Department of Energy & Climate Change

RECORD OF THE HABITATS REGULATIONS ASSESSMENT UNDERTAKEN UNDER REGULATION 25 OF THE OFFSHORE MARINE CONSERVATION REGULATIONS 2007 (AS AMENDED) FOR AN APPLICATION UNDER THE PLANNING ACT 2008 (AS AMENDED)

***Project Title*: TRITON KNOLL OFFSHORE WIND FARM**

July 2013

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1. INTRODUCTION

Background

1.1 This is a record of the Habitats Regulation Assessment (HRA) that the Secretary of State for Energy and Climate Change has undertaken under Regulation 25 of the Offshore Marine Conservation (Natural Habitats & c.) Regulations 2007 (as amended) in respect of the Development Consent Order (DCO) and Deemed Marine Licence (DML) for the proposed Triton Knoll Offshore Wind Farm and its associated infrastructure (the Project). For the purposes of Regulation 25, the Secretary of State is the competent authority.

1.2 On 31 January 2012, Triton Knoll Offshore Wind Farm Ltd. (TKOWFL) submitted an application to the Infrastructure Planning Commission (IPC), the functions of which were transferred to the Planning Inspectorate (PINS) on 1 April 2012, for consent under Section 37 of the Planning Act 2008 (as amended) for the construction and operation of a 1,200 MW offshore wind farm, and its associated offshore infrastructure, in the North Sea approximately 33km off the coast of Lincolnshire and 48km off the coast of North Norfolk at its nearest point. The project is wholly outside the 12 nautical mile (nm) limit of territorial waters, and entirely within the UK's Renewable Energy Zone (REZ). The electrical systems that will take generated electricity from the site to the national grid (i.e. subsea export cabling and onshore grid connection infrastructure) do not form part of this project application and these will require separate consent(s) and assessment(s) at a later date. The Project application is described in more detail in Section 2.

1.3 In England and Wales, offshore energy generating stations greater than 100 MW constitute nationally significant infrastructure projects (NSIPs) and applications for consent are subject to the requirements of the Planning Act 2008 (as amended). This Project constitutes an NSIP as it has a generation capacity of 1,200 MW.

1.4 The Project was accepted by the IPC on 23 February 2012 and the Chair of the IPC appointed a three-member Panel of Inspectors (the Panel) as the Examining Authority for the application. The examination of the Project application began on 23 July 2012 and was completed on 21 January 2013. The Panel submitted its report of the examination including its recommendation (the Panel's Report) to the Secretary of State on 17 April 2013.

1.5 The Secretary of State's conclusions on habitats and wild birds issues contained in this HRA report have been informed by the Panel's Report to him and further information and analysis, including a Report on the Implications for European Sites (RIES) and written responses to it.

1.6 Natural England (NE) is the Statutory Nature Conservation Body (SNCB) for England and for English waters within the 12nm limit. The Joint Nature Conservation Committee (JNCC) is a UK-wide SNCB, responsible for, amongst other matters, UK waters beyond the 12nm limit. They are jointly referred to in this HRA as SNCBs as both participated in the examination and co-ordinated and submitted joint responses.

Habitats Regulation Assessment

1.7 Council Directive 92/43/EC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and Council Directive 2009/147/EC on the conservation of wild birds (the Birds Directive) aim to ensure the long-term survival of certain species and habitats by protecting them from adverse effects of plans and projects.

1.8 The Habitats Directive provides for the designation of sites for the protection of habitats and species of European importance. These sites are called Special Areas of Conservation (SACs). The Birds Directive provides for the classification of sites for the protection of rare and vulnerable birds and for regularly occurring migratory species. These sites are called Special Protection Areas (SPAs). SACs and SPAs are collectively termed European sites and form part of a network of protected sites across Europe. This network is called Natura 2000.

1.9 In the UK, the Conservation of Habitats and Species Regulations 2010 (as amended) (the Habitats Regulations) transpose the Habitats and Birds Directives into national law as far as the 12 nm limit of territorial waters. Beyond territorial waters, the Offshore Marine Conservation (Natural Habitats & c.) Regulations 2007 (as amended) (the Offshore Habitats Regulations) serves the same function for the UK's offshore marine area. The Convention on Wetlands of International Importance 1972 (the Ramsar Convention) provides for the listing of wetlands of international importance. These sites are called Ramsar sites. UK Government policy is to afford Ramsar sites the same protection as European sites.

1.10 Regulation 25 of the Offshore Habitats Regulations provides that:
"…..*before deciding to give consent, permission or other authorisation for, a plan or project which is to be carried out on any part of the waters or on or in any part of the seabed or subsoil comprising an offshore marine area or on or in relation to an offshore marine installation and which is likely to have a significant effect on a European marine site (either alone or in combination) and which is not directly connected with or necessary to the management of the site, the competent authority must make an appropriate assessment of the implications for the site in view of the site's conservation objectives.*"

1.11 This project is not directly connected with, or necessary to, the management of a European site or a European marine site. Regulation 25 of the 2007 Offshore Habitats Regulations requires that, where the project is likely to have a significant effect on any such site, an appropriate assessment (AA) is carried out to determine whether or not the project will adversely affect the integrity of the site in view of its Conservation Objectives. In this document, the assessments as to whether there are likely significant effects (LSEs), and, where required, the AAs, are referred to collectively as the HRA.

1.12 The HRA takes account of mitigation measures being secured, by requirements and conditions, within the DCO and DML.

1.13 In considering the possible impacts of the Project and in reaching his conclusions, the Secretary of State has also taken into account duties and obligations provided for under the

Offshore Marine Conservation (Natural Habitats, & c.) (Amendment) Regulations 2012, SI 2012 No. 1928, which came into force on 16th August 2012 and amend the Offshore Regulations, transposing aspects of the Birds Directive to secure compliance. The Secretary of State is satisfied that in reaching his conclusions he has taken these into account.

The RIES and Statutory Consultation

1.14 Under Regulation 25 of the Offshore Habitats Regulations, the competent authority must, for the purposes of an AA, consult the appropriate nature conservation body and have regard to any representation made by that body within such reasonable time as the authority specify.

1.15 The Panel, with support from PINS, prepared a RIES, based on working matrices prepared by TKOWFL. The RIES documented the information received during the examination and presented the Panel's understanding of the main facts regarding the HRA to be carried out by the Secretary of State.

1.16 The RIES was published on PINS planning portal website and circulated to interested parties on 29 November 2012 for a period of 21 days for the purposes of statutory consultation. The RIES and written responses to it have been taken into account in this assessment. Formal responses raising specific issues on the RIES were received from NE and TKOWFL. The Panel's Report notes that these responses were, however, in broad agreement with the findings of the RIES in all significant respects (Panel's Report 5.2.10). For this reason the Secretary of State is content to accept the Panel's recommendation that the RIES and written responses to it, can be relied upon as robust source of information on the impact of the project on European sites and species.

Errata Sheet

1.17 Following the submission of the Panel's Report to the Secretary of State, PINS prepared an Errata Sheet to correct typographical errors in the Panel's Report and in the RIES. The Secretary of State has taken the Errata Sheet into consideration and has reached his conclusions based upon the corrections contained within it. For example, the Panel's Report and RIES contained a typographical error that referred to '9' Sandwich tern mortalities. PINS produced an Errata Sheet to confirm that this figure should instead be '8' Sandwich tern mortalities, a correction that is critical to the Secretary of State's decision.

Background

1.18 This HRA report should be read in conjunction with the following documents that provide extensive background information:

- Planning Act 2008. The Triton Knoll Offshore Wind Farm. Panel's Report to the Secretary of State, 17 April 2013 (the Panel's Report);
- Errata Sheet Triton Knoll Offshore Wind Farm (Ref. EN010005) Corrections Agreed by the Examining Authority prior to the decision being made (the Errata Sheet);

- Report on the Implications for European Sites (RIES). Triton Knoll Offshore Wind Farm. An Examining Authority report prepared with the support of the Planning Inspectorate Secretariat. Version 1.0. November 2012 (the RIES);
- Triton Knoll Offshore Wind Farm – Report to Inform the Habitats Regulations Assessments. Revision B. Document Reference 04/02 RWE npower renewables. January 2012 (TKOWFL's HRA);
- TKOWFL Environmental Statement (the ES);
- Appropriate Assessment undertaken for Docking Shoal Race Bank and Dudgeon (June 2012) (the Greater Wash AA);
- The Statement of Common Ground between Triton Knoll Offshore Wind Farm Limited, JNCC and NE regarding Ornithology (11 October 2012) (the Ornithology SoCG);
- The Statement of Common Ground between Triton Knoll Offshore Wind Farm Limited, JNCC and NE regarding Marine Mammals (Revised) (12 October 2012) (the Marine Mammal SoCG);
- RSPB Letter of 7 August 2012 (RSPB representation);
- SNCB written representation 14 September 2009 (SNCB written representation);
- TKOWFL 'Technical Note – Potential Wave Impacts on Coastal Designated Sites' (TKOWF Technical Note); and
- Natural England response to DCO and RIES matrices consultation (SNCB RIES response) and TKOWFL response to DCO and RIES matrices consultation (TKOWFL RIES response) (collectively RIES responses).

1.19 The key information in these documents and written representations is summarised and referenced in this report.

2. PROJECT DESCRIPTION

Project Components

2.1 The project will comprise the construction and operation of up to 288 wind turbines, with a maximum installed capacity of up to 1,200 MW, as well as up to:

- Four High Voltage Alternating Current (HVAC) collector substations;
- Four meteorological monitoring stations;
- Four High Voltage Direct Current (HVDC) substations or two large HVDC substations; and
- A network of cables between the wind turbine generators, the meteorological stations, and substations.

2.2 Each of the wind turbines will have a maximum blade tip height of up to 220 metres above lowest astronomical tide (LAT), a maximum hub height of up to 140 metres above LAT and a maximum rotor diameter of 180 metres. Each turbine will be fixed to the seabed by one of five foundation types namely, monopile, jacket, tripod, suction bucket monopod or gravity base foundation.

2.3 Up to four HVAC collector substations, fixed to the seabed by jacket or monopile foundations, will be used to collect power from multiple wind turbine generators and electrically convert it for transmission. Up to four HVDC substations, fixed to the seabed by gravity, jacket or monopile foundations, will be used if HVDC is used to convey the power output of the wind turbines to shore.

2.4 Buried subsea cabling will inter-connect both the turbines and the offshore substations. Up to four meteorological monitoring stations, fixed to the seabed by either monopole, jacket, tripod, suction bucket, monopod or gravity based foundations, will be used to collect meteorological and oceanographic data.

2.5 Full details of the infrastructure to be used in the Project are detailed in the DCO.

Rochdale Envelope

2.6 The Project seeks to retain flexibility in the final project design and has been framed to allow for multiple design options in accordance with the Rochdale Envelope concept. This allows flexibility for different sizes of turbines, foundation types, and layout as long as they lie within the limits of the authorised consenting (Rochdale) envelope.

2.7 The ES states that the number of turbines able to be installed will be limited to a maximum of 288 by the 1,200 MW maximum export capacity of the Project. It describes the Project's Rochdale Envelope in terms of three indicative sizes of turbine; 3.6 MW, 5 MW and 8 MW, the characteristics of which are summarised in Table 2.1, with the 3.6 MW representing all turbines in the smaller range, 5 MW in the medium sized range, and 8 MW for the larger turbine models. It is noted in the ES that turbines with a rated capacity greater than 8 MW or smaller than 3.6 MW may be installed if their characteristics do not exceed the defined limits (ES V1 C6: 6.10).

Table 2.1: Project Design Envelope: Turbine Parameters that fall within the DCO

Indicative turbine size class	Max number for indicative size	Max hub height above LAT	Max rotor diameter	Upper blade tip above LAT
3.6 MW	288	110m	125m	160m
5 MW	240	126m	150m	190m
8 MW	150	140m	180m	220m

Source: TKOWFL's HRA: Table 2.

2.8 Prescriptive locations of individual turbines are not included in consents for offshore wind farms, as flexibility is required to ensure that the scheme can be delivered post-consent. Although indicative locations for the offshore structures have been developed and assessed in the ES, the precise layout of the turbines within the application boundary will be determined post consent, once detailed ground investigations and design optimisation work has been undertaken alongside the results of procurement tendering exercises.

2.9 TKOWFL is still considering both AC and HVDC connection options which require different connection infrastructure such as substations.

2.10 The ES is based on the assessment of the worst realistic case scenario for turbine type, foundations type and scour protection. The Project is however, bound by the DCO application boundary, which sets out areas within which the infrastructure can be located, together with various technical restrictions. The Panel's Report notes that the constructed project could not combine all of the most adverse impacts that represent the worst realistic case scenario and that, a significant precautionary margin is built into the Rochdale Envelope assessment (Panel's Report: 4.1.11). The Panel's Report highlights that the extent to which precaution has been factored in means that it is likely that the effects described in the ES would exceed those arising from the actual Project (Panel's Report: 4.1.7). The Secretary of State is content to accept the Panel's conclusions that the degree of flexibility provided for in the ES is both reasonable and necessary and compliant with the flexibility intended in the relevant National Policy Statements (NPS) (Panel's Report: 4.1.15).

Electrical System Components

2.11 The Project does not include any works to connect the offshore wind farm to the national grid. The Panel note that such works would require separate consent(s) at a later date (Panel's Report: 2.4.1).

2.12 During the examination, TKOWFL identified an indicative 'Electrical Infrastructure Area of Search' extending from the wind farm and a possible connection to the national grid at the Bicker Fen substation (Panel's Report: 2.4.1). RWE are currently considering possible options.

2.13 The NPS for Renewable Energy (EN-3) (DECC, 2011a) states that 'where the applicant does not know the precise location of any cabling or any necessary onshore and/or offshore substations, a corridor should be identified within which the cable and any offshore substation is likely to be located. The EIA for the proposed project should assess the effects of including this infrastructure within that corridor' (DECC, 2011a: 2.6.38). It also states that 'where the point of onshore connection is unknown at the time of the application, the applicant should assess a corridor from the wind farm to the shore that is considered to be a reasonably likely area for the cable and any offshore substation should be assessed as part of the EIA' (DECC, 2011a: 2.6.39).

2.14 The overarching NPS for new energy infrastructure (EN-1) (DECC, 2011b) states that the Government envisages that 'wherever possible, applications for new generating stations and related infrastructure should be contained in a single application … or in separate applications submitted in tandem which have been prepared in an integrated way' (DECC, 2011b: 4.9.2). However, it also allows that where the level of information available on different elements of a project varies 'applicant(s) may therefore decide to put in an application that seeks consent only for one element but contains some information on the second' (DECC, 2011b: 4.9.2). EN-1 states that where this option is pursued the applicant(s) 'must ensure they provide sufficient information to comply with the EIA Directive including the indirect, secondary and cumulative effects, which will encompass information on grid connections' and also states that 'the IPC must be satisfied that there are no obvious reasons why the other element are likely to be refused' (DECC, 2011b: 4.9.3).

2.15 The EIA Directive[1] accepts that EIA information requirements can be limited to what is relevant to a given stage of the consent procedure and to the specific characteristics of a particular project or type of project and the environmental features likely to be affected.

2.16 The Infrastructure Planning (EIA) Regulations 2009[2] (EIA Regulations) state that information required is limited to that which can be 'reasonably required' having regard 'in particular to current knowledge'[3].

2.17 The Panel's Report notes that a considerable number of parties to the examination made representations that the grid connection for the Project should form part of the application. For example, NE question the degree to which it was possible to assess the whole proposal in the absence of clarity about the detail of the grid connection (Panel's Report 4.1.22).

2.18 In the Secretary of State's view, the Panel's Report makes a thorough assessment of the adequacy of the approach taken by TKOWFL. Its assessment considers: the policy framework set by the NPSs (EN-1 and EN-3) and EIA Regulations; the representations made; the extensive nature of the ES; the fact that the relevant paragraphs of the EIA Regulations require

[1] Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment
[2] As amended by SI 20011/2741 and SI 2012/635
[3] Directive 2011/92/EU, Article 5 (a) and (b)

only the ‘significant’ and ‘main’ effects be addressed; and the late change to the grid connection available to TKOWFL.

2.19 The Panel concluded that the ES constitutes an adequate assessment of the indirect, secondary and cumulative effects of the development and that the ES encompasses the information on grid connections to the extent necessary for this Project application (Panel’s Report: 4.1.19). The Panel also consider that full assessment of the impacts of onshore elements would only be possible in the event of an application being made for these to the relevant authority(ies) (Panel’s Report: 3.14.3).

2.20 The Panel concluded that potential impacts of the infrastructure area of search considered were not ‘proven by substantive evidence to be incapable of satisfactory mitigation’ and given the fact that TKOWFL would be able to bring forward a number of alternative routes and/or solutions there were ‘no obvious reasons why the second elements of the project would be likely to be refused’ (Panel’s Report 5.1.43).

2.21 The Secretary of State agrees with the recommendations of the Panel and considers that sufficient information has been presented on the grid connection for the purposes of assessing this application under the Offshore Habitats Regulations. He is of the view that there is no risk of adverse effects on the integrity of European Sites as a result of not assessing future grid connection works in this HRA report, as a separate HRA would be required for any future applications for these works. This would be required to take into account the potential cumulative impacts of both the grid connection and this Project before consent could be granted for the connection infrastructure. There is, therefore, no possibility of unacceptable cumulative impacts occurring because the competent authority for the connection works would not be able to grant consent without securing suitable mitigation for those impacts. Furthermore, the Panel notes that that there are other available options to explore should the preferred route present insurmountable consenting problems (Panel’s Report: 5.1.42).

Indicative construction schedule

2.22 TKOWFL indicates in its ES that construction of the offshore components is proposed to commence in 2018, be carried out in three or four phases and be completed by 2020 (ES: Annex A). However, this is an indicative programme that could be affected by many factors such as weather, sea conditions and procurement-related issues. The DCO contains a requirement for construction to commence within 7 years of issue.

Operation and Maintenance

2.23 TKOWFL states in its ES, that once commissioned, the wind farm would operate automatically with each wind turbine operating independently of the others. The operation and control of the wind farm will be assessed by a Supervisory Control and Data Acquisition (SCADA) system, installed at each turbine and at the onshore control base. The SCADA system will enable the remote control of individual turbines or the wind farm in general, as well as information transfer,

storage and the shutdown of any wind turbine in emergency circumstances. A number of maintenance options are under consideration for the Project.

Decommissioning and Repowering

2.24 The Project falls within the scope of the Energy Act 2004 which includes decommissioning provisions. Broadly speaking, the Secretary of State shall require a person who is responsible for an offshore renewable energy installation to prepare a costed decommissioning programme and ensure that it is carried out. The Secretary of State can approve, modify or reject a decommissioning programme at any point.

2.25 Decommissioning activities will need to comply with all relevant UK legislation at the time. The person(s) responsible for the wind farm will produce and agree a decommissioning programme with DECC and in consultation with the Marine Management Organisation (MMO), SNCBs or their respective successors.

2.26 Decommissioning will take place at the end of the Project lifetime and will involve the removal of all accessible installed components of the wind turbine including parts of the wind turbine foundation structures (those above seabed level) and the sections of the inter-array cables close to the offshore structures, as well as sections of the export cable(s). The decision on repowering would be taken on commercial grounds, based on the performance of the wind farm and would be subject to a future consents application and a fresh assessment under the Offshore Habitats Regulations by the relevant authorities at that time.

3. PROJECT LOCATION AND DESIGNATED SITES

Location

3.1 The Project is located in the southern North Sea within the Greater Wash region. It lies approximately 33 km off the coast of Lincolnshire and 48 km off the coast of North Norfolk at its nearest point, occupying an area of up to 135km^2. The Project is located in the vicinity of the Triton Knoll sandbank, which is some 40 km east of the Humber Estuary's Mouth and 55 km north of the North Norfolk coast. A map of the Project location is given at Figure 3.1.

European and International Sites

3.2 The following sites were included in the RIES LSE screening matrices as they were identified by TKOWFL

- North Norfolk Coast SPA,;
- Flamborough Head and Bempton Cliffs SPA;
- Forth Islands SPA;
- Inner Dowsing, Race Bank and North Ridge cSAC;
- Humber Estuary SAC;
- Wash and North Norfolk SAC, identified by TKOWFL; and
- North Norfolk Coast Ramsar: TKOWFL's HRA Report jointly assesses the North Norfolk Coast SPA and the North Norfolk Coast Ramsar sites (TKOWFL HRA: 7.5). The North Norfolk Coast Management Plan (NE, 2003) states that the 'Ramsar site effectively covers the same area as the SPA'. The SPA standard data form (JNCC, 2006) and Ramsar information sheet (JNCC, 2008) state the same location coordinates (00 35 55 E 52 58 13 N). UK Government policy is to afford Ramsar sites the same protection as European sites. For the purposes of this assessment, treatment of the North Norfolk Coast Ramsar designation will be in parallel with the SPA designation. The boundaries of the SPA and Ramsar designations are entirely coincident and the qualifying features of the SPA broadly align with the Ramsar, with many of the same bird species (see Annex A for a list of each site's features);

3.3 The Wash Ramsar was identified as relevant to the Project in the SNCBs written representation due to its status as a 'Wetland of International Importance for wetland habitats, threatened ecological communities and species, and waterbirds' (SNCBs written representation: 4.33). Therefore the site was included within the RIES;

3.4 The RIES also includes the following sites as a result of concerns raised by the SNCBs regarding the potential impact on coastal sites designated for their nature conservation interest as a result of changes to physical processes due to the presence of the Project. A subsequent request from the Panel to prepare an assessment of those impacts, led TKOWFL to produce 'Technical Note – Potential Wave Impacts on Coastal Designated Sites' which considered the following additional sites:

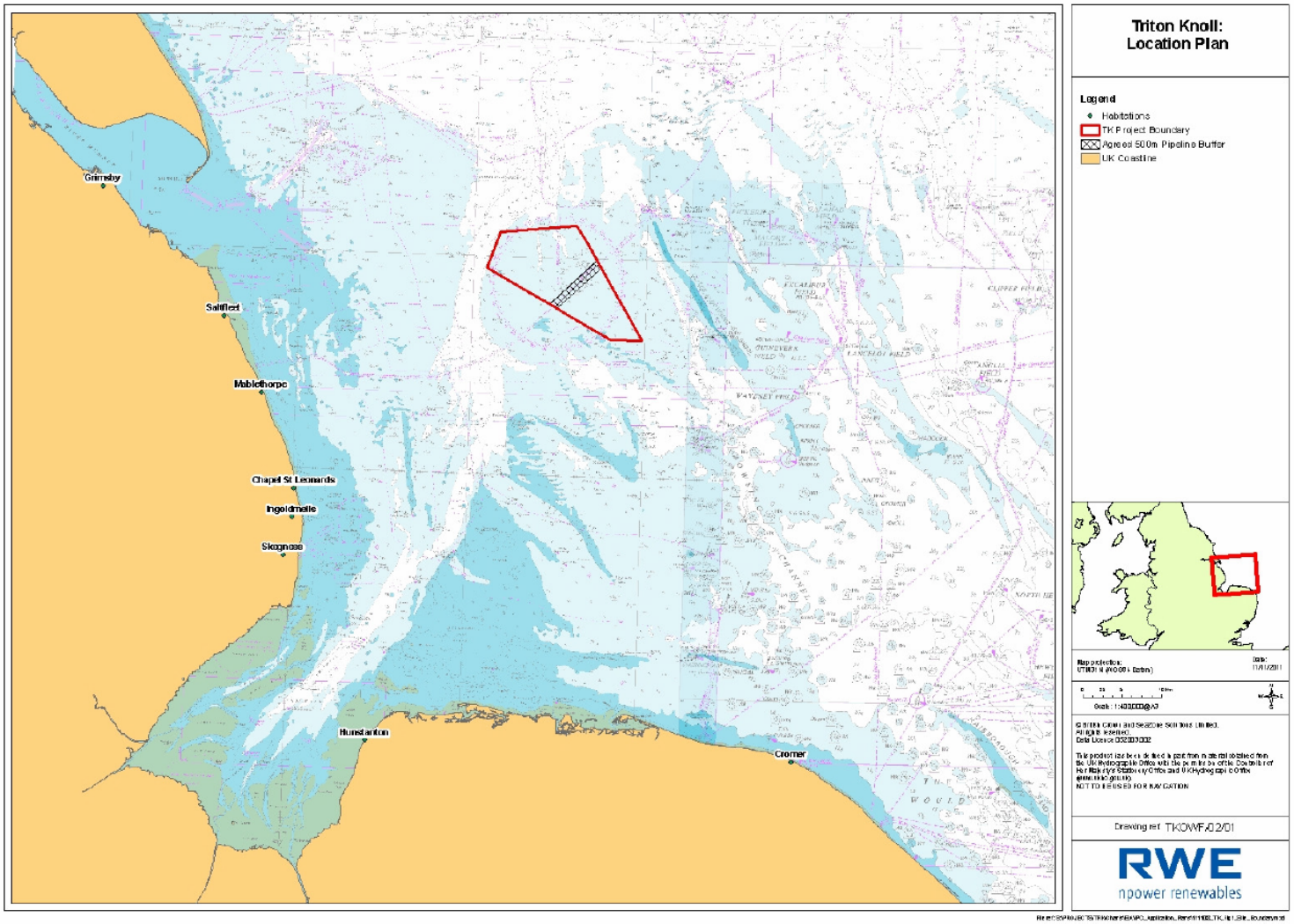
- North Norfolk Coast SAC;

- Overstrand Cliffs SAC;
- Saltfleetby – Theddlethorpe Dunes SAC;
- Winterton – Horsey Dunes SAC;
- Humber Estuary SPA;
- Gibraltar Point SPA;
- The Wash SPA; and
- Humber Estuary Ramsar.

3.5 The RIES highlights that, whilst the SPA and Ramsar sites are not designated for coastal features, the potential for indirect effects as a result of impacts on supporting habitats has been considered within the matrices (RIES: 2.6).

3.6 A Table listing the qualifying features of each for each of these sixteen European sites is presented in Appendix A.

Figure 3.1: Map of Project location



Source: ES V1 C6 (Fig. 6.1)

4 SCREENING FOR LIKELY SIGNIFICANT EFFECTS

Likely Significant Effects Test

4.1 An AA is required if a plan or project is likely to have a significant effect on a European site, either alone or in combination. A LSE is, in this context, any effect that may be reasonably predicted as a consequence of a plan or project that may affect the conservation objectives of the features for which the site was designated, but excluding trivial or inconsequential effects.

4.2 The purpose of this test is to identify LSEs on European sites that may result from the Project and to record the Secretary of State's conclusions on the need for an AA and his reasons for screening activities, sites or in-combination plans and projects in or out of further consideration in the AA. For those features where an LSE is identified, these must be subject to an AA. The Panel's Report (5.2.13-14) describes this review of potential implications as a 'two-tier process' with the LSE test as the first tier and the review of effects on integrity (AA) as the second tier.

4.3 This section addressed this first tier of the HRA, for which the Secretary of State has considered the potential impacts of the Project both alone and in-combination with other plans and projects on each of the interest features of the sixteen European sites identified in the RIES (and listed in paragraph 3.2-3.4) to determine whether or not there will be an LSE. Where there are predicted LSEs, these are described briefly in Table 4.1. Further detail is set out in the RIES Matrices.

Treatment of decommissioning impacts

4.4 At the end of the Project lifetime, decommissioning must take place and at that point separate authorisation will be required, as a planning matter, after the preparation of an EIA and HRA (including appropriate consultation with the relevant SNCBs). It is not possible at this stage to predict with any certainty what the European and Ramsar site context of the Project will be in the future: sites may increase or decrease in importance over that time.

4.5 However, if the environmental baseline were to be similar to the current situation, then the impacts of decommissioning of the project could be expected to be similar to the anticipated impacts of construction, without the impacts of piling. There is no reason to suppose that the impacts of decommissioning would cause an adverse impact on site integrity and on this basis, the Secretary of State considers that it is reasonable not to include a detailed discussion on decommissioning impacts in this report. He accepts in principle the advice in the RIES that the effects will be similar in nature to those during construction and he is satisfied that they will be addressed fully by the relevant authorities, prior to decommissioning and in light of more detailed information on decommissioning processes and environmental conditions at that time.

Treatment of grid connection works

4.6 As outlined in Section 2, any future grid connection works would be made under a separate application, and, consequently, do not form part of this HRA.

Likely Significant Effects: Project Alone

4.7 Matrices 2.1 – 2.16 in the RIES present the potential interactions of each stage of the project alone (construction, operation, decommissioning) with those qualifying features of the sixteen sites (listed in Annex A).

4.8 In considering whether there would be an LSE from the project alone, all parties were in agreement that potential for LSE could not be excluded for six features of five designated sites. These are listed in Table 4.1.

Table 4.1: Qualifying features for which a likely significant effect cannot be excluded

Site	Qualifying feature	Key reasons why potential for LSE cannot be excluded (both alone and in-combination)
North Norfolk Coast SPA and Ramsar	Sandwich tern (*Sterna sandvicensis)* (Breeding population)	There is potential for a LSE on Sandwich tern from the SPA as a result of potential collision risk impacts.
Flamborough Head and Bempton Cliffs SPA	Gannet (*Morus bassanus)* (Breeding population)	There is potential for a LSE on Gannet from the SPA as a result of potential collision risk impacts.
	Kittiwake (*Rissa tridactyla)* (Breeding population)	There is potential for a LSE on Kittiwake from the SPA as result of potential collision risk impacts.
Inner Dowsing, Race Bank & North Ridge cSAC	Sandbanks slightly covered by seawater at all times (Annex I Habitat)	The Project is not located within the cSAC however there is potential for a LSE on sandbanks due to changes to the hydrodynamic regime.
Humber Estuary SAC	Grey seal (*Halichoerus grypus*)	There is potential for a LSE on Grey seal due to potential for disturbance of this SAC population during construction.
Wash and North Norfolk Coast SAC	Harbour seal *(Phoca vitulina)*	There is potential for a LSE on Harbour seal due to potential for disturbance of this SAC population during construction.

Source: RIES Matrices 2.1, 2.2, 2.4, 2.5, and 2.6.

4.9 All parties were in agreement that LSE could be excluded for all other qualifying features. For this reason, the Secretary of State has focussed his AA for the Project alone on the six features listed in Table 4.1.

Likely Significant Effects: Project In-Combination

4.10 A number of other plans and projects could potentially affect some of the same European sites as the Project. These include a number of planned and existing offshore wind farms within the vicinity of the Project (a map showing surrounding offshore wind farm projects is at Figure 4.1). As well as these, there are a number of other activities in the vicinity of the Project location such as aggregate dredging activities, shipping and navigation, commercial fisheries, and offshore oil and gas developments.

4.11 Matrices 2.1 – 2.16 in the RIES show the potential interactions of the Project in-combination with other plans and projects and consider LSE on the qualifying features of the sixteen sites listed in Annex A.

4.12 Table 4.2 identifies those plans and projects that have been considered in-combination with the Project for each qualifying feature for which LSE was identified. These other plans and projects may affect some of the same European sites as the Project and have been screened in for further consideration. The Secretary of State is content to limit the LSE in-combination assessment to those plans and projects listed in Table 4.2.

4.13 TKOWFL included Docking Shoal Offshore Wind Farm within its in-combination assessments; however this project has subsequently been refused consent (DECC, 2012) and so does not form part of this HRA in-combination assessment.

4.14 All parties were in agreement that those features for which an LSE could not be excluded alone (listed in Table 4.1) a LSE could also not be excluded in-combination with other plans and projects for the same reasons.

4.15 In considering the impact of the project in-combination with other plans and projects, LSEs on all other qualifying features (listed in Annex 1) were excluded to the agreement of all parties. For this reason, the Secretary of State has focussed his in-combination AA on the six features listed in Table 4.1.

Table 4.2 Plans and projects considered in–combination for features where there is a LSE

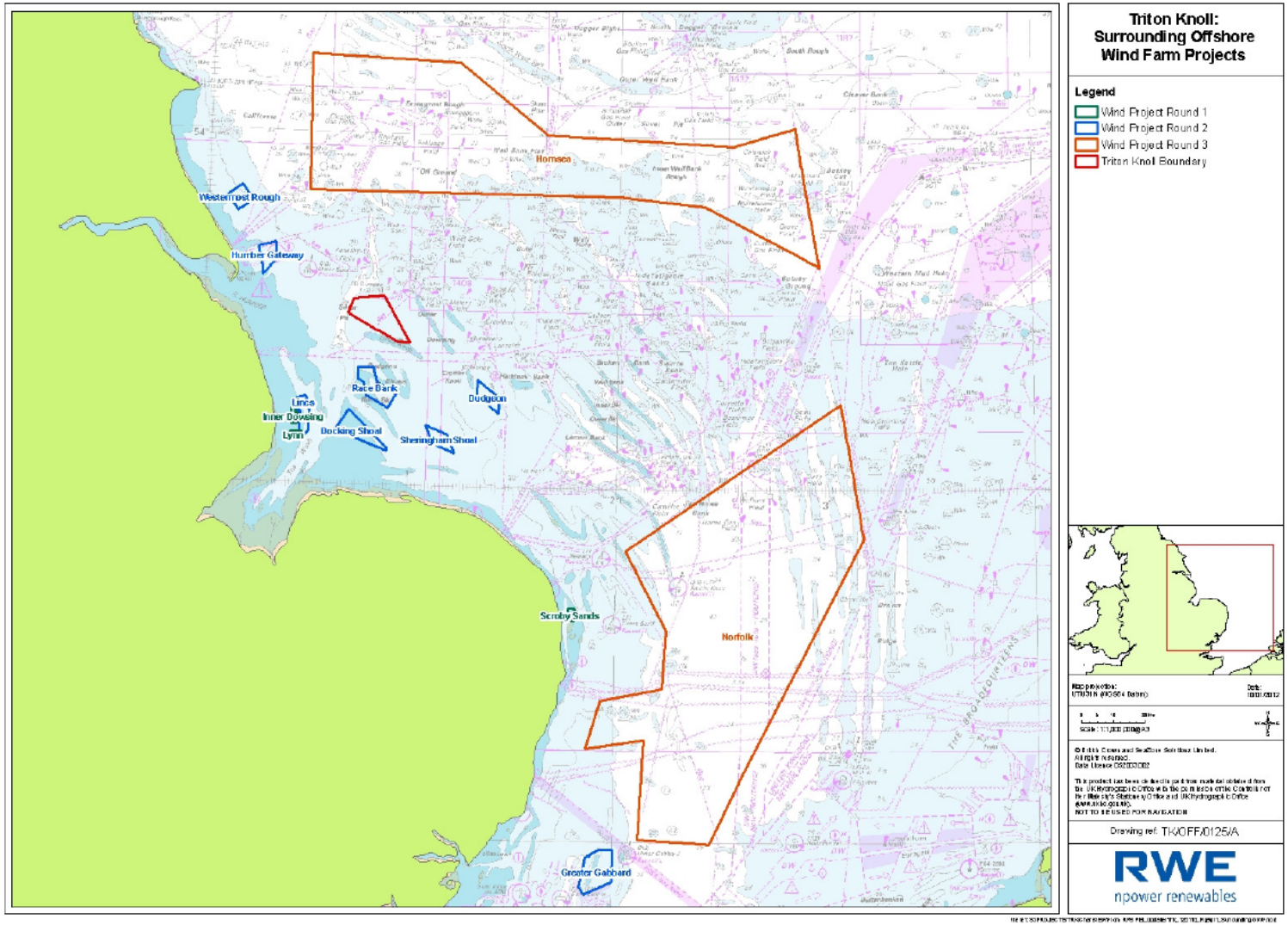
	Sandwich tern	Gannet[4]	Kittiwake	Sandbank	Grey seal	Harbour seal
Lincs Offshore	x	x			x	x
Sheringham Shoal	x	x			x	x
Dudgeon	x	x			x	x
Humber Gateway	x	x	x		x	x
Race Bank	x	x	x	x	x	x
Lynn	x	x				
Inner Dowsing	x	x				
Westermost Rough	x	x	x		x	x
Hornsea Project 1[5]	x					
Kentish Flats		x				
Kentish Flats extension		x				
Gunfleet Sands		x				
London Array		x				
Greater Gabbard		x				
Galloper		x				
Aggregate dredging in the Greater Wash					x	x

Sources: TKOWFL ES: Table 6.14; ES V2 C6: 6.173; TKOWFL HRA Table 16; TKOWFL HRA: 9.57-9.58; 10:70.

[4] Due to the extensive foraging range of Gannet, wind farms in the Thames estuary region were taken into account by TKOWFL in its in-combination assessment in addition to other wind farms in the Greater Wash area.

[5] No other Round 3 offshore wind farms were considered by TKOWFL in its in-combination assessment as these projects were 'insufficiently developed in the public domain' (ES V1 C5: 5.31).

Figure 4.1: Location of offshore wind farms in the vicinity of the Project



Source: ES V1 C5 Figure 5.1 (Note: Docking Shoal subsequently refused)

Conclusions on Likely Significant Effects

4.16 The Secretary of State agrees with the Panel that there is a LSE, as a result of the project alone and in-combination with other plans and projects, on the European sites and features summarised in Table 4.1, and it is these features that are relevant to his AA.

4.17 The Secretary of State agrees with the Panel that there are no other LSEs on any of the other interest features of those sixteen sites listed in Annex A as a result of the Project alone or in-combination with other plans or projects. As a result the Secretary of State is content that these features need not be subject to any further assessment.

4.18 The Secretary of State notes that in the SoCG between the SNCBs and TKOWFL it is agreed that 'where a likely significant effect on a site of European importance is predicted to arise from a proposed application then the Secretary of State is required to undertake an Appropriate Assessment before the Development Consent Order is made' (Ornithology SoCG: 5.8).

4.19 Having given due consideration to the information and analysis presented to him, the Secretary of State considers that the scope of the AA should be those sites and features for which LSE could not be excluded identified at Table 4.1. The Secretary of State considers that sufficient information has been provided to inform a robust assessment in line with his duties under Regulation 25.

4.20 The Secretary of State has considered which plans and projects should be included in the in-combination assessment and these are listed in Table 4.2.

5 APPROPRIATE ASSESSMENT

Test for Adverse Effect on Site Integrity

5.1 An AA is triggered when the competent authority, in this case the Secretary of State, determines that a plan or project is likely to have a significant effect on a European site. Guidance issued by the European Commission states that the purpose of an AA is to determine whether adverse effects on the integrity of the site can be ruled out as a result of the plan or project, either alone or in-combination with other plans and projects, in view of the site's conservation objectives (European Commission, 2000).

5.2 The purpose of this AA is therefore to determine whether or not adverse effects on the integrity of those sites and features identified at the LSE 'screening stage' can be ruled out as a result of the Project alone or in-combination with other plans and projects in view of the sites conservation objectives and using the best scientific evidence available.

5.3 If the competent authority cannot ascertain the absence of an adverse effect on site integrity within reasonable scientific doubt, then under the Offshore Habitats Regulations, alternative solutions should be sought. In the absence of an acceptable alternative, the project can proceed only if there are imperative reasons of overriding public interest (IROPI). Considerations of IROPI are beyond the scope of this AA.

Conservation Objectives

5.4 European Commission guidance indicates that disturbance to a species or deterioration of a European site must be considered in relation to the integrity of that site and its conservation objectives (European Commission, 2000). Section 4.6.3 defines site integrity as:

"…the coherence of the site's ecological structure and function, across its whole area, or the habitats, complex of habitats and/or populations of species for which the site is or will be classified."

5.5 Conservation objectives outline the desired state for any European site, in terms of the interest features for which it has been designated. If these interest features are being managed in a way which maintains their nature conservation value, they are assessed as being in a 'favourable condition'. An adverse effect on integrity is likely to be one which prevents the site from making the same contribution to favourable conservation status for the relevant feature as it did at the time of its designation (English Nature, 1997).

5.6 There are no set thresholds at which impacts on site integrity are considered to be adverse. This is a matter for interpretation on a site-by-site basis, depending on the designated feature and nature, scale and significance of the impact. The conservation objectives for the five sites in Table 4.1 for which LSE were identified have been taken into account by the Secretary of State in reaching his decision, alongside the potential for adverse impacts on integrity, as a result of the project alone and in-combination.

Approach taken for this Appropriate Assessment

5.7 The Panel's Report notes that agreement was reached between all parties that adverse effect on integrity both alone and in-combination could be excluded for all sites except for North Norfolk Coast SPA (Panel's Report: Table 5.2). The RIES, which summarises this position, was subject to consultation and all parties, notably including the SNCBs, agreed with the conclusions of the RIES.

5.8 The Secretary of State is of the opinion that, in cases where interested parties identify that there may be an adverse effect, or where disagreement occurs, and this remains the case at the end of PINS' examination, this merits particular consideration on his part. This is the case for the North Norfolk Coast SPA, and consequently a more detailed AA has been produced (Section 6)

5.9 Where all relevant parties are confident that an adverse effect can be excluded (as is the case for the four sites listed below) the Secretary of State is content to rely on the RIES, written responses to it and the Panel's recommendations to inform his view. He considers that the evidence behind these judgements has been fully tested as part of the examination process. For these reasons, a high-level assessment is considered to be appropriate for the following sites:

- Flamborough Head and Bempton Cliffs SPA
- Inner Dowsing, Race Bank and North Ridge cSAC
- Humber Estuary SAC
- Wash and North Norfolk Coast SAC

5.10 Additional reasoning is set out below that informs the Secretary of State's conclusions on these four sites.

Flamborough Head and Bempton Cliffs SPA

5.11 Collision risk during Project operation is the key issue for Gannet and Kittiwake at Flamborough Head and Bempton Cliffs SPA. Collision risk and population modelling was undertaken by TKOWFL for both species to determine the levels of additional mortality that can be supported by those populations without risk of decline.

5.12 In reaching his decision on alone and in combination impacts the Secretary of State considered TKOWFL's initial Gannet and Kittiwake collision risk modelling (CRM) (TKOWFL HRA), subsequent additional Gannet in-combination CRM (Ornithology SoCG Appendix 3) undertaken by TKOWFL, and the SNCBs comments upon this (Ornithology SoCG) and agrees that collision mortality for adult Gannet and Kittiwake from the SPA populations will be below the acceptable collision mortality thresholds for those species.

5.13 A key step in predicting collision mortality is to define the percentage of birds that are likely to make a behavioural response to the presence of a wind farm, or to an individual turbine, so as

to avoid flying on a path that puts them at risk of collision with the rotating turbine blades. This is the avoidance rate. The choice of avoidance rate has a significant influence on the number of predicted collisions, with a 1% increase in avoidance rate giving rise to a doubling in the predicted collision mortalities. The overall avoidance rate will be the result of a combination of factors including macro-avoidance (of the whole wind farm, by diverting over or around it) and micro-avoidance (ability to avoid collision with a turbine once within a wind farm). The actual avoidance rate for a given location will also be affected by site-specific issues, including the layout of turbines, weather and visibility, whether the birds are foraging or migrating and also whether they are part of a large flock.

5.14 Whilst collision avoidance rates can be generic, where essentially the same rate of turbine blade avoidance is assumed for a wide range of bird species, irrespective of any behavioural assumptions or empirical observations, they can also be made specific to a species or a group of species on the basis of both qualitative assessment (taking known behaviours including manoeuvrability into account) and empirical data (such as surveys of actual bird behaviours for example blade avoidance, or mortality impacts evidenced by recovered dead bird counts). Species-specific avoidance rates have been developed by Scottish Natural Heritage to take into account factors such as the behaviour patterns, reactions, size and agility of different bird species (Scottish Natural Heritage, 2010).

5.15 TKOWFL applied an avoidance rate of 98% for Gannet. However the SNCBs advise that whilst this 98% is the currently accepted figure, there is a recent empirical study (Krijgsveld *et al* 2011) that documents greater avoidance of windfarms by Gannets than many other species and estimates an overall avoidance rate of 99.1% for this species. Consequently SNCBs stated that in their view, in the current case, an avoidance rate of 99% may be appropriate, pending further consideration of the Scottish Natural Heritage guidance (Ornithology SoCG: Appendix 2). The Secretary of State agrees with the SNCBs, and concludes that an avoidance rate of 99% for Gannets may be sufficiently precautionary for this species, based on the most recent evidence, although he notes that there would not be an adverse impact even with a 98% avoidance rate in this instance.

5.16 The Secretary of State has considered other risks to Gannet and Kittiwake including disturbance/displacement and indirect effects. He is satisfied that the birds are unlikely to be disturbed by the presence of the wind farm due to their flexible habitat use and the fact that impacts from increased vessel movements will be minimal. Indirect effects are also unlikely in relation to prey species as both Gannet and Kittiwake show flexibility in their foraging areas and diet.

5.17 The Secretary of State agrees with the Panel's conclusion that no adverse effects on the integrity of the breeding Kittiwake and Gannet populations of the Flamborough Head and Bempton Cliffs SPA are expected to arise from the Project either alone or in-combination with other plans and projects, subject to mitigation measures secured in the DML that will be

adopted to minimise effects. These mitigation measures comprise an ornithological monitoring programme and post-construction surveys (DML Part 2 Conditions 9, 13, and 15).

Inner Dowsing, Race Bank and North Ridge cSAC

5.18 The potential for changes to the sediment regime due to construction activities, changes to the wave climate due to the presence of foundations, and resulting changes to scour or sediment transportation pathways are the key issues for the feature of sandbanks slightly covered in seawater at all times at Inner Dowsing, Race Bank and North Ridge cSAC.

5.19 TKOWFL identified that considering the location of the coastal sites and the outcome of the detailed site specific and cumulative hydrodynamic modelling studies set out in the ES, no significant impacts were anticipated upon any of the coastal features of the designated sites considered. SNCBs agreed that it is highly unlikely there will be an impact on physical processes operating at the coast such that there is likely to be an impact on designated coastal sites.

5.20 In reaching his decision on alone and in-combination impacts the Secretary of State considered the additional Technical Note produced by TKOWFL (TKOWFL Technical Note) which reviewed potential impacts, and the SNCB's subsequent written representation which confirmed that they are satisfied that it is highly unlikely there will be an impact on physical processes operating at the coast such that there is likely to be an impact on designated coastal sites. The Panel concluded that in its view the Project would not adversely affect the cSAC through impacts on the sandbank feature.

5.21 The Secretary of State agrees with the Panel and concludes that no adverse effects on the integrity of the Inner Dowsing, Race Bank and North Ridge cSAC are expected to arise from the Project either alone or in-combination with other plans and projects.

Humber Estuary SAC

5.22 Impacts on Grey seal were identified as potentially having a LSE on site integrity of the Humber Estuary SAC due to disturbance effects during construction, particularly piling. The Marine Mammal SoCG confirms that there is agreement that the assessment presented in TKOWFL's HRA Report is appropriate and that the conclusion of no adverse impact on the integrity of the Humber Estuary SAC is accurate. In their RIES response, the SNCBs agree that adverse integrity effects on the SAC with respect to the Grey seal can be excluded, noting that the proposed DCO includes measures to manage the cumulative effects of piling with other projects through construction monitoring and marine mammal mitigation protocols (DML Part 2 Conditions 9 and 14). The Panel concluded that in their view the Project would not adversely affect the SAC through impact on the Grey seal.

5.23 The Secretary of State agrees with the Panel and concludes that no adverse effects on the integrity of the Humber Estuary SAC are expected to arise from the Project either alone or in-

combination with other plans and projects, subject to mitigation measures secured in the DML that will be adopted to minimise effects**.**

Wash and North Norfolk Coast SAC

5.24 Impacts on Harbour seal were identified as potentially having a LSE on site integrity due to disturbance effects during construction, particularly piling. All parties were in agreement that adverse effects on site integrity can be excluded, as a result of the Project alone and in-combination with other plans and projects, subject to requirements in the DCO to mitigate cumulative effects of construction with other projects through construction monitoring and marine mammal mitigation protocols (DML Part 2 Conditions 9 and 14) (SNCB RIES response; Marine Mammal SoCG). The Panel also concluded that the proposal will not lead to adverse effect, subject to the delivery of the construction programme, designed to minimise the occurrence of cumulative or sequential piling with other projects (Panel's Report: 5.2.79).

5.25 The Secretary of State agrees with the Panel and concludes that no adverse effects on the integrity of the Wash and North Norfolk Coast SAC are expected to arise from the Project either alone or in-combination with other plans and projects**,** subject to mitigation measures secured in the DCO/DML that will be adopted to minimise effects.

Conclusions

5.26 All parties were in agreement that adverse effects on site integrity as a result of the Project can be excluded for Flamborough Head and Bempton Cliffs SPA, Inner Dowsing, Race Bank and North Ridge cSAC, Humber Estuary SAC, and Wash and North Norfolk Coast SAC. The Secretary of State has examined the evidence submitted as part of the application and during the examination and has considered the views of the parties and the reasoning of the Panel to inform a high level assessment of the potential for adverse effect on these sites. He agrees with the recommendations of the Panel and the advice of the SNCBs, and concludes that no adverse effects on the integrity of these sites can be expected to arise from the Project either alone or in-combination with other plans and projects, subject to mitigation measures secured in the DML that will be adopted to minimise effects, as detailed above.

6. NORTH NORFOLK COAST SPA AND RAMSAR

6.1 The North Norfolk Coast SPA encompasses much of the northern coastline of Norfolk, in eastern England. It is a low-lying barrier coast that extends for 40 km from Holme to Weybourne and includes a great variety of coastal habitats (JNCC, 2001).

6.2 The main habitats found along the whole coastline include extensive intertidal sand and mud-flats, saltmarshes, shingle and sand dunes, together with areas of freshwater grazing marsh and reedbed, which has developed in front of rising land (JNCC, 2001).

6.3 The great diversity of high-quality freshwater, intertidal and marine habitats results in very large numbers of waterbirds occurring throughout the year. In summer, the site holds large breeding populations of waders, four species of terns, Bittern and wetland raptors such as Marsh Harrier. In winter, the coast is used by very large numbers of geese, sea-ducks, other ducks and waders. The coast is also of major importance for staging waterbirds in the spring and autumn migration periods. Breeding terns, particularly Sandwich tern and wintering sea-ducks regularly feed outside the SPA in adjacent coastal waters (JNCC, 2001).

6.4 JNCC's SPA site description (JNCC, 2001) indicates that the site qualifies under Article 4.1 of the Birds Directive by supporting a number of populations of European importance (Annex I Species), as well as under Article 4.2 by regularly supporting at least 20,000 waterfowl.

6.5 The low-lying barrier coastline of North Norfolk is designated as a Ramsar site for its diverse and extensive wetland habitats and associated species (notably waterfowl). The Ramsar encompasses a variety of habitats including intertidal sands and muds, saltmarshes, shingle and sand dunes, together with areas of reclaimed freshwater grazing marsh and reed bed, which is developed in front of rising land. Both freshwater and marine habitats support internationally important numbers of wildfowl in winter and several nationally rare breeding birds. The sandflats, sand dune, saltmarsh, shingle and saline lagoon habitats are of international importance for their fauna, flora and geomorphology (TKOWFL HRA: 7.5). TKOWFL states in its HRA Report that the North Norfolk Coast Ramsar site effectively covers the same area as the North Norfolk Coast SPA. As noted in section 3, for the purposes of this assessment, the North Norfolk Coast Ramsar designation will be assessed jointly with the North Norfolk Coast SPA designation.

6.6 The conservation objectives of the SPA are set out in Table 6.1. The qualifying features for this site are listed in Annex A.

Table 6.1: Conservation objectives for the North Norfolk Coast SPA

Conservation Objectives	Avoid the deterioration of the habitats of the qualifying features, and the significant disturbance of the qualifying features, ensuring the integrity of the site is maintained and the site makes a full contribution to achieving the aims of the Birds Directive. Subject to natural change, to maintain or restore (for each qualifying feature): ➢ 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 the qualifying features; ➢ The distribution of the qualifying features within the site.

Source: NE, 2001a.

Sandwich tern

6.7 Breeding Sandwich tern, *Terna sandvicensi,* are a qualifying feature of the North Norfolk Coast SPA and Ramsar sites. The designation population of this species was 3,457 pairs in 1989; its usual range is between 3,000 and 4,500 pairs at the site. It is part of the assemblage of species for which that site has been classified (RIES: 5.2.18).

Population Size, Distribution and Trends

6.8 The Sandwich tern has an estimated world population of 160,000 – 170,000 pairs. The European population of Sandwich tern is approximately 60,000-79,000 pairs. The UK population of Sandwich tern is estimated to be around 11,000 pairs some 14-16 % of the European population. Sandwich tern remains Amber listed as a species of conservation concern in the UK. The UK Sandwich tern population exhibits the most erratic population trends and distribution of any seabird breeding in the UK. The Sandwich tern population fluctuates dramatically among years owing to large variations in the proportion of breeding birds whilst distribution varies due to mass movements between colonies in the UK and across Europe (JNCC, 2013). As TKOWFL note in their HRA, movement of individuals between breeding colonies has implications for colony dynamics, with the potential for both rapid increases and decreases in colony size (TKOWFL HRA: 7.8).

6.9 Sandwich terns arrive in the UK to breed in late March and generally leave in September. The breeding season is between April, with the first eggs laid at the end of the month, and July, when young typically fledge from the colony. Adults and dependent juveniles leave the colony and may disperse widely to other parts of the UK and even cross the North Sea, with the potential for birds from colonies on the continent undertaking some reciprocal movement (Wernham et al., 2002).

6.10 The majority of the UK population of Sandwich tern is divided between a few large colonies, the most significant of which is located on the North Norfolk coast (TKOWFL HRA: 7.7). The North Norfolk Coast SPA and Ramsar sites support the largest, long-standing, breeding population of

Sandwich tern in Great Britain. It is estimated that the North Norfolk SPA and Ramsar colonies represent at least 40% of the national population, 5 – 6% of the European population and 2.3 – 2.8% of the world population (Mitchell *et al*., 2004).

6.11 At the North Norfolk Coast SPA and Ramsar, Sandwich terns nest in colonies at Blakeney Point and Scolt Head. Both of these colonies have been monitored since their establishment in the 1920s indicating that there has been an overall increase in the size of the colonies since the early 1960s, with peak numbers of 5,600 breeding pairs in 1979. Stiffkey Binks has also previously been used as nest site (Panel's Report: 5.2.19).

6.12 Breeding pairs at North Norfolk Coast SPA and Ramsar were recorded in the SPA review as 3,457, from a 5-year mean of the population between 1994 and 1998, (Stroud et al. 2001). Figures for 2000 – 2004 estimate the population as a mean of 4,047 pairs (TKOWFL HRA: 7.32). SNCBs recommended that the more precautionary population estimate of figure of 3,457 pairs (6,914 individuals) should be used for the purposes of the Secretary of State's AA.

6.13 The life history of Sandwich tern is one of delayed maturity, with individuals not breeding until they reach at least three years of age (Mitchell *et al.,* 2004).

Diet

6.14 The diet of Sandwich tern is predominantly fish based, especially Clupeids (such as Herring) and Sandeel, with some invertebrates, especially Squid. Sandwich terns have a specialised diet during the breeding season, depending almost exclusively on Clupeids and Sandeels (Stienen et al., 2000). Favoured fishing areas include Seal Sand in the centre of the Wash and in the vicinity of Race Bank, 12 km north of Blakeney Point. Those passing Sheringham and Cromer are thought to fish near Happisburgh Sands, 10 km offshore. Large groups of birds occur in post breeding flocks (TKOWFL HRA: 7.3).

Foraging patterns

6.15 The foraging range of Sandwich tern has implications for the provenance of individuals from the North Norfolk Coast SPA and Ramsar that may be found at the Project site, as well as implications for plans and projects to be considered in-combination with the Project.

6.16 The RIES notes that Sandwich terns range widely throughout the Wash or southern North Sea area and forage on waters including those within the proposed DCO area, albeit at a relatively low level of utilisation (RIES: 5.2.20).

6.17 The distance of the Project site from the North Norfolk Coast SPA is 46.8 km. TKOWFL state that Sandwich tern can travel a considerable distance to feed (TKOWFL's HRA Report: 7.3). TKOWFL rely in their ES on precautionary foraging ranges for Sandwich terns presented by Langston (Langston, 2010) (TKOWFL ES V2 C6: 6.37 and Table 6.7). TKOWFL note in their HRA that similar studies (Perrow *et al*., 2011) showed that the mean range of birds from different colonies from different years was much lower, 6.6 - 12.9 km (TKOWFL HRA Report: 7.10). TKOWFL rely on these studies to demonstrate that although the Project site falls outside

the mean maximum foraging range, it is within the maximum foraging range of Sandwich tern (TKOWFL HRA Annex H:1.212).

6.18 However, a more recent study by Thaxter *et al.* (2012) found Sandwich tern foraging ranges to be much lower than presented in the 2010 Langston study. The results of each study are presented in Table 6.3. This new data presented by Thaxter *et al.* (2012) was published after TKOWFL's HRA and was not raised during the examination nor mentioned in the Panel's Report. However, the Secretary of State considers it to be relevant to informing his conclusions in this assessment.

Table 6.2: Sandwich tern foraging ranges

Source	Maximum foraging range (km)	Mean of maximum foraging range (km)	Mean foraging range (km)
Langston (2010)	70	42	15
Thaxter *et al.* (2012)	54	49 (± 7.1)	11.5 (± 4.7)

Sources: Thaxter *et al*., 2012; and Langston, 2010.

Birds flying at rotor height

6.19 TKOWFL's HRA draws particular attention to the percentage of birds flying at rotor height (which it defines as 12.8%) and states that this has the greatest bearing on collision risk, noting however that although flight height may vary according to behaviour such as foraging activity, it also varies according to weather conditions particularly wind strength and direction (Perrow *et al.,* 2010).

6.20 A recent review of current information on flight heights by Cook *et al.* (2012) concluded that Sandwich terns tend to fly at lower altitudes, below the minimum height of any turbine's rotor blades and that (assuming a turbine with a minimum rotor blade height of 20 m and a maximum rotor blade height of 150 m) only approximately 3.6 % of flights by Sandwich terns are likely to be at a height which places them at risk of collision with turbine blades (Cook *et al*, 2012: 3.1.28). This extensive review has implications for this assessment and the Secretary of State places weight on the fact that the percentage of Sandwich terns likely to fly at rotor height presented in the applicant's modelling appears to be precautionary when compared to this wider study.

Evidence from Surveys

6.21 TKOWFL report that Sandwich terns were recorded in the Project site during its boat-based surveys in 2008 from early April to mid-June and in 2009 from early April to mid-August. (TKOWFL HRA: 7.10). TKOWFL note that it applied a precautionary measure to its

assessments by making the assumption that all birds recorded from the boat based surveys from April to July originated from the SPA. They suggest that as the TKOWF site is at the extreme of the species foraging range from the SPA this, in reality, is unlikely to be the case (TKOWFL HRA: 7.33).

6.22 TKOWFL report that the maximum estimate of Sandwich tern density in the Project site and buffer in aerial surveys was 0.95 individuals per km^2, adjusted to account for the North Norfolk Coast SPA Sandwich tern colonies and the low species identification rate (TKOWFL HRA: 7.9). TKOWFL also report that the peak population in the breeding season was low, reaching a maximum of 34 individuals in 2009 (density of 0.17 individuals per km^2) and just 17 individuals in 2008 (density of 0.08 individuals per km^2) (TKOWFL HRA: 7.11). TKOWFL propose that this demonstrates that the prospect of breeding birds from either colony in North Norfolk reaching the Project site was low. In light of the review by Thaxter *et al.* (2012), the Secretary of State agrees that this is likely to be the case.

Evidence from other wind farm sites

6.23 Sandwich terns have been recorded at a number of operational offshore wind farms. The evidence from these studies has not identified any significant or adverse population level effects on Sandwich terns. A summary of these studies is presented in the Greater Wash AA and replicated below:

6.24 *Zeebrugge,* Belgium: Between 2001 and 2005, the Sandwich tern population at Zeebrugge increased from 920 breeding pairs to 2,538 peaking at 4,067 pairs in 2004 attributable to provision of artificial nesting habitat at the colony. During this period, 25 small to medium sized wind turbines were operating along a seawall within 100 m from the colony. Studies undertaken between 2000 and 2005 included assessing the collision risk to Sandwich terns from the wind turbines (Everaert 2003, Everaert and Stienen 2006, Everaert and Kuijken 2007). The studies concluded that the probability of a Sandwich tern colliding with a turbine when flying at rotor height was between 0.046% and 0.088%.

6.25 *Horns Rev,* Denmark: Extensive studies have been undertaken at the Horns Rev Offshore Wind Farm in Denmark. A total of 4,726 Sandwich terns out of 8,747 were observed during the study; primarily during the spring and autumn migration periods. The study noted that Sandwich tern displayed no reaction to the turbines when entering the wind farm; whereas avoidance behaviour was recorded in Arctic/Common terns (Petersen *et al.* 2006). Although significant behavioural reactions (i.e. avoidance) to the wind farm and single turbines were not observed in any of the Gull and Tern species, which dominated the birds observed within the area of the wind farm, it was noted that birds were more likely to enter the wind farm between two inactive turbines than they would if one or both were operating; suggesting some degree of avoidance behaviour does occur. The studies concluded that 'Divers, Gannet, Common scoter, Auks, Skuas, Gulls and Terns did not exhibit a high risk of colliding with the turbines' and no collisions were recorded (Petersen *et al.* 2006).

6.26 *Egmond aan Zee,* Netherlands: Egmond aan Zee lies 10km to 15km from the Dutch coast. Extensive visual and radar studies showed that terns did not avoid the wind farm and continued to forage within the operational wind farm. No collisions were observed for any bird species and terns were observed entering the site at stationary turbines suggesting some degree of avoidance does occur (Lindeboom *et al.* 2011). The overall collision risk at Egmond aan Zee was considered to be 'low', based on observations and model calculations (Lindeboom *et al.* 2011).

6.27 *Thornton Bank,* Belgium: Thornton Bank Offshore Wind Farm lies approximately 35km from the Belgian coast and is in an area frequently used by Sandwich terns, particularly during the summer months when relatively high densities occur. Unlike the studies at Zeebrugge; Sandwich terns at Thornton Bank are likely to be foraging in the wind farm. Monitoring results from Thornton Bank are surprising in that Sandwich tern activity in the Thornton Bank wind farm area appears to have significantly increased since the first turbines were built; numbers of Sandwich terns in the wind farm increased by 30% whilst dropping in the control area suggesting a possible attraction to the turbines (Vanermen *et al.* 2011). Vanermen *et al.* (2011) offer no reason for this apparent attraction to the wind turbines but note that clear positive effects on fish communities are already visible (Reubens *et al.* 2010). Collision Risk Modelling undertaken using turbine encounter rates calculated using Bolker *et al.* (2008); the Band model (2000) and an avoidance rate of 99.2% derived from Zeebrugge data, suggested that there was a collision risk of 0.001%: i.e. there was one in a one hundred thousand chance of a collision (Vanermen and Steinen 2009). However, Vanermen *et al.* (2011) conclude that the attraction of Terns to the Thornton Bank turbines should receive maximum attention in the coming monitoring years although no collisions have been recorded.

6.28 *Blyth,* UK: Two turbines were constructed 1km off the Northumberland coast. After construction, 177 visual observations were carried out to determine the effect of the turbines on seabirds, including Sandwich terns. Each observation lasted approximately 2 hours and was carried out over a period of 32 months when the turbines were operating. No observations were made after dark or in poor daytime visibility. During this period, 2,135 Sandwich terns were observed in flight, near the turbines. In summer, numbers of Sandwich terns increased post-construction. No Sandwich tern collisions were recorded (Rothery *et al.* 2009).

Assessment of Effects Resulting from the Project Alone

Operation: Collision Risk

6.29 Sandwich tern utilising the operational Project site could potentially collide with turbines, resulting in mortality.

Collision risk modelling and input parameters

6.30 To quantify the potential risk of additional mortality above the likely baseline level, collision risk modelling (CRM) was undertaken as part of TKOWFL's impact assessment process. This is detailed in its HRA and ES.

6.31 TKOWFL adopted the same approach to CRM for the Project as that taken by the Secretary of State in the Greater Wash AA (DECC, 2012) (as part of the determination of Docking Shoal, Race Bank and Dudgeon offshore wind farms, of which Docking Shoal was not approved) as part of the analysis of Sandwich tern at the North Norfolk Coast SPA.

6.32 This approach was disputed by the SNCBs who took the view that it was not the appropriate basis for considering the conclusion regarding impact on Sandwich tern as they were of the view that that Greater Wash AA was based on an approach to collision risk modelling that is not sufficiently precautionary (Ornithology SoCG: 6.10; 7.4).

6.33 The differences in approach to CRM, advocated by the SNCBs and TKOWFL, in particular the differences in choice of model and input parameters are of relevance to the Secretary of State's AA for this Project in relation to the Sandwich tern feature of the North Norfolk Coast SPA and Ramsar.

Choice of CRM

6.34 One of the principle areas of disagreement between the SNCBs and TKOWFL was choice of CRM used. TKOWFL applied the 'Folkerts' model, whereas the SNCBs advocated the use of the 'Band' model (Band, 2012), each party relying on the conclusions reached from each model.

6.35 The SNCBs agreed that the Folkerts model is one method for the quantification of predicted collision mortality rates and that its application for the TKOWF is consistent with other wind farm assessments in the region (Ornithology SoCG: 5.13) (the Secretary of State applied the Folkerts model to the Greater Wash Projects in relation to Sandwich tern at North Norfolk Coast SPA), however they did not agree that the use of the Folkerts model was appropriate for this Project.

6.36 The Folkerts model combines the geometry and rotational speed of the turbines, the dimensions and speed of the birds and other physical conditions to predict the number of birds that could be struck if they exhibited no response to the presence of the wind farm. The Folkerts model is a variant of the Band model which has been adapted to better reflect the offshore environment, turbine characteristics and differences between onshore 'static' survey methods as opposed to mobile, boat based surveys used offshore (DECC, 2012: 7.4).

6.37 The Ornithology SoCG states that the point of disagreement between the parties centres on differences between collision mortality outputs of the two models. The SNCBs maintained that the Folkerts model, when compared with the Band model, tends to produce estimates of collision mortality which are consistently lower, in the majority of cases, 'close to or less than 20%' and therefore less precautionary (Ornithology SoCG: 7.3).

6.38 The reasons for the two models producing different results (as outlined in DECC, 2012: 7.8) are that they have conceptual and structural differences, the Folkerts model making the following assumptions which depart from the Band model:

- *'Mean distance across the site'*: In the Folkerts model this factor is used, with flight speed, to calculate the number of flights across the site based on the density of birds present.
- *'Passing factor'*: A bird may fly across the site at rotor height but between the turbine rows and thus never encounter a rotor. The Folkerts model calculates this probability by modelling random, straight line passages through the site and determining the proportion that pass through a rotor circle. In reality, the rotor is in a specific position depending on wind direction. The bird may therefore pass through the rotor circle (i.e. the circle representing all the possible positions which the rotor could occupy) but miss the actual rotor because of its orientation. Both these elements are incorporated into the passing factor which is dependent on site layout and turbine size. This factor is not actually represented explicitly in the Band model;
- '*Oblique flights':* The Folkerts model makes the realistic assumption that the bird may fly into the rotor at any angle between 0 and 90 degrees. It therefore includes a numerical integration over all possible incident angles in order to calculate the collision risk factor. Band recognises that this approach is valid but concludes that it is an unnecessary sophistication. However, the use of this factor is clearly a matter of expert opinion. Band does not identify any major flaws in the Folkerts model which render the Folkerts model incorrect but considers that it is likely to underestimate by a modest degree the collision risk at oblique approach angles.

6.39 TKOWFL asserts that the Folkerts model is methodologically sound and the predictions it makes are fit for purpose. It cites the need for consistency with the approach taken in the Greater Wash AA (DECC, 2012) and also the independent review of the Folkerts model commissioned by MMO (CEH, 2012) which concluded that the use of the model was scientifically robust (Ornithology SoCG: 7.3).

6.40 The Panel notes in its recommendations that the Folkerts model has been specifically developed for the marine environment and to incorporate a number of revisions that were argued to make it better adapted to the circumstances of offshore wind farm operation than the Band model (Panel's Report: 5.2.34).

6.41 The Secretary of State gives weight to the independent review of the Folkerts model (CEH, 2012), which found it to be scientifically robust and sound for use in the assessment of collision risk in the Greater Wash area, and also to the recommendations of the Panel.

Avoidance rate

6.42 The avoidance rate is critical in determining whether there is likely to be an adverse effect on the Sandwich tern population. The SNCBs requested that TKOWFL include a range of avoidance rates in its CRM for Sandwich terns. TKOWFL modelled the impact of the Project using the following avoidance rates: 0%, 95%, 98%, 98.83%, 99% and 99.5%. Of these, TKOWFL advocate a species specific avoidance rate of 98.83%, derived from empirical observations of Sandwich tern behaviour at the constructed Zebrugge wind farm initially presented by Everaert & Stienen (2007) and re-worked by NE (TKOWFL HRA: 7.26).

6.43 The SNCBs do not agree with TKOWFL's preferred avoidance rate of 98.83% (Ornithology SoGC: 7.2) and instead recommend that an avoidance rate of 98% should be used (Ornithology SoGC: 2.6). The RIES clarifies that SNCBs advise an avoidance rate of 98% on a precautionary basis due to uncertainties in applying the higher figure (including different configurations of TKOWF to Zebrugge and differing behaviour of birds at each site i.e. searching/foraging at TKOWF compared to transiting at Zebrugge). It clarifies also that SNCBs are of the view that reliance on one study relating to a site that might not be representative reduces confidence in the avoidance rate presented by the Applicant, and until the evidence base has developed, they will continue to advise an avoidance rate of 98% (RIES: Matrix 3.1). This rate is presented in the Scottish Natural Heritage Guidance (Scottish Natural Heritage, 2010) which suggests an avoidance rate of 98% for Sandwich terns (and Terns in general).

6.44 The Panel notes in its recommendations that the 98% rate is not adjusted to take account of any particular qualitative analysis or empirical observations of Sandwich tern behaviour and that indeed the same rate is used for a wide range of species, including some acknowledged to be significantly less agile and responsive in flight than the Sandwich tern (Panel's Report: 5.2.37).

6.45 Table 6.3 outlines the modelled effect of both a 98% avoidance rate (applied to the Band Model) and a 98.83% avoidance rate (applied to the Folkerts Model) on the collision risk to the North Norfolk Coast SPA and Ramsar breeding population of Sandwich tern. This is based on an estimated breeding population of 6,914 individuals and a natural mortality of 691 individuals per annum. The applicant modelled the predicted collisions for adult birds. The Secretary of State agrees with this approach as it is the adult birds that make up the breeding population.

Table 6.3: Predicted significance of (adult) Sandwich tern collision mortality at 98% and 98.83% avoidance rates

Parameters	98% avoidance rate	98.83% avoidance rate
Number (individuals) of predicted collisions per annum	**14**	**8**
Proportion (%) of population affected per annum	0.20	0.12
Proportional increase (%) above background mortality	2.03	1.16

Source: TKOWFL HRA: Table 15.

6.46 TKOWFL calculates collision related adult mortality to be 8 Sandwich terns per year, based on an avoidance rate of 98.83%.

6.47 DECC has previously applied an avoidance rate of 98.83% in the Greater Wash AA (DECC, 2012). The SNCBs' advice to the Secretary of State during consideration of the Greater Wash AA was also that a generic 98% collision avoidance rate was the appropriate rate to be used. The SNCBs took the view during the examination of this Project that the Greater Wash AA was wrongly decided, maintaining that the collision avoidance rate for the Sandwich tern used in the Greater Wash AA of 98.83% was contrary to their advice and was not justified in scientific or legal terms, because it was insufficiently precautionary (Panel's Report: 5.2.31).

6.48 The Secretary of State concluded on the Greater Wash AA that a 98.83% avoidance rate was most appropriate as, for example, the dataset from which the rate is derived had been peer reviewed and is considered one of the best empirical datasets currently available for Sandwich terns (DECC, 2012: 7.14).

Population Viability Analysis Mortality Threshold

6.49 TKOWFL applied a population viability analysis (PVA) threshold of cumulative Sandwich tern mortality of 94 collisions per annum (based on a 98.83% avoidance rate). SNCBs instead advised that this threshold should be 75 collisions per annum (based on a 98% avoidance rate).

6.50 The PVA threshold is not of material relevance to this alone assessment, as the Project alone will not lead to increases in mortality above either PVA mortality threshold. This will be addressed fully in the assessment of in-combination effects, where it is relevant to the Secretary of States conclusions.

Conclusions

6.51 The Panel addressed the three key areas of disagreement (choice of model, avoidance rate and PVA) during the examination. The Panel concluded that in the absence of demonstrated unreasonableness in the Greater Wash AA decision (DECC, 2012) or of any new scientific evidence, that the applicant was justified in relying upon it and upon the Folkerts Model for the purposes of carrying out its ES and preparing evidence on impacts on European sites (Panel's Report: 5.2.51).

6.52 The Secretary of State considers that the Folkerts collision risk model is valid and robust and appropriate for the assessment of Sandwich tern at North Norfolk Coast SPA and Ramsar for the following reasons:

- The Folkerts model was developed specifically for offshore sites;
- It uses extensive and relevant bird data sourced from observations of Sandwich tern foraging behaviour off the North Norfolk coast including birds followed at sea to record their flight behaviour and use of foraging areas; and
- It takes account of site specific factors, such as the individual turbine layout at each site, the recorded wind speeds, the predicted down time for turbine maintenance, and the

number of birds that can be expected not to be breeding birds from the North Norfolk Coast colonies.

6.53 The Secretary of State considers that the application of a 98.83% avoidance rate applied to the Folkerts model for the Sandwich tern at North Norfolk Coast SPA in relation to this Project is appropriate as it is based on best available empirical data on Tern mortality. He is of the view that the application of a 98% avoidance rate would be disproportionately precautionary.

6.54 There was disagreement between parties on the appropriate PVA threshold to apply: whether this should be set at 94 or 75 Sandwich tern collisions in combination with other plans and projects. This will be addressed in the in-combination assessment section.

6.55 The Secretary of State is not aware of any new evidence, nor has any new evidence been provided by any interested parties, that would lead him to depart from the approach previously taken for assessment of Sandwich tern from the North Norfolk Coast SPA in the Greater Wash AA (DECC, 2012).

6.56 The Secretary of State accepts that the Project could result in up to 8 predicted adult Sandwich tern collisions per annum. Therefore, irrespective of which PVA mortality threshold is applied (75 or 94), the project alone would not lead to unacceptable increases in mortality above the threshold that would result in an adverse effect on the integrity of the site. All parties are in agreement that adverse effect on integrity as a result of collision mortality (alone) can be excluded.

Construction: Disturbance/ Displacement

6.57 TKOWFL's HRA identified that Sandwich tern could potentially experience disturbance and/ or displacement from the Project area as a result of construction as Sandwich tern are classed as being of high sensitivity to disturbance by Garthe and Hüppop (2004). However, there is little potential for displacement or barrier effects as few Sandwich terns forage within the Project site. TKOWFL notes that survey data suggests that the Project site is not an important foraging area during the breeding season or during post-breeding dispersal.

6.58 Furthermore, evidence from other wind farms suggests that Sandwich tern ignore vessels. The RIES states that disturbance effects resulting from construction, such as pile driving, are unlikely to have an additive effect on Sandwich tern and that vessel movement and construction activity are unlikely to displace any from the Project site (RIES: Matrix 3.1 (a)). All parties were in agreement that adverse effect on integrity as a result of disturbance and displacement during construction (alone) can be excluded. The Secretary of State finds no reason to disagree.

Construction: Indirect Effects

6.59 TKOWFL's HRA identified that Sandwich tern may be indirectly affected by the impact of the construction of the Project on prey abundance and distribution, as Sandwich tern primarily feed on Clupeids and Sandeels. Sandeels are not sensitive to noise, whereas Clupeids (such as Herring) are considered sensitive. Sandwich terns have flexibility in their selection of foraging

locations and the Project site is at the limit of Sandwich tern foraging range. The RIES (Matrix 3.1 (b)) states that a behavioural avoidance response from Clupeids during construction could lead to some displacement, pushing fish closer to shore (although not necessarily out of the Sandwich tern foraging range). The RIES notes that Sandwich tern forage over wide areas such that they could utilise other locations within the same foraging distance. Additionally disturbance is expected to be temporary with fish expected to return once construction has ceased.

6.60 The Secretary of State has considered the Panel's recommendation (Panel's Report: 5.4.10 – 5.4.18) and representations from the MMO and TKOWFL on the matter of measures to mitigate the impact of pile driving during construction on Herring. He agrees with the MMO and the Panel's recommendation that a condition be included in the DML to ensure that pile driving is not carried out during the peak spawning period for Banks Herring in order to reduce the risk of injury and disturbance during this period. The condition allows variation to this restriction, on agreement of the MMO. The DML (Part 2 Condition 16) requires that 'No pile driving works shall be carried out by or on behalf of the undertaker as part of or in relation to the authorised scheme between 1st September and 16th October each year unless the MMO provides written confirmation to the undertaker beforehand that such works can take place, in all or in a specified part of the site, during this period or a part of this period.'

6.61 SNCBs identified that Sandwich tern may be indirectly affected by changes to physical processes of site supporting characteristics due to the presence of the Project.

6.62 All parties were in agreement that adverse effects on integrity as a result of indirect effects during construction (alone) can be excluded. The Secretary of State finds no reason to disagree.

Operation: Disturbance

6.63 TKOWFL identified that Sandwich tern could experience disturbance as a result of the operation of the Project. The RIES (Matrix 3.1 (c)) and TKOWFL's HRA both state that disturbance from maintenance vessels is likely to be similar in scope to that during the construction phase, although vessel traffic is expected to be much lower than during the construction. All parties were in agreement that adverse effect on integrity as a result of disturbance during operation (alone) can be excluded. The Secretary of State finds no reason to disagree.

Operation: Displacement

6.64 TKOWFL's HRA identified that Sandwich tern could potentially experience displacement as a result of the operation of the Project. Evidence from Horns Rev wind farm which suggests that Sandwich tern are not displaced by operational wind farms is presented in TKOWFL's HRA. The RIES (matrix 3.1 (d)) states that, as the Project is located beyond the mean maximum foraging range for Sandwich tern, there is little potential for displacement from the site. All parties were in agreement that adverse effect on integrity as a result of displacement during operation (alone) should be excluded. The Secretary of State finds no reason to disagree.

Operation: Barrier Effects

6.65 TKOWFL's HRA identified that the operation of the Project could potentially create a barrier to Sandwich tern, with turbines potentially disrupting their flight-lines, increasing journey distances and therefore representing an energetic cost. The RIES states that as the Project is at the edge of the mean maximum foraging range for Sandwich tern it is unlikely that the Project will provide a barrier to foraging commutes (RIES Matrix 3.1 (e)). TKOWFL's HRA notes post-construction studies at operational wind farms show that Tern species do not exhibit any significant avoidance of operational wind farms (notably at Zeebrugge). All parties were in agreement that adverse effect on integrity as a result of the operation of the Project (alone) causing a barrier to movement can be excluded. The Secretary of State finds no reason to disagree.

Conclusions: Project Alone

6.66 All parties were in agreement that adverse effect on integrity of the North Norfolk Coast SPA and Ramsar could be excluded as a result of impacts during construction and operation related to the Project alone.

6.67 With regards Project operation, there remained however key differences of opinion between TKOWFL and the SNCBs as regards to the assessment methodologies used for modelling operational collision risk. TKOWFL relied on the approach to CRM previously taken by the Secretary of State in the Greater Wash AA (DECC, 2012), namely applying a 98.83% avoidance rate to the Folkerts model. The SNCBs however proposed a 98% avoidance rate applied to the Band Model. The Secretary of State is of the view that the application of a 98% avoidance rate to the Band model would be disproportionately precautionary and agrees with the Panel that the approach taken by TKOWFL is justified and appropriate. No evidence has been presented to the Secretary of State to convince him that his judgement on the Greater Wash AA was flawed or incorrect. On this basis, the Secretary of State concludes that the Project alone could result in up to 8 predicted adult Sandwich tern collision mortalities per annum. This does not present a limiting factor to the project alone as it does not lead to unacceptable increases in mortality above the PVA mortality thresholds advocated by either TKOWFL or the SNCBs.

6.68 The Secretary of State concludes that there will be no adverse effects on the integrity of the breeding Sandwich tern population feature of the North Norfolk Coast SPA and Ramsar from the Project alone. This takes into account mitigation secured in the DML which restricts piling activity during the Herring spawning season.

Assessment of Effects from the Project In-Combination

6.69 It is agreed by TKOWFL and the SNCBs that the Project will not have an adverse impact on the breeding Sandwich tern population of the North Norfolk Coast SPA and Ramsar when considered alone. There is disagreement however over whether the Project would have an adverse effect in-combination with other plans and projects. Those projects identified by TKOWFL that could have an adverse in combination impact are identified in Table 4.2.

Operation: Collision Risk

6.70 The Greater Wash AA established, and all parties are in agreement, that the Project has the lowest impact of any other offshore wind project in the Greater Wash region on Sandwich terns, having a per turbine mortality level significantly lower than any of the other projects and being located farthest from the SPA (DECC, 2012: 7:32).

6.71 However there is disagreement between TKOWFL and the SNCBs on whether there will be an adverse effect in relation to impacts of in-combination operational collision mortality. Disagreement centres on three key aspects of collision modelling: the collision risk model used; the avoidance rate applied to the model; and the PVA mortality threshold applied to the assessment. The first two of these factors have been addressed in the alone assessment section, and the approach taken by TKOWFL (a 98.83% avoidance rate applied to the Folkerts model) is considered by the Secretary of State to be appropriate. Consequently, it is the PVA mortality threshold that is of critical importance to the Secretary of State's in-combination assessment.

6.72 The Secretary of State applied an annual mortality threshold of 94 for the breeding Sandwich tern population of the North Norfolk Coast SPA, for the Greater Wash AA (DECC, 2012). TKOWFL advocate a PVA mortality threshold of 94 additional Sandwich tern mortalities per annum in combination with other projects (based on a 98.83% avoidance rate applied to the Folkerts model). They identify that there is capacity within this threshold of 94, having considered all other plans and projects, for the Project to contribute up to 8 mortalities. On this basis TKOWFL's assessments conclude that there will be no adverse effect on site integrity.

6.73 However, the SNCBs advocate a PVA mortality threshold of up to 75 Sandwich tern mortalities per annum (based on a 98% avoidance rate). The SNCB's advice is consistent with their previous advice to the Secretary of State on the Greater Wash AA that 75 annual mortalities is the 'critical population threshold level beyond which no more mortality could be absorbed' (Panel's Report: 5.2.38). The SNCBs maintain that the Project, 'would give rise to potential adverse in-combination effects and that these effects were not sufficiently managed down or mitigated by design or operational measures' (Panel's Report: 5.2.23).

6.74 The PVA threshold is critical to determine whether there is sufficient biological capacity to accommodate the Project. TKOWFL are of the view that there is sufficient capacity, based on the premise that the Project, in-combination with other plans and projects, does not exceed the

mortality threshold of 94 individuals per annum. SNCBs maintain that, applying their suggested mortality threshold of 75 individuals per annum, that there is no such capacity.

6.75 Prior to application, TKOWFL initially assessed the impact of a maximum design envelope of 333 wind turbines on Sandwich tern. Following analysis of the results, TKOWFL concluded that the environmental impact of the development would only be acceptable with a reduced maximum number of turbines and so reduced the maximum turbine number from 333 to 288 prior to application as a measure to mitigate in-combination collision mortality (TKOWFL HRA: 1.61).

6.76 The Greater Wash AA modelled the in-combination operational collision mortality effects of the following five offshore wind farm projects:

- Docking Shoal;
- Race Bank;
- Dudgeon;
- Sheringham Shoal; and
- Triton Knoll.

6.77 In his Greater Wash AA (DECC, 2012), the Secretary of State concluded that, to keep within a mortality threshold of 94, Docking Shoal should be refused. The remaining projects, which included Triton Knoll Offshore Wind Farm, were considered not to pose a risk of adverse impact on the breeding population of Sandwich tern.

6.78 TKOWFL used data from the Greater Wash AA, to model in-combination, operational collision risk. This is shown in Table 6.4.

Table 6.4: Annual (adult) Sandwich tern mortality per project at a 98.83% avoidance rate

Site	Turbine Layout	Predicted Mortality per annum
Race Bank (530.8 – 580 MW) (consented)	86 x 6.15 MW	**45.1**
	94 x 6.15 MW	45
	88 x 6.0 MW	45.1
Dudgeon (327-560 MW) (consented)	109 x 3 MW	**27.6**
	114 x 3.6 MW	27.6
	85 x 6.15 MW	26
Sheringham Shoal (317 MW) (constructed)	88 x 3.6 MW	**13**
Triton Knoll	288 x 3.6 MW	**8**
Total (worst case)		**93.7**

Source: Adapted from TKOWFL HRA Report: Table 18a.

6.79 TKOWFL propose that, based on the evidence from other sites and the implementation of mitigation measures, the sites in the Greater Wash (including the Project) would not exceed the threshold of 94 individuals and consequently would not act in-combination to have an adverse effect on the integrity of the North Norfolk Coast SPA (TKOWFL HRA: 7.58).

6.80 The SNCBs advised on the Greater Wash that the absolute risk of decline to the Sandwich tern population should be capped at less than 66%. The Secretary of State concluded in that AA (DECC, 2012) that for a reference population of 6,914 birds, an additional mortality of 75 birds per annum would be characterised as an absolute risk of 62.6%, where the risk of the population experiencing decline could be characterised as being 'about as likely as not', rather than 'likely'. He extrapolated then that the upper mortality boundary for the Sandwich tern, above which the risk of the population experiencing decline could be characterised as likely, should be set at 94.8 per annum and so accepted a maximum annual mortality of 94 Sandwich tern (Panel's Report: 5.2.43), based on a 66% risk of decline.

6.81 With regard to the increase in the magnitude of the risk, SNCBs advised on the Greater Wash AA that a PVA of 75 suggested that the 25 year effect of the Project being constructed in combination with other plans and projects would reduce the SPA Sandwich tern population to approximately 4% lower than its current value of 6,914 birds (Panel's Report: 5.2.42). However the loss of 94 birds per year would result in the SPA population being 4.76% lower than the reference population. In determining the Greater Wash projects, the Secretary of State considered this slight increase of 0.76% acceptable (DECC, 2012: 7:20).

6.82 The Secretary of State acknowledged in the Greater Wash AA that the adoption of a 94, as opposed to a 75, annual mortality rate would increase the probability of population decline overall by 2%, which he accepted as a 'marginal and acceptable' increase when considered in the light of the levels of precaution incorporated into the modelling (Panel's Report: 5.2.44).

6.83 The Secretary of State had close regard to PVA modelling of the SPA Sandwich tern population in the Greater Wash AA which suggested that a loss after 25 years of operation of 5% to 10% of the reference population size might be regarded as offering a reasonable chance of retaining population and site integrity. This equates to an annual harvesting level of 98 to 157 birds (DECC, 2012: 7.20). The Panel notes in its recommendations that this upper level of 157 suggests that the figure of 94 is not an upper level outlier, rather it is a centre of field proposition, incorporating a considerable precautionary margin (Panel's Report: 5.2.44).

6.84 In drawing his conclusion on adverse effects, the Secretary of State places weight on the reasoning above and considers that applying a PVA mortality threshold of 94 individuals to the Sandwich tern breeding population at North Norfolk Coast SPA and Ramsar in relation to this Project is appropriate and considers that the adoption of this value in his assessment is acceptable and suitably precautionary.

6.85 The Secretary of State notes the Panel's conclusions that TKOWFL was justified in relying on the approach taken in the Greater Wash AA (Panel's Report: 5.2.51).

6.86 The Panel conclude that in its view, with an 8[6] bird worst-case additional mortality due to the construction of the maximum number of 288 turbines, the impact on Sandwich terns is acceptable (Panel's Report: 5.2.51). The Panel support a PVA mortality threshold of 94 and identify that there is capacity within this threshold, having considered all other projects in-combination, for the Project to contribute 8 mortalities. On this basis their assessments conclude that there will be no adverse effect on site integrity. The Secretary of State agrees with the Panel's conclusions that there is capacity within the mortality threshold of 94 adult Sandwich terns for the Project to contribute 8 adult Sandwich tern mortalities. His conclusion takes into account both the Panel's Report and Errata Sheet published alongside it.

Mitigation

6.87 TKOWFL took the view that mitigating the effects of the Project by reducing the number of turbines from 333 to 288 prior to the Project's application was sufficient and that no further mitigation was either necessary or feasible. However SNCBs took the view that their recommended threshold of 75 had already been exceeded by already consented projects and that therefore the Project should be required to mitigate all of the predicted collision mortality for Sandwich terns, to reduce its impact to 0.

6.88 TKOWFL and the SNCBs agreed, and the Panel concluded, that there were no specific changes to the configuration of development within the application site that could further mitigate the effects of the Project on Sandwich tern (Panel's Report: 5.2.53). It was not possible to model potential alternative wind farm configurations which deliver material additional mitigation. SNCBs acknowledge that there are no obvious 'tern sensitive areas' within the Project area and therefore it would be difficult to mitigate the number of Sandwich tern deaths through changing the wind farm footprint (RIES Matrix 3.1 (g) (iv)).

6.89 The Panel examined the degree to which possible residual impacts on Sandwich tern might, if necessary, be managed by offsite mitigation in addition to or in substitution for any possible onsite mitigation. By offsite mitigation, the Panel meant the development of Sandwich tern population management measures to be delivered in locations other than the application site,

[6] The Panel's Report and RIES contains a typographical error that refers to '9' Sandwich tern mortalities. PINS produced an Errata Sheet to confirm that this figure should instead be '8' Sandwich tern mortalities. The Errata Sheet states that 'At paragraphs 5.2.40 and 5.2.51 the Examining Authority has incorrectly referred to the mortality figure for ALL Sandwich tern mortalities ((9) as identified in the Applicants HRA report see Tables 14 and 15, page 63). The reference should in actual fact be to the 8 additional ADULT Sandwich tern mortalities identified in the DECC Southern Wash AA, relied upon by the Applicant in their report to inform the HRA and accurately identified at Table 5.3 of the Examining Authority's report. In addition Matrix 3.1 (g) of the RIES incorrectly referred to the mortality figure for ALL Sandwich tern mortalities 9. The reference should in actual fact be to the 8 additional ADULT Sandwich tern mortalities'. The Secretary of State has taken PINs Errata Sheet into consideration and has reached his conclusions on the basis of the correct figure of '8' Sandwich tern mortalities.

which could have the effect of offsetting any residual Sandwich tern mortality due to the operation of the proposed offshore wind farm by delivering a net stabilisation or reduction in this mortality. The Panel noted that the SNCBs advised in their response to the RIES that there was little immediate prospect of designing and implementing useful offsite mitigation measures (Panel's Report: 5.2.58) and concluded that impacts of the development on Sandwich tern would be acceptable without offsite mitigation (Panel's Report: 5.2.61).

6.90 The Secretary of State considers that the Project (in combination with other plans and projects) will not have an adverse effect on the breeding population of Sandwich tern at the North Norfolk Coast SPA and Ramsar as a result of operational in-combination collision mortality. He considers that there is no need for further mitigation in relation to collision mortality as the impacts on Sandwich tern are acceptable without mitigation. The Secretary of State maintains the view that a 98.83% avoidance rate, the use of the Folkerts model and the application of a 94 mortality threshold is robust and suitably precautionary. This view is shared by the Panel. The Secretary of State acknowledges that this is not the view of the SNCBs who recommend a more precautionary approach.

Operational: Disturbance, Displacement, and Barrier Effects

6.91 TKOWFL state that on-going maintenance of all wind farms in the Greater Wash area during their operational lifetime is likely to overlap for the majority of this period (TKOWFL ES V2 C6: 6.156).

6.92 Disturbance: The magnitude of the effect of disturbance arising from each wind farm is considered to be negligible and, given the localised and intermittent nature of this effect and the insensitivity of most species to vessel activity, a significant cumulative impact is not predicted (TKOWFL ES V2 C6: 6.156).

6.93 Displacement: TKOWFL state that there is no reason to suspect that the cumulative magnitude of any avoidance or displacement effect will be greater than that which was predicted for the Project alone (i.e. low) implying a potential impact of moderate, but tolerable, significance for Sandwich tern (TKOWFL ES V2 C6: 6.161).

6.94 Barrier Effect: TKOWFL state that the magnitude of any barrier effect is not predicted to be more than low, implying an impact of moderate but tolerable significance for Sandwich tern in-combination (TKOWFL ES V2 C6: 6.167).

6.95 Assessment of the operational effects of the project on site integrity (in terms of disturbance, displacement, and barrier effects) in-combination with other plans and projects is made by TKOWFL and deemed to be of low to moderate significance. This was not challenged by the SNCBs. On this basis the Secretary of State concludes that the Project (in combination with other plans and projects) will not have an adverse effect on the breeding population of Sandwich tern at the North Norfolk Coast SPA and Ramsar as a result of operational effects.

Construction: Disturbance/Displacement, and Indirect Effects

6.96 TKOWFL establish that the effects from other wind farms acting in-combination with the Project are dependent upon the temporal and spatial scales associated with these projects *(*TKOWFL HRA: 7.45). TKOWFL present a currently understood construction timetable for wind farms in the Greater Wash area in its HRA. Its analysis suggests that there will be no overlap between the construction schedule of the Project, and any other wind farms recognising that there are uncertainties. Table 6.5 shows the proposed offshore wind farm construction timetable in the Greater Wash area up to 2021.

Table 6.5 Greater Wash offshore wind farm construction timetable

Project (developer)	Construction period										
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Lincs	■	■									
Race Bank			■	■							
Docking Shoal					■	■					
Humber Gateway		■	■								
Westermost Rough		■	■	■							
Dudgeon			■	■	■						
Sheringham Shoal	■	■									
Triton Knoll							■	■	■	■	■

Source: TKOWFL HRA Table 17. (Note: Docking Shoal subsequently refused)

6.97 **Disturbance/ Displacement:** The RIES states that although there may be an overlap in construction due to the spatial variation in these projects it is unlikely there will be an in-combination displacement effect (RIES Matrix 3.1 (g)).

6.98 **Indirect effects:** TKOWFL state that the potential for a cumulative impact of wind farm construction on prey availability for bird species is likely to depend on the extent to which foraging activity is exposed to the impact (from piling noise) in both space and time; and the sensitivity of the prey species to the effect (noise piling) (TKOWFL HRA: 7.49). The piling noise effect zones (for Clupeids) from each site's piling activity (assuming piling is required) will be large and overlap with the foraging range of the North Norfolk Coast SPA Sandwich tern population (TKOWFL HRA: 7.50), however the extent of this is deemed to be acceptable in light of mitigation (through piling restriction during the Herring spawning season as detailed at Paragraph 6.60).

6.99 TKOWFL's assessment of the construction effects of the project on site integrity in-combination with other plans and projects was not challenged by interested parties. The Secretary of State concludes that the Project (in-combination with other plans and projects) will not have an

adverse effect on the breeding population of Sandwich tern at the North Norfolk Coast SPA and Ramsar as a result of the effect of construction.

Conclusions: in combination

6.100 All parties were in agreement that adverse effect on the integrity of the North Norfolk Coast SPA and Ramsar could be excluded as a result of impacts during construction of the Project in-combination with other plans and projects. With regards Project operation however, there remained differences of opinion between TKOWFL and the SNCBs as regards to the mortality threshold, with TKOWFL advocating a threshold of 94 additional Sandwich tern mortalities and SNCBs advocating a threshold of 75.

6.101 The Panel support a PVA mortality threshold of 94 and identify that there is capacity within this, having considered all other projects in-combination, for the Project to contribute 8 mortalities. On this basis their assessments conclude that there will be no adverse effect on site integrity. The Secretary of State agrees with the Panel's conclusions that there is capacity within the mortality threshold of 94, for the Project to contribute 8 mortalities. If the SNCBs PVA threshold of 75 were accepted the effect would be that there would be no biological impact envelope within which the Project could be constructed.

6.102 In reaching his conclusion the Secretary of State has considered the absolute risk and magnitude of the risk to the Sandwich tern population as well as the probability of population decline and on the balance of evidence concludes that there would be no adverse effect on integrity from collision risk in-combination with other plans and projects.

6.103 The Secretary of State concludes that no adverse effects on the integrity of the breeding Sandwich tern population feature of the North Norfolk Coast SPA and Ramsar are expected to arise from the Project in-combination with other plans and projects as a result of impacts during construction, operation or decommissioning.

7 CONCLUSIONS ON SITE INTEGRITY

7.1 The Secretary of State has considered the impacts of the Project alone and in-combination with other plans and projects on each of the interest features of the sixteen European sites identified, to determine whether there will be an LSE and whether an AA is required.

7.2 He agrees with the Panel that there is a risk of LSE on five European sites. These are:

- North Norfolk Coast SPA and Ramsar;
- Flamborough Head and Bempton Cliffs SPA;
- Inner Dowsing, Race Bank & North Ridge cSAC;
- Humber Estuary SAC; and
- The Wash and North Norfolk Coast SAC.

7.3 The Secretary of State agrees with the Panel's recommendation that an AA is required. He is satisfied that sufficient information is available to enable him to make an AA which sets out matters covered in Regulation 25 of the Offshore Habitats Regulations. This comprises environmental information provided to the Panel, its report to him, written representations from the SNCBs and published data and analysis from other sources.

7.4 The Secretary of State considers that there will be no adverse effects on the integrity of any of the above sites as a result of the Project alone or in-combination with other plans and projects. This conclusion takes account of relevant mitigation measures included in the DCO and DML. A summary of the Secretary of State's reasons for reaching his conclusions are set out below.

North Norfolk Coast SPA and Ramsar

7.5 The Secretary of State has considered the risk to Sandwich tern at North Norfolk Coast SPA and Ramsar from collisions with operational turbines, based on predictions from the Folkerts Model. Having assessed the evidence, the Secretary of State concludes that the Folkerts Model is valid, robust and suitably precautionary. This is an accord with his judgement in the Greater Wash AA (DECC, 2012) and with the recommendations of the Panel. This judgement is not supported by SNCBs who consider that the Band model (Band, 2012) is a more appropriate and precautionary model that would estimate a collision level some 20% greater. In reaching his decision, the Secretary of State gives weight to the fact that the Folkert's Model has been developed specifically to predict bird collisions with offshore wind turbines, takes account of site specific factors and has been independently reviewed and found to be fit for purpose.

7.6 As regards modelling parameters, the Secretary of State is confident that a 98.83% avoidance rate is suitably precautionary based on peer-reviewed species specific empirical data. He maintains that a PVA threshold of 94 bird per annum additional mortality is appropriate, in line with the reasoning he adopted in the Greater Wash AA and decisions (DECC, 2012). He notes that the SNCBs maintain that a more precautionary 98% avoidance rate and 75 bird PVA mortality threshold would be more appropriate. However, he is not aware of any new scientific evidence that would lead him to depart from his previous judgement, nor of any demonstrable

unreasonableness in that decision. On this basis, he estimates adult mortality from the Project to be of the order of 8 adult Sandwich terns per annum.

7.7 When considered in-combination with other plans and projects (Race Bank, Dudgeon and Sheringham Shoal offshore wind farms), the annual collision mortality rises to up to 93.7 adult Sandwich tern per annum. As this does not exceed the PVA mortality threshold of 94, the Secretary of State, therefore, concludes that the Project, either alone or in combination will not lead to unacceptable increases in collision mortality that may have adverse effects on the integrity of the North Norfolk Coast SPA and Ramsar site. The Secretary of State has considered the absolute risk and magnitude of the risk to the Sandwich tern population, the probability of population decline, and the Panel's recommendations to him in reaching this conclusion.

7.8 The Secretary of State has considered other potential risks to Sandwich tern, including disturbance and displacement during construction and barrier effects once the Project is operational. He is of the view that there is little potential for displacement/barrier effects as very few Sandwich tern forage within the Project footprint which is at the limit of their foraging range, being some 46.8 km from the SPA. Furthermore, evidence from other wind farms suggests that they ignore vessels and the species is not prone to displacement. To mitigate potential impacts on herring (a prey species) he has placed a restriction on piling during the Herring spawning season within the DML.

7.9 With this mitigation in place, the Secretary of State concludes that there will be no adverse effects on the integrity of the North Norfolk Coast SPA and Ramsar as a result of the Project alone or in-combination with other plans and projects.

Other European Sites

7.10 All parties were in agreement that adverse effects on site integrity as a result of the Project can be excluded for Flamborough Head and Bempton Cliffs SPA, Inner Dowsing, Race Bank and North Ridge cSAC, Humber Estuary SAC, and Wash and North Norfolk Coast SAC. The Secretary of State has undertaken a high level assessment of the potential for adverse effect on these sites. He agrees with the recommendations of the Panel, and concludes that no adverse effects on the integrity of these sites are expected to arise from the Project either alone or in-combination with other plans and projects subject to the mitigation measures secured in the DML that will be adopted to minimise effects.

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ANNEX A: European Sites identified for the purposes of the HRA and their qualifying features

Designated site	Site qualifying features	Distance to TKOWF
North Norfolk Coast SPA	Sandwich tern, *Sterna sandvicensis* (breeding) Common tern, *Sterna hirundo* (breeding) Great bittern, *Botaurus stellaris* (breeding and non-breeding) Mediterranean gull, *Larus melanocephalus* (breeding) Roseate tern, *Sterna dougallii* (breeding) Bar-tailed godwit, *Limosa lapponica* (non-breeding) Pied avocet, *Recurvirostra Avosetta* (breeding, non-breeding and over wintering) Little tern, *Sterna albifrons* (breeding) Eurasian marsh harrier, *Circus aeruginosus* (breeding) European golden plover, *Pluvialis apricaria* (non-breeding) Hen harrier, *Circus cyaneus* (non-breeding) Ruff, *Philomachus pugnax* (non-breeding) Common redshank, *TringaTetanus* (breeding and non-breeding) Ringed plover, *Charadrius hiaticula* (breeding and non-breeding) Dark-bellied brent goose, *Branta bernicla bernicla* (over wintering and non-breeding) Red knot, *Calidris canutus* (wintering and non-breeding) Pink-footed goose, *Anser Brachyrhynchus* (over wintering and non-breeding) Northern pintail, *Anas acuta* (non-breeding) Eurasian wigeon, *Anas Penelope* (over wintering and non-breeding) Montagu's harrier, *Circus Pygargus* (breeding) Waterbird assemblage (waterfowl) (over wintering)	46.8 km
North Norfolk Coast Ramsar	Sandwich tern, *Sterna sandvicensis* (breeding) Common tern, *Sterna hirundo hirundo* (breeding) Little tern, *Sterna albifrons albifrons* (breeding) Red knot, *Calidris canutus islandica* (over wintering) Pink-footed goose, *Anser brachyrhynchus* (over wintering) Dark-bellied brent goose, *Branta bernicla Bernicla* (over wintering) Eurasian wigeon, *Anas penelope* (over wintering) Northern pintail, *Anas acuta* (over wintering) Ringed plover, *Charadrius hiaticula* (peak counts in spring/autumn) Sanderling, *Calidris alba* (peak counts in spring/autumn) Bar-tailed godwit, *Limosa lapponica lapponica* (peak counts in spring/autumn)	53km (approx.)

Designated site	Site qualifying features	Distance to TKOWF
Flamborough Head and Bempton Cliffs SPA	Gannet*, Morus bassanus* (breeding) Kittiwake, *Rissa tridactyla* (breeding) Razorbill*, Alca torda* (assemblage species) Guillemot*, Uria aalge* (assemblage species) Puffin, *Fratercula arctica* (assemblage species) Herring gull, *Larus argentatus* (assemblage species)	83.1 km
Inner Dowsing, Race Bank and North Ridge cSAC	Sandbanks slightly covered by seawater at all times (Annex I habitat) Reefs (of *Sabellaria alveolata*) (Annex I habitat) Harbour porpoise, *Phocoena Phocoena* (Annex II species) Grey seal, *Halichoerus grypus* (Annex II species)	4.5 km
Humber Estuary SAC	Grey seal, *Halichoerus Grypus* (Annex II species) River lamprey, *Lampetra fluviatilis* (Annex II species) Twaite shad, *Alosa fallax* (Annex II species) Allis shad, *Alosa alosa* (Annex II species) Harbour seal, *Phoca vitulina* (Annex II species) Estuaries (Annex I habitat) Sandbanks slightly covered by seawater at all times (subtidal sandbanks) (Annex I habitat) Mudflats and sandflats not covered by seawater at low tide (intertidal) (Annex I habitat) Atlantic salt meadows, *Glauco-Puccinellietalia maritimae* (Annex I habitat) Coastal lagoons (Annex I habitat) Annual vegetation of drift lines (Annex I habitat) *Salicornia* and other annuals colonizing mud and sand (Annex I habitat) *Spartina* swards, *Spartinion maritimae*(Annex I habitat) Embryonic shifting dunes (Annex I habitat) Shifting dunes along the shoreline with *Ammophila arenaria* (Annex I habitat) Fixed dunes with herbaceous vegetation (grey dunes) (Annex I habitat) Dunes with *Hippophae rhamnoides* (Annex I habitat)	31.9 km
Wash and North Norfolk SAC.	Grey seal, *Halichoerus grypus* (Annex II species) Harbour seal, *Phoca vitulina* (Annex II species) Otter, *Lutra lutra* (Annex II species) Sandbanks which are slightly covered by sea water all the time (subtidal sandbanks) (Annex I habitat) Mudflats and sandflats not covered by seawater at low tide (intertidal) (Annex I habitat) Coastal lagoons (Annex I habitat) Large shallow inlets and bays (Annex I habitat) Reefs (Annex I habitat) *Salicornia* and other annuals colonising mud and sand (Annex I habitat) *Spartina* swards, *Spartinion maritimae* (Annex I habitat)	39.7 km

Designated site	Site qualifying features	Distance to TKOWF
	Atlantic salt meadows, *Glauco- Puccinellietalia maritimae* (Annex I habitat) Mediterranean and thermo-Atlantic halophilous scrubs, *Sarcocornetea fruticosi* (Annex I habitat)	
Forth Islands SPA	Gannet*, Morus bassanus* (breeding and assemblage species during breeding season) Razorbill, *Alca torda* (assemblage species during breeding season) Puffin, *Fratercula arctica* (breeding and assemblage species during breeding season) Northern fulmar*, Fulmarus glacialis* (assemblage species during breeding season) Herring gull, *Larus argentatus* (assemblage species during breeding season) Lesser black-backed gull, *Larus fuscus* (breeding and assemblage species during breeding season) Shag, *Phalacrocoraxaristotelis* (breeding and assemblage species during breeding season) Great cormorant,*Phalacrocorax carbo* (assemblage species during breeding season) Kittiwake, *Rissa tridactyla* (assemblage species during breeding season) Roseate tern, *Sterna dougallii* (breeding and assemblage species during breeding season) Common tern, *Sterna hirundo* (breeding and assemblage species during breeding season) Arctic tern, *Sterna paradisaea* (breeding and assemblage species during breeding season) Sandwich tern, *Sterna sandvicensis* (breeding and assemblage species during breeding season) Guillemot, *Uria aalge* (assemblage species during breeding season)	376 km
The Wash Ramsar	Eurasian oystercatcher, *Haematopus ostralegus* (species with peak counts in spring/autumn) Grey plover, *Pluvialis squatarola* (species with peak counts in spring/autumn) Red knot, *Calidris canutus islandica* (species with peak counts in spring/autumn) Sanderling, *Calidris alba* (over wintering) Eurasian curlew, *Numenius arquata arquata* (over wintering) Common redshank, *Tringa totanus tetanus* (breeding) Ruddy turnstone, *Arenaria interpres interpres* (breeding) Pink-footed goose, *Anser brachyrhynchus* (species with peak counts in winter) Dark-bellied brent goose, *Branta bernicla* (species with peak counts in winter) Common shelduck, *Tadorna tadorna* (species with peak counts in winter) Northern pintail, *Anas acuta* (species with peak counts in winter) Dunlin, *Calidris alpina alpina* (species with peak counts in winter) Bar-tailed godwit, *Limosa lapponica lapponica* (species with peak counts in winter) Ringed plover, *Charadrius hiaticula* (species with peak counts in spring/autumn) Black-tailed godwit, *Limosa limosa islandica* (species with peak counts in spring/autumn) European golden plover, *Pluvialis apricaria* (species with peak counts in winter) Northern lapwing, *Vanellus vanellus* (species with peak counts in winter)	66km (approx.)
North Norfolk Coast SAC	Coastal lagoons (Annex I habitat) Perennial vegetation of stony banks (Annex I habitat) Coastal shingle vegetation outside the reach of waves Mediterranean and thermo-Atlantic halophilous scrubs, *Sarcocornetea fruticosi* (Annex I habitat)	53km (approx.)

Designated site	Site qualifying features	Distance to TKOWF
	Mediterranean saltmarsh scrub Embryonic shifting dunes (Annex I habitat) Shifting dunes along the shoreline with *Ammophila arenaria* (Annex I habitat) Shifting dunes with marram Fixed dunes with herbaceous vegetation (Annex I habitat) Dune grassland Humid dune slacks (Annex I habitat) Great crested newt, *Triturus cristatus* (Annex II species) Otter, *Lutra lutra* (Annex II species) Petalwort, *Petalophyllum ralfsii* (Annex II species)	
Overstrand Cliffs SAC	Vegetated sea cliffs of the Atlantic and Baltic coasts (Annex I habitat)	58km (approx.)
Saltfleetby – Theddlethorpe Dunes and Gibraltar Point SAC	Mediterranean and thermo-Atlantic halophilous(Annex I habitat) Scrubs, *Sarcocornetea fruticosi* Embryonic shifting dunes (Annex I habitat) Shifting dunes along the shoreline with *Ammophila arenaria* (Annex I habitat) Shifting dunes with marram (Annex I habitat) Atlantic decalcified fixed dunes, *Calluno-Ulicetea* Dunes with *Hippophae rhamnoides* (Annex I habitat) Dunes with seabuckthorn (Annex I habitat) Humid dune slacks (Annex I habitat)	33 km
Winterton – Horsey Dunes SAC	Embryonic shifting dunes (Annex I habitat) Shifting dunes along the shoreline with *Ammophila arenaria* (Annex I habitat) Shifting dunes with marram (Annex I habitat) Atlantic decalcified fixed dunes, *Calluno-Ulicetea* (Annex I habitat) Dunes with *Hippophae Rhamnoides* (Annex I habitat) Humid dune slacks (Annex I habitat) Great crested newt, *Triturus cristatus* (Annex II species)	79 km (approx.)
Humber Estuary SPA	Great bittern, *Botaurus stellaris* (non-breeding and breeding) Common shelduck, *Tadorna tadorna* (non-breeding) Eurasian marsh harrier, *Circus aeruginosus* (breeding) Hen harrier, *Circus cyaneus* (non-breeding) Pied avocet, *Recurvirostra avosetta* (non-breeding and breeding) European golden plover, *Pluvialis apricaria* (non-breeding) Red knot, *Calidris canutus* (non-breeding and staging) Dunlin, *Calidris alpina alpina* (non-breeding) Ruff, *Philomachus pugnax* (non-breeding)	42 km (approx.)

Designated site	Site qualifying features	Distance to TKOWF
	Black-tailed godwit, *Limosa limosa islandica* (non-breeding) Bar-tailed godwit, *Limosa lapponica* (non-breeding) Common redshank, *Tringa totanus* (non-breeding) Little tern, *Sterna albifrons* (breeding) Eurasian teal, *Anas crecca* (over wintering) Eurasian wigeon, *Anas penelope* (over wintering) Mallard, *Anas platyrhynchos* (over wintering) Ruddy turnstone, *Arenaria interpres* (over wintering) Common pochard, *Aythya farina* (over wintering) Greater scaup, *Aythya marila* (over wintering) Dark-bellied brent goose, *Branta bernicla bernicla* (over wintering) Common goldeneye, *Bucephala clangula* (over wintering) Sanderling, *Calidris alba* (over wintering and staging) Dunlin, *Calidris alpina alpina* (over wintering and staging) Red knot, *Calidris canutus* (over wintering and staging) Ringed plover, *Charadrius hiaticula* (staging) Hen harrier, *Circus cyaneus* (over wintering) Eurasian oystercatcher, *Haematopus ostralegus* (over wintering) Eurasian curlew, *Numenius arquata* (over wintering) Whimbrel, *Numenius Phaeopus* (staging) Ruff, *Philomachus pugnax* (staging) Grey plover, *Pluvialis squatarola* (over wintering and staging) Common greenshank, *Tringa nebularia* (staging) Northern lapwing, *Vanellus vanellus* (over wintering) Waterbird assemblage	
Gibraltar Point SPA	Grey plover, *Pluvialis squatarola* (non-breeding) Sanderling, *Calidris alba* (non-breeding) Bar-tailed godwit, *Limosa lapponica* (non-breeding) Little tern, *Sterna albifrons* (breeding) Red knot, *Calidris canutus* (non-breeding) Waterbird assemblage (identified by the 2001 UK SPA Review)	48km (approx.)
The Wash SPA	Bewick's swan, *Cygnus columbianus bewickii* (over wintering) Pink-footed goose, *Anser brachyrhynchus* (over wintering) Dark-bellied brent goose, *Branta bernicla bernicla* (over wintering) Common shelduck, *Tadorna tadorna* (over wintering) Eurasian wigeon, *Anas penelope* (over wintering) Gadwall, *Anas strepera* (over wintering)	66km (approx.)

Designated site	Site qualifying features	Distance to TKOWF
	Northern pintail, *Anas acuta* (over wintering) Black (common) scoter, *Melanitta nigra* (over wintering) Common goldeneye, *Bucephala clangula* (over wintering) Eurasian oystercatcher, *Haematopus ostralegus* (over wintering) Grey plover, *Pluvialis squatarola* (over wintering) Red knot, *Calidris canutus* (over wintering) Sanderling, *Calidris alba* (on passage) Dunlin, *Calidris alpina alpina* (over wintering) Black-tailed godwit, *Limosa limosa islandica* (over wintering) Bar-tailed godwit, *Limosa lapponica* (over wintering) Eurasian curlew, *Numenius arquata* (over wintering) Common redshank, *Tringa tetanus* (over wintering) Ruddy turnstone, *Arenaria interpres* (over wintering) Common tern, *Sterna hirundo* (breeding) Little tern, *Sterna albifrons* (breeding) Whooper swan, *Cygnus Cygnus* (over wintering) Eurasian marsh harrier, *Circus aeruginosus* (breeding) Pied avocet, *Recurvirostra avosetta* (over wintering) Ringed plover, *Charadrius hiaticula* (on passage) European golden plover, *Pluvialis apricaria* (over wintering) Waterbird assemblage	
Humber Estuary Ramsar	European golden plover, *Pluvialis apricaria apricaria* (over wintering) Red knot, *Calidris canutus islandica* (over wintering) Dunlin, *Calidris alpina alpina* (non-breeding and over wintering) Black-tailed godwit, *Limosa limosa islandica* (over wintering) Common redshank, *Tringa totanus totanus*(over wintering) Common shelduck, *Tadorna tadorna* (breeding) Bar-tailed godwit, *Limosa lapponica lapponica*(over wintering)	46km (approx.)

Source: RIES Matrices 2.1 – 2.16