relevance all ≥8km distant to site boundary. Section 5.3 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

Outer Thames Estuary SPA

Site information

Area (ha): 392,451
Relevant qualifying features: Overwintering red-throated diver. See further details in Table 5.1 above.
Conservation objectives: See Table 5.1 above.

Relevant Blocks underwater noise effects

53/8, 53/13

Assessment of effects on site integrity

Rig site survey and VSP
Blocks 53/8 and 53/13 are ≥ 6km distant to the easternmost boundary of the site. Given the location of the site relative to the Blocks, and the amplitude and likely propagation of noise from rig site survey and/or VSP, the likelihood of significant behavioural disturbance of the red-throated diver qualifying feature and its prey species by underwater noise is considered extremely remote. As such, there will be no adverse effects on site integrity.

Conductor piling
The impulsive underwater noise produced should conductor pipes need to be piled into the seabed is of significantly lower magnitude than that generated in the piling of offshore wind turbine monopile foundations (see Table 2.2). Considering the noise source characteristics, the location of the Blocks, the short duration of the activity, and the occasional use of this technique to meet technical requirements; when combined with mandatory mitigation measures (Section 2.3.2), disturbance to overwintering divers within the site is considered unlikely, and will not result in an adverse effect on site integrity.

In-combination effects
Intra-plan in-combination underwater noise effects are considered highly unlikely given that low potential for effects identified above, and that only two Blocks applied for are of relevance to the site for acoustic disturbance. Section 5.3 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

Southern North Sea cSAC

Site information

Area (ha): 3,695,054
Relevant qualifying features: Harbour porpoise.
Conservation objectives: See Table 5.1 above.

Relevant Blocks for underwater noise effects

42/13b, 42/14, 42/15b, 42/17, 42/18, 42/20a, 42/30d, 43/2, 43/7, 43/8, 43/10, 43/14, 43/15, 43/16, 43/17a, 43/23, 43/24b, 43/26c, 44/6, 44/7, 44/8b 44/9b 44/11d, 44/12d, 44/12e, 47/2d, 47/3f, 47/7, 47/8f, 47/10d, 47/15c, 48/6d, 48/8b, 48/11c, 48/11d, 48/12b, 48/16, 48/17d, 48/18b, 48/19b, 48/20c, 48/24a, 53/1b, 53/8, 53/9, 53/13, 53/14b

Assessment of effects on site integrity

Rig site survey and VSP
For 2D and 3D seismic surveys, individuals within 10km of airgun arrays are expected to be affected, through displacement and reduced foraging opportunities. In the case of rig site survey and VSP noise, the effects radius could reasonably be expected to be smaller, of the order of 5-10km, given the lower amplitude source. Harbour porpoises are known to be able to travel over large distances (>20km) within a day and given the current understanding of harbour porpoise distribution and abundance across the North Sea, there is no evidence to suggest that areas where individuals may be displaced into would be of significantly lower quality. Based on the temporal and spatial scale of the activity (Table 2.2), the likelihood that these activities take place (e.g. for some Blocks, no VSP may be necessary), and the application of mandatory mitigation at the project level (see Section 2.3.2), as well as further mitigation measures if required (see Section 5.2.3), rig site surveys and VSP will not

result in an adverse effect on site integrity. Negative indirect effects of rig site survey and VSP activities on harbour porpoise may potentially arise through effects on prey species, primarily small fish, if those prey are subject to injury or disturbance which reduce their availability to harbour porpoise. While there is evidence that a reduction in catches of some fish species can be associated with seismic survey activity, these are temporary in nature. Any such effects associated with VSP or rig site survey are expected to be minor, considering their shorter duration, smaller spatial extent and lower amplitude source relative to the 2D and 3D seismic surveys (to which most reported effects relate). Additionally, the disturbance of sensitive spawning periods for potential fish prey species will be considered through the activity consenting process. Consequently, any underwater noise effects on fish associated with the licensing of relevant Blocks are not anticipated to result in significant effects on the food resources of the harbour porpoise **Conductor piling** The impulsive underwater noise produced should conductors need to be piled into the seabed is of significantly lower magnitude than that generated in the piling of offshore wind turbine monopile foundations (see Table 2.2). Considering the noise source characteristics, the short duration of the activity, and the occasional use of this technique to meet technical requirements; when combined with mandatory mitigation measures (Section 2.3.2), disturbance to harbour porpoise within the site will be highly localised, short-term, and will not result in an adverse effect on site integrity. **In-combination effects** Given our current understanding of the site and its feature being in favourable condition, having taken into consideration current and past activity, and considering the likely disturbance footprint of rig site surveys and VSP, even a worst-case scenario of multiple concurrent or back-to-back surveys such activities are not expected to result in adverse effect on site integrity. For comparison, the number of 3D seismic surveys undertaken within or adjacent to this cSAC between 2001 and 2015 has ranged between zero and six surveys per year (cumulative coverage of approximately 18,531km^2 over 34 surveys). The greatest survey coverage during this period was in 2013, within which an area of up to 7,682km^2 was shot across six surveys. Additionally, 2D surveys have also been conducted but comparable information on area or duration is not readily available. Section 5.3 provides a consideration of potential Block activities in-combination with other relevant plans and projects
Doggersbank SAC (Netherlands)
Site information
Area (ha): 473,992 **Relevant qualifying features:** Grey seal, harbour seal, harbour porpoise. See further details in Table 5.1 above. **Conservation objectives:** See Table 5.1 above.
Relevant Blocks for underwater noise effects
44/9b
Assessment of effects on site integrity
Rig site survey and VSP Block 44/9b lies 9km west of the Doggersbank SAC, and therefore there would be very limited propagation of noise from activities such as rig site surveys and VSP into the site. For these activities, which would generate the highest amplitude noise of any activities associated with the proposed work programme, a conservative estimate of the likely effects on qualifying features is considered to be short-term and temporary displacement of harbour porpoise and, to a lesser extent, seals, from the periphery of the site. Such effects would be likely to last for the duration of the activity (several hours), with evidence suggesting a return to baseline animal distribution and activity within a matter of hours of the noise-generating activity ceasing, even in the case of louder noise sources than site survey or VSP. As such, no adverse effects on the integrity of the site are expected. Negative indirect effects of rig site survey and VSP activities on the qualifying features may potentially arise through effects on prey species, primarily small fish, if those prey are subject to injury or disturbance which reduce their availability to seals and harbour porpoise. While there is evidence that a reduction in catches of some fish species can be associated with seismic survey activity, these are temporary in nature. Furthermore, evidence suggests that sandeels (a key prey species of marine mammals in the Dogger Bank area) have a low sensitivity to low frequency noise. Any such effects associated with VSP or rig site survey are expected to be minor, considering their shorter duration, smaller spatial extent and lower amplitude source relative to the 2D and 3D seismic surveys (to which most reported effects relate). Additionally, the disturbance of sensitive spawning periods for potential fish prey species will be considered through the activity consenting process. Consequently, any underwater noise effects on fish associated with the licensing of relevant Blocks are not anticipated to result in significant effects on the food resources of the qualifying features.

Conductor piling
The impulsive underwater noise produced should conductor pipes need to be piled into the seabed is of significantly lower magnitude than that generated in the piling of offshore wind turbine monopile foundations (see Table 2.2). Considering the noise source characteristics, the location of the Block, the short duration of the activity, and the occasional use of this technique to meet technical requirement; when combined with mandatory mitigation measures (Section 2.3.2), disturbance to harbour porpoise within the site will be highly localised, short-term, and will not result in an adverse effect on site integrity.

In-combination effects
No intra-plan in-combination underwater noise effects are likely given that Block 44/9b is the only Block applied for of relevance to the site. Section 5.3 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

Humber Estuary SAC
Site information
Area (ha): 36,657 **Relevant qualifying features:** River lamprey, sea lamprey, grey seal. See further details in Table 5.1 above. **Conservation objectives:** See Table 5.1 above.
Relevant Blocks for underwater noise effects
47/7
Assessment of effects on site integrity

Rig site survey and VSP
At its closest point to shore, Block 47/7 lies 5km off the English coast, 7km northeast of the boundary of the Humber Estuary SAC, and approximately 20km north of the grey seal colony at Donna Nook. At-sea distribution modelling suggests that Block 47/7 is outwith the areas of highest grey seal density occurring around the mouth of the Humber Estuary, and also the higher density offshore areas to the north-east. Model-predicted densities within Block 47/7 range between 0.5 and 1.5 seals per km^2. Considering the distance of Block 47/7 from the site and location of the breeding colony at Donna Nook, there would be very limited propagation of noise from activities such as rig site surveys and VSP into the site and areas of greatest importance for seals. For these activities, a conservative estimate of the likely effects on qualifying features is considered to be short-term and temporary displacement of grey seals within 5-10km of the activities, which may affect the northern periphery of the site and seals associated with the site while located outside of the site boundaries. Such effects would be likely to last for the duration of the activity (several hours), with evidence suggesting a return to baseline animal distribution and activity within a matter of hours of the noise-generating activity ceasing, even in the case of louder noise sources such as high energy impact piling of wind turbine foundations (e.g. Russell *et al*. 2016). As such, no adverse effects on the integrity of the site are expected.

Both river and sea lamprey utilise marine habitats for feeding prior to returning to freshwater to spawn; however, their distribution in marine habitats is largely restricted to estuaries and nearshore coastal waters (Silva *et al.* 2014), with designated UK sites considered to provide an important migration route (to spawning rivers) and/or feeding grounds. Considering the location of the Block relative to the site and distribution of the lamprey qualifying features, adverse effects on site integrity due to underwater noise is not expected.

Negative indirect effects of rig site survey and VSP activities on grey seal may arise through effects on prey species, primarily small fish, if those prey are subject to injury or disturbance which reduce their availability to the qualifying feature. While there is evidence that a reduction in catches of some fish species can be associated with seismic survey activity, these are temporary in nature. Furthermore, evidence suggest that sandeels (a key prey species of grey seals in the southern North Sea) have a low sensitivity to low frequency noise. Any such effects associated with VSP or rig site survey are expected to be minor, considering their shorter duration, smaller spatial extent and lower amplitude source relative to the 2D and 3D seismic surveys (to which most reported effects relate). Additionally, the disturbance of sensitive spawning periods for potential fish prey species will be considered through the activity consenting process. Consequently, any underwater noise effects on fish associated with the licensing of relevant Blocks are not anticipated to result in significant effects on the food resources of the grey seal qualifying features.

Conductor piling
The impulsive underwater noise produced should conductor pipes need to be piled into the seabed is of significantly lower magnitude than that generated in the piling of offshore wind turbine monopile foundations (see Table 2.2). Considering the noise source characteristics, the short duration of the activity, and the occasional use of this technique to meet the technical requirements; when combined with mandatory mitigation measures (Section 2.3.2), disturbance to the grey seal or lamprey qualifying features within the site will be highly localised,

short-term, and will not result in an adverse effect on site integrity.

In-combination effects
No intra-plan in-combination underwater noise effects are likely given that Block 47/7 is the only Block applied for of relevance to the site. Section 5.3 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

5.2.3 Further mitigation measures

BEIS require operators to provide sufficient information in the EIA on the potential impact of proposed activities on relevant sites and their qualifying features as well as proposed further mitigation measures in their applications for a Geological Survey consent, though it should be noted that no seismic survey has been proposed in any of the southern North Sea Block work programmes. The information provided by operators must be detailed enough for BEIS to make a decision on whether the activities could lead to a likely significant effect, and whether the activities should therefore be subject to the requirement for HRA. Depending on the nature and scale of the proposed activities (e.g. area of survey, source size, timing and proposed mitigation measures) and whether likely effects are identified for these, BEIS may undertake further HRA to assess the potential for adverse effects on the integrity of sites at the activity specific level. As part of consent condition, operators would be required to follow the JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys.

Consent for project-level activities will not be granted unless the operator can demonstrate that the proposed activities, which may include small-scale geophysical rig site survey, VSP and drilling (which may incorporate conductor piling), will not have an adverse effect on the integrity of relevant sites.

The planning of underwater noise-generating activities should minimise exposure of qualifying features to underwater noise by consideration of the timing with respect to 1) seasonal differences in the distribution of the harbour porpoise across the Southern North Sea cSAC and across the wider southern North Sea and 2) the presence of other underwater noise-generating activities (i.e. other geophysical surveys and impact piling). It is advised that the licensees of the 47 Blocks of relevance for underwater noise effects on the Southern North Sea cSAC (listed in Table 5.2) establish early discussions with BEIS and also the leaseholders of OWF areas, to understand the nature and timing of proposed activities such that significant in-combination effects can be avoided (see Section 5.3). Early consultation of the relevant SNCBs in this regard will also be an advantage.

5.2.4 Conclusion

The risks of injury and disturbance to relevant qualifying features is limited both by the nature of the indicative work programmes for the Blocks applied for and controls currently in place, such that it is concluded that activities arising from the licensing of those Blocks listed in Table 5.2, in so far as they may generate underwater noise effects, will not cause an adverse effect on the integrity of the relevant sites identified. Consent for project specific activities will not be granted unless the operator can demonstrate that the proposed activities which may include rig site survey, VSP or conductor piling, will not have an adverse effect on the integrity of relevant sites. These activities may be subject to activity level EIA and where appropriate, HRA.

5.3 In-combination effects

5.3.1 Introduction

Potential incremental, cumulative, synergistic and secondary effects from a range of operations, discharges and emissions (including noise) were considered in the latest Offshore Energy SEA (DECC 2016; see also OSPAR 2000, 2010[60]). There are a number of potential interactions between activities that may follow licensing and those existing or planned activities in the southern North Sea, for instance in relation to renewable energy, fishing, shipping and aggregate extraction. These activities are subject to individual permitting or consenting mechanisms, or are otherwise managed at a national or international level. In English waters the North East Marine Plans are in preparation and will complement the first Marine Plans (East Inshore and East Offshore) published in June 2014 to set out objectives and policies to guide development in the southern North Sea over a 20-year period.

The potential for effects in-combination with other plans or projects was considered and a number of sites were highlighted in Sections 5.1 and 5.2 for which there is the potential for intra-plan in-combination effects (i.e. that multiple Blocks have the potential to be licensed within the same site).

5.3.2 Sources of potential effect

Table 5.3 and Figures 5.3-5.4 highlight projects which have recently been granted consent, or which are currently the subject of an application for consent, and have the potential to interact with operations that could arise from 30th Round Block licensing. Interactions were identified on the basis of the nature and location of the proposed activities, using a combination of documents submitted as part of project applications and related spatial datasets in a Geographic Information System (GIS). Additionally, potential interactions with existing activities are considered including those associated with oil and gas, shipping, military practice and exercise and fisheries.

The principal sources of in-combination effects are regarded to be related to noise, physical disturbance, and physical presence, primarily arising from offshore wind development. OWF development will introduce noise and disturbance sources (particularly during construction) and present an additional physical presence in the marine environment. Offshore wind zones (e.g. Round 3) have already been subject to SEA and HRA, and any related projects have been or will be subject to their own individual assessment and HRA processes[61]. Figure 5.3 indicates the location of wind farms/wind farm zones in relation to the Blocks subject to this assessment and relevant Natura 2000 sites.

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[60] Note that an intermediate assessment was published by OSPAR in 2017: https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/

[61] For those sites having already been subject to HRA, note that the competent authority is under an obligation to reconsider and review consents for projects that are likely to have a significant effect on new SAC and SPA sites once they become a candidate site. Consultations on the review of consents for offshore wind farms in relation to the Southern North Sea cSAC is underway, with consultation on an HRA exercise due to commence in February 2018, and conclude later in the year. See: https://itportal.beis.gov.uk/EIP/pages/ola.htm

The UK Government believes that the oil & gas and the renewables industry can successfully co-exist, as stated in OGA's Other Regulatory Issues for the 30th Round, "…*we [(OGA)] advise that potential applicants on such blocks [(areas where oil and gas licenses and proposed or actual wind farm sites exist and indeed overlap)] should make early contact with the holders of any relevant wind farm lease or Agreement for lease (AfL), or the relevant zone developer(s), and establish in good time a mutual understanding of the respective proposals and time frames envisaged (acknowledging that not all aspects of the future plans of either side will necessarily be definitively decided at that time)*"[62]. Early discussions between the developers will ensure that any potential conflict can be mitigated so that both developments can proceed with minimal delay and without the need to determine any part of an existing Crown Estate Lease or Agreement for Lease. In addition to renewables activities, early engagement with other users (e.g. through fisheries liaison, vessel traffic surveys, consultation with the MoD or holders of other Crown Estate offshore interests)[63] where scheduling overlaps may occur should allow both for developer cooperation, and the mitigation of potential cumulative or in-combination effects.

This is also reflected in the East Inshore and East Offshore Marine Plans (paragraph 295) which state "*Future oil and gas activity has the potential to require access to the same area of seabed as other activities. In most cases, the consequence of this will be insignificant due to the small footprint of oil and gas production infrastructure. In some cases this may not be the case, such as where another user of the sea bed has a lease in place. Where a lease has been agreed for a co-located activity, there may be a requirement for negotiation between parties involved*." and is supported in plan policies such as GOV2 and GOV3, which respectively promote the maximisation of activity co-existence, and the demonstration that activity displacement will be avoided, minimised or mitigated. Policies for the other marine plan areas of relevance to the southern North Sea Blocks (North East Inshore and Offshore) are yet to be drafted, but may be expected to be consistent with those of the East Marine Plans.

Table 5.3: Projects relevant to the in-combination effects assessment

Relevant projects	Project summary	Project status/indicative timing	Relevant sites[1]
Offshore Renewables			
Dogger Bank Creyke Beck A Dogger Bank Creyke Beck B	Located approximately 131km offshore, these two wind farms will collectively contain up to 400 turbines with a total capacity of up to 2,400MW. The turbines may be fixed to the seabed using monopile, jacket or gravity base foundations. Additionally, collector and converter stations will be required offshore. Export cables will have their landfall on the coast of the East Riding of Yorkshire.	Consented. Installation expected from 2020.	Dogger Bank SCI, Southern North Sea cSAC
Dogger Bank Teesside A	Located approximately 165-196km offshore, these two wind farms will collectively contain up to 400 turbines	Consented. Installation	Dogger Bank SAC

62 OGA 30th Round Other Regulatory Issues
63 https://www.ogauthority.co.uk/licensing-consents/overview/the-crown-estate-interests/

Relevant projects	Project summary	Project status/indicative timing	Relevant sites[1]
Dogger Bank Teesside B	with a total capacity of up to 2,400MW. The turbines may be fixed to the seabed using monopile, jacket or gravity base foundations. Additionally, collector and converter stations will be required offshore. Export cables will have their landfall on the Teesside coastline.	expected from 2023.	Dogger Bank SAC, Southern North Sea cSAC
Hornsea Project One	Located approximately 100km to the east of the Yorkshire coast, Hornsea Project One is made up of the Heron and Njord wind farm areas, with a total capacity of up to 1,218MW delivered from between 152 and 203 turbines depending on the capacity of the generators installed. Foundations may be monopile, jacket, gravity base or mono-suction caisson types. The export cable route travels to the south west and has its landfall at Horse Shoe Point to the south of Grimsby. Cable installation methods potentially include jetting, ploughing, trenching, rock-cutting, surface laying with protection depending on ground conditions.	Onshore construction has commenced. Offshore construction expected in 2018, and operation from 2020.	Southern North Sea cSAC
Hornsea Project Two	The wind farm has a proposed capacity of 1,800MW generated by up to 300 wind turbines located approximately 90km to the east of the Yorkshire coast. The turbines may be fixed to the seabed using monopile, jacket or gravity base foundations. The export cable route shares that of Project One.	Consented. Installation expected from 2020.	Southern North Sea cSAC
Hornsea Project Three[2]	The wind farm is at a pre-application stage, though is expected to have a capacity of up to 2,400MW generated by 300 turbines using fixed foundations. It is expected that up to 6 cables will take power ashore in a corridor extending from the south west corner of the zone to a landfall on the North Norfolk Coast.	Pre-application. Expected to apply in May 2018.	Southern North Sea cSAC, North Norfolk Sandbanks and Saturn Reef SAC
Triton Knoll	Located approximately 30km offshore, it is proposed that the wind farm have a capacity of up to 900MW generated by turbines using fixed foundations (one of monopile, jacket, tripod, suction bucket monopod or gravity base foundation).	Consented. Final investment decision expected in 2018.	Inner Dowsing, Race Bank and North Ridge SAC
East Anglia North Tranche One West (Norfolk Vanguard West and East)	The Vanguard wind farm is split between two areas, at a minimum distance of 47km from the coast, and has a proposed capacity of up to 1.8GW. Up to six cables will take power ashore, and the landfall study area encompassing Bacton Green to Eccles-on-Sea.	Pre-application. Expected to apply Q2 2018.	Southern North Sea cSAC, North Norfolk Sandbanks and Saturn Reef SAC
East Anglia North Tranche 2 (Norfolk Boreas)	The proposed wind farm is located 72km offshore and will have an installed capacity of up to 1.8GW. Rated capacities of turbines will be kept open in view of developments during planning, but may be between 7GW and 20GW. Both fixed and floating foundations are being considered. Up to six cables will take power ashore at one of three areas: Bacton Green, Walcott Gap or Happisburgh South.	Pre-application. Expected to apply Q2 2019	Southern North Sea cSAC
East Anglia Three	The wind farm was given development consent in August 2017, and is proposed to consist of up to 172 turbines with a capacity of up to 1200MW, at a location approximately 69km offshore. Power will be exported to shore via up to four cables, making landfall at Bawdsey, Suffolk.	Consented. Offshore construction expected Q4 2021.	Southern North Sea cSAC

Relevant projects	Project summary	Project status/indicative timing	Relevant sites[1]
East Anglia One North	The wind farm area is located approximately 36km offshore, and is presently proposed to contain up to 115 turbines with an overall installed capacity of 600-800MW.	Pre-application. Expected to apply in 2020.	Southern North Sea cSAC
Oil & gas projects			
Sillimanite gas condensate field	Located in Block 44/19a, an exploration well relating to the field was drilled in July 2015, but no further details are available on the timing or nature of any development.	Exploration	Dogger Bank SCI, Southern North Sea cSAC
Audrey field[3]	The Audrey A and B platforms are located in Blocks 49/11a and 48/15a respectively, and a subsea well (11a-7) is tied back to Audrey A. The platforms will be removed and returned to shore for re-use and recycling. Pipelines will be partially removed.	Activity may take place between Q3 2018 and Q3 2023.	Southern North Sea cSAC, North Norfolk Sandbanks and Saturn Reef SAC
Saturn (Annabel) Field[3]	Located in Block 48/10a, the Annabel field infrastructure to be decommissioned include two subsea wellhead protection structures (AB1 and AB2), a subsea manifold and related pipelines/umbilicals. Subsea structures are to be removed and returned to shore for re-use or recycling, and pipelines are to be partially removed.	Activity may take place between Q3 2018 and Q2 2022.	Southern North Sea cSAC, North Norfolk Sandbanks and Saturn Reef SAC
Ann and Alison fields[3]	Located in Blocks 49/6a (Ann) and 49/11a (Alison), the infrastructure to be decommissioned includes subsea wellheads and related pipelines/umbilicals. Subsea structures are to be removed and returned to shore for re-use or recycling, and pipelines are to be partially removed.	Activity expected between Q3 2017 and Q2 2023.	Southern North Sea cSAC, North Norfolk Sandbanks and Saturn Reef SAC
LOGGS Satellites Vulcan UR, Viscount VO, Vampire OD	The LOGGS satellite platforms to be decommissioned as part of this project are located in Blocks 48/25b (the Vulcan UR) and 49/16a (Viscount VO, Vampire OD). All platforms are to be removed to shore for recycling or disposal. Associated pipelines are to be left *in situ*.	Removal due to take place Q1 2018-Q3 2021.	Southern North Sea cSAC, North Norfolk Sandbanks and Saturn Reef SAC
Viking platforms	The Viking platforms to be decommissioned as part of this project are located in Blocks 49/17a (Viking CD, DD, GD and HD) and 49/16a (ED). All platforms are to be removed to shore for recycling or disposal. Associated pipelines are to be left *in situ*.	Platforms expected to be decommissioned 2017-2018, and pipelines 2018-2019.	Southern North Sea cSAC, North Norfolk Sandbanks and Saturn Reef SAC
Aggregate areas			
Aggregates production areas 515/1 and 515/2	These areas are licensed for the extraction of marine aggregates. As part of the wider Humber region, 18.72km² were actively dredged in 2016, representing 7.93% of the total licenced area, with 90% of effort in 8.49km². Dredging intensity over these areas is considered to be low to moderate.	Active production areas	Southern North Sea cSAC, Inner Dowsing, Race Bank and North Ridge SAC
Aggregates production areas 514/1, 2, 3, 4		Active production areas	Southern North Sea cSAC

Sources: RenewableUK (2017), relevant Development Consent Orders and related post-consent modifications (https://infrastructure.planninginspectorate.gov.uk/ – accessed 7/12/2017), OGA Project Pathfinder current list of projects (https://itportal.decc.gov.uk/pathfinder/currentprojectsindex.html – accessed 05/12/2017), BEIS Oil & gas: decommissioning of offshore installations and pipelines (https://www.gov.uk/guidance/oil-and-

gas-decommissioning-of-offshore-installations-and-pipelines – accessed 18/12/2017), DECC (2016), The Crown Estate (2017).
Notes: [1] – those sites considered to be relevant to 30th seaward round exploration activities, [2] – Agreement for Lease area not yet defined for the cable corridor associated with this project [3] – decommissioning plan is yet to be approved at time of writing.

Figure 5.3: Location 30th Round Blocks in relation to other projects

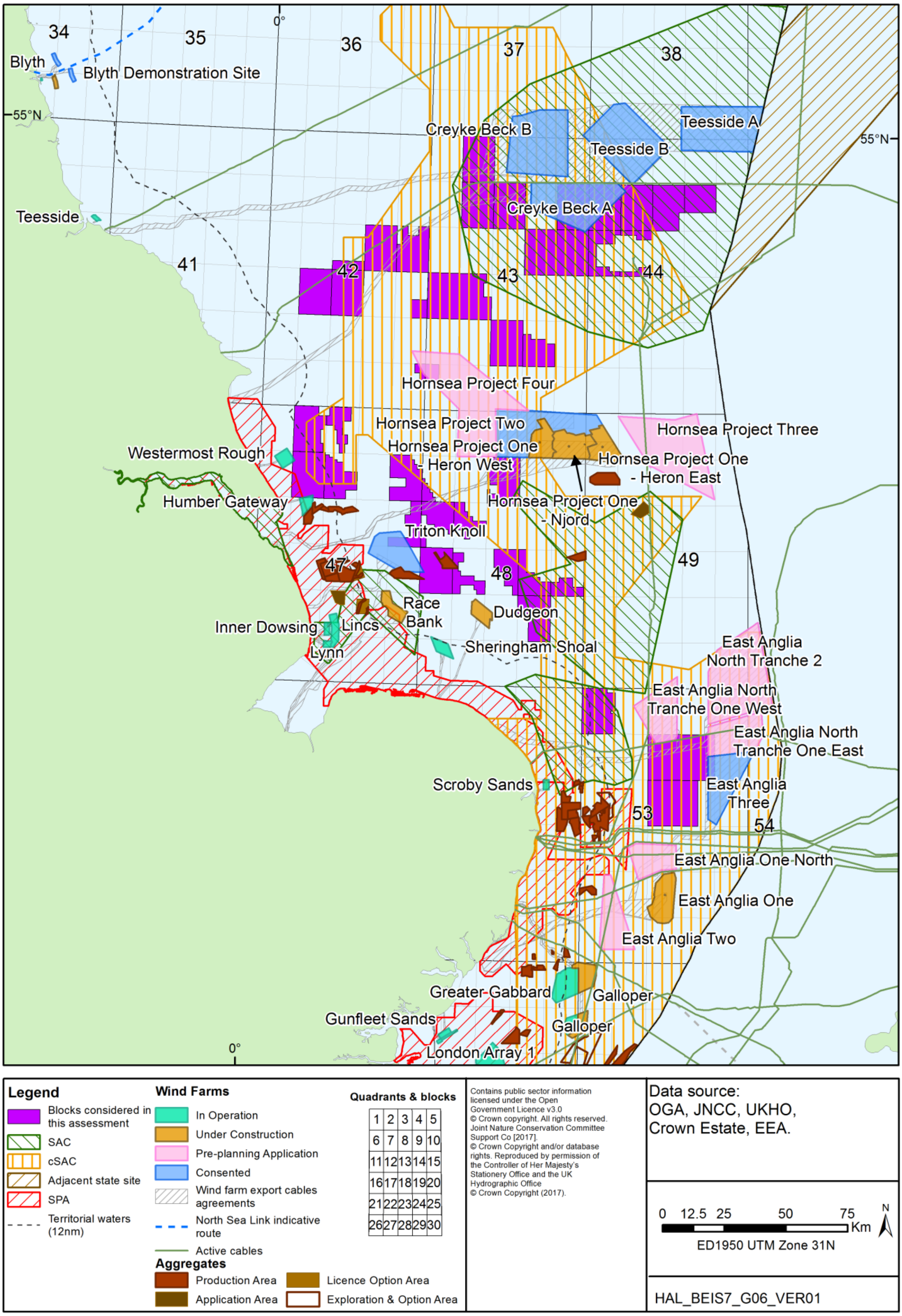
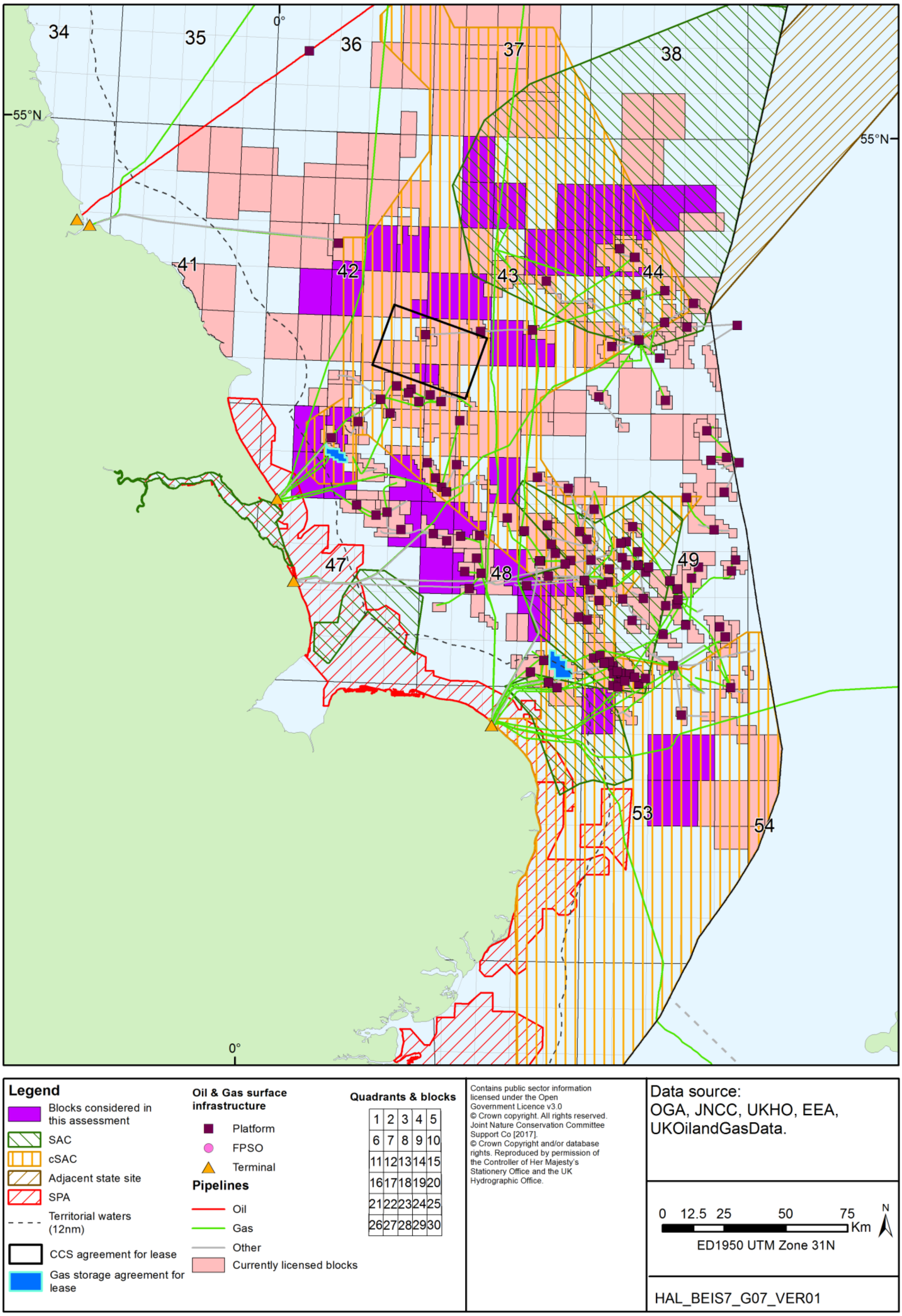


Figure 5.4: Location 30th Round Blocks in relation to other projects (continued)



5.3.3 Physical disturbance and drilling

Potential sources of physical disturbance to the seabed, and damage to biotopes, associated with oil and gas activities that could result from licensing were described in Section 4.2 and Section 5.1 and include the siting of jack-up drilling rig and wellhead placement and recovery.

Existing or proposed oil & gas projects and CCS lease/licence areas

Though existing oil and gas infrastructure is widespread in the southern North Sea (Figure 5.4), the relative density and footprint of these is small. A review of field development and decommissioning projects (as of November 2017) published by OGA's Project Pathfinder[64] indicates three current projects for Blocks within the southern North Sea (Blocks 44/19a: Sillimanite, 48/1a, c: Platypus, 49/21: Vulcan East). Two projects (Sillimanite and Vulcan East) are located within the Southern North Sea cSAC, and are also within the Dogger Bank SAC and North Norfolk Sandbanks and Saturn Reef SAC respectively, however firm project plans are not presently known.

There are a number of decommissioning projects presently scheduled to take place in the southern North Sea between 2017 and 2023 which are summarised in Table 5.3. These are primarily located in Quadrants 48 and 49 and are partly or entirely relevant to the Southern North Sea cSAC and North Norfolk Sandbanks and Saturn Reef SAC. In addition to those listed in Table 5.3, the Hewett field and its satellites (Big Dotty, Little Dotty and Dawn; Blocks 48/29 and 48/30) and related infrastructure are listed under decommissioning projects as part of the OGA's Project Pathfinder but decommissioning plans are yet to be submitted. The potential for Hewett to be used for gas storage is also being considered; note that this field is located immediately adjacent to the Deborah gas storage AfL. Activities associated with decommissioning plans will result in some physical disturbance which will largely be within existing field development areas (e.g. from removal of pipeline spool pieces, pipeline sections, protection materials, subsea wellheads, manifolds and platform footings, well abandonment where this requires a mobile rig, and any anchoring and rock placement), and levels of activity (e.g. shipping) may not be significantly greater than ongoing operations in the southern North Sea, and will be temporally limited.

Where appropriate, BEIS will undertake Habitats Regulations Assessment in relation to oil and gas development and decommissioning activities, including a consideration of in-combination effects. BEIS has undertaken such an assessment for the Viking and LOGGS decommissioning programmes in relation to the Southern North Sea cSAC and North Norfolk Sandbanks and Saturn Reef SAC, and concluded that these would not result in adverse effects on site integrity. It is recognised that further decommissioning programmes are likely to come forward in this area of the southern North Sea in coming years, which will be subject to further HRA as appropriate, including in relation to in-combination effects.

Blocks 42/30d and 43/26c are within the only extant CO_2 appraisal and storage licence (CS001) and AfL on the UKCS, which are held by National Grid for the 5/42 candidate CO_2

[64] https://itportal.decc.gov.uk/pathfinder/currentprojectsindex.html

storage site. The licence and AfL have end dates of 01 January 2021, inclusive. The 5/42 site was appraised under the CCS Commercialisation Competition. Despite having not been developed to date, the technical and economic learning developed through the CCS Commercialisation Competition, and proximity to existing emissions sources, means 5/42 will remain of high interest to prospective CO_2 storage operators into the future. The government has recently published its revised approach to Carbon Capture, Usage and Storage (CCUS) through the Clean Growth Strategy, which includes commitments to set out a deployment pathway during 2018 and to work with prospective CCUS developers to test the potential for deployment of the technology. Depending upon the outcome of this work, prospective storage operators may seek that the 5/42 site is licensed for potential CO_2 storage beyond 01 January 2021.

Given the small and temporary seabed footprint associated with drilling activities which may follow the licensing of 30th Round Blocks, and those standard and additional mitigation measures set out already in Section 2.2 and 5.1.3, significant in-combination effects associated with those other oil and gas related activities discussed are not expected.

With respect to drilling discharges, previous discharges of WBM cuttings across relevant parts of the UKCS have been shown to disperse rapidly and to have minimal ecological effects (See Section 4.2). Dispersion of further discharges of mud and cuttings could lead to localised accumulation in areas where reduced current allows the particles to accumulate on the seabed. However, in view of the scale of the proposed activity, extent of the region, the water depths and currents, this is considered unlikely to be detectable and to have negligible cumulative ecological effect (DECC 2016). Similarly, the potential for in-combination effects relating to chemical usage and discharge from exploratory drilling is limited by the existing legislative and permitting controls that are in place, which the UK Marine Strategy[65] has identified as making an ongoing contribution to managing discharges.

Offshore renewables

OWFs are the only type of operational or proposed renewable energy projects in the southern North Sea. Sources of effect from physical disturbance associated with these projects include installation of turbines (using monopile, jacket, gravity base or possibly tethered foundations) and associated infrastructure such as interconnecting and export cables. Cables would typically be trenched and buried (e.g. in keeping with East Marine Plan policy CAB1), with protection materials used strategically at cable/pipeline crossings or should there be difficulties achieving burial depth due to the nature of the shallow geology. The current project timelines for project proposals indicate the potential for interaction with exploration activity as part of the Initial Term of 30th Round licences (up to 9 years), as construction is proposed to take place within this period. As indicated above, early engagement between any Block licence holder

[65] https://www.gov.uk/government/publications/marine-strategy-part-three-uk-programme-of-measures

and wind farm developer can help to avoid spatial conflict, and applicants taking part in the 30th Round were made aware of such relevant Crown Estates interests[66].

Sixteen Blocks were identified on the basis of a potential for likely significant effect in relation to the Dogger Bank SAC, and were considered in Section 5.1.2, and of these four also coincide with the Creyke Beck A wind project area. None of the Blocks entirely cover any project area (though substantial portions of Blocks 43/10 and 43/26c overlap Creyke Beck A and Hornsea Project Four respectively). Mitigation may be provided by the ability to locate any drilling rig, if used, outside of the wind farm boundaries or through dialogue to avoid any conflict of interest. Further mitigation is available through activity timing/phasing, such that those sources of effect from wind farm installation and operation (e.g. localised and temporary increases in suspended sediment concentrations including re-suspension of contaminants, loss of sandbank habitat[67]) are not compounded by rig installation – note that the footprint of any drilling rig would be small (approximately 0.001km^2 – also see Table 2.2) and temporary, and tidal currents in the shallow southern North Sea are generally such that discharged cuttings are rapidly dispersed. It is therefore not regarded that activity which could take place in the initial term of licences offered as part of the 30th Round would lead to a physical change significant enough to lead to an adverse effect on site integrity on its own or in-combination with Dogger Bank, Hornsea and East Anglia OWF projects.

Once firm project proposals are known, existing statutory and planning processes allow for further consideration of interactions between other activities and, where applicable, subject to project level HRA. Should one or more Blocks be granted a licence within any wind farm zone for which an interaction with a Natura 2000 site has also been established, the in-combination effects of the proposed work programme must be considered as part of any project level HRA. Given the small and temporary seabed footprint associated with drilling activities, significant in-combination effects associated with offshore renewables projects are not expected.

Fisheries

Fishing and particularly bottom trawling has historically contributed to seabed disturbance over extensive areas, and was identified as an ongoing problem in the UK initial assessment for MSFD[68]. It was also noted that depending on the nature of future measures (e.g. in relation to MPA management in the wider environment and within MPAs), such effects are likely to be reduced and therefore some improvement in benthic habitats could be expected. The management of fisheries in relation to Article 6 of the Habitats Directive is fundamentally different to other activities such as offshore energy development, and a revised approach to

[66] https://www.ogauthority.co.uk/licensing-consents/overview/the-crown-estate-interests/
[67] See the record of the HRA undertaken in relation to the Dogger Bank Creyke Beck Offshore Wind Farm: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010021/EN010021-000003-Habitats%20Regulations%20Assessment.PDF
[68] https://www.gov.uk/government/publications/marine-strategy-part-one-uk-initial-assessment-and-good-environmental-status

the management of commercial fisheries in European sites[69] has sought to implement steps to ensure that they are managed in accordance with Article 6.

In England, management is coordinated between the Inshore Fisheries and Conservation Authorities and the Marine Management Organisation for sites within 12nm[70] (note that any measure which may influence vessels of other member states can only be adopted after consultation with the Commission, other Member States and the Regional Advisory Councils) and for offshore sites beyond 12nm from the coast, measures are required to be proposed by the European Commission in accordance with the CFP[71]. In relation to specific sites of relevance to this AA, management proposals for the Dogger Bank have been drawn up through the Dogger Bank Steering Group, with stakeholder engagement made through the North Sea Regional Advisory Council. The proposed measures include a number of zones which would be closed for beam trawl, bottom/otter trawl, dredges and semi-pelagic trawl fisheries. A joint management proposal with measures covering those Dogger Bank Natura 2000 sites in UK and adjacent state waters[72] was agreed in early 2017, and was followed by a Joint Recommendation process submission to the European Commission.

Whilst fishing may be linked to historical damage to site features, and presents an ongoing risk to these, future management measures should limit the potential for in-combination effects with other activities, particularly when considered in addition to mitigation which is available to avoid effects on sites from exploration activity (see Section 5.2), and other activities including offshore renewables which are subject to statutory environmental impact assessment and where appropriate, an HRA.

It should also be noted that when oil and gas surface structures (fixed and floating installations) become operational, safety zones with a radius of 500m are created under the *Petroleum Act 1987* such that other activities are excluded from taking place there, including fisheries. This includes mobile drilling rigs and is notified to other users of the sea (e.g. through notices to mariners and Kingfisher charts). Additionally, appropriate fisheries liaison between operators proposing to undertake exploration activities and fishermen can avoid negative interactions. In view of the differences in relative scale of physical impacts resulting from trawling and from oil and gas exploration (both spatially and temporally), significant incremental effects may be considered unlikely.

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[69] https://www.gov.uk/government/publications/revised-approach-to-the-management-of-commercial-fisheries-in-european-marine-sites-overarching-policy-and-delivery and see http://www.gov.scot/Topics/marine/marine-environment/mpanetwork/SACmanagement
[70] For example see bylaws relating to Haisborough, Hammond and Winterton SAC and Inner Dowsing, Race Bank and North Ridge SAC
[71] See: http://ec.europa.eu/environment/nature/natura2000/marine/docs/fish_measures.pdf and also refer to Regulation (EU) No. 1380/2013 on the Common Fisheries Policy.
[72] See http://jncc.defra.gov.uk/page-6508 and http://www.nsrac.org/reports/meetings-c/ecowg/spatial-planning-working-group-meeting-4th-july-2016-the-hague/

Aggregate extraction

There are a number of licences for the extraction of aggregates held in the southern North Sea, these are also indicated on Figure 5.3 (also see Table 5.3). In relation to the Blocks considered in this assessment, Blocks 48/16 and 48/17d partly overlap with Crown Estate Production Area 515/2, with the former block also partly overlapping Production Area 515/1, and a number of other Production Areas (514/1, 2, 3 and 4) are also located adjacent to Blocks 47/7 and 47/8f. Analogous to the advice provided in relation to offshore wind farms, applicants should make contact with the relevant aggregates companies in order that proposed oil and gas activity is undertaken in co-operation with the relevant lease or licence holders. In view of the limited spatial overlap with Blocks applied for, the potential to site rigs away from licence areas, and the nature and scale of physical effects associated with activity which may follow licensing (see Section 5.1), in-combination impacts which could lead to adverse effects on the integrity of sites considered in this AA are not anticipated.

5.3.4 Physical presence

Physical presence of offshore infrastructure and support activities may potentially cause behavioural responses in fish, birds and marine mammals (see Section 5.6 of BEIS 2018). Previous SEAs have considered the majority of behavioural responses resulting from interactions with offshore oil and gas infrastructure (whether positive or negative) to be insignificant; in part because the number of surface facilities is relatively small (of the order of a few hundred) and because the majority are at a substantial distance offshore. The larger numbers of individual surface or submerged structures associated with offshore wind developments, the presence of rotating turbine blades and considerations of their location and spatial distribution (e.g. in relation to coastal breeding or wintering locations for waterbirds and important areas for marine mammals), indicate a higher potential for physical presence effects. Potential displacement and barrier effects have been an important consideration at the project level for the large offshore wind developments that are planned for the area of the southern North Sea (Figure 5.3) and formed an important part of associated HRAs[73]. It is not regarded that the temporary addition of a drilling rig and associated shipping will lead to adverse effects on the integrity of relevant sites considered in this AA. At present no further extensions to existing wind farms in the southern North Sea are known[74], though it is noted that The Crown Estate intend to consider new leasing areas for offshore wind in the future[75].

Shipping densities over the relevant Blocks range from low to moderate (43/2, 42/15b, 42/20a, 43/7, 43/8, 43/10, 43/14, 43/16, 43/17a, 44/6, 44/7, 44/8b, 44/11d), and high to very high (42/14, 42/17, 42/18, 43/23, 43/24b, 44/12d, 47/2d, 47/3f, 47/7, 47/8f, 47/10d, 48/11d, 48/8b, 48/16, 53/1b, 53/8, 53/9, 53/13). Additional vessels associated with drilling and site survey will

[73] Refer to those HRAs in relation to Dogger Bank Creyke Beck, Dogger Bank Teesside, Hornsea Projects One and Two, and East Anglia projects One and Three.
[74] Note that an application was made for the extension of Thanet wind farm, and that The Crown Estate are accepting applications for extensions until May 2018.
[75] https://www.thecrownestate.co.uk/news-and-media/news/2017/the-crown-estate-to-consider-new-leasing-for-offshore-wind-projects/ also see: http://www.thecrownestate.co.uk/energy-minerals-and-infrastructure/offshore-wind-energy/working-with-us/potential-new-leasing/

represent a small increment to existing traffic, for example typical supply visits to rigs while drilling may be in the order of 2 to 3 per week. Moreover, given the location of the Blocks applied for are within existing mature hydrocarbon basins, helicopters and vessels are likely to use established routes.

Though representing an incremental source of activity in and around OWF zones, it is anticipated that in-combination effects can be avoided through early engagement with lease holders. The transient nature of exploration drilling and the timing of OWF construction activities are such that any activity associated with the work programmes could be phased in such a way as to avoid in-combination effects from physical presence on any qualifying features of relevant European sites. Such interactions would need to be considered as part of assessments, including in HRA where appropriate, for project-level activity.

5.3.5 Underwater noise

A number of projects are relevant to the consideration of in-combination effects with activities which may follow the licensing of 30th Round Blocks (see Table 5.3) as they have associated activities which can generate noise levels which are known to have the potential to result in disturbance or injury to animals associated with relevant sites (see DECC 2016), including the harbour porpoise feature of the Southern North Sea cSAC.

Of most relevance to the Blocks being considered are a series of Round 3 and Round 2 extension wind farms. While the operation, maintenance and decommissioning of offshore wind energy developments will introduce noise into the marine environment, these are typically of low intensity. The greatest noise levels arise during the construction phase, and it is these which have the greatest potential for acoustic disturbance effects (see DECC 2016). Pile-driving of mono-pile foundations or pin piles used in jacket-type foundations is the principal source of construction noise, which will be qualitatively similar to pile-driving noise resulting from harbour works, bridge construction and oil and gas platform installation. Mono-pile foundations are the most commonly used for OWF developments at present (including in the studies looking at the effect of wind farm construction on harbour porpoise behaviour, as discussed in Section 4.3.2), however for some of the proposed developments, sufficient flexibility in foundation type remains in their Development Consent Orders to allow for the potential use of gravity base and even tethered foundations that may generate less noise on installation. The final selection of foundation type is uncertain for some developments as this will be subject to detailed design.

Of those wind farms listed in Table 5.3, several are either under construction or are planned to be constructed before 2020 and are within or in close proximity to the Southern North Sea cSAC (Hornsea Project One, East Anglia One and Galloper Extension). Additionally, the Dogger Bank Creyke Beck and Teesside developments are scheduled for construction from 2020 and 2023 respectively and Hornsea Project Two is due for construction from 2020 (see

Section 2.7.4 and Appendix 1h of DECC 2016[76], [73]). A number of other developments are in the pre-application stage. These projects, if executed, are expected to result in changes in harbour porpoise distribution and a reduction of foraging activity for those individuals within the impacted area. However, assessment of the integrity of the site must be undertaken with respect to the site contributing to maintaining the Favourable Conservation Status of the wider harbour porpoise population. It follows that projects across the whole North Sea Management Unit are therefore also relevant. It should be noted that a review of consents is presently being undertaken for southern North Sea offshore wind farms following the submission of the Southern North Sea cSAC to the European Commission. This will augment those HRAs[73] already undertaken for these projects, and a draft document is due to be published for public consultation in May/June 2018[77].

Given the spatially limited, temporary nature and limited scale of noise generating activity associated with the 30th Round Blocks (see Section 5.2), and that there is significant scope to avoid concurrent OWF construction (which may include some further site survey and unexploded ordnance disposal)[78] and site survey activity either through dialogue with relevant leaseholders or by virtue of wind farm construction timelines, significant in-combination effects are considered to be unlikely. Additionally, mitigation measures (including HRA, where appropriate, at the activity specific level) are available to avoid such effects.

Several modelling frameworks are being developed and refined to assess population level impacts of acoustic disturbance (Thompson *et al.* 2013b, King *et al.* 2015, Tougaard *et al*. 2016, Heinis *et al*. 2015, van Beest *et al*. 2015, Nabe-Nielsen & Harwood 2016); while progress is being made, the degree of uncertainty in extrapolating from individual empirical observations to modelled population estimates is still high. It has not yet been possible to establish criteria for determining limits of acceptable cumulative impact at the UK or EU level, but the collation of data through the Marine Noise Registry (https://mnr.jncc.gov.uk/) has been an important first-step. BEIS is cognisant of the ongoing efforts to implement the MSFD and will review the results of the ongoing process closely with respect to the consenting of relevant activities which may result from future licensing, as well as other activities which generate noise in the marine environment. The draft conservation objectives and advice on operations for the Southern North Sea cSAC state that, *“Case Work Advice Guidance in relation to various activities is being developed and expands this supplementary advice to define ‘significant portion and period’ in the context of impacting site integrity”*.

There is the potential for seismic surveys to take place in adjacent Blocks which are yet to be fully explored or which have been developed (not covered by the plan being assessed). The timing, location and scale of any such surveys are unknown and a meaningful assessment of

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[76] Also see: RenewableUK Offshore Wind Project Timelines (August 2017): http://www.renewableuk.com/news/294516/Offshore-Wind-Project-Timelines.htm
[77] https://itportal.beis.gov.uk/EIP/pages/ola.htm
[78] Note that the encounter rate of UXO and its nature is uncertain and disposal operations are subject to separate marine licensing.

these cannot be made at this time, but they will be subject to activity specific permitting, including HRA where appropriate.

In addition to those activities which may follow licensing of the southern North Sea Blocks and the other potentially relevant projects listed in Table 5.3, there are a variety of other existing (e.g. oil and gas production, fishing, shipping, military exercise areas, wildlife watching cruises) and planned (e.g. oil and gas exploration and production) noise-producing activities in overlapping or adjacent areas. Despite this, BEIS is not aware of any projects or activities which are likely to cause cumulative and in-combination effects that, when taken in-combination with the likely number and scale of activities likely to result from Block licensing (Section 2.2), would adversely affect the integrity of the relevant sites. This is due to the presence of effective regulatory mechanisms (Section 5.2 and also Appendix 3 of DECC 2016) which ensure that operators, BEIS and other relevant consenting authorities take such considerations into account during activity permitting. These mechanisms generally allow for public participation in the process, and this has been strengthened by recent Regulations[79] amending the offshore EIA regime which came into force in May 2017. These reflect Directive 2014/52/EU (amending the EIA Directive) which provides for closer co-ordination between the EIA and Habitats Directives, with a revised Article 3 indicating that biodiversity within EIA should be described and assessed "with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC".

5.3.6 Conclusions

Available evidence (see e.g. UKBenthos database and OSPAR 2010) for the southern North Sea indicates that past oil and gas activity and discharges has not led to adverse impacts on the integrity of European sites in the area. Any activities relating to the work programmes, and any subsequent development that may occur if site appraisal is successful, will be judged on its own merits and in the context of wider development in the North Sea (i.e. any potential incremental effects). The current controls on terrestrial and marine industrial activities, including oil and gas operations that could follow licensing, can be expected to prevent significant in-combination effects affecting relevant European sites.

BEIS will assess the potential for in-combination effects whilst considering project specific EIAs and, where appropriate, through HRAs. This process will ensure that mitigation measures are put in place to ensure that activities, if consented, will not result in adverse effects on integrity of European sites. Therefore, bearing this in mind, it is concluded that the in-combination effects from activities arising from the licensing of the relevant 30th Round Blocks with those from existing and planned activities in the southern North Sea will not adversely affect the integrity of relevant European Sites.

[79] *The Offshore Petroleum Production and Pipe-lines (Environmental Impact Assessment and other Miscellaneous Provisions) (Amendment) Regulations 2017*

6 Overall conclusion

Taking account of the evidence and assessment presented above, the report determines that the licensing through the 30th Licensing Round of the 47 Blocks considered in this AA will not have a significant adverse effect on the integrity of the relevant sites (identified in Section 1.3), and BEIS have no objection to the OGA awarding seaward licences (subject to meeting application requirements) covering Blocks 42/13b, 42/14, 42/15b, 42/17, 42/18, 42/20a, 42/30d, 43/2, 43/7, 43/8, 43/10, 43/14, 43/15, 43/16, 43/17a, 43/23, 43/24b, 43/26c, 44/6, 44/7, 44/8b, 44/9b, 44/11d, 44/12d, 44/12e, 47/2d, 47/3f, 47/7, 47/8f, 47/10d, 47/15c, 48/6d, 48/8b, 48/11c, 48/11d, 48/12b, 48/16, 48/17d, 48/18b, 48/19b, 48/20c, 48/24a, 53/1b, 53/13, 53/14b, 53/8, 53/9. This is because there is certainty, within the meaning of the ECJ Judgment in the Waddenzee case, that implementation of the plan will not adversely affect the integrity of relevant European Sites (as described in Section 5), taking account of the mitigation measures that can be imposed through existing permitting mechanisms on the planning and conduct of activities (as described in Section 5.1 and 5.2).

These mitigation measures are incorporated in respect of habitat and species interest features through the range of legislation and guidance (see https://www.gov.uk/guidance/oil-and-gas-offshore-environmental-legislation) which apply to activities which could follow licensing. Where necessary, project-specific HRA based on detailed project proposals would be undertaken by BEIS to ensure that permits/ consents are only granted where the proposed activity will not result in adverse effects on integrity of relevant sites.

Even where a site/interest feature has been screened out, or where a conclusion of no adverse effect on integrity has been reached at plan level, it is likely that a project level HRA will be necessary if, for example, new relevant sites have been designated after the plan level assessment; new information emerges about the nature and sensitivities of interest features within sites, new information emerges about effects including in-combination effects; or if plan level assumptions have changed at the project level.

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