Department for
Business, Energy
& Industrial Strategy

OFFSHORE OIL & GAS LICENSING 31ST SEAWARD ROUND

Habitats Regulations Assessment

Draft Appropriate Assessment: Irish Sea

February 2019

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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 10th July 2018, the OGA invited applications for licences relating to 1,779 Blocks in a 31st Seaward Licensing Round covering mature and frontier areas of the UK Continental Shelf (UKCS). Applications were received for licences covering 164 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) 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 2018, the Secretary of State undertook a screening assessment to determine whether the award of any of the Blocks offered would be likely to

[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).

have a significant effect on a relevant site, either individually or in combination[3] with other plans or projects (BEIS 2018a). In doing so, BEIS 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 1,779 Blocks offered. The screening identified 525 whole or part Blocks as requiring further assessment prior to decisions on whether to grant licences (BEIS 2018a). Following the closing date for 31st 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 41 of the Blocks applied for. Because of the wide distribution of these Blocks around the UKCS, the AAs are documented in four regional reports as follows:

- Mid North Sea High
- Moray Firth
- 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 (2014) 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.

- English Channel

1.2.1 Irish Sea Blocks

The Irish Sea Blocks applied for in the 31st 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

109/10	109/15	110/1	110/4	110/6
110/7b	110/8b	110/9c	110/11	110/12c
113/22				

1.3 Relevant Natura 2000 sites

The screening identified the relevant Natura 2000 sites and related Blocks requiring further assessment in the Irish Sea (refer to Appendix B of BEIS 2018a). Following a reconsideration of those Blocks and sites screened in against those Blocks applied for, 12 Natura 2000 sites were identified as requiring further assessment in relation to 11 Blocks (Table 1.2 and Figure 1.1). Abbreviations and species common names follow those in Appendix A of BEIS (2018a).

Table 1.2: Relevant sites requiring further assessment

Relevant site Features	Relevant Blocks applied for	Potential effects
Special Protection Areas (SPAs)		
Morecambe Bay and Duddon Estuary SPA Breeding: common tern, sandwich tern, little tern Over winter: whooper swan, little egret, golden plover, ruff, bar-tailed godwit, Mediterranean gull, lesser black-backed gull, herring gull; On passage: pink-footed goose, shelduck, oystercatcher, ringed plover, grey plover, knot, sanderling, dunlin, black-tailed godwit, curlew, pintail, turnstone, redshank, lesser black-backed gull. Seabird and waterbird assemblage all year round	110/4, 110/9c, 113/22	Underwater noise
	110/4, 113/22	Physical disturbance and drilling
Ribble and Alt Estuaries SPA Breeding: common tern, ruff On passage: ringed plover, sanderling, redshank, whimbrel; Over winter: bar-tailed godwit, Bewick's swan, golden plover, whooper swan, lesser black-backed gull, black-headed gull pintail, teal, wigeon, pink-footed goose, scaup, sanderling, dunlin, knot, oystercatcher, black-tailed godwit, common scoter, curlew, cormorant, grey plover, shelduck, redshank, lapwing. Breeding seabird and overwintering waterbird assemblages	110/4, 110/9c	Underwater noise
	110/9c	Physical disturbance and drilling
Liverpool Bay SPA Breeding: little tern, common tern Over winter: red-throated diver, little gull,	109/15, 110/1, 110/4, 110/6, 110/7b, 110/8b, 110/9c, 110/11, 110/12c	Underwater noise

Relevant site Features	Relevant Blocks applied for	Potential effects
common scoter Wintering waterbird assemblage	109/15, 110/4, 110/7b, 110/8b, 110/9c, 110/11, 110/12c	Physical disturbance and drilling
Mersey Narrows and North Wirral Foreshore SPA Breeding: common tern On passage: little gull, common tern Over winter: bar-tailed godwit, knot Wintering waterbird assemblage	109/15, 110/4, 110/7b, 110/8b, 110/9c, 110/11, 110/12c	Physical disturbance and drilling
The Dee Estuary SPA Breeding: common tern, little tern On passage: Sandwich tern, redshank Over winter: bar-tailed godwit, pintail, teal, dunlin, knot, oystercatcher, black-tailed godwit, curlew, grey plover, shelduck, redshank Wintering waterbird assemblage	109/15, 110/4, 110/7b, 110/8b, 110/9c, 110/11, 110/12c	Physical disturbance and drilling
Anglesey Terns / Morwenoliaid Ynys Môn SPA Breeding: roseate tern, common tern, Arctic tern, Sandwich tern	109/15	Physical disturbance and drilling
Special Areas of Conservation (SACs)		
Drigg Coast SAC Annex I habitat: estuaries, coastal dunes, mudflats and sandflats, saltmarsh and salt meadows, coastal dunes	113/22	Physical disturbance and drilling
Morecambe Bay SAC Annex I habitat: estuaries, mudflats and sandflats, inlets and bays, vegetation of stony banks, saltmarsh and salt meadows, coastal dunes, sandbanks, coastal lagoons, reefs, coastal dunes	110/4	Physical disturbance and drilling
Shell Flat and Lune Deep SAC Annex I habitat: reefs	110/4, 110/8b, 110/9c	Physical disturbance and drilling
North Anglesey Marine / Gogledd Môn Forol SCI Annex II species: harbour porpoise	109/10, 109/15	Underwater noise
	109/15	Physical disturbance and drilling
Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC Annex I habitats: sandbanks, estuaries, coastal lagoons, inlets and bays, reefs, mudflats and sandflats, saltmarsh and salt meadows, sea caves Annex II species: bottlenose dolphin, otter, grey seal	109/15	Underwater noise
Cardigan Bay/ Bae Ceredigion SAC Annex I habitats: sandbanks, reefs, sea caves Annex II species: sea lamprey, river lamprey, grey seal, bottlenose dolphin	109/15	Underwater noise

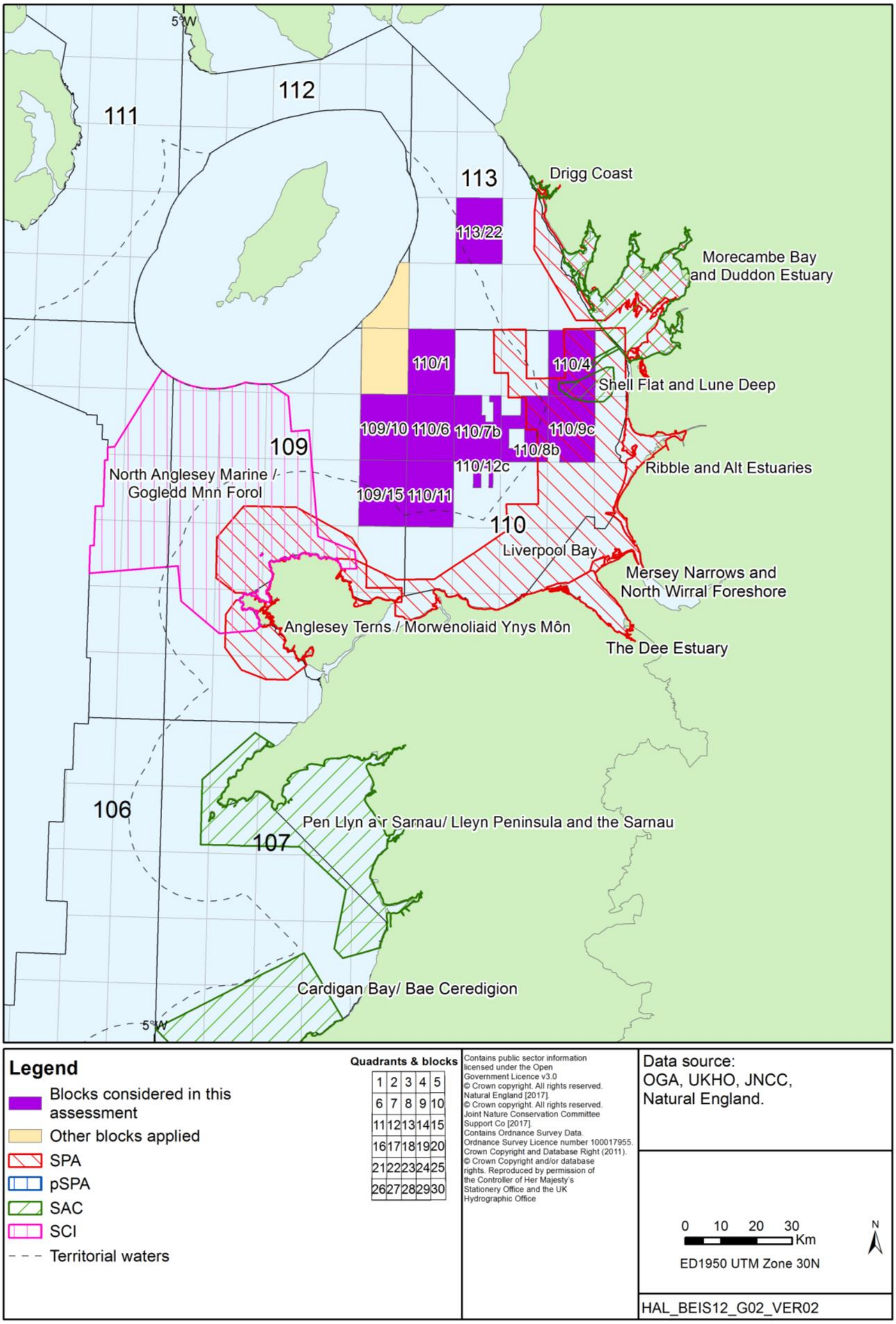
1.4 Assessment overview

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 (Sections 5-8)
- Overall conclusion (Section 9)

As part of this HRA process, the AA document is being subject to consultation with appropriate nature conservation bodies and the public and will be amended as appropriate in light of comments received. The final AA document will be available via the 31st Round Appropriate Assessment webpage of the gov.uk website.

Figure 1.1: Blocks and sites relevant to this Appropriate Assessment



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 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 that may follow licensing are subject to a range of statutory permitting and consenting requirements, including, where relevant, activity specific AA as required 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 31st 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 31st 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 31st Seaward Licensing Round and the various environmental assessments including HRA. Offshore activities such as drilling and seismic survey 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 Blocks being applied for are relevant.

2.2.1 Likely scale of activity

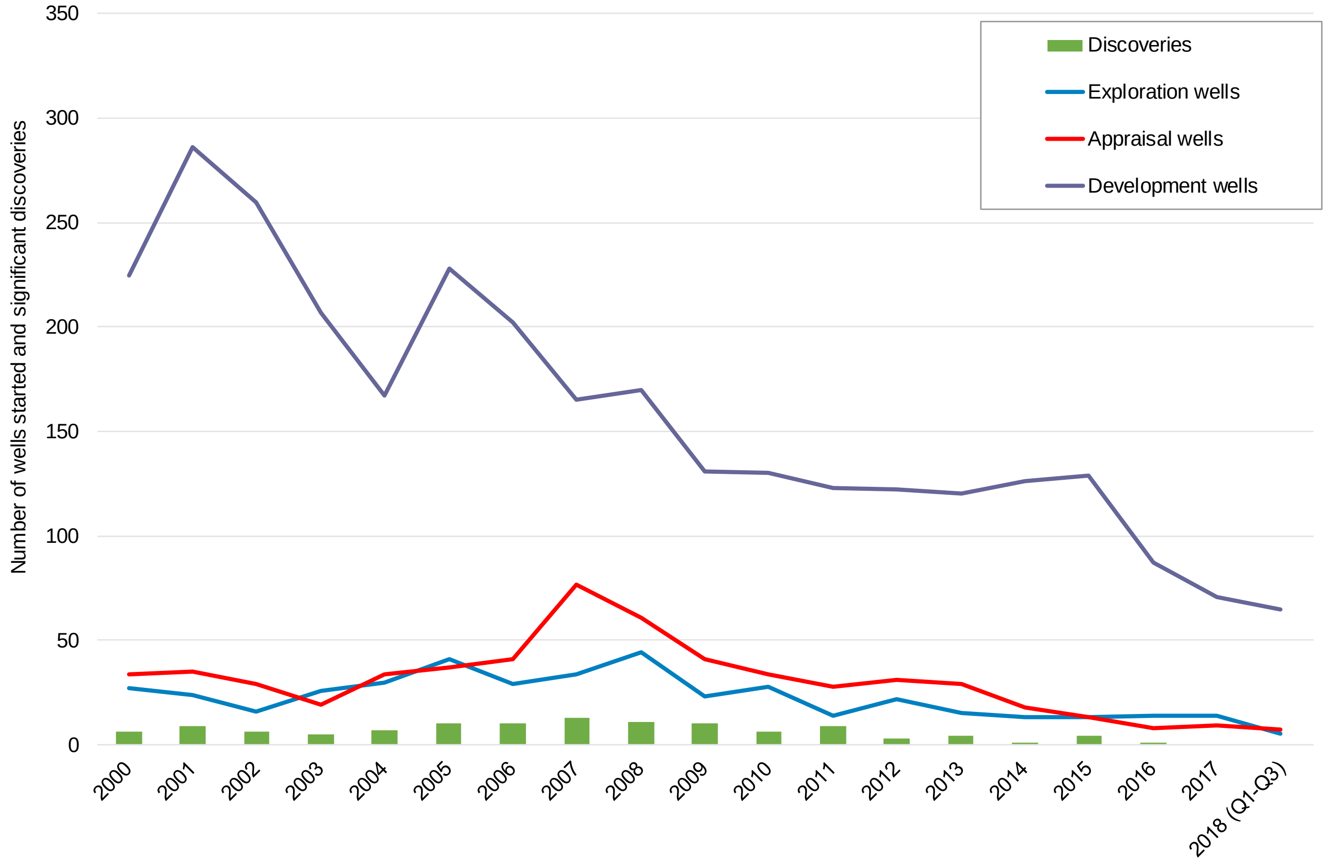
On past experience the activity that actually takes place is less than what is included in the work programmes at the licence application stage. A proportion of Blocks awarded may be relinquished without any offshore activities occurring. Activity after the Initial Term is much harder to predict, as 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).

Discoveries that progress to development may require further drilling, installation of infrastructure such as wellheads, pipelines and possibly fixed platform production facilities,

[9] https://www.ogauthority.co.uk/media/4950/general-guidance-31st-seaward-licensing-round-july-2018.docx

although recent developments are mostly tiebacks to existing production facilities rather than stand-alone developments. For example, of the 39 current projects identified by the OGA's Project Pathfinder (as of 24th August 2018)[10], 13 are planned as subsea tie-backs to existing infrastructure, 3 involve new stand-alone production platforms and 10 are likely to be developed via Floating Production, Storage and Offloading facilities (FPSO). 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 31st Round Blocks.

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 (November 2018), Significant Offshore Discoveries (October 2018)

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

2.2.2 31st Round activities considered by the HRA

The nature, extent and timescale of development, if any, which may ultimately result from the licensing of 31st 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) cannot be made. Moreover, once project plans are in place, subsequent permitting processes relating to exploration, development and decommissioning, would require assessment including where appropriate an HRA, 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. It is noted that none of the indicative work programmes for the Irish Sea region include the option to conduct 3D seismic survey and, therefore, potential underwater noise effects are restricted to those associated with drilling and well evaluation (e.g. site survey, vertical seismic profiling, rig and vessel movement, possible conductor piling). Additionally, the number of wells presented represents a worst-case scenario since several Blocks may be included in one licence and the drill or drop well/contingent well applies to the licence, i.e. it is likely that fewer wells will be drilled than indicated 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
109/10	-	-	✓

[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
109/15	-	-	✓
110/1	-	-	✓
110/4	-	-	✓
110/6	-	-	✓
110/11	-	-	✓
110/12c	-	-	✓
110/7b	-	-	✓
110/8b	-	-	✓
110/9c	-	-	✓
113/22	-	-	✓

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. Unlike semi-submersible rigs, jack-up rigs do not require anchors to maintain station and these are not typically deployed for exploration activities, with positioning achieved using several tugs, with station being maintained by contact of the rig spudcans with the seabed. Anchors may be deployed to achieve precision siting over fixed installations or manifolds at production facilities, which are not considered in this assessment.	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, 6 of which included drilling operations in the Irish Sea since 2009 (specifically in quadrants 110 and 113) 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.
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.

Potential activity	Description	Assumptions used for assessment
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 drilled. Where the nature of the seabed sediment and shallow geological formations are such that they would not support a 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). MacGillivray (2018) reported underwater noise measurements during the piling of six 26" conductors at a platform, six miles offshore of southern California in 365m water depth. After initially penetrating the seabed under its own weight, each conductor was driven approximately 40m further into the seabed (silty-clay and clayey-silt) with hammer energies that increased from 31 ±7 kJ per strike at the start of driving to 59 ±7 kJ per strike. Between 2.5-3 hours of active piling was required per conductor. Sound levels were recorded by fixed hydrophones positioned at distances of 10-1,475m from the source and in water depths of 20-370m, and by a vessel-towed hydrophone. The majority of sound energy was between 100-1,000Hz, with peak sound levels around 400Hz. Broadband sound pressure levels recorded at 10m from source and 25m water depth were between 180-190dB re 1μPa (SEL = 173-176dB re 1μPa·s), reducing to 149-155dB re 1μPa at 400m from source and 20m water depth (SEL = 143-147dB re 1μPa·s).	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 during which time impulses sound would be generated primarily in the range of 100-1,000Hz, with each impulse of a sound pressure level of approximately 150dB re 1μPa at 500m from the source.

Potential activity	Description	Assumptions used for assessment
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. Support and supply vessels (50-100m in length) 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).
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 160 in^3) and a much shorter hydrophone streamer. Arrays used on site surveys and some Vertical Seismic Profiling (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).	A rig site survey typically covers 2-3km^2. The rig site survey vessel may also be used to characterise seabed habitats, biota and background contamination. 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 around 500 in^3 and with a maximum of 1,200 in^3, Stone 2015) is deployed from the rig, and measurements are made using a series of geophones deployed inside the wellbore.	VSP surveys are of short duration (one or two days at most).

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 control measures which may be identified and employed to avoid likely significant effects on relevant sites. These further control measures are identified in Sections 5.2.3 and 5.3.3 with reference to the two main sources of effect identified.

2.3.1 Physical disturbance and drilling

The routine sources of potential physical disturbance and drilling effects associated with exploration are assessed and controlled through a range of regulatory processes, such as Environmental Impact Assessment (EIA) under the *Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999* (as amended) as part of the Drilling Operations Application through the Portal Environmental Tracking System and, where relevant, HRA to inform decisions on those applications[12].

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)[13]. If required, survey reports must be made available to the relevant statutory bodies on submission of a relevant permit application or Environmental Statement for the proposed activity, 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 and 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 EIAs, (and where necessary through HRAs) and chemical risk assessments under existing permitting procedures.

[12] https://www.gov.uk/guidance/oil-and-gas-offshore-environmental-legislation
[13] See BEIS (2018). The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended) – A Guide.

2.3.2 Underwater noise effects

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-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 2017) in addition to referring to European Protected Species (EPS) guidance (JNCC 2010). Applicants are expected to 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 Seismic Guidelines are followed. Where appropriate, EPS disturbance licences may also be required under the *Conservation of Offshore Marine Habitats and Species Regulations 2017*[14]. JNCC have recently updated their guidelines (2017) and reaffirm that adherence to these 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 qualifying species (or their prey) may be avoided by the seasonal timing of offshore activities. For example, periods of seasonal concern for individual Blocks on offer have been highlighted with respect to seismic survey and fish spawning (see Section 2 of OGA's Other Regulatory Issues[15] which accompanied the 31st 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.

[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/4942/other-regulatory-issues_june-2018.docx

Figure 2.2: Stages of plan level environmental assessment

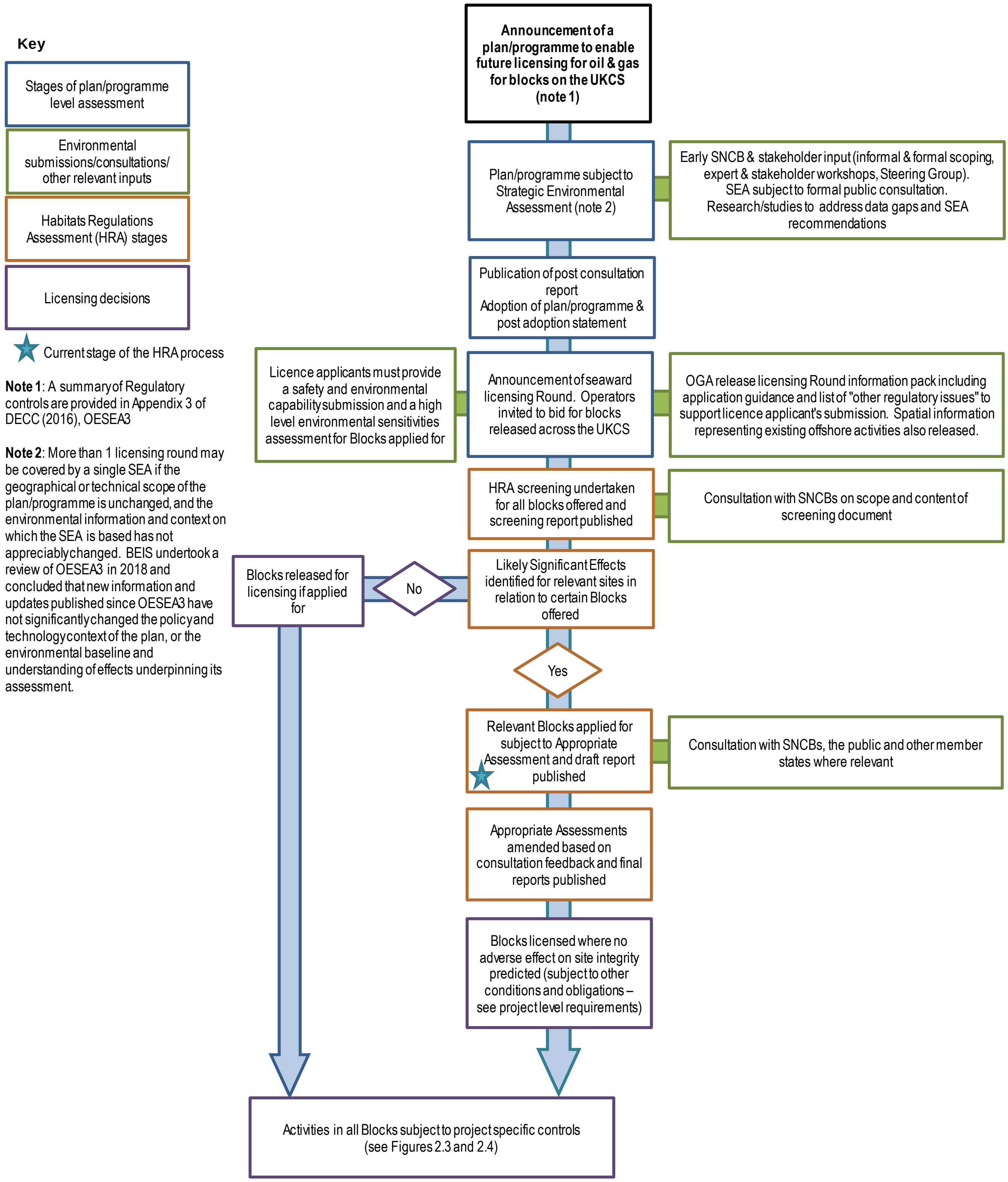
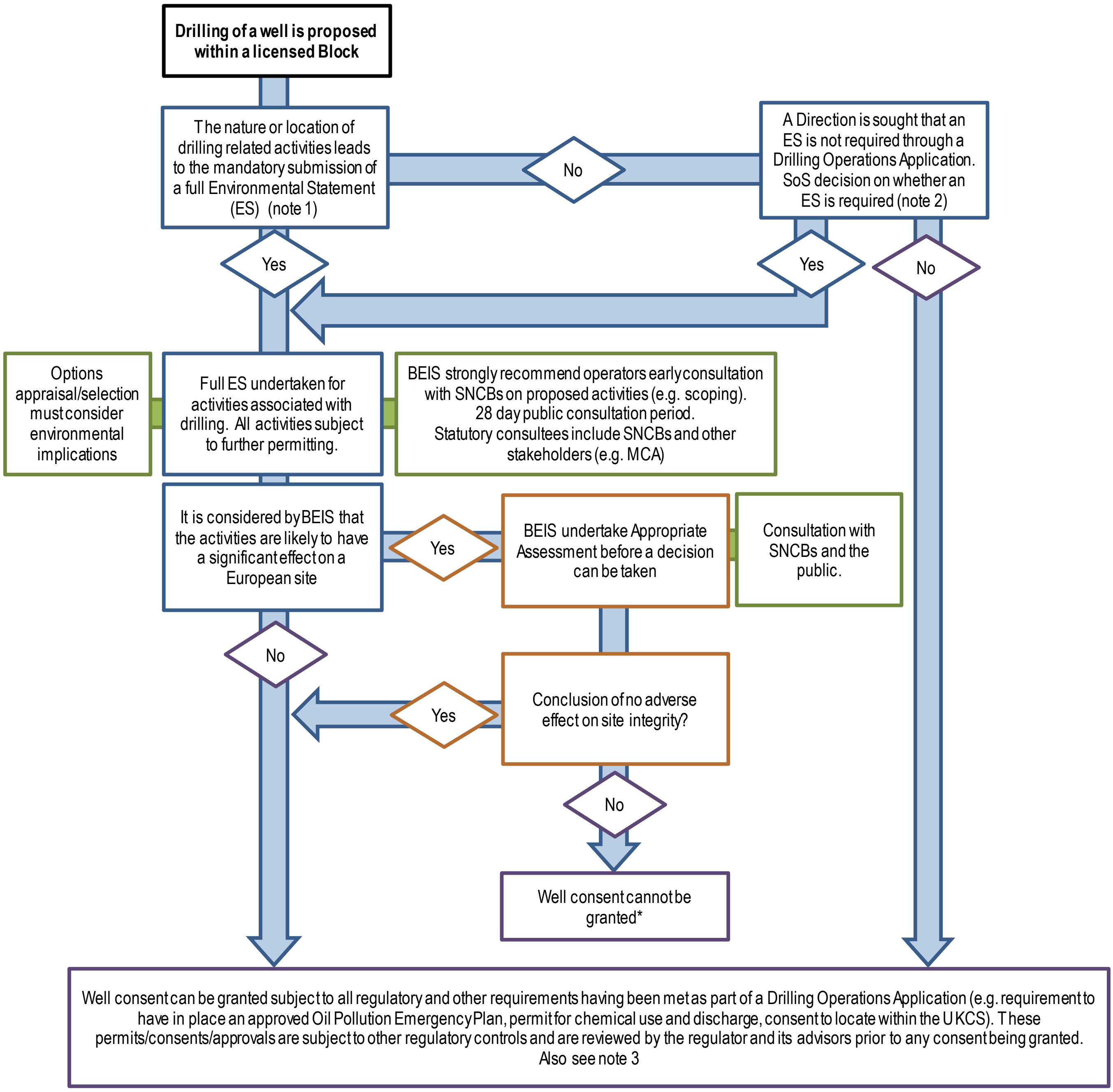


Figure 2.3: High level overview of exploration drilling environmental requirements



Key

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

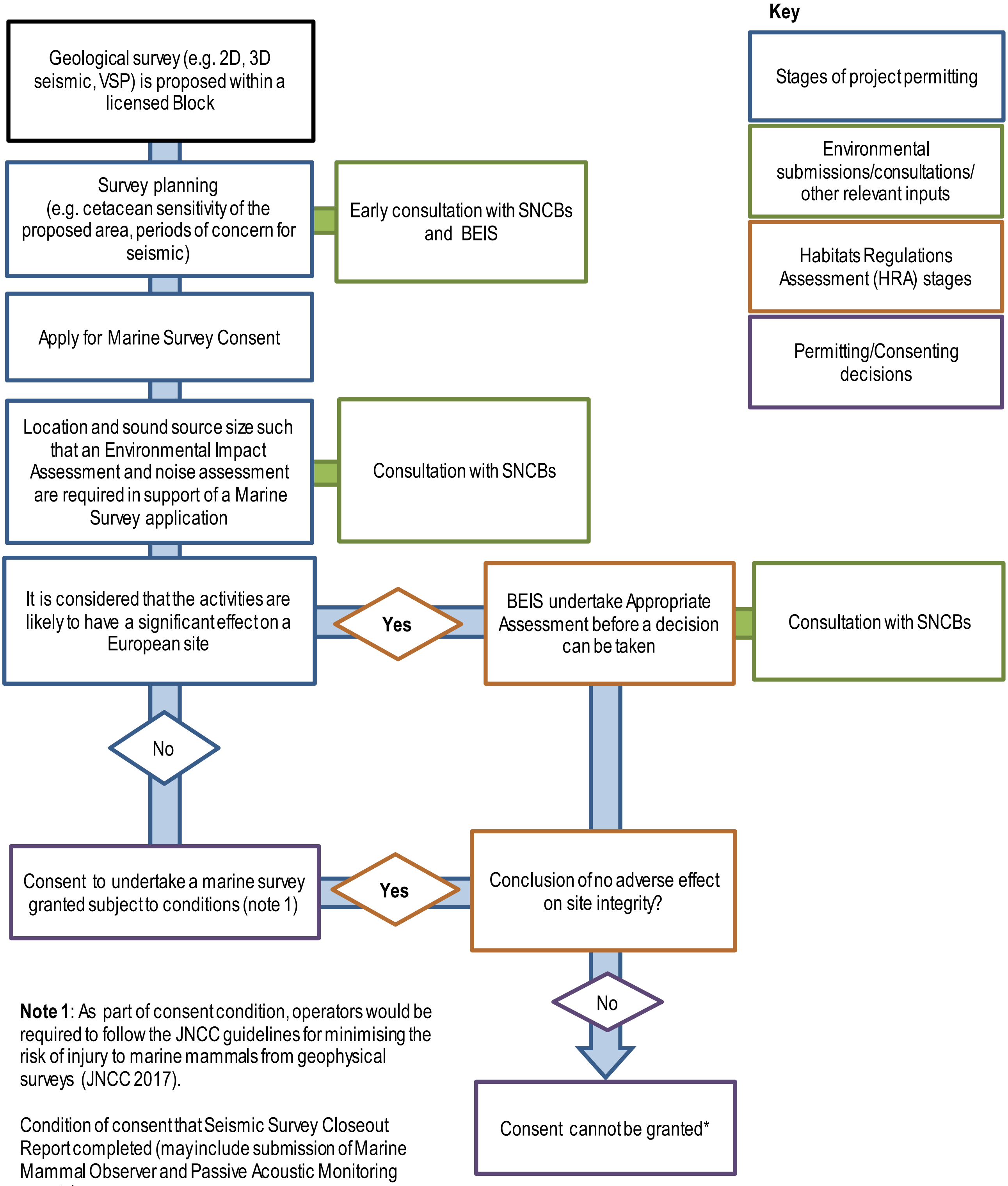
Note 1: See BEIS (2018). The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended) – A Guide. The Offshore Petroleum Regulator for Environment and Decommissioning, 80pp.

Note 2: Early consultation between BEIS and licensed 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 result in altering the ecological structure and functioning of the site which 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[17]. 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 (MHCLG 2018), 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 Sections 5-8. 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. 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
- Underwater noise effects
- In-combination effects

[17] Noting that those typical species of the protected Annex I habitat types (as defined in Article 1), and other species and habitats types to the extent that they are necessary for the conservation of Annex I habitats or Annex II species must also be considered in appropriate assessment (as clarified in ECJ Judgement on Case C-461/17 of *Holohan and others v An Bord Pleanála*).

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, much work has been undertaken in the area of sensitivity assessments and activity/pressure (i.e. mechanisms of effect) matrices (e.g. Tillin *et al*. 2010, JNCC 2013, Tillin & Tyler-Walters 2014, Defra 2015, Robson *et al.* 2018, the Scottish Government Feature Activity Sensitivity Tool, FeAST, the MarESA tool, Tyler-Walters *et al*. 2018). These matrices are intended to describe the types of pressures that act on marine species and habitats from a defined set of activities and are related to benchmarks where the magnitude, extent or duration is qualified or quantified in some way and against which sensitivity may be measured – note that benchmarks have not been set for all pressures. The sensitivity of features to any pressure is based on tolerance and resilience and can be challenging to determine (e.g. see Tillin & Tyler-Walters 2014, Pérez-Domínguez *et al.* 2016, Maher *et al.* 2016), for example due to data limitations for effect responses of species making up functional groups and/or lack of consensus on expert judgements. Outputs from such sensitivity exercises can therefore be taken as indicative.

This activity/pressure approach now underpins advice on operations (e.g. as required under Regulation 37(3) of the *Conservation of Habitats and Species Regulations 2017*[18]*,* Regulation 21 of the *Conservation of Offshore Marine Habitats and Species Regulations 2017* and those relevant to Regulations of the devolved administrations) for many of the sites included in this assessment. Where available, the advice on operations identifies a range of pressures for site features in relation to oil and gas exploration activity[19], along with a standard description of the

[18] Under this Regulation, advice must be provided by the appropriate nature conservation body to other relevant authorities as to: a European site's conservation objectives and any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which the site has been designated.
[19] Under the activity category, "oil and gas exploration and installation", pressures include: above water noise, abrasion/disturbance of the substrate on the surface of the seabed, penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion, habitat structure changes - removal of substratum (extraction), siltation rate changes, including smothering (depth of vertical sediment overburden), hydrocarbon & PAH contamination, introduction of other substances (solid, liquid or gas), synthetic compound contamination, transition elements & organo-metal (e.g. TBT) contamination, introduction or spread of non-indigenous species, litter, barrier to species movement, collision above/below water with static or moving objects not naturally found in

activity, pressure benchmarks, and justification text for the activity-pressure interaction (including with reference to source information). The relevance of the pressures to site specific features are identified; however, in many instances assessment of the sensitivity of a feature to a given pressure has not been made, or it has been concluded that there is insufficient evidence for a sensitivity assessment to be made at the pressure benchmark[20]. Whilst the matrices provided as part of the advice are informative and identify relevant pressures associated with hydrocarbon exploration, resultant impacts at a scale likely to give rise to significant effects are not inevitable consequences of activity, and they can often 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.

A review of the range of pressures identified in SNCB advice for the relevant sites (where available[21]) was undertaken for the purpose of this assessment. The review concluded that the evidence base for potential effects of oil and gas exploration from successive Offshore Energy SEAs and the review of the OESEA3 Environmental Report (BEIS 2018b) covers the range of pressures identified in the advice for the relevant sites (as summarised in Sections 4.2-4.3) and has therefore been used to underpin the assessment against site specific information. It is noted that existing controls are in place for many relevant pressures (e.g. hydrocarbon & PAH contamination, introduction of other substances (solid, liquid or gas), synthetic compound contamination (including antifoulants), transition elements & organo-metal contamination, introduction or spread of non-indigenous species, and litter), either directly in relation to oil and gas activities (as outlined in Section 2.3) or generally in relation to shipping controls (e.g. MARPOL Annex I and V controls on oil and garbage respectively, and the Ballast Water Management Convention). In addition to Natura 2000 site advice on operations, the conservation objectives and any Supplementary Advice on Conservation Objectives (SACO) have been taken into account.

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 are located (Figure 1.1).

4.2 Physical disturbance and drilling effects

The pressures which may result from exploration activities and cause physical disturbance and drilling effects on the relevant Natura 2000 sites assessed in Section 5.3 are described below.

the marine environment (e.g., boats, machinery, and structures), introduction of light, visual disturbance, underwater noise changes and vibration.

[20] Note that pressure benchmarks are used as reference points to assess sensitivity and are not thresholds that identify a likely significant effect within the meaning of the Habitats Regulations.

[21] https://www.gov.uk/government/publications/irish-sea-marine-area-index-map-and-site-packages

4.2.1 Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion

Jack-up rigs are likely to be used in the Irish Sea Blocks due to water depths (depths across the Blocks are <50m). Such rigs 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 Barrow offshore wind farm off the Cumbria coast (partly within Block 113/29, see Figure 5.3) indicated that faint jack-up leg depressions were present close to a number of the turbine locations approximately four months after construction. However, most of the depressions were almost completely infilled by mobile sediments (BOWind 2008). As part of the Walney Extension wind farm geophysical survey in April-July 2011, sidescan sonar identified spud can depressions associated with two well locations (113/26b-3 and 113/27b-6), drilled in April 2010 and November 2009 respectively. No information on the depths of the depressions was provided but they were identifiable at least one year post-drilling (Gardline Geosurvey 2013). 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 (see 4.2.4 below).

The response of benthic macrofauna to physical disturbance has been well characterised in peer-reviewed literature, with increases in abundance of small opportunistic fauna and decreases in larger more specialised fauna (Eagle & Rees 1973, Newell *et al.* 1998, van Dalfsen *et al.* 2000, Dernie *et al*. 2003).

Habitat recovery from temporary disturbance (caused by spud can placement, anchor scarring, anchor mounds) 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 from anchor scarring, anchor mounds and cable scrape is likely to be relatively rapid (1-5 years) (van Dalfsen *et al.* 2000, Newell & Woodcock 2013).

4.2.2 Abrasion/disturbance of the substrate on the surface of the seabed and habitat structure changes – removal of substratum

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 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. 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)).

The extent and potential impact of drilling discharges have been reviewed in successive SEAs, OESEA, OESEA2 and OESEA3 (DECC 2009, 2011 and 2016, respectively, also see BEIS 2018b).

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).

4.2.3 Physical change to another seabed type

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 in theory 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.

4.2.4 Contamination[22]

The past discharge to sea of drill cuttings contaminated with oil based drill mud (OBM) resulted in well documented acute and chronic effects at the seabed (e.g. Davies *et al.* 1989, Olsgard &

[22] Including contamination from transition elements and organo-metals, hydrocarbons and PAHs, synthetic compounds and the introduction of other substances (solid, liquid or gas).

Gray 1995, Daan & Mulder 1996). These effects resulted from the interplay of a variety of factors of which direct toxicity (when diesel based muds were used) or secondary toxicity as a consequence of organic enrichment (from hydrogen sulphide produced by bacteria under anaerobic conditions) were probably the most important. Through OSPAR and other actions, the discharge of oil based and other organic phase fluid contaminated material is now effectively banned. The "legacy" effects of contaminated sediments on the UKCS resulting from OBM discharges have been the subject of joint industry work (UKOOA 2002) and reporting to OSPAR.

The UK Government/Industry Environmental Monitoring Committee has reviewed UK offshore oil and gas monitoring requirements and developed a monitoring strategy which aims to ensure that adequate data is available on the environmental quality status in areas of operations for permitting assurance and to meet the UK's international commitments to report on UK oil industry effects. This strategy has been implemented since 2004 and has included a regional study of the Irish Sea.

In contrast to historic oil based mud discharges[23], effects on seabed fauna resulting from 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 cutting discharges has indicated that deposition of material is generally thin and quickly reduces away from the well.

OSPAR (2009) concluded that the discharge of water-based muds and drill cuttings 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, for example corals and sponges. Field 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

[23] 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.

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).

4.2.5 Introduction or spread of non-indigenous species

Through the transport and discharge of vessel ballast waters (and associated sediment), and to a lesser extent fouling organisms on vessel/rig hulls, non-native species may be introduced to the marine environment. Should these introduced species survive and form established breeding populations, they can 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, which entered into force in 2017[24]. The Convention includes Regulations with specified technical standards and requirements (IMO Globallast website[25]). 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 (e.g. rigs may 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.

4.2.6 Visual disturbance and above water noise

Blocks may support important numbers of birds 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

[24] http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Control-and-Management-of-Ships%27-Ballast-Water-and-Sediments-(BWM).aspx
[25] http://archive.iwlearn.net/globallast.imo.org/the-bwmc-and-its-guidelines/index.html

activities could temporarily disturb birds from relevant SPA sites. In areas where helicopter transits are regular, a degree of habituation to disturbance amongst some birds has been reported (see Smit & Visser 1993). The anticipated level of helicopter traffic associated with Block activity (2-3 trips per week, see Table 2.2) is likely to be insignificant in the context of existing helicopter and civilian aircraft activity levels. Helicopter traffic associated with Block activity is also unlikely to deviate from established routes (e.g. in the Liverpool and Morecambe Bay areas[26]), which will reduce the potential of causing temporary disturbance of birds not previously exposed to this pressure.

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). Mendel *et al.* (2019) further note behavioural response in red-throated diver within 5km of ships. With respect to the disturbance and subsequent displacement of seabirds in relation to offshore wind farm (OWF) developments, the Joint SNCB interim displacement advice[27] 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 to offshore development and associated boat and helicopter traffic. Therefore, for divers and sea ducks a 4km displacement buffer is recommended. Whilst displacement effects for divers have been detected at greater distances (e.g. 5-7km, Webb 2016; 10-16.5km, Mendel *et al.* 2019), 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.

4.2.7 Introduction of light

A significant number of various bird species migrate across the Irish Sea region twice a year or use the area for feeding, resting, or overwintering. Some species crossing or using the area may become attracted to offshore light sources, especially in poor weather conditions with restricted visibility (e.g. low clouds, mist, drizzle, Wiese *et al*. 2001), and this attraction can potentially result in mortality through collision (OSPAR 2015). As part of navigation and worker safety, and in accordance with international requirements, drilling rigs and associated vessels are lit at night and the lights will be visible at distance (some 10-12nm in good visibility). Guidelines (applicable to both existing and new offshore installations) aimed at reducing the impact of offshore installations lighting on birds in the OSPAR maritime area are available (OSPAR 2015). Exploration drilling activities are temporary so a drilling rig will be present at a location for a relatively short period (e.g. up to 10 weeks), limiting the potential for significant

[26] http://www.ead.eurocontrol.int/eadbasic/pamslight-81072FDBD0B24F4CBA8C115950435376/7FE5QZZF3FXUS/EN/Charts/ENR/AIRAC/EG_ENR_6_1_15_7_en_2017-12-07.pdf

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

interaction with migratory bird populations. Given 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.

4.2.8 Collisions above or below water with static or moving objects

Worldwide, collisions with vessels are a potential source of mortality to marine mammals, primarily cetaceans. Whales are occasionally reported to be struck and killed, 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 North Anglesey Marine/Gogledd Môn Forol SCI [28] 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.

4.3 Underwater noise effects[29]

The current level of understanding of sources, measurement, propagation, ecological effects and potential mitigation of underwater 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). The following description of noise sources and potential effects builds on these previous publications, augmented with more recent literature sources.

4.3.1 Noise sources and propagation

Of those oil and gas activities that generate underwater sound, deep geological seismic survey (2D and 3D) is of primary concern due to the high amplitude, low frequency and impulsive nature of the sound generated over a relatively wide area. Typical 2D and 3D seismic surveys consist of a vessel towing a large airgun array, made up of sub-arrays or single strings of multiple airguns, along with towed hydrophone streamers. Total energy source volumes vary between surveys, most commonly between 1,000 and 8,000 inches^3, with typical broadband source levels of 248-259 dB re 1μPa (OGP 2011). Most of the energy produced by airguns is low frequency: below 200Hz and typically peaking around 100Hz; source levels at higher frequencies are low relative to that at the peak frequency but are still loud in absolute terms and relative to background levels. As detailed in Section 2.2.2, none of the work programmes relating to the Irish Sea Blocks applied for in the 31st Round include the intention to conduct a 3D seismic survey.

[28] http://jncc.defra.gov.uk/pdf/NorthAngleseyMarineConservationObjectivesAndAdviceOnActivities.pdf
[29] Note that all underwater noise effects fall within the "underwater noise change" and "vibration" pressure definitions.

In addition to seismic surveys, relevant 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 pile-driving of conductors during drilling. Compared to deep geological survey, these smaller volume 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 guns[30]. 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 a comparable amplitude, 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 particularly sensitive to underwater noise effects 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.

[30] 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 2017).

Marine mammals

The risk of physical injury (hearing loss) from an activity can be assessed by modelling the propagation of sound from an activity and using threshold criteria corresponding to the sound levels at which permanent hearing loss (permanent threshold shift, PTS) would be expected to occur. 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, NOAA has further updated the acoustic thresholds, including alternative frequency-weighting functions (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 injury may occur will be even smaller. Within this zone, JNCC (2017) provide guidelines which are thought sufficient in minimising the risk of injury to marine mammals to negligible levels.

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[31]. 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 on the effects of geophysical surveys on odontocetes and pinnipeds is limited but of note are studies 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; 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 affected 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

[31] See Table 4 (p450) of Southall *et al.* (2007) for a full description of response scores.

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).

As concluded in 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 from relevant sites) 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 harbour porpoise responses 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 Irish Sea. Empirical studies during the construction of OWFs in the North and Baltic Seas (Carstensen *et al*. 2006, Tougaard *et al*. 2009, Brandt *et al*. 2011, 2018, 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 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 on similar equipment are 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 field measurements of sound propagation from this activity (Jiang *et al*. 2015, MacGillivray 2018), suggest a very low potential for significant disturbance of marine mammals.

Noise from drilling activity from a jack-up rig is audible to marine mammals but is not of the characteristics sufficient to cause injury and is typically of similar amplitude and frequency to that of a medium-large sized merchant vessel. 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 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 (Rolland *et al.* 2012, Dyndo *et al.* 2015, Veirs *et al.* 2016). 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. Statistical analyses showed that higher levels of medium- to high-frequency components of vessel noise (250Hz to 63 kHz octave bands) significantly increase the probability of porpoising. By contrast, there was no significant relationship between porpoising behaviour and low-frequency components of vessel noise (3.51 to 125Hz) or the presence of pulses from echo-sounders on the vessels (Dyndo *et al.* 2015). A tagging study of a small number of free-ranging porpoises in Danish coastal waters estimated that porpoises encountered vessel noise 17–89% of the time (from evaluation of the wideband sound and movement tag recordings). Occasional high levels of noise levels (coinciding with the passage of a fast ferry) were associated with vigorous fluking, bottom diving, interrupted foraging and even cessation of echolocation, leading to significantly fewer prey capture attempts at received levels greater than 96 dB re 1 µPa (16 kHz third-octave band, Wisniewska *et al.* 2018).

More evidence is available on bottlenose dolphins, especially for coastal populations. Shore-based monitoring of the effects of boat activity on the behaviour of bottlenose dolphins off the US South Carolina coast, indicated that slow moving, large vessels, like ships or ferries, appeared to cause little to no obvious response in bottlenose dolphin groups (Mattson *et al*. 2005). Pirotta *et al*. (2015) used passive acoustic techniques to quantify how boat disturbance affected bottlenose dolphin foraging activity in the inner Moray Firth. The presence of moving motorised boats appeared to affect bottlenose dolphin buzzing activity (foraging vocalisations), with boat passages corresponding to a reduction by almost half in the probability of recording a buzz. The boat effect was limited to the time where a boat was physically present in the sampled area and visual observations indicated that the effect increased for increasing numbers of boats in the area (Pirotta *et al.* 2013). Dolphins appeared to temporarily interrupt their activity when disturbed, staying in the area and quickly resuming foraging as the boat moved away.

Of primary concern for this HRA is whether vessels linked to potential operations result in a significant increase to overall local traffic. New *et al*. (2013) developed a mathematical model simulating the complex social, spatial, behavioural and motivational interactions of coastal bottlenose dolphins in the Moray Firth to assess the biological significance of increased rate of behavioural disruptions caused by vessel traffic. A scenario was explored in which vessel traffic increased from 70 to 470 vessels a year but despite the more than six fold increase traffic, the dolphins' behavioural time budget, spatial distribution, motivations and social structure remained unchanged. 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 (see Table 2.2). In UK waters, a modelling study indicated a negative relationship between the number of ships and the presence and abundance of harbour porpoises within relevant management units when shipping intensity exceeded a suggested threshold of approximately 50 ships per day (within any of the model's 5km grid cells) in the Celtic Sea/Irish Sea and 80 ships per day in the North Sea (Heinänen & Skov 2015).

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). More recently, Harding *et al.* (2016) note a lower sensitivity at 100Hz than previously reported (Hawkins & Johnstone 1978), and greater sensitivity at frequencies of >200Hz, with evidence of some response at 400-800Hz. However, the authors qualify their results with differences in methodological approach, and the use of fish maintained in tanks receiving low frequency ambient sound within the greatest range of sensitivity (<300Hz) for some time in advance of the experiments taking place. The ability of salmon 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 relative to other fish species (Hawkins & Johnstone 1978, cited by Gill & Bartlett 2010, Harding *et al.* 2016).

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. Fish species of known importance to both diving seabirds and marine mammals in the North Sea include sandeels, 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 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, all of which are qualifying species of one or more relevant sites considered in this HRA (see Appendix A).

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). 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. 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 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 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 prey 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 Great northern diver *Gavia immer* **Red-throated diver *Gavia stellata*** Black-throated diver *Gavia arctica* Little grebe *Tachybaptus ruficollis* Great crested grebe *Podiceps cristatus* 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*	**Diving ducks** Pochard *Aythya ferina* Tufted duck *Aythya fuligula* Scaup *Aythya marila* **Eider *Somateria mollissima*** Long-tailed duck *Clangula hyemalis* **Common scoter *Melanitta nigra*** Velvet scoter *Melanitta fusca* **Goldeneye *Bucephala clangula*** **Red-breasted merganser *Mergus serrator*** Goosander *Mergus merganser*

*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 2018a) identified a number of sites in the Irish Sea where there was the potential for likely significant effects associated with proposed activities that could follow licensing of Blocks offered in the 31st Round. The further assessment of 10 sites in relation to 11 Blocks applied for in the Irish Sea is given below. This assessment has been informed by the evidence base on the environmental effects of relevant oil and gas activities (Section 4) and the assumed nature and scale of potential activities (Table 2.2).

5.1 Relevant sites

A description of the each of the relevant sites is provided below based on the site citation and site selection information, which has been augmented by additional information from grey and primary sources relevant to site qualifying features, which are cited throughout. The assessment of these sites in relation to the 31st Round Irish Sea Blocks is documented in Sections 5.2-5.4.

Morecambe Bay and Duddon Estuary SPA

The boundary of the Morecambe Bay and Duddon Estuary SPA is formed by the recent amalgamation of two existing SPAs (Morecambe Bay SPA and Duddon Estuary SPA); and the addition of a marine foraging area for terns identified and defined by the modelled foraging area for sandwich terns breeding at Hodbarrow Lagoon. In total, 25 species of waterbirds and seabirds (gulls and terns) are present in qualifying numbers (≥1% of GB/biogeographic population); qualifying assemblages (in any season) of seabirds and waterbirds are present, with the latter including the diving species of eider, goldeneye, red-breasted merganser and cormorant[32]. While red-throated diver are not listed as qualifying features, aerial surveys indicate their presence within the site, particularly off the mouth of the Duddon Estuary. Morecambe Bay is a large, very shallow, predominantly sandy bay at the confluence of four principal estuaries, the Leven, Kent, Lune and Wyre. The Duddon Estuary is to the north of Morecambe Bay, although directly connected to it by Walney Channel. At low tide vast areas of intertidal sandflats are exposed, with small areas of mudflat, particularly in the upper reaches of the associated estuaries. The sediments of the bay are mobile and support a range of community types, from those typical of open coasts (mobile, well-sorted fine sands), grading through sheltered sandy sediments to low-salinity sands and muds in the upper reaches. Apart from the areas of intertidal flats and subtidal sandbanks, Morecambe Bay supports exceptionally large beds of mussels *Mytilus edulis* on exposed "scars" of boulder and cobble, and small areas of reefs with fucoid algal communities. Of particular note is the rich community of sponges and other associated fauna on tide-swept pebbles and cobbles at the

[32] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/641980/morecambe-duddon-citation.pdf

southern end of Walney Channel[33]. Extensive intertidal eelgrass beds are present around Foulney Island and in the south Walney Channel. The Duddon and Ravenglass Estuaries support saltmarsh, intertidal mud and sand communities and sand dune systems with small areas of stony reef[34].

Ribble and Alt Estuaries SPA

The Ribble and Alt Estuaries SPA comprises two estuaries, of which the Ribble Estuary is the larger, together with an extensive area of sandy foreshore along the Sefton Coast. The site consists of extensive sand- and mud-flats and, particularly in the Ribble Estuary, large areas of saltmarsh. There are also areas of coastal grazing marsh located behind the sea embankments. The highest densities of feeding birds are on the muddier substrates of the Ribble, though sandy shores throughout are also used. The saltmarshes and coastal grazing marshes support high densities of grazing and seed-eating wildfowl and these, together with the intertidal sand- and mud-flats, are used as high-tide roosts. Important populations of waterbirds occur in winter, including swans, geese, ducks and waders. The SPA is also of major importance during the spring and autumn migration periods, especially for wader populations moving along the west coast of Britain. The larger expanses of saltmarsh and areas of coastal grazing marsh support breeding birds during the summer, including large concentrations of gulls and terns. These seabirds feed both offshore and inland, outside the SPA. In total, 21 species of waterbirds and seabirds (gulls and terns) are seasonally present in qualifying numbers (≥1% of GB/biogeographic population); qualifying assemblages of seabirds (breeding) and waterbirds (over-winter) are present, with the latter including the diving species of common scoter and cormorant[35].

Liverpool Bay SPA

The Liverpool Bay/Bae Lerpwl SPA is in the east of the Irish Sea, bordering northern England and north Wales, and running as a broad arc from Morecambe Bay to the east coast of Anglesey. The seabed and waters of the site provide an important habitat in the non-breeding season for major concentrations of red-throated divers and sea ducks, notably common scoter, which visit the area to feed on the fish, mollusc and crustacean populations. Annual aerial surveys over winter from 2004-2011 revealed the distribution and abundance of red-throated diver, common scoter and other bird species within the site and adjacent waters (Lawson *et al*. 2016). Red-throated diver were widely distributed throughout the site, with the highest density areas off the north Wales coast, the Wirral, Formby and the mouth of the Ribble Estuary; areas of higher density were also recorded off the Duddon Estuary and south into outer Morecambe Bay. Common scoter were less widely distributed, with two areas of notably high density: off the north Wales coast from Rhos on Sea to the mouth of the Dee estuary, and off Blackpool from Fleetwood south to the mouth of the Ribble Estuary. Peak winter abundance shows large fluctuations between years; mean peak winter abundance estimates across the five years of survey were 1,409 red-throated diver and 57,995 common scoter, in addition to 826 for

[33] http://publications.naturalengland.org.uk/file/4531557855395840
[34] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/492891/morecambe-duddon-departmental-brief.pdf
[35] http://jncc.defra.gov.uk/pdf/SPA/UK9005103.pdf

cormorant and 160 for red-breasted merganser (both also qualifying species). The recent extension to the site includes an area to the north and west of the existing SPA, identified to support non-breeding little gulls. The highest densities of little gull were consistently located offshore of Blackpool and the Ribble Estuary, close to the 12 nautical mile line (Lawson *et al.* 2016). The site also includes a marine foraging area for terns identified and defined by little terns breeding within The Dee Estuary SPA and the predicted foraging area for common terns breeding within Mersey Narrows & North Wirral Foreshore SPA. These areas add marine habitat extending into the Mersey Estuary, and a small intertidal area abutting the western boundary of The Dee Estuary SPA. The seabed of the SPA consists of a wide range of mobile sediments. Large areas of muddy sand stretch from Rossall Point to the Ribble Estuary, and sand predominates in the remaining areas, with a concentrated area of gravelly sand off the Mersey Estuary[36]. Tidal currents throughout the Bay are generally weak and this combined with a relatively extended tidal range of 6 to 8m along the Lancashire coastline facilities the deposition of sediments, encouraging mud and sand belts to accumulate[37].

Mersey Narrows and North Wirral Foreshore SPA and The Dee Estuary SPA

Contiguous with Liverpool Bay SPA are the Mersey Narrows and North Wirral Foreshore SPA and The Dee Estuary SPA, which are designated for a variety of species during different times of the year. The relevant features to this Appropriate Assessment are breeding little tern (The Dee Estuary SPA) and breeding common tern (Mersey Narrows and north Wirral Foreshore SPA), as these two species forage within the Liverpool Bay SPA - therefore providing a potential pathway to effects, despite these two colony SPAs being located at least 25km distant to the nearest 31st Round Block (Figure 5.1). The mean reported maximum foraging ranges of breeding common tern is 15.2km (mean foraging range = 4.5km) and for little tern is 6.3km (mean = 2.1km), meaning that these two qualifying features of the two colony SPAs will likely forage within waters of the colony SPAs themselves and waters in the southern part of Liverpool Bay SPA.

Anglesey Terns / Morwenoliaid Ynys Môn SPA

The site was designated in 2017 as a reclassification and extension to the Ynys Feurig, Cemlyn Bay and The Skerries SPA. The site extension was made to cover the foraging area of tern species whose breeding areas were covered by the existing SPA, with the foraging area determined by a combination of site specific or generic or modelling based on sea usage of terns from the wider UK network of SPAs supporting these features and using a combination of observed behaviour and environmental variables (see Wilson *et al.* 2014). The qualifying species are breeding common tern (*Sterna hirundo*), Arctic tern (*Sterna paradisea*), roseate tern (*Sterna dougalli*) and Sandwich tern (*Sterna sandvicensis*). Counts based on the 2001

[36] http://publications.naturalengland.org.uk/file/5301807986769920
[37] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/566835/liverpool-bay-bae-lerpwl-spa-departmental-brief.pdf

SPA review (Stroud 2001) indicate the presence of 189 (1.5% of the GB population), 1,290 (2.9%), 3 (5%) and 460 (3.3%) pairs respectively for each tern species[38].

The three breeding sites are: Ynys Feurig, a series of islets off the west coast of Anglesey connected to the shore at low tide, (primarily supports breeding Arctic terns and a smaller population of common terns); Cemlyn Bay, located to the north of Anglesey and contains a saline lagoon where terns breed on two small islets (primarily Sandwich terns but with some Arctic terns); and The Skerries, a group of rocky islets 3km off the north west of Anglesey (primarily with a population of breeding Arctic terns and a smaller population of common terns).

Drigg Coast SAC

The site is composed of extensive sand dunes, salt marsh, intertidal mudflats and saltflats, and estuaries, reflected in the range of Annex I habitats for which the site is designated. The site extends for 11km along the Cumbrian coast, centred on Ravenglass where there is a small bar-built estuary fed by the rivers Irt, Mite and Esk[39]. Within the site there is an excellent zonation of saltmarsh habitats from pioneer through to upper marsh and some of the least disturbed transitions to terrestrial habitats, particularly to sand dune, shingle and freshwater swamp which are scarce elsewhere in the UK due to land claim.

The intertidal mudflat and sandflat communities are a key component of the estuary. At its entrance, coarse sandy sediments of the mid and lower shores support a community dominated by bivalve molluscs (e.g. *Ensis* spp.), amphipods and the sea potato (*Echinocardium cordatum*); the sheltered muddy sands provide habitat for infaunal species including ragworm (*Hediste diversicolor*) the Baltic tellin (*Macoma balthica*) and burrowing amphipod (*Corophium volutator*); and the upper estuarine sediments are dominated by lugworm (*Arenicola marina*), *C. volutator* and the isopod *Eurydice pulchra*. While principally comprised of soft sediment, the estuary also contains areas of intertidal boulder and cobble. These are largely dominated by mussels (*Mytilus edulis*), and also include barnacles (*Semibalanus balanoides* and *Elminius modestus*) and shore crab (*Carcinus maenas*), while other areas are characterised by fucoids including bladder wrack (*Fucus vesiculosus*), serrated wrack (*Fucus serratus*) and knotted wrack (*Ascophyllum nodosum*), and *Fucus ceranoides* in brackish areas. Dense clusters of common periwinkle (*Littorina littorea*) and rough periwinkle (*L. saxatilis*) are also present.

The pioneer saltmarsh communities are dominated by glasswort (*Salicornia europaea*), occasional sea-blite (*Suaeda maritima*) and increasingly common cord grass (*Spartina anglica*). Lower and mid marsh communities are more diverse and determined by grazing management, with grazed areas dominated by common saltmarsh-grass (*Puccinellia maritima*), red fescue (*Festuca rubra*), sea milkwort (*Glaux maritima*) and sea rush (*Juncus maritimus*), lightly grazed areas having a greater number of herbs, and ungrazed areas having

[38] https://www.naturalresources.wales/guidance-and-advice/environmental-topics/consultations/our-own-consultations-closed/new-marine-sac/anglesey-terns/?lang=en
[39] https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK0013031

sensitive species such as sea purslane (*Atriplex portulacoides*). Upper marshes and those with freshwater influence have a greater proportion of less salt-tolerant plants.

The transition from saltmarsh to sand dune and mire display habitats ranging from species rich saltmarsh with P. *maritima* to fixed and mobile dune communities dominated by sand couch (*Elytrigia juncea*), Lyme grass (*Leymus arenarius*) or marram (*Ammophila arenaria*). There are also substantial areas of coastal dune heathland and acidic dune grassland[40].

Morecambe Bay SAC

The Morecambe Bay SAC includes four large estuaries namely the Leven, Kent and the Lune which flow directly into Morecambe Bay and the Duddon estuary and into the eastern Irish Sea. The SAC has a very large tidal range of approximately 10 metres on spring high tides which produces the largest continuous area of intertidal mudflats and sandflats in the UK and means that many of the habitats in the SAC are heavily influenced by tidal cycles and processes. Around the site, areas of coarse sediment, boulders and cobbles create intertidal reefs, known locally as 'skears', that provide a hard substrate for dense beds of mussel that can cover large areas, and provide important feeding habitats for a variety of species. The stony reefs support additional species such as the honeycomb worms, *Sabellaria* spp., and in the sheltered waters of the Walney Channel the cobbles and coarse sediments support important communities of sponges and sea squirts. Below the low water mark, subtidal sandbanks of varying shapes and sizes form important habitats for invertebrates and young fish.

In wave sheltered and estuarine areas, the intertidal sediment transitions into large and extensive areas of saltmarsh and pioneer saltmarsh, which can also include nationally rare habitat transitions from saltmarsh to freshwater and terrestrial vegetation. The saltmarshes are important for their vegetation which can be diverse, supporting a number of rare and uncommon plants, as well as an abundant invertebrate population including a variety of nationally scarce species.

Above the low water mark extensive well-developed dune systems provide excellent examples of dune succession supporting a number of rare plants and animals such as the natterjack toad and the great crested newt. Walney Island, a barrier island of high geomorphological interest, supports a number of saline and brackish lagoons and nationally rare vegetated stony habitats which form on the shingle banks.

Shell Flat and Lune Deep SAC

The Shell Flat and Lune Deep SAC is characterised by a deep water channel (Lune Deep) and a large sandbank feature (Shell Flat) at the mouth of Morecambe Bay surrounded by shallower areas to the north and south. The reef habitat present in the Lune Deep represents a good example of boulder and bedrock reef with the northern edges of the channel characterised by heavily silted cobble and boulder slopes, subject to strong tidal currents with a dense hydroid

[40] http://publications.naturalengland.org.uk/file/6226945595408384

and bryozoan turf (Emblow 1992) including the bryozoans *Flustra foliacea* and *Eucratea loricata*, the hydroids *Nemertesia* spp. and *Hydrallmania falcata*, and the erect sponge *Haliclona oculate* (O'Dell *et al.* 2016). It was noted in a recent video survey (O'Dell *et al.* 2016) that the non-native *Molgula manhattensis* was prevalent, however the supplementary advice on conservation objectives[41] notes that there are problems with the taxonomy of this species which may be the native *Molgula socialis*. It further notes that there is no evidence of the site being impacted by non-native species. This unique enclosed deep provides a contrasting habitat to the surrounding muddy communities of the Eastern Irish Mudbelt. Data from a 2004 survey show that the northern flanks of Lune Deep are composed of exposed bedrock with a rugged seabed physiography. In contrast, the southern flank consists of a smooth seabed which is a sink for muddy sands[42]. Habitat distribution maps show the northern flank supporting moderate and exposed circalittoral rock habitats and the southern flank having mixed substrate biotopes with occasional sand influenced habitats (Envision 2015).

The Shell Flat sandbank forms a continuous structure approximately 15km long from east to west. The bank is an example of a banner bank, which are generally only a few kilometres in length with an elongated pear/sickle-shaped form, located in water depths less than 20m. The predicted distribution of sediment types show the Shell Flat to be dominated by slightly gravelly sand on the top of the bank with slightly gravelly muddy sands in the deeper areas. The fine shallower sediments of the bank are occupied by the *Fabulina fabula* and *Magelona mirabilis* biotope with *Abra alba* and *Nucula nitidosa* biotope occurring in the deeper and slightly muddier sediments found on the slopes and in deeper areas of the bank (Envision 2015). Shell Flat is known to provide important habitats for commercial fish species and bird populations and overlaps with the Liverpool Bay SPA. Density estimates of the distribution of qualifying features within the SPA, indicate that the Shell Flat area coincides with high densities of overwintering common scoter in particular (Lawson *et al*. 2016).

The supplementary advice on conservation objectives for the site indicate that for attributes of the site features for which there is evidence (e.g. presence and spatial distribution of biological communities, extent and distribution, non-native species and pathogens, sediment composition and distribution, species composition of component communities, topography, volume, water quality – contaminants) the site features are shown to be in a good condition and/or currently un-impacted by anthropogenic activities.

North Anglesey Marine / Gogledd Mnn Forol SCI

The Southern North Sea SCI 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

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41 https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK0030376&SiteName=shell+flat&SiteNameDisplay=Shell+Flat+and+Lune+Deep+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=

42 http://publications.naturalengland.org.uk/file/3275848

favourable[43]. 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 North Anglesey Marine SCI supports an estimated 2.4% of the UK Celtic and Irish Seas Management Unit (MU) population. 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 site contains a mixture of hard substrate and sediments, including rock, coarse sediment, sand and mud. Medium to high energy levels at the seabed (including wave and tidal energy) are estimated across the majority of the site[44]. The current draft conservation objectives[45] 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.

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

The Cardigan Bay SAC and Lleyn Peninsula and the Sarnau SAC include coastal waters of Cardigan Bay on the west coast of Wales. These sites are each designated for a variety of Annex I habitats and several Annex II species, including bottlenose dolphins. Neither of the two sites met the initial screening criteria of BEIS (2018a); however, in view of the evidence of bottlenose dolphin movement outside of the site boundaries (described below), they were considered to be relevant to two additional Blocks, including Block 109/15 which was applied for and are therefore considered in this assessment. Likely significant effects for the qualifying Annex I habitats and other Annex II species were not identified in BEIS (2018a) for either of these two sites, and therefore these features are not considered to be relevant to this assessment and are not considered further.

The boundary of Cardigan Bay SAC covers a proportion of southern/central coastal waters of Cardigan Bay to 20km offshore approximately between the mouths of the rivers Teifi and Aeron. The boundary was determined to encompass all qualifying species and habitats, though primarily to include a core area of importance for a population of bottlenose dolphins, many individuals of which show a high degree of site fidelity to the SAC and wider Cardigan Bay, but some are also known to range more widely throughout the Irish Sea. This population falls within the Irish Sea Management Unit (IAMMWG 2015). The Lleyn Peninsula and the

[43] 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 November 2018).
[44] http://jncc.defra.gov.uk/pdf/NorthAngleseyMarineSelectionAssessmentDocument.pdf
[45] http://jncc.defra.gov.uk/pdf/NorthAngleseyMarineConservationObjectivesAndAdviceOnActivities.pdf

Sarnau SAC encompasses coastal waters of northern Cardigan Bay and those around the Lleyn Peninsula itself. Within this boundary, bottlenose dolphins are regularly sighted, albeit at lower rates than the Cardigan Bay SAC; they are a qualifying feature of this site and not a primary reason for site selection.

The most recent abundance estimates of bottlenose dolphins in the Cardigan Bay SAC and surrounding coastal waters in summer 2016 were presented by Lohrengel *et al.* (2018) alongside data from ongoing monitoring efforts dating back to 2001. For the wider Cardigan Bay area, line-transect surveys estimated bottlenose dolphin abundance at 289 (CV=0.23) individuals. Closed population estimates for bottlenose dolphins from capture-recapture photo-identification analysis were 147 (95%CI=127-194) in the SAC, and 174 (95%CI=150-246) in the wider Cardigan Bay. These estimates for the wider bay are within the range of those from recent years (2011-2013). Considerable inter-annual variability in abundance has been reported, likely due to the population ranging beyond the study area; an initial trend analysis on bottlenose dolphin photographic identification data indicates a decline in the last 10 years, but no significant trend in overall between 2001 and 2016 (Lohrengel *et al*. 2018). The most recent feature condition assessment (May 2017) listed the both the population and range components of the bottlenose dolphins as *favourable* (NRW 2018). The condition assessment also applies to the Lleyn Peninsula and the Sarnau SAC as it is the same population.

Since 2007, monitoring efforts have been extended to include opportunistic surveys off parts of North Wales, with a particular focus on the north coast of Anglesey. Photo-identification data has shown that individuals observed in Cardigan Bay are regularly sighted off North Wales and as far as the Isle of Man (Pesante *et al.*, 2008, Baines & Evans 2012, Evans *et al*. 2015, Lohrengel *et al*. 2018). It is apparent that a large proportion of this population spend the winter in waters off north Wales, whilst smaller numbers can be seen in this area throughout the year (Pesante *et al*. 2008). Coastal waters around the north and east coast of Anglesey appear to be of particular importance, where sightings rates are comparable to those from land- and vessel-based surveys in Cardigan Bay (Evans *et al*. 2015).

5.2 Assessment of physical disturbance and drilling effects

5.2.1 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 the Irish Sea Blocks applied for in the 31st Round and sites with relevant qualifying features, potential likely significant effects are considered to remain for eight Blocks (or part Blocks), in respect of 10 sites (Figure 5.2). These are assessed in Section 5.2.2.

5.2.2 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 has been considered against the work programmes for the Blocks applied for to determine whether they could adversely affect site integrity. The results are given in Table 5.1 below. All mandatory control 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 in the Irish Sea to be subject to further assessment for physical disturbance and drilling effects

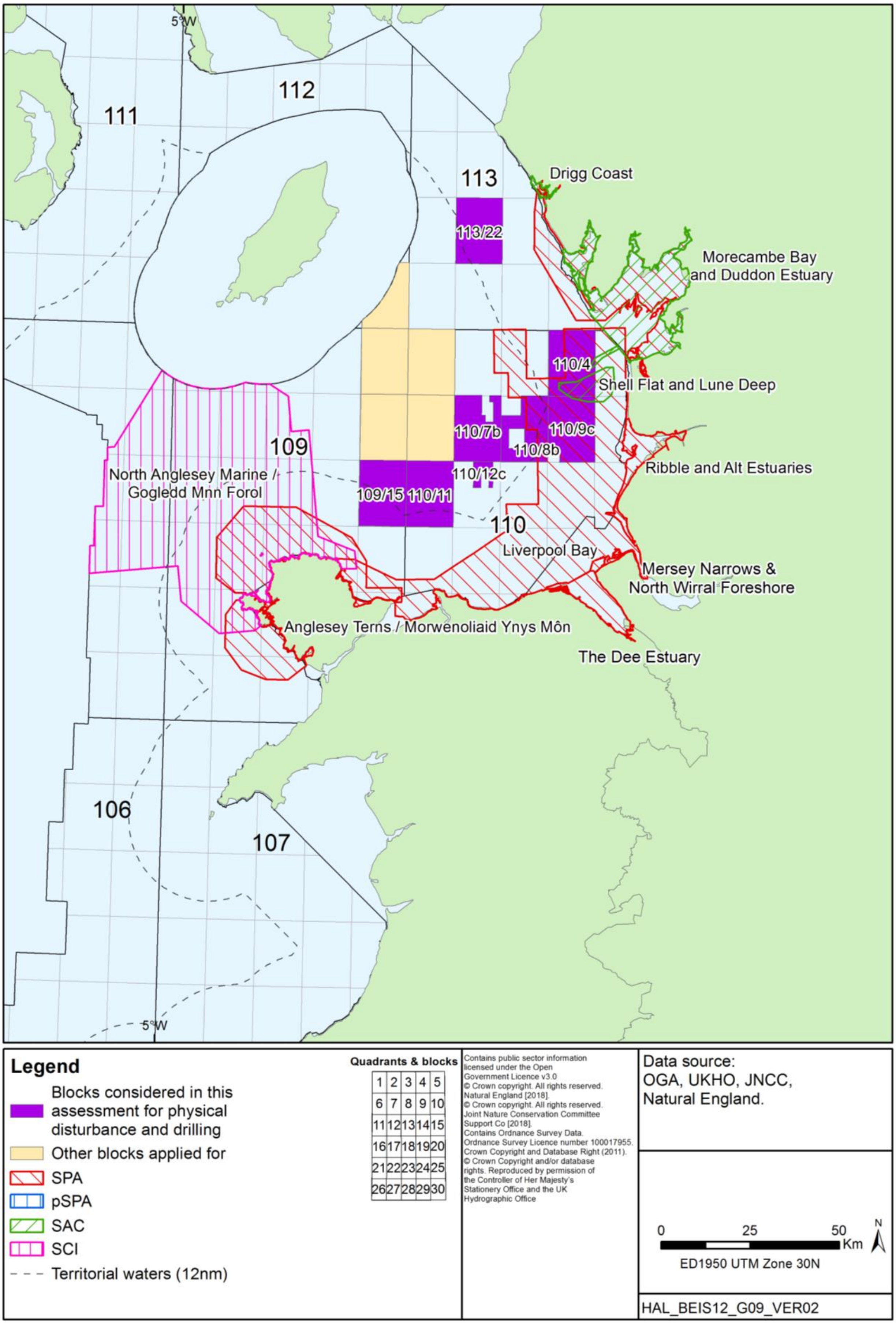


Table 5.1: Consideration of potential physical disturbance and drilling effects and relevant site conservation objectives

Morecambe Bay and Duddon Estuary SPA
Site information
Area (ha): 66,899 **Relevant qualifying features:** Breeding: common tern, sandwich tern, little tern; over winter: whooper swan, little egret, golden plover, ruff, bar-tailed godwit, Mediterranean gull, lesser black-backed gull, herring gull; On passage: pink-footed goose, shelduck, oystercatcher, ringed plover, grey plover, knot, sanderling, dunlin, black-tailed godwit, curlew, pintail, turnstone, redshank, lesser black-backed gull. Seabird (including herring gull, lesser black-backed gull, Sandwich tern, common tern, little tern) and waterbird (including great egret, spoonbill, brent goose, wigeon, teal, mallard, common eider, goldeneye, red-breasted merganser, cormorant, lapwing, little stint, common greenshank, spotted redshank) assemblage all year round. See Natura 2000 standard data form for details of qualifying features[46] **Conservation objectives:** Subject to natural change, the integrity of the site is maintained or restored as appropriate, and 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 populations of qualifying features • the distribution of qualifying features within the site Attributes and related targets have been set for the site features which are presented in the site SACO[47]. These include a number of targets to restore the supporting habitat and breeding populations of gull and tern species, and non-breeding populations of grey plover, dunlin, sanderling and turnstone.
Relevant Blocks for physical disturbance and drilling effects
110/4, 113/22
Assessment of effects on site integrity
Rig siting **(Relevant pressures:** *penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion, introduction or spread of non-indigenous species***)**[48] Blocks 110/4 and 113/22 are 3 and 9km 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 habitats of the qualifying features, and no adverse effects on site integrity are predicted. There may be a requirement for rig stabilisation depending on local seabed conditions (Block 113/22 and part of Block 110/4 are within the east Irish Sea Mudbelt). However, it is assumed that rock placement (if required) would be within a spatial footprint of 0.8km^2 (500m of a rig, Table 2.2). It should be noted that the advice on operations does not identify physical change (to another seabed type) as a relevant pressure. Given that the Block is at least 3km from the site boundary, the potential loss of extent of any supporting habitat (outside of the site boundaries) would be small compared to the extent of the circalittoral fine sand and sandy mud habitat across the Block and the wider region. It is concluded that the site conservation objectives will not be undermined and there will be no adverse effect on site integrity. Further assessment, including HRA where appropriate, would be undertaken at the project level, at which stage the assessment would be informed by specific rig siting information.

[46] http://jncc.defra.gov.uk/pdf/SPA/UK9020326.pdf

[47] https://designatedsites.naturalengland.org.uk/Marine/FAPMatrix.aspx?SiteCode=UK9020326&SiteName=&SiteNameDisplay=Morecambe+Bay+and+Duddon+Estuary+SPA&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=

[48] https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK9020326

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
(Relevant pressures: *abrasion/disturbance of the substrate on the surface of the seabed; habitat structure changes – removal of substratum, contamination).*

It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2). Therefore, drilling discharges will not significantly impact the extent and distribution or the structure and function of the habitats of the qualifying features for any Blocks identified as relevant as these are at least 3km from the site boundaries. In any case, the small scale and temporary nature of potential smothering, and mandatory control 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.

Other effects
(Relevant pressures: *visual disturbance, above water noise***)**

Blocks 110/4 and 113/22 are not located within the site and the potential for disturbance to impact the distribution of qualifying features is therefore primarily associated with the movement of supply vessels and helicopters to drilling rigs. Of the qualifying features likely to be present within the site, breeding common tern, sandwich tern, lesser black-backed gull and herring gull are all moderately sensitive to disturbance by ship and helicopter traffic (Garthe & Hüppop 2004). Both Blocks 110/4 and 113/22 are currently exposed to high shipping densities, and the temporary nature of drilling activities and limited number of associated supply vessel and helicopter trips (Table 2.2), is unlikely to represent a significant increase in the level of disturbance of moderately sensitive qualifying features. Further control measures are also available (Section 5.2.3) 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 neither relevant Block (110/4 and 113/22) are located within the site and are distant from one another (~22km). Therefore, the likelihood of in-combination footprint effects is extremely low. There is the potential for in-combination effects associated with the presence and movement of supply vessels to rigs within each of the Blocks. However, given the existing high shipping densities and the limited and temporary supply vessel traffic (see Table 2.2) intra-plan effects are not considered likely for the two Blocks. Further control measures are also available (Section 5.2.3) and will be required, where appropriate, to ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity. Section 5.4 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

Ribble and Alt Estuaries SPA

Site information

Area (ha): 12,450
Relevant qualifying features:
Breeding: common tern, ruff; on passage: ringed plover, sanderling, redshank, whimbrel; over winter: bar-tailed godwit, Bewick's swan, golden plover, whooper swan, lesser black-backed gull, black-headed gull, pintail, teal, wigeon, pink-footed goose, scaup, sanderling, dunlin, knot, oystercatcher, black-tailed godwit, common scoter, curlew, cormorant, grey plover, shelduck, redshank, lapwing. Breeding seabird (including lesser black-backed gull, black-headed gull, common tern) and overwintering waterbird (including cormorant, Bewick's swan, whooper swan, pink-footed goose, shelduck, wigeon, teal, pintail, scaup, common scoter, oystercatcher, ringed plover, golden plover, grey plover, lapwing, red knot, sanderling, dunlin, black-tailed godwit, bar-tailed godwit, whimbrel, curlew, redshank) assemblages. See Natura 2000 standard data form for details of qualifying features.[49]

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

[49] http://jncc.defra.gov.uk/pdf/SPA/UK9005103.pdf

• 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 • the distribution of the qualifying features within the site Attributes and related targets have been set for the site features which are presented in the site SACO[50]. These include a number of targets to restore the abundance and diversity of the breeding seabird assemblage, and the abundance of common tern.
Relevant Blocks for physical disturbance and drilling effects
110/9c
Assessment of effects on site integrity
Potential effects on the breeding common tern qualifying features when foraging outside of the SPA within the Liverpool Bay SPA are considered against that site separately below. **Rig siting** **(Relevant pressures:** *penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion; physical change (to another seabed type), introduction or spread of non-indigenous species*)[51] Block 110/9c is a minimum of 7.5km 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 within the site, or those outside of site boundaries which may be used by individuals foraging away from colonies. Common terns forage outside of the site boundaries within the Liverpool Bay SPA for which they are also a qualifying feature, and therefore potential effects on the foraging habitat of this species is considered separately below. With the exception of gull species, the foraging habitats of the remaining species are coastal and there is no foreseeable interaction with these from rig siting. Adverse effects on site integrity are not predicted. There may be a requirement for rig stabilisation depending on local seabed conditions (part of Block 110/9c is within the east Irish Sea Mudbelt). However, it is assumed that rock placement (if required) would be within a spatial footprint of 0.8km^2 (500m of a rig, Table 2.2). It should be noted that the advice on operations does not identify physical change (to another seabed type) as a relevant pressure. Given that the Block is at least 7.5km from the site boundary, the potential loss of extent of any supporting habitat (outside of the site boundaries) would be small compared to the extent of the circalittoral fine sand and sandy mud habitat across the Block and the wider region. Moreover, further mitigation measures are available which include use of removable mud mats or anti-scour mats as an alternative to rock placement (Section 5.2.3). It is concluded that the site conservation objectives will not be undermined and there will be no adverse effect on site integrity. Further assessment, including HRA where appropriate, would be undertaken at the project level, at which stage the assessment would be informed by specific rig siting information. 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** **(Relevant pressures:** *abrasion/disturbance of the substrate on the surface of the seabed; habitat structure changes - removal of substratum (extraction), contaminants*) It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2). Therefore, drilling discharges will not significantly impact the extent and distribution or the structure and function of the habitats of the qualifying features for Blocks 110/9c as it is 7.5km from the site boundaries. In any case, the small scale and temporary nature of potential smothering, and mandatory control requirements with respect to

50 https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK9020326&SiteName=morecambe&SiteNameDisplay=Morecambe+Bay+and+Duddon+Estuary+SPA&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=

51 https://designatedsites.naturalengland.org.uk/Marine/FAPMatrix.aspx?SiteCode=UK9005103&SiteName=&SiteNameDisplay=Ribble+and+Alt+Estuaries+SPA&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=

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.

Other effects
(Relevant pressures: *visual disturbance, above water noise***)**

As the Block is outside of the site boundary, the potential for disturbance to impact the distribution of qualifying features within the site is primarily associated with the movement of supply vessels and helicopters to drilling rigs. The qualifying features are sensitive to visual disturbance and airborne noise although these are low risk pressures[52]. Block 110/9c is exposed to low shipping densities[53] and the temporary nature of drilling activities and limited number of associated supply vessel and helicopter trips (Table 2.2), is unlikely to represent a significant increase in the level of disturbance of the site qualifying features. Further control measures are available (Section 5.2.3) 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 the Block is outside of the site boundary. There is the potential for in-combination effects associated with the presence and movement of supply vessels to rigs within the Block and other adjacent Blocks which may be licensed in the 31st Round. However, given the limited and temporary supply vessel traffic (see Table 2.2) and the potential for a high level of spatial and temporal separation of any 31st Round activities (the duration of the initial term being up to 9 years), intra-plan effects are not considered likely for the Block. Section 5.4 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

Liverpool Bay/Bae Lerpwl SPA

Site information

Area (ha): 252,773
Relevant qualifying features:
Breeding: little tern, common tern; Over winter: red-throated diver, little gull, common scoter
Wintering waterbird assemblage (including red-throated diver, little gull, common scoter, cormorant, red-breasted merganser). See Natura 2000 standard data form for details of qualifying features [54]

Conservation objectives:
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
- the distribution of the qualifying features within the site

Relevant Blocks for physical disturbance and drilling effects

109/15, 110/4, 110/7b, 110/8b, 110/9c, 110/11, 110/12c

Assessment of effects on site integrity

Rig siting
(**Relevant pressures:** *penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion; physical change (to another seabed type), introduction or spread of non-indigenous species*)[55]

52 https://designatedsites.naturalengland.org.uk/Marine/FAPMatrix.aspx?SiteCode=UK9005103&SiteName=&SiteNameDisplay=Ribble+and+Alt+Estuaries+SPA&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=
53 https://www.ogauthority.co.uk/media/1419/29r_shipping_density_table.pdf, https://data.gov.uk/dataset/vessel-density-grid-2015
54 http://jncc.defra.gov.uk/pdf/SPA/UK9020294.pdf
55 http://publications.naturalengland.org.uk/file/5733149452009472 - note that the "pressure" nomenclature has changed since the publication of the Regulation 35 advice for Liverpool Bay SPA. For the purposes of this assessment, they have been reviewed against the current JNCC pressure-activity database (JNCC 2018) and those considered to be relevant are listed and considered above.

Blocks 109/15, 110/11, 110/12c, and 110/7b are all at least 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 habitats of the qualifying features. This includes the potential requirement for rig stabilisation measures, which 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. Seabed sediments in Blocks which overlap the site (110/4, 110/8b and 110/9c) are likely to consist of circalittoral fine sand and sandy mud which are widespread. It is assumed that if rock placement is required it would be within 500m of a rig and based on a review of submitted ESs could cover an area of 0.001-0.004km^2 (Table 2.2). Hence, the potential loss of extent of sediment is small compared to the widespread nature of these sediment types across the large site (2,258km^2). Further mitigation measures are available which include use of removable mud mats or anti-scour mats as an alternative to rock placement (Section 5.2.3). Such measures will be required, where appropriate, to ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity. Further assessment, including HRA where appropriate, would be undertaken at the project level, at which stage the assessment would be informed by specific rig siting information.

Blocks 110/4, 110/8b and 110/9c are partly or entirely within the site and coincide with foraging areas for little gull (Lawson *et al.* 2015). The foraging ranges of common and little terns are such that these species are unlikely (common tern) or highly unlikely (little tern) to interact with the relevant Blocks. The closest Block to the relevant colony SPAs (110/9c) is 25km from the Mersey Narrows and North Wirral Foreshore SPA, compared to a reported mean maximum foraging range for common tern of 15.2km, while Block 110/9c is 30km from The Dee Estuary SPA, compared to a reported mean maximum foraging range for little tern of 6.3km (Thaxter *et al*. 2012). Blocks 110/8b and 110/4 have 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. In the event that a rig is placed in these Blocks, or Block 110/9c, the maximum spatial footprint of physical damage associated with jack-up rig siting is small (0.8km^2) relative to the size of the site, and effects would be temporary.

The eastern half of Blocks 110/4 and 110/9c partly coincide with an area of high common scoter density over winter (Lawson *et al.* 2016), the distribution of which is strongly associated with the distribution of its benthic prey species (Kaiser *et al*. 2006). Wintering red-throated diver occur throughout much of the Liverpool Bay SPA, through with greatest densities off the Ribble Estuary, North Wales and the North Wirral Foreshore (Webb *et al.* 2006), likely coinciding with sandbanks which support key prey species. Benthic communities of sandy sediments are in general relatively resilient to physical damage. However, repeated damage to the habitats (through changes in suspended sediment or physical disturbance such as anchoring) could adversely affect the ability of the habitats to recover, leading to permanent damage and ultimately lead to loss of prey species. This may result in a reduction in the value of habitats as foraging sites for the overwintering populations of common scoter and red-throated diver. Therefore, the overall sensitivity of common scoter and red-throated diver to damage to their habitat is considered to be moderate in the case of siltation and abrasion impacts, but with a low sensitivity in the area due to a low level of exposure. A single well may be drilled in either of Blocks 110/4 and 110/9c, thus limiting the potential for repeated damage to supporting habitats.

In view of the physical scale and temporary nature of the activities, site conservation objectives will not be undermined as a result of abrasion/disturbance resulting from rig siting or the use of stabilisation materials, and there will be 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
(**Relevant pressures:** *abrasion/disturbance of the substrate on the surface of the seabed; habitat structure changes - removal of substratum (extraction*), *contaminants)*

It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2). Therefore, with respect to Blocks 109/15, 110/11, 110/12c, and 110/7b which are at least 2km outside of the site, drilling discharges will not result in any impact on the extent and distribution, or structure and function of the habitats of the qualifying features. However, for those Blocks located partly or wholly within the site (as in the case of Blocks 110/4, 110/8b and 110/9c), the maximum spatial footprint within which smothering by drilling discharges may occur (0.8km^2) is small (representing a maximum of 0.095% of the total site area for 3 potential wells). Physical loss by smothering of any of the habitats on which common scoter depend may result in the loss of foraging sites and therefore the reduction of the food resource for the overwintering population. This would consequently be detrimental to the favourable condition of the interest feature. Thus, the overwintering population is considered to be highly sensitive to physical loss of habitat through its removal or smothering. However, the small scale (as compared to the extent of supporting habitat) and temporary nature of potential smothering, and mandatory control 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.

Other effects
(**Relevant pressures:** *visual disturbance, above water noise*)

Red-throated diver, common scoter and the cormorant feature of the wintering waterbird assemblage are highly sensitive to disturbance from ship and helicopter traffic (Garthe & Hüppop 2004, also see Schwemmer *et al.* 2011 and Mendel *et al.* 2019) and by extension, are likely to be equally sensitive to other sources of non-physical disturbance, especially those creating noise and/or movement. Disturbance can cause birds to reduce or cease feeding in a given area or to fly away from an area (i.e. be displaced), and advice on operations for the Liverpool Bay SPA notes that vulnerability to such disturbance is high for both the common scoter and red-throated diver features. Given that most of the Blocks are outside of the site or have areas outside of the site boundaries, the potential for disturbance to impact the distribution of qualifying features within the site is primarily associated with the movement of supply vessels and helicopters to drilling rigs (that may be located outside of the site, with the exception of Block 110/9c which is wholly within the site). The Blocks are already exposed to high shipping densities[56] and the temporary and localised nature of drilling activities and limited number of associated supply vessel and helicopter trips (see Table 2.2) is unlikely to represent a significant increase in the level of disturbance of sensitive qualifying features. Further mitigation measures are available (Section 5.2.3) 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 are unlikely to overlap spatially or temporally between Blocks, or with the site (three Blocks are partly or wholly inside the site, and it is highly unlikely that a well will be drilled in each). 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 wells are unlikely to coincide either spatially or temporally to such an extent that the level of disturbance would lead to significant adverse impacts on the population or distribution of sensitive qualifying features. Section 5.4 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

Anglesey Terns / Morwenoliaid Ynys Môn SPA

Site information

Area (ha): 101,931
Relevant qualifying features:
Breeding roseate tern, common tern, Arctic tern and Sandwich tern. See Natura 2000 standard data form for details of qualifying features[57]

Conservation objectives:
The following draft conservation objectives relate to all of the features for the site:

- The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term
- The distribution of the population should be being maintained, or where appropriate increasing
- There should be sufficient habitat, of sufficient quality, to support the population in the long term
- Factors affecting the population or its habitat should be under appropriate control

Each of the above points are defined in the draft objectives in relation to roseate tern, common tern, Arctic tern and Sandwich tern[58].

Relevant Blocks for physical disturbance and drilling effects

109/15

[56] https://www.ogauthority.co.uk/media/1419/29r_shipping_density_table.pdf, https://data.gov.uk/dataset/vessel-density-grid-2015
[57] http://jncc.defra.gov.uk/pdf/SPA/UK9013061.pdf
[58] https://cdn.naturalresources.wales/media/675726/anglesey-terns-pspa-draft-conservation-objectives-final.pdf?mode=pad&rnd=131625760740000000

Assessment of effects on site integrity
Rig siting **(Relevant pressures:** *No relevant pressures identified in available site information. The following pressures have been considered on the basis of their relevance to similar sites and the activities associated with oil and gas exploration: penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion; physical change (to another seabed type), introduction or spread of non-indigenous species***)** The site boundary was selected on the basis of the foraging area for each tern species determined using a combination of observed behaviour and environmental variables (see Section 5.1). In view of the distance between Block 109/15 and the site boundary (3.5km), and the distance from a jack-up rig within which effects may occur (500m, see Table 2.2), rig installation and any associated stabilisation (if required) will not significantly impact the extent and distribution of the habitats of the qualifying features. No adverse effect on site integrity. **Drilling discharges** **(Relevant pressures:** *No relevant pressures identified in available site information. The following pressures have been considered on the basis of their relevance to similar sites and the activities associated with oil and gas exploration: abrasion/disturbance of the substrate on the surface of the seabed; habitat structure changes – removal of substratum, contamination).* It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2). Therefore, in view of the distance between Block 109/15 and the site boundary (3.5km), 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. **Other effects** **(Relevant pressures:** *No relevant pressures identified in available site information. The following pressures have been considered on the basis of their relevance to similar sites and the activities associated with oil and gas exploration: visual disturbance, above water noise***)** Given that the Block is outside of the site boundary, which was selected based on areas of high tern usage (see Section 5.1), the potential to impact the distribution of qualifying features within the site is primarily associated with the movement of supply vessels and helicopters to drilling rigs, noting that the qualifying features are moderately sensitive to disturbance by shipping (Garth & Hüppop 2004). Typical helicopter routes taken to facilities in the Irish Sea are such that they are unlikely to interact with the site[59]. The southern and central parts of Block 109/15 are exposed to moderate to high shipping densities from vessels travelling between Liverpool and the IMO traffic separation scheme to the north of Anglesey, with other parts of the Block experiencing relatively low levels of traffic[60]. The temporary nature of drilling activities and limited number of associated supply vessel and helicopter trips (Table 2.2), is unlikely to represent a significant increase in the level of disturbance of the site qualifying features. Further control measures are available (Section 5.2.3) 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 the Block is outside of the site boundary. There is the potential for in-combination effects associated with the presence and movement of supply vessels to rigs within the Block. However, given the existing moderate to high shipping densities and the limited and temporary supply vessel traffic (see Table 2.2) intra-plan effects are not considered likely for the Block. Section 5.4 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

[59] http://www.ead.eurocontrol.int/eadbasic/pamslight-81072FDBD0B24F4CBA8C115950435376/7FE5QZZF3FXUS/EN/Charts/ENR/AIRAC/EG_ENR_6_1_15_7_en_2017-12-07.pdf
[60] https://www.ogauthority.co.uk/media/1419/29r_shipping_density_table.pdf, https://data.gov.uk/dataset/vessel-density-grid-2015

Drigg Coast SAC
Site information
Area (ha): 1,397 **Relevant qualifying features:** estuaries, coastal dunes, mudflats and sandflats, saltmarsh and salt meadows. See Natura 2000 standard data form for details of qualifying features[61] **Conservation objectives:** With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), 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 • the structure and function of the habitats of 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 Attributes and related targets have been set for the site features which are presented in the site SACO[62].
Relevant Blocks for physical disturbance and drilling effects
113/22
Assessment of effects on site integrity
Rig siting **(Relevant pressures:** *penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion; physical change (to another seabed type), introduction or spread of invasive non-indigenous species*)[63] In view of the distance between Block 113/22 and the site boundary (at least 8.5km), and the distance from a jack-up rig within which effects may occur (500m, see Table 2.2), rig installation and any associated stabilisation (if required) will not significantly impact the extent and distribution of the qualifying habitats, or their related species, and there will be no adverse effect on site integrity. **Drilling discharges** **(Relevant pressures:** *abrasion/disturbance of the substrate on the surface of the seabed; habitat structure changes - removal of substratum (extraction), contaminants***)** It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2). Therefore, in view of the distance between Block 113/22 and the site boundary (8.5km), 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. **Other effects** None **In-combination effects** In view of the distance of all of the Blocks applied for from the site, and the relative spatial and temporal separation of activities which could follow licensing, no intra-plan in-combination effects are considered to be likely. Section 5.4 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

[61] http://publications.naturalengland.org.uk/file/3019081

[62] https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK0013031&SiteName=drigg+coast&SiteNameDisplay=Drigg+Coast+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=

[63] https://designatedsites.naturalengland.org.uk/Marine/FAPMatrix.aspx?SiteCode=UK0013031&SiteName=drigg%20coast&SiteNameDisplay=Drigg+Coast+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=

Morecambe Bay SAC
Site information
Area (ha): 61,506 **Relevant qualifying features:** estuaries, mudflats and sandflats, inlets and bays, vegetation of stony banks, saltmarsh and salt meadows, coastal dunes, sandbanks, coastal lagoons, reefs, great crested newt. See Natura 2000 standard data form for details of qualifying features[64] **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 • 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 • the distribution of qualifying species within the site Attributes and related targets have been set for the site features which are presented in the site SACO[65].
Relevant Blocks for physical disturbance and drilling effects
110/4
Assessment of effects on site integrity
Rig siting **(Relevant pressures:** *penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion; physical change (to another seabed type), introduction or spread of invasive non-indigenous species*) [66] In view of the distance between Block 110/4 and the site boundary (approximately 2km), and the distance from a jack-up rig within which effects may occur (500m, see Table 2.2), rig installation and any associated stabilisation (if required) will not significantly impact the extent and distribution of the qualifying habitats, or their related species, and there will be no adverse effect on site integrity. **Drilling discharges** **(Relevant pressures:** *abrasion/disturbance of the substrate on the surface of the seabed; habitat structure changes – removal of substratum, contamination).* It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2). Therefore, in view of the distance between Block 110/4 and the site boundary (2km), 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. **Other effects** None **In-combination effects** In view of the distance of all of the Blocks applied for from the site, and the relative spatial and temporal separation of activities which could follow licensing, no intra-plan in-combination effects are considered to be likely. Section 5.4 provides a consideration of potential Block activities in-combination with other relevant plans

[64] http://jncc.defra.gov.uk/protectedsites/sacselection/n2kforms/UK0013027.pdf

[65] https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK0013027&SiteName=morecambe&SiteNameDisplay=Morecambe+Bay+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=

[66] https://designatedsites.naturalengland.org.uk/Marine/FAPMatrix.aspx?SiteCode=UK0013027&SiteName=morecambe&SiteNameDisplay=Morecambe+Bay+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=

and projects.
Shell Flat and Lune Deep SAC
Site information
Area (ha): 10,565 **Relevant qualifying features:** Sandbanks which are slightly covered by sea water all the time, reefs. See Natura 2000 standard data form for details of qualifying features[67] **Conservation objectives:** The objectives are to 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 Attributes and related targets have been set for the site features which are presented in the site SACO[68].
Relevant Blocks for physical disturbance and drilling effects
110/4, 110/8b, 110/9c
Assessment of effects on site integrity
Rig siting **(Relevant pressures:** *penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion; physical change (to another seabed type), introduction or spread of invasive non-indigenous species*)[69] Block 110/8b is a minimum of 3.5km 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 qualifying features. Blocks 110/4 and 110/9c have significant areas outside the site boundaries in which rig siting would be possible (note that only one well is likely to be drilled), and therefore interaction with 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 ($0.8km^2$) relative to the size of the site (approximately $96km^2$ covering the Shell Flat sandbank and $9km^2$ covering Lune Deep), but the qualifying features are sensitive to disturbance and abrasion pressures. Recovery from physical damage of the scale associated with rig placement would be rapid for Shell Flat in light of typical sandbank communities which are adapted to erosion and accretion; the more stable boulder and bedrock reef of Lune Deep being more sensitive to abrasion/disturbance[70]. Further mitigation measures are available (Section 5.2.3) and will be required, where appropriate, to ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity. The requirement for rig stabilisation measures would be determined by site survey of local conditions. In soft sediments (which includes the circalittoral muds and muddy sands covering much of the relevant Blocks), rock placement may cause smothering of existing sediments and a physical change of seabed type. With respect to Blocks 110/4 and 110/9c, there are significant areas outside of the site boundaries in which rig siting and stabilisation would be possible, and therefore interaction with the qualifying features could be avoided. If located within the site, it is assumed that if rock placement is required it would be within 500m of a rig and based on a

67 http://jncc.defra.gov.uk/protectedsites/sacselection/n2kforms/UK0030376.pdf

68 https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK0030376&SiteName=shell%20flat&SiteNameDisplay=Shell+Flat+and+Lune+Deep+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=

69 https://designatedsites.naturalengland.org.uk/Marine/FAPMatrix.aspx?SiteCode=UK0030376&SiteName=shell+flat&SiteNameDisplay=Shell+Flat+and+Lune+Deep+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=

70 http://publications.naturalengland.org.uk/file/3268971

review of submitted ESs it could cover an area of 0.001-0.004km^2 (Table 2.2), which is small relative to the overall size of the site. Further mitigation measures are available (see Section 5.2.3) and will be required, where appropriate, to ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity. Further assessment, including HRA where appropriate, would be undertaken at the project level, at which stage the assessment would be informed by specific rig siting information. 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** **(Relevant pressures:** *abrasion/disturbance of the substrate on the surface of the seabed; habitat structure changes - removal of substratum (extraction)***)** 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 features given the distance of Block 110/8b. With respect to Blocks 110/4 and 110/9c, as mentioned above 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. The qualifying features are sensitive to smothering and siltation rate changes, however it is noted that this is generally low for Lune Deep due to the high degree of natural sediment influence there and relatively high level of recoverability, and also for Shell Flat due to frequent disturbance and recoverability[70]. The small scale and temporary nature of potential smothering and the potential for further mitigation measures to be implemented once project plans are known (Section 5.2.3), will ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity. **Other effects** None. **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 only one well is likely to be drilled in any of the Blocks, and those others applied for are some distance from the Shell Flat and Lune Deep SAC. Section 5.3 provides a consideration of potential Block activities in-combination with other relevant plans and projects.
North Anglesey Marine / Gogledd Mnn Forol SCI
Site information
Area (ha): 324,949 **Relevant qualifying features:** harbour porpoise. See Natura 2000 standard data form for details of qualifying features[71] **Conservation objectives:** To avoid deterioration of the habitats of the harbour porpoise or significant disturbance to the harbour porpoise, thus ensuring that the integrity of the site is maintained, and the site makes an appropriate contribution to maintaining Favourable Conservation Status for the UK harbour porpoise. To ensure for harbour porpoise that, subject to natural change, the following attributes are maintained or restored in the long term: • 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
109/15
Assessment of effects on site integrity
Rig siting **(Relevant pressures:** *No relevant pressures identified in available site information[72]. Given draft nature of advice, the following potential pressures are also assessed: penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion; physical change (to another seabed type)***)**

[71] http://jncc.defra.gov.uk/protectedsites/sacselection/n2kforms/UK0030398.pdf
[72] http://jncc.defra.gov.uk/pdf/NorthAngleseyMarineConservationObjectivesAndAdviceOnActivities.pdf

The delineation of the North Anglesey Marine site was based on the prediction of 'harbour porpoise habitat' within the wider UK seas, including the Irish Sea (Heinänen & Skov 2015). The analysis indicated a preference for shallow water depths (<40m) throughout the year, with current speed, eddy potential and the coarseness of the seabed sediment (such as sand/gravel)[73] also being important. Physical damage to benthic habitats through disturbance or abrasion by the placement of spud cans as part of rig installation or smothering of existing sediments and a physical change of seabed type from the placement of rig stabilisation material (if required), 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 109/15 which is beyond this distance from the site (at least 6.5km).

Drilling discharges
(Relevant pressures: *Contaminants. Given draft nature of advice, the following potential pressures also assessed: abrasion/disturbance of the substrate on the surface of the seabed; habitat structure changes – removal of substratum***)**

It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2). Therefore, with respect to Block 109/15, 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.

Other effects
None

In-combination effects
In view of the distance of all of the Blocks applied for from the site, and the relative spatial and temporal separation of activities which could follow licensing, no intra-plan in-combination effects are considered to be likely. Section 5.4 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

5.2.3 Further mitigation measures

Further mitigation measures are available which are identified through the EIA process and operator's environmental management system 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 or consider utilising systems (e.g. anti-scour mats, mud mats) that can be removed following drilling. For those Blocks where proposed activities could result in the physical disturbance of overwintering divers 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.

[73] http://jncc.defra.gov.uk/pdf/NorthAngleseyMarineSelectionAssessmentDocument.pdf

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.

5.2.4 Conclusions

Likely significant effects identified with regards to physical damage to the seabed, drilling discharges and other effects (see Section 5.2.2) when considered along with project level mitigation (Section 5.2.3) and relevant activity permitting (see Sections 2.3), 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[74] 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 Blocks 109/15, 110/4, 110/7b, 110/8b, 110/9c, 110/11, 110/12c, 113/22, 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. Following award of any licence, consent for activities will not be granted unless the operator can demonstrate that the proposed activities will not have an adverse effect on the integrity of relevant sites.

5.3 Assessment of underwater noise effects

5.3.1 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, the location of Irish Sea Blocks applied for in the 31st Round and the sites with relevant qualifying features, potential likely significant effects are considered to remain for 11 Blocks (or part Blocks), in respect of six sites (Figure 5.2).

5.3.2 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 altering 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. All mandatory control requirements (as given in Section 2.3.2) are assumed to be in place as a standard for all activities assessed at this stage.

[74] The *Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended)*

Figure 5.2: Sites and Blocks in the Irish Sea to be subject to further assessment for underwater noise effects

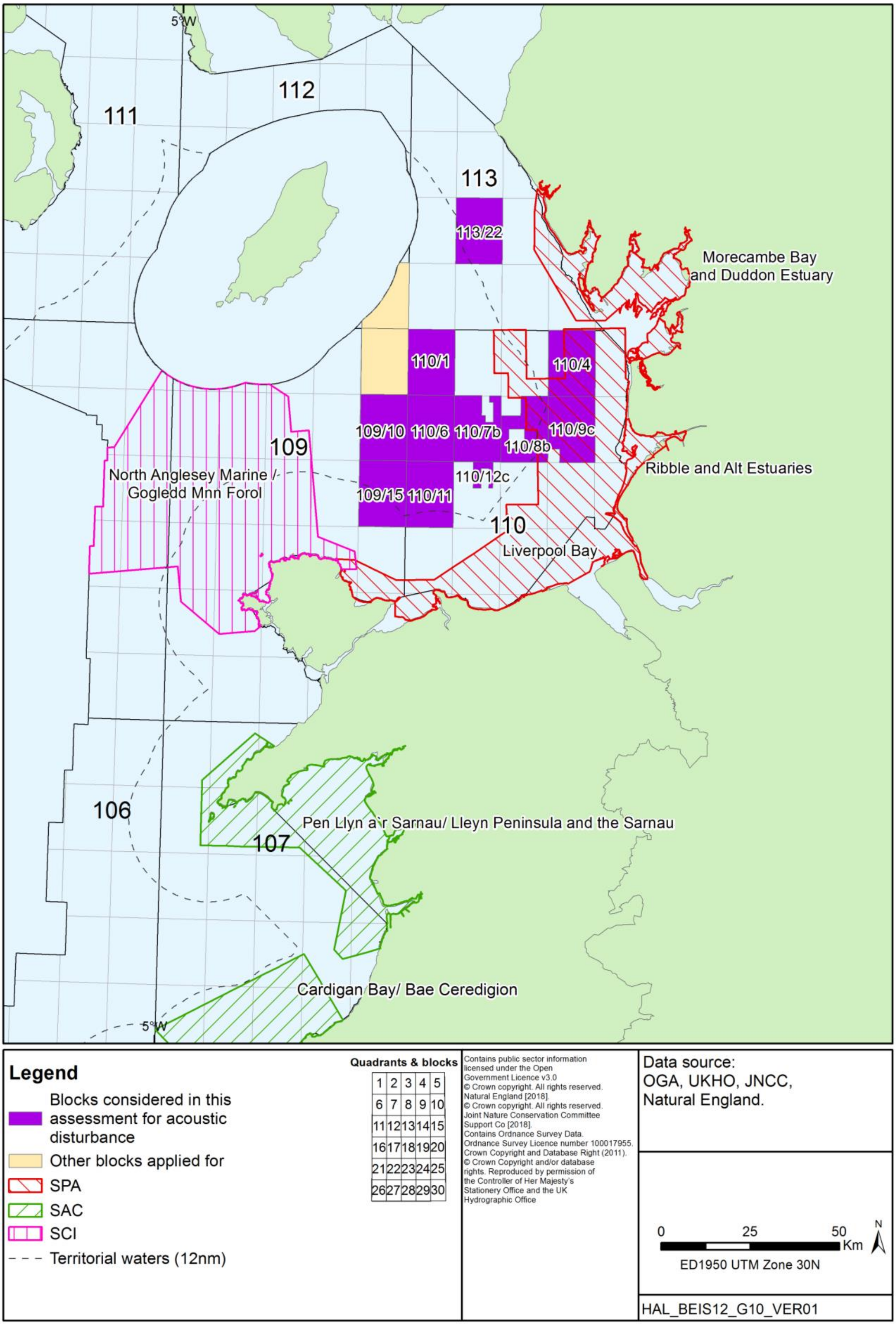


Table 5.2: Consideration of potential underwater noise effects and relevant site conservation objectives

Morecambe Bay and Duddon Estuary SPA
Site information
Area (ha): 66,899.97 **Relevant qualifying features (diving species only):** Year-round waterbird assemblage (including eider, goldeneye, red-breasted merganser, cormorant) **Conservation objectives:** See Table 5.1 above.
Relevant Blocks for underwater noise effects
110/4, 110/9c, 113/22
Assessment of effects on site integrity
None of the relevant Blocks overlap the site; Block 110/9c lies within 3km of the site boundary, while Blocks 110/4 and 113/22 are 8 and 13km distant, respectively. The qualifying species all favour shallow, coastal waters and are unlikely to spend significant time, or occur in significant numbers, in waters offshore of the site boundaries. **Impulsive noise (rig site survey, VSP, conductor piling)** *(**Relevant pressures:** underwater noise change, vibration)* The licence applications for the relevant Blocks do not propose any new 3D seismic survey within their work programmes. Consequently, rig site survey, VSP and conductor piling are the relevant sources of impulsive noise, all of which are of a lower amplitude, shorter duration and smaller geographic footprint compared to larger scale 2D or 3D seismic survey. As detailed in Section 4.3.2, there is very little evidence of impacts of underwater noise on diving birds. Mortality of seabirds has not been observed during extensive seismic operations in the North Sea and elsewhere, and flushing disturbance associated with the physical presence of survey vessels and rigs would be expected to displace most diving seabirds from close proximity to noise sources. Such avoidance behaviour is also expected to reduce the potential for diving birds to be exposed to noise levels which may result in potential behavioural disturbance, although it is noted that very little evidence for such effects exist and, should they occur, they would be expected to be short-term, temporary and of limited spatial extent. Negative indirect effects of impulsive noise on qualifying features may arise through effects on prey species, primarily small fish, if those prey are subject to injury or disturbance which reduce their availability to qualifying seabirds. Such effects are not anticipated for eider or goldeneye, as their diet in coastal habitats is largely restricted to molluscs and crustaceans. While there is evidence that a reduction in fish catches 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). The disturbance of sensitive spawning periods for potential fish prey species will also 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 diving bird features. Considering the above, particularly the noise source characteristics and distance between the relevant Blocks and the site; when combined with mandatory control measures (Section 2.3.2), disturbance to qualifying features or their prey is highly unlikely and should any such effects occur, they will be highly localised, short-term, and will not result in an adverse effect on site integrity. **Continuous noise (drilling, vessel & rig movements)** *(**Relevant pressures:** underwater noise change, vibration)* No significant effects on the relevant qualifying species are anticipated from continuous underwater noise from drilling and vessel movements due to the lower amplitude and non-impulsive nature of the sound resulting in no potential for acute trauma and no evidence of significant disturbance to diving birds from such sources. **In-combination effects** Intra-plan in-combination underwater noise effects are considered highly unlikely given the low potential for effects identified above and the lack of any overlap between relevant Blocks and the site. Section 5.4 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

Ribble and Alt Estuaries SPA
Site information
Area (ha): 12,361.13 **Relevant qualifying features (diving species only):** Overwintering waterbird assemblage (including cormorant, common scoter) **Conservation objectives:** See Table 5.1 above.
Relevant Blocks for underwater noise effects
110/4, 110/9c
Assessment of effects on site integrity
None of the relevant Blocks overlap the site; Block 110/9c lies a minimum of 7km west of the site boundary off the mouth of the Ribble estuary, while Block 110/4 is >10km to the northwest of the site. The cormorant and common scoter qualifying features may use areas outside of the site boundaries as they move between adjacent bays/estuaries and coastal waters; however, their occurrence in these areas and likely interaction with relevant Blocks is considered through their listing as qualifying features of the neighbouring Liverpool Bay SPA and Morecambe Bay and Duddon Estuary SPA. **Impulsive noise (rig site survey, VSP, conductor piling)** *(**Relevant pressures:** underwater noise change, vibration)* The licence applications for the relevant Blocks do not propose any new 3D seismic survey within their work programmes. Consequently, rig site survey, VSP and conductor piling are the relevant sources of impulsive noise, all of which are of a lower amplitude, shorter duration and smaller geographic footprint compared to larger scale 2D or 3D seismic survey. As detailed in Section 4.3.2, there is very little evidence of impacts of underwater noise on diving birds. Mortality of seabirds has not been observed during extensive seismic operations in the North Sea and elsewhere, and flushing disturbance associated with the physical presence of survey vessels and rigs would be expected to displace most diving seabirds from close proximity to noise sources, particularly in the case of common scoter which are known to display a large avoidance radius of vessels and surface infrastructure (up to several kilometres). Such avoidance behaviour is also expected to reduce the potential for diving birds to be exposed to noise levels which may result in potential behavioural disturbance, although it is noted that very little evidence for such effects exist and, should they occur, they would be expected to be short-term, temporary and of limited spatial extent. The diet of common scoter in the non-breeding season is dominated by sessile bivalve molluscs; as such, underwater noise effects on prey species are not anticipated. While cormorant are piscivorous and their fish prey species have the potential to be temporarily displaced by underwater noise; however, such effects are considered highly unlikely to significantly impact upon the qualifying feature given nature of the noise source and distance between the Block and the site. Considering the above, particularly the noise source characteristics and distance between the relevant Blocks and the site; when combined with mandatory control measures (Section 2.3.2), disturbance to qualifying features or their prey is highly unlikely and should any such effects occur, they will be highly localised, short-term, and will not result in an adverse effect on site integrity. **Continuous noise (drilling, vessel & rig movements)** *(**Relevant pressures:** underwater noise change, vibration)* No significant effects on the relevant qualifying species are anticipated from continuous underwater noise from drilling and vessel movements due to the lower amplitude and non-impulsive nature of the sound resulting in no potential for acute trauma and no evidence of significant disturbance to diving birds from such sources. **In-combination effects** Intra-plan in-combination underwater noise effects are considered highly unlikely given the low potential for effects identified above and that there are only two Blocks relevant to the site for such effects, both of which are ≥7km distant. Section 5.4 provides a consideration of potential Block activities in-combination with other relevant plans and projects

Liverpool Bay SPA
Site information
Area (ha): 252,773 **Relevant qualifying features (diving species only):** Overwintering red-throated diver, common scoter; overwintering waterbird assemblage (including common scoter, red-throated diver, red-breasted merganser, and cormorant). **Conservation objectives:** See Table 5.1 above.
Relevant Blocks for underwater noise effects
109/15, 110/1, 110/4, 110/6, 110/7b, 110/8b, 110/9c, 110/11, 110/12c
Assessment of effects on site integrity
The majority of Block 110/4 overlaps the site, Block 110/9c overlaps entirely, and approximately half of Block 110/8b overlaps the site. Block 110/7b is a minimum of 2km from the site boundary, while the remaining five relevant Blocks are all >5km from the site boundary. The areas within Liverpool Bay SPA identified as supporting the highest densities of red-throated diver over winter are to the south of Blocks 110/4, 110/8b and 110/9c (Lawson *et al.* 2016). The eastern half of Block 110/9c overlaps an area identified as supporting a moderate (relative to the rest of the SPA) density of red-throated diver. While the distribution of these mobile species within the site will vary, there appears to be limited spatial overlap between the Blocks and those areas of greatest importance for divers and therefore a low potential for underwater noise effects. The eastern half of Blocks 110/4 and 110/9c partially overlap an area identified as supporting high densities of common scoter density over winter; all other relevant Blocks show no overlap with surveyed areas in the greater Liverpool Bay region shown to be of particular importance to common scoter (Lawson *et al.* 2016). The distribution of cormorant within the site during winter shows the majority of birds to occur in inshore areas which do not overlap with the relevant Blocks, including the adjacent bays and estuaries from Morecambe south to the Dee Estuary (Kober *et* al. 2010), while red-breasted merganser also favour inshore waters. **Impulsive noise (rig site survey, VSP, conductor piling)** *(**Relevant pressures:** underwater noise change, vibration)* The licence applications for the relevant Blocks do not propose any new 3D seismic survey within their work programmes. Consequently, rig site survey, VSP and conductor piling are the relevant sources of impulsive noise, all of which are of a lower amplitude, shorter duration and smaller geographic footprint compared to larger scale 2D or 3D seismic survey. As detailed in Section 4.3.2, there is very little evidence of impacts of underwater noise on diving birds. Mortality of seabirds has not been observed during extensive seismic operations in the North Sea and elsewhere, and flushing disturbance associated with the physical presence of survey vessels and rigs would be expected to displace most diving seabirds from close proximity to noise sources, particularly in the case of divers and scoters which are known to display a large avoidance radius of vessels and surface infrastructure (up to several kilometres). Such avoidance behaviour is also expected to reduce the potential for diving birds to be exposed to noise levels which may result in potential behavioural disturbance, although it is noted that very little evidence for such effects exist and, should they occur, they would be expected to be short-term, temporary and of limited spatial extent. Negative indirect effects of impulsive noise on qualifying features may arise through effects on prey species, primarily small fish, if those prey are subject to injury or disturbance which reduce their availability to qualifying seabirds. Such effects relate to the primarily piscivorous red-throated diver, as the winter diet of common scoter is largely restricted to sessile bivalves on the seabed (Fox 2003). While there is some evidence that a reduction in fish catches can be associated with seismic survey activity, these effects 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 2D and 3D seismic surveys (to which most reported effects relate). The disturbance of sensitive spawning periods for potential fish prey species will also 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 diving bird features. Considering the noise source characteristics, the location of the majority of the Blocks relative to the distribution of qualifying features within the site, the propensity of strong avoidance of surface structures by the qualifying features, and the short duration of the activities; when combined with mandatory control measures (Section 2.3.2),

any disturbance to qualifying features or their prey will be highly localised, short-term, and will not result in an adverse effect on site integrity.

Continuous noise (drilling, vessel & rig movements)
*(**Relevant pressures:** underwater noise change, vibration)*

No significant effects on the relevant qualifying species are anticipated from continuous underwater noise from drilling and vessel movements due to the lower amplitude and non-impulsive nature of the sound resulting in no potential for acute trauma and no evidence of significant disturbance to diving birds from such sources.

In-combination effects
Intra-plan in-combination underwater noise effects are considered highly unlikely given the low potential for effects identified above and the likely temporal and spatial separation of any 31st Round activities which could take place in the Blocks. Section 5.4 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

North Anglesey Marine / Gogledd Mnn Forol SCI
Site information
Area (ha): 324,949 **Relevant qualifying features:** Harbour porpoise **Conservation objectives:** See Table 5.1 above.
Relevant Blocks for underwater noise effects
109/10, 109/15
Assessment of effects on site integrity

None of the relevant Blocks overlap the site. Blocks 109/10 and 109/15 lie a minimum of 13km east and 7km northeast of the site boundary, respectively. Within the site, high rates of harbour porpoise sightings have been reported off the north and northwest coast of Anglesey (Evans *et al*. 2015), while modelling of survey data indicate the entire site to be an area of persistently high use in summer (Heinänen & Skov 2015). Harbour porpoise are highly mobile and wide-ranging, with the North Anglesey Marine SCI representing an area of particular importance to a significant proportion of the wider population falling within the Celtic and Irish Seas Management Unit. Adjacent areas where harbour porpoise are also frequently observed include from the Lleyn Peninsula south to Pembrokeshire and, to a lesser extent, off the north Wales coast to the Mersey.

Impulsive noise (rig site survey, VSP, conductor piling)
*(**Relevant pressures:** underwater noise change, vibration)*

The licence applications for the relevant Blocks do not propose any new 3D seismic survey within their work programmes. Consequently, rig site survey, VSP and conductor piling are the relevant sources of impulsive noise, all of which are of a lower amplitude, shorter duration and smaller geographic footprint compared to larger scale 2D or 3D seismic survey.

In the case of rig site survey and VSP noise, the disturbance effects radius could reasonably be expected to be in the order of 5-10km, given the amplitude source (e.g. relative to 2D/3D seismic survey), resulting in a low potential for disturbance to animals within either the site itself or adjacent areas where they are also known to occur with some regularity. Should any disturbance occur, evidence suggests that it would be short-term, of limited spatial extent, and, considering the location of relevant Blocks, be unlikely to affect animals within the site itself. 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 Celtic and Irish Seas, there is no evidence to suggest that any disturbance of animals from activities occurring in the relevant Blocks would displace individuals into habitat of significantly lower quality. It is noted that the site has been shown to consistently support high densities of harbour porpoise within a broader population in favourable status, and that the location of the relevant Blocks and likely activities are within the envelope of those which have occurred over several decades of exploration and production activities within this mature area.

Negative indirect effects of impulsive noise 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 larger-scale 2D and 3D seismic surveys. 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.

Considering: the location of the relevant Blocks relative to the site; 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 or conductor piling may be necessary); and, the application of mandatory controls at the project level (see Section 2.3.2) and further mitigation measures if required (see Section 5.3.3), it is concluded that impulsive noise occurring as a result of the licensing of relevant Blocks will not result in an adverse effect on site integrity.

Continuous noise (drilling, vessel & rig movements)
*(**Relevant pressures:** underwater noise change, vibration)*

Given the low potential for disturbance associated with drilling noise described in Section 4.3.2 and the distance between the relevant Blocks and the sites, effects from drilling noise are considered highly unlikely and will not result in an adverse effect on the integrity of the site. 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). Shipping routes with high levels of traffic (in the range 50-100 vessels per week in 2015) traverse the site, including through the Off Skerries traffic separation scheme to the north of Anglesey. (It is noted that the relevant Blocks are outside of the site boundaries, and there may be no contribution to shipping within the site depending on the supply port and vessel route.) Given the persistent high densities of harbour porpoise in the site alongside high levels of existing shipping activity, the temporary nature of drilling activities and limited number of associated supply vessel trips, continuous noise arising from the licensing of the relevant Blocks 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, and will not result in adverse effects on the integrity of the site.

In-combination effects
Intra-plan in-combination underwater noise effects are considered highly unlikely given the low potential for effects identified above and the likely temporal and spatial separation of any 31st Round activities which could take place in the Blocks. Section 5.4 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

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

Site information

Area (ha): 146,023.48
Relevant qualifying features: Bottlenose dolphin. See Natura 2000 standard data form for details of qualifying features[75].

Conservation objectives:
To achieve Favourable Conservation Status, all the following, subject to natural processes, need to be fulfilled and maintained in the long-term:

- The overall distribution and extent of the habitat features within the site, and each of their main component parts is stable or increasing
- The physical biological and chemical structure and functions necessary for the long-term maintenance and quality of the habitat are not degraded
- The presence, abundance, condition and diversity of typical species is such that habitat quality is not degraded
- For qualifying species, the population is maintaining itself on a long-term basis as a viable component of its natural habitat
- The qualifying species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future
- The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing
- With regard to the restoration and recovery of **bottlenose dolphins**, populations should be increasing.

[75] http://jncc.defra.gov.uk/protectedsites/sacselection/n2kforms/UK0013117.pdf

Further details are available in advice provided by Natural Resources Wales in fulfilment of Regulation 37 of the *Conservation of Habitats and Species Regulations 2017*.[76]
Relevant Blocks for underwater noise effects
109/15
Assessment of effects on site integrity
The Lleyn Peninsula and the Sarnau SAC, and the Cardigan Bay SAC to the south, are the two sites of relevance to the Irish Sea management unit for bottlenose dolphins. The core distribution of this population lies within these two sites and the wider Cardigan Bay, but a considerable proportion of the population also shows regular use of coastal waters off north Wales, particularly off the northeast coast of Anglesey during winter, whilst smaller numbers can be seen in this area throughout the year (Pesante *et al*. 2008, Baines & Evans 2012, Evans *et al*. 2015). While Block 109/15 is located some 80km from the northern boundary of the Lleyn Peninsula and the Sarnau SAC, the Block is a minimum of 11km offshore of the northeast coast of Anglesey, and so was screened in for further assessment of potential underwater noise effects on both the Lleyn Peninsula and the Sarnau SAC and the Cardigan Bay SAC. **Impulsive noise (rig site survey, VSP, conductor piling)** *(**Relevant pressures:** underwater noise change, vibration)* The licence applications for the relevant Blocks do not propose any new 3D seismic survey within their work programmes. Consequently, rig site survey, VSP and conductor piling are the relevant sources of impulsive noise, all of which are of a lower amplitude, shorter duration and smaller geographic footprint compared to larger scale 2D or 3D seismic survey. In the case of rig site survey and VSP noise, a precautionary disturbance effects radius in the order of 5-10km could be assumed (although evidence is very limited), given the amplitude source (e.g. relative to 2D/3D seismic survey), resulting in a low potential for disturbance to animals using waters around the coast of Anglesey and north Wales. Should any disturbance occur, for example to animals occurring further offshore of the coast, evidence suggests that it would be short-term and of limited spatial extent. It is noted that the waters off Anglesey and north Wales have been shown to be used by this population of bottlenose dolphins (which are considered to be in favourable condition) consistently over multiple years, likely increasingly so, and that the location of the relevant Block and likely activities are within the envelope of those which have occurred over several decades of exploration and production activities within this mature area. Negative indirect effects of impulsive noise on bottlenose dolphins may potentially arise through effects on prey species, primarily 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 larger-scale 2D and 3D seismic surveys. 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 bottlenose dolphins associated with the Lleyn Peninsula and the Sarnau SAC and the Cardigan Bay SAC. Considering: the location of the relevant Block relative to the area of importance for the qualifying species; 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 or conductor piling may be necessary); and, the application of mandatory controls at the project level (see Section 2.3.2) and further mitigation measures if required (see Section 5.3.3), it is concluded that impulsive noise occurring as a result of the licensing of Block 109/15 will not result in an adverse effect on site integrity. **Continuous noise (drilling, vessel & rig movements)** *(**Relevant pressures:** underwater noise change, vibration)*

[76] https://cdn.naturalresources.wales/media/684520/pen-llyn-ar-sarnau-reg-37-report-2018.pdf?mode=pad&rnd=131662693580000000

Given the low potential for disturbance associated with drilling noise described in Section 4.3.2 and the distance between the Block 109/15 and the area of greatest apparent importance to the qualifying species (Anglesey coast), effects from drilling noise are considered highly unlikely and will not result in an adverse effect on the integrity of the site. Bottlenose dolphins are considered less sensitive to underwater noise from shipping than harbour porpoise, and their primarily coastal distribution means that they are likely to remain several kilometres from vessel and rig movements associated with activities in Block 109/15. Shipping routes with high levels of traffic (in the range 50-100 vessels per week in 2015) occur off the Anglesey coast, including that to/from Holyhead. Given the movements of bottlenose dolphins around the coast of Anglesey and north Wales alongside high levels of existing shipping activity, the temporary nature of drilling activities and limited number of associated supply vessel trips, continuous noise arising from the licensing Block 109/15 is unlikely to significant disturbance to bottlenose dolphins and will not result in adverse effects on the integrity of the site.

In-combination effects

Intra-plan in-combination underwater noise effects are considered highly unlikely given the low potential for effects identified above, the single relevant Block, and the likely temporal and spatial separation of any 31st Round activities which could take place in the relevant Block and others applied for in the region. Section 5.4 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

Cardigan Bay/ Bae Ceredigion SAC

Site information

Area (ha): 95,857.06

Relevant qualifying features: Bottlenose dolphin. See Natura 2000 standard data form for details of qualifying features[77].

Conservation objectives:

To achieve Favourable Conservation Status, all the following, subject to natural processes, need to be fulfilled and maintained in the long-term:

- The overall distribution and extent of the habitat features within the site, and each of their main component parts is stable or increasing
- The physical biological and chemical structure and functions necessary for the long-term maintenance and quality of the habitat are not degraded
- The presence, abundance, condition and diversity of typical species is such that habitat quality is not degraded
- For qualifying species, the population is maintaining itself on a long-term basis as a viable component of its natural habitat
- The qualifying species' populations within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future
- The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing
- With regard to the restoration and recovery of **bottlenose dolphins**, populations should be increasing.

Further details are available in advice provided by Natural Resources Wales in fulfilment of Regulation 37 of the *Conservation of Habitats and Species Regulations 2017*.[78]

Relevant Blocks for underwater noise effects

109/15

Assessment of effects on site integrity

The Cardigan Bay SAC, and the Lleyn Peninsula and the Sarnau SAC to the north, are the two sites of relevance to the Irish Sea management unit for bottlenose dolphins. The core distribution of this population lies within these two sites and the wider Cardigan Bay, but a considerable proportion of the population also shows regular use of coastal waters off north Wales, particularly off the northeast coast of Anglesey during winter, whilst smaller numbers can be seen in this area throughout the year (Pesante *et al*. 2008, Baines & Evans 2012, Evans *et al*. 2015). While Block 109/15 is located some 150km from the northern boundary of the Cardigan Bay SAC, the

[77] http://jncc.defra.gov.uk/protectedsites/sacselection/n2kforms/UK0012712.pdf

[78] https://cdn.naturalresources.wales/media/684512/cardigan-bay-reg-37-report-2018.pdf?mode=pad&rnd=131662693710000000

Block is a minimum of 11km offshore of the northeast coast of Anglesey, and so was screened in for further assessment of potential underwater noise effects on both the Cardigan Bay SAC and the Lleyn Peninsula and the Sarnau SAC.

The pathway for potential underwater noise effects from the licensing of Block 109/15 on the Cardigan Bay SAC relates to the occurrence of bottlenose dolphins off the Anglesey and north Wales coast, with these animals being from a single population for which both the Cardigan Bay SAC and the Lleyn Peninsula and the Sarnau SAC are designated. Consequently, the assessment is identical to that presented for the Lleyn Peninsula and the Sarnau SAC (see above), and it can be concluded that underwater noise from activities following the licensing of Block 109/15 will not result in an adverse effect on the integrity of the Cardigan Bay SAC.

5.3.3 Further mitigation measures

The assessment concluded that no further mitigation measures were required beyond existing regulatory controls (see Section 2.3.2) in order to avoid adverse effects on the integrity of the relevant sites. 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 3D seismic survey has been proposed in any of the Irish 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 require 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 have been 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. A standard consent condition requires operators 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 (including conductor piling), will not have an adverse effect on the integrity of relevant sites.

5.3.4 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 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 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.

5.4 In-combination effects

5.4.1 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[79] and BEIS 2018b). There are a number of potential interactions between activities that may follow licensing and those existing or planned activities in the Irish Sea, for instance in relation to existing oil and gas development, renewable energy, fishing and shipping. These activities are subject to individual permitting or consenting mechanisms or are otherwise managed at a national or international level. In English and Welsh waters relevant to the Irish Sea 31st Round Blocks, the North West Marine Plans and Welsh National Marine Plan is expected to set out objectives and policies to guide development in these areas over a 20-year period respectively. Both plans are in preparation and are expected to be adopted by 2021.

The potential for intra-plan in-combination effects was considered for those sites subject to AA in Sections 5.2 and 5.3 (i.e. that multiple Blocks have the potential to be licensed within the same site). The following section considers the potential for in-combination effects with other relevant plans and programmes.

5.4.2 Sources of potential effect

Projects for which potential interactions with operations that could arise from the licensing of 31st Round Blocks (see Table 5.3) have been identified. Interactions were identified on the basis of the nature and location of existing or proposed activities and spatial datasets in a Geographic Information System (GIS). The principal sources of in-combination effects are related to noise, physical disturbance, and physical presence, primarily arising from offshore wind development, and fisheries. Offshore wind farm (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[80]. The Crown Estate released information on its plans for a further round of offshore wind leasing (Round 4) in November 2018, that identified five regions that are proposed to be included, which include areas over North Wales and the Irish Sea[81]. The round has not been formally announced, and there are no Agreements for Lease of draft project plans to consider at this stage. Additionally, The Crown Estate intend to conduct an HRA to support the fourth round of offshore leasing which will consider the likely significant effects of the plan in due course.

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

[80] 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.

[81] https://www.thecrownestate.co.uk/en-gb/media-and-insights/news/2018-the-crown-estate-shares-further-detail-on-plans-for-round-4-including-proposed-locations-to-be-offered-for-new-seabed-rights/

Figures 5.3 and 5.4 indicate the location of other relevant projects in relation to the Blocks subject to this assessment and relevant Natura 2000 sites.

The UK Government believes that the oil & gas and the renewables industries can successfully co-exist, as stated in OGA's Other Regulatory Issues for the 31st Round, "…*we [(OGA)] advise that potential applicants on such blocks [(areas where oil and gas licences 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)*"[82]. 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)[83] where scheduling overlaps may occur should allow both for developer cooperation, and the mitigation of potential cumulative or in-combination effects.

Marine plans and their related policies also clarify this position, for example the draft Welsh National Marine Plan, noting that the Blocks are some distance from Welsh waters, (see paragraphs 659-666 and policies including ECON_02, O&G_03, O&G_04); "*Future oil and gas activity has the potential to require access to the same area of seabed or sea surface as other activities. Interactions with other sea users will vary depending on the technology, location and intensity of use of other marine activities. In most cases, the consequence of this will be minor due to the current offshore location of oil and gas interests, the small footprint of oil and gas production infrastructure and the limited duration of any exploration activities, e.g. regional or site-specific seismic surveys and drilling operations. Other activities may therefore continue in proximity outside of a safety buffer zone."* (Paragraph 659). A number of relevant draft common policies[84] are available for other marine plans of relevance to the Irish Sea Blocks (North West Inshore and Offshore) including NW-CO-1, "*Proposals will minimise their use of space and consider opportunities for co-existence with other activities*" and NW-OG-1, "*Proposals in areas where a licence for oil and gas has been granted or formally applied for should not be authorised unless it is demonstrated that the other development or activity is compatible with the oil and gas activity*." The final remaining marine plans for English waters, including those of the North West are expected to be adopted by 2021.

82 OGA 31st Round Other Regulatory Issues

83 https://www.ogauthority.co.uk/licensing-consents/overview/the-crown-estate-interests/

84 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/588798/proposed_draft_common_policies_by_marine_plan_area.xls

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

Relevant projects	Project summary	Project status/indicative timing	Relevant sites[1]
Offshore Renewables			
Barrow Offshore Wind Farm	Located approximately 7km from the Cumbrian coast, the project area contains 30 turbines and together have an overall installed capacity of 90MW. The wind farm export cable runs in parallel with those of the Ormonde, West of Duddon sands and Walney I offshore wind farms in the nearshore, having its landfall near Heysham.	In operation	Liverpool Bay SPA, Morecambe Bay and Duddon Estuary SPA, Shell Flat & Lune Deep SAC
Ormonde Offshore Wind Farm	Located approximately 9km from the Cumbrian coast, the wind farm contains 30 turbines with an overall capacity of 150MW. The wind farm export cable runs in parallel with those of Ormonde, West of Duddon sands and Walney I in the nearshore, having its landfall near Heysham.	In operation	Liverpool Bay SPA, Morecambe Bay and Duddon Estuary SPA, Shell Flat & Lune Deep SAC
West of Duddon Sands Offshore Wind Farm	West of Duddon Sands is located approximately 14km offshore, and contains 108 turbines, with an overall installed capacity of 389MW. The export cable landfall is at Heysham.	In operation	Liverpool Bay SPA, Morecambe Bay and Duddon Estuary SPA, Shell Flat & Lune Deep SAC
Walney I Walney II	Located approximately 14km from the Cumbrian coast, each project area contains 51 turbines and together have an overall installed capacity of 367MW. Walney I and II export cable landfalls are near Heysham and Fleetwood, respectively.	In operation	Liverpool Bay SPA, Morecambe Bay and Duddon Estuary SPA, Shell Flat & Lune Deep SAC
Walney extension	Located approximately 19km from the Cumbrian coast, and to the north west of the Walney I and II windfarms, the extension is due to have an installed capacity of 659MW generated from 87 turbines. The export cables are routed to the south of the Walney and West of Duddon Sands wind farms and have a landfall near Heysham.	In operation	Liverpool Bay SPA, Morecambe Bay and Duddon Estuary SPA, Shell Flat & Lune Deep SAC
Rhyl flats	Located approximately 8km from the coast, with a cable landfall at Towyn. Has an installed capacity of 90MW generated by 25 turbines.	In operation	Liverpool Bay SPA
North Hoyle	Located approximately 7km from the coast, with a cable landfall at Rhyl. Has an installed capacity of 60MW generated by 30 turbines.	In operation	Liverpool Bay SPA
Burbo Bank	Located approximately 7km from the coast, with a cable landfall at Wallasey. Has an installed capacity of 90MW generated by 20 turbines.	In operation	Liverpool Bay SPA
Burbo Bank extension	Located approximately 7km from the coast, with a cable landfall between Rhyl and Prestatyn. Has an installed capacity of 258MW generated by 32 turbines.	In operation	Liverpool Bay SPA
Gwynt y Môr	Located approximately 13km from the coast, with a cable landfall at Pensarn. Has an installed capacity of 574MW generated by 160 turbines. The Crown Estate has indicated an extension with an installed capacity of up to 576MW has been applied for.	In operation	Liverpool Bay SPA

Relevant projects	Project summary	Project status/indicative timing	Relevant sites[1]
Oil & Gas			
Gateway gas storage project	An Agreement for Lease area is located approximately 24km offshore within Block 110/3. It is proposed that natural gas is stored in artificially created salt caverns, connected to the shore at Barrow-in-Furness via pipeline.	EIA consent decision was made in 2008. No development activities have taken place to date.	Liverpool Bay SPA, Morecambe Bay and Duddon Estuary SPA, Shell Flat & Lune Deep SAC
Aggregates			
Aggregates production area 392 and 457	As part of the wider north west region, 1.52km^2 were actively dredged in 2016, representing 1.75% of the total licensed area, with 90% of effort in 0.59km^2. Dredging intensity in the 392 area is considered to be high, covering 0.16km^2, with the wider remaining area dredged (including area 457) being low to moderate.	Active production area.	Liverpool Bay SPA

Sources: RenewableUK (2018), relevant Development Consent Orders and related post-consent modifications (https://infrastructure.planninginspectorate.gov.uk/ – accessed 20/11/2018), OGA Project Pathfinder current list of projects (https://itportal.decc.gov.uk/pathfinder/currentprojectsindex.html – accessed 19/11/2018), The Crown Estate and the British Marine Aggregate Producers Association (2017), The Crown Estate website (https://www.thecrownestate.co.uk/en-gb/media-and-insights/news/2018-the-crown-estate-completes-initial-assessment-of-offshore-wind-extension-applications/ – accessed 28/11/2018)
Notes: [1] – those sites considered to be relevant to 31st seaward round exploration activities

5.4.3 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 5.2 and include the siting of jack-up drilling rigs, drilling discharges and wellhead placement and recovery.

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

Existing oil and gas infrastructure is widespread in the eastern Irish Sea (Figure 5.4), although the relative density and footprint of these is small. A review of field development and decommissioning projects (as of November 2018) published by OGA's Project Pathfinder[85] includes the Gateway Gas Storage Project, an Agreement for Lease for an area in Block 110/3b but firm project plans are not presently known. Where appropriate, BEIS will undertake HRA in relation to oil and gas development and decommissioning activities, including a consideration of in-combination effects.

Given the small and temporary seabed footprint associated with drilling activities which may follow the licensing of 31st Round Blocks, and those standard and additional control measures set out already in Section 2.2 and 5.2.3, significant in-combination effects associated with other oil and gas related activities are not expected.

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

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[86] has identified as making an ongoing contribution to managing discharges. In view of the conclusions of Section 5.2 in relation to potential discharges from 31st Round activity and the nature of those projects identified in Table 5.3, significant in-combination effects on the integrity of any of the relevant sites is not predicted.

Offshore renewables

OWFs are the only type of renewable energy projects in the Irish Sea of relevance to 31st Round licensing. All of these projects are operational with the exception of the proposed extension to Gwynt y Môr OWF, applied for as part of The Crown Estate's call for extensions to existing sites, which closed on 31st May 2018. No project plans are available to consider at this stage, but The Crown Estate has indicated that Agreements for Lease could be issued in summer 2019, subject to the outcome of an HRA covering the wider set of proposed extensions[87]. The advice on operations for sites relevant to this HRA reflect the sensitivity to pressures associated with the physical impacts of OWF installation and operation[88]. It should be noted that these consented and operation wind farms have been subject to their own HRA processes. Applicants taking part in the 31st Round were made aware of relevant Crown Estate interests[89] which include offshore renewables zones and developments.

[86] https://www.gov.uk/government/publications/marine-strategy-part-three-uk-programme-of-measures
[87] https://www.thecrownestate.co.uk/en-gb/media-and-insights/news/2018-the-crown-estate-completes-initial-assessment-of-offshore-wind-extension-applications/
[88] https://www.gov.uk/government/publications/irish-sea-marine-area-index-map-and-site-packages
[89] https://itportal.ogauthority.co.uk/web_files/gis/ukcs_maps/TCE_Leases_and_OG_Licences.pdf

Figure 5.3: Other projects relevant to the Irish Sea: renewables

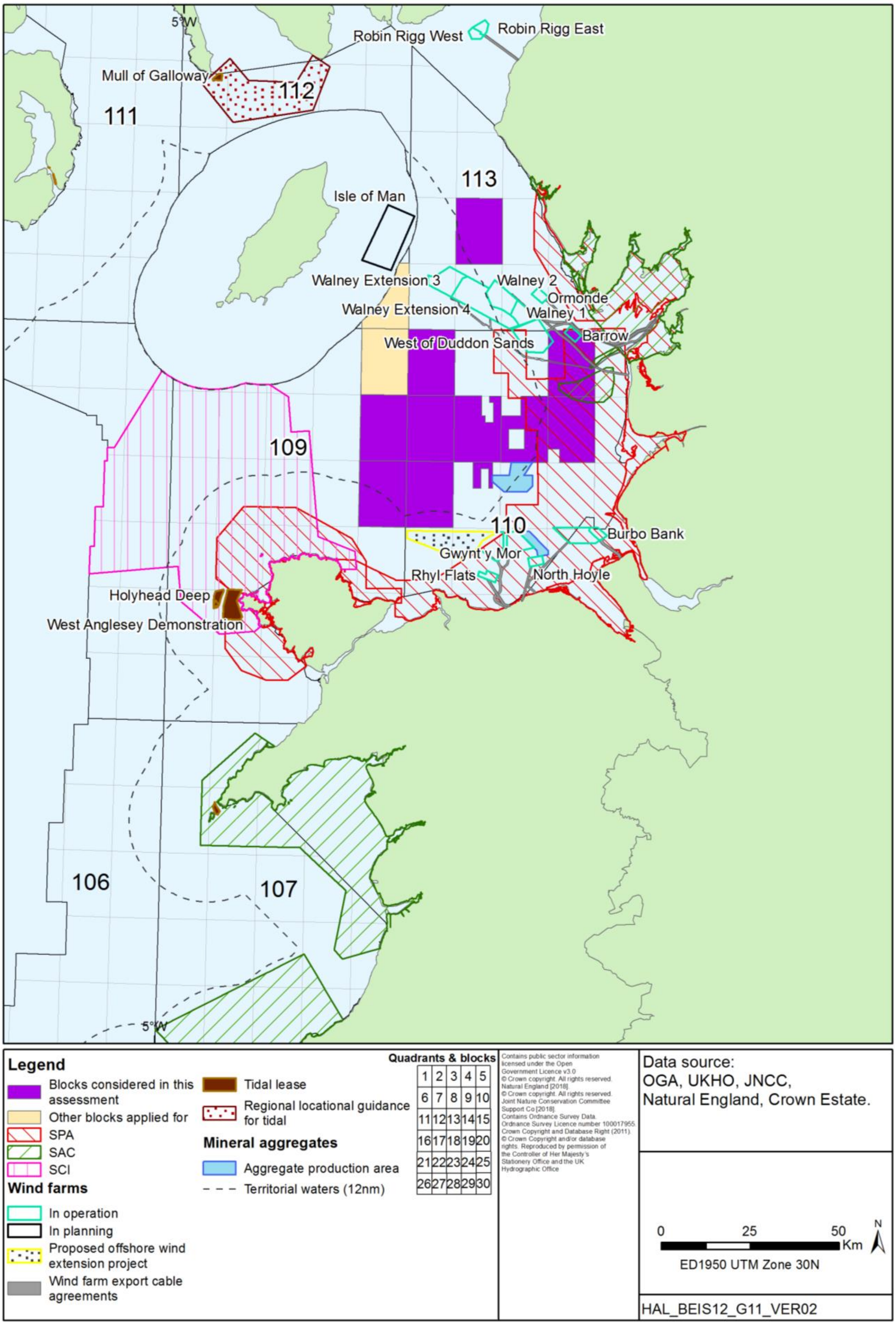
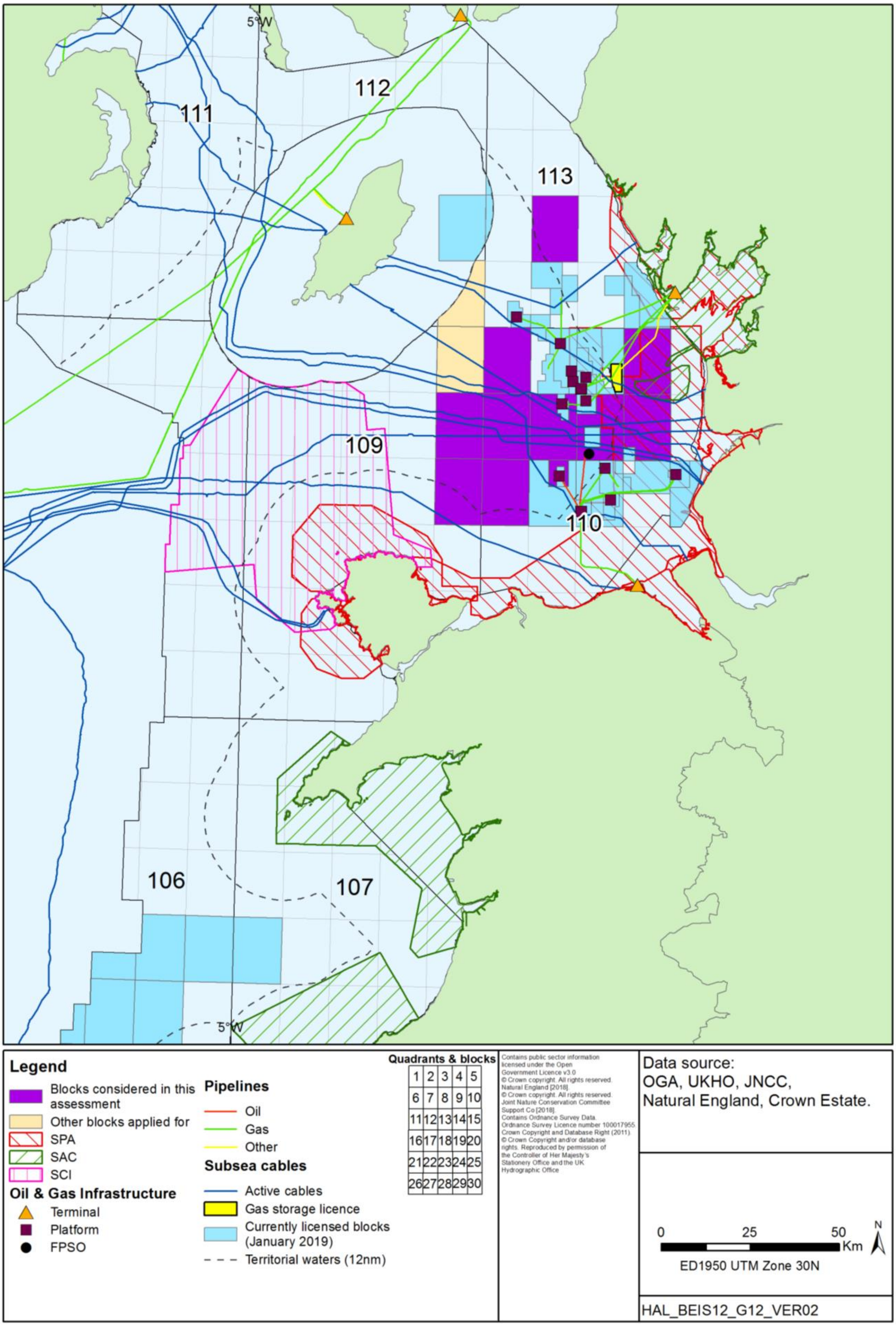


Figure 5.4: Other projects relevant to the Irish Sea: oil & gas and cables



Seven Blocks were identified on the basis of a potential for likely significant effect in relation to the Liverpool Bay SPA and were considered in Section 5.2.2 and, of these, one (Block 110/4) also coincides with the Barrow and West of Duddon Sands wind farms, both of which are operational. In addition to the wind farm footprints, export cables from Walney I, II and the Walney extension, Ormonde, Barrow and West of Duddon Sands either interact with or are in close proximity to the Shell Flat and Lune Deep SAC, which was subject to assessment in Section 5.2 in relation to three Blocks (110/4, 110/8b, 110/9c). The other wind farms in the Irish Sea are located outside of all of the Blocks applied for, though some are within the boundaries of the Liverpool Bay SPA. Though identified as sensitive to the physical loss or damage of supporting habitat for qualifying red-throated diver and common scoter, current levels of impact are considered small due to the scale of activities in relation to the size of the wider site – note that the current advice package is awaiting an update[90].

The footprint of any drilling rig would be small (approximately $0.001km^2$ – also see Table 2.2 and Section 5.1.2) and temporary. It is therefore not regarded that activity which could take place in the initial term of licences would lead to a physical change significant enough to cause an adverse effect on the site integrity of Liverpool Bay SPA, Shell Flat and Lune Deep SAC, Morecambe Bay and Duddon Estuary SPA and Morecambe Bay SAC, either on its own or in-combination with 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, the undertaking of project level HRA. Should one or more Blocks be granted a licence which overlaps with 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.

Cables

A range of cables traverse 31st Round Irish Sea Blocks, including both electricity grid interconnectors and telecommunications cables (see Figure 5.4). In particular, Blocks 109/10, 110/1, 110/6, 110/7b, 110/8b and 110/9c are crossed between two and five times. The surface area of these cables is extremely small, and they are well-charted features which are avoided by oil and gas operators, including during exploration. All of these cables are operational, and there is only one proposed project, the Organic Power International 750MW HVDC interconnector, connecting the UK and Ireland. The project has a potential landfall in North Wales or somewhere in the wider Liverpool Bay area, however it is at a very early stage of development and is yet to be subject to consenting or assessment, and definitive details are lacking on which to make a consideration at this stage.

[90] See: http://publications.naturalengland.org.uk/publication/3236717 and https://www.gov.uk/government/publications/irish-sea-marine-area-index-map-and-site-packages

Fisheries

Fishing and particularly bottom trawling has historically contributed to seabed disturbance over extensive areas, and was identified as an ongoing issue in the UK initial assessment for MSFD[91]. 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 the management of commercial fisheries in European sites[92] 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 (IFCAs) and the Marine Management Organisation for sites within 12nm (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[93]. In relation to specific sites of relevance to this AA, there is a bylaw prohibiting towed gear for the reef component of the Shell Flat & Lune Deep SAC[94], although further fisheries management measures have not been implemented. Management of inshore fisheries in Wales is undertaken by the Welsh Government, though in view of the widespread nature of fishing, liaison takes place with IFCAs, MMO and Regional Fisheries Advisory Councils (as noted in the draft Welsh National Marine Plan). Natural Resources Wales are progressing a project to evaluate that impact of fisheries on Marine Protected Areas in Welsh waters to inform potential management measures[95].

It should be noted that while the above reflects the current approach to fisheries management in relation to Marine Protected Areas in English waters, the UK is expected to formally leave the CFP on its exit from the EU in March 2019. The Fisheries White Paper, “Sustainable Fisheries for Future Generations” [96], outlines the UK Government’s present vision for how fisheries would be managed when the UK no longer participates in the CFP.

Whilst fishing may be linked to historical damage to site features, and presents a continuing risk to these (for example as noted in Advice on Operations for Liverpool Bay SPA, Morecambe Bay and Duddon Estuary SPA, Shell Flat and Lune Deep SAC), future

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[91] https://www.gov.uk/government/publications/marine-strategy-part-one-uk-initial-assessment-and-good-environmental-status

[92] https://www.gov.uk/government/publications/revised-approach-to-the-management-of-commercial-fisheries-in-european-marine-sites-overarching-policy-and-delivery

[93] 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.

[94] http://nw-ifca.gov.uk/app/uploads/NWIFCA-Byelaw-6.pdf

[95] https://naturalresources.wales/about-us/our-projects/marine-projects/assessing-welsh-fishing-activities/?lang=en

[96] See: https://www.gov.uk/government/consultations/fisheries-white-paper-sustainable-fisheries-for-future-generations and also the draft Fisheries Bill: https://services.parliament.uk/bills/2017-19/fisheries.html

management measures should limit the potential for in-combination effects with other activities. Effects on sites from exploration activity can be reduced or avoided (see Sections 2.3.1 and 5.2.3), and other oil and gas related activities are subject to statutory environmental impact assessment and where appropriate, HRA.

When an oil and gas surface structure (fixed and floating installations) becomes operational, a safety zone with a radius of 500m is created under the *Petroleum Act 1987* and other activities are excluded from taking place within the zone, including fisheries. Safety zones apply to mobile drilling rigs and are notified to other users of the sea (e.g. through notices to mariners and Kingfisher charts). 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 are not predicted.

Aggregate extraction, maintenance and capital dredging and disposal

There are two licences for the extraction of aggregates held in the Irish Sea, these are also indicated on Figure 5.3 (also see Table 5.3). Active aggregate production area 457 abuts Blocks 110/8b and 110/12c[97], with the most recent regional statistics for the wider North West region indicating that in 2016 dredging took place within 1.52km^2, representing 1.75% of the total licensed area in the Irish Sea. Extraction from area 457 was is considered to be medium to low. 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 5.2), in-combination impacts which could lead to adverse effects on the integrity of sites considered in this AA are not anticipated. 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.

Several licensed dredge disposal areas are located in the Irish Sea for the purpose of depositing capital or maintenance dredge material from harbours and ports. The Barrow D site (IS205) is of most relevance, being located within Block 110/4. There remains significant space outside of this disposal site in which to site a rig as well as the potential to avoid interaction through the timing of activities (the initial term lasting for up to 9 years), and such avoidance is consistent with the draft dredge disposal policy for the north west marine plan (NW-DD-1). A larger site (IS150) is located in Liverpool Bay and is used for the disposal of capital and maintenance dredging from the Mersey and is approximately 5.5km to the south of the nearest Block applied for (110/8b). Interaction with the siting of any drilling rig, in view of the potential scale of physical disturbance that could result (see Table 2.2), is not considered possible such that in-combination effects are not predicted for any relevant site. Additionally, the deposit of any material at these sites is subject to separate marine licensing.

[97] There are wider areas within the Irish Sea which have been identified as prospective for sand and gravel extraction (see: https://www.thecrownestate.co.uk/energy-minerals-and-infrastructure/downloads/mineral-resource-assessments/ and the draft Welsh National Marine Plan) though there is only limited overlap with a single relevant Block (113/30).

5.4.4 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 2018a). 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 located in the Irish Sea (Figure 5.3), and formed an important part of associated HRAs[98]. All of the wind farms in the Irish Sea are presently operational, with no further project proposals available to consider at this time. There is limited overlap between Block 110/4 and the Barrow and West of Duddon Sands wind farms, with the other Blocks applied for located some distance from any OWF. 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, and the 31st Round materials included details of such relevant Crown Estates interests[99]. 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.

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 due to physical presence in-combination with operational wind farms. As noted above, The Crown Estate intend to consider new leasing areas for offshore wind as part of a fourth round of offshore wind leasing, but details on the specific nature and location of projects is not yet known to allow consideration of the potential for further in-combination effects.

Shipping densities over the relevant Blocks range from low (110/9c) to moderate (110/8b), high (109/10, 109/15, 110/1, 110/4, 110/6, 110/7b, 110/11, 113/22) and very high (110/12c). Additional vessels associated with drilling and site survey will 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 in the context of 2015 weekly average vessel densities within routes around Liverpool and Morecambe Bay being in the range 20 to >200[100]. As the Blocks applied for are

[98] For example refer to those HRAs in relation to Burbo Bank Extension and Walney Extension
[99] https://www.ogauthority.co.uk/licensing-consents/overview/the-crown-estate-interests/ and https://itportal.ogauthority.co.uk/web_files/gis/ukcs_maps/TCE_Leases_and_OG_Licences.pdf
[100] https://data.gov.uk/dataset/vessel-density-grid-2015

within an existing mature hydrocarbon basin, helicopters and vessels are also likely to use established routes.

The limited spatial and temporal presence of a rig and related shipping (see Table 2.2) is not considered likely to lead to adverse effects on site integrity in-combination with other relevant activities in Irish Sea. Further consideration of in-combination effects relating to interactions between offshore windfarm construction and operation would need to be considered as part of project-level assessments, including in HRA where appropriate.

5.4.5 Underwater noise

A number of projects are relevant to the consideration of in-combination effects with activities which may follow the licensing of 31st Round Blocks (see Table 5.3). The associated activities 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).

Of most relevance to the Blocks being considered are those OWFs listed in Table 5.3, all of which are operational. 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). Given the spatially limited, temporary nature and limited scale of noise generating activity associated with the 31st Round Blocks (see Section 5.3), and the lack of any potential overlap with OWF construction noise, is such that in-combination effects are considered to be unlikely. As noted elsewhere, The Crown Estate intend to consider new leasing areas for offshore wind as part of a fourth round of offshore wind leasing, and intend to take forward the areas of North Wales and the Irish Sea, while the area around Anglesey is to be subject to further consideration[101]. Additionally, an extension to Gwynt y Môr OWF has been proposed, applied for as part of The Crown Estate's call for extensions to existing sites which closed on 31st May 2018. No project plans are available to consider at this stage, however The Crown Estate has indicated that Agreements for Lease could be issued in summer 2019. For both the Gwynt y Môr extension and Round 4, The Crown Estate are to undertake HRA.

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 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 Irish 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

[101] https://www.thecrownestate.co.uk/en-gb/what-we-do/on-the-seabed/energy/offshore-wind-potential-new-leasing/

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 5.3 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[102] 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”.

5.4.6 Conclusions

Available evidence (see e.g. UKBenthos database and OSPAR 2010) for the Irish 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 exploration/appraisal is successful, will be judged on its own merits and in the context of wider development in the Irish Sea (i.e. any potential incremental effects). The current regulatory 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 consider the potential for in-combination effects whilst considering project specific EIAs and, where appropriate, through HRAs. This process will ensure that, if consented, projects will not result in adverse effects on integrity of European sites. Therefore, it is concluded that the in-combination effects from activities arising from the licensing of Blocks in the Irish Sea (Table 1.1) with those from existing and planned activities will not adversely affect the integrity of relevant European Sites.

[102] *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 31st Licensing Round of the 11 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 those Blocks listed in Table 1.1. 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 Sections 5-8), taking account of the control measures that can be imposed through existing permitting mechanisms on the planning and conduct of activities (as described in Section 2.3, and in Sections 5.2.3 and 5.3.3).

These control 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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