Triton Knoll Offshore Wind Farm

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Non Material Change Application: Consolidated Screening Review of Potential Impacts on Natura 2000 Sites

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TRITON KNOLL

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1 INTRODUCTION

1.1 Overview

This report has been prepared to inform the Non-Material Change (NMC) application submitted by Triton Knoll Offshore Wind Farm Limited (TKOWFL) to reduce capacity of the site to 900MW. The report provides a summary of the assessments completed to date for the additional Natura 2000 sites that have been brought forward since Triton Knoll Offshore Wind Farm (TKOWF) was consented.

1.2 Background to the Project

Triton Knoll Offshore Wind Farm (TKOWF) is located off the east coast of England, approximately 32km from the Lincolnshire coast and 50km from the coast of north Norfolk, with the export cable landfall located at Anderby Creek on the Lincolnshire coast (Figure 1-1). The footprint of the consented development area is approximately 145km^2. TKOWF has progressed through two separate consent applications, the Triton Knoll Offshore Wind Farm Array (TK Array) which was granted development consent on 11 July 2013[1] (TK Array DCO), and Triton Knoll Electrical System (TK Electrical System), which was granted development consent on 5 September 2016[2] (TK Electrical System DCO). The TK Array and the TK Electrical System are being brought forward as a single development by Triton Knoll Offshore Wind Farm Ltd (TKOWFL). References to TKOWF in this document should be read as a reference to both the TK Array and the TK Electrical System.

The TK Array DCO allows for up to 288 wind turbine generators (WTGs) fixed to the seabed by one of five foundation types (monopile, jacket, tripod, suction bucket monopod and gravity base), with an installed capacity of up to 1,200 MW. The TK Array DCO also specifies up to eight offshore substations (comprising up to four collector substations and up to four High Voltage Direct Current (HVDC) substations), up to four meteorological stations and a network of underground cables between the offshore elements of the development.

The TK Electrical System DCO allows for up to six seabed export cables to transfer the electricity to shore, together with infrastructure to connect the offshore and onshore cables and the associated onshore infrastructure required to transport the power for connection to the National Grid.

In January 2014, following detailed technical and commercial optimisation studies undertaken by TKOWFL, the generating capacity of TKOWF was decided to be a maximum of 900 MW. Further project optimisation work continued post-consent and TKOWF was awarded a Contract for Difference (CfD) by the UK Government on 11 September 2017 for a generating capacity of 900 MW.

In February 2018, TKOWFL submitted an application for a non-material change (NMC Application) to the TK Array DCO in accordance with the Infrastructure Planning (Changes to, and Revocation of, Development Consent Orders) Regulations 2011. The NMC Application seeks a reduction to the wind farm capacity, the number of turbines and the number of collector offshore substations consented by the TK Array DCO, and also seeks the removal of the meteorological stations and the option for any HVDC substations. No changes are being requested to the TK Electrical System DCO.

[1] https://infrastructure.planninginspectorate.gov.uk/projects/east-midlands/triton-knoll-offshore-wind-farm/
[2] https://infrastructure.planninginspectorate.gov.uk/projects/east-midlands/triton-knoll-electrical-system/

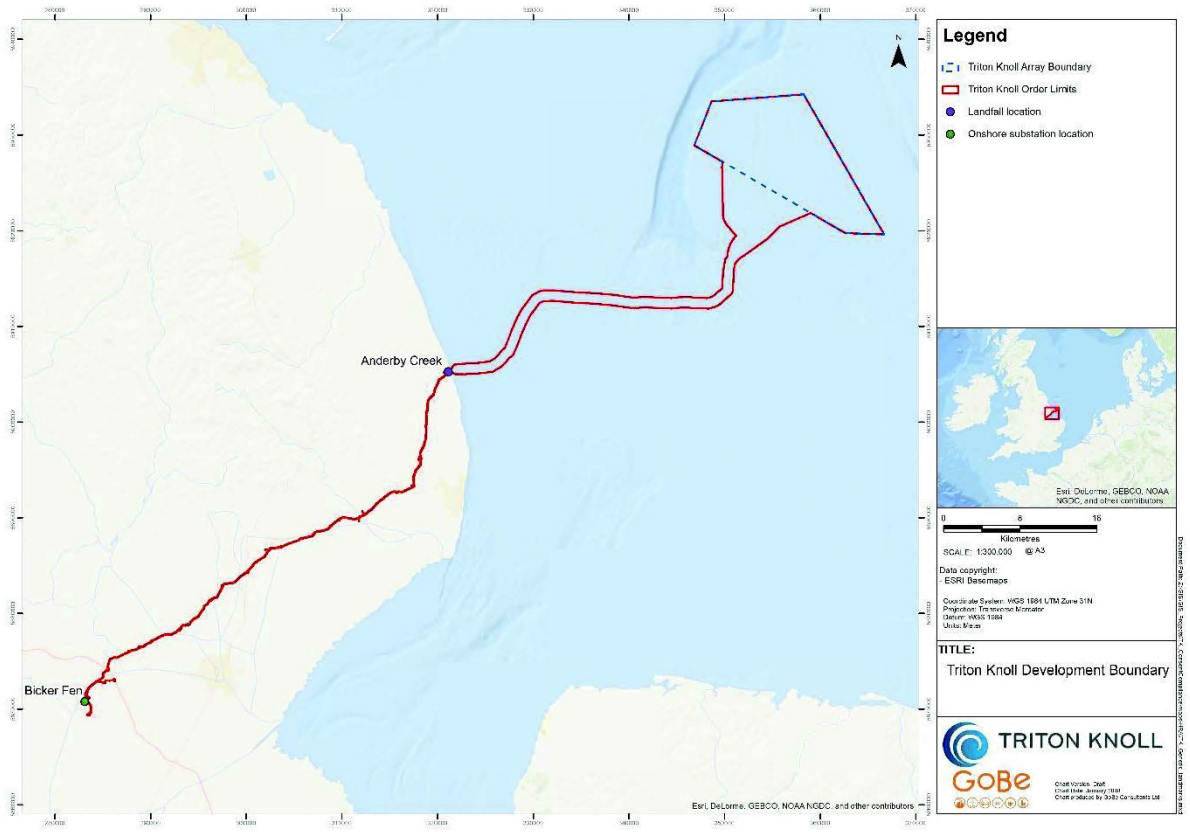

Figure 1-1 Location of the Triton Knoll Offshore Wind Farm and Triton Knoll Electrical System

1.3 Purpose of this report

This document has been produced to provide relevant information on the reduced TK Array to supplement the information provided in the Report to Inform Appropriate Assessment submitted as part of the NMC Application in relation to relevant Natura 2000 sites. The information provided in this report draws on Habitats Regulations Assessments (HRAs) and associated reports completed to date.

The NMC application seeks to reduce capacity from 1,200MW to 900MW, with the associated changes in infrastructure for the TK Array summarised below in Table 1-1.

Table 1-1 Changes to the original consented project within the NMC Application

Project Component	As Consented	Refined Project Design for NMC Application
Capacity	1,200MW	Up to 900MW
Number of WTGs	288 (333 assessed within the ES)	Up to 90
Offshore Substation Platforms (OSPs)	Up to eight OSPs, including up to four offshore collector stations and up to four HVDC substations	Two OSPs, no HVDC substations
Meteorological stations	Up to 4 meteorological stations	No meteorological stations

TKOWFL do not consider that the proposed reduction in capacity and associated changes to the TK Array DCO by themselves trigger a requirement to carry out a HRA or to obtain any new or additional licences. It is noted, however, that since the TK Array DCO was granted in 2013, additional Natura 2000 sites have been brought forward in the region by the UK Government. It is highlighted that these

new sites have already been considered for the relevant components of the TKOWF Project as a whole, however the documents have not previously been brought together in relation to the reduced TK Array and reported under a single title. This report has therefore been produced as a reference source for the NMC Application to provide a collated source of HRA information, data and assessments relevant to TKOWF and to present a screening review of the proposed reductions to the TK Array.

The following sections re-state the existing impacts associated with the TKOWF and assess any implications of the changes sought within the NMC Application on designated Natura 2000 sites, through reference to and comparison with the potential impacts assessed as arising from the consented Project design. The report also provides a summary of the assessments undertaken for the more recently designated sites (i.e. The Greater Wash proposed Special Protection Area (pSPA) and the Southern North Sea candidate Special Area of Conservation (SNS cSAC)) to ensure all relevant sites have been appropriately considered.

The HRA documents of relevance to TKOWF comprise the following:

- Triton Knoll Offshore Wind Farm: Report to Inform the Habitats Regulations Assessment (RWE, 2012);
- Triton Knoll Electrical System: Report to Inform Appropriate Assessment (RWE, 2015);
- Triton Knoll Offshore Wind Farm: Greater Wash pSPA Shadow Habitats Regulations Assessment (TKOWFL, 2017); see Appendix I and
- Southern North Sea candidate Special Area of Conservation (SNS cSAC): Report to Inform Appropriate Assessment (TKOWFL, 2018).

The Natura 2000 sites included and assessed within each of these documents are listed in Table 1-2.

Table 1-2 Existing assessments and the Natura 2000 sites considered within them

Document	Date Published	Natura 2000 Sites Assessed
Triton Knoll Offshore Wind Farm: Report to inform the Habitats Regulations Assessment	January 2012	• North Norfolk Coast SPA; • Flamborough Head and Bempton Cliffs SPA; • Humber Estuary SAC; • The Wash and North Norfolk Coast SAC; and • Inner Dowsing, Race Bank and North Ridge cSAC.
Triton Knoll Electrical System: Report to Inform Appropriate Assessment	April 2015	• Inner Dowsing, Race Bank and North Ridge Site of Community Importance (SCI)[3]
Triton Knoll Offshore Wind Farm Greater Wash pSPA Shadow Habitats Regulations Assessment	July 2017	• Greater Wash pSPA
Triton Knoll Offshore Wind Farm Southern North Sea candidate Special Area of Conservation (SNS cSAC): Report to Inform Appropriate Assessment	February 2018	• Southern North Sea cSAC

[3] The Inner Dowsing, Race Bank and North Ridge SCI site was designated as a SAC in September 2017

1.4 Approach

All topics and potential impacts on designated Natura 2000 sites as set out in the documents outlined in Table 1-2 for the TK Array and the TK Electrical System (as relevant) have been screened against the refined project design parameters of the NMC Application. This involved consideration of the environmental impacts of the proposed changes and, in particular, whether these impacts could result in a different level of effect to that identified in the existing assessments.

Where the significance of the effect would be unchanged or reduced from the TKOWF project alone assessment, it is considered that the significance of any cumulative impacts would also be unchanged or reduced.

The screening is presented within tables in the following sections, with each of the relevant HRA documents considered separately

1.5 Consultation

Following submission of the NMC Application on 19 February 2018, consultation was carried out with BEIS including a teleconference on 08 May 2018. An updated Report to Inform Appropriate Assessment was issued to BEIS together with supplementary HRA information on 25 May 2018, with a further teleconference held on 06 June 2018. Key to that discussion was the need to include consideration of three designated sites for which a change in the designation (extent and/or features) had occurred in the intervening period between the original assessments undertaken for the TK Array and the TK Electrical System. The sites specifically highlighted are:

- Hamford Water SPA;
- Outer Thames Estuary SPA; and
- Flamborough and Filey Coast pSPA.

Consideration and assessment of the changes at these sites is presented in Section 6 of this report.

2 TRITON KNOLL OFFSHORE WIND FARM: REPORT TO INFORM THE HABITATS REGULATIONS ASSESSMENT

2.1 Original Assessment

The Triton Knoll Offshore Wind Farm: Report to Inform the Habitats Regulations Assessment (RWE, 2012) (TK Array HRA) examined the potential for adverse effects of the TK Array (including inter-array cabling) on two SPAs (Norfolk Coast, and Flamborough Head and Bempton Cliffs) and three SACs (Humber Estuary, the Wash and North Norfolk Coast, and the Inner Dowsing, Race Bank and North Ridge cSAC). The impacts assessed are listed inTable 2-1, with a finding presented for the implications of the reduced (CfD) Project parameters, in accordance with the details set out within the NMC Application.

Full details of the TK Array HRA produced for the TK Array DCO[4] and the HRA undertaken by the Secretary of State (SoS)[5] are available on the Planning Inspectorate website.

[4] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010005/EN010005-000305-0402%20Habitats%20Regulations%20Assessment%20report.pdf
[5] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010005/EN010005-000014-Habitats%20Regulations%20Assessment.pdf

2.1 Screening of Impacts

Table 2-1 Screening of the impacts of the TKOWF on Natura 2000 sites as assessed in the Report to inform the Habitats Regulations Assessment (2012) and the implications of the changes sought by the NMC Application

Site	Relevant Designation Feature(s)	Original Impact Assessment	Conclusion of Original Assessment	Change in Effect Significance due to changes sought by the NMC Application
Inner Dowsing, Race Bank and North Ridge cSAC	Annex I habitat feature sandbanks slightly covered by seawater all the time.	Impacts screened and assessed for LSE: • Increase in suspended sediment concentration (SSC) as a result of foundation installation; • Increase in SSC as a result of inter-array cable installation; • Changes to sediment transport regime due to presence of turbine foundations; and • Scour due to presence of turbine foundations.	There will be no direct loss of sand bank habitat as a result of the construction, operation, or decommissioning of the TKOWF. It is therefore concluded that there will be no adverse effects on the feature of the site as a result of TKOWF.	The proposed changes to the TKOWF comprise a reduction in the number of structures, all of which will be within the dimensions set out within the TK Array DCO/dMLs and within the TK Array order limits. There is also an associated reduction in activities across all phases of the TKOWF Project. Overall, there will be a reduction in the magnitude of potential impacts and no change to the integrity of the site. **There is therefore no change (no increase) in effect significance and no adverse effect is predicted.**

Site	Relevant Designation Feature(s)	Original Impact Assessment	Conclusion of Original Assessment	Change in Effect Significance due to changes sought by the NMC Application
North Norfolk Coast SPA and Ramsar site	Breeding populations of Sandwich tern *(Sterna sandvicensis*).	Impacts screened and assessed for LSE: • Disturbance and displacement from increased vessel traffic and construction activity; • Indirect impacts from pile driving; • Avoidance and displacement from TKOWF site; • Barrier effects from presence of TKOWF; and • Direct collision with turbine blades.	The habitat and prey availability for SPA populations will be maintained; no adverse effect on population assemblage is predicted from the construction, operation or decommissioning phase of the TKOWF.	The proposed changes to the TKOWF comprise a reduction in the number of structures, all of which will be within the dimensions set out within the TK Array DCO/dMLs and within the TK Array order limits. There is also an associated reduction in activities across all phases of the TKOWF Project. Overall, there will be a reduction in the magnitude of potential impacts and no change to the integrity of the site. **There is therefore no change (no increase) in effect significance and no adverse effect is predicted.**
Flamborough Head and Bempton Cliffs SPA[6]	Breeding population of Kittiwake (*Rissa tridactyl*a) and	Impacts screened and assessed for LSE:	The habitat and prey availability for SPA populations will be maintained; no	The proposed changes to the TKOWF comprise a reduction in the number of structures, all of which will be within the

[6] Note the Flamborough Head and Bempton Cliffs SPA has been revised and renamed as the Flamborough and Filey Coast pSPA. Consideration of the changes and any attendant implications are set out in Section 6 of this report.

Site	Relevant Designation Feature(s)	Original Impact Assessment	Conclusion of Original Assessment	Change in Effect Significance due to changes sought by the NMC Application
	Gannet (*Morus bassanus*) as an assemblage species.	• Disturbance and displacement from increased vessel traffic and construction activity; • Indirect impacts on prey species from pile driving; • Avoidance and displacement from the TKOWF site; • Barrier effects from presence of the TKOWF; and • Direct collision with turbine blades.	adverse effect on population assemblage is predicted from the construction, operation or decommissioning of TKOWF.	dimensions set out within the TK Array DCO/dMLs and within the TK Array order limits. There is also an associated reduction in activities across all phases of the TKOWF Project. Overall, there will be a reduction in the magnitude of potential impacts and no change to the integrity of the site. **There is therefore no change (no increase) in effect significance and no adverse effect is predicted.**
Humber Estuary SAC	Annex II species grey seal (*Haliochoerus grypus*).	Impacts screened and assessed for LSE: • Potential physical damage and temporary disturbance and displacement due to piling, vessel movement and other construction activities; • Lethal injury; • Serious physical injury; • Auditory injury: permanent threshold shift (PTS); • Behavioural impacts;	The construction, operation and decommissioning of TKOWF will not affect the breeding population of female grey seals from the SAC and will therefore not impact on reproduction rates for this species. The construction, operation and decommissioning of TKOWF will	The proposed changes to the TKOWF comprise a reduction in the number of structures, all of which will be within the dimensions set out within the TK Array DCO/dMLs and within the TK Array order limits.

Site	Relevant Designation Feature(s)	Original Impact Assessment	Conclusion of Original Assessment	Change in Effect Significance due to changes sought by the NMC Application
		• Temporary effects on the distribution and abundance of prey species due to habitat disturbance and direct prey disturbance resulting from the noise and vibration from piling, vessels, cable trenching and other construction activities; • Habitat loss – physical removal of habitat or loss due to disturbance; • Potential increase in vessel strike between vessels and marine mammals as a result of increased vessel activity during construction activities; • Disturbance and displacement of marine mammals resulting from operational noise and vibration from servicing and maintenance vessels; and • Potential increase in vessel strike between vessels and marine mammals as a result of increased vessel activity during service and maintenance activities.	not have any effect on SAC usage by grey seal due to the distance of the site from the project area; any displacement effects will not restrict usage within the SAC. The construction, operation and decommissioning of TKOWF does not affect the accessibility of the SAC for grey seal. It is therefore concluded that there will be no adverse effects on the features of the site as a result of TKOWF.	There is also an associated reduction in activities across all phases of the TKOWF Project. Overall, there will be a reduction in the magnitude of potential impacts and no change to the integrity of the site. **There is therefore no change (no increase) in effect significance and no adverse effect is predicted.**
Wash and North Norfolk SAC	Annex II species harbour seal (*Phoca vitulina*)	Impacts screened and assessed for LSE: • Potential physical damage and temporary disturbance and displacement due to piling, vessel movement and other construction activities; • Lethal effects;	There will not be a reduction in the population of harbour seals as a direct result of the construction, operation and decommissioning of TKOWF. Although there may be displacement from areas	The proposed changes to the TKOWF comprise a reduction in the number of structures, all of which will be within the dimensions set out within the TK Array DCO/dMLs and within the TK Array order limits.

Site	Relevant Designation Feature(s)	Original Impact Assessment	Conclusion of Original Assessment	Change in Effect Significance due to changes sought by the NMC Application
		• Serious physical injury; • Auditory injury: Permanent Threshold Shift (PTS); • Behavioural effects; • Potential increase in vessel strike between vessels and marine mammals as a result of increased vessel activity during construction activities; • Disturbance and displacement of marine mammals resulting from operational noise and vibration from servicing and maintenance vessels; and • Potential increase in vessel strike between vessels and marine mammals as a result of increased vessel activity during service and maintenance activities.	used as a transit route, this will not reduce fitness to the extent that it will have a population effect. The distribution of moulting harbour seals within the SAC will not be affected by the construction, operation or decommissioning of TKOWF due to spatial separation between TKOWF and haul out sites. It is therefore concluded that there will be no adverse effect on the features of the site as a result of TKOWF.	There is also an associated reduction in activities across all phases of the TKOWF Project. Overall, there will be a reduction in the magnitude of potential impacts and no change to the integrity of the site. **There is therefore no change (no increase) in effect significance and no adverse effect is predicted.**

2.2 Implications of the NMC Application

2.2.1 Conclusion of the TK Array HRA

The report concluded that the proposed development of TK Array, together with mitigation and monitoring as proposed, was not expected to have any Adverse Effect on the Integrity (AEoI) of any of the assessed sites in respect of the Birds Directive and Habitats Directive, either as a stand-alone project or in combination with other projects (Table 2-1).

2.2.2 SoS Decision

The TK Array DCO was granted by the SoS on 11 July 2013 and the decision letter included the following statements:

> *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".*

Following an assessment into the Likely Significant Effect (LSE) of the Project on the North Norfolk Coast SPA and Ramsar site, the SoS concluded that with mitigation measures in place "*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*."

2.2.3 NMC application (CfD Project) Screening Result

Given that the changes in Project design sought by the NMC Application will result in a reduced number of WTG's and associated offshore infrastructure, there will be no change in the impacts of the construction, operation and decommissioning phases of TKOWF on the Natura 2000 sites assessed within the report (as listed inTable 2-1) either as a stand-alone project or in-combination with other projects. Therefore, the conclusion of the TK Array HRA that there will be no adverse effect on any of the sites in respect of the Birds Directive and Habitats Directive, as agreed upon by the SoS, remains unchanged.

3 TRITON KNOLL ELECTRICAL SYSTEM: REPORT TO INFORM APPROPRIATE ASSESSMENT

3.1 Original Assessment

The TK Electrical System Report to Inform Appropriate Assessment (RWE, 2015) (TK Electrical System RIAA) examined the potential for adverse effects arising from the TK Electrical System the (including the offshore cable route) on the Inner Dowsing, Race Bank and North Ridge SCI, and, more specifically solely on the *S.spinulosa* reef designation feature of the site. At the time of writing the TK Electrical System RIAA, the site had not been formally designated as a SAC by the UK Government, but was adopted by the European Commission and was therefore classified as a SCI and subject to protection under the Habitats Directive. The site was subsequently designated as an SAC in September 2017. The impacts assessed are listed in Table 3-1, with a finding presented for the implications of the reduced (CfD) Project parameters, in accordance with the details set out within the NMC application.

Full details of the reports informing the RIAA[7] produced for the TK Electrical System and the HRA undertaken by the SoS[8] are available on the Planning Inspectorate website.

[7] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN020019/EN020019-000355-5.3%20Report%20to%20Inform%20Appropriate%20Assessment.pdf
[8] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN020019/EN020019-004775-Habitats%20Regulations%20Assessment.pdf

3.2 Screening of Impacts

Table 3-1: Screening of the impacts of the TK Electrical System on the Inner Race Bank and North Ridge SCI as assessed in the Report to inform Appropriate Assessment (2015) and the implications of the changes sought by the NMC Application

Site	Designation Feature(s)	Original Impact Assessment	Conclusion of original assessment	Change in Effect Significance due to changes sought by the NMC Application
Inner Dowsing, Race Bank, and North Ridge SCI	*Sabellaria spinulosa* reef features	Impacts screened and assessed for LSE: • Direct physical damage by object(s) to S. *spinulosa* reef (or the substrate onto which it is attached), including possible destruction and/or removal; • Temporary and localised increases in suspended sediment; • Permanent loss of natural substrate for S. *spinulosa* reef; and • Impairment of the potential for reefs to develop in the future.	There will not be a likely significant effect arising from the works associated with the TK Electrical System during the construction, operation and maintenance, or decommissioning phases of the project. It is therefore concluded that there will be no adverse impact arising from the Triton Knoll Electrical System either alone or in-combination with other projects.	The proposed changes to the TKOWF comprise a reduction in the number of structures, all of which will be within the dimensions set out within the TK Array DCO/dMLs and the TK Array and order limits. Whilst there will be no change to the TK Electrical System DCO parameters, there will be an associated reduction in activities across all phases of the TKOWF Project. Overall, there will be a reduction in the magnitude of potential impacts from TKOWF and no change to the integrity of the site. **There is therefore no change (no increase) in effect significance and no adverse effect is predicted.**

3.3 Implications of the NMC Application

3.3.1 Conclusion of the TK Electrical System RIAA

The TK Electrical System RIAA concluded that there will be no LSE on the Inner Dowsing, Race Bank and North Ridge (IDRBNR) SCI, and more specifically on the *S.spinulosa* reef designation feature, as a result of the construction, operation and decommissioning phases of the TK Electrical System either as a stand-alone project or in-combination with other projects. During the Examination of the TK Electrical System application and following consultation with Natural England, it was concluded that as a result of the operation and maintenance phases of Lincs and the Lynn and Inner Dowsing offshore wind farms having a LSE on the *S. spinulosa* reef features of the SCI, there followed a potential for the TK Electrical System to have a likely significant effect *in-combination* with those projects. This was set out in the Applicant's Response to Deadline 1 (October 2015; Examination Library document reference REP1-044)[9] and allowed more detailed assessment of the potential impacts to be set out. The assessment concluded no AEoI of the IDRBNR SCI.

3.3.2 SoS Decision

The TK Electrical System DCO was granted by the SoS on 5 September 2016 and the decision letter included the following:

> *6.5: "The Secretary of State considers that the Development has the potential to have a likely significant effect on the Sabellaria spinulosa reef feature of the SCI. The Secretary of State has, therefore, undertaken an Appropriate Assessment – taking account of all relevant information – of the SCI's conservation objectives to determine whether the proposed Development, either alone or in-combination with other plans and projects, will result in an adverse effect on the site's integrity. The Secretary of State concludes that the Development, with mitigation in place, will not have an adverse effect on the integrity of any European site either alone or in-combination with other plans or projects"; and*
>
> *7.5 "The Secretary of State has determined that the Project, with mitigation in place, will not have an adverse effect on site integrity on any European site either alone or in combination with other plans or projects. He has undertaken a robust assessment using all of the information available to him, not least the advice from Natural England, the recommendation of the Panel and the views of the Applicant".*

3.3.3 Screening Result

There will be no change to the TK Electrical System DCO parameters and a reduction to the TK Array DCO parameters as a result of the NMC Application. Overall, this will result in a reduction in activities across all phases of the TKOWF project. Therefore, the conclusions of the SoS that there will be no adverse effect on the Inner Dowsing, Race Bank and North Ridge SCI, and more specifically on the *S.spinulosa* reef feature remains unchanged.

[9] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN020019/EN020019-001104-Triton%20Knoll%20Offshore%20Wind%20Farm%20Limited.pdf

4 TRITON KNOLL OFFSHORE WIND FARM: GREATER WASH PSPA SHADOW HABITATS REGULATIONS ASSESSMENT

4.1 Original Assessment

The Triton Knoll Offshore Wind Farm: Greater Wash pSPA Shadow Habitats Regulation Assessment (TKOWFL, 2017) (TKOWF Shadow HRA) provided an assessment of the potential for impacts on the features of the Greater Wash proposed Special Protection Area (pSPA) as a result of the construction, operation and decommissioning of the TK Array, acting both alone and in-combination with other projects. This assessment was conducted according to the consented TK Array of 288 WTGs, as well as a reduced project of 120 WTGs. The document is presented at Appendix I. TKOWF is located wholly outside the boundaries of the pSPA, thus this assessment was based on precautionary assumptions about the likelihood of the connectivity between the features of the pSPA, in line with advice received from Natural England in response to TKOWF's consultation response to the pSPA.

The report focused solely on relevant aspects of the TK Array rather than the TK Electrical System as the consent awarded to the TK Array pre-dated the identification of the pSPA, whereas the TK Electrical System undertook assessment of potential implications for the pSPA as part of the application and consenting process for the DCO. The pSPA site was screened out from any potential impacts arising from the TK Electrical System development proposals, as agreed with NE during the TK Electrical System DCO Application and as reflected in the HRA completed by the SoS. Furthermore, the TKOWF Shadow HRA assessment considered only the Greater Wash pSPA with respect to the consented TKOWF development as all other Natura 2000 sites had been previously considered and, where relevant, subject to Appropriate Assessment by the relevant Competent Authority as part of the consenting process under the Planning Act 2008[10].

The following qualifying ornithological interests for the Greater Wash pSPA were assessed for the possibility of a LSE as a result of the TK Array: Sandwich tern; Common tern; Little tern; Red-throated diver; Common scoter; and Little gull. Based upon the outcome of these assessments, it was then determined whether or not there would be an AEoI of the Greater Wash pSPA as a result. The impacts assessed are listed in Table 4-1, with a finding presented for the implications of the reduced (CfD) Project parameters (including a reduction in turbines to up to 90), in accordance with the details set out within the NMC Application.

[10] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN020019/EN020019-004775-Habitats%20Regulations%20Assessment.pdf

4.2 Screening of Impacts

Table 4-1: Screening of the impacts of the TKOWF on the Greater Wash pSPA as assessed in the Greater Wash pSPA Shadow Habitats Regulations Assessment (2017) and the implications of the changes sought by the NMC Application

Site	Designation Feature(s)	Original Impact Assessment	Conclusion of original assessment	Change in Effect Significance due to changes sought by the NMC Application
Greater Wash pSPA	Sandwich tern (*Sterna sandvicensis*); Common tern (*Sterna hirundo*); Little tern (*Sternula albifrons*); Red-throated diver (*Gavia stellata*); Common scoter (*Melanitta nigra*); and Little gull (*Hydrocoloeus minutus*).	Impacts of TKOWF (TK Array) screened and assessed for LSE on the relevant features of the Greater Wash pSPA during any phase of the development, either alone or in-combination in both development scenarios assessed (i.e. 288 WTGs and 120 WTGs): • Sandwich tern • Common tern • Little tern • Red-throated Diver • Common Scoter • Little gull	Red throated diver (displacement) and little gull (collision risk) were the only two receptors for which a LSE was deemed to arise. The findings of the assessment were: • Red throated diver: no AEoI of the site as a result of displacement from the TKOWF alone or in-combination (in both development scenarios); • Little gull: no AEoI of the site as a result of collisions at the TKOWF or in-combination (in both development scenarios).	The proposed changes to the TKOWF comprise a reduction in the number of structures, all of which will be within the dimensions set out within the TK Array DCO/dMLs and within the TK Array order limits. There is also an associated reduction in activities across all phases of the TKOWF project. Overall, there will be a reduction in the magnitude of potential impacts and no change to the integrity of the site. **There is therefore no change (no increase) in effect significance and no adverse effect is predicted.**

4.3 Implications of the NMC Application

4.3.1 Conclusion of the TKOWF Shadow HRA

Following an assessment of each of the qualifying ornithological interests for the Greater Wash pSPA, little gull and red throated diver represented the only species for which the potential for a LSE could not be ruled out.

For little gull this finding was made on the basis of collision risk during operation due to both the project alone and in-combination with other offshore wind farms. Following an evidence based review, the mortality for little gull predicted to affect the pSPA population was found to be very small, thus it was concluded that no AEoI was assessed for the Greater Wash pSPA due to collision mortality at the TKOWF alone or in-combination with other wind farms.

For red throated diver, the finding was made on a precautionary basis in relation to potential displacement effects from the TKOWF area and surrounding buffer, both alone and in-combination with other offshore wind farms. Following an assessment, it was deemed that the effect on the population density within the Greater Wash pSPA would be undetectable against the baseline, and therefore, no AEoI of the Greater Wash pSPA as a result of displacement from TKOWF alone or in-combination would occur.

4.3.2 Agreement with Natural England

Agreement on the findings of the shadow HRA was reached with Natural England, which confirmed by email (26/07/17) following consultation on the report.

4.3.3 Screening Result

The changes in Project design sought by the NMC Application will result in a reduced number of WTG's and associated offshore infrastructure. Thus, there will be no change in the impacts of the construction, operation and decommissioning phases of TKOWF on the relevant features of the Greater Wash pSPA, as listed inTable 4-1, and the conclusion that there will be no AEoI of the Greater Wash pSPA remains unchanged.

5 TRITON KNOLL OFFSHORE WIND FARM SOUTHERN NORTH SEA CANDIDATE SPECIAL AREA OF CONSERVATION (SNS CSAC): REPORT TO INFORM APPROPRIATE ASSESSMENT

5.1 The Assessment

The Triton Knoll Offshore Wind Farm Southern North Sea Candidate Special Area of Protection (SNS cSAC): Report to Inform Appropriate Assessment (TKOWFL 2018) (TKOWF RIAA) presents the information relevant to an HRA for TKOWF in response to the designation of the Southern North Sea candidate Special Area of Conservation (SNS cSAC), approved by the UK Government and submitted to the European Commission on 30 January 2017 for approval. The TKOWF RIAA is available on the PINs website[11]. The existing TK Array HRA did not consider the SNS cSAC, as the HRA undertaken in support of the TK Array DCO application predated the proposed designation of the site. The SNS cSAC lies wholly within UK waters, with harbour porpoise being the sole feature of interest.

The TKOWF RIAA considered the potential for LSE and AEoI on the SNS cSAC during construction, operation and decommissioning alone and in-combination with other projects for two development scenarios; the consented 288 WTG (1,200MW) project; and the reduced 90 WTG (900MW) project as detailed in the NMC Application. The impacts assessed and the conclusions of the RIAA are listed inTable 5-1.

[11] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010005/EN010005-000874-Annex%20D%20-%20Triton%20Knoll%20NMC%20-%20SNS%20cSAC%20Report%20to%20Inform%20Appropriate%20Assessment.pdf

5.2 Screening of Impacts

Table 5-1: Screening of the impacts of the TKOWF on the Southern North Sea cSAC as assessed in Southern North Sea cSAC Report to Inform Appropriate Assessment (2018)

Site	Designation Feature(s)	Impact Assessment	Conclusion of assessment
Southern North Sea cSAC	Harbour porpoise (*Phocoena phocoena*)	Impacts screened and assessed for LSE: • Underwater Noise: - Temporary disturbance of marine mammals resulting from noise and vibration from piling, vessels, and construction activities; - Temporary effects on prey species from noise, vessels, and construction activities; - Potential physical damage, masking effects and disturbance resulting from noise and vibration from piling, vessels, cable installation and other construction activities; and • Collision risk: - Increase in vessel strikes on marine mammals.	The assessment of AEoI has been made both alone and in-combination, and in all cases, and with the implementation of Project mitigation, TKOWF (alone and in-combination), will not lead to an AEoI on the SNS cSAC. Therefore, subject to natural change, the Conservation Objectives for harbour porpoise will be maintained at the site in the long term. These conclusions were drawn for both the consented TK Array parameters and the proposed reduced parameters set out in the NMC Application.

5.2.1 Conclusion of the TKOWF RIAA

The determination of LSE considered the potential for the Project during construction, operation and decommissioning to result in an impact on the SNS cSAC alone and in-combination (Table 5-1) finding the potential for LSE to apply to potential behavioural disturbance from underwater noise during construction only. The assessment of AEoI was made both alone and in-combination, and concluded that TKOWF (alone and in-combination) will not lead to an AEoI on the SNS cSAC. Therefore, subject to natural change, the Conservation Objectives for harbor porpoise will be maintained at the site in the long term.

6 AMENDMENTS TO DESIGNATED SITES ASSESSED

6.1 Relevant Designated Sites

As noted in Section 1.5, revisions have been made to three designated sites following the original assessments considered above. The relevant sites are as follows:

- Hamford Water SPA;
- Outer Thames Estuary SPA; and
- Flamborough and Filey Coast pSPA.

These sites were designated in some form during the application process for TKOWF (both the TK Array and TK Electrical System). Consideration to these changes is given below, in the context of the original assessments undertaken and agreed, in particular the screening process completed.

6.1.1 Screening for the TK Array HRA

The RIAA undertaken for the TK Array (dated 2012, Doc Ref 04/02) summarises consultation undertaken on the HRA with respect to the TK Array in Section 2.13. As part of this consultation the relevant designated sites and features to be considered within the RIAA were discussed and agreed with consultees. The European sites potentially affected and identified for further consideration (as bullet pointed under 2.15) were as follows:

- North Norfolk Coast SPA- Breeding populations of Sandwich tern (*Sterna sandvicensis*) and common tern (*Sterna hirundo*);
- Kittiwake (*Rissa tridactyla*) breeding population of Flamborough Head and Bempton Cliffs SPA;
- Gannet (*Morus bassanus*) assemblage species of Flamborough Head and Bempton Cliffs SPA;
- Gannet (*Morus bassanus*) a population of European importance at Forth Islands SPA;
- Guillemot (*Uria aalge*) assemblage species of Flamborough Head and Bempton Cliffs SPA;
- Razorbill (*Alca torda*) assemblage species of Flamborough Head and Bempton Cliffs SPA;
- Inner Dowsing, Race Bank and North Ridge (IDRBNR) cSAC- Annex I habitat feature sandbanks slightly covered by seawater all the time;
- The Wash and North Norfolk SAC- Annex II species harbour seal (*Phoca vitulina*); and
- Humber Estuary SAC – Annex II species grey seal (*Haliochoerus grypus*).

All other designated sites and features were screened out.

Following initial investigation, the completion of the ornithological technical report and further consultation with JNCC, the SPA features to be assessed were refined to the following sites and features (as well as the non-bird features listed above):

- North Norfolk Coast SPA – Breeding populations of Sandwich tern (*Sterna sandvicensis*);
- Kittiwake (*Rissa tridactyla*) breeding population of Flamborough Head and Bempton Cliffs SPA; and
- Gannet (*Morus bassanus*) assemblage species of Flamborough Head and Bempton Cliffs SPA.

A summary of this process is provided Section 2.16 of the TK Array RIAA. It is clear that, at the time of writing the TK Array HRA (i.e. January 2012), no additional designated sites or species were considered

relevant. The conclusion in all cases was for no adverse effect; as presented in Table 2-1 above. These conclusions remain valid.

6.1.2 Screening for the TK Electrical System HRA

The RIAA undertaken for the TK Electrical System (Dated 2015, Doc Ref 5.3) summarises consultation undertaken on the HRA with respect to the TK Array in Section 1.14. As part of that consultation the relevant designated sites and features to be considered within the RIAA were discussed and agreed with consultees. The RIAA confirmed that the IDRBNR SCI, specifically the *S. spinulosa* reef feature, should be the sole site considered within the HRA. Other sites were screened out on the basis of there being no impact pathway from the proposed development to the European site.

It is clear that, at the time of writing (i.e. April 2015), no additional designated sites or species were considered relevant. The conclusion in all cases was for no adverse effect; as presented in Table 3-1, that conclusion remains valid.

6.1.3 Offshore Ornithology Sensitivity Review

In order to inform final turbine design and ornithological monitoring for TKOWF, a review of the offshore ornithology sensitivity with respect to TK Array was conducted in 2016, which includes reference to the Flamborough and Filey Coast pSPA and/or species highlighted subsequently below (specifically gannet and kittiwake). The report was prepared to provide a basis for subsequent discussions with the Marine Management Organisation and Natural England on ornithological monitoring, with the content agreed with Natural England through consultation. Specifically, the report noted the following:

- Flamborough Head and Bempton Cliffs SPA, as updated by the Flamborough and Filey Coast pSPA - there is potential for LSE on gannet associated with the Flamborough Head and Bempton Cliffs SPA (as updated by the Flamborough and Filey Coast pSPA) as a result of collision risk (in-combination) and on kittiwake as a result of collision risk (in-combination).
- Gannet - The very low densities of gannet in the breeding season suggests that very little foraging occurs on TK Array by birds from the nearest breeding colony for this species, Flamborough and Filey Coast pSPA. The spring and autumn peaks, which exceeded the regional threshold for this species, indicate the passage of birds migrating both to this colony and also breeding colonies farther north. Gannet is included on the BoCC amber list, but is not an Annex 1 or Schedule 1 species.
- The very low numbers of kittiwake recorded during the breeding season (including no observations in some surveys) indicated little, if any connection, between TK Array and the nearest breeding colony at Flamborough and Filey Coast pSPA. Kittiwakes were present in regionally important numbers during the post-breeding and pre-breeding periods (August-September and March respectively). Kittiwake has recently been moved to the BoCC red list, due to continued population decline, but is not an Annex 1 or Schedule 1 species.
- During the examination it was agreed between TK Array and NE and the Joint Nature Conservation Committee (JNCC) that both the project alone and in-combination would not have an adverse effect on the integrity of the Flamborough Head and Bempton Cliffs SPA in relation to collision risk for either gannet or kittiwake.
- The report also updated the collision mortality estimates for TK Array, specifically for gannet, kittiwake, lesser black backed gull and greater black backed gull. These updated collision mortality estimates were based on revised parameters and therefore included the

consented 288 turbines. For gannet, impacts relate primarily to collision risk in the breeding season (27 individuals) and on migration (4 individuals; all consented totals); for kittiwake, impacts relate to collision risk in the breeding season (3.3 individuals) and on migration (14 individuals; all consented totals).

Further, the report found the following:

'Following the sensitivity review, four species have been identified as the key focus for monitoring at TKOWF; namely gannet, kittiwake, Sandwich tern and little gull (Section 2: Monitoring Screening Exercise) and it is noted that all four of these species are features of SPAs or pSPAs in the region. As demonstrated through the modelling, the impact magnitudes on these species at TKOWF alone are all very small and so there is little justification for monitoring project alone impacts. Consequently, it is proposed that the focus for monitoring at TKOWF should be on undertaking strategic level work, which will contribute towards a greater understanding of effects across wind farms in the Southern North Sea region as a whole.
Following agreement on the outcomes of this sensitivity review, monitoring proposals will be developed by TKOWFL for submission and discussion with the MMO and NE.'

Of the above species, two are in particular referenced below (namely gannet and kittiwake).

6.2 Consideration of the Changes to the Designated Sites

Each of the designated sites highlighted under Section 6.1 above are discussed below, in the context of the relevant screening undertaken to date (as summarised in 6.1.1-6.1.3) and the changes made since that process to the designations.

6.2.1 Hamford Water SPA

Hamford Water SPA was initially designated in 1993[12]. It was not identified as relevant to TKOWF during screening of the TK Array or the TK Electrical System. The concern raised relates to the recent change in the designation, and whether that change would result in a change in the original screening undertaken. The most recent citation for Hamford Water is dated 13/09/17[13], with the resulting change in the designation being the inclusion of Little tern (*Sterna albifrons*). All other qualifying species counts remain as per the 1993 classification. Foraging range for little tern, drawing on Thaxter *et al.,* 2012, is 11km as a maximum, and is therefore not considered a relevant site for TK Array as the project is at a significantly greater distance from the site than this (being some 115km at its closet point). It can therefore be concluded that Hamford Water SPA, following the update to the citation in 2017, would remain screened out for HRA purposes.

6.2.2 Outer Thames Estuary SPA

The Outer Thames Estuary SPA was originally classified in August 2010, solely for Red Throated Diver (RTD)[14]. Following consultation in 2016, the site was amended in 2017, effectively increasing the area designated and including two new species, common tern and little tern. The Outer Thames Estuary SPA was not identified as relevant to TKOWF during screening of the TK Array or the TK Electrical System. Foraging range for little tern, drawing on Thaxter *et al.,* 2012, is 11km as a maximum, and for

[12] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/641925/hamford-water-consultation-report.pdf
[13] http://publications.naturalengland.org.uk/file/5844175410429952
[14] http://jncc.defra.gov.uk/page-7249

common tern as 30km as a maximum. These ranges are much smaller than the distance between the Outer Thames Estuary SPA and the boundary of TKOWF (being some 97km at its closest point) and it can therefore be concluded that the Outer Thames Estuary SPA, following the update to the citation in 2017, would remain screened out for HRA purposes.

6.2.3 Flamborough and Filey Coast pSPA

The Flamborough and Filey Coast pSPA is effectively a revised and renamed Flamborough and Bempton Cliffs SPA; the latter having been designated at the time of both the TK Array and TK Electrical System HRA. The designated site was screened out of the TK Electrical System HRA, but screened in for two species only for the TK Array. The changes in the designation following that original HRA process are summarised below.

The citation for the Flamborough and Bempton Cliffs SPA at the time of the TK Array HRA confirms the designation for the following[15]:

- During the breeding season: kittiwake (*Rissa tridactyla*), 83,370 pairs, representing at least 2.6% of the breeding Eastern Atlantic population (count as of 1987);
- Assemblage qualification: during the breeding season regularly supports 305,784 individual seabirds including puffin (*Fratercula arctica*), razorbill (*Alca torda*), guillemot (*Uria aalge*), herring gull (*Larus argentatus*), gannet (*Morus bassanus*) and kittiwake (*Rissa tridactyla*).

The revised Flamborough and Filey Coast pSPA is designated for the following[16]:

- Black-legged kittiwake (*Rissa tridactyla*), 44,520 pairs (2008-2011);
- Northern gannet (*Morus bassanus*) 8,469 pairs (2008-2012);
- Common guillemot (*Uria aalge*) 41,607 pairs (2008-2011);
- Razorbill (*Alca torda*) 10,570 pairs (2008-2011); and
- Assemblage qualification: during the breeding season regularly supports 215,750 individual seabirds including black-legged kittiwake, northern gannet, common guillemot, razorbill, northern fulmar (*Fulmarus glacialis*) (2008-2012).

Table 6-1 below summarises those changes with respect to TKOWF.

[15] http://jncc.defra.gov.uk/default.aspx?page=1995
[16] http://publications.naturalengland.org.uk/file/6644233915072512

Table 6-1 Summary of the Change in Site Designation (kittiwake)

Species	Flamborough and Bempton Cliffs SPA	Flamborough and Filey Coast pSPA	Original HRA conclusion	Change
Black-legged kittiwake	During the breeding season 83,370 pairs Assemblage qualification	Migratory species 44,520 pairs 89,041 breeding adults	Screened in for assessment	See comment below
Puffin	Assemblage qualification	Not mentioned	Screened out of assessment	No change
Razorbill	Assemblage qualification	Migratory species 10,570 pairs	Screened out of assessment	No change
Guillemot	Assemblage qualification	Migratory species 41,607 pairs	Screened out of assessment	No change
Herring gull	Assemblage qualification	Not mentioned	Screened out of assessment	No change
Gannet	Assemblage qualification	Migratory species 8,469 pairs	Screened in for assessment	See comment below
Northern fulmar	Not mentioned	Assemblage qualification	Not assessed as not included in the original citation and therefore not subject to screening	See comment below

The three species for which a change is apparent between the original and current citations are discussed in turn below.

6.2.3.1 Black-legged Kittiwake

Black-legged kittiwake, referred to as kittiwake in the original citation, was screened in for assessment within the TK Array HRA process, with the assessment concluding no adverse effect. The change noted above is in relation to the reference population of breeding pairs, which has changed since the original TK Array HRA was undertaken. However, it should also be noted that the TK Array HRA was based on a worst case that included 333 wind turbines – this compares to the 90 wind turbines that are proposed for the TKOWF.

The TK Array HRA assessment undertaken for kittiwake considered the following, as summarised in Table 6-2 below.

Table 6-2 Summary of the Relevance for Black-legged kittiwake

Effect	Conclusion	Comment
Construction: Disturbance and displacement from increased vessel traffic and construction activity	(Paragraph 8.6) Construction activities may create foraging opportunities for gannet and kittiwake and it is therefore predicted there will be no effect on these species from construction activity.	Conclusion of no adverse effect remains valid
Construction: Indirect impacts on prey species from pile driving	(Under paragraph 8.12) The habitat and prey availability for SPA populations will be maintained; no adverse effect on population assemblage is predicted from the construction of TKOWF.	Conclusion of no adverse effect remains valid
Operation: Avoidance and displacement from the TKOWF site	(Paragraph 8.13) Kittiwake are unlikely to be disturbed by the presence of the wind farm site, with no adverse effect concluded under paragraph 8.39.	Conclusion of no adverse effect remains valid
Operation: Barrier effects from presence of the TKOWF	(Paragraph 8.16) There is no evidence at present for the displacement of kittiwake from wind farms and as a result there is little chance of a barrier effect, with no adverse effect concluded under paragraph 8.39.	Conclusion of no adverse effect remains valid
Operation: Direct collision with turbine blades	**TK Array HRA (concluding no adverse effect)** Table 22 (noting that these numbers were based on the original 333 wind turbines and not the 90 now relevant) presented predicted collision mortality in kittiwake (all birds) as being 0.14-0.24% of the breeding population, representing an increase on background mortality of 0.74-1.27%. Table 23 presented the information on collision mortality for adult birds (again based on the originally proposed 333 turbines), being 0.016-0.09% of the population, representing an increase on background mortality of 0.5-0.85%. These calculations were based on an estimated breeding population of 75,234 individuals. The conclusion overall was of no adverse effect. **Change in the reference population and turbine numbers** The current Flamborough and Filey Coast pSPA citation hosts 44,520 pairs of black legged kittiwake, equivalent to 89,041 individual breeding adults, an increase of 13,807 individuals or a 15.5% increase when compared to the estimated breeding population assessed (75,234	Conclusion of no adverse effect remains valid

Effect	Conclusion	Comment
	individuals). The TK Array HRA assessment for kittiwake was based on an assumed 333 turbines, which has subsequently been reduced in the DCO to 288, with the NMC Application further reducing to a maximum of 90 turbines at TKOWF. This results in a 69% reduction in turbine numbers from the 288 consented in the DCO and a 73% reduction in turbine numbers when compared to that assessed in the TK Array HRA. It would be reasonable to consider that although the reference population has slightly increased (by approximately 15.5%), as the potential for effect has significantly decreased following the reduction in turbine numbers (by some 73%), that the potential for effect overall has also significantly decreased. Further, the percentages above, as presented in the Array HRA (based on 333 turbines), were based on significantly higher collision numbers than those presented in the revised 2016 Ornithology Sensitivity Review described above (based on 288 turbines and as agreed with Natural England) – for example, the TK Array HRA presented total numbers of adult collision birds at risk of collision as 71-121 (and for all birds being 107-182); the revised and agreed numbers in the 2016 report are much reduced at 3.3 (breeding) and 14 (migration). The reduction in numbers resulted from the reduction in turbine numbers (333 to 288) and revised avoidance rates. Paragraph 8.23 of the TK Array HRA concluded that the predicted increase in background mortality (based on the predictions in the TK Array HRA and not the revised and accepted smaller increase from the Ornithology Sensitivity Review, which in itself was based on 288 turbines) indicates there will be no adverse effect on the SPA population. **Subsequent assessments in-combination with TKOWF** It should be noted that subsequent assessments have been made in-combination, with respect to the Flamborough and Filey Coast pSPA (e.g. East Anglia THREE[17]), that have incorporated the revised site designation and population numbers together with TKOWF.	

[17] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010056/EN010056-000553-5.4%20Habitats%20Regulation%20Assessment%20Report.pdf

Effect	Conclusion	Comment
	The assessment found in paragraph 431 '*The number of predicted in-combination kittiwake collisions attributed to the Flamborough & Filey Coast pSPA remains below the sustainable levels estimated using PBR and on the basis of population modelling (MacArthur Green 2015d) is not at a level which would trigger a risk of significant population decline. The impact on the Flamborough and Filey Coast pSPA kittiwake population resulting from in-combination collisions is below the thresholds of concern proposed for recently consented developments…Therefore it can be concluded that there would be no adverse effect on the integrity of Flamborough & Filey Coast pSPA from impacts on kittiwake due to the proposed East Anglia THREE project in-combination with other projects.*' The conclusion was accepted by the Secretary of State in the Appropriate Assessment in paragraph 6.64[18]. **Overall conclusion** The combination of recent findings, together with the significant reduction in wind turbine numbers from that originally assessed in the TK Array HRA, results in the conclusion that, despite the change in population numbers, the existing conclusion of no adverse effect remains valid.	
Decommissioning: the same as during construction, without disturbance from piling	Therefore the existing conclusion of no adverse effect remains valid.	Conclusion of no adverse effect remains valid

[18] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010056/EN010056-002381-East%20Anglia%20THREE%20Habitats%20Regulations%20Assessment%20Dated%207%20August%202017.pdf

6.2.3.2 Gannet

The seabird assemblage of the Flamborough and Bempton Cliffs SPA, which included gannet as a named species, was screened in for assessment within the TK Array HRA process. The assessment concluded no adverse effect. The change noted above, with respect to the citation now termed the Flamborough and Filey Coast pSPA, results from gannet now being included as a qualifying species in its own right, with a reference population of 8,469 pairs identified in the citation (2008-2012)[19]. The original assessment within the TK Array HRA (Table 19) was based on an estimated breeding population of 16,408 individuals. The difference in population number originally assessed compared to that now within the designated site is a change from 16,408 individuals (assessed) to 8,469 pairs within the citation, which can be equated to 16,938 individuals, an increase in population of just 530 individuals, representing an approximate 3% increase in the population as assessed.

The TK Array HRA assessment undertaken for gannet considered the following, as summarised in Table 6-3 below.

[19] http://publications.naturalengland.org.uk/file/6644233915072512

Table 6-3 Summary of the Change in Site Designation (gannet)

Effect	Conclusions	Comment
Construction: Disturbance and displacement from increased vessel traffic and construction activity	(Paragraph 8.6) Construction activities may create foraging opportunities for gannet and kittiwake and it is therefore predicted there will be no effect on these species from construction activity.	Conclusion of no adverse effect remains valid
Construction: Indirect impacts on prey species from pile driving	(Under paragraph 8.12) The habitat and prey availability for SPA populations will be maintained; no adverse effect on population assemblage is predicted from the construction of TKOWF.	Conclusion of no adverse effect remains valid
Operation: Avoidance and displacement from the TKOWF site	(Paragraph 8.14) A large proportion of gannet were observed foraging within the site during surveys highlighting the potential for displacement, however, due to the flexibility of habitat use by this species, the main effect from operation is likely to be collision risk related.	Conclusion of no adverse effect remains valid
Operation: Barrier effects from presence of the TKOWF	(Paragraph 8.16) There is little chance of a barrier effect.	Conclusion of no adverse effect remains valid
Operation: Direct collision with turbine blades	**TK Array HRA (concluding no adverse effect)** Table 22 (noting that these numbers were based on the original 333 wind turbines and not the reduced 288) presented predicted collision mortality in gannet (all birds) as being 0.53-0.9% of the breeding population, representing an increase on background mortality of 8.8-14.7%. Table 23 presented the information on collision mortality for adult birds (again based on the originally proposed 333 turbines), being 0.37-0.63% of the population, representing an increase on background mortality of 6.09-10.46%. **Change in the reference population and turbine numbers** These estimates within the TK Array HRA were based on an estimated breeding population of 16,408 individuals. As noted above, the current citation hosts 16,938 individuals, an increase in population of 530 individuals, or approximately 3% more that the population as assessed. However, the TK Array HRA assessment for gannet was based on an assumed 333 turbines, although this has	Conclusion of no adverse effect remains valid

Effect	Conclusions	Comment
	subsequently been reduced in the DCO to 288, with the NMC amending that further to 90 as a maximum – the NMC is a 69% reduction in turbine numbers on the 288 in the DCO and a 73% reduction in turbine numbers compared to that assessed in the TK Array HRA. It would therefore be reasonable to consider that although the reference population has slightly increased (by approximately 3%), as the potential for effect has significantly decreased following the reduction in turbine numbers (by some 73%), that the potential for effect overall has also significantly decreased. Although the proportion of the gannet population that may be affected by collision was found to be below 1%, further assessment was undertaken in the TK Array HRA to determine if a 10% increase in background mortality would have a population level effect, using population biological removal (PBR) calculations. The PBR was found to be 4.4%, which effectively indicates that up 4.4% of the population can be removed without the carrying capacity of the population being affected. Given than the 333 wind turbines predicted a removal of 0.63% of the population, it was concluded that TKOWF would not have an adverse effect on the gannet population (paragraph 8.37). Despite the above conclusion, a reduction in turbine array from 333 to 288 was considered in the TK Array HRA, as a means of reducing the background mortality of gannet to below 10%; the reduction in the array was found (paragraph 8.39) to further reduce collision mortality. Further, the percentages above were based on significantly higher collision numbers than those presented in the Ornithology Sensitivity Report 2016 report described above (and as agreed with Natural England) – for example, the TK Array HRA presented total numbers of adult collision birds at risk of collision as 60-103 (and for all birds being 87-149); this compares to the much reduced 27 (breeding) and 4 (migration) in the 2016 report. **Subsequent assessments in-combination with TKOWF** As for kittiwake above, it should be noted that subsequent assessments have been made in-combination, with respect to the Flamborough and Filey Coast pSPA (e.g. East Anglia THREE[20]), that	

[20] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010056/EN010056-000553-5.4%20Habitats%20Regulation%20Assessment%20Report.pdf

Effect	Conclusions	Comment
	have incorporated the revised site designation and population numbers. The assessment found, in Section 3.5.42, that the in-combination mortality in all individuals (including the in-combination effect from TKOWF) and apportioned to the Flamborough and Filey Coast pSPA remained 'clearly well below both the previously accepted, and the revised PBR thresholds (paragraph 395)'. The document concluded in paragraph 396 that 'there will be no adverse effect on the integrity of Flamborough and Filey Coast pSPA as a result of gannet collisions'. The conclusion was accepted by the Secretary of State in the Appropriate Assessment in paragraph 6.39[21]. **Overall conclusion** The combination of recent findings, together with the significant reduction in wind turbine numbers from that originally assessed in the TK Array HRA, results in the conclusion that, despite the small change in population numbers, the existing conclusion of no adverse effect remains valid.	
Decommissioning: the same as during construction, without disturbance from piling	Therefore the existing conclusion of no adverse effect remains valid.	Conclusion of no adverse effect remains valid

[21] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010056/EN010056-002381-East%20Anglia%20THREE%20Habitats%20Regulations%20Assessment%20Dated%207%20August%202017.pdf

6.2.3.3 Northern Fulmar

Fulmar did not form part of the original TK Array HRA, as the species was not listed in the citation at that time. The revised citation does, however, include fulmar, as part of the wider assemblage (given as 215,750 for all species, 2008-2012). Although the TK Array HRA did not assess the potential for effect on fulmar, the Environmental Statement (Volume 2: Chapter 6 – Ornithology) did. Paragraph 6.40 found that fulmar were seen throughout the year in both years of site specific survey, although very few birds (0.23%) were observed foraging, suggesting most birds ranged through the site. A summary of the assessment conclusions is provided in Table 6-4 below.

Table 6-4 Summary of the Change in Site Designation (northern fulmar)

Effect	Effect	Comment
Construction: potential disturbance due to increased boat traffic	Fulmar are highly mobile foragers that spend a significant proportions of time in flight and hence all are considered to have low or negligible vulnerability to disturbance by boat traffic. Consequently, the impact significance of localised vessel activity was predicted to be minor or negligible.	Conclusion of not significant remains valid
Construction: potential disturbance due to construction activity	Opportunistic scavenging species such as fulmar may benefit from foraging opportunities created by construction works. As such, the significance of the potential impact on fulmar was assessed as minor or negligible.	Conclusion of not significant remains valid
Potential indirect impacts (pile driving effect on fish prey species)	Fulmar show flexibility with respect to foraging area (and have a varied diet). Omnivorous species in particular that do not entirely rely on fish in their diet may be insensitive to the temporary displacement of fish even should this occur. In conjunction with the characteristics of piling, it was considered that the indirect effects on prey were of negligible magnitude and hence minor or negligible significance.	Conclusion of not significant remains valid
Operation: disturbance due to maintenance activity	Disturbance of birds resulting from maintenance vessel activity around turbines is likely to be similar in scope to that in relation to the construction phase. Whilst associated maintenance and vessel activity will be permanent (for the lifetime of the wind farm), it will be at significantly lower intensity than during construction.	Conclusion of not significant remains valid
Operation: avoidance and displacement from the wind farm site	It is not expected that fulmar will completely avoid the operational wind farm area. It is generally tolerant of human activity and their low flight height implies that they will continue to use the site to some extent. Whilst some birds recorded at the wind farm site may relate to the breeding population of Hunstanton Cliffs SSSI, the peaks in abundance outside of the breeding period strongly suggest the site is mainly used by the large, secure wider population in the UK. Outside of the breeding season Fulmar wander over large distances across the North Sea and their reliance on the proposed wind farm site is considered to be low. On this basis, the magnitude of avoidance and displacement is considered to be negligible and the potential impact is assessed as minor significance.	Conclusion of not significant remains valid
Operation: barrier effects	There is no evidence that the TKOWF site lies on a regular flight path of birds, such as waterfowl, that might be prevented from accessing foraging or roosting habitat. The boat-based and aerial survey data indicated the presence of significant numbers of birds	Conclusion of not significant remains valid

Effect	Effect	Comment
	moving through this part of the Greater Wash during dispersal and migration, particularly during the autumn. It is likely that all of these species are moving across a relatively broad front (compared to the proposed wind farm footprint) and that TKOWF is unlikely to present a significant barrier to this type of movement. In the event that migrating birds deviate from their flight path to avoid the wind farm, the additional movement will represent a negligible increase in overall flight distances and is unlikely to result in any additional energetic cost (Masden et al. 2009). It is clear that many of the passage species observed at the TKOWF site, including fulmar, little gull, guillemot, razorbill, puffin, sooty shearwater, Arctic skua, and common tern forage as they move through the region. In some cases, such as gulls, it is expected that birds will continue to pass through the wind farm area in any case. The magnitude of any barrier effect on these species was, therefore, considered to be negligible implying an impact of minor significance for fulmar.	
Operation: direct collision of birds with turbines	Table 6.12 summarises the predicted annual collisions at the TKOWF site (based on 333 turbines) in terms of individuals. For fulmar, numbers were provided for the Flamborough Head and Bempton Cliffs SPA, being 7 predicted collisions per annum (from a total of 8 per annum). The majority of fulmars recorded during surveys were observed to fly below rotor height and as a consequence few collisions were predicted for this species. The magnitude of the collision risk on the east coast passage population is considered to be negligible and hence an impact of negligible significance is predicted. Table 6.15 summarised the cumulative assessment during construction, which for fulmar was found to be of minor significance, and the operational effects in table 6.17, which were at most moderate but tolerable. The cumulative collision risk for fulmar (all and therefore not limited to the SPA population) was found to be 17 collisions per annum. It was considered that this represents a negligible proportion of the potential east coast passage population and the magnitude of this cumulative impact is considered to be negligible, implying an impact of minor significance.	Conclusion of not significant remains valid

From the above, which was based on an assumed 333 turbines and not the 90 turbines that the TKOWF will comprise (as reflected within the NMC application) it is clear that the potential for impact on fulmar in general was not significant, and the potential for collision risk with fulmar linked to the SPA to be low. It is therefore reasonable to conclude, given the significant reduction in turbine numbers from the original assessment (i.e. a reduction from 333 to 90 turbines, a 73% reduction), that the risk posed by TKOWF is now considerably less than it was at the time of writing the TK Array ES, when a negligible to minor significance was concluded for the project alone The above therefore does not raise concerns for the species, even when linked to a designated site.

7 CONCLUSION

From the summaries presented within this report, it is clear that all relevant Natura 2000 sites have been considered through one or more of the following routes:

- Within HRA assessments completed by the applicant, as informing the subsequent AA completed by the Appropriate Authority; and/or
- Within shadow HRA or Reports to Inform Appropriate Assessments produced by TKOWFL; and/or
- Within the current Consolidated Screening Review of Potential Impacts on Natura 2000 Sites, which presents a re-assessment for sites where changes have occurred (extent and/or features) following initial assessment to check and confirm that existing conclusions remain valid.

The TKOWF project reports referred to in this report, on which the current Consolidated Screening Review of Potential Impacts on Natura 2000 Sites report is based have been consulted upon with relevant Statutory Nature Conservation Bodies. All of the proposed changes to the TKOWF Project design parameters for the NMC Application relate to reductions, principally in the number of structures and associated activities, and this is considered to apply across all phases of TKOWF: construction; operation and maintenance; and decommissioning works. Consideration of the reduced TKOWF Project, as presented above, illustrates attendant reductions in the magnitude of impacts and, a consequential no change (i.e. no increase) finding in the significance of any of the potential effects on any of the previously assessed Natura 2000 sites.

8 REFERENCES

RWE Npower Renewables Ltd (2012). Triton Knoll Offshore Wind Farm: Report to Inform the Habitats Regulations Assessment.

RWE Npower Renewables Ltd (2015). Triton Knoll Electrical System: Report to Inform Appropriate Assessment.

Triton Knoll Offshore Wind Farm Limited (2018). Triton Knoll Offshore Wind Farm: Southern North Sea candidate Special Area of Conservation (SNS cSAC) Report to Inform Appropriate Assessment.

Triton Knoll Offshore Wind Farm Limited (2017). Triton Knoll Offshore Wind Farm: Greater Wash pSPA Shadow Habitats Regulations Assessment.

APPENDIX I

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Triton Knoll Offshore Wind Farm

Greater Wash pSPA

Shadow Habitats Regulations Assessment

Date: July 2017
Author: MacArthur Green
Revision: Final
Document Management System Number: 2505-TKN-CON-K-RA-0011

Revision and Approvals

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0.2	14.04.2017	Minor revisions	MacArthur Green	RS;TG	TG
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1. Executive Summary

1.1.1. This report provides an assessment of the potential for impacts on the features of the Greater Wash proposed Special Protection Area (pSPA) as a result of the construction, operation and decommissioning of the Triton Knoll Offshore Wind Farm (TKOWF) acting both alone and in-combination with other offshore wind farm developments with the potential for connectivity. It should be noted that TKOWF is located wholly outside the boundaries of the pSPA and so this assessment has been based on precautionary assumptions about the likelihood of connectivity between the features of the pSPA, in line with advice received from Natural England in response to TKOWF's consultation response on the pSPA.

1.1.2. TKOWF has progressed through planning in two stages; the offshore array, which was granted consent on 11 July 2013, and Triton Knoll Electrical System (TKES), which was granted consent on 3 September 2016. This report focuses only on relevant aspects of the TKOWF array rather than TKES as the consent awarded to the array pre-dated the identification of the pSPA, whereas TKES undertook assessment of potential implications for the pSPA as part of the application and consenting process for the DCO. Additionally, the assessment considers solely the Greater Wash pSPA with respect to the consented TKOWF development as all other Natura 2000 sites have been previously considered and, where relevant, subject to Appropriate Assessment by the relevant Competent Authority as part of the consenting process under the Planning Act (2008).

1.1.3. This assessment considers each of the qualifying ornithological interests for the Greater Wash pSPA, with little gull and red throated diver representing the only species for which the potential for a Likely Significant Effect (LSE) could not be ruled out. For little gull this finding was made on the basis of collision risk during operation due to both the project alone and in-combination with other offshore wind farms, with the finding for red-throated diver made on a precautionary basis in relation to potential displacement effects from the TKOWF area and surrounding buffer, both alone and in-combination with other offshore wind farms.

1.1.4. Assessment of the collision risk for little gull included the application of updated reported estimates for the small gull avoidance rate from 98% to 99.2% (Cook *et al.* 2014) and consideration of reduced numbers of turbines from consented through to built or planned projects in line with detailed design work undertaken by projects post-consent.

1.1.5. Following an evidence based review of information on little gull populations and movements, the magnitude of mortality for little gull predicted to affect the pSPA population was found to be very small; with a project alone estimated annual mortality of less than one individual and an in-combination estimated annual mortality of four individuals. It can therefore be concluded that this level of additional mortality would be undetectable against the pSPA population and hence no Adverse Effect on Integrity (AEoI) was assessed for the Greater Wash pSPA due to collision mortality at the TKOWF alone or in-combination with other wind farms.

1.1.6. In respect of the potential LSE for red-throated diver, the maximum estimated population in TKOWF and buffer was 15 individuals against a Greater Wash pSPA designated population size of 1,511. The addition of up to 15 individuals due to displacement from TKOWF and buffer would therefore increase the population within the pSPA by up to 1%. The low level of population density increase was also considered in the context of available evidence that suggests red-throated divers are unlikely to be affected by density-dependent competition for resources during the non-breeding period (Dierschke *et al.* 2017). It was concluded that the potential increase in population density within the Greater Wash pSPA would be undetectable against the baseline, and that owing to the very small scale of this impact from TKOWF, this conclusion also applies to the potential for an in-combination effect. Therefore, no AEoI of the Greater Wash pSPA as a result of displacement from TKOWF alone or in-combination would occur.

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2. Introduction

2.1. Purpose of the report

2.1.1. This document has been prepared to provide information in the form of a shadow Habitats Regulations Assessment (HRA) for the consented Triton Knoll Offshore Wind Farm (TKOWF) and the associated consented Triton Knoll Electrical System (TKES) (collectively 'the Project') to inform a potential review of consents process to be undertaken for the Greater Wash proposed Special Protection Area (pSPA). This shadow HRA focuses solely upon the Greater Wash pSPA site as all other relevant Natura 2000 sites were considered in detail as part of the Development Consent Order (DCO) process for the Project, with associated HRAs completed by the Competent Authority and published at the time of consent for the projects (DECC, 2013; DBEIS, 2016). For both the array and the electrical system assessments, the findings were that with mitigation in place, the proposed developments would not have an adverse effect on site integrity on any European site either alone or in combination with other plans or projects. Full details of the determinations made by the Competent Authority in respect of the Natura 2000 sites, features and HRA process undertaken for are provided in DECC (2013) and DBEIS (2016) for the TKOWF and TKES respectively.

2.1.2. This shadow HRA provides information relevant only to the offshore wind farm array, rather than including details of the Electrical System component of the project since TKES was granted consent in 2016 and so an assessment of the potential implications of the pSPA was undertaken as part of the application for TKES. As part of the EIA Evidence Plan process for TKES (EIA Evidence Plan (Doc Ref 8.16) Annex A-006-30-05-14) it was determined that there would be no likely significant effect on the future Greater Wash SPA either alone or in-combination from any of the construction, operation or decommissioning activities associated with the export cable works. This conclusion was made on the basis of the information provided in the EIA Evidence Plan (Application Document 8.16), the red throated diver annex Volume 4, Annex 3.1), and Natural England confirmed in an email dated 07 July 2014 that the proposed development avoids any hotspots identified off the Lincolnshire coast, as well as any areas to the north east of The Wash.

2.1.3. This document therefore provides an assessment of the potential for Likely Significant Effects (LSE) to occur on the proposed features of the Greater Wash pSPA as a consequence of the development of Triton Knoll Offshore Wind Farm (TKOWF) array, both alone and in-combination with other offshore windfarm developments in the region.

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2.2. Project Background

2.2.1. The Triton Knoll offshore array is located approximately 32 km off the Lincolnshire coast and 50 km from the North Norfolk coast, with the export cable landfall located at Anderby Creek on the Lincolnshire coast (Figure 2-1). The footprint of the development area is approximately 135 km².

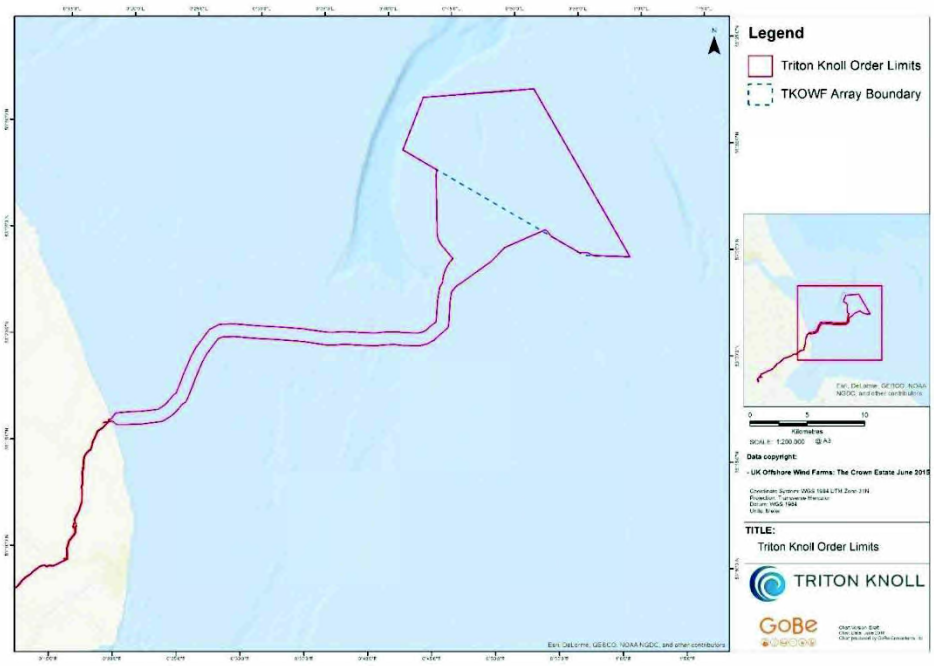

Figure 2-1. Triton Knoll Offshore Wind Farm and Order limits including cable corridor.

2.2.2. The consent application for TKOWF was submitted to the Planning Inspectorate in January 2012 and for TKES in April 2015. The offshore array was awarded consent on 11 July 2013, with the TKES (which includes the offshore cable route) consented on 3 September 2016.

2.2.3. The development consent for TKOWF allows for up to 288 wind turbines fixed to the seabed by one of five foundation types (monopole, jacket, tripod, suction bucket monopod and gravity base), to provide an installed capacity of up to 1,200 MW. However, in January 2014 following detailed technical and commercial optimisation studies undertaken by TKOWFL, together with discussion with The Crown Estate, it was decided to reduce the overall generating capacity of the scheme to a maximum of 900 MW. This is considered to make better use of the site within the TKOWF consented boundary. The consent application for TKOWF also includes for up to four offshore collector stations, up to two meteorological masts and a network of underground cables between the offshore elements of the development.

2.2.4. TKOWF lies wholly outside the Greater Wash pSPA, with the inshore boundary of TKOWF located approximately 5-10 km from the outer boundary of the Greater Wash pSPA.

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2.3. Overview of relevant aspects and features of the Greater Wash pSPA

2.3.1. The Greater Wash pSPA (Natural England and JNCC 2016) is located in the mid-southern North Sea between Bridlington Bay in the north and the Outer Thames Estuary SPA in the south (Figure 2.2). To the north, seabed habitats primarily comprise coarse sediments, with occasional areas of sand, mud and mixed sediments. Subtidal sandbanks occur at the mouth of the Humber Estuary, primarily comprising sand and coarse sediments. Offshore, soft sediments dominate with extensive areas of subtidal sandbanks off The Wash and north and east Norfolk coasts. Closer inshore at The Wash, sediments comprise a mosaic of sand, muddy sand, mixed sediments and coarse sediments, as well as occasional *Sabellaria* reefs. Close to shore along the north Norfolk Coast seabed habitats are primarily intertidal mudflats composed of sand and mud, with occasional mussel bed reefs.

2.3.2. The landward boundary of the Greater Wash pSPA covers the coastline from Bridlington Bay in the north (at the village of Barmston), to the existing boundary of the Outer Thames Estuary SPA in the south. The seaward boundary lies approximately 14 nautical miles (26km) from the shore at its furthest extent and is determined by the distribution of red-throated diver along the length of the pSPA, with a small length off the north Norfolk Coast determined by the area used by foraging Sandwich terns. The pSPA covers an area of 3,443 km2.

2.3.3. Qualifying ornithological interests for the Greater Wash pSPA are:

- Sandwich tern (colony counts 2010-2014 of 3,852 breeding pairs);
- Common tern (colony counts 2010-2014 of 510 breeding pairs);
- Little tern (colony counts 2009-2013 of 798 breeding pairs);
- Red-throated diver (mean peak count 2002-03 to 2005-06 of 1,511 non-breeding birds);
- Common scoter (mean peak count 2002-03 to 2007-08 of 3,463 non-breeding birds); and
- Little gull (mean peak count 2004-05 to 2005-06 of 1,303 non-breeding birds).

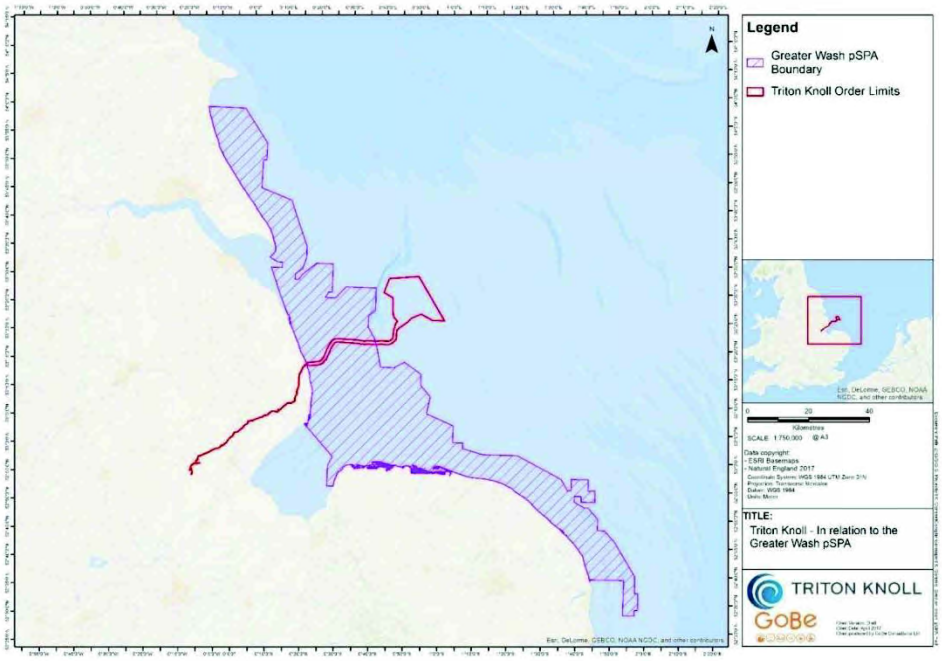

Figure 2-2. Greater Wash proposed Special Protection Area.

2.4. Need for the Shadow HRA

2.4.1. Natural England is responsible for recommending SPAs in English waters out to 12 nautical miles to the Department for Environment Food and Rural Affairs (Defra) for classification. As part of this role, Natural England is currently recommending the designation of the Greater Wash pSPA.

2.4.2. As part of the process for site designation, consultation has been undertaken on the Greater Wash pSPA site, which closed on the 18 January 2017. It is understood that the results of this consultation will be submitted as a report to the Secretary of State (SoS) for the Environment Food and Rural Affairs. Following consideration of the report by the SoS, a decision will be made as to whether the site should be classified and if designated, documentation will be sent in support of this classification to the European Commission.

2.4.3. As stated previously, TKES considered potential implications arising from the development with respect to the potential for the Greater Wash pSPA to be brought forward as part of the DCO process, however, the DCO application for TKOWF pre-dated the initial identification of the Greater Wash pSPA site. If designated, a review of consents will be required to be undertaken by the SoS for Business, Energy and Industrial Strategy (BEIS). The review of consents will be completed to ensure an informed understanding of the potential risks to the conservation objectives of the new site and its features arising from developments that have not yet been considered with respect to the site features and overall site integrity is achieved. To this end, this shadow HRA has been completed to inform that process with respect to the consented TKOWF.

2.4.4. The process followed in this shadow HRA for the Greater Wash pSPA in relation to TKOWF comprises the following steps:

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- Screening of features to establish potential for LSE and a summary of potential for connectivity between the TKOWF and the Greater Wash pSPA;
- Assessment of features taken through following LSE/no LSE screening; and
- Conclusions

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3. Screening: Relevant Features of the Greater Wash pSPA

3.1. Sandwich tern

3.1.1. Within the Greater Wash pSPA, Sandwich terns breed at coastal colonies on the north Norfolk coast at Scolt Head and Blakeney Point.

3.1.2. Thaxter *et al.* (2012) reviewed existing tracking data to determine the mean maximum foraging range of breeding Sandwich terns as 49km from the colony. Boat-based visual tracking of breeding birds from these colonies was used to define the outer boundary of the Greater Wash pSPA in this area (Wilson *et al.* 2013, Natural England and JNCC 2016), with few Sandwich terns foraging more than 12 nm (22km) from the two north Norfolk colonies (Win *et al.* 2013).

3.1.3. On the basis of these colony-specific tracking data, the Departmental Brief included in the consultation documents for the Greater Wash pSPA stated *"Areas of sea which are distant to the colony are predicted to have very little or no usage by foraging terns"* (Natural England and JNCC 2016).

3.1.4. TKOWF lies more than 46km from the two north Norfolk colonies. During surveys undertaken as part of the Environmental Impact Assessment (EIA) for TKOWF, Sandwich terns were observed at TKOWF from April to August (Triton Knoll Offshore Wind Farm Limited 2011). Sandwich tern numbers were seen to peak at 77 individuals in August and were attributed to autumn migration. Sandwich tern numbers during the main breeding season reached a maxima of 34 individuals in 2009 and 17 individuals in 2008, however the mean number present across the breeding season was around 10 birds (Triton Knoll Offshore Wind Farm Limited 2011). Hence, in relation to the total size of the Sandwich tern colonies within the pSPA (3,852 breeding pairs) the number of birds recorded at TKOWF is very small; this is consistent with the results in Thaxter *et al.,* (2012) which indicated that TKOWF is at the limit of foraging range of breeding Sandwich terns.

3.1.5. It can therefore be concluded with a high degree of confidence that TKOWF will have no LSE in relation to Sandwich terns in the Greater Wash pSPA during any phase of the development, and will contribute little or nothing to any potential in-combination impacts.

3.2. Common tern

3.2.1. The mean maximum foraging range of breeding common terns from the Greater Wash pSPA was assessed as 15.2km (Thaxter *et al.* 2012). Within the pSPA, common terns breed at Breydon Water, Scroby Sands and at several sites on north Norfolk coast. Boat-based tracking at these colonies identified colony-specific foraging ranges of 10km from Blakeney Point, 10km from Scolt Head, and 13km from Breydon Water (Wilson *et al.* 2013, Win *et al.* 2013); consistent with the mean figure of 15.2km identified previously by Thaxter *et al.* (2012).

3.2.2. During surveys undertaken as part of the EIA for TKOWF, common terns were mostly seen at TKOWF in August in small numbers only and were entirely absent in the early part of the main breeding season (April to early July), thereby implying that these birds were migrants rather than commuting from local colonies (Triton Knoll Offshore Wind Farm Limited 2011). TKOWF is located more than 35km from the nearest common tern colony and so well beyond the foraging range of breeding common terns; this is consistent with the results in Thaxter *et al.* (2012).

3.2.3. It can therefore be concluded that TKOWF will have no LSE in relation to common terns in the Greater Wash pSPA during any phase of the development, either alone or in-combination.

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3.3. Little tern

3.3.1. The mean maximum foraging range of breeding little terns from the Greater Wash pSPA was assessed as 6.3km (Thaxter *et al*. 2012). TKOWF lies more than 35km from the nearest little tern colony and therefore any connectivity of TKOWF with breeding birds can be ruled out.

3.3.2. Little terns are predominantly coastal in their ecology and tend to avoid crossing open sea except when unavoidable during migration. This is in line with survey work carried out at TKOWF to inform the EIA, during which no little terns were observed at TKOWF (Triton Knoll Offshore Wind Farm Limited 2011).

3.3.3. It can therefore be concluded that TKOWF will have no LSE in relation to little terns in the Greater Wash pSPA during any phase of the development, either alone or in-combination.

3.4. Red-throated diver

3.4.1. Mapping of red-throated diver distribution within the Greater Wash pSPA is presented within the Departmental Brief for the Greater Wash pSPA consultation. These data showed a strong decrease in red-throated diver abundance with distance from the shore and resulted in the outer boundary of the Greater Wash pSPA being defined by a rapid decrease in red-throated diver density around 12nm (22km) from shore (Natural England and JNCC 2016).

3.4.2. This is consistent with the low numbers of red-throated divers reported in surveys at TKOWF, with the median number of red-throated divers recorded within TKOWF and a surrounding buffer during winter of only 1 individual (Triton Knoll Offshore Wind Farm Limited 2011). The maximum total number of red-throated divers within TKOWF and the surrounding buffer was estimated to be 15 individuals recorded during spring (Triton Knoll Offshore Wind Farm Limited 2011).

3.4.3. Although there is no evidence-based estimate of red-throated diver avoidance rates at offshore wind farms, the avoidance rate of this species at terrestrial wind farms is estimated to be 0.995 (Furness 2015). Red-throated divers at sea tend to fly relatively little, spending most of their time on the sea surface. When flying, only an estimated 6% of flight is at collision risk heights (Johnston *et al*. 2014). The low flight activity combined with the low proportion of flight at collision risk height and the scarcity of red-throated divers in TKOWF surveys therefore means that this species can be discounted in relation to potential collision impacts from TKOWF.

3.4.4. Red-throated divers are highly sensitive to disturbance (Furness *et al*. 2013) and hence cable laying and boat traffic associated with TKOWF may disturb and displace divers from along the cable and construction shipping routes. This potential impact was considered as part of the application for TKES (RWE Innogy UK 2015) and included consideration of vessel disturbance occurring within the boundaries of the pSPA. However, even with this direct spatial overlap, the assessment concluded that there would be no LSE on red-throated divers due to construction or boat traffic associated with TKOWF as the numbers of red-throated divers recorded along the cable and shipping route were assessed as very low. This conclusion was accepted by Natural England (Natural England 2016) as part of the examination for TKES.

3.4.5. The TKOWF boundary is 6km from the Greater Wash pSPA boundary at its closest point and given the very small numbers of red-throated divers that were recorded at TKOWF, the likelihood of a displacement impact due to TKOWF at the population level would be expected to be very small. However, following advice from Natural England, a precautionary approach has been adopted by TKOWFL and the potential for a LSE due to displacement from TKOWF and a surrounding buffer has not been ruled out.

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3.5. Common scoter

3.5.1. Common scoters tend to fly low over the sea and so are at a relatively low risk of collision. Based on previously published literature, Furness *et al.* (2013) estimated that only 3% of common scoter flight activity occurs at collision risk heights in the offshore environment and based on boat survey data acquired from many sites, Johnston *et al.* (2014) calculated that only 1.9% of common scoter flight activity occurs at collision risk heights in the offshore environment.

3.5.2. However, common scoters are particularly sensitive to disturbance and displacement (Furness *et al.* 2013), especially by construction-related and maintenance boat traffic. Common scoters are a non-breeding season feature of the Greater Wash pSPA, arriving in autumn, remaining in the area through winter, and departing to higher latitude breeding areas in spring. Common scoters feed on benthic invertebrates, and so tend to occur in flocks over suitable shallow sea foraging habitat. Within the Greater Wash pSPA, common scoters are concentrated in a small area close to the southern coast of Lincolnshire and spanning across the mouth of the Wash to the north-western coast of Norfolk (Natural England and JNCC 2016); all of this concentration of common scoters lies within 7nm (13km) of the coast. Indeed, survey data used in the designation of the Greater Wash pSPA noted negligible numbers of common scoters more than 12nm (22km) from the coast (Natural England and JNCC 2016), although migration across the North Sea means that common scoter must pass offshore wind farm sites at least during autumn and spring migrations.

3.5.3. Boat traffic from harbours to TKOWF will pass through Greater Wash pSPA and so will potentially contribute to disturbance and displacement of common scoters from the site. However, the volume of boat traffic associated with TKOWF will be minimal in relation to existing traffic and furthermore, this traffic is unlikely to pass through the small area where common scoters aggregate.

3.5.4. It can therefore be concluded that TKOWF will have no LSE in relation to common scoters in the Greater Wash pSPA during any phase of the development, either alone or in-combination.

3.6. Little gull

3.6.1. It should be noted that the recent Hornsea Project Two OWF HRA assessment (SMart Wind Ltd 2015) concluded no potential for LSE in relation to the Greater Wash pSPA little gull feature for in-combination impacts (including TKOWF), and this conclusion was accepted by both Natural England and the Planning Inspectorate. The agreed position as presented in the Hornsea Project Two HRA assessment is therefore re-iterated below.

3.6.2. Little gull is a species for which very little is known. The main breeding population is located in central Asia but extends to western Europe where it has been increasing in numbers in recent decades. BirdLife International (2004) suggest that about 24,000 to 58,000 pairs breed in Europe and that this represents 25 to 49% of the global population; thereby implying a global population of 49,000 to 232,000 pairs.

3.6.3. Considerably increasing numbers of little gull pass through UK waters on migration, perhaps reflecting a more westerly migration route developing in this species as well as increasing breeding numbers particularly in Finland (del Hoyo *et al.* 1996; Brown and Grice 2005). Musgrove *et al.* (2013) and BTO BirdFacts were unable to give an estimate of numbers occurring in the UK, but Skov *et al.* (2007) estimated that 5,400 birds winter in the North Sea (although this represents only a small fraction of the numbers passing though on migration). Brown and Grice (2005) report that the little gull is most numerous in English waters during spring and autumn migration and that *"numbers passing through England have increased enormously since the 1950s"*. Brown and Grice (2005) report also that *"outside the breeding season, little gulls are largely coastal"*. Large numbers of little gull may therefore occur on passage. For example, 4,100 were seen at

Flamborough Head on 21 September 1995, 5,413 passed Flamborough Head between 24 September and 7 October 1982 (Brown and Grice 2005), and 10,000 were seen off Spurn on 11 September 2003 (Hartley 2004). The species is recorded along the entire English coastline in autumn, winter and spring, with largest counts in autumn and often associated with onshore gales (Balmer *et al.* 2013).

3.6.4. The population of little gull in the Greater Wash pSPA in winter was estimated at 1,303, however the population in the Area of Search was 2,153 (mean of peak counts in the winter period for 2004-05 and 2005-06; Natural England and JNCC 2016).

3.6.5. The little gull population estimates are highly uncertain for several reasons. Firstly, little gull counts were made in late October or November. However, little gull numbers peak in autumn, with relatively few birds remaining in the North Sea during winter (Brown and Grice 2005, Skov *et al.* 2007). This is clearly demonstrated by the Trektellen data (downloaded from trektellen web page) which show that numbers of little gulls seen at UK North Sea sea-watching sites (which are mostly in areas from Yorkshire to Kent and therefore highly relevant here) reported about 5 times as many little gulls in September as in late October or November (Figure 1).

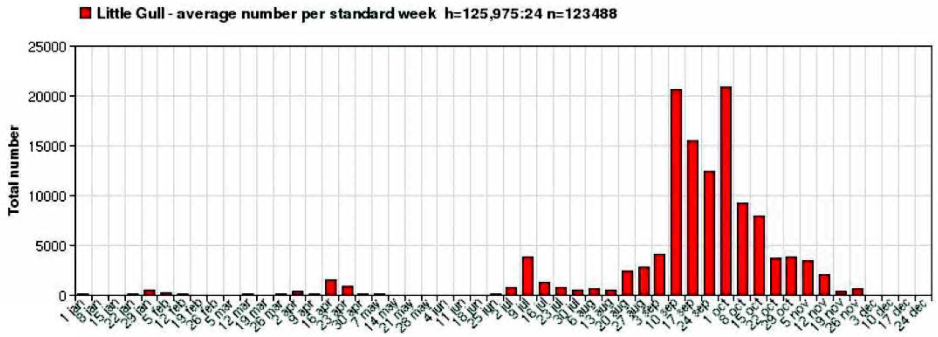

Figure 1. Counts of little gulls seen from sea watching vantage points on the east coast of England. Data from the Trektellen web page, summed for all years and sites.

3.6.6. Therefore, numbers of little gulls within the pSPA are likely to be much higher in September than in late October or November when JNCC's aerial surveys as part of the designation of the pSPA were carried out.

3.6.7. Secondly, little gull numbers and distribution show considerable variability between both years and between days (Natural England and JNCC 2016), with birds apparently showing little site-fidelity (Brown and Grice 2005). Thus, a population estimate based on aerial surveys across just two winters is unlikely to provide a reliable estimate of population size.

3.6.8. Thirdly, it is evident that the aerial survey used for the pSPA designation was unable to provide an accurate count of little gulls. According to Natural England and JNCC (2016) *"Little gulls are difficult to distinguish from other small gull species on aerial surveys so many little gulls may have been recorded as 'small gull species' or the birds missed altogether by less experienced observers. Little gulls were certainly under recorded on some aerial surveys but it is impossible to estimate the proportion of birds recorded as 'small gull species' that were actually little gulls. Only birds identified as little gulls were included in the analyses"*. Use of this approach to assessment

therefore means that little gull numbers are likely to be significantly underestimated. According to Natural England and JNCC (2016) *"The true numbers of little gull within the survey area may have been at least double that recorded".*

3.6.9. Taken together, these factors therefore suggest that the population of little gulls in the Area of Search in winter is likely to be at least twice as large (as acknowledged by Natural England and JNCC 2016) as that presented in the Greater Wash pSPA citation, and so is likely to exceed 4,300 birds. Indeed, the little gull population in autumn during peak migration is likely to be even larger than this estimate (perhaps five times larger, based on coastal observations). Combined with a high turnover of individuals, it is likely that several tens of thousands of little gulls pass through the Greater Wash pSPA area each year, however the total cannot be estimated with any confidence.

Potential for impacts on little gull at the Greater Wash pSPA during the construction/ decommissioning of TKOWF

3.6.10. The potential impacts during the construction or decommissioning phases of TKOWF would be due to disturbance from the construction/ decommissioning activity itself (e.g. turbine installation or removal) and vessel movements.

3.6.11. There is very little consistent evidence regarding displacement of little gulls by operational offshore wind farms. Leopold *et al.* (2011) observed significant displacement of little gulls by Dutch offshore windfarms during a single survey however this was not observed in six other surveys at the same windfarms. Petersen *et al.* (2006) tentatively suggest that little gulls were attracted by Horns Rev offshore windfarm after construction, but the data appear somewhat inconclusive. Vanermen *et al.* (2012) present evidence that little gull numbers increased significantly at Thorntonbank offshore wind farm post-construction, but that there was no change in little gull numbers at Blighbank offshore windfarm post-construction. Dierschke *et al.* (2016) have also reviewed available literature on avoidance/attraction responses of seabirds to offshore wind farms. In their review, they noted that little gulls have been recorded within offshore wind farms relatively often, however several studies indicate some avoidance. Three studies indicated 'strong avoidance', one indicated 'weak avoidance', four indicated 'no wind farm effect on little gull numbers or distribution', while two studies showed non-significant trends with a decrease at one but increase at the other. It was therefore concluded that little gulls tend to show 'weak avoidance' but that the response is somewhat inconsistent. From the evidence presented above, it is clear that there is very little consistent evidence regarding displacement of little gulls by offshore wind farms.

3.6.12. Sources of disturbance during construction and decommissioning of TKOWF will differ from those during operation, however the spatial scale for impacts from construction and decommissioning will be much smaller (e.g. limited to the vicinity of a few turbines and associated vessels) and the temporal overlap between construction/decommissioning activity and little gull presence will be short. Garthe and Hüppop (2004) gave little gull the lowest rank (1 out of 5) for disturbance by helicopter and ship traffic.

3.6.13. Given the low sensitivity to disturbance and the small spatial and temporal extent of potential impacts during construction or decommissioning of TKOWF, it can therefore be concluded that TKOWF will have no LSE at the site alone with respect to construction or decommissioning impacts on little gulls as a feature in the Greater Wash pSPA.

3.6.14. The current construction timetable for TKOWF does not overlap with other wind farms in the Greater Wash (e.g. Race Bank, Dudgeon) which could contribute to a cumulative construction disturbance impact. Therefore, it can be concluded that TKOWF will have no LSE in-combination

with other developments with respect to construction impacts on little gulls as a feature in the Greater Wash pSPA.

Potential for impacts on little gull at the Greater Wash pSPA during operation of TKOWF

3.6.15. The potential sources of impact during the operational phase of TKOWF would be due to mortality resulting from collisions of birds with turbines and displacement due to avoidance of the wind farm itself and associated vessel movements.

3.6.16. Little gulls tend to fly low over the water. According to Johnston *et al.* (2014), based on modelling data from numerous boat-based surveys at proposed offshore wind farm sites the mean percentage of little gull flying at collision risk height (defined as above 20m) is 15.1%. Although, surveys conducted at the TKOWF site found that only 4.3% of little gull flight activity was at collision risk height (also defined as above 20m, Triton Knoll Offshore Wind Farm Limited 2011).

3.6.17. The original TKOWF assessment (based on 333 turbines) reported a little gull annual collision mortality of 75 individuals, at an avoidance rate of 98%. Prior to consent the wind farm was reduced in size to 288 turbines, which thereby reduced the predicted collision rate to 65. In addition, the avoidance rate for small gulls (inc. little gull) has since been revised upwards from 98% to 99.2% (Cook *et al.* 2014); this further reduces the collision mortality for the consented design to 26. Based on detailed design work currently being undertaken by the project, the indicative final layout will comprise up to 120 turbines, for which the collision risk is estimated to be 15 individuals (MacArthur Green 2016).

3.6.18. A precautionary estimate of the population size of little gulls visiting the Area of Search is around 10,000 individuals per year, while a more realistic estimate is likely to be around 20,000 individuals per year. The only published estimate of little gull survival suggests a survival rate of adults of 0.8 (Horswill and Robinson 2015). At this survival rate, natural annual mortality for little gull will be between 2,000 and 4,000 birds. The estimated maximum TKOWF collision mortality of 26 birds represents an increase in mortality of between 0.65% and 1.3%. The most likely built wind farm, with a predicted mortality of 15 individuals would result in natural mortality increases of 0.37% to 0.75%.

3.6.19. As the precautionary estimate for the increase in mortality (based on the smaller estimated regional population size of 10,000 and the consented wind farm design) exceeds 1%, an LSE cannot be ruled out due to collision risk to the little gull feature of the Greater Wash pSPA.

3.6.20. Other wind farms in the vicinity of the Greater Wash pSPA which could contribute to an in-combination collision risk and for which little gull collisions have been predicted are; Race Bank, Sheringham Shoal and Hornsea Projects One and Two. Little gull collisions for TKOWF in combination with these other wind farms are presented in Table 1. The updated estimates incorporate the higher avoidance rate for small gulls (99.2%, Cook *et al.* 2014) and adjustments to account for the reduced rotor swept area of built or proposed developments compared to the assessed ones.

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Table 1. Original assessed collision rates and updated little gull collision predictions for offshore wind farm sites with potential connectivity to the Greater Wash pSPA.

Wind farm	Annual collisions	Avoidance rate (%)	Assessed wind farm size	Collisions updated for 99.2% avoidance rate	Built or proposed wind farm size	Collisions updated for built or proposed wind farm
Triton Knoll	65	98	288 * 3.6MW	26	TBC. c. 120	c. 15
Race Bank	52	98	206 * 3MW	21	91 * 6MW	12
Sheringham Shoal	8	98	108 * 3MW	3	88 * 3.6MW	3
Hornsea P1	10	98	332 * 3.6MW	4	174 * 7MW	2
Hornsea P2	1.3	98	360 * 5MW	0.5	N/A	0.5
In-combination total				**54.5**		**32.5**

3.6.21. On the basis of the precautionary population estimate for little gulls visiting the Area of Search of around 10,000 per year and the realistic population estimate of 20,000, natural annual mortality is expected to be between 2,000 and 4,000 birds. The estimated in-combination collision mortality for the consented wind farms of 54.5 birds represents an increase in annual mortality of between 1.4% and 2.7%, while the estimated in-combination collision mortality for the built or proposed wind farms, with a predicted mortality of 32.5 individuals, represents an increase in natural mortality of between 0.8% and 1.6%.

3.6.22. As the precautionary increase in mortality (based on the smaller estimated regional population size of 10,000 and the consented wind farm designs) exceeds 1%, an LSE cannot be ruled out due to collision risk to the little gull feature of the Greater Wash pSPA.

3.6.23. However, as stated previously, there is very little consistent evidence regarding displacement of little gulls by offshore wind farms. Leopold *et al.* (2011) observed significant displacement of little gulls by Dutch offshore windfarms during only a single survey and this was not observed in six other surveys at the same windfarms. Petersen *et al.* (2006) tentatively suggest that little gulls were attracted by Horns Rev offshore windfarm after construction, but the data appear somewhat inconclusive. Vanermen *et al.* (2012) present evidence that little gull numbers increased significantly at Thorntonbank offshore windarm post-construction, but that there was no change in little gull numbers at Blighbank offshore windfarm post-construction. Dierschke *et al.* (2016) have also reviewed available literature on avoidance/attraction responses of seabirds to offshore wind farms. In their review, they noted that little gulls have been recorded within offshore wind farms relatively often, however several studies indicate some avoidance. Three studies indicated 'strong avoidance', one indicated 'weak avoidance', four indicated 'no wind farm effect on little gull numbers or distribution', while two studies showed non-significant trends with a decrease at one but increase at the other. They concluded that little gulls tend to show 'weak avoidance' but that the response is somewhat inconsistent. From the evidence presented above, it is clear that there is very little consistent evidence regarding displacement of little gulls by offshore wind farms.

3.6.24. JNCC/NE have not yet provided guidance on how impacts on a non-breeding population outside an SPA should be assessed in relation to a non-breeding population in a nearby SPA, and as such there is no available guidance on which to base an assessment. It is possible that displacement

from TKOWF might result in a very slight increase in numbers of little gull in the pSPA, which at face value seems positive rather than negative in relation to the SPA conservation objectives. However, given the wide range over which little gulls move and the irregular nature of their movements it seems unlikely that displacement from an OWF area will be of any real consequence at a population level. The lack of understanding of little gull numbers, population dynamics or ecology however, makes this effect difficult to quantify.

3.6.25. While it is recognised that there may be some slight displacement of little gulls by TKOWF, given the scale of these effects and the lack of available data for little gull it can be concluded that TKOWF will have no LSE in relation to little gulls as a feature in the Greater Wash pSPA.

3.7. Summary of potential for connectivity between TKOWF and the Greater Wash pSPA

3.7.1. Table 2 provides a summary of the predicted likelihood of connectivity between the Greater Wash pSPA and the TKOWF and the results of screening for LSEs.

Table 2. Summary of screening for connectivity and LSE.

Feature	Potential for connectivity	Potential for LSE
Sandwich tern	No	No
Common tern	No	No
Little tern	No	No
Red-throated diver	Yes	Yes (displacement risk)
Common scoter	No	No
Little gull	Yes	Yes (collision risk)

4. Assessment of Potential Effects

4.1. Red-throated diver displacement risk: TKOWF alone

4.1.1. As noted in section in 3.4, the maximum estimated red-throated diver population in TKOWF and buffer was 15 individuals. The Greater Wash pSPA designated population size is 1,511, therefore the addition of up to 15 individuals due to displacement from TKOWF and buffer would increase the population by 1%. There is a very small potential risk that this displacement would increase the population density within the pSPA, thereby increasing competition for resources in the pSPA and in turn leading to a potential increase in mortality. However, available evidence suggests that red-throated divers are unlikely to be affected by density-dependent competition for resources during the non-breeding period (Dierschke *et al.* 2017). Impacts of displacement are also likely to be context-dependent. In years when food supply has been severely depleted, for example due unsustainably high fishing mortality of sandeel stocks as has occurred several times in recent decades (ICES 2013), displacement of sandeel-dependent seabirds from optimal habitat may increase mortality. However, in years when food supply is good displacement is unlikely to have any negative effect on seabird populations. Red-throated divers take a wide diversity of small fish prey (i.e. they are not limited to sandeels) and so would be expected to be buffered from fluctuations in abundance of individual fish species.

4.1.2. Thus, while the potential for an LSE due to displacement from the TKOWF site and buffer could not be ruled out for red-throated divers, it can be concluded that the resulting increase in population density within the Greater Wash pSPA will be undetectable and there will be no Adverse Effect on the Integrity (AEoI) of the Greater Wash pSPA as a result of displacement from the TKOWF.

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4.2. Red-throated diver displacement risk: In-combination

4.2.1. There is a risk that displacement of red-throated divers from TKOWF could act in-combination with displacement from other wind farms with potential connectivity to the Greater Wash pSPA. The project alone displacement affect for TKOWF is predicted to affect a maximum of 15 individuals. The best available evidence indicates that red-throated divers are not affected by density-dependent competition for resources during the non-breeding period (Dierschke *et al.* 2017), thus the potential for this magnitude of displacement from TKOWF to contribute to an in-combination effect is very small. Furthermore, it is evident from the Greater Wash pSPA consultation documentation that TKOWF is located in the lowest density region for this species (see Figure 2, Natural England and JNCC 2016). The 'loss' of habitat as a result of TKOWF would therefore be expected to be trivial since it does not represent important habitat. Thus, the likelihood that TKOWF could materially contribute to an in-combination displacement effect on red-throated diver is considered to be extremely small. Therefore, it can be concluded that the magnitude of effect due to TKOWF is so small that it would make no material contribution to any potential AEoI on the Greater Wash pSPA due to red throated diver displacement.

4.3. Little gull collision risk: TKOWF alone

4.3.1. As noted in section 3.6, the predicted mortality of little gull at TKOWF for the consented project was 26 (including update for revised avoidance rate). Given a regional little gull population of between 10,000 and 20,000 this represents an increase in background mortality of between 0.65% and 1.3%. It should be noted that based on advice from Natural England (May 2016), even a population estimate of 20,000 remains precautionary: Stienen *et al.* (2007) reported that the flyway population with potential connectivity to the southern North Sea was up to 75,000. Potential impacts when considered on a population of 75,000 would therefore be reduced to almost a quarter of those noted above. However, this assessment has been conducted on the basis of the more precautionary population sizes of 10,000 to 20,000.

4.3.2. The Greater Wash pSPA designated population of little gull is 1,303, which is 13% of a population of 10,000 or 6.5% of a population of 20,000. On this basis, and assuming collisions would be distributed uniformly throughout the population, this would imply that a maximum of 3 individuals from the Greater Wash pSPA population could be killed by collisions (13% of 26), although the most likely built project would reduce this maximum to 1.8, which would be reduced further to <1 on the basis of the more realistic wider population (of 20,000).

4.3.3. Thus, while the potential for an LSE could not be ruled out due to little gull collision risk at the TKOWF alone, it can be concluded that the maximum additional mortality of 3 individuals from the pSPA population will be undetectable and there will be no AEoI of the Greater Wash pSPA as a result of collisions at the TKOWF.

4.4. Little gull collision risk: In-combination

4.4.1. As noted in section 3.6, the predicted mortality of little gull at TKOWF in-combination with other wind farms with potential connectivity to the Greater Wash pSPA little gull population for the consented projects was 54.5 (including update for revised avoidance rate). Given a regional little gull population of between 10,000 and 20,000 this represents an increase in background mortality of between 1.4% and 2.7% (although as noted above in section 4.3 the population may be as large as 75,000, further reducing the magnitude of potential impact).

4.4.2. The Greater Wash pSPA designated population of little gull is 1,303, which is 13% of a population of 10,000 or 6.5% of a population of 20,000. On this basis, and assuming collisions would be distributed uniformly throughout the population, this would imply that a maximum of 7 individuals from the Greater Wash pSPA population could be killed by collisions (13% of 54.5),

although the actual built projects (or planned designs) would reduce this maximum to 4, which would be reduced further to 2 on the basis of the more realistic wider population (of 20,000).

4.4.3. Thus, while the potential for an LSE could not be ruled out due to in-combination little gull collision risk, the realistic additional maximum mortality of 4 individuals (based on the precautionary wider population of 10,000 and built wind farms) from the pSPA population will be undetectable and there will be no AEoI of the Greater Wash pSPA as a result of in-combination collision mortality.

5. Conclusion

5.1.1. This report provides an assessment of the potential for impacts on the features of the Greater Wash pSPA as a result of the TKOWF acting alone and in-combination with other wind farm developments with the potential for connectivity. This assessment was based on precautionary assumptions about the likelihood of connectivity between the features of the pSPA since TKOWF is located outside the pSPA boundary.

5.1.2. The only species for which the potential for an LSE could not be ruled out were red-throated diver for displacement risk and little gull for collision risk.

5.1.3. Consideration of the potential displacement risk for red-throated diver found that the maximum potential displacement effect might increase the population within the pSPA by 1%. This is a very small increase, and since the best available evidence indicates that this species is unlikely to be affected by density-dependent competition during the non-breeding season (Dierschke *et al.* 2017) it was concluded that there would be no AEoI for the Greater Wash pSPA as a result of displacement from TKOWF either alone or in-combination with other wind farms.

5.1.4. Consideration of the collision risk for little gull included updating reported estimates to account for the upward revision in the small gull avoidance rate from 98% to 99.2% (Cook *et al.* 2014) and the reduced number of turbines for built or planned projects.

5.1.5. On the basis of an evidence based review of information on little gull populations and movements, the magnitude of mortality predicted to affect the pSPA population was found to be minimal, with a project alone estimated annual mortality of <1 and an in-combination estimated annual mortality of 4. It can therefore be concluded that this level of additional mortality would be undetectable and hence no AEoI was assessed for the Greater Wash pSPA due to collision mortality at the TKOWF alone or in-combination with other wind farms.

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