Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

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Chapter 4: Offshore Ornithology

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Thanet Extension Offshore Wind Farm

Volume 2

Chapter 4: Offshore Ornithology

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Drafted By:	Sean Sweeney & Roger Buisson - APEM Ltd
Approved By:	Helen Jameson
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Vattenfall Wind Power Ltd

First Floor

1 Tudor Street

London

EC4Y 0AH

T +44 207 451 1150

www.vattenfall.co.uk

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4 Offshore Ornithology

4.1 Introduction

4.1.1 This chapter presents the assessment of the potential impacts on offshore ornithological receptors that might arise from construction, Operations and Maintenance (O&M) and decommissioning of the offshore components of the proposed Thanet Extension Offshore Wind Farm (Thanet Extension) project.

4.1.2 This chapter describes the consultation that has been held with stakeholders, the scope and methodology of the assessment, the baseline data on offshore birds acquired through desk based study and surveys and it assesses the potential impacts on offshore birds. The receptor sensitivity, predicted magnitude of impacts and significance of effects arising due to construction, O&M and decommissioning of the wind farm on offshore ornithological receptors are assessed on the basis of the worst-case development scenario. Measures to prevent or reduce the significance of the possible effects are discussed where appropriate. Cumulative impacts arising from the proposed development and other offshore plans, projects and activities are assessed as appropriate.

4.1.3 Consideration of birds in intertidal areas is provided in Volume 3, Chapter 5: Onshore Biodiversity (Document Ref: 6.3.5).

4.1.4 This chapter is supported by a number of technical annexes, included in Volume 4 of the Environmental Statement (ES), as listed below:

- Offshore Ornithology Baseline Technical Report (Volume 4, Annex 4-1, Document Ref: 6.4.4.1);
- Historic Data Report (Volume 4, Annex 4-2, Document Ref: 6.4.4.2);
- Displacement Matrices (Volume 4, Annex 4-3, Document Ref: 6.4.4.3); and
- Collision Risk Modelling Report (Volume 4, Annex 4-4, Document Ref: 6.4.4.4).

4.1.5 This chapter should be read in conjunction with the scheme description provided in Volume 2, Chapter 1: Project Description (offshore) and Volume 1, Chapter 3: Approach to Environmental Impact Assessment (EIA).

4.1.6 It should be noted that the assessments within this chapter are based upon the abundances and densities of seabirds within the PEIR Red Line Boundary (RLB), as described in the Offshore Ornithology Baseline Technical Report (Document Ref: 6.4.4.1). The size of the Thanet Extension site has subsequently been reduced by 4.05 km2 or 5.56 %, with the revised RLB presented in Figure 4.1, meaning that the assessments in this chapter are precautionary, as they are based on higher levels of abundances for each species.

4.2 Statutory and policy context

4.1.7 Legal protection for wild birds and the habitats that support them is provided by a combination of European and national legislation. Both the EU Birds Directive and the Wildlife and Countryside Act 1981 (as amended) provide protection against killing of birds (with a few exceptions) and provide protection for sites that support either specific bird species or concentrations of birds.

4.1.8 The Birds Directive (Council Directive 2009/147/EC on the Conservation of Wild Birds [this being the revised Directive accounting for EU enlargement since the original Directive of 1979]) provides a framework for the conservation and management of wild birds in EU member states. The most relevant provisions of the Directive are the identification and classification of Special Protection Areas (SPAs) for rare or vulnerable species listed in Annex I of the Directive and for all regularly occurring migratory species (required by Article 4). The Directive requires national Governments to establish SPAs and to have in place mechanisms to protect and manage them. The SPA protection procedures originally set out in Article 4 of the Birds Directive have been replaced by the Article 6 provisions of the Habitats Directive. The Birds Directive also establishes a general scheme of protection for all wild birds (required by Article 5).

4.1.9 The Habitats Directive (Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora) provides a framework for the conservation and management of natural habitats, wild fauna (except birds) and flora in EU member states. The provisions of the Directive relevant to offshore ornithology are the procedures for the protection of Special Areas of Conservation (SACs) and SPAs (Article 6). The procedures require an appropriate assessment of any plan or project likely to affect a SAC or SPA and not to approve any plan or project that would have an adverse effect on the integrity of a SAC or SPA except under very tightly constrained conditions. The procedures for the protection of SACs and SPAs are implemented in the United Kingdom (UK) through the Conservation of Habitats and Species Regulations 2017 and the Conservation of Offshore Marine Habitats and Species Regulations 2017 for waters beyond 12 nautical miles (nm).

4.1.10 The Conservation of Habitats and Species Regulations 2017 (the 'Habitats Regulations') consolidate and update The Conservation of Habitats and Species Regulations 2010; which in turn had consolidated and updated The Conservation (Natural Habitats, &c.) Regulations 1994, which transposes the Birds Directive and the Habitats Directive into national law in the terrestrial, coastal and inshore (out to 12 nm) environment, operating in conjunction with the Wildlife and Countryside Act 1981. The Habitats Regulations place an obligation on 'competent authorities' to carry out an appropriate assessment of any proposal likely to affect a SAC or SPA, to seek advice from Natural England (NE) and/ or Joint Nature Conservation Committee (JNCC), and not to approve an application that would have an adverse effect on a SAC or SPA (except under very tightly constrained conditions that involve decisions by the Secretary of State).

4.1.11 The Conservation of Offshore Marine Habitats and Species Regulations 2017 (the 'Offshore Regulations'), which consolidate and update The Offshore Marine Conservation (Natural Habitats &c.) Regulations 2007, transpose the Birds Directive and the Habitats Directive into national law in the offshore (beyond 12 nm) environment. The Offshore Regulations place an obligation on 'competent authorities' to carry out an appropriate assessment of any proposal likely to affect a SAC or SPA, to seek advice from Natural England and/ or JNCC, and not to approve an application that would have an adverse effect on a SAC or SPA (except under very tightly constrained conditions that involve decisions by the Secretary of State).

4.1.12 The Wildlife and Countryside Act 1981 (as amended) is the principal mechanism for the legislative protection of wildlife in Great Britain. It provides protection for all wild birds with the few exceptions being provided by a licensing system. The act establishes the system of site protection for species and habitats through the notification of a suite of Sites of Special Scientific Interest (SSSI). On land and down to MLWS all SPAs and SACs are also notified as SSSIs.

4.1.13 The Natural Environment and Rural Communities Act 2006 imposes a duty on public bodies to conserve biodiversity, including a requirement to compile a list of habitats and species of principal importance for the purpose of conserving biodiversity.

4.1.14 Policy aimed at protecting wild birds and their habitats is contained in both environmental policy and through specific provision in policy applying to particular sectors such as energy and development planning.

4.1.15 The Overarching National Policy Statement for Energy (NPS EN-1) states at Paragraph 5.3.3 that the applicant should ensure that the Environmental Statement (ES) clearly sets out any effects on internationally, nationally and locally designated sites of ecological importance, on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity. Paragraph 5.3.4 states that the applicant should also show how the proposed project has taken advantage of opportunities to conserve and enhance biodiversity interests. Paragraph 5.3.18 states that the applicant should include appropriate mitigation measures as an integral part of the proposed development.

4.1.16 The National Policy Statement for Renewable Energy Infrastructure (NPS EN-3) states at Paragraph 2.6.64 that the assessment of offshore ecology and biodiversity should be undertaken by the applicant for all stages of the lifespan of the proposed offshore wind farm. Paragraph 2.6.102 states that the scope, effort and methods required for ornithological surveys should have been discussed with the relevant statutory advisor. Paragraph 2.6.104 states that it may be appropriate for the assessment to include collision risk modelling for certain bird species.

4.1.17 The National Planning Policy Framework (DCLG, 2012) sets out the Government's planning policies for England and how these are expected to be applied. The document establishes a number of core land-use planning principles in Paragraph 17 that should underpin both plan-making and decision-taking. This includes the seventh bullet point of Paragraph 17 that planning should "*contribute to conserving and enhancing the natural environment*". In Section 11 on conserving and enhancing the natural environment, Paragraph 109 states that the planning system should contribute to and enhance the natural and local environment by minimising impacts on biodiversity and providing net gains in biodiversity where possible, contributing to the Government's commitment to halt the overall decline in biodiversity, including establishing coherent ecological networks that are more resilient to current and future pressures.

4.1.18 'Biodiversity 2020: A strategy for England's wildlife and ecosystem services' sets out the strategic direction for biodiversity policy in England for the next decade on land and at sea. Its mission is "to halt overall biodiversity loss, support healthy well-functioning ecosystems and establish coherent ecological networks, with more and better places for nature for the benefit of wildlife and people." In the marine environment it seeks to establish a well-managed, ecologically coherent network of Marine Protected Areas.

4.1.19 The Kent Biodiversity Action Plan has been developed by the Kent Biodiversity Partnership and has produced Action Plans for 24 priority habitats and for 85 species, 11 of which are bird species.

4.1.20 A summary of the legislation and policy described above and how the key provisions are addressed in this chapter is outlined in Table 4.1.

Table 4.1: Legislation and policy context

Policy/ legislation	Key provisions	Section where provision addressed
The Birds Directive	Protection of Annex 1 and migratory species (Article 4) and protection of SPAs (via Article 6 of Habitats Directive)	Potential effects on Annex 1 and migratory species and protection of SPAs considered through the assessment in Sections 4.11 to 4.14 and the Habitat Regulations Assessment (HRA) Screening Report
The Habitats Directive	Protection of SPAs achieved through the measures in Article 6 of this Directive	Protection of SPAs considered through the HRA Screening Report
The Conservation of Habitats and Species Regulations 2017	Protection of SPAs (Regulation 24)	Protection of SPAs considered through the HRA Screening Report
The Conservation of Offshore Marine Habitats and Species Regulations 2017	Protection of SPAs (Regulation 28)	Protection of SPAs considered through the HRA Screening Report
The Wildlife and Countryside Act 1981	Protection for all wild birds and protection of SSSIs	Potential effects on wild birds considered through the assessment in Section 4.11 to 4.14
Natural Environment and Rural Communities Act 2006	Duty on public bodies to conserve biodiversity, compile a list of habitats and species of principal importance for the purpose of conserving biodiversity	This assessment provides the information on which the Secretary of State will base their decision, including species of principal importance that might be affected by the proposal.
The Overarching National Policy Statement for Energy (NPS EN-1)	Environmental Impact Assessment (EIA) to include effects on, opportunities to enhance and mitigation for biodiversity	Potential effects, opportunities and mitigation on birds considered through the assessment in Sections 4.11 to 4.14
The National Policy Statement for Renewable Energy Infrastructure (NPS EN-3)	EIA to include all project stages, consultation over surveys and Collision Risk Model (CRM)	Potential effects at all stages and CRM in the assessment in Sections 4.11 to 4.14, consultation over surveys in Section 4.3
The National Planning Policy Framework	For biodiversity, minimise impacts, provide net gains where possible and contribute to halting decline	Potential effects, opportunities and mitigation on birds considered through the assessment in Sections 4.11 to 4.14
Biodiversity 2020: A strategy for England's wildlife and ecosystem services	Halt overall biodiversity loss, and seek to establish a well-managed, ecologically coherent network of Marine Protected Areas	Potential effects on birds and Marine Protected Areas with bird interest features considered through the assessment in Sections 4.11 to 4.14
Kent Biodiversity Action Plan	Deliver actions for priority species and habitats	Offshore birds are not priority species for this BAP

Table Note: In this ES chapter there are assesments made of bird species that are interest features of SPAs, pSPAs and Ramsar sites. The RIAA (HRA Report, Document ref: 5.2) provides the particular assessment of these species in relation to the SPAs, pSPAs and Ramsar sites for which they are interest features and that detail is not repeated here.

4.1.21 With respect to guidance, the most relevant guidance on EIA for marine ecology receptors, including birds, is the Guidelines for Ecological Impact Assessment in Britain and Ireland: Marine and Coastal published by the Institute of Ecology and Environmental Management (CIEEM, 2010). The EIA methodology applied in this chapter is based on that Chartered Institute of Ecology and Environmental Management (CIEEM) guidance.

4.1.22 Specific guidance on the assessment of the potential impacts of renewable energy generation on offshore birds has been produced by a number of statutory bodies, non-Governmental organisations (NGOs) and consultants including:

- Assessment methodologies for offshore wind farms (Maclean *et al.*, 2009);
- Guidance on ornithological cumulative impact assessment for offshore wind developers (King *et al.*, 2009);
- Advice on assessing displacement of birds from offshore wind farms (Statutory Nature Conservation Bodies (SNCBs), 2017);
- Collision risk modelling to assess bird collision risks for offshore wind farms (Band, 2012);
- Collision risk modelling incorporating variability and uncertainty to assess bird collision risks for offshore wind farms (Masden, 2015);
- Assessing the risk of offshore wind farm development to migratory birds (Wright *et al.*, 2012);
- Vulnerability of seabirds to offshore wind farms (Furness and Wade 2012; Furness *et al.*, 2013);
- Seabird sensitivity to offshore wind farms in English Territorial Waters (Bradbury *et al.*, 2014);
- The avoidance rates of collision between birds and offshore WTGs (Cook *et al.*, 2014);
- Joint Response from the Statutory Nature Conservation Bodies to the Marine Scotland Science Avoidance Rate Review (JNCC *et al.*, 2014); and
- Consideration of quantifying impact assessments for selected seabird populations (MacArthur Green, 2016).

4.3 Consultation and scoping

Table 4.2: Summary of consultation relating to offshore ornithology

Date and consultation phase/ type	Consultation and key issues raised	Section where comment addressed
December 9th, 2016. First (Pre-scoping) Evidence Topic Group Meeting (ETG1)	Discussion on data availability for Preliminary Environmental Information Report (PEIR) and ES Chapter modelling, reporting and assessments. Once the submission deadline is agreed then the data available for use in the PEIR and ES Chapter assessments will be reviewed. APEM raised the possibility of using historical data in order to verify any months of the current survey programme without two years of data available. NE and Royal Society for the Protection of Birds (RSPB) both stated that their preference was for use of a full 24 month dataset.	Throughout ETG1 Minutes.
	CRM methodology was discussed and it was agreed that the Masden (2015) model would be the most suitable for assessments. NE suggested that the Masden (2015) was a good step forward from the Band (2012) model, though it would require additional details on the input parameters.	ETG1 Minutes – Section 5.
February 28th, 2017 Post-scoping Evidence Topic Group Meeting (ETG2)	Confirmation that the PEIR modelling, reporting and assessments would be based on 13 months of aerial digital survey data collected between March 2016 and March 2017. NE and RSPB agreed that this would be appropriate for use at the PEIR stage.	ETG2 Minutes – Section 3.1.
	NE confirmed that their preference for data collection for use in the final ES Chapter would be from survey coverage over a 24 month period. Should this not be possible and the use of existing sources of data from historic surveys is to be used then NE requested a clear description as to how these data would be incorporated.	ETG2 Minutes – Section 3.2.

Date and consultation phase/ type	Consultation and key issues raised	Section where comment addressed
	NE confirmed again that the most appropriate model to use for CRM is the Masden (2015) model. Following discussion between APEM and NE regarding research projects led by NE and Marine Scotland there may be additional guidance on the use of the Masden (2015) model. It was agreed that depending on the timing of the release of any new guidance this may not be able to be incorporated into the CRM at the PEIR stage.	ETG2 Minutes – Section 3.3.
	It was agreed that the definition of different bio-seasons as defined in the Furness (2015) paper was most appropriate, though where site-specific evidence can be provided changes may be applied.	ETG2 Minutes – Section 3.4.
	It was agreed between that the latest guidance on disturbance and displacement (SNCBs, 2017) would be used in the PEIR assessments.	ETG2 Minutes – Section 3.4.
	It was agreed that the proposed EIA methodologies detailed in the Scoping Report were appropriate for use.	ETG2 Minutes – Section 5.2.
April 20th, 2017 Third Evidence Topic Group Meeting (ETG3)	Agreement that Baseline Technical Report for PEIR would only focus on key species. Any species only recorded once would not be included in the reporting. NE agreed in principle, but requested that this be reviewed again for the ES Chapter baseline reporting, when additional data would be available.	ETG3 Minutes – Section 3.1.
	It was agreed that the method used to apportion unidentified birds for abundance estimates was appropriate. This was confirmed to follow the previously agreed methods applied to APEM's aerial digital survey data for the East Anglia THREE project.	ETG3 Minutes – Section 3.2.
	It was agreed that the method used to correct for availability (the use of a correction factor) for auks (razorbill and guillemot) was appropriate, though NE requested that the method was re-submitted as part of the PEIR reporting. This was confirmed to follow the previously agreed correction factor applied to APEM's aerial digital survey data on auks in the East Anglia ONE and THREE projects.	ETG3 Minutes – Section 3.3.
	It was agreed that the most appropriate starting point for cumulative and in-combination CRM assessments for seabirds would be based upon the latest agreed figures from NE – that which was agreed during the examination period for East Anglia THREE. These would require review and revisions as appropriate to account for the tiered approach.	ETG3 Minutes – Section 4.
	NE provided an update on their contracted project work on the Masden (2015) CRM model. Subsequent to previous advice, due to a number of uncertainties within the model identified through their contract, NE now advise the use of Band (2012) model for CRM assessments.	ETG3 Minutes – Section 5.
June 13th, 2017 Fourth Evidence Topic Group Meeting (ETG4)	It was agreed that the use of background mortality rates based upon the Horswill & Robinson (2015) and presented in the last Offshore Wind Farm (OWF) development application (East Anglia THREE) were appropriate.	ETG4 Minutes – Section 7.1.
	It was agreed that only five seabirds would be subject to CRM for the PEIR (gannet, kittiwake, herring gull, great black-backed gull and lesser black-backed gull). Fulmar would not be assessed due to very low numbers recorded in the Thanet Extension site and their low risk of collision mortality due to their typical flight height being close to sea level.	ETG4 Minutes – Section 7.1.

Date and consultation phase/ type	Consultation and key issues raised	Section where comment addressed
July 12th, 2017 Fifth Evidence Topic Group Meeting (ETG5)	NE and RSPB agreed that cumulative impact assessments for disturbance and displacement as well as collision risk would follow current recommended practice and use a 5 Teir' approach.	ETG5 Minutes – Section 4.
	NE and RSPB agreed that the change from boat-based surveys to aerial digital surveys for the collection of baseline data was the best method and in keeping with all other current offshore wind farm projects.	ETG5 Minutes – Section 5.
	NE and RSPB agreed that the Band CRM model (Band, 2012) would be used in the final ES Chapter, with upper and lower confidence intervals for key parameters, where possible (akin to Hornsea P2).	ETG5 Minutes – Section 5.
October 4th, 2017 Sixth Evidence Topic Group Meeting (ETG6)	NE and RSPB agreed that fulmar could be screened out of collision risk assessment on the basis of low densities at Thanet Extension and its tendency to fly close to the water surface.	ETG6 Minutes – Section 8.
	NE and RSPB agreed that 34 10 MW turbines was the worst-case scenario for CRM in the stochastic (Masden, 2015) model runs and that this was the only array design to be re-run in the Band Model for the final ES Chapter.	ETG6 Minutes – Section 8.
	A proposed approach new for understanding Thanet Extension's contribution to cumulative effects on red-throated diver was agreed with NE and RSPB. This included applying a diver density distribution from a single source and applying a 4 km distance within which displacement could be predicted to occur to varying degrees. It was agreed as an appropriate methodology with the use of density data held in SeaMaST (Seabird Mapping and Sensitivity Tool) agreed as a suitable source, with confirmation that this approach would be undertaken for the final ES Chapter but would not be in the PEIR.	ETG6 Minutes – Section 8.
December 12th, 2017 Seventh Evidence Topic Group Meeting (ETG7)	It was agreed that locally collected data should be considered in the assessment of disturbance and displacement. However, NE and RSPB requested more standardised approaches to presenting data with reference to generic displacement rates and distances (buffer zones) should be taken from the most recent SNCB guidance note (SNCBs, 2017). It was agreed that information on generic displacement rates and distances (buffer zones) would be completed in standard matrices, though those that differ from site-specific survey data would only be presented in an annex.	ETG6 Minutes – Section 8.
	It was agreed that the final ES Chapter would include the provision of annual displacement rates for species during the construction and operational phases of Thanet Extension.	ETG7 Minutes – Section 3.
	APEM and Vattenfall provided NE and RSPB with information relating to the site-specific evidence based displacement rates being applied within the ES Chapter. These rates being those found within the final post-construction monitoring report for TOWF (Royal HaskoningDHV, 2013). NE and RSPB expressed their desire for displacement rates to be calculated using SNCB guidance (SNCBs, 2017), for which APEM and Vattenfall agreed to provide additional displacement matrices using SNCB displacement rates in a separate annex to the main ES Chapter.	ETG7 Minutes – Section 3.
	APEM confirmed to the attendees that data on bird flights from the ORJIP project had been received. It was explained that due to a number of uncertainties within that dataset and how it could be most appropriately used in the Band CRM model it would not be relying on the outputs. Accordingly, any CRM outputs using ORJIP data would be presented within an annex to the main ES Chapter.	ETG7 Minutes – Section 3.

Date and consultation phase/ type	Consultation and key issues raised	Section where comment addressed
	It was agreed with NE and RSPB that mean peaks would be presented for the bio-season abundance estimates, based on the mean of the peaks from year and year two of each survey year.	ETG7 Minutes – Section 3.
	APEM provided a a brief run through the paper "*Red-throated Diver Cumulative (EIA) and In-combination (HRA) Assessment – Proposed Methodology*" that had been circulated before the meeting. The key points from the paper were – • "Placing the 'alone' contribution of Thanet Extension in context, relative to all other proposed, consented or constructed offshore wind farms, mitigating the false confidence that can arise when considering absolute numbers derived from uncertain sources. • Applying a single source of red-throated diver density across all the offshore wind farms included in the assessment. • Applying, where relevant, the as-built layout of the array rather than the worst-case design for the array as assessed in the application. • Considering the two ends of the range of scenarios over which standardised displacement matrices are prepared. For the HRA, apportioning a percentage of birds to the relevant SPA where the wind farm is located outside the SPA."	ETG7 Minutes – Section 5.
	The key points from the red-throated diver cumulative / in-combination assessment discussion were: NE welcomed the approach of using a single source for red-throated diver distribution and density from which to undertake cumulative / in-combination assessments. The assumptions underlying the methodology would need to be explained in the assessment. Re-emphasised that NE and RSPB will base their views on an assessment using the SNCB parameters of 100% displacement up to 4 km.	ETG7 Minutes – Section 5.
PEIR s42 comments	Agence Francaise pour la Biodiversite (AFB) requested consideration of the potential inter-annual variability of seabirds for foraging range and wintering area.	The assessments in this ES make use of two years of data (the PEIR applied data from a shorter period) providing a stronger basis on which to make assessments and reducing the uncertainties surrounding potential issues such as inter-annual variation. In addition, a separate report on historic data and its comparison to more recent data collected has been included as an annex to the ES Chapter (Doc ref: 6.4.4.2).

Date and consultation phase/ type	Consultation and key issues raised	Section where comment addressed
PEIR s42 comments	AFB requested information on how potential mortality rates associated with displacement of seabirds were identified.	There is no reference defining actual mortality rates associated with displacement rates. Many other factors are precautionary in the consideration of Disturbance and Displacement (D&D) impacts, whilst it is commonly assumed that rates of mortality between 1-5% are presented for assessment of this potential effect. In addition, displacement matrices are provided for all species based upon the data deemed appropriate in the ES Chapter, with additional matrices providing a full range of displacement and mortality rates in an annex to the ES Chapter (Doc ref: 4.4.4.3).
PEIR s42 comments	AFB requested consideration of potential cumulative effects from disturbance and displacement from the French OWFs of Calvados, Fécamp (and upcoming Dieppe-Le Tréport and potentially Dunkirk) in terms of the most sensitive species. Also requested consideration of French SPAs including; Bancs des Flandres, Cap Gris Nez, Estuaire de la Canche and Littoral Seino-marin.	Consideration of French OWFs is given in the transboundary assessment and the RIAA.
PEIR s42 comments	AFB requested consideration of collision risk for French SPA qualifying species.	This has been addressed in the RIAA.
PEIR s42 comments	AFB requested consideration of the potential effects of collision risk to account for the OWFs of Calvados, Fécamp (and upcoming Tréport, and potentially Dunkirk) in terms of the most sensitive species, as Black-backed gulls and large gulls, Kittiwake and Gannet and a number of French SPAs; Bancs des Flandres, Cap Gris Nez, Littoral Seino-marin.	Consideration has now been given to the species and designated sites during screening for the RIAA.
PEIR s42 comments	AFB requested consideration of French SPAs in the HRA Screening including Bancs des Flandres, Cap Gris Nez, Estuaire de la Canche and Littoral Seino-marin. They also referenced the breeding colony of Northern Gannet in Alderney (Les Etacs, Ortac, Little Burhou, Coque Lihou) where there is a RAMSAR site, the Alderney west coast and Burhou islands. Alderney Wildlife Trust recorded in 2014 up to 7000 individuals. This RAMSAR site might be considered too.	Two of these sites have been included in the HRA Screening assessment of transboundary sites - Bancs des Flandres and Cap Gris Nez - and were screened out. The other sites raised were reconsidered for screening although it is already known, based on tagging studies, that the gannet from the Alderney Ramsar site do not move as far up the Channel as TEOWF.
PEIR s42 comments	AFB requested that consideration be given to French SACs and SPAs with qualifying species whose mean maximum foraging or migratory range overlaps with Thanet Extension.	Consideration has been given to the French seabird colonies and the relevant designated sites in the screening for the RIAA.
PEIR s42 comments	AFB requested that the proposed Dunkirk OWF project be considered in cumulative assessments for Thanet Extension.	This project was considered, but due to no details being available on birds it was not included in the cumulative assessment. Consideration has also been given to the proposed project in the screening for the RIAA.

Date and consultation phase/ type	Consultation and key issues raised	Section where comment addressed
PEIR s42 comments	AFB requested that the potential for a barrier effect on migratory and foraging routes of seabird species associated with French SPAs and qualifying species.	Seabirds breeding in France are too far from Thanet Extension to present a significant barrier effect. The more pertinent assessment is on the potential for displacement of seabirds, which is addressed in more detail in Section 4.12. Barrier effect has been considered for all seabirds and colonies within the UK. This is highly unlikely to be any different when considering French sites.
PEIR s42 comments	AFB requested consideration of changes in prey availability during construction, operation and maintenance phases as a result of habitat disturbance and an increase in noise. AFB suggests that considering all the development activities in this part of the English Channel and North Sea, the loss of foraging areas should be taken into account in Environmental Statement / Appropriate Assessment.	We rely on assessments from other chapters, none of which considered that significant effects would occur on prey species. Section 4.12 considers this and concluded that this would not be a significant effect indirectly on birds. Consideration has also been given to this in the RIAA.
PEIR s42 comments	NE agree with the species identified as the species most sensitive to the potential impacts from this project.	Species identified for assessment detailed in Section 4.11 and 4.12.
PEIR s42 comments	NE suggest that whilst the collision risk to all species is likely to be not significant for project alone, we need to see the results based on the full survey data before any final agreement can be made.	24 months of data applied in the assessments in this ES (Sections 4.11 and 4.1).
PEIR s42 comments	NE agree with presenting cumulative tables based on the Basic Band Options 1 and 2, and to base them on the totals agreed at East Anglia 3 hearing.	Cumulative tables presented in Section 4.13.
PEIR s42 comments	NE currently disagree with the assumption that no red-throated divers are displaced from the 4 km buffer to the proposed extension. We advise that the assessment should be based on an assumption of 100 % displacement occurring out to 4 km, as per the 2017 joint SNCB advice note on assessing disturbance. NE advise that figures assuming up to 100% displacement within the windfarm footprint and 100% displacement out to 4km are presented.	The use of site-specific evidence on displacement levels continues through the final ES Chapter. However, provision of additional displacement matrices are included in the Displacement Annex of this ES Chapter (Doc Ref: 4.2.2.2).
PEIR s42 comments	NE welcome the use of the Masden model for collision risk modelling, however as it is still currently undergoing testing we advise that the Band (2012) model is used.	The Band (2012) CRM model has been used in the ES calculations in Section 4.12.
PEIR s42 comments	NE request that the method for assessing cumulative impact on red throated diver by taking figures from Environmental Statements is not appropriate. Instead, it would be more appropriate to base the assessment of cumulative effects by taking a diver density distribution from a single source (e.g. JNCC designation data) and overlaying all the OWF footprints and a 4km buffers. This approach was agreed in the Evidence Plan process, but it was acknowledged that such an approach will be included in the Environmental Statement, but would not be in the PEIR. Therefore there is a need to base any conclusions on an assessment using the agreed methodology.	A revised assessment based on these principles was agreed through consultation with RSPB and NE on this topic and an updated assessment included in Section 4.13.

Date and consultation phase/ type	Consultation and key issues raised	Section where comment addressed
PEIR s42 comments	NE request that the assessment of potential displacement mortality for each season is presented separately and across the whole annual cycle. The joint SCNB displacement advice note recommends that when a multi-season assessment is taking place, the predicted mortalities from these various tables should be summed across seasons. However, an alternative approach for EIA may have to be taken where the appropriate population scale varies with each season. In these instances, the assessment of potential impacts may need to be undertaken against the most appropriate population scale, for each season in turn, although the default position is to assess the summed annual mortality against the largest population scale in the annual cycle for EIA.	Presentation of potential disturbance and displacement effects as an annual impact is included in Sections 4.11 and 4.12.
PEIR s42 comments	NE note that a number of species have been excluded from this PEIR assessment on the basis that they are species not commonly recorded from the site-specific surveys (within Thanet Extension and a 4 km buffer), we advise that these are re-assessed once all of the survey data have been collected. These may include skua species and little gull that are likely to pass through the area, which may not get picked up during a snap shot survey. These shouldn't be screened out just because they were recorded in small numbers, and consideration needs to be given to flux/turnover of birds through the area. Similarly, it is not clear if there has been any consideration/risk of non-seabird migrant collision.	Further assessment and screening was completed for the ES Chapter using the full 24 months of aerial digital data (Doc ref: 4.2.2.1) with the key species remaining the same as in the PEIR. In comparison to other OWF projects species included for both CRM and displacement are included at level of abundances that would not normally be screened in, so this ES provides a precautionary approach. Migrant seabirds and non-seabirds have been considered in Section 4.12, the result of which determined that no additional work was required due to the referencing other OWF projects with agreed minimal impacts on this topic and noting that this is a small scale extension project.
PEIR s42 comments	NE note that displacement for razorbill and guillemot have been considered within a 1km buffer based on post consent monitoring report from Thanet OWF. Whilst we recognise that site specific evidence from TOWF is given as the reason for assessing out to 1km, we advise that that displacement rates are considered at 100% out to 2km as set out in the 2017 SNCB advice note on Displacement, are also presented.	The use of site-specific evidence on displacement levels continues through the assessment in this final ES Chapter (Sections 4.11 and 4.12). However, provision of additional displacement matrices are included in the Displacement Annex of this ES Chapter (Doc ref: 4.2.2.2).

Date and consultation phase/ type	Consultation and key issues raised	Section where comment addressed
PEIR s42 comments	NE suggested that it is not clear how the potential collision height (PCH) has been derived. It needs to be specified whether site specific flight heights have been derived from the digital aerial surveys, or whether it has been possible to obtain any flight height data from the ORJIP Bird Avoidance Study undertaken at Thanet Offshore Windfarm. An action at an ETG meeting was to check if this data would be available to inform the assessment of this project.	CRM was completed using SOSS 02 data for the ES Chapter, due to uncertainties in the site-specific data sets from aerial digital and ORJIP. The aerial digital survey data was used to undertake a parallel set of CRM that are presented in the CRM Annex (Doc ref: 4.2.2.4) Due to uncertainties in the ORJIP data, how to use it and other CRM parameters appropriately and ongoing work by the SNCBs, no assessments are included using the ORJIP data.
PEIR s42 comments	RSPB are content with the approach and methodology used to collect baseline data, but has several remarks on the way the offshore impacts have been assessed.	Comments with regards to how impacts have been assessed relate to the assessment of disturbance and displacement (Sections 4.11 and 4.12). The use of site-specific evidence on displacement levels continues through the final ES Chapter. However, provision of additional displacement matrices are included in the Displacement Annex of this ES Chapter (Doc ref: 4.2.2.2).
PEIR s42 comments	RSPB consider that red-throated diver is a species of key concern within the region that the proposed Thanet extension is situated. There are several aspects of the assessment of this species that do not meet either SNCB guidance (SNCBs (2017)), or follow the advice given by Natural England (NE) and ourselves during consultation meetings prior to the PEIR preparation.	The use of site-specific evidence on displacement levels continues through the assessment in this final ES Chapter (Sections 4.11 and 4.12). However, provision of additional displacement matrices are included in the Displacement Annex of this ES Chapter (Doc ref: 4.2.2.2).
PEIR s42 comments	RSPB consider that the use of the 2013 post-construction monitoring data/ reporting from the Thanet site (Royal Haskoning DHV, 2013), to inform the assessment of the extension was not discussed in detail during meetings prior to the preparation of the PEIR. Therefore we did not have the opportunity to comment on the suitability of these data in relation to the current assessment nor could we provide our feedback as to how this information is best used to inform the assessment before the PEIR was finalised.	Reference to the use of site based evidence, that includes the RHDHV reports, was part of the evidence plan process.
PEIR s42 comments	Table 4.2: This currently states that “NE and Royal Society for the Protection of Birds (RSPB) raised the possibility of using historical data in order to verify any months of the current survey programme without two years of data available.”; however this is not the case. Our position, in line with that of NE, has consistently been that the collection of a full 24 months of baseline data is needed for the assessment. This could be supplemented with the use of other data for context but ‘historical’ data should not be considered as a substitute for a full two years of data collection. Our position on this has been clear throughout the consultation.	This has been explained to RSPB, recorded in the Evidence Plan conference call notes and agreement put in place on how to prepare data appropriately for use in the ES Chapter, which has subsequently been completed in accordance with that agreement.

Date and consultation phase/ type	Consultation and key issues raised	Section where comment addressed
PEIR s42 comments	RSPB recommend that a displacement rate of up to 100% should be considered for red-throated diver within the Site and a 4km buffer. The use of alternate displacement rates, as presented in the PEIR are not sufficiently precautionary to estimate the impact of possible displacement.	The use of site-specific evidence on displacement levels continues through the assessments in this final ES Chapter (Sections 4.11 and 4.12). However, provision of additional displacement matrices are included in the Displacement Annex of this ES Chapter (Doc ref: 4.2.2.2).
PEIR s42 comments	RSPB recommend that auk displacement during construction and operation should be considered out to 2km as per SNCB guidance, even if the currently 1km scenario is also presented alongside this.	The use of site-specific evidence on displacement levels continues through the assessments in this final ES Chapter (Sections 4.11 and 4.12). However, provision of additional displacement matrices are included in the Displacement Annex of this ES Chapter (Doc ref: 4.2.2.2).
PEIR s42 comments	RSPB agree with NE's position, that whilst there is uncertainty around the validity of the outputs of the R-based stochastic CRM ("Masden" model-Masden (2015)) then the previous spread-sheet based Band model should be reverted to, whilst still incorporating some uncertainty. We recommend using 24 months of site-specific data where possible, but agree with the use of the BTO flight height distributions where site.	Revised CRM using Band 2012 with the use of bird density data from a full set of 24 months of data has been used in combination with SOSS02 flight height data (Section 4.12).
PEIR s42 comments	The RSPB recognise that the ES data being used to calculate cumulative displacement for red-throated divers will vary due to the data collection methods, spatial extent of surveys and predicted impacts applied. These inconsistencies in historical ES data could mean the relative contribution of the TEOWF and that the overall cumulative impact assessment, as currently presented, is unreliable. We accept that this assessment is problematic as are the multiple issues surrounding the use of 'historical' data. To circumvent these issues, we suggest the use of a 'common' underlying dataset of diver abundance, which covers the region of interested; to which the same impact (100% displacement over 4km buffers) could be applied to all sites of interest. This, for example, could use the SeaMaSTs data set and previously discussed during consultation meetings. We understand that the current cumulative assessment is subject to change, and is likely to adopt the approach suggested above or similar. We look forward to commenting on the revised cumulative assessment.	A revised assessment based on these principles was agreed through consultation with RSPB and NE on this topic and an updated assessment included in Section 4.13.

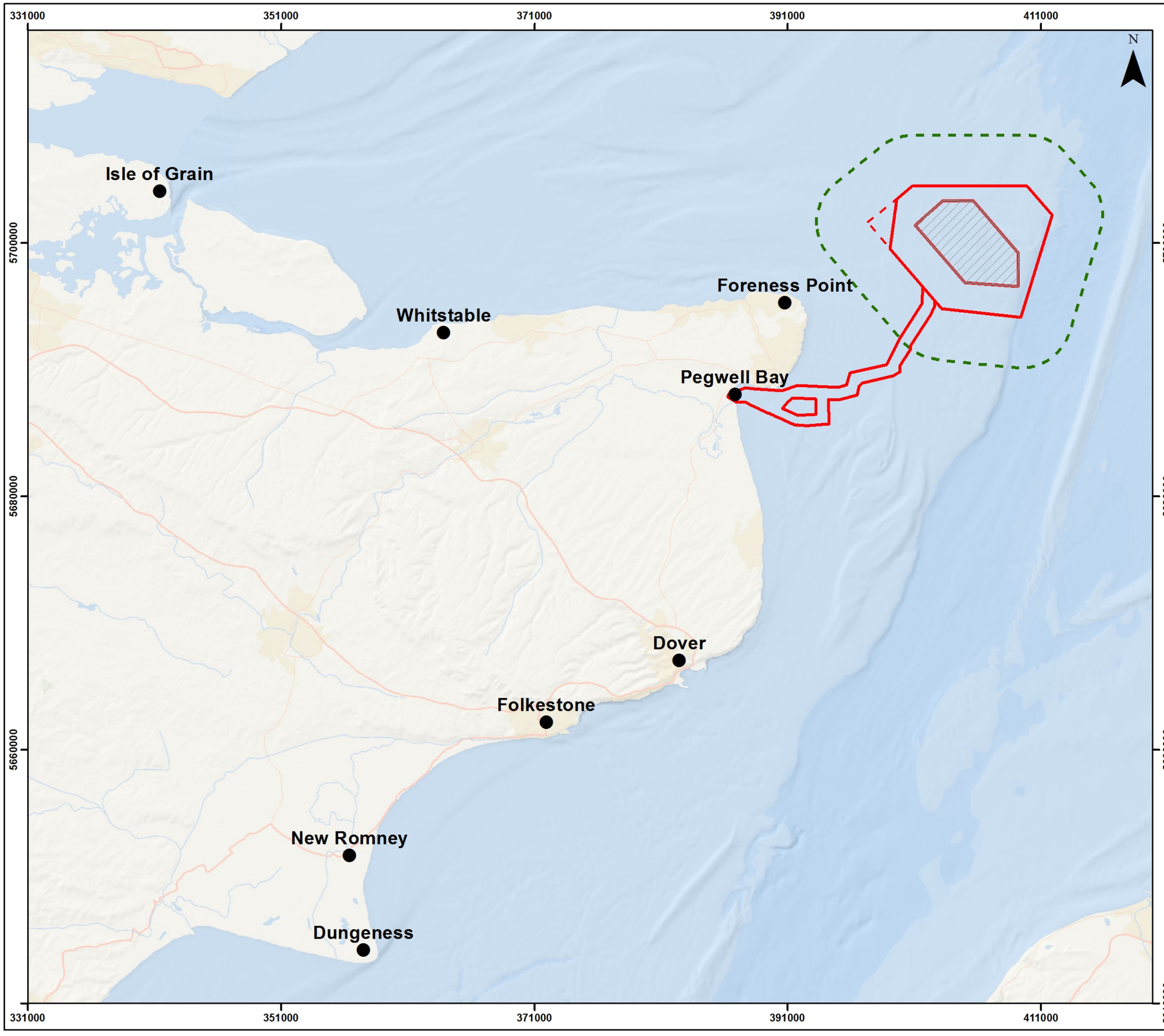
4.4 Scope and methodology

4.1.23 The offshore ornithology study area (Figure 4.1) includes the operational Thanet OWF area, the proposed Thanet Extension array area and a 4 km buffer around it, that extent of buffer being standard practice for offshore wind farm ornithology characterisation surveys and agreed as suitable with NE and RSPB (Table 4.2). The study area also includes the linear Offshore Export Cable Corridor (OECC) up to the Mean Low Water Spring (MLWS) mark. Birds occurring on the intertidal mud and sandflats are within the onshore ornithology study area and are assessed in Volume 3, Chapter 5, Terrestrial Ecology (Document Ref: 6.3.5).

4.1.24 It should be noted that the size of the Thanet Extension array area has subsequently been reduced by 4.05 km2 or 5.56 %, with the revised RLB presented in Figure 4.1. This means that the assessments in this chapter are precautionary, as they are based on the abundances presented in the Offshore Ornithology Baseline Technical Report (Document Ref: 6.4.4.1), which are based on the abundances accounting for bird distribution in relation to the PEIR RLB. As that PEIR RLB encompasses a greater area, those calculated bird abundances are higher than they would be if calculated from the revised RLB presented in Figure 4.1.

4.1.25 Baseline information obtained by desk based study was sourced as follows:

- Existing and proposed designated sites with birds as interest features from the websites of NE (https://www.gov.uk/government/organisations/natural-england), JNCC (http://jncc.defra.gov.uk/) and the Natura 2000 Network Viewer (http://natura2000.eea.europa.eu/#);
- The spatial extent of designated sites from the MAGIC map application (http://www.natureonthemap.naturalengland.org.uk/MagicMap.aspx);
- Historical information on bird distribution at sea e.g. from Skov *et al.* (1995) and Stone *et al.* (1995) and of seabird breeding colonies from Mitchell *et al.* (2004);
- Recent information on seabird breeding colonies from the JNCC seabird colony database (http://jncc.defra.gov.uk/page-4460);
- Information presented in the ES for the operational Thanet Offshore Wind Farm (TOWF);
- Information presented in the ES and Habitats Regulations Assessment (HRA) documents submitted by other OWF developers; and
- Published academic and ‘grey’ literature to which specific reference is made.
- Baseline information obtained by survey included:
- Aerial digital survey data were collected for 24 continuous months from March 2016 to February 2018, inclusive. The results of these 24 surveys are presented in full as well as summarised in the Offshore Ornithology Baseline Technical Report (Document Ref: 6.4.4.1); and
- Boat-based visual surveys from January to March 2016 with the results summarised in the Offshore Ornithology Baseline Technical Report (Document Ref: 6.4.4.1).
- Historical survey data was also accessed, including that from:
- A survey programme in support of the application for the TOWF comprising boat-based visual surveys over a 12 month period in 2004/05 and summarised in the ES;
- A survey programme of the TOWF and a 2 km buffer covering the pre-construction, construction and post-construction periods. This consisted of boat-based visual surveys over the winters of 2009/10, 2010/11, 2011/12 and 2012/13 as part of the discharge of licence consent conditions. These survey data are reported on and compared to more recent data are detailed in the Assessment of Historic Data from Thanet OWF in comparison to more recent Thanet Extension Data (Document Ref: 6.4.4.2) and summarised in the species accounts in the Offshore Ornithology Baseline Technical Report (Document Ref: 6.4.4.1); and
- A survey programme of the coastal and marine waters between Kent and Essex that led to the classification of the Outer Thames Estuary SPA (O’Brien et al., 2012).



APEM VATTENFALL

THANET EXTENSION OFFSHORE WIND FARM

Figure 4.1

Offshore ornithology study area (including Thanet Extension and the export cable corridor)

Legend

- Offshore Red Line Boundary
- Offshore PEIR Boundary
- Offshore PEIR Boundary 4 km Buffer
- Thanet Offshore Wind Farm
- Seabird Colony Sites

Datum: ETRS 1989
Projection: UTM31N

1:300,000 0 3 6 km 0 2 4 nm

Drg No	Figure 4.1 Offshore ornithology study area		
Rev	5.1	Date	16/05/2018
By	BG	Layout	N/A

Figure 4.1

4.5 Assessment criteria and assignment of significance

4.1.26 The terms beneficial or adverse have been used in this Chapter, and have been defined in Volume 1, Chapter 3: EIA Methodology (Document Ref: 6.1.3), to describe the nature of any potential effects. The terms Negligible, Minor, Moderate or Major have been used in this chapter, and have been defined in Volume 1, Chapter 3: EIA Methodology (Document Ref: 6.1.3), to describe the significance of predicted impacts. Any impacts that are assessed as moderate or major are deemed to be significant in terms of the EIA Regulations.

4.1.27 The terms short-, medium- or long-term have been used in this chapter, and have been defined in Volume 1, Chapter 3: EIA Methodology (Document Ref: 6.1.3) to describe the duration of the predicted effects. Effects have also been described as either temporary or permanent.

4.1.28 The terms temporary or permanent have been used in this Chapter, and have been defined in Volume 1, Chapter 3: EIA Methodology (Document Ref: 6.1.3), to describe the temporal nature of any potential effects.

4.1.29 The terms local (on site or neighbouring site), district (e.g. borough), regional (e.g. county), national (UK) and international have been used in this Chapter, and have been defined in Volume 1, Chapter 3: EIA Methodology (Document Ref: 6.1.3), to describe the geographical scale of the importance of receptors.

4.1.30 The magnitude of impact is defined in Table 4.3.

Table 4.3: Magnitude of Impact

Magnitude	Definition
High	A change in the size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site that is predicted to irreversibly alter the population in the short to long-term and to alter the long-term viability of the population and/ or the integrity of the protected site. Recovery from that change predicted to be achieved in the long-term (i.e. more than 5 years) following cessation of the development activity.
Medium	A change in the size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site that occurs in the short and long-term, but which is not predicted to alter the long-term viability of the population and/ or the integrity of the protected site. Recovery from that change predicted to be achieved in the medium-term (i.e. no more than five years) following cessation of the development activity.
Low	A change in the size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site that is sufficiently small-scale or of short duration to cause no long-term harm to the feature/ population. Recovery from that change predicted to be achieved in the short-term (i.e. no more than one year) following cessation of the development activity.
Negligible	Very slight change from the size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site. Recovery from that change predicted to be rapid (i.e. no more than circa 6 months) following cessation of the development activity.

4.1.31 The sensitivity of the receptors to sources of effect is defined in Table 4.4.

Table 4.4: Sensitivity of receptors to sources of effect

Receptor sensitivity	Description/ reason
High	Bird species has very limited tolerance of sources of disturbance such as noise, light, vessel movements and the sight of people.
Medium	Bird species has limited tolerance of sources of disturbance such as noise, light, vessel movements and the sight of people.
Low	Bird species has some tolerance of sources of disturbance such as noise, light, vessel movements and the sight of people.
Negligible	Bird species is generally tolerant of sources of disturbance such as noise, light, vessel movements and the sight of people.

4.1.32 The assessment of the significance of potential effects is described in Table 4.5.

Table 4.5: The assessment of the significance of potential effects

		Sensitivity			
		High	Medium	Low	Negligible
Negative Magnitude	High	*Major*	*Major*	*Moderate*	*Minor*
	Medium	*Major*	*Moderate*	*Minor*	*Negligible*
	Low	*Moderate*	*Minor*	*Minor*	*Negligible*
	Negligible	*Minor*	*Minor*	*Negligible*	*Negligible*
Beneficial Magnitude	Negligible	*Minor*	*Minor*	*Negligible*	*Negligible*
	Low	*Moderate*	*Minor*	*Minor*	*Negligible*
	Medium	*Major*	*Moderate*	*Minor*	*Negligible*
	High	*Major*	*Major*	*Moderate*	*Minor*

Note: Shaded cells are defined as significant effects in respect of the EIA Regulations.

4.6 Uncertainty and technical difficulties encountered

4.1.33 With regard to uncertainty, two issues have been identified:

- There are uncertainties related to the baseline information used to inform the assessment where this is based on survey information. Seabirds are highly mobile species and surveys conducted on one day per month are snapshots of the seabird density and distribution at the site and it should be recognised that abundance can vary considerably on both spatial and temporal scales. The use of the historic data from the TOWF pre-consent and post-consent surveys reduces this uncertainty by providing information over longer timescales.
- There are uncertainties related to the information available on other projects for inclusion in the cumulative assessments, particularly for projects that have been proposed, but are not yet consented. This is highlighted by the use of a tiered structure for the cumulative assessment with different degrees of uncertainty relating to each tier.

4.1.34 With regard to technical difficulties, two issues have been identified:

- The Thanet Extension RLB was changed at a late stage in the assessment process and the calculated bird abundances derived from aerial digital surveys of the Thanet Extension array area and a 4 km buffer around it have not been updated due to the short timescales and the complexity of the recalculations required. The result is that the bird abundances remain as calculated against the boundary published in the PEIR. This means that the assessment includes an additional element of precaution as those abundances calculated against the PEIR boundary will be higher than if they had been calculated against the reduced RLB.
- The proportion of birds at risk of potential collision, a key parameter applied in collision risk modelling using the Band method, is determined from field measurements of the range of heights at which each species of bird flies. There are three potential sources of bird flight height information. Two of these are specific to TOWF and Thanet Extension – that from the aerial digital surveys conducted by APEM and that from the ORJIP Bird Collision Avoidance Study. The third is derived from a large set of offshore wind farm pre-consent surveys conducted by boat-based observers throughout UK waters. There are technical difficulties with both the aerial digital survey flight height data and the ORJIP Bird Collision Avoidance Study. As a result the flight height information derived from surveys throughout UK waters has been applied in the collision risk modelling.

4.7 Existing environment

4.1.35 The proposed Thanet Extension array area, the 4 km buffer around it and the operational TOWF area are all sited off the north coast of Kent at the southern end of the North Sea. The linear OECC up to the MLWS mark in Pegwell Bay starts off the north coast of Kent but once it has passed a line east of North Foreland Point it can be considered to have entered the English Channel. Both the southern North Sea bioregion and the English Channel bioregion are not noted for large populations of breeding seabirds but the area is the route that large numbers take on their annual migrations between breeding and wintering areas each spring and autumn. Information about the existing bird populations using the offshore ornithology study area throughout the year is given below.

4.1.36 The distribution and numbers of birds present in the marine waters off the coast of Kent varies by season and in relation to biotic and geographic features such as food supply, water depth and distance from the shore. The at-sea distribution of seabirds based on the European Seabirds at Sea (ESAS) database has been described in Stone *et al.* (1995) and concentrations of seabirds in the southern North Sea described in Skov *et al.* (1995). The seasonal and spatial distribution of the most numerous bird species off the Kent coast is summarised below.

4.1.37 Seabirds that breed around the coast of Kent will forage in marine and coastal waters, with the distance travelled away from the breeding site dependent on the species (Thaxter et al., 2012). The location of seabird breeding colonies around the coast of Kent was identified through a systematic programme of surveys in 1998 - 2002 (Mitchell et al., 2004) and partially updated through the National Bird Atlas (Balmer et al., 2013) and the Kent Ornithological Society Tetrad Atlas 2007-11 (http://www.kentos.org.uk/atlas/). Seabird colony counts continue to be updated at some sites through the Seabird Monitoring Programme (SMP).

4.1.38 The SMP online database holds records for the following seabird colonies around the coast of Kent (travelling in a clockwise direction from the Isle of Grain to the Dungeness peninsula): Cliffe Pits; Medway Estuary and Marshes SPA; Rushenden Marsh; The Swale SPA; Whitstable; Herne Bay; Bishopstone (Reculver); Reculver; Foreness Point; North Foreland; Pegwell Bay; Pfizer's (Sandwich); Hope Point; Fan Bay; Langdon Cliffs; Dover Town; Shakespeare/Abbots Cliff; Copt Point, Folkestone; Folkestone; Hythe Town; Greatstone to Dymchurch; New Romney; and Dungeness to Pett Level SPA. In some cases the SMP database holds counts for several seabird colonies within a single protected site. In other cases a seabird colony occurs outside of any protected site (e.g. urban roof nesting gulls). This information is summarised in Table 4.6.

4.1.39 Table 4.6 which presents the most recent seabird colony data, noting that where there is both an 'accurate' count and an 'estimated' count for recent years, the year of the accurate count is presented (key to count: IL = individual on land; ON = Occupied Nests; OS = Occupied Site; OT = Occupied Territory. Key to data count standard: Accurate = (ac); Estimate = (es)). It is understood that sites for, and counts of, little tern and Mediterranean gull have not been included in the public access database as they are considered to be sensitive species (http://jncc.defra.gov.uk/page-4460).

Table 4.6: Seabird colony sites and recent counts around the coast of Kent

Seabird colony and protected site (where relevant)	Breeding seabird species	Year of count	Count (IL = individual on land; ON = Occupied Nests; OS = Occupied Site; OT = Occupied Territory) and Accurate = (ac); Estimate = (es)
Cliffe Pits, RSPB Reserve Thames Estuary & Marshes SPA	Black-headed gull	2015	2,300 ON (ac)
	Common tern	2015	10 ON (ac)
	Sandwich tern	2015	1 ON (ac)
Nor Marsh, RSPB Reserve Medway Estuary and Marshes SPA	Common tern	2015	1 ON (ac)
	Herring gull	2015	1 ON (ac)
	Lesser black-backed gull	2014	5 ON (ac)
	Black-headed gull	2014	483 ON (ac)
Burntwick Island Medway Estuary and Marshes SPA	Sandwich tern	2008	351 ON (ac)
	Common tern	2008	143 ON (ac)
	Black-headed gull	2000	8,750 IL (ac)
Deadmans Island Medway Estuary and Marshes SPA	Common tern	2006	0 OT (ac)
Greenborough Medway Estuary and Marshes SPA	Black-headed gull	2000	5,000 IL (ac)
	Lesser black-backed gull	2000	9 ON (ac)
	Common tern	2001	130 OT (ac)
Northward Hill, RSPB Reserve Medway Estuary and Marshes SPA	Common tern	2008	7 ON (es)
Rushenden Marsh	Black-headed gull	1986	20 ON (ac)
Castle Coote The Swale SPA	Black-headed gull	2011	0 ON (ac)
Elmley, RSPB Reserve The Swale SPA	Black-headed gull	2012	162 ON (ac)
	Common gull	2012	12 ON (ac)
	Lesser black-backed gull	2012	1 ON (ac)
Flanders Mare The Swale SPA	Black-headed gull	2004	2,000 IL (ac)
	Common tern	2007	0 ON (ac)
	Lesser black-backed gull	2006	0 ON (ac)
Mocketts Saltmarsh The Swale SPA	Black-headed gull	2002	227 ON (ac)
	Common tern	2000	3 ON (ac)
	Lesser black-backed gull	2002	2 ON (ac)
Murston Pits The Swale SPA	Black-headed gull	1990	30 ON (ac)
River Swale The Swale SPA	Black-headed gull	2000	160 IL (ac)
Shell Ness The Swale SPA	Lesser black-backed gull	2000	5 ON (ac)
	Black-headed gull	2003	200 IL (ac)

Seabird colony and protected site (where relevant)	Breeding seabird species	Year of count	Count (IL = individual on land; ON = Occupied Nests; OS = Occupied Site; OT = Occupied Territory) and Accurate = (ac); Estimate = (es)
Whitstable	Herring gull	2002	65 ON (ac)
	Lesser black-backed gull	2002	7 ON (es)
Herne Bay	Herring gull	2002	40 ON (es)
Bishopstone, Reculver	Fulmar	2000	3 ON (es)
Reculver	Black-headed gull	1999	4 IL (ac)
Foreness Point	Fulmar	1986	54 OS (ac)
North Foreland	Fulmar	1986	17 OS (ac)
Pegwell Bay	Fulmar	2016	9 OS (ac)
Pfizer's (Sandwich)	Herring gull	1994	6 OT (ac)
Hope Point	Kittiwake	1993	0 ON (ac)
	Fulmar	2016	7 OS (ac)
	Herring gull	2016	10 ON (ac)
Fan Bay, Crab and Fan Bay Cliffs	Kittiwake	2007	35 ON (ac)
	Herring gull	1994	63 ON (ac)
	Fulmar	1994	32 OS (ac)
Langdon Cliffs and Bay	Kittiwake	2001	0 ON (ac)
	Herring gull	1986	45 ON (ac)
	Fulmar	2001	14 OS (ac)
Dover Town	Herring gull	1994	323 ON (ac)
	Fulmar	1987	8 ON/S (ac)
Shakespeare/ Abbots Cliff	Fulmar	1999	6 ON (es)
Copt Point, Folkestone	Fulmar	1999	5 OS (es)
Folkestone Rooftops, Folkestone	Lesser black-backed gull	1999	3 ON (ac)
Hythe Town	Herring gull	1994	46 ON (ac)
Greatstone to Dymchurch, Dymchurch	Herring gull	2002	2 OS (ac)
Greatstone to Dymchurch, Greatstone	Herring gull	2002	2 ON (ac)
Greatstone to Dymchurch, St Mary's Bay	Herring gull	2002	2 OS (ac)
New Romney	Herring gull	1994	1 OT (ac)
ARC Pit, RSPB Reserve Dungeness to Pett Level SPA	Herring gull	2015	3 ON (ac)
	Lesser black-backed gull	2014	0 ON (ac)
	Great cormorant	2014	0 ON (ac)
	Common tern	2014	0 ON (ac)
	Black-headed gull	2014	0 ON (ac)
	Common gull	2014	0 ON (ac)
Burrowes Pit, RSPB Reserve Dungeness to Pett Level SPA	Common gull	2015	3 ON (ac)
	Great cormorant	2015	58 ON (ac)
	Herring gull	2015	9 ON (ac)

4.1.40 The Offshore Ornithology Baseline Technical Report (Document Ref: 6.4.4.1) presents the abundance and density estimates for all bird species recorded during site-specific surveys of the study area. Species included in this assessment are those recorded during the site-specific surveys that are considered to be at potential risk from the proposed project due to being present in high abundances, being potentially sensitive to OWFs or due to species-specific biological characteristics (such as flying at rotor swept heights), which make them potentially susceptible. This approach was agreed at the third Evidence Plan Meeting (see Table 4.2). These species include red-throated diver, gannet, kittiwake, herring gull, great black-backed gull, lesser black-backed gull, razorbill and guillemot for consideration against the potential impacts of the Thanet Extension site and 4 km buffer.

4.1.41 In agreement with NE and RSPB (Table 4.2) those species excluded from this assessment are species not commonly recorded from the site-specific surveys (within Thanet Extension and a 4 km buffer), those not sensitive to offshore wind farms and those with species-specific biological characteristics (such as flying below the rotor swept area), which make them not susceptible to potential impacts associated with offshore wind farms. These species include brent goose, shelduck, common scoter, great crested grebe, fulmar, cormorant, shag, little egret, Arctic skua, pomarine skua, great skua, black-headed gull, little gull, Mediterranean gull, common gull, Iceland gull, Sandwich tern and 'commic' tern.

4.1.42 With regards to the consideration of bird species within the OECC between Thanet Extension and the landfall on the Kent coast at Pegwell Bay a different range of species identified through a desk study are included within this assessment. These species include red-throated diver common scoter, razorbill and guillemot.

4.1.43 Set out in Table 4.7 is information on the conservation status of the species that are being carried forward for detailed assessment in the offshore ornithology assessment. The following status categories have been identified:

- IUCN Red List [status] – status as listed in the International Union for the Conservation of Nature (IUCN) Red List for Birds (BirdLife International, 2017);

  EU Red List [status] – status as listed in the European Union 27 Member States Red List of Birds (BirdLife International, 2015);
- EU Birds Annex 1 – listed in Annex 1 of the Birds Directive as a species for which SPAs should be identified;
- BoCC4 [status] – status (Red/Amber/Green) as listed in Birds of Conservation Concern 4 (Eaton *et al*., 2015); and
- NERC Sn 41 – listed as a species of principal importance for the conservation of biodiversity in England through the provisions of Section 41 of the Natural Environment and Rural Communities Act 2006;

Table 4.7: Conservation status of the species being assessed

Species	Conservation status
Red-throated diver	IUCN Least Concern; EU Red List Least Concern; EU Birds Annex 1; BoCC4 Green.
Gannet	IUCN Least Concern; EU Red List Least Concern; BoCC4 Amber.
Kittiwake	IUCN Least Concern; EU Red List Endangered; BoCC4 Red.
Herring gull	IUCN Least Concern; EU Red List Vulnerable; BoCC4 Red; NERC Sn 41.
Great black-backed gull	IUCN Least Concern; EU Red List Least Concern; BoCC4 Amber.
Lesser black-backed gull	IUCN Least Concern; EU Red List Least Concern; BoCC4 Amber.
Razorbill	IUCN Near Threatened; EU Red List Least Concern; BoCC4 Amber.
Guillemot	IUCN Least Concern; EU Red List Least Concern; BoCC4 Amber.

The array

4.1.44 The numbers and distribution of the species identified as being present in the area of the proposed array are described in the Offshore Ornithology Baseline Technical Report (Document Ref: 6.4.4.1). Summarised in Table 4.8 is the seasonal distribution, number and density found for each of the bird species that are the subject of detailed assessment. In addition, the bio-season abundance and density estimates are provided, with the peak bio-season highlighted in bold (note that data is not provided for the 4 km buffer for species not subject to assessment for disturbance and displacement assessments).

4.1.45 It should be noted that the assessments within this chapter are based upon the abundances and densities of seabirds within the PEIR Red Line Boundary (RLB), as described in the Offshore Ornithology Baseline Technical Report (Document Ref: 6.4.4.1). The size of the Thanet Extension site has subsequently been reduced by 4.05 km^2 or 5.56 %, with the revised RLB presented in Figure 4.1, meaning that the assessments in this chapter are precautionary, as they are based on higher levels of abundances for each species.

Table 4.8: Summarised species accounts

Species	Summary information				
Red-throated diver	Red-throated divers were absent from the Thanet Extension site and 4 km buffer for a large part of the calendar year (May to November inclusive, seven out of twelve months). Red-throated diver numbers peaked in the Thanet Extension site in the winter bio-season with an estimated mean peak of 194 individuals (2.66 birds/ km^2) and during the same bio-season in the 4 km buffer area with an estimated mean peak of 241 individuals (1.14 birds/ km^2), representing the peak bio-seasons for each area.				
	Bio-season	Migration-spring	Migration-free breeding	Migration-autumn	**Winter**
	Mean peak abundance (Site)	44	0	0	**194**
	Mean peak density (birds / km^2 in Site)	0.60	0.00	0.00	**2.66**
	Mean peak abundance (4 km Buffer)	217	0	0	**241**
	Mean peak density (birds / km^2 in 4 km Buffer)	1.03	0.00	0.00	**1.14**
Gannet	Gannets were present in the Thanet Extension site in migration-autumn and migration-spring bio-seasons (two of three bio-seasons) with a mean peak abundance of 96 individuals (1.31 birds/ km^2) estimated to be present during the migration-spring bio-season, representing the peak bio-season. They were present in all three bio-seasons in the 4 km buffer with an estimated mean peak of 384 individuals (1.81 birds/ km^2), representing the peak bio-season.				
	Bio-season	**Migration-spring**	Migration-free breeding	Migration-autumn	Winter
	Mean peak abundance (Site)	**96**	0	77	n/a
	Mean peak density (birds / km^2 in Site)	**1.31**	0.00	1.06	n/a
	Mean peak abundance (4 km Buffer)	**384**	27	324	n/a
	Mean peak density (birds / km^2 in 4 km Buffer)	**1.81**	0.13	1.53	n/a
Kittiwake	Kittiwakes were recorded in the Thanet Extension site during the migration-spring, migration-free breeding and migration-autumn bio-seasons (all three bio-seasons) with a mean peak of 235 individuals (3.23 birds/ km^2) estimated to be present during the migration-spring bio-season, representing the peak bio-season.				
	Bio-season	**Migration-spring**	Migration-free breeding	Migration-autumn	Winter
	Mean peak abundance (Site)	**235**	9	65	n/a
	Mean peak density (birds / km^2 in Site)	**3.23**	0.12	0.89	n/a
Herring gull	Herring gulls were recorded in the Thanet Extension site in all four bio-seasons, with the mean peak of 63 individuals (0.86 birds/ km^2) estimated to be present during the winter bio-season, representing the peak bio-season.				
	Bio-season	Migration-spring	Non-migratory breeding	Migration-autumn	Winter
	Mean peak abundance (Site)	62	17	4	**63**
	Mean peak density (birds / km^2 in Site)	0.85	0.23	0.05	**0.86**

Species	Summary information				
Great black-backed gull	Great black-backed gulls were recorded in the Thanet Extension site in all four bio-seasons, with the mean peak abundance of 78 individuals (1.07 birds/ km^2) estimated to be present during the migration-autumn bio-season, representing the peak bio-season.				
	Bio-season	Migration-spring	Migration-free breeding	**Migration-autumn**	Winter
	Mean peak abundance (Site)	39	9	**78**	65
	Mean peak density (birds / km^2 in Site)	0.54	0.12	**1.07**	0.89
Lesser black-backed gull	Lesser black-backed gulls were recorded in the Thanet Extension site in all four bio-seasons, with the mean peak abundance of 42 individuals (0.58 birds/ km^2) estimated to be present during the migration spring bio-season, representing the peak bio-season.				
	Bio-season	**Migration-spring**	Migration-free breeding	Migration-autumn	Winter
	Mean peak abundance (Site)	**42**	13	9	9
	Mean peak density (birds / km^2 in Site)	**0.58**	0.17	0.12	0.12
Razorbill	Razorbills were present in the Thanet Extension site during the migration-autumn, winter and migration-spring bio-seasons (three of four bio-seasons) with a mean peak abundance of 29 and 215 individuals in the Thanet Extension and 4 km buffer areas, respectively, (0.40 and 1.02 birds/ km^2) both estimated to be present during the migration-spring bio-season, representing the peak bio-season.				
	Bio-season	**Migration-spring**	Migration-free breeding	Migration-autumn	Winter
	Mean peak abundance (Site)	**29**	0	4	28
	Mean peak density (birds / km^2 in Site)	**0.40**	0.00	0.05	0.38
	Mean peak abundance (4 km Buffer)	**215**	0	52	71
	Mean peak density (birds / km^2 in 4 km Buffer)	**1.02**	0.00	0.25	0.33
Guillemot	Guillemots were present in the Thanet Extension site during all four bio-seasons with the mean peak abundance of 884 and 1,713 individuals in the Thanet Extension and 4 km buffer areas, respectively, (12.14 and 8.09 birds/ km^2) both estimated to be present during the migration-spring bio-season, representing the peak bio-season.				
	Bio-season	Migration-spring	Migration-free breeding	**Migration-autumn**	Winter
	Mean peak abundance (Site)	884	12.14	**1,713**	8.09
	Mean peak density (birds / km^2 in Site)	88	1.12	**339**	1.60
	Mean peak abundance (4 km Buffer)	5	0.06	**24**	0.11
	Mean peak density (birds / km^2 in 4 km Buffer)	9	0.12	**110**	0.52

The offshore export cable corridor

4.1.46 The OECC was subject to limited site-specific surveys in the marine environment between the low water mark of the landfall location and the Thanet Extension site. Survey records for the export cable through the 4 km buffer surrounding the Thanet Extension site and within 1-2 km offshore from the low water mark of the landfall location represent the only areas surveyed.

4.1.47 Due to the limited spatial and temporal nature of activities associated with the laying of an export cable only the most sensitive species would warrant assessment for this element of the proposed project. Site-specific data, alongside desk based study evidence, of bird species recorded within the proposed OECC, suggest that red-throated diver, common scoter, razorbill and guillemot are present.

4.1.48 Red-throated divers were recorded in the 4 km buffer during site-specific surveys (Document Ref: 6.4.4.1) and also within the near shore environment from the wintering bird surveys (Volume 5, Annex 5-5). They are also noted as present along the coast of Kent throughout the winter (Balmer et al., 2013), suggesting that they are present along the length of the proposed OECC.

4.1.49 Common scoters were not regularly recorded in the site-specific surveys within the Thanet Extension 4 km buffer (Document Ref: 6.4.4.1), but were recorded from November to February in the near shore environment (Volume 5, Annex 5-5). They are noted as present along the coast of Kent throughout the winter (Balmer et al., 2013), suggesting that they are more of feature of the near shore rather than the offshore section of the proposed OECC.

4.1.50 Both common scoter and red-throated diver are non-breeding visitors to the Kent coast. Surveys of the Thanet Extension site and 4 km buffer identify that red-throated diver is absent for a large part of the calendar year and that numbers will peak in the winter or migration-spring bio-seasons. Common scoter is expected to follow a similar pattern. The Sandwich Bay Bird Observatory lists it as a 'migrant and winter visitor' (http://sbbot.org.uk/species-lists/birds/) and applies the same description to red-throated diver. The migration recording website Trektellen (http://www.trektellen.nl/) records peak counts of common scoter at Sandwich Bay in November.

4.1.51 Both razorbill and guillemot were recorded in the 4 km buffer during site-specific surveys (Document Ref: 6.4.4.1) and also within the near shore environment from the wintering bird surveys (Volume 5, Annex 5-3, Document Ref: 6.5.5.3). They are also noted as present along the coast of Kent throughout the winter (Balmer et al., 2013), suggesting that they are present along the length of the proposed OECC. Both species are non-breeding visitors to the Kent coast and are absent for a large part of the calendar year, with numbers peaking in the winter or migration-spring bio-seasons.

4.8 Key parameters for assessment

4.1.52 The project design envelope sets out a series of design options for the project. The project design envelope has a reasoned minimum and maximum extent for a number of key parameters. The final design would lie between the minimum and the maximum extent of the consent sought, for all aspects of the project; this includes spatial, temporal and installation methodology. The project design envelope is used to establish the extent to which the project would impact on the environment, which is defined as the maximum adverse scenario or worst-case (Table 4.9). The detailed design of the project could then vary within this 'envelope' without rendering the assessment inadequate.

4.1.53 It should be noted that the worst-case scenario is based on the PEIR Red Line Boundary (RLB), as described in the Offshore Ornithology Baseline Technical Report (Document Ref: 6.4.4.1). The size of the Thanet Extension site has subsequently been reduced by 4.05 km2 or 5.56 %, with the revised RLB presented in Figure 4.1, meaning that the assessments in this chapter are precautionary, as they are based on higher levels of abundances for each species.

Table 4.9: Maximum design scenario assessed

Potential effect	Maximum design scenario assessed	Justification
Construction		
Impact 1: Disturbance and Displacement from increased vessel activity	A maximum of up to 48 vessels may be in operation on site at the same time during the construction phase.	The maximum number of vessel movements would cause the greatest disturbance and displacement to birds within the site and 4 km buffer. The maximum estimated period for construction is over 28 months. Construction activities would be scheduled to be undertaken 24 hours a day and 7 days a week for offshore works during that period, though would be intermittent and subject to periods of downtime.
Impact 2: Indirect effects as a result of displacement of prey species due to increased noise and disturbance to seabed	Spatial worst-case impact (maximum area of impact at one time and maximum anticipated pile energy) Monopiles: Single piling event, 30 x 10 m diameter WTG foundations, 28 x 12MW WTGs, one offshore substation and one met mast. Maximum hammer drive energy is 5,000 kJ. Temporal worst-case impact (greatest duration of pile driving) Jackets: Single piling event, 34 WTG foundations with four piles each, one offshore substation and one met mast. Maximum hammer drive energy is 5,000 kJ.	These spatial and temporal worst-case impacts were identified in relation to benthic organisms and fish that are potential bird prey in Volume 2, Chapter 5: Benthic Ecology (Document Ref: 6.2.5) and in Volume 2, Chapter 6: Fish and Shellfish Ecology (Document Ref: 6.2.6).
	Disturbance/ displacement from increased suspended sediment concentration.	The maximum scale for increased suspended sediment concentration was identified in Volume 2, Chapter 5: Benthic Ecology (Document Ref: 6.2.5).
	The maximum area of disturbance to benthic habitats during construction would be approximately 1.6 km^2 across the Thanet Extension site and OECC.	This maximum area was identified in relation to benthic habitats that support potential bird prey in Volume 2, Chapter 5: Benthic Ecology (Document Ref: 6.2.5).
O&M		
Impact 3: Disturbance and Displacement from offshore infrastructure and due to increased vessel and helicopter activity	An area of 73 km^2 plus a 4 km buffer with a maximum of 34 WTGs, with a minimum spacing of 716 x 480 m. Maximum of one offshore substation and one met mast. Maximum of 6 support vessels making a total of approximately 307 round trips to port per year combined to support the O&M programmes.	These are the parameters that identify the infrastructure and activity that can potentially give rise to disturbance and displacement and quantify the upper limit of each for the maximum adverse scenario.
Impact 4: Indirect effects due to habitat loss/ change of key prey species	The maximum possible above seabed footprint of the project including scour protection plus any cable protection. The overall total footprint for long-term habitat loss is: 0.30km^2	This maximum area was identified in relation to benthic habitats that support potential bird prey in Volume 2, Chapter 5: Benthic Ecology (Document Ref: 6.2.5).
Impact 5: Collision risk	Maximum number of WTGs, 34 10 MW WTGs, represents the worst-case scenario.	The CRM methods and outputs are provided for all three WTG scenarios in Document Ref: 6.4.4.2.
Impact 6: Barrier effects	Maximum offshore project area of 73 km^2 with a maximum of 34 WTGs, with minimum spacing of 716 x 480 m between WTGs as well as 1 offshore collector and 1 met mast.	These are the parameters that identify the infrastructure that can potentially give rise to a barrier effect and quantifies the upper limit of each for the maximum adverse scenario.

Potential effect	Maximum design scenario assessed	Justification
Decommissioning		
Impact 7: Disturbance and Displacement from decommissioning activities	Up to 48 vessels on site at any one time. Assumed to be similar to construction phase.	The nature and scale of impacts arising from the decommissioning phase are, at worst-case, expected to be similar to those generated during the construction phase.
Impact 8: Indirect effects due to habitat loss/ change for key prey species	Similar to construction phase, there would be habitat disturbance effects up to 0.30 km^2 across the Thanet Extension site. There would be limited noise disturbance due to no piling. There may also be reduced disturbance from cabling, if it remains *in situ*.	The nature and scale of impacts arising from the decommissioning phase are, at worst-case, expected to be similar to those generated during the construction phase.
Cumulative effects		
Cumulative 1: Offshore wind farm O&M phase direct disturbance and displacement	The cumulative effects of O&M, consented and proposed OWFs in the North Sea.	Projects have been identified for consideration in the cumulative assessment and placed in to a ‘tiered’ structure with those projects categorised as follows: • Built and operational projects • Projects that are under construction • Consented applications not yet implemented • Submitted applications not yet determined • Future [foreseeable] projects • This broad approach to the inclusion of projects identifies the maximum cumulative adverse scenario.
Cumulative 2: Offshore wind farm O&M phase collision risk	The cumulative effects of O&M, consented and proposed OWFs in the North Sea.	Projects have been identified for consideration in the cumulative assessment and placed in to a ‘tiered’ structure with those projects categorised as follows: • Built and operational projects • Projects that are under construction • Consented applications not yet implemented • Submitted applications not yet determined • Future [foreseeable] projects • This broad approach to the inclusion of projects identifies the maximum cumulative adverse scenario.
Cumulative 3: Offshore cable construction phase direct disturbance and displacement	The cumulative effects of consented and proposed offshore cable laying off the coast of Kent.	Projects have been identified for consideration in the cumulative assessment and placed in to a ‘tiered’ structure with those projects categorised as follows: • Built and operational projects • Projects that are under construction • Consented applications not yet implemented • Submitted applications not yet determined • Future [foreseeable] projects • This broad approach to the inclusion of projects identifies the maximum cumulative adverse scenario.

4.9 Embedded mitigation

4.1.54 Mitigation measures that were identified and adopted as part of the evolution of the project design (embedded into the project design) and that are relevant to offshore ornithology are listed in Table 4.10.

Table 4.10: Embedded mitigation relating to offshore ornithology

Parameter	Mitigation measures embedded into the project design
General	
Site Selection	The original (pre-scoping) site boundary was reduced in size in order that the 4 km buffer surrounding it did not extend into the Outer Thames Estuary SPA, thus distancing Thanet Extension from this European site. Following the formal Section 42 consultation process the array boundary has been further reduced with the benefit of minimising interactions with sensitive receptors inclusive of those relating to offshore ornithology, and the Outer Thames Estuary SPA in particular.
Construction	
N/A	Nothing further required
Operation and Maintenance	
N/A	Nothing further required
Decommissioning	
N/A	Nothing further required

4.10 Scoping of effects for assessment

4.1.55 The potential effects arising from the proposed Thanet Extension that might affect birds that occur in the offshore area are as follows:

Construction Phase

Impact 1: Direct disturbance and displacement:

4.1.56 The construction phase has the potential to affect birds in the marine environment through disturbance due to construction activities, including the installation of foundations, towers, blades, export cables and other infrastructure and the movement of vessels and helicopters. The disturbance created has the potential to result in displacement of birds from the site of construction, from a buffer around it and from routes used by vessels to access the construction site. This displacement would effectively result in temporary habitat loss through a reduction in the area available to birds for feeding, resting and moulting.

Impact 2: Indirect impacts through effects on habitats and prey species:

4.1.57 Indirect impacts through effects on habitats and prey species: Effects on habitats and prey species during the construction phase include those resulting from the production of underwater noise, as will occur during piling, and the creation of suspended sediments, as will occur during the preparation of the seabed for foundations. These effects might alter the behaviour or availability of bird prey species such as fish. Underwater noise might cause fish and mobile invertebrates to avoid the construction area or otherwise affect their behaviour. Suspended sediments might cause fish and mobile invertebrates to avoid the construction area. Suspended sediments might smother and hide immobile benthic prey. These processes result in less prey being available within the construction area and a buffer around it to foraging birds. Such potential effects on benthic invertebrates are assessed in Volume 2, Chapter 5: Benthic Ecology (Document Ref: 6.2.5), and on fish in Volume 2, Chapter 6: Fish and Shellfish Ecology (Document Ref: 6.2.6), both of which conclude that there are no significant effects predicted as a result of the proposed development.

Operation and Maintenance Phase

Impact 3: Direct disturbance and displacement

4.1.58 The presence of the operating WTGs has the potential to directly disturb and displace birds from within and around the proposed OWF. This has the potential to reduce the area available to birds for feeding, resting and moulting. Vessel activity associated with routine and unplanned maintenance also has the potential to disturb and displace birds, equally resulting in a reduction in the area available to birds for feeding, resting and moulting. The potential for impact on offshore birds from O&M disturbance and displacement effects is greater for birds that occupy an area for a long period such as when they are breeding nearby or are resident for the winter. Displacement of birds on passage (migration) is more appropriately better considered in terms of a barrier effect (dealt with below).

Impact 4: Indirect impacts through effects on habitats and prey species

4.1.59 Effects on habitats and prey species during the O&M phase include those resulting from the production of underwater noise, as will occur through the O&M of the WTGs, the production of Electro-Magnetic Fields (EMF) around the offshore electrical cabling and the generation of suspended sediments, as will occur due to scour around foundations or maintenance activities. These effects might alter the behaviour or availability of bird prey species such as fish and invertebrates as already described for the construction phase above. Similarly, these processes result in less prey being available within the O&M area and a buffer around it to foraging birds. Such potential effects on fish and benthic invertebrates are assessed in Document Ref: 6.2.6 and Document Ref: 6.2.5, respectively.

Impact 5: Collision risk

4.1.60 Birds which fly through the proposed WTG array whilst foraging for food, commuting between breeding sites and foraging areas or passing through on migration are at potential risk of collision with the WTG rotors and associated infrastructure. This might result in injury or death. The probability of this occurring is predicted through collision risk modelling (CRM).

Impact 6: Barrier effect

4.1.61 The presence of the operating Thanet Extension could potentially create a barrier to seasonal migratory movements and/ or regular foraging flights. The result would be permanent changes in bird flight routes. A bird making a detour around a WTG array would fly a greater distance, either daily or seasonally, which would increase its energy expenditure and potentially decrease its survival chances or those of the dependent young for which it was making foraging flights. Such effects might be expected to be greater on birds that regularly commute around a wind farm rather than on migrants that might encounter the wind farm once or twice per year.

4.11 Environmental assessment: Construction phase

4.1.62 There are two main potential impacts that may cause effects to bird populations during this phase of the proposed development, which are;

- Impact 1: Disturbance/ displacement; and
- Impact 2: Indirect impacts through effects on habitats and prey species.

Impact 1: Disturbance/ displacement

4.1.63 The offshore elements of the proposed development would take a maximum of 28 months to construct. The construction phase would, therefore, coincide with a maximum of three bird breeding periods, three wintering periods and up to five migration periods.

4.1.64 The construction phase would require the mobilisation of vessels and equipment and the installation of foundations, export cables and other infrastructure. These activities have the potential to disturb and displace birds from within and around the site of the offshore elements of the proposed project, including the location of the WTGs and the offshore cable corridor.

4.1.65 Direct disturbance of birds during the construction phase of a wind farm may occur due to vessel movements (moving to, from and within the area under construction), the physical presence of vessels, installation equipment (e.g. cranes) and their crews, as well as underwater and airborne noise from foundation installation and cable laying activities. Any impacts resulting from disturbance and displacement from these activities are considered to be short-term, temporary and reversible in nature, lasting only for the duration of construction activity, as birds would return to the area once construction activities have ceased. Disturbance and displacement of birds during the construction phase is most likely to affect birds foraging in and around the construction area.

4.1.66 The level of disturbance at each work location would differ dependent on the activities taking place, but there could be vessel movements at any time of day or night over the entire construction period.

4.1.67 Some species are more susceptible than others to disturbance, from construction activities, which may lead to subsequent displacement. Dierschke *et al.* (2016) noted both avoidance to varying degrees by some seabird species while others were attracted to offshore wind farms. Gulls are not considered susceptible to disturbance, as they are often associated with fishing boats (e.g. Camphuysen, 1995; Hüppop and Wurm, 2000;) and have been noted in association with construction vessels at the Greater Gabbard Offshore Wind Farm (GGOWL 2011) and close to active foundation piling activity at the Egmond aan Zee (OWEZ) wind farm, where they showed no noticeable reactions to the works (Leopold and Camphuysen, 2007). However, species such as divers and scoter have been noted to avoid shipping (Mitschke *et al*., 2001 from Exo et al., 2003, Schwemmer *et al*., 2011) with one study identifying the flushing distances of common scoter to have a median value of 804 m and a maximum value of 3.2 km (Schwemmer *et al*., 2011) and red-throated diver flushing at a median value of 400 m and a maximum value of 2 km (Bellebaum *et al*., 2006).

4.1.68 There are a number of different measures used to assess bird disturbance and displacement from areas of sea in response to activities associated with an offshore wind farm. Garthe and Hüppop (2004) developed a scoring system for such disturbance factors, which is used widely in OWF EIAs. Furness and Wade (2012) developed disturbance ratings for particular species, alongside scores for habitat flexibility and conservation importance in Scottish waters. These factors were used to define an index value that highlights the sensitivity of a species to disturbance and displacement. As many of these references relate to disturbance from helicopter and vessel activities, these are considered relevant to this assessment. Bradbury et al (2014) provided an update to the Furness and Wade (2012) paper to consider seabirds in English waters. More recently a joint SNCB interim displacement advice note (SNCBs, 2017) provides the latest advice for UK development applications on how to consider, assess and present information and potential consequences of seabird displacement from OWFs.

4.1.69 In order to focus the assessment of disturbance and displacement, a screening exercise was undertaken to identify those species most likely to be at risk (Table 4.11). The species identified as at risk were then assessed within the biological season within which an effect was most likely to occur. Any species with a low sensitivity to displacement, or recorded only in very small numbers within the Study Area (Figure 4.1) (that includes the offshore cable corridor) during the non-migratory breeding and wintering bio-seasons, were screened out of further assessment. Potential impacts during the spring and autumn migration bio-seasons were screened out as birds moving through the Thanet Extension site are not tied to any particular location and as a result displacement is not considered to result in any significant effects. However, in response to consultation with SNCBs and RSPB (Table 4.2), for those species that are screened in, additional assessments consider the potential effect of disturbance and displacement over all bio-seasons across a single year (an annual impact).

4.1.70 Following the screening exercise, those species potentially at risk as a result of disturbance and displacement during the construction phase of the Thanet Extension development were assessed using site-specific evidence from the TOWF post-consent monitoring surveys and reporting (Royal HaskoningDHV, 2013). The evidence available for the Thanet Extension project puts it in a unique and fortunate position, as the extensive post-consent monitoring survey programme analysed the abundance and density of non-breeding seabirds within and in close proximity to the TOWF site to provide evidence of bird behaviour in response to the project. These data are given priority over other data sources available on disturbance and displacement, as they are recent and site-specific, offering as robust an assessment as possible.

4.1.71 Definitive mortality rates associated with displacement for any seabird are not known and precautionary estimates have to be used (SNCBs, 2017). The approach taken for the proposed Thanet Extension project is to account for a range of mortality rates, from 1 to 5%, associated with the displacement of all seabirds considered in this assessment.

4.1.72 As described in section 4.1.6 It should be noted that abundances and densities of seabirds are based on the PEIR RLB (Figure 4.1). The size of the Thanet Extension site has subsequently been reduced by 4.05 km2 or 5.56 %, meaning that the assessments for disturbance and displacement are precautionary, as they are based on higher levels of abundances for each species.

Table 4.11: Construction Phase Disturbance and Displacement Screening

Receptor	Sensitivity to Disturbance & Displacement	Construction Phase Screening Result (IN or OUT)
Red-throated diver	High	**Screened IN** for all construction activities, including within the Thanet Extension site and OECC.
Common scoter	High	**Screened OUT** as the species was only recorded in minimal numbers within the Thanet Extension site and OECC.
Gannet	Very low (Negligible)	**Screened OUT** as the species was only recorded during its migration bio-seasons and has a Very Low (Negligible) sensitivity to construction activities.
Kittiwake	Very low (Negligible)	**Screened OUT** as species has a Very Low (Negligible) sensitivity to disturbance and displacement.
Herring gull	Very low (Negligible)	**Screened OUT** as species has a Very Low (Negligible) sensitivity to disturbance and displacement.
Great black-backed gull	Low	**Screened OUT** as species has a Low sensitivity to disturbance and displacement.
Lesser black-backed gull	Low	**Screened OUT** as species has a Low sensitivity to disturbance and displacement.
Razorbill	Medium & Low	**Screened IN** as regularly found in Thanet Extension site and 4 km buffer in the winter and migration spring bio-seasons in reasonable numbers. The species has a Medium sensitivity with regards to offshore wind farm construction activities and a Low sensitivity to cable laying.
Guillemot	Medium & Low	**Screened IN** as regularly found in Thanet Extension site and 4 km buffer in small numbers during the migration-free breeding, migration autumn and wintering bioseasons and in high numbers during the migration spring bio-seasons. The species has a Medium sensitivity with regards to offshore wind farm construction activities and a Low sensitivity to cable laying.

Red-throated diver

4.1.73 Red-throated diver has been identified as being particularly sensitive to human activities in marine areas, including through the disturbance effects of ship and helicopter traffic (Garthe and Hüppop, 2004, Schwemmer et al., 2011, Furness and Wade, 2012, Wade et al., 2016; SNCBs, 2017).

4.1.74 During the construction period red-throated divers may be subject to potential disturbance and displacement from the Thanet Extension site as well as the OECC, due to activities associated with the installation of WTGs and vessel movements in and out of the site. However, construction activities will be limited spatially, as construction works will not simultaneously occur at all WTG locations. The evidence from the TOWF during-construction monitoring surveys is that displacement of red-throated divers within the site was 82% and beyond the site boundary there was no displacement (Royal HaskoningDHV, 2013). Consequently, any potential effects are predicted to be limited to within a sphere of influence within the Thanet Extension site and not extend into the 4 km buffer.

4.1.75 During the migration-spring bio-season red-throated divers were present in the Thanet Extension site with a mean peak density of 0.60 birds/km^2 or an abundance of 44 individuals. If an 82% displacement rate is applied to the migration-spring red-throated diver population within the Thanet Extension site then an estimated 36 individuals may be subject to potential displacement. The estimated number of red-throated divers potentially subject to mortality during the migration-spring bio-season is between zero and two individuals (this is based upon mortality rates of 1% and 5%). The migration-spring BDMPS for red-throated divers is 13,277 (Furness, 2015). The potential magnitude of impact from the loss of up to two individuals during this bio-season will be Negligible (as this represents a potential increase in mortality relative to baseline mortality of between 0.01% to 0.06%), particularly considering the construction works are temporary and localised in nature. As the species is of High sensitivity to disturbance, the effect significance is at most Minor adverse. Displacement matrices with mean peak abundance estimates of red-throated diver during migrations-spring bio-season within the Thanet Extension site and a 4 km buffer are presented in Document Ref: 6.4.4.1.

4.1.76 During the winter bio-season red-throated divers were present in the Thanet Extension site with a mean peak density of 2.66 birds/ km^2 or an abundance of 194. If an 82% displacement rate is applied to the winter population of red-throated divers within the Thanet Extension site then an estimated 159 individuals may be subject to potential displacement. The estimated number of red-throated divers potentially subject to mortality during the winter bio-season is between two and eight individuals (this is based upon mortality rates of 1% or 5%). The winter BDMPS for red-throated divers is 10,177 (Furness, 2015). The potential magnitude of impact from a loss of two to eight individuals during this bio-season will be Negligible (as this represents a potential increase in mortality relative to baseline mortality of between 0.07% to 0.34%), particularly considering the construction works are temporary and localised in nature. As the species is of High sensitivity to disturbance, the effect significance is at most Minor adverse. Displacement matrices with mean peak abundance estimates of red-throated diver during the winter bio-season within the Thanet Extension site and a 4 km buffer are presented in Document Ref: 6.4.4.3.

4.1.77 Collectively, the total number of potentially displaced red-throated diver within all bio-seasons (in this case the migration-spring and wintering bio-seasons) would be 195 individuals. The estimated number of red-throated divers subject to mortality per annum would therefore be between two and ten individuals (this is based upon mortality rates of 1% or 5%). The total BDMPS with connectivity to UK waters for red-throated divers is 27,000 (Furness, 2015)., The potential magnitude of impact from a loss of two to ten individuals per annum will be Negligible (as this represents a potential increase in mortality relative to baseline mortality of between 0.03% to 0.16%), particularly considering the construction works are temporary and localised in nature. As the species is of High sensitivity to disturbance, the effect significance is at most Minor adverse. Additional displacement matrices with mean peak abundance estimates of red-throated diver during the winter bio-season within the Thanet Extension site and a 4 km buffer are presented in Document Ref: 6.4.4.3.

4.1.78 There is potential for disturbance and displacement of non-breeding red-throated diver resulting from the presence of a vessel installing the offshore cables, including the entire length of the export cable between the Thanet Extension site and the landfall location on the Kent coastline. However, cable laying vessels are static for large periods of time, and move only short distances as cable installation takes place. Offshore cable installation activity is also a low noise emitting operation, particularly when compared to noise associated with activities such as piling.

4.1.79 The magnitude of disturbance to red-throated diver has been estimated on a worst-case basis in accordance with the most recent SNCB guidance (SNCBs, 2017), as there is no site-specific evidence available. This is that there would be 100% displacement of those birds in a 2 km buffer surrounding the source - the cable laying vessel. This level of displacement can be evidenced as appropriate in this instance through Bellebaum *et al.* (2006), who recorded divers flying away from vessels at a distance of up to 2 km with a median value of 400 m and through Schwemmer *et al.* (2011).

4.1.80 In order to calculate the number of red-throated divers that would be potentially subject to displacement from the offshore cable corridor during the cable laying process, the density of red-throated divers recorded in the baseline aerial digital surveys (Document Ref: 6.4.4.1) in the 2 km buffer has been assumed to be the same along the length of the offshore cable corridor. The worst-case area from which birds could be displaced was defined as a circle with a 2 km radius surrounding the cable laying vessel, which is an area of 12.57 km2. If 100% displacement is assumed to occur in this area during the migration-spring and winter bio-seasons then up to 13 and 14 individuals, respectively would be displaced at any given time. Although the cable laying vessel moves slowly between Thanet Extension and the landfall area and individually displaced birds may move back into areas of sea where the vessel has vacated, for the purpose of this assessment displacement considers those birds displaced within a 2 km radius of the vessel, as calculated above, over the course of the cable laying period.

4.1.81 If the level of mortality of displaced birds were between 1 and 5% then under one bird would be potentially subject to mortality across a single migration-spring bio-season and under one bird in the winter bio-season as a result of any potential displacement effects from the offshore cable installation activities. When considering the migration and winter biologically defined minimum population scales (BDMPS) for the UK North Sea are 13,277 and 10,177 individuals (Furness, 2015), respectively, then the potential loss of between a minimum of zero and a maximum of one individual across each bio-season is considered to be an impact of Negligible magnitude. When considering the wider BDMPS population with connectivity to UK waters of 27,000 then the combined annual potential loss of between zero and one individual would also be an impact of Negligible magnitude.

4.1.82 The construction works, specifically offshore cable laying, are temporary and localised in nature and the magnitude of impact has been determined as Negligible. As the species is of High sensitivity to disturbance, the effect significance is at most minor adverse, but due to the very low number of individuals potentially effected the finding is therefore **Negligible** adverse significance.

Razorbill

4.1.83 Razorbills were recorded within the Thanet Extension site predominantly during the migration-spring and winter bio-seasons with mean peak estimates of 29 and 28 individuals, respectively (or densities of 0.40 and 0.38 birds/ km^2). Razorbills were also recorded within the 4 km buffer, mostly during the migration-spring bioseason, but also the migration autumn and winter bio-seasons, with mean peak estimates of 215, 52 and 71 individuals, respectively (or densities of 1.02, 0.25 and 0.33 birds/ km2). Razorbills are considered to have Medium general sensitivity to disturbance and displacement, based on their sensitivity to ship and helicopter traffic in Garthe and Hüppop (2004), Furness and Wade (2012), Wade *et al.* (2016) and the SNCB guidance (SNCBs, 2017). The assessment of potential construction activities affecting razorbill does not consider the migration-free breeding bio-season on its own, as this species was not present in this period within the Thanet Extension site or 4 km buffer.

4.1.84 During the construction period razorbills may be subject to potential disturbance and displacement from the Thanet Extension site as well as the OECC, due to activities associated with the installation of WTGs and vessel movements in and out of the site. However, construction activities will be limited spatially, as construction works will not simultaneously occur at all WTG locations. The evidence from the TOWF during-construction monitoring surveys is that displacement of razorbills within the site was 89% and beyond the site boundary up to 25% displacement within a 500 m buffer occurred (Royal HaskoningDHV, 2013). Consequently, any potential effects are predicted to be limited to within a sphere of influence within the Thanet Extension site and a 500 m buffer only. Additional displacement matrices with mean peak abundance estimates of razorbills for each bio-season within a 2 km buffer are presented in Document Ref: 6.4.4.3.

4.1.85 During the migration-spring bio-season razorbill were present in the Thanet Extension site and 4 km buffer with mean peak densities of 0.40 birds/ km^2 and 1.02 birds/ km2, respectively. If 89% and 25% displacement rates are applied to the migration-spring densities of razorbill within the Thanet Extension site and a 500 m buffer then an estimated 26 and 5 individuals, or 31 in total, may be subject to potential displacement, respectively. The estimated number of razorbills potentially subject to mortality during the migration-spring bio-season is between zero and two individuals (this is based upon mortality rates of 1% or 5%). The migration-spring BDMPS for razorbill is 591,874 (Furness, 2015). The potential magnitude of impact from the loss of between zero to two individuals during this bio-season will be Negligible (as this represents a potential increase in mortality relative to baseline mortality of between 0.00% to 0.002%), particularly considering the construction works are temporary and localised in nature. As the species is of medium sensitivity to disturbance, the effect significance is at most minor adverse, though this level of effect is more likely to cause no material difference, so the finding is therefore Negligible

4.1.86 During the migration-autumn bio-season razorbill were present in the Thanet Extension site and 4 km buffer with mean peak densities of 0.05 birds/ km^2 and 0.25 birds/ km2, respectively. If 89% and 25% displacement rates are applied to the migration-autumn densities of razorbill within the Thanet Extension site and a 500 m buffer then an estimated four and one individuals, or five in total, may be subject to potential displacement, respectively. The estimated number of razorbills potentially subject to mortality during the migration-autumn bio-season is zero individuals (this is based upon mortality rates of 1% or 5%), so there will be no potential impact magnitude or effect significance during the migration-autumn bio-season.

4.1.87 During the winter bio-season razorbills were present in the Thanet Extension site and 4 km buffer the mean peak densities were 0.38 birds/ km2 and 0.33 birds/ km2, respectively. If 89% and 25% displacement rates are applied to the winter densities of razorbill with the Thanet Extension site and 500 m buffer then an estimated 25 and two individuals, or 27 in total, may be subject to potential displacement, respectively. The estimated number of razorbills potentially subject to mortality during the winter bio-season is zero individuals (this is based upon mortality rates of 1 to 5%), so there will be no potential impact magnitude or effect significance during the winter bio-season.

4.1.88 Collectively, the total number of potentially displaced razorbills within all bioseasons (in this case the migration-spring, migration-autumn and wintering bioseasons) would be 63 individuals. The estimated number of razorbills potentially subject to mortality per annum would therefore be between one and two individuals (this is based upon mortality rates of 1% or 5%). The total BDMPS with connectivity to UK waters for razorbills 1,707,000 (Furness, 2015). The potential magnitude of impact from the loss of one to two individuals per annum will be Negligible (as this represents a potential increase in mortality relative to baseline mortality of under 0.001%), particularly considering the construction works are temporary and localised in nature. As the species is of medium sensitivity to disturbance, the effect significance is at most minor negative, but considering the number of individuals subject to mortality is very low a more realistic conclusion is that the effect significance is Negligible. Displacement matrices with mean peak abundance estimates of razorbill during the winter bio-season within the Thanet Extension site and a 2 km buffer are presented in Document Ref: 6.4.4.3.

4.1.89 The construction works, specifically offshore export cable laying, are temporary and more localised in nature, therefore the magnitude of impact has been determined as Negligible. If the mean peak densities of razorbills within the 4 km buffer are used for the entire cable corridor during the migration-spring, migration-autumn and wintering bioseasons bio-season of 1.02, 0.25 and 0.33 birds/ km^2, respectively then up to three, one and one individuals may be subject to displacement from a 1 km buffer surrounding the cable laying vessel, respectively. If mortality rates of between 1% and 5% are applied to these numbers of razorbills then zero individuals may be subject to mortality as a result when considering each bioseason individually or combined as an annual total. For this particular activity the species is considered to have a low sensitivity to disturbance in comparison to the wider scale of the full Thanet Extension site construction, therefore with no potential impact there is no negative effect significance.

Guillemot

4.1.90 Guillemots were recorded within the Thanet Extension site predominantly during migration-spring bio-season, with a mean peak of 602 individuals (8.26 birds/ km^2). Although the month of March is categorised as being within the migration-free breeding bio-season (Document Ref: 6.4.4.1), it is likely that birds within or in close proximity to the Thanet Extension site are migrating through the southern North Sea during this month to more northerly breeding colonies and are not local breeding birds (they are listed as a migrant and non-breeder in the Kent Ornithological Society Tetrad Atlas 2007-11 http://www.kentos.org.uk/atlas/2008/GU.shtml and the JNCC SMP database does not record any breeding guillemot on the Kent coast – see 'Existing environment' section above). This is evidenced by a drop off in numbers in April through to December 2016, reflecting the distance to the closest guillemot colonies on the North East coast of England, such as Bempton Cliffs, Yorkshire (312 km away). Therefore, those guillemots recorded in the month of March are included within the migration-spring bio-season as these individuals most likely reflect late passage migrants. Guillemots were also recorded within the 4 km buffer, mostly during migration-spring bio-season with a mean peak of 1,412 individuals (a density of 5.39 birds/ km2). Guillemots are also considered to have Low to Medium general sensitivity to disturbance and displacement, based on their sensitivity to ship and helicopter traffic in Garthe and Hüppop (2004), Furness and Wade (2012), Wade *et al.* (2016) and the SNCB guidance (SNCBs, 2017). The assessment of potential construction activities affecting guillemot does not consider the migration-free breeding, migration-autumn or winter bio-seasons as this species is only present in very low numbers during these periods within the Thanet Extension site. However, an annual total is provided, which accounts for this potential effect across all four periods together.

4.1.91 During the construction period guillemots may be subject to potential disturbance and displacement from the Thanet Extension site and 4 km buffer as well as the OECC, due to activities associated with the installation of WTGs and vessel movements in and out of the site. However, construction activities will be limited spatially, as construction works will not simultaneously occur at all WTG locations. The evidence from the TOWF during-construction monitoring surveys is that displacement of guillemots within the site was 67% and beyond the site boundary up to 25% displacement within a 1 km buffer occurred (Royal HaskoningDHV, 2013). Consequently, any potential effects are predicted to be limited to within a sphere of influence within the Thanet Extension site and a 1 km buffer only. Additional displacement matrices with mean peak abundance estimates of razorbills for each bio-season within a 2 km buffer are presented in Document Ref: 6.4.4.3.

4.1.92 During the migration-spring bio-season guillemots were present in the Thanet Extension site and 4 km buffer with mean peak densities of 8.26 birds/ km^2 and 5.39 birds/ km2 or mean peaks of 602 and 1,142 individuals, respectively. If 67% and 25% displacement rates are applied to the migration-spring densities of guillemot within the Thanet Extension site and 1 km buffer then an estimated 403 and 59 individuals, or 462 in total, may be subject to potential displacement, respectively. The estimated number of guillemots potentially subject to mortality during the migration-spring bio-season is between five and 24 individuals (this is based upon mortality rates of 1% or 5%). The migration-spring BDMPS for guillemot is 1,617,306 (Furness, 2015). The potential effect on this many individuals during this bio-season will be Negligible, particularly considering the construction works are temporary and localised in nature. As the species is of medium sensitivity to disturbance, the effect significance is at most Minor adverse.

4.1.93 Collectively, the total number of potentially displaced guillemots within all bio-seasons (in this case all four bio-seasons) would be 621 individuals within the Thanet Extension site and 265 in a 1 km buffer surrounding Thanet Extension. If 67% and 25% displacement rates are applied to the annual mean peak abundance of guillemot within the Thanet Extension site and 1 km buffer then an estimated 416 and 66 individuals, or 482 in total, may be subject to potential displacement, respectively. The estimated number of guillemots potentially subject to mortality per annum would therefore be between five and 24 individuals (this is based upon mortality rates of 1% or 5%). The total BDMPS with connectivity to UK waters for guillemots is 4,125,000 (Furness, 2015). The potential magnitude of impact of a loss of this number of individuals per annum will be Negligible, particularly considering the construction works are temporary and localised in nature. As the species is of Medium sensitivity to disturbance, the effect significance is at most Minor adverse. Displacement matrices with mean peak abundance estimates of guillemot during the winter bio-season within the Thanet Extension site and a 2 km buffer are presented in Document Ref: 6.4.4.3.

4.1.94 The construction works, specifically offshore export cable laying, are temporary and more localised in nature, therefore the magnitude of impact has been determined as Negligible. If the density of guillemots within the 4 km buffer is used for the entire cable corridor during the migration–spring and wintering bio-seasons of 5.39 and 0.52 birds/ km2 then 17 and two individuals may be subject to displacement from a 1 km buffer surrounding the cable laying vessel. If mortality rates of between 1% and 5% are applied to this number of guillemots then between zero to one and zero individuals may be subject to mortality as a result in the migration-spring and wintering bioseasons, respectively or between zero and one collectively. For this particular activity the species is considered to have a low sensitivity to disturbance in comparison to the wider scale of the full Thanet Extension site construction, therefore the effect significance is at most **Negligible** adverse.

Impact 2: Indirect impacts through effects on habitats and prey species

4.1.95 Indirect disturbance and displacement of birds may occur during the construction phase if there are impacts on prey species and the habitats of prey species. These indirect effects include those resulting from the production of underwater noise (e.g. during piling) and the generation of suspended sediments (e.g. during preparation of the seabed for foundations) that may alter the behaviour or availability of bird prey species. Underwater noise may cause fish and mobile invertebrates to avoid the construction area and also affect their physiology and behaviour. Suspended sediments may cause fish and mobile invertebrates to avoid the construction area and may smother and hide immobile benthic prey. These mechanisms result in less prey being available within the construction area to foraging seabirds. Such potential effects on benthic invertebrates and fish have been assessed in Volume 2, Chapter 5, Benthic Ecology (Document Ref: 6.2.5) and Volume 2, Chapter 6, Fish and Shellfish Ecology (Document Ref: 6.2.6) and the conclusions of those assessments inform this assessment of indirect effects on ornithology receptors.

4.1.96 With regard to noise impacts on fish, Volume 2, Chapter 6 Fish and Shellfish Ecology (Document Ref: 6.2.6) discusses the potential impacts upon fish relevant to ornithology as prey species. With regard to physical injury or behavioural changes underwater noise impacts on fish during construction of the proposed Thanet Extension project are considered to be Minor or Negligible (see Table 5-15, Document Ref: 6.2.6) for species such as herring, sprat and sandeel which are the main prey items of seabirds such as gannet, red-throated diver and auks. With a Minor or Negligible impact on fish that are bird prey species, it could be concluded that the indirect effect on seabirds occurring in or around the proposed Thanet Extension project during the construction phase is of a **Negligible** adverse effect.

4.1.97 With regard to changes to the seabed and to suspended sediment levels, Volume 2, Chapter 5 Benthic Ecology (Document Ref: 6.2.5) discusses the nature of any change and impact. Such changes are considered to be temporary, small scale and highly localised. The consequent indirect impact on fish through habitat loss is considered to be Minor or Negligible (see Table 5-15, Document Ref: 6.2.6) for species such as herring, sprat and sandeel which are the main prey items of seabirds such as gannet, red-throated diver and auks. With a Minor or Negligible impact on fish that are bird prey species, it could be concluded that the indirect effect on seabirds occurring in or around the proposed Thanet Extension project during the construction phase is of a **Negligible** adverse effect.

4.12 Environmental assessment: O&M phase

4.1.98 There are four main potential impacts that may cause effects to bird populations during this phase of the proposed development, which are;

- Impact 3: Disturbance/ displacement;
- Impact 4: Indirect impacts through effects on habitats & prey species;
- Impact 5: Collision risk; and
- Impact 6: Barrier effect.

Impact 3: Disturbance/ displacement

4.1.99 The presence of WTGs has the potential to directly disturb and displace birds from within and around the proposed development site. This is assessed as an indirect habitat loss, as it has the potential to reduce the area available to birds for feeding, resting and moulting. Vessel activity and the lighting of WTGs and associated ancillary structures could also attract (or repel) certain species of birds and affect migratory behaviour on a local scale.

4.1.100 Seabird species vary in their reactions to the presence of operational infrastructure (e.g. WTGs, substations and met mast) and to the maintenance activities that are associated with it (particularly ship and helicopter traffic), with Garthe and Hüppop (2004) presenting a scoring system for such disturbance factors, which is used widely in offshore wind farm EIAs. As OWFs are a new feature in the marine environment, there is limited evidence as to the disturbance and displacement effects of the operational infrastructure in the long-term.

4.1.101 There are a number of different measures used to determine bird displacement from areas of sea in response to activities associated with an offshore wind farm. Furness and Wade (2012), for example, use disturbance ratings for particular species, alongside scores for habitat flexibility and conservation importance to define an index value that highlights the sensitivity to disturbance and displacement. These authors also recognise that displacement may contribute to individual birds experiencing fitness consequences, which at an extreme level could lead to the mortality of individuals.

4.1.102 NE and JNCC issued a joint Interim Displacement Guidance Note (NE and JNCC 2012), which provides recommendations for presenting information to enable the assessment of displacement effects in relation to offshore wind farm developments. This has been superseded most recently by a joint SNCB interim displacement advice note (SNCBs, 2017), which provides the latest advice for UK development applications on how to consider, assess and present information and potential consequences of seabird displacement from offshore wind farms. These guidance notes have shaped the assessment provided below.

4.1.103 Both the presence of the infrastructure and the O&M activities associated with the proposed development have the potential to directly disturb birds. These activities could potentially displace birds from important areas for feeding, moulting and loafing. Reduced access to some areas could result, at the extreme, in changes to feeding and other behavioural activities resulting in a loss of fitness and a reduction in survival chances. Those species most at risk from displacement are those which rely on specialised habitats and food sources that have limited availability (Furness and Wade, 2012; Bradbury et al., 2014). However, for the majority of seabirds recorded in the Thanet Extension site, and a 4 km buffer surrounding it, similarly suitable habitats are found across the southern North Sea, which may be used should individuals be displaced and so any potential impacts on these species are unlikely.

4.1.104 The methodology presented in the NE/ JNCC joint Interim Advice Note (NE and JNCC, 2012) recommends a matrix is presented for each key species showing potential bird losses at differing rates of displacement and mortality. The approach to presenting disturbance and displacement incorporating the spatial extent of any influence out from the proposed development follow this guidance. This assessment estimates the potential risk as a result of disturbance and displacement from the Thanet Extension development using site-specific evidence from the TOWF post-consent monitoring surveys and reporting (Royal HaskoningDHV, 2013). The evidence available for the Thanet Extension project puts it in a unique and fortunate position, as the extensive post-consent monitoring survey programme analysed the abundance and density of non-breeding seabirds within and in close proximity to the TOWF site to provide evidence of bird behaviour in response to the project. These data are given priority over other data sources available on disturbance and displacement, as they are recent and site-specific, offering as robust an assessment as possible. With regards to the assessment of predicted losses, a range is used between 1 to 5%. These potential losses are then placed in the context of the relevant BDMPS populations to determine the magnitude of impact.

4.1.105 The assessment of O&M disturbance and displacement does not consider such effects on birds on migration for the majority of seabirds. This is because birds are most at risk from the effects of displacement when they are resident (e.g. during the migration-free breeding or wintering bio-seasons) and any displacement of migrating individuals is captured by an assessment presented in the section on barrier effects. However, in response to consultation with SNCBs and RSPB (Table 4.2), for each species additional assessments consider the potential effect of disturbance and displacement over all bio-seasons across a single year (an annual impact).

4.1.106 Following installation of the offshore cabling, the required O&M activities may have short-term and localised disturbance and displacement impacts on birds using the proposed development's site. However, disturbance from O&M activities associated with offshore cables would be minimal, temporary and localised, and is unlikely to result in detectable effects at either the local or regional population level. Therefore no effect is predicted. The focus of this section is therefore on the disturbance and displacement of birds due to the presence and operation of WTGs, other offshore infrastructure and any maintenance operations associated with them.

4.1.107 In order to focus the assessment of disturbance and displacement, a screening exercise was undertaken to identify those species most likely to be at risk (Table 4.12), focussing on the main species described in the Baseline Offshore Ornithology Technical Report (Document Ref: 6.4.4.1). The species identified as at risk were then assessed within the bio-season/s within which an effect was most likely to occur (e.g. red-throated diver in the winter bio-season). Any species with a low sensitivity to displacement, or recorded only in very small numbers within the Thanet Extension site and species-specific buffer area during the breeding and wintering seasons, was screened out of further assessment. In response to consultation with SNCBs, potential effects from displacement during the migration bio-seasons are also covered within this assessment, but may constitute the barrier effect also, which is discussed in the following sections.

4.1.108 It must be noted that all species abundances used in this assessment are based on the PEIR RLB. The RLB subsequently reduced in size from 72.83 km2 to 68.78 km2, a reduction of 4.05 km2. Therefore, each of the species-specific assessments for disturbance and displacement are considered to be precautionary, as they are based on higher abundances across a larger area.

4.1.109 Table 4.12 presents the general sensitivity to disturbance and displacement for each species. Displacement rates are based on the most recent guidance in the SNCB interim displacement advice note (SNCBs, 2017), which advocates the use of site-specific data where available to quantify species-specific displacement rates. Additional consideration in individual species assessments is given to monitoring reports on operational wind farms in European waters that have published figures on the extent of displacement (Krijgsveld et al., 2011; Leopold et al., 2011; Mendel et al., 2014; Vanermen et al., 2016; Braasch et al., 2013; Walls et al., 2013; Percival et al., 2015), where site-specific data is not available from the extensive programme of pre-construction, during construction and post-construction monitoring surveys of TOWF (Royal Haskoning, 2013).

Table 4.12: O&M Phase Disturbance and Displacement Screening

Receptor	Disturbance Susceptibility & Habitat Specialisation Scores	Overall Displacement Score & (Sensitivity)	Bio-season/s with peak numbers	O&M Phase Screening Result (IN or OUT)
Red-throated diver	5 & 4	9 (High)	Winter	**Screened IN** as regularly found in the Thanet Extension site and 4 km buffer.
Common scoter	5 & 4	9 (High)	Winter & Migration-spring	**Screened OUT** as only recorded in minimal numbers
Gannet	2 & 1	3 (Negligible)	Migration-spring & autumn	**Screened IN** as guidance requests inclusion regardless of scores.
Kittiwake	2 & 2	4 (Low)	Migration-spring	**Screened OUT** as species has a Low sensitivity to disturbance and displacement.
Herring gull	2 & 1	3 (Negligible)	Winter & Migration-autumn	**Screened OUT** as species has a Low sensitivity to disturbance and displacement.
Great black-backed gull	2 & 2	4 (Low)	Winter & Migration-spring	**Screened OUT** as species has a Low sensitivity to disturbance and displacement.
Lesser black-backed gull	2 & 1	3 (Negligible)	Migration-spring	**Screened OUT** as species has a Low sensitivity to disturbance and displacement.
Razorbill	3 & 3	6 (Medium)	Winter & Migration-spring	**Screened IN** as regularly found in Thanet Extension site and 4 km buffer in the winter and migration spring bio-seasons has a Low to Medium sensitivity.
Guillemot	3 & 3	6 (Medium)	Migration-spring	**Screened IN** as regularly found in Thanet Extension site and 4 km buffer in the migration-free spring bio-seasons and has a Low to Medium sensitivity.

Red-throated diver

4.1.110 Red-throated divers were recorded in the Thanet Extension site and 4 km buffer during the winter and migration-spring bio-seasons, being absent throughout the remainder of the year. Mean peak abundances were highest during the winter bio-season with an estimated 194 individuals within the Thanet Extension site and 241 individuals in the 4 km buffer (totalling 435 individuals). Mean peak abundances in the migration-spring bio-season were lower, with an estimated 44 individuals in the Thanet Extension site and 217 individuals in the 4 km buffer (totalling 261 individuals). They are considered to have high sensitivities to disturbance and displacement, based on their sensitivity to ship and helicopter traffic in Garthe and Hüppop (2004), Langston (2010) and an interpretation of the Furness and Wade (2012), Bradbury *et al.* (2014) and more recent SNCB interim guidance (SNCBs, 2017) species concern index values in the context of disturbance and/or displacement from a habitat.

4.1.111 In line with the SNCB interim guidance (SNCBs, 2017) the abundance estimates for the winter and migration-spring bio-periods have each been placed into individual displacement matrices. This assessment considers a site-specific worst-case displacement of 73% of all divers from within the Thanet Extension site and no displacement from the 4 km buffer for use as the estimate of the number of birds potentially disturbed and displaced. This was determined from the evidence provided by the analysis of the TOWF post-construction surveys that concluded there was 73% displacement within the wind farm site (Royal HaskoningDHV, 2013). The TOWF post-construction evidence found no divers were displaced beyond the site boundary (Royal HaskoningDHV, 2013), which has also been applied in this assessment. Each displacement matrix completed for this assessment has been prepared to present the abundances of red-throated divers within the Thanet Extension site only, as the assumption is that no divers are displaced from the 4 km buffer. In response to consultation with SNCBs and RSPB, additional displacement matrices with mean peak abundance estimates of red-throated diver during the winter and migration-spring bio-seasons within the Thanet Extension site and a 4 km buffer are presented in Document Ref: 6.4.4.3.

4.1.112 Definitive mortality rates associated with displacement for any seabird are not known and precautionary estimates have to be used. The approach taken for the proposed Thanet Extension project is to account for a range of mortality rates, from 1 to 5%, associated with the displacement of red-throated diver in the two bio-seasons considered in this assessment.

4.1.113 Applying these displacement rates to the winter bio-season would mean that 142 individuals within the Thanet Extension site (Table 4.13) and zero in the 4 km buffer would be subject to potential displacement. The estimated number of red-throated divers potentially subject to mortality during the winter bio-season within the Thanet Extension site and the 4 km buffer is between one and seven individuals (this is based upon mortality rates of 1 to 5%).

4.1.114 As the average baseline mortality rate for red-throated diver is 0.228 (Horswill and Robinson, 2015) and the winter BDMPS for red-throated divers is 10,177 (Furness, 2015)) then the total number of individuals lost from this BDMPS population per year is 2,320. If a maximum of one to seven individuals were to be lost from this BDMPS population due to the proposed development then the potential magnitude of impact during the winter bio-season would be Negligible as this level of loss would only be between 0.06 - 0.31% increase in mortality relative to baseline mortality rate, which is well under a 1.0% increase. As the species has High sensitivity to disturbance, the effect significance is **Minor** adverse at most during the winter bio-season.

Table 4.13: Displacement matrix presenting the number of red-throated divers in the Thanet Extension site only, during the winter bio-season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	1	1	1	1	1	2	2	2
10	0	0	1	2	4	6	8	10	12	14	16	17	19
20	0	0	2	4	8	12	16	19	23	27	31	35	39
30	0	1	3	6	12	17	23	29	35	41	47	52	58
40	0	1	4	8	16	23	31	39	47	54	62	70	78
50	0	1	5	10	19	29	39	49	58	68	78	87	97
60	0	1	6	12	23	35	47	58	70	81	93	105	116
70	0	1	7	14	27	41	54	68	81	95	109	122	136
73	0	1	7	14	28	42	57	71	85	99	113	127	142
80	0	2	8	16	31	47	62	78	93	109	124	140	155
90	0	2	9	17	35	52	70	87	105	122	140	157	175
100	0	2	10	19	39	58	78	97	116	136	155	175	194

4.1.115 Applying the same displacement rates to the migration-spring bio-season population of red-throated divers would mean that 32 individuals within the Thanet Extension site (Table 4.14) and zero individuals in the 4 km buffer would be subject to potential displacement. The estimated number of red-throated divers potentially subject to mortality during the migration-spring bio-season within the Thanet Extension site and the 4 km buffer is between zero and two individuals (this is based upon mortality rates of 1 to 5%).

4.1.116 As the average baseline mortality rate for red-throated diver is 0.228 (Horswill and Robinson, 2015) and the migration-spring BDMPS for red-throated diver is 13,277 (Furness, 2015) then the total number of individuals lost from this BDMPS population per year is 3,027. If a maximum of zero to two individuals were to be lost from this BDMPS population due to the proposed development then the potential magnitude of impact during the migration-spring bio-season would be no change to Negligible as this level of loss would only be between 0.01 - 0.05% increase in mortality relative to baseline mortality rate, which is well under a 1.0% increase. As the species has High sensitivity to disturbance, the effect significance is Minor adverse at most during the migration-spring bio-season, but due to the very low number of individuals potentially affected the finding is therefore **Negligible** adverse.

Table 4.14: Displacement matrix presenting the number of red-throated divers in the Thanet Extension site only, during the migration-spring bio-season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	1	1	2	2	3	3	4	4	4
20	0	0	0	1	2	3	4	4	5	6	7	8	9
30	0	0	1	1	3	4	5	7	8	9	11	12	13
40	0	0	1	2	4	5	7	9	11	12	14	16	18
50	0	0	1	2	4	7	9	11	13	15	18	20	22
60	0	0	1	3	5	8	11	13	16	18	21	24	26
70	0	0	2	3	6	9	12	15	18	22	25	28	31
73	0	1	7	14	28	42	57	71	85	99	113	127	142
80	0	0	2	4	7	11	14	18	21	25	28	32	35
90	0	0	2	4	8	12	16	20	24	28	32	36	40
100	0	0	2	4	9	13	18	22	26	31	35	40	44

4.1.117 Collectively, the total number of potentially displaced red-throated diver within all bio-seasons (in this case the migration-spring and wintering bio-seasons) would be 174 individuals. The estimated number of red-throated divers subject to mortality per annum would therefore be between two and nine individuals (this is based upon mortality rates of 1% or 5%). The total BDMPS with connectivity to UK waters for red-throated divers is 27,000 (Furness, 2015), therefore the potential magnitude of impact of a loss of this number of individuals per annum will be Negligible. As the species is of High sensitivity to disturbance, the effect significance is at most **Minor** adverse. Displacement matrices with mean peak abundance estimates of red-throated diver during the winter bio-season within the Thanet Extension site and a 4 km buffer are presented in Document Ref: 6.4.4.3.

Gannet

4.1.118 Gannets show a low level of sensitivity to ship and helicopter traffic (Garthe and Hüppop, 2004, Furness and Wade, 2012); however a detailed study (Krijgsveld et al., 2011) using radar and visual observations to monitor the post-construction effects of the OWEZ established that 64% of gannets avoided entering the wind farm (macro-avoidance). The results of the post-consent monitoring surveys for TOWF found that gannet densities reduced within the site in the third year, but the report did not quantify this (Royal HaskoningDHV, 2013). A more recent study by APEM (APEM, 2014) provided evidence that during their migration most gannets would avoid flying into areas with operational WTGs (macro avoidance), with the estimated macro avoidance being 95%. The same paper (APEM, 2014) found the most significant avoidance in response to turbines and no significant avoidance with respect to buffer zones away from the overall wind farm footprint.

4.1.119 The displacement matrices in Table 4.15 and Table 4.16 have been populated with data for gannets during the migration-spring and migration-autumn bio-seasons within the Thanet Extension site only, as there is no evidence that gannets are displaced beyond wind farm site boundaries, particularly during migration.

4.1.120 For the purpose of this assessment the percentage displacement rates are presented at 10% intervals (0 - 100%), with additional columns for 1 – 5% mortality rates. The cells highlighted in green are for a displacement rate 100%. The cells highlighted in pink represent a precautionary estimate for potential mortality rates for gannets during the migration bio-seasons, which are assumed to lie between 1 – 5% (5% representing a very precautionary level), as they score highly for habitat flexibility (Furness and Wade, 2012; Bradbury et al, 2014). A high score in habitat flexibility is given to species that use a wide range of habitats over a large area, and usually with a relatively wide range of foods (Furness and Wade 2012). In addition, as the peak bio-seasons for gannet in the Thanet Extension are both migratory periods then any effects are Negligible as birds are not resident or dependant upon the area during these periods. Overall gannet's sensitivity to displacement is considered to be low for the purpose of this assessment, where the birds occur outside their breeding season, predominantly on migration.

4.1.121 The estimated number of gannets potentially subject to mortality during the migration-spring bio-season is a single individual (this is based upon a mortality rate of 1% applied to 100% of birds displaced from the Thanet Extension site only) or a very precautionary five individuals (based upon a mortality rate of 5% applied to the 100% of birds displaced from the Thanet Extension site only). The UK North Sea and Channel BDMPS population of gannets during the migration-spring bio-season is estimated at 248,385 individuals (including adults, juveniles and immature birds), with a baseline mortality rate of 19.1% (Horswill and Robinson, 2015), which equates to the loss of 47,442 individuals per annum from this BDMPS population. The potential loss of a maximum additional five individuals to this BDMPS population as a result of being displaced by the proposed development represents under a 0.01% increase relative to the current BDMPS mortality rate. When applying the matrix approach to impact assessment, the magnitude of impact at this BDMPS level during the migration spring bio-season is considered to be Negligible. As this species is of Low sensitivity to disturbance and displacement, the effect significance during the migration-spring bio-season is **Negligible** adverse.

Table 4.15: Displacement matrix presenting the number of gannets in the Thanet Extension site only, during the migration-spring bio-season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
10	0	0	0	0	0	0	1	2	3	4	5	6	7	8	9	10
20	0	0	0	1	1	1	2	4	6	8	10	12	13	15	17	19
30	0	0	1	1	1	1	3	6	9	12	14	17	20	23	26	29
40	0	0	1	1	2	2	4	8	12	15	19	23	27	31	35	38
50	0	0	1	1	2	2	5	10	14	19	24	29	34	38	43	48
60	0	1	1	2	2	3	6	12	17	23	29	35	40	46	52	58
70	0	1	1	2	3	3	7	13	20	27	34	40	47	54	60	67
80	0	1	2	2	3	4	8	15	23	31	38	46	54	61	69	77
90	0	1	2	3	3	4	9	17	26	35	43	52	60	69	78	86
100	0	1	2	3	4	5	10	19	29	38	48	58	67	77	86	96

4.1.122 The estimated number of gannets potentially subject to mortality during the migration-autumn bio-season is one individual (this is based upon a mortality rate of 1% applied to 100% of birds displaced from the Thanet Extension site only) or a very precautionary four individuals (based upon a mortality rate of 5% applied to the 100% of birds displaced from the Thanet Extension site only). The UK North Sea and Channel BDMPS population of gannets during the migration-autumn bio-season is estimated at 456,298 individuals (including adults, juveniles and immature birds), with a baseline mortality rate of 19.1%, which equates to the loss of 87,153 individuals per annum from this BDMPS population. The potential loss of an additional one individual to this BDMPS population as a result of being displaced by the proposed development represents under a 0.001% increase relative to the current BDMPS mortality rate. When applying the matrix approach to impact assessment the magnitude of impact at this BDMPS level during the migration autumn bio-season is considered to be no change, or Negligible at worse. As this species is of Low sensitivity to disturbance and displacement, the effect significance during the migration-autumn bio-season is **Negligible** adverse.

Table 4.16: Displacement matrix presenting the number of gannets in the Thanet Extension site only, during the migration-autumn bio-season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
10	0	0	0	0	0	0	1	2	2	3	4	5	5	6	7	8
20	0	0	0	0	1	1	2	3	5	6	8	9	11	12	14	15
30	0	0	0	1	1	1	2	5	7	9	12	14	16	18	21	23
40	0	0	1	1	1	2	3	6	9	12	15	18	22	25	28	31
50	0	0	1	1	2	2	4	8	12	15	19	23	27	31	35	39
60	0	0	1	1	2	2	5	9	14	18	23	28	32	37	42	46
70	0	1	1	2	2	3	5	11	16	22	27	32	38	43	49	54
80	0	1	1	2	2	3	6	12	18	25	31	37	43	49	55	62
90	0	1	1	2	3	3	7	14	21	28	35	42	49	55	62	69
100	0	1	2	2	3	4	8	15	23	31	39	46	54	62	69	77

4.1.123 Collectively, the total number of potentially displaced gannets within all bio-seasons (in this case the migration-spring and migration-autumn bio-seasons) would be 173 individuals. The estimated number of gannets subject to mortality per annum would therefore be between two and nine individuals (this is based upon mortality rates of 1% or 5%). The total BDMPS with connectivity to UK waters for gannets is 1,180,000 (Furness, 2015), therefore the potential magnitude of impact of a loss of this number of individuals per annum will be no change or Negligible. As this species is of Low sensitivity to disturbance and displacement, the effect significance is at most **Negligible** adverse.

Auks (Razorbill and Guillemot)

4.1.124 Both razorbills and guillemots were recorded in the Thanet Extension site and 4 km buffer, with abundances being highest during the migration-spring bio-season (Jan to Mar for razorbills and Dec to Mar for guillemots). They are considered to have low to medium sensitivities to disturbance and displacement, based on their sensitivity to ship and helicopter traffic in Garthe and Hüppop (2004), Langston (2010) and an interpretation of the Furness and Wade (2012), Bradbury *et al.* (2014) and more recent SNCB interim guidance (SNCBs, 2017) species concern index values in the context of disturbance and/or displacement from a habitat.

4.1.125 In line with the SNCB interim guidance (SNCBs, 2017) the mean peak abundance estimates for the migration-spring bio-periods have each been placed into individual displacement matrices for each auk species. An additional displacement matrix is presented for razorbill for the winter bioseason. Each displacement matrix completed for this assessment has been prepared to present the mean peak abundances of guillemots and razorbills within the Thanet Extension development site, with additional displacement from an appropriately sized buffer determined by the post-construction monitoring of TOWF (Royal HaskoningDHV, 2013).

4.1.126 Each matrix displays displacement rates and mortality rates for each species with ranges from 0 – 100% within the Thanet Extension site. For the purpose of these assessments displacement rates of 79% within the Thanet Extension site and 23% within a 1 km buffer have been determined from site-specific evidence for guillemot (Royal HaskoningDHV, 2013). For the assessments on razorbill displacement rates of 95% within the Thanet Extension site and 25% within a 1 km buffer have been determined from site-specific evidence for razorbill (Royal HaskoningDHV, 2013). However, these displacement rates were only found during the first year of post-construction surveys, with increases for both species to above pre-construction abundances (and densities) in the second and third year of post-construction surveys (Royal HaskoningDHV, 2013). Mortality rates of between 1 - 5% are highlighted in each matrix, representing the worst-case scenario for this assessment. In response to consultation with SNCBs and RSPB additional displacement matrices with mean peak abundance estimates of razorbills and guillemots within the Thanet Extension site and a 2 km buffer are presented in Document Ref: 6.4.4.3 for the same bio-seasons assessed in this section.

Razorbill

4.1.127 During the migration-spring bio-season razorbills were present in the Thanet Extension site and 4 km buffer with mean peak densities of 0.40 birds/ km2 and 1.02 birds/ km2 or mean peak abundances of 29 and 215 individuals, respectively. The mean peak abundance of razorbills in a 500 m buffer surrounding the Thanet Extension site is 21 individuals. If the level of displacement described in paragraph 4.1.126 is applied to the migration-spring densities of razorbill within the Thanet Extension site and a 500 m buffer then an estimated 28 (Table 4.17) and five (Table 4.21), a total of 33, individuals may be subject to potential disturbance and displacement, respectively. The number of individuals potentially subject to mortality in the migration-spring bio-season may be between one and two individuals with a range of between 1 and 5% mortality rates.

4.1.128 As the average baseline mortality rate for razorbill is 0.174 (Horswill and Robinson, 2015) and the migration-spring BDMPS for razorbill is 591,874 (Furness, 2015) then the total number of individuals lost from this BDMPS population per year is 102,986. If the total is between zero and two individuals estimated to be lost from this BDMPS population due to the proposed development then the potential magnitude of impact during the migration-spring bio-season will be no change to Negligible as it is well under a 0.01% increase in mortality relative to baseline mortality and nowhere close to approaching the 1% threshold considered for further assessment. As the species has Low to Medium sensitivity to disturbance, the significance of effect is **Negligible** adverse during the migration-spring bio-season.

Table 4.17: Displacement matrix presenting the number of razorbill in the Thanet Extension site only, during the migration-spring bio-season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	1	1	1	1	2	2	2	3	3
20	0	0	0	1	1	2	2	3	3	4	5	5	6
30	0	0	0	1	2	3	3	4	5	6	7	8	9
40	0	0	1	1	2	3	5	6	7	8	9	10	12
50	0	0	1	1	3	4	6	7	9	10	12	13	15
60	0	0	1	2	3	5	7	9	10	12	14	16	17
70	0	0	1	2	4	6	8	10	12	14	16	18	20
80	0	0	1	2	5	7	9	12	14	16	19	21	23
90	0	0	1	3	5	8	10	13	16	18	21	23	26
95	0	0	1	3	6	8	11	14	17	19	22	25	28
100	0	0	1	3	6	9	12	15	17	20	23	26	29

Table 4.18: Displacement matrix presenting the number of razorbill in the 500 m buffer only, during the migration-spring bio-season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	1	1	1	1	1	2	2	2
20	0	0	0	0	1	1	2	2	3	3	3	4	4
25	0	0	0	1	1	2	2	3	3	4	4	5	5
30	0	0	0	1	1	2	3	3	4	4	5	6	6
40	0	0	0	1	2	3	3	4	5	6	7	8	9
50	0	0	1	1	2	3	4	5	6	7	9	10	11
60	0	0	1	1	3	4	5	6	8	9	10	12	13
70	0	0	1	1	3	4	6	7	9	10	12	13	15
80	0	0	1	2	3	5	7	9	10	12	14	15	17
90	0	0	1	2	4	6	8	10	12	13	15	17	19
100	0	0	1	2	4	6	9	11	13	15	17	19	21

4.1.129 During the winter bio-season razorbills were present in the Thanet Extension site and 4 km buffer with mean peak densities of 0.38 birds / km2 and 0.30 birds / km2 or mean peak abundances of 28 and 71 individuals, respectively. The mean peak abundance of razorbills in a 500 m buffer surrounding the Thanet Extension site is 6 individuals. If the level of displacement described in section 4.1.126 is applied to the migration-spring densities of razorbill within the Thanet Extension site and a 500 m buffer then an estimated 27 (Table 4.19) and two (Table 4.2Table 4.2), a total of 29 individuals may be subject to potential disturbance and displacement, respectively. The number of individuals potentially subject to mortality in the winter bio-season may be zero individuals with a range of between 1 and 5% mortality rates. As there are no razorbills estimated to be subject to mortality during the winter bio-season then the potential magnitude of impact will be no change and consequently the significance of effect is No Change also.

Table 4.19: Displacement matrix presenting the number of razorbill in the Thanet Extension site only, during the winter bio-season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	1	1	1	1	2	2	2	3	3
20	0	0	0	1	1	2	2	3	3	4	4	5	6
30	0	0	0	1	2	3	3	4	5	6	7	8	8
40	0	0	0	1	2	3	4	6	7	8	9	10	11
50	0	0	0	1	3	4	6	7	8	10	11	13	14
60	0	0	0	2	3	5	7	8	10	12	13	15	17
70	0	0	0	2	4	6	8	10	12	14	16	18	20
80	0	0	0	2	4	7	9	11	13	16	18	20	22
90	0	0	0	3	5	8	10	13	15	18	20	23	25
95	0	0	0	3	5	8	11	13	16	19	21	24	27
100	0	0	0	3	6	8	11	14	17	20	22	25	28

Table 4.20: Displacement matrix presenting the number of razorbill in the 500 m buffer only, during the winter bio-season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	1	1	1
20	0	0	0	0	0	0	1	1	1	1	1	1	1
25	0	0	0	0	0	0	1	1	1	1	1	1	2
30	0	0	0	0	0	1	1	1	1	1	2	2	2
40	0	0	0	0	1	1	1	1	2	2	2	2	3
50	0	0	0	0	1	1	1	2	2	2	3	3	3
60	0	0	0	0	1	1	2	2	2	3	3	3	4
70	0	0	0	0	1	1	2	2	3	3	4	4	4
80	0	0	0	1	1	2	2	3	3	4	4	5	5
90	0	0	0	1	1	2	2	3	3	4	5	5	6
100	0	0	0	1	1	2	3	3	4	4	5	6	6

4.1.130 Collectively, the total number of potentially displaced razorbills within all bio-seasons (in this case the migration-spring, migration autumn and winter bio-seasons as none recorded in breeding bio-season) would be 66 individuals. The estimated number of razorbills subject to mortality per annum would therefore be between one and two individuals (this is based upon mortality rates of 1% or 5%). The total BDMPS with connectivity to UK waters for razorbills is 1,707,000 (Furness, 2015), therefore the potential magnitude of impact of a loss of this number of individuals per annum will be no change or Negligible. As this species is of Low to Medium sensitivity to disturbance and displacement, the effect significance is at most **Negligible** adverse.

Guillemot

4.1.131 During the migration-spring bio-season guillemots were present in the Thanet Extension site and 4 km buffer with mean peak densities of 8.26 birds/ km2 and 5.39 birds/ km2 or mean peak abundances of 602 and 1,142 individuals, respectively. The mean peak abundance of guillemots in a 1 km buffer surrounding the Thanet Extension site is 235 individuals. If the level of displacement described in section 4.1.126 is applied to the migration-spring densities of guillemot within the Thanet Extension site and 1 km buffer then an estimated 476 (Table 4.21) and 54, a total of 530 individuals may be subject to potential disturbance and displacement, respectively. The number of individuals potentially subject to mortality in the migration-spring bio-season may be between five and 27 with a range of between 1 and 5% mortality rates.

4.1.132 As the average baseline mortality rate for guillemot is 0.140 (Horswill and Robinson, 2015) and the migration-spring BDMPS for guillemot is 1,617,306 (Furness, 2015) then the total number of individuals lost from this BDMPS population per year is 226,423. If the total is between five and 27 individuals estimated to be lost from this BDMPS population due to the proposed development then the potential magnitude of impact during the migration-spring bio-season will be Negligible to Minor as it is under a 0.02% increase in mortality relative to baseline mortality and nowhere close to approaching the 1% threshold considered for further assessment. As the species has Low to Medium sensitivity to disturbance, the significance of effect is Negligible to Minor during the migration-spring bio-season.

Table 4.21: Displacement matrix presenting the number of guillemot in the Thanet Extension site only, during the migration-spring bio-season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	1	1	2	2	3	4	4	5	5	6
10	0	1	3	6	12	18	24	30	36	42	48	54	60
20	0	1	6	12	24	36	48	60	72	84	96	108	120
30	0	2	9	18	36	54	72	90	108	126	144	163	181
40	0	2	12	24	48	72	96	120	144	169	193	217	241
50	0	3	15	30	60	90	120	151	181	211	241	271	301
60	0	4	18	36	72	108	144	181	217	253	289	325	361
70	0	4	21	42	84	126	169	211	253	295	337	379	421
79	0	5	24	48	95	143	190	238	285	333	380	428	476
80	0	5	24	48	96	144	193	241	289	337	385	433	482
90	0	5	27	54	108	163	217	271	325	379	433	488	542
100	0	6	30	60	120	181	241	301	361	421	482	542	602

Table 4.22: Displacement matrix presenting the number of guillemot in the 1 km buffer only, during the migration-spring bio-season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)												
	0	1	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	1	1	1	1	2	2	2	2
10	0	0	1	2	5	7	9	12	14	16	19	21	23
20	0	0	2	5	9	14	19	23	28	33	38	42	47
25	0	1	3	6	12	18	23	29	35	41	47	53	59
30	0	1	4	7	14	21	28	35	42	49	56	63	70
40	0	1	5	9	19	28	38	47	56	66	75	84	94
50	0	1	6	12	23	35	47	59	70	82	94	106	117
60	0	1	7	14	28	42	56	70	84	99	113	127	141
70	0	2	8	16	33	49	66	82	99	115	131	148	164
80	0	2	9	19	38	56	75	94	113	131	150	169	188
90	0	2	11	21	42	63	84	106	127	148	169	190	211
100	0	2	12	23	47	70	94	117	141	164	188	211	235

4.1.133 Collectively, the total number of guillemots within all bio-seasons (in this case all four bio-seasons) is 621 and 265 individuals within the Thanet Extension site and a 1 km buffer, respectively. If the level of displacement described in section 4.1.126 is applied to the annual abundances of guillemot within the Thanet Extension site and 1 km buffer then an estimated 491 and 61 or a total of 552 individuals may be subject to potential disturbance and displacement, respectively. The estimated number of guillemots subject to mortality per annum would therefore be between six and 27 individuals (this is based upon mortality rates of 1% or 5%). The total BDMPS with connectivity to UK waters for guillemots is 4,125,000 (Furness, 2015), therefore the potential magnitude of impact of a loss of this number of individuals per annum will be Negligible. As this species is of Low to Medium sensitivity to disturbance and displacement, the effect significance is at most **Negligible** adverse.

Impact 4: Indirect impacts through effects on habitats and prey species

4.1.134 Indirect disturbance and displacement of birds may occur during the O&M phase if there are impacts on prey species and the habitats of prey species. These indirect effects include those resulting from the production of underwater noise (e.g. the turning of the WTGs), EMF and the generation of suspended sediments (e.g. due to continuing scour) that may alter the behaviour or availability of bird prey species. Underwater noise and EMF may cause fish and mobile invertebrates to avoid the O&M area and also affect their physiology and behaviour. Suspended sediments may cause fish and mobile invertebrates to avoid the O&M area and may smother and hide immobile benthic prey. These mechanisms result in less prey being available within the O&M area to foraging seabirds.

4.1.135 With regard to noise impacts on fish, Volume 2, Chapter 6 Fish and Shellfish Ecology (Document Ref: 6.2.6) discusses the potential impacts upon fish relevant to ornithology as prey species. With regard to behavioural changes related to underwater noise impacts on fish during the O&M of the proposed Thanet Extension project, Section 6.11 *et seq* identifies that the sensitivity of fish and shellfish species to O&M noise is considered to be low and the magnitude of impact Negligible. It concludes a **Negligible** adverse effect on fish (see section 6.11 *et seq*). With a Negligible adverse effect on fish that are bird prey species, it could be concluded that the indirect effect on seabirds occurring in or around the Thanet Extension site during the O&M phase is similarly a **Negligible** adverse effect.

4.1.136 With regard to changes to the seabed and to suspended sediment levels, Document Ref: 6.2.5 discusses the nature of any change and impact. It identifies that the small quantities of sediment released due to scour processes would rapidly settle within a few hundred metres of each WTG or cable protection structure. Therefore, the magnitude of the impact is likely to be Negligible to Low (see Document Ref: 6.2.5) and that smothering due to increased suspended sediment during O&M of the project would result in an effect of **Minor** adverse significance. With a Minor adverse effect on benthic habitats and species, it could be concluded that the indirect effect on seabirds occurring in or around the Thanet Extension site during the O&M phase is a **Negligible** adverse effect.

4.1.137 With regard to EMF effects these are identified as highly localised with the majority of cables being buried to up to 3 m depth further reducing the effect of EMF (see Document Ref: 6.2.5, Section 5.11 *et seq*). The magnitude of impact is considered Negligible on benthic invertebrates and low on fish. With a Minor or Negligible impact on invertebrates and fish, it could be concluded that the indirect effect on seabirds occurring in or around the Thanet Extension site during the O&M phase is of only a **Negligible** adverse effect.

Impact 5: Collision risk

4.1.138 There is a potential collision risk to birds which fly through the proposed development site whilst foraging for food, commuting between breeding sites and foraging areas, or when on migration. The risk to birds arises from colliding with the WTG rotors and associated infrastructure resulting in injury or fatality.

4.1.139 CRM has been used in this assessment to estimate the potential risk to birds associated with the proposed development. Modelling has been carried out using the Band (2012) model applied in Microsoft Excel to the density of flying birds measured by 24 months of aerial survey to produce predictions of mortality for particular species across set time periods (biological seasons) and on an annual basis. The approach to CRM is presented in Document Ref: 6.4.4.4 and provides the methods, data input and results of the CRM, using the most recent version of the Band (2012) collision risk model that has been designed specifically for application to OWF developments. The approach to CRM, as agreed with the Evidence Plan Technical Review Group (Table 4.2), is summarised here for the purposes of assessment.

4.1.140 CRM accounts for a number of different species-specific behavioural aspects of birds being assessed, including the height at which birds fly, their ability to avoid moving or static structures and how active they are diurnally and nocturnally, respectively. Details of these considerations are provided in in Document Ref: 6.4.4.4.

4.1.141 The collision predictions included in this assessment present the results that have been output from a specific set of model runs. This is Band CRM Option 2 incorporating the bird flight height information drawn from the BTO SOSS-02 report (Cook et al, 2012) that sets out the percentage at potential collision height (PCH) for each seabird species determined from a large number of surveys carried out in UK waters. These PCHs are provided in summary within Table 4.27.

Table 4.23: Proportion at potential collision risk height used in the collision risk modelling of the proposed for the Thanet Extension

Species	Proportion of Birds Flying at Potential Collision Risk Height (PCH) (SOSS02)
Gannet	0.989 ± 0.002
Kittiwake	0.989 ± 0.002
Lesser black-backed gull	0.995 ± 0.001
Herring gull	0.995 ± 0.001
Great black-backed gull	0.995 ± 0.001

4.1.142 Additional data were available on bird behaviour for Thanet Extension from APEM's site-specific aerial digital surveys and from the initial data released from the ORJIP project. Due to a combination of a low number of birds being recorded in flight and recent uncertainties in the flight height estimates provided in the aerial digital survey data this source was deemed it unsuitable for use in the assessment of collision risk (though results from this Band Option 1 run are presented in an appendix to the CRM Annex – Doc ref: 6.4.4.4). The ORJIP data were also deemed unsuitable for use in the current Band CRM model, as it is unclear how the estimated flight heights from this project are to be applied in the model. There is also ongoing debate and further work being undertaken by the SNCBs and other stakeholders on appropriate avoidance rates and other key parameters to include in CRM when using data from ORJIP. Due to these uncertainties in relation to these two site-specific datasets the assessment of potential collision risk is based on Band Option 2 with SOSS percentage at PCH.

4.1.143 The avoidance rates applicable to Band CRM Option 2 (Cook et al, 2014) have been used, as agreed with through the Evidence Plan Technical Review Panel (Table 4.2), updated where relevant to account for the SNCB review of those avoidance rates (JNCC et al, 2014). A summary of the avoidance rates are provided in Table 4.24, whilst other parameters and the outputs from the application of alternative model options using PCHs determined from other survey data sets are included in the CRM Annex (Document Ref: 6.4.4.4).

Table 4.24: Collision risk model option with associated avoidance rates for Thanet Extension

Species	Band Option 2
Gannet	0.989 ± 0.002
Kittiwake	0.989 ± 0.002
Lesser black-backed gull	0.995 ± 0.001
Herring gull	0.995 ± 0.001
Great black-backed gull	0.995 ± 0.001

4.1.144 It should be recognised that the collision estimates provided by the modelling are expected to be an overestimate of annual mortality rates, that is they are a precautionary assessment. This is the result of a number of factors, including:

- Modelling using the worst-case turbine array with respect to collision risk (a development of 34 10 MW WTGs) as agreed with the Evidence Plan Technical Review Panel (Table 4.2);
- Assuming a continuous flux of birds through the Thanet Extension site at a rate resulting from the mean peak density for the relevant bio-season being applied on all days in that bio-season;
- Assuming that flying birds encounter all WTGs within the Thanet Extension site and the level of activity remains constant regardless of losses;
- Assuming each bird crosses through the longest possible trajectory in a straight line through the Thanet Extension site; and
- Using the RLB from the PEIR, which is greater in size and contains a longer maximum length through the wind farm area to that which is included in the final RLB for the Thanet Extension site.

4.1.145 The magnitude of impact of collision mortality was assessed using the following process. Collision risk modelling for the worst-case scenario WTG array design (as agreed with NE and RSPB, Table 4.2) was carried out to produce predictions of the numbers of each species subject to mortality for the defined breeding, migration and wintering seasons. The worst-case was then selected for assessment within this chapter.

4.1.146 The mortality numbers for each biological season were then compared to the relevant BDMPS population mortality estimates for each species. Where the mortality rates are very low for individual bio-seasons the total per annum has been used in the assessment process. The final stage of the process was used to quantify the magnitude of effect with respect to collision risk. This involves the calculation of the relative change (%) in the number of birds subject to mortality 'Increase in mortality (number of individual birds) relative to current mortality (%)' that is presented in Table 4.27.

4.1.147 The annual CRM results for the proposed development are presented in summary form in Table 4.25, whilst the full details of the CRM, all input parameters used and the outputs (including any deviations and variations) for each species are provided within Document Ref: 6.4.4.4. These CRM results are based on the worst-case scenario, which would be the development of 34 10 MW WTGs. In Table 4.25 the annual collision estimates are presented from the maximum likelihood mean density outputs with corresponding lower and upper confidence interval values.

Table 4.25: Overall annual collision estimates for five key seabirds for 10 MW WTG option and Band Model Option 2

Species	Option	Mean	Mean Lower	Mean Upper
Gannet	2	13.55	4.99	25.78
Kittiwake	2	14.74	3.56	32.26
Lesser black-backed gull	2	2.35	0.28	7.62
Herring gull	2	14.04	2.20	33.47
Great black-backed gull	2	22.17	3.15	57.17

4.1.148 A full breakdown of the monthly CRM results for the proposed development is presented in Document Ref: 6.4.4.4, whilst the bio-season totals for each of the five species are presented in Table 4.26 and will form the basis of this assessment.

Table 4.26: Collision estimates for five key seabirds for 10 MW WTG option and Band Model Option 2 for each bio-season

Species	Option	Migration - Spring	Breeding	Migration - Autumn	Winter	Annual Total (Mean)
Gannet	2	9.10	0.00	4.45	n/a	13.55
Kittiwake	2	9.82	1.48	3.43	n/a	14.74
Lesser black-backed gull	2	0.44	1.52	0.00	0.40	2.35
Herring gull	2	4.91	3.11	0.56	5.46	14.04
Great black-backed gull	2	7.40	1.33	9.80	3.64	22.17

4.1.149 For each of the five species subject to CRM the estimated bio-season collision mortality rates have been considered against the most appropriate BDMPS populations and the baseline mortality rates for each species. The majority of the estimated bio-season total mortality rates (Table 4.26) for each species are estimated to be very small (under five individuals). For the purpose of this assessment any bio-season mortality rates below five individuals are not included, as they are deemed too small to cause an effect at the BDMPS level. However, all bio-season mortality rates at or above five are included as well as the annual number of collision mortalities against the overall BDMPS, which is summed and presented in Table 4.27.

4.1.150 The predicted level of mortalities at any bio-season or total annual levels for all five species assessed for collision risk fall well under the 1% threshold relative to baseline mortality rates. As a consequence the resulting magnitude of this impact is considered to be Negligible for all species. The five species considered for collision risk modelling all have High sensitivities towards collision risk, which results in the overall significance of effect for each of the five species (gannet, kittiwake, herring gull, great black-backed gull and lesser black-backed gull) being of **Minor** adverse significance. However, with regards to lesser black-backed gull it can be concluded that due to the very low number of collisions the effect significance is **Negligible** adverse for this species.

4.1.151 Other seabirds and non-seabirds are known to migrate to and from the UK mainland across the southern North Sea (Wright *et al*, 2012) during the spring and autumn bio-seasons. The desk study and baseline reporting for Thanet Extension (Doc ref 4.4.4.1) provided an assessment of the species recorded across the 24 months of recent aerial digital survey data and three months of boat-based data, covering a 26 month period. During this period no species of migratory birds were recorded in numbers to suggest that significant numbers were at risk of collision. This is further supported by the post-consent monitoring reports undertaken for the Thanet OWF project, that were completed by boat-based survey methods over an extended number of years, with an additional third observer to increase coverage for more sensitive species.

4.1.152 Other OWF development applications have assessed the potential collision risk of migratory seabirds and non-seabirds such as Rampion OWF and East Anglia THREE, for which detailed migration modelling and migration apportionment were undertaken. The outputs from collision risk modelling for these two projects concluded that the number of individuals for a limited range of species that may be subject to potential mortality did not pose any significant impacts. Due to the small scale nature of Thanet Extension and considering it is an extension project surrounding an existing OWF the risk is deemed to be considerably lower than that of other OWFs that assessed this potential impact. Therefore, although no quantitative assessment is presented in this ES Chapter it is judged that the risk of mortality as a consequence collision is minimal, the magnitude of impact on all seabird and non-seabird species to be Negligible with an effect significance of **Negligible** nature also.

Table 4.27: Collision estimates for five key seabirds for 10 MW WTG option and Band Model Option 2 for each bio-season

Species	Baseline Mortality Rate (%)	Band Model Option	Spring Migration				Autumn Migration				Winter				Annual			
			BDMPS	Baseline Mortality	No. Collisions	% Increase Relative to Baseline Mortality	BDMPS	Baseline Mortality	No. Collisions	% Increase Relative to Baseline Mortality	BDMPS	Baseline Mortality	No. Collisions	% Increase Relative to Baseline Mortality	BDMPS	Baseline Mortality	No. Collisions	% Increase Relative to Baseline Mortality
Gannet	19.10%	2	248,385	47,442	9.10	**0.02**	456,298	87,153	4.45	**0.01**	N/A				1,180,000	225,380	13.55	**0.01**
Kittiwake	15.60%	2	627,816	97,939	9.82	**0.01**	N/A				N/A				5,100,000	795,600	14.74	**0.00**
Herring gull	17.20%	2	466,511	80,240	4.91	**0.01**	N/A				466,511	80,240	5.46	**0.01**	1,098,000	188,856	14.04	**0.01**
GBB gull	7.00%	2	91,399	6,398	7.40	**0.12**	91,399	6,398	9.80	**0.15**	N/A				235,000	16,450	22.17	**0.13**
LBB gull	12.60%	2	N/A				N/A				N/A				864,000	108,864	2.35	**0.00**

Impact 6: Barrier effect

4.1.153 The presence of the proposed project could potentially create a barrier to bird migratory and foraging routes, and as a consequence, the proposed development has the potential to result in long-term changes to bird movements. It has been shown that some species (divers and scoters) avoid wind farms by making detours around WTG arrays which potentially increases their energy expenditure (Petersen 2005; Petersen and Fox 2007) and potentially decreases survival chances. Such effects may have a greater impact on birds that regularly commute around a wind farm (e.g. birds heading to/ from foraging grounds and roosting/ nesting sites) than migrants that would only have to negotiate around a wind farm once per migratory period, or twice per annum, if flying the same return route (Speakman *et al.* 2009).

4.1.154 During the spring and autumn, the route taken by migrating individuals may change due to the barrier effect created by the WTGs. Although migrating birds may have to increase their energy expenditure to circumvent the Thanet Extension site at a time when their energy budgets are typically restricted, this effect is likely to be small for one-off avoidances. Speakman *et al.* (2009) calculated that the costs of one-off avoidances during migration were small, accounting for less than 2% of available fat reserves. Therefore, the impacts on birds that only potentially migrate (including seabirds, waders and waterbirds on passage) through the site could be considered Negligible and these species have been scoped out of detailed assessment.

4.1.155 Several species of seabirds could be susceptible to the barrier effect, outside of passage movements, if the presence of WTGs prevented access to foraging grounds or made the journey to or from the foraging grounds more energetically expensive, particularly during the breeding season. However, the Thanet Extension site is located outside of the foraging range for the majority of species during the non-migratory breeding season, with the exception of herring gull and lesser black-backed gull. However, the Thanet Extension site is towards the periphery of the mean maximum foraging range (Thaxter *et al.* 2012) for both of these species and so it is highly unlikely that anything other than a Negligible magnitude impact through the barrier effect would be created. All of these species are considered to have a Low sensitivity to barrier effects (Maclean *et al.* 2009) and are generally tolerant of the presence of operational WTGs, with the exception of gannet. The effect significance of the barrier effect for all of these species is assessed as **Negligible** adverse.

4.2 Environmental assessment: decommissioning phase

4.2.1 The potential effects of the decommissioning phase are predicted to be the same as identified for the construction phase (disturbance/ displacement; and indirect impacts through effects on habitats and prey species).

4.2.2 The nature and scale of impacts arising from the decommissioning phase are expected to be similar, or of reduced magnitude, to those generated during the construction phase. This is because certain activities such as piling would not be required.

4.2.3 To date, no large offshore wind farm has been decommissioned in UK waters. It is anticipated that any future programme of decommissioning would be developed in close consultation with the relevant statutory marine and nature conservation bodies. This would enable the guidance and best practice of that time to be applied to minimise any potential impacts.

4.13 Environmental assessment: cumulative effects

4.2.4 Cumulative effects refer to effects upon receptors arising from Thanet Extension when considered alongside other proposed developments and activities and any other reasonably foreseeable project(s) proposals. In this context the term projects is considered to refer to any project with comparable effects and is not limited to offshore wind projects.

4.2.5 The approach to cumulative assessment for Thanet Extension takes into account the Cumulative Impact Assessment Guidelines issued by RenewableUK (2013), together with comments made in response to other renewable energy developments within the Southern North Sea, and the Planning Inspectorate (PINS) 'Advice Note 9: Rochdale Approach' and 'Advice Note 17: Cumulative Effects Assessment'. The renewable energy developments that have informed this approach and the suggested tiers have been agreed through the Evidence Plan Process.

4.2.6 The projects and plans selected as relevant to the assessment of impacts to offshore ornithology are based upon an initial screening exercise undertaken on a long list (HRA Screening Report). This long list included a wide range of different types of activity including marine aggregate extraction, port dredgings disposal, other OWFs, oil and gas extraction, cables (including those from OWFs), pipelines, shipping, coastal developments and commercial fisheries. Each project, plan or activity has been considered and scoped in or out on the basis of effect–receptor pathway, data confidence and the temporal and spatial scales involved. The result of that screening is provided in Table 4.29 which lists the projects that have been screened in to the cumulative assessment of offshore ornithology receptors.

4.2.7 In assessing the potential cumulative impact(s) for Thanet Extension, it is important to bear in mind that for some projects, predominantly those 'proposed' or identified in development plans etc. may or may not actually be taken forward. There is thus a need to build in some consideration of certainty (or uncertainty) with respect to the potential impacts which might arise from such proposals. For example, relevant projects/ plans that are already under construction are likely to contribute to cumulative impact with Thanet Extension (providing effect or spatial pathways exist), whereas projects/ plans not yet approved or not yet submitted are less certain to contribute to such an impact, as some may not achieve approval, may not ultimately be built due to other factors or may be built at a lesser scale than had been assessed and approved.

4.2.8 For this reason, all relevant projects/ plans considered cumulatively alongside Thanet Extension have been allocated into 'Tiers', reflecting their current stage within the planning and development process. This allows the cumulative effect assessment to present several future development scenarios, each with a differing potential for being ultimately built out. Appropriate weight may therefore be given to each scenario (Tier) in the decision making process when considering the potential cumulative effect associated with Thanet Extension.

4.2.9 The proposed tier structure applied to offshore ornithology varies from the tier structure for the wider Thanet Extension ES and is based on the approach initially recommended by JNCC and NE in the consenting process for East Anglia ONE OWF (JNCC & NE, 2013) and subsequently taken forward in other recent OWF assessments as a 'five tier approach'. These five tiers are categorised as follows along with consideration about the certainty of the assessment and relevant data available, see Table 4.28.

Table 4.28: Tier structure

Tier	Description	Availability of information about the assessment and associated data and level of confidence
Tier 1	Built and operational projects	To gain consent the developer will have submitted an ES, potentially supplementary information and, in the case of NSIP developments, additional information during the course of the Hearing. There may also be post-construction monitoring information. Any variation in project design (within the scope of the Rochdale Envelope) will have been decided. With regard to impact induced mortality of birds, this effect, even though arising from an operational project, may not have yet fed through to, and been captured in, estimates of "baseline" population conditions i.e. the background distribution and/ or mortality rate of birds. Accordingly, such projects are included within the cumulative assessment rather than excluded on the basis that they are part of the baseline/ background. High confidence
Tier 2	Projects that are under construction	To gain consent the developer will have submitted an ES, potentially supplementary information and, in the case of NSIP developments, additional information during the course of the Hearing. Any variation in project design (within the scope of the Rochdale Envelope) will have been decided. High confidence
Tier 3	Consented applications not yet implemented	To gain consent the developer will have submitted an ES, potentially supplementary information and, in the case of NSIP developments, additional information during the course of the Hearing. The consented project design may not be the one that is constructed and a reduced scale project (i.e. within the scope of the Rochdale Envelope) might be implemented. The consented project may not yet proceed because of financial or other considerations. Medium confidence
Tier 4	Submitted applications not yet determined	The submitted application will have been accompanied by an ES but prior to the decision there is still the possibility that supplementary information and, in the case of NSIP developments, additional submissions during the course of the Hearing will be provided that contains significant changes to predicted impacts. The proposed project might be withdrawn or consent refused. Low confidence
Tier 5	Future [foreseeable] projects	Projects that have been announced by the developer, projects that are listed in the Planning Inspectorate programme of projects and projects that are at the pre-scoping and scoping stage will not have any published assessment or data available about impacts. The proposed project might not progress to an application for consent. Low confidence

4.2.10 As noted above, this approach with five tiers differs from that presented in other chapters of this assessment that have only three tiers. NE (2014) has argued that a higher number of tiers provides for a better resolution of the different stages that different projects are at in their lifecycle. The five tier approach still differentiates between those projects with high, medium and low confidence in the data that is applied in the three tier approach in other chapters of this assessment. Both allow the decision maker to give more weight to those projects for which there is higher confidence in the data.

4.2.11 Further uncertainty arises with a number of offshore wind farm projects in Scotland that have been the subject of court action (Inch Cape, Neart na Gaoithe, Seagreen Alpha and Seagreen Bravo). At present their consents stand as valid. In the meantime, the developers of these wind farms (Inch Cape, Neart na Gaoithe and a combined Seagreen Alpha and Seagreen Bravo proposal called Seagreen Phase 1) have submitted scoping reports for revised proposals that are for a smaller number of larger WTGs. In addition a further Scottish consented OWF, Moray East, has submitted a scoping report that is for a development of a smaller number of larger WTGs. It can be expected that project design changes will result in changes to the scale of impacts predicted. At present these projects fall in to Tier 3. Should a new application be submitted for any of these projects and it is made clear that the previous consented application will not be implemented, then such projects will move to Tier 4.

4.2.12 The specific projects scoped into this cumulative effect assessment, and the tiers into which they have been allocated are presented in Table 4.29 below (the projects are listed alphabetically within each tier). It has been recent practice with OWF proposals to recognise that the effects of bird mortality that have been predicted to result from collision with WTGs will not become manifest in the relevant seabird populations for some years. The consequence is that such predicted mortality will not yet be reflected in the baseline characterisation. As a result, on the advice of the SNCBs, operational OWFs and their predictions of seabird mortality are included within the list of projects in the cumulative assessment.

4.2.13 Two OWF proposals fall in to Tier 4 – Hornsea Project 3 and Norfolk Vanguard. Hornsea Project 3 has submitted its application and Norfolk Vanguard has published a PEIR. They both have a consenting timetable that is expected to be similar to Thanet Extension. The information in the Norfolk Vanguard PEIR provides some indication of the likely quantitative effects of collision risk and displacement that can be included within a quantitative cumulative assessment of Thanet Extension. It is not certain though those quantitative predictions will be the same in the final application for this project.

4.2.14 Projects related to marine aggregate extraction, port dredgings disposal, oil and gas extraction, pipelines, shipping, coastal developments and commercial fisheries have been screened out on a series of factors including those that do not overlap spatially with Thanet Extension, those that do not give rise to effects that are cumulative with Thanet Extension, those that are recurring or ongoing from before the baseline period and those that are ongoing activities rather than projects with a consenting process.

Table 4.29: Projects considered in the cumulative assessment

Development type	Project	Status	Data confidence assessment/ phase	Tier
Offshore Wind Farm	Beatrice Demonstrator	Built, formerly operational but at present out of commission	High: Data in applicant's ES	1
Offshore Wind Farm	Blyth	Built, formerly operational but at present out of commission	High: Data in applicant's ES	1
Offshore Wind Farm	Blyth Demonstrator Array 2	Operational	High: Data in applicant's ES	1
Offshore Wind Farm	Dudgeon	Operational	High: Data in applicant's ES	1
Offshore Wind Farm	Galloper	Fully constructed but not commissioned	High: Data in applicant's ES	1
Offshore Wind Farm	Greater Gabbard	Operational	High: Data in applicant's ES	1
Offshore Wind Farm	Gunfleet Sands I & 2	Operational	High: Data in applicant's ES	1
Offshore Wind Farm	Hywind	Operational	High: Data in applicant's ES	1
Offshore Wind Farm	Humber Gateway	Operational	High: Data in applicant's ES	1
Offshore Wind Farm	Kentish Flats	Operational	High: Data in applicant's ES	1
Offshore Wind Farm	Kentish Flats Extension	Operational	High: Data in applicant's ES	1
Offshore Wind Farm	Lincs	Operational	High: Data in applicant's ES	1

Development type	Project	Status	Data confidence assessment/ phase	Tier
Offshore Wind Farm	London Array	Operational	High: Data in applicant's ES	1
Offshore Wind Farm	Lynn and Inner Dowsing	Operational	High: Data in applicant's ES	1
Offshore Wind Farm	Race Bank	Operational	High: Data in applicant's ES	1
Offshore Wind Farm	Rampion	Fully constructed but not commissioned	High: Data in applicant's ES	1
Offshore Wind Farm	Scroby Sands	Operational	High: Data in applicant's ES	1
Offshore Wind Farm	Sheringham Shoal	Operational	High: Data in applicant's ES	1
Offshore Wind Farm	Teesside	Operational	High: Data in applicant's ES	1
Offshore Wind Farm	Thanet	Operational	High: Data in applicant's ES	1
Offshore Wind Farm	Westermost Rough	Operational	High: Data in applicant's ES	1
Offshore Wind Farm	Beatrice	Under construction	High: Data in applicant's ES	2
Offshore Wind Farm	East Anglia ONE	Under construction	High: Data in applicant's ES	2
Offshore Wind Farm	EOWDC [Aberdeen]	Under construction	High: Data in applicant's ES	2
Offshore Wind Farm	Hornsea Project One	Under construction	High: Data in applicant's ES	2
Offshore Wind Farm	Dogger Bank Creyke Beck Projects A and B	Consented but not implemented	Medium: Data in applicant's ES but design might change	3
Offshore Wind Farm	Dogger Bank Teesside Project A	Consented but not implemented	Medium: Data in applicant's ES but design might change	3
Offshore Wind Farm	Firth of Forth (Seagreen) Alpha and Bravo	Consented but not implemented	Medium: Data in applicant's ES but design might change	3
Offshore Wind Farm	Hornsea Project Two	Consented but not implemented	Medium: Data in applicant's ES but design might change	3
Offshore Wind Farm	Inch Cape	Consented but not implemented	Medium: Data in applicant's ES but design might change	3
Offshore Wind Farm	Kincardine	Consented but not implemented	Medium: Data in applicant's ES but design might change	3
Offshore Wind Farm	Moray Firth (Eastern DA)	Consented but not implemented	Medium: Data in applicant's ES but design might change	3
Offshore Wind Farm	Neart na Gaoithe	Consented but not implemented	Medium: Data in applicant's ES but design might change	3
Offshore Wind Farm	Sofia (Dogger Bank Teesside B)	Consented but not implemented	Medium: Data in applicant's ES but design might change	3
Offshore Wind Farm	Triton Knoll	Consented but not implemented	Medium: Data in applicant's ES but design might change	3
Offshore Wind Farm	East Anglia THREE	Consented but not implemented	Low: Data in applicant's ES but design might change	3

Development type	Project	Status	Data confidence assessment/ phase	Tier
Offshore Wind Farm	Hornsea Project 3	Application submitted	Low: Data in applicant's ES but design might change in the course of examination or at consent	4
Offshore Wind Farm	Norfolk Vanguard	Pre-application (PEIR issued)	Low: PEIR data available	4
Offshore Wind Farm	East Anglia ONE North	Pre-application (Scoping Report submitted)	Low: Scoping Report data available	5
Offshore Wind Farm	East Anglia TWO	Pre-application (Scoping Report submitted)	Low: Scoping Report data available	5
Offshore Wind Farm	Moray Firth (Western DA)	Pre-application (Scoping Report submitted)	Low: Scoping Report data available	5
Offshore Wind Farm	Norfolk Boreas	Pre-application (Scoping Report submitted)	Low: Scoping Report data available	5
Offshore Cable	Nemo Link (UK-Belgium interconnector)	Under construction	High: Data in applicant's ES	2

4.2.15 For the two types of project screened in for cumulative assessment (offshore wind farms and offshore cables) consideration has to be given to the types of impact that might result in cumulative impact. The following types of cumulative impact, by project type, are considered:

- Cumulative Impact 1: Offshore cables construction phase direct disturbance and displacement
- Cumulative Impact 2: Offshore wind farms O&M phase direct disturbance and displacement
- Cumulative Impact 3: Offshore wind farms O&M phase collision risk

4.2.16 The potential cumulative impacts are considered in turn below.

4.2.17 Cumulative Impact 1: Offshore cable construction phase direct disturbance and displacement

4.2.18 The potential impact of Thanet Extension arising from direct disturbance and displacement during the cable laying (construction) phase has been considered alone above. Any direct disturbance and displacement in the construction phase will be short-term (temporary) and it is this type of potential impact that has been screened in for cumulative impact assessment together with other offshore cable laying operations. Once operational, underwater power cables are not known to have any significant direct or indirect effects on offshore ornithology receptors and as a result cable O&M phase impacts have been screened out.

4.2.19 A single cable laying operation has been identified and screened in for the cumulative assessment – Nemo Link; a decision to no longer pursue Thanet Cable Replacement having been made by the applicant in 2018. The cable laying operation for this project is currently in progress (2017/18) and is expected to have been completed before Thanet Extension might be under construction. Any O&M effects associated with this project will be spatially and temporally discrete and any interaction considered to be highly unlikely to contribute to a cumulative effect with the construction phase of the Thanet Extension. Note that such temporal spacing also results in the potential for cumulative impacts between cable laying activities and the O&M phase of Thanet Extension to be screened out.

4.2.20 The assessment of Thanet Extension alone for the potential impacts through disturbance and displacement effects in the construction phase has screened out gannet, kittiwake, herring gull, great black-backed gull and lesser black-backed gull and it is only for red-throated diver, razorbill and guillemot that disturbance and displacement impacts were assessed.

4.2.21 The Thanet Extension alone assessment for disturbance and displacement impacts in the construction phase concluded on the significance for the screened in species as follows:

- Red-throated diver: **Minor** adverse effect significance during the winter and migration-spring bio-seasons;
- Razorbill: No adverse effect significance during the winter and migration-autumn bio-seasons and a **Negligible** adverse effect significance during the migration-spring bio-season; and
- Guillemot: No adverse effect significance during the winter and migration-autumn bio-seasons and a **Minor** adverse effect significance during the migration-spring bio-season.

4.2.22 The Thanet Extension alone assessment quantitative predictions of mortality on a bio-season basis if up to 100% displacement (noting that it is species specific and detailed in the alone assessment sections) occurred and this resulted in 1% - 5% mortality of the displaced birds was for each species screened in:

- Red-throated diver: between two and eight individuals in the winter and between zero and two individuals in the migration-spring bio-seasons respectively;
- Razorbill: zero individuals in the winter bio-season, between zero and two in the migration-spring bio-season and zero individuals in the migration-autumn bio-season; and
- Guillemot: between five and 24 individuals in the migration-spring bio-season.

4.2.23 For a quantitative assessment of the cumulative impacts it requires the Nemo Link interconnector to have published predicted numbers on birds that would be displaced during its construction phase.

4.2.24 The Nemo Link interconnector has been granted consent and the successful application was accompanied by an ES that included a volume on the marine environment (PMSS, 2013) and a chapter on the biological environment that assessed impacts on birds (Section 7.2), including offshore birds. The assessment concluded with respect to offshore birds that it "is not likely that the proposed cable installation will have a substantially greater impact on these bird species than the existing shipping already present in this area" (Section 7.2.3.1) and did not carry out any quantitative assessment of impacts.

4.2.25 In the absence of quantitative information on the Nemo Link interconnector a qualitative approach to assessment is necessary. Both projects have been assessed – Nemo Link and Thanet Extension – and neither has been assessed as having a significant impact alone with respect to cable laying (although the construction operations alone that relate to the Thanet Extension array installation have been screened in for LSE in this RIAA). Accordingly it is considered highly unlikely that these two projects, even if they were to be implemented at the same time or in close succession, will act in-combination.

4.2.26 The Nemo Link interconnector is progressing with the marine cable laid in UK marine waters over the winter of 2017/18. The Thanet Extension array installation and export cable laying are planned, subject to consent, for early in 2021. These project timelines mean that cable laying for Nemo Link will not occur in the same year as Thanet Extension construction, removing such a potential type of in-combination impact. The potential for the successive cable laying operations that occur through sub-tidal waters in to Pegwell Bay in 2017/18 and 2021 to have a significant in-combination impact is also considered unlikely given that they are each of short duration and take place in waters that do not support significant populations of red-throated diver (both cable laying operations avoid the Outer Thames Estuary SPA). It is concluded that the cumulative impact of cable laying operations on marine birds is of N**egligible** impact significance.

4.2.27 Cumulative Impact 2: Offshore wind farm O&M phase direct disturbance and displacement

4.2.28 The potential impact of Thanet Extension arising from direct disturbance and displacement has been considered alone above. Any direct disturbance and displacement in the O&M phase will last for the lifetime of the project and it is this type of potential impact that has been screened in for cumulative impact assessment together with other offshore wind farms during their O&M phase.

4.2.29 The assessment of Thanet Extension alone has screened out kittiwake, herring gull, great black-backed gull and lesser back-backed gull and, for that same reason of low sensitivity to disturbance and displacement, Thanet Extension does not contribute to a cumulative effect. It is only for red-throated diver, gannet, razorbill and guillemot that O&M phase disturbance and displacement impacts were assessed. Within this cumulative assessment gannet, razorbill and guillemot are approached in the same manner as other assessed and consented OWFs, whilst red-throated diver has been assessed using a bespoke method for this project in order to account for uncertainties identified in an initial assessment that was conducted and to respond to feedback from Natural England and RSPB (Table 4.2). As a result gannet, razorbill and guillemot are assessed first, followed by the bespoke assessment of red-throated diver.

4.2.30 The Thanet Extension alone assessment conclusions on significance for the screened in species were:

- Gannet: **Negligible** effect significance during the migration-spring bio-season and **Negligible** effect significance during the migration-autumn bio-season;
- Razorbill: **Negligible** effect significance during the migration-spring bio-season and no effect significance during the winter bio-season; and
- Guillemot: **Negligible** to **Minor** adverse effect significance during the migration-spring bio-season.

4.2.31 The Thanet Extension alone assessment quantitative predictions on the scale of disturbance and displacement for the screened in species were:

- Gannet: Number within the area potentially subject to displacement is 96 individuals in the migration-spring bio-season and 77 individuals in the migration-autumn bio-season. Predicted annual mortality, based on 100% displacement with resultant 1 - 5% mortality (the full matrix being presented in the relevant section above), is between one and five individuals in the migration-spring bio-season and between one and four individual in the migration-autumn bio-season.

- Razorbill: Number within the area potentially subject to displacement is 28 individuals in the Thanet Extension site and 5 individuals in the 500 m buffer in the migration-spring bio-season. The number within the area potentially subject to displacement is 27 individuals in the Thanet Extension site and 2 individuals in the 500 m buffer in the winter bio-season. Predicted annual mortality, based on 95% displacement within the Thanet Extension site and 25% displacement in a 500 m buffer with resultant 1 - 5% mortality (the full matrix being presented in the relevant section above), is between zero to one individual in the migration-spring bio-season and zero in the winter bio-season.
- Guillemot: Number within the area potentially subject to displacement is 602 individuals in the Thanet Extension site and 235 individuals in the 1 km buffer in the migration-spring bio-season. Predicted annual mortality, based on 79% displacement within the Thanet Extension site and 23% displacement in a 1 km buffer with resultant 1 - 5% mortality (the full matrix being presented in the relevant section above), is between five and 27 individuals in the migration-spring bio-season.

4.2.32 The predicted Thanet Extension contributions to the cumulative assessment arise from impacts to populations of gannet, razorbill and guillemot outside the breeding season. In the non-breeding periods (migration-autumn, winter and migration-spring) these species of birds are mobile and it is considered that the geographical scale at which the cumulative assessment should be undertaken is that of the total biogeographic population (including both adults and immatures) with connectivity to UK waters (Furness, 2015).

4.2.33 As a first 'screening' approach to a quantitative cumulative assessment consideration can be given to the population that has been identified as potentially at risk of effects within the relevant area in and around the proposed Thanet Extension area compared to the cumulative total summed across the operating, consented and proposed wind farms identified in Table 4.29. Only if Thanet Extension is making a material contribution to the cumulative total is there a need to progress to a more detailed stage where consideration is given to the predicted number displaced, the predicted number that might consequentially die (i.e. the application of the matrix approach) and what is the significance of that number (assessed for instance through a population viability analysis).

4.2.34 This 'screening' on a quantitative basis for cumulative disturbance and displacement impacts is presented in Table 4.30 where the number potentially at risk of displacement from Thanet Extension is compared to the cumulative number potentially at risk and compared to the relevant BDMPS (Furness, 2015). The cumulative number at risk has been derived from the following sources:

- Gannet: A cumulative total is not available from recent applications for OWFs because the possibility of such disturbance or displacement has been screened out or identified as of Negligible scale or impact significance and the cumulative assessment has not been undertaken on a quantitative basis.
- Razorbill: From the cumulative totals submitted to the East Anglia THREE Hearing (ScottishPower Renewables, 2016a).
- Guillemot: From the cumulative totals submitted to the East Anglia THREE Hearing (ScottishPower Renewables, 2016a).

Table 4.30: Quantitative screening for cumulative disturbance and displacement impacts

	Gannet	Razorbill	Guillemot
Thanet Extension	96 (migration-spring) 77 (migration-autumn	28 (winter) 29 (migration-spring)	602 (migration-spring)
OWF cumulative number at risk	N/A	84,131	176,970
Contribution of Thanet Extension to the cumulative number	-	0.068%	0.034%
BDMPS (total biogeographic population)	1,180,000	1,707,000	4,125,000
Thanet Extension at risk in relation to the BDMPS	0.015%	0.003%	0.015%

4.2.35 It is considered that Table 4.30 provides the evidence that the contribution of Thanet Extension to the cumulative total is so small for razorbill (0.068%) and guillemot (0.034%) as to not materially alter the significance of the overall in-combination mortality figure or the likelihood of an adverse effect. Razorbill can be screened out from further, more detailed consideration as the scale of the Thanet Extension contribution is Negligible. As razorbill has low to medium sensitivity to disturbance, the significance of effect is Negligible. Guillemot can be screened out from further, more detailed consideration as the scale of the Thanet Extension contribution is Negligible. As guillemot has low to medium sensitivity to disturbance, the significance of effect is Negligible.

4.2.36 For gannet a figure for the cumulative total is not available but two considerations provide the evidence that Thanet Extension is likely to make a very small contribution to any cumulative adverse effect – the scale of the Thanet Extension predicted displacement is very small in relation to the BDMPS (0.015%) and the gannets potentially affected are birds passing through on spring and autumn migration. Such passage birds are migrating from breeding colonies around the coasts of north-west Europe to wintering areas farther south (e.g. off the coast of West Africa) in the autumn and vice versa in the spring. Gannets are considered to be highly flexible in their foraging requirements and displacement from wind farms while on passage is unlikely to represent a loss of any importance. It is considered that the contribution of Thanet Extension to the cumulative total is so small as to not materially alter the significance of the overall in-combination mortality figure or the likelihood of an adverse effect. Gannet can be screened out from further, more detailed consideration as the scale of the Thanet Extension contribution is Negligible. As gannet has low sensitivity to disturbance, the significance of effect is **Negligible** adverse.

Red-throated diver

4.2.37 The cumulative assessment of the potential effects of disturbance and displacement on red-throated diver in the PEIR (APEM, 2017b) was carried out using published guidance and SNCB advice (JNCC & NE, 2013; King et al., 2009; RenewableUK, 2013; The Planning Inspectorate, 2012 and 2015) and follows the practice of ESs submitted by other OWF developers. The result of the cumulative assessment in the PEIR was a prediction of a minor to moderate adverse significance of effect.

4.2.38 The methodology applied in the PEIR and the resulting outcomes were discussed with stakeholders in the Evidence Plan meetings held on 2nd October 2017 in relation to the HRA and on 4th October 2017 in relation to the offshore environment (Table 4.2).

4.2.39 After publication of the PEIR, but prior to the deadline for responses to be submitted, a conference call was held with Natural England and the RSPB on 12th December 2017. Attendees from Natural England and the RSPB were provided with a briefing paper about the issues arising from the method by which the cumulative assessment had been carried out. Those issues included:

- Some ESs did not assess red-throated diver displacement at all;
- Some ESs did not assess red-throated diver displacement in a quantitative fashion;
- Some ESs applied a buffer that was significantly less than current recommended practice; and
- A number of the OWFs have been built out at a scale that is less than that which was assessed as the worst-case in the ES.

4.2.40 A possible resolution of these issues was proposed using a new approach. That was to standardise the sources of information, parameters and analysis rather than adopt the different approaches used in different ESs. This standardised approach was supported in principle by Natural England and the RSPB.

4.2.41 The standardisation in the method for the cumulative assessment included:

- Placing the 'alone' contribution of Thanet Extension in context, relative to all other proposed, consented or constructed offshore wind farms, mitigating the false confidence that can arise when considering absolute numbers derived from uncertain sources;
- Applying a single source of red-throated diver density across all the offshore wind farms included in the assessment, this being the density that was modelled for the Seabird Mapping and Sensitivity Tool (SeaMaST) dataset (Bradbury *et al.* 2014), a copy of which was supplied by Natural England;
- Using GIS to overlay development boundaries on to the red-throated diver density model with those boundaries, where relevant, being the as-built layout of the array or the DCO/dML consented array layout, rather than the worst-case design for the array as assessed in the application and published in the ES;
- Considering the two ends of the range of scenarios over which standardised displacement matrices are prepared, that is a) complete displacement within the OWF and none outside it, and b) complete displacement within the OWF accompanied by complete displacement for a distance of 4 km outside it; and
- Those OWFs that have the potential to have an impact on the SW North Sea winter BDMPS red-throated diver population through causing displacement were identified based on geographic proximity. Those OWFs whose potential displacement effects were attributed to the SW North Sea winter BDMPS red-throated diver population are listed in Table 4.31, ordered by Tier. Those OWFs further to the north (in Scottish waters) and further south (in the English Channel) do not form part of this cumulative assessment.

Table 4.31: OWFs with potential displacement effects within the SW North Sea winter BDMPS population of red-throated diver, ordered by Tier

Offshore wind farm	Tier
Blyth	1
Dudgeon	1
Galloper	1
Greater Gabbard	1
Gunfleet Sands	1
Humber Gateway	1
Inner Dowsing	1
Kentish Flats	1
Kentish Flats Extension	1
Lincs	1
London Array	1
Lynn	1
Race Bank	1
Scroby Sands	1
Sheringham Shoal	1
Teesside	1
Thanet	1
Westermost Rough	1
East Anglia ONE	2
Hornsea Project One	2
Dogger Bank Creyke Beck A & B	3
Dogger Bank Teesside A & Sofia	3
East Anglia THREE	3
Hornsea Project Two	3
Triton Knoll	3
Hornsea Project Three	4
Norfolk Vanguard East & West	4
Thanet Extension	4

4.2.42 Two data limitations placed a minor constraint on the geographical scope of the cumulative assessment. These were a) that the SeaMaST dataset was largely restricted to English waters which meant that proposed OWFs in Scottish waters could not be included on this standardised basis and b) the geographical division in the SeaMaST data set and in the derivation of reference biogeographical populations was for the North Sea which meant that the single OWF under construction in the English Channel, Rampion, could not be included on this standardised basis. The exclusion of the Scottish projects and of Rampion is not considered to make a material effect on the conclusion of the assessment of cumulative impacts on red-throated diver.

4.2.43 In the process of adding up contributions from each OWF account had to be taken of the fact that when considering adjacent, nearby or extended OWFs there was a possibility that they were being developed within the 4 km buffer of a preceding OWF or that the 4 km buffer of the more recently proposed OWF overlapped with the site of, or the 4 km buffer extending from, a preceding OWF. In such instances, in the assessment scenario that displacement does occur in the 4 km buffer, then 'double-counting' of red-throated diver displacement would occur. This 'double-counting' was avoided in the analysis using GIS by only accounting for the additional contribution made by the subsequent OWF.

4.2.44 The analysis using GIS, of the OWF development boundary overlaps and the red-throated diver density, coupled with the 'tiered' approach to examining OWFs (detailed in 4.2.6 to 4.2.14) allowed a number of key quantitative comparisons to be made to inform the cumulative assessment.

4.2.45 Table 4.32 and Table 4.33 identify the relative contribution that Thanet Extension makes to the red-throated diver that are predicted to be displaced by the OWFs included in the cumulative assessment. This identifies that when the scenario is applied of 100% displacement within each OWF and no displacement outside then the relative contribution that Thanet Extension makes is 0.8%. This increases to 1.6% under the scenario of 100% displacement within each OWF and within a 4 km buffer around each OWF. The large majority (approx. 98%) of the contribution to red-throated diver potential displacement is made by OWFs that have been consented and are already operational (Tier 1).

Table 4.32: The relative contribution of Thanet Extension to the cumulative displacement of red-throated diver, scenario no displacement outside OWF

Offshore wind farms in the English North Sea summed by Tier Scenario: 100% displacement in OWF, no displacement outside	Relative contribution to RTD potentially displaced
Tier 1: Operational	98.3%
Tier 2: Under construction	0.3%
Tier 3: Consented but not constructed	0.4%
Tier 4: Application in process – other than Thanet Extension	0.3%
Tier 4: Thanet Extension	0.8%

Table 4.33: The relative contribution of Thanet Extension to the cumulative displacement of red-throated diver, scenario no displacement outside OWF

Offshore wind farms in the English North Sea summed by Tier Scenario: 100% displacement in OWF, 100% displacement in 4 km buffer	Relative contribution to RTD potentially displaced
Tier 1: Operational	97.6%
Tier 2: Under construction	0.2%
Tier 3: Consented but not constructed	0.4%
Tier 4: Application in process – other than Thanet Extension	0.1%
Tier 4: Thanet Extension	1.6%

4.2.46 Table 4.34 and Table 4.35 identify the contribution that Thanet Extension makes to the proportions of red-throated diver that are predicted to be displaced relative to the SW North Sea winter BDMPS red-throated diver population. This identifies that when the scenario is applied of 100% displacement within each OWF and no displacement outside then the relative contribution that Thanet Extension makes is 0.06% of the SW North Sea winter BDMPS red-throated diver population. This increases to 0.25% under the scenario of 100% displacement within each OWF and within a 4 km buffer around each OWF. The largest contribution made to red-throated diver potential displacement relative to the SW North Sea winter BDMPS red-throated diver population is made by OWFs that have been consented and are already operational (Tier 1).

Table 4.34: The contribution of Thanet Extension to the cumulative displacement of red-throated diver relative to the SW N Sea winter BDMPS population, scenario no displacement outside OWF

Offshore wind farms in the English North Sea summed by Tier Scenario: 100% displacement in OWF, no displacement outside	Contribution to RTD potentially displaced relative to SW N Sea population
Tier 1: Operational	7.58%
Tier 2: Under construction	0.02%
Tier 3: Consented but not constructed	0.03%
Tier 4: Application in process – other than Thanet Extension	0.02%
Tier 4: Thanet Extension	0.06%

Table 4.35: The contribution of Thanet Extension to the cumulative displacement of red-throated diver relative to the SW N Sea winter BDMPS population, scenario no displacement outside OWF

Offshore wind farms in the English North Sea summed by Tier Scenario: 100% displacement in OWF, 100% displacement in 4 km buffer	Contribution to RTD potentially displaced relative to SW N Sea population
Tier 1: Operational	15.1%
Tier 2: Under construction	0.04%
Tier 3: Consented but not constructed	0.07%
Tier 4: Application in process – other than Thanet Extension	0.01%
Tier 4: Thanet Extension	0.25%

4.2.47 Displacement may result in the mortality of a proportion of the birds displaced. Definitive mortality rates associated with displacement for any seabird are not known and precautionary estimates have to be used (SNCBs, 2017). The approach taken in the assessment of Thanet Extension is to consider a range of mortality rates, for this species the lower limit is 1% mortality resulting from displacement and the upper limit is 5%. The assessment also considers that resultant mortality in the context of the background mortality in the population. The key parameter is the percentage change relative to background mortality in the SW North Sea winter BDMPS red-throated diver population. Table 4.36 and Table 4.37 identify that change for both 1% and 5% resultant mortality. Table 4.36 identifies the change under the scenario of 100% displacement within each OWF and no displacement outside which for Thanet Extension alone is 0.003% and 0.014% for 1% and 5% resultant mortality. When applying the matrix approach to impact assessment, the magnitude of impact on the SW North Sea winter BDMPS population of red-throated diver is Negligible. As the species is of High sensitivity to disturbance and displacement, the effect significance is **Minor** adverse.

4.2.48 Table 4.36 identifies the change under the scenario of 100% displacement within each OWF and no displacement outside which cumulatively with all the OWFs potentially affecting the SW North Sea winter BDMPS red-throated diver population is 0.338% and 1.691% for 1% and 5% resultant mortality, respectively.

4.2.49 Table 4.37 identifies the change under the scenario of 100% displacement within each OWF and within a 4 km buffer around each OWF which for Thanet extension alone is 0.011% and 0.055% for 1% and 5% resultant mortality. When applying the matrix approach to impact assessment, the magnitude of impact on the SW North Sea winter BDMPS population of red-throated diver is Negligible. As the species is of High sensitivity to disturbance and displacement, the effect significance is **Minor** adverse.

4.2.50 Table 4.37 identifies the change under the scenario of 100% displacement within each OWF and within a 4 km buffer around each OWF which cumulatively with all the OWFs potentially affecting SW North Sea winter BDMPS red-throated diver population the resultant mortality is 0.68% and 3.401% for 1% and 5% resultant mortality, respectively.

4.2.51 The very small percentage change resulting from Thanet Extension alone identifies that the great majority of the contribution to the cumulative percentage change arises from OWFs that have been consented and are already operational (Tier 1).

Table 4.36: Change in background mortality predicted to result from Thanet Extension alone and for the cumulative OWFs giving rise to 1% or 5% mortality, scenario no displacement outside OWF

Offshore wind farms in the English North Sea Scenario: 100% displacement in OWF, no displacement outside	Thanet Extension alone	Cumulative OWFs
Increase in mortality from background resulting from 1% resultant mortality by displacement	0.003%	0.338%
Increase in mortality from background resulting from 5% resultant mortality by displacement	0.014%	1.691%

Table 4.37: Change in background mortality predicted to result from Thanet Extension alone and for the cumulative OWFs giving rise to 1% or 5% mortality, scenario 100% displacement in 4 km buffer

Offshore wind farms in the English North Sea Scenario: 100% displacement in OWF, 100% displacement in 4 km buffer	Thanet Extension alone	Cumulative OWFs
Increase in mortality from background resulting from 1% resultant mortality by displacement	0.011%	0.680%
Increase in mortality from background resulting from 5% resultant mortality by displacement	0.055%	3.401%

4.2.52 The cumulative assessment of potential impacts on red-throated diver, considering the displacement relative to the SW North Sea winter BDMPS red-throated diver population and the change in mortality relative to background mortality of the same population varies between 0.338-0.68% (under the scenario of 100% displacement within each OWF and no displacement outside) and 1.691-3.401% (the scenario of 100% displacement within each OWF and within a 4 km buffer around each OWF) for 1% and 5% resultant mortality. This assessment has identified that the contribution of Thanet Extension is very small and that the addition it makes to mortality relative to baseline is **Negligible** adverse.

4.2.53 Therefore, it is judged that Thanet Extension does not make a material contribution to potential effects that have been attributed to OWFs that have been consented and are already operational.

Cumulative Impact 3: Offshore wind farm O&M phase collision risk

4.2.54 The potential impact of Thanet Extension arising from collision risk, that occurs in the O&M phase, has been considered alone above. Any collision risk arising in the O&M phase will last for the lifetime of the project and it is this type of potential impact that has been screened in for cumulative impact assessment together with other OWFs during their O&M phase.

4.2.55 The assessment of Thanet Extension alone has screened out a number of seabird species for which very low numbers of birds were noted as flying through the proposed Thanet Extension WTG array (red-throated diver, fulmar, black-headed gull, common gull, razorbill and guillemot). It is only for gannet, kittiwake, lesser black-backed gull, herring gull and great black-backed gull that O&M phase collision risk impacts were assessed.

4.2.56 The collision risk assessment of Thanet Extension alone is based on the worst-case scenario which would be the development of 34 10 MW WTGs.

4.2.57 The Thanet Extension alone assessment conclusions on significance for the screened in species were:

- Gannet: **Minor** when assessed on an annual basis;
- Kittiwake: **Minor** when assessed on an annual basis;
- Lesser black-backed gull: **Minor** when assessed on an annual basis;
- Great black-backed gull: **Minor** when assessed on an annual basis; and
- Herring gull: **Minor** when assessed on an annual basis.

4.2.58 The Thanet Extension alone assessment quantitative predictions of mortality on an annual for the screened in species were:

- Gannet: 13.55 individuals;
- Kittiwake: 14.74 individuals;
- Lesser black-backed gull: 2.35 individuals;
- Great black-backed gull: 22.17 individuals; and
- Herring gull: 14.04 individuals.

4.2.59 These Thanet Extension alone predictions can be added to those predictions made for other OWFs in the waters in the North Sea that have been screened in for consideration (Table 4.29). To enable an assessment of cumulative impacts that is consistent with those that have recently been given detailed scrutiny through the relevant consultation and consenting processes, the predictions set out in the cumulative assessment for the consented East Anglia THREE have been used in this assessment. The use of these cumulative predictions was agreed with NE in the Evidence Plan process (Table 4.2) with NE advising that the figures to be used are those presented in Appendix 1 of the CRM document submitted at Deadline 5 of the Development Consent Order (DCO) Hearing (ScottishPower Renewables, 2016b). The predictions for annual mortality for each OWF project in that document have been collated and presented in

4.2.60 Table 4.38, with the OWF projects set out in the order Tier 1 to Tier 3 (as they were in ScottishPower Renewables, 2016b) and alphabetically within each tier. To this has been added two Tier 4 projects (Hornsea Project 3 and Norfolk Vanguard) that were not at the stage of publishing quantitative predictions when ScottishPower Renewables (2016b) was prepared. Tier 5 projects have no collision prediction figures available and as a result cannot be included in this table.

4.2.61 All of the individual project collision risk predictions presented in the cumulative tables included in Appendix 1 of the EA THREE CRM document (ScottishPower Renewables, 2016b) are based on Band model Option 1 outputs. Accordingly the Band Option 1 outputs for Thanet Extension alone are applied when comparing the project alone contribution with the existing information on cumulative predictions. The Thanet Extension alone predictions based on Band model Option 1 have been added at the foot of

4.2.62 Table 4.38. In a similar manner Band model Option 1 outputs from the application ES for Hornsea Project 3 (herring gull was not assessed quantitatively) and for Norfolk Vanguard have been included.

4.2.63 The individual project collision risk predictions collated in the ScottishPower Renewables (2016b) Appendix are drawn primarily from the respective Environmental Statements with the published predictions based on a worst-case WTG number and specification within the Rochdale Envelope. The OWFs will not necessarily be constructed on that basis with the as-built array potentially being of a specification that would result in lower mortality predictions (but not greater as that would not satisfy the consent given). The consequence is that the mortality predictions summed in

4.2.64 Table 4.38 will include varying degrees of overestimation and the total will be an overestimate. This is demonstrated through The Crown Estate's report on ornithological headroom (MacArthur Green, 2017), whereby CRM results were reconfigured according to more recent changes to consented and proposed OWFs. As the predicted contribution of Thanet Extension to cumulative collision risk is small in comparison to other consented and proposed projects use of or further amendments to the headroom data were not deemed appropriate to demonstrate that the contribution of Thanet Extension is **Negligible** adverse.

4.2.65 There is also an element of underestimation as a result of the two floating wind farm projects in Scottish waters (Hywind and Kincardine) not being included in the data collated in ScottishPower Renewables (2016b). These two projects are for a small number of turbines (five and seven respectively) and as a result the underestimation is not significant.

Table 4.38: Annual collision mortality predictions for OWFs and the cumulative totals

Tier	Project	Gannet	Kittiwake	Lesser B-b Gull	Great B-b Gull	Herring Gull
1	Beatrice Demonstrator	2.2	5.0	0.0	0.0	0.0
1	Blyth	8.4	5.4	0.0	6.3	2.7
1	Greater Gabbard	27.5	27.5	62.0	75.0	0.0
1	Gunfleet Sands	0.0	0.0	1.0	0.0	0.0
1	Humber Gateway	4.5	7.7	1.3	6.3	1.5
1	Kentish Flats	3.3	2.2	1.6	0.3	2.2
1	Lincs	5.0	2.8	8.5	0.0	0.0
1	London Array	5.5	5.5	0.0	0.0	0.0
1	Lynn and Inner Dowsing	0.5	0.0	0.0	0.0	0.0
1	Scroby Sands	0.0	0.0	0.0	0.0	0.0
1	Sheringham Shoal	17.6	0.0	8.3	0.0	0.0
1	Teesside	6.7	77.1	0.0	43.6	43.2
1	Thanet	1.1	1.1	16.0	0.5	24.5
1	Westermost Rough	0.5	0.6	0.3	0.1	0.1
2	Beatrice	95.7	145.2	0.0	151.0	246.8
2	Dudgeon	80.3	0.0	38.3	0.0	0.0
2	EOWDC [Aberdeen]	9.3	18.7	0.0	3.0	4.8
2	Galloper	61.6	65.9	138.8	22.5	27.2
2	Race Bank	49.5	31.4	54.0	0.0	0.0
2	Rampion	101.8	121.0	7.9	26.0	155.0
3	Dogger Bank Creyke Beck Projects A and B	16.5	718.9	13.0	29.1	0.0

Tier	Project	Gannet	Kittiwake	Lesser B-b Gull	Great B-b Gull	Herring Gull
3	Dogger Bank Teesside Project A and Sofia	35.7	444.4	12.0	31.9	0.0
3	East Anglia ONE	96.0	140.8	27.0	32.0	18.0
3	Firth of Forth (Seagreen) Alpha and Bravo	915.9	715.0	10.5	66.8	31.0
3	Hornsea Project One	66.0	122.0	21.8	85.8	14.5
3	Hornsea Project Two	27.0	27.0	4.0	23.0	23.8
3	Inch Cape	371.3	301.4	0.0	36.8	13.5
3	Moray Firth (Eastern DA)	124.9	45.4	0.0	35.0	52.0
3	Neart na Gaoithe	570.1	93.4	1.5	4.5	17.5
3	Triton Knoll	121.0	209.0	37.0	122.0	0.0
3	East Anglia THREE	49.0	112.7	10.0	39.0	23.0
Total up to and including Tier 3		**2,874.4**	**3,446.9**	**474.8**	**840.5**	**701.3**
4	Hornsea Project 3	17	33	14	32	n/a
4	Norfolk Vanguard	93.0	256.5	176.4	37.4	4.4
4	Thanet Extension	13.55	14.74	2.35	22.17	14.04
Total including Thanet Extension		**2,888.0**	**3,461.6**	**488.8**	**862.6**	**703.65**
Total including Hornsea 3, Vanguard and Thanet Extension		**2,998.0**	**3,751.1**	**679.2**	**932.0**	**708.05**

4.2.66 The cumulative total predicted mortality up to, and including, the Tier 3 projects with the addition of the predictions relating to Thanet Extension can be placed in the context of the baseline mortality of each seabird population and the individual contribution of Thanet extension to the total. This information has been presented in Table 4.39. The population parameters and their derivation are the same as already presented for the Thanet Extension alone in Table 4.27. The comparison is made with the total biogeographic population with connectivity to UK waters (this includes both adults and immatures) as the assessment is for the annual total predicted mortality.

Table 4.39: Cumulative collision predictions in the context of the relevant populations

	Gannet	Kittiwake	Lesser B-b Gull	Great B-b Gull	Herring Gull
Cumulative predicted mortality up to and including Tier 3	2,874.4	3,446.9	474.8	840.5	701.3
Thanet Extension predicted contribution	13.55	14.74	2.35	22.17	14.04
Total cumulative predicted mortality	2,888.0	3,461.6	488.8	862.6	703.65
BDMPS (total biogeographic population)	1,180,000	5,100,000	864,000	235,000	1,098,000
Annual baseline mortality rate	19.10%	15.60%	12.60%	7.00%	17.20%
Baseline mortality within this population	225,380	795,600	108,864	16,450	188,856
Cumulative mortality relative to baseline, excluding Thanet Extension	1.275%	0.433%	0.436%	5.109%	0.371%
Cumulative mortality relative to baseline, including Thanet Extension	1.281%	0.435%	0.449%	5.244%	0.373%
Thanet Extension contribution - relative to baseline mortality	0.006%	0.002%	0.013%	0.135%	0.002%

4.2.67 All five of the seabird species assessed for the significance of cumulative collision mortality have high sensitivities towards collision risk. The magnitude of the existing (i.e. before Thanet Extension is added in to the total) cumulative predicted collision mortality relative to baseline mortality varies between the species with great black-backed gull the highest at 5.109% and herring gull the lowest at 0.371%. The increase that the addition of Thanet Extension makes to mortality relative to baseline for all five seabird species is N**egligible** and has been assessed as not making a material contribution to the overall cumulative collision mortality impact.

4.14 Inter-relationships

4.2.68 The potential impacts that could arise through inter-relationships between project activities are considered to be those that have effect pathways that operate through bird food chains. Such inter-relationships have already been addressed in this offshore ornithology chapter by addressing them as ‘indirect effects’. Those indirect effects that have already been assessed are:

- In the construction phase - Impact 2: Indirect impacts through effects on habitats and prey species – whereby underwater noise or the generation of suspended sediments may alter the behaviour or availability of bird food prey such as fish or benthic invertebrates. The assessment concluded that all relevant effects are of a **Negligible** or **Minor** adverse significance; and
- In the O&M phase - Impact 4: Indirect impacts through effects on habitats and prey species – whereby underwater noise or EMFs or the generation of suspended sediments may alter the behaviour or availability of bird food prey such as fish or benthic invertebrates. The assessment concluded that all relevant effects are of a **Negligible** or **Minor** adverse significance.

4.15 Mitigation

4.2.69 No further mitigation actions are proposed beyond that already included in the design of the project as embedded mitigation. That embedded mitigation is to ensure that there is a 4 km buffer between Thanet Extension and the Outer Thames Estuary SPA.

4.16 Transboundary statement

4.2.70 Potential transboundary effects have been considered by an evaluation of concentrations of non-breeding seabirds and seabird breeding colonies in adjacent countries bordering the southern North Sea and English Channel and accounting for the transboundary consultation responses received from the relevant authorities in those countries.

4.2.71 With respect to seabird breeding colonies an examination of seabird foraging ranges (Thaxter et al., 2012) allowed an assessment of the likelihood of any linkages to those colonies through feeding flights that might take them close to or within the site of the proposed Thanet Extension. This has not identified any significant likelihood of seabird breeding colonies located in other countries being subject to significant adverse effects as a result of Thanet Extension.

4.2.72 With respect to concentrations of non-breeding seabirds consideration was given to migratory routes to and from those areas of sea and the likelihood or not that their migratory movements would take them past or across the site of the proposed Thanet Extension. This has not identified any significant likelihood of birds moving to or from concentrations of non-breeding seabirds located in other countries being subject to significant adverse effects as a result of Thanet Extension.

4.2.73 With respect to the transboundary consultation responses, ones detailing potential concern about seabirds were received from French authorities and they specifically named sites at Bancs des Flandres, Cap Griz Nez, Littoral Seino-marin, Estuaire de la Canche and the west coast of Alderney and the Burhou Islands. These sites have also been addressed with respect to specific interest features of relevant designations (SPA and Ramsar sites) in the RIAA. An assessment of these sites has identified that the seabirds using them will not be subject to significant adverse effects as a result of Thanet Extension.

4.17 Summary of effects

4.2.74 A summary of the effects of the proposed development during construction, O&M and decommissioning phases on all offshore ornithology at the Thanet Extension site are presented Table 4.40.

Table 4.40: Summary of predicted impacts of Thanet Extension.

Description of impact	Impact	Possible mitigation measures	Residual impact
Construction			
Direct disturbance and displacement	Red-throated diver: **Minor** adverse Razorbill: **Negligible** adverse Guillemot: **Minor** adverse	N/A	Red-throated diver: **Minor** adverse Razorbill: **Negligible** adverse Guillemot: **Minor** adverse
Indirect impacts through effects on habitats and prey species	All seabirds: **Negligible** adverse	N/A	All seabirds: **Negligible** adverse
Operation and Maintenance			
Direct disturbance and displacement	Red-throated diver: **Minor** adverse Gannet: **Negligible** adverse Razorbill: **Negligible** adverse Guillemot: **Negligible** or **Minor** adverse	N/A	Red-throated diver: **Minor** adverse Gannet: **Negligible** adverse Razorbill: **Negligible** adverse Guillemot: **Negligible** or **Minor** adverse
Indirect impacts through effects on habitats and prey species	All seabirds: **Negligible** adverse	N/A	All seabirds: **Negligible** adverse
Collision risk	Gannet: **Minor** adverse Kittiwake: **Minor** adverse Lesser black-b'd gull: **Negligible** adverse Great black-b'd gull: **Minor** adverse Herring gull: **Minor** adverse	N/A	Gannet: **Minor** adverse Kittiwake: **Minor** adverse Lesser black-b'd gull: **Negligible** adverse Great black-b'd gull: **Minor** adverse Herring gull: **Minor** adverse
Barrier effect	Gannet: **Negligible** adverse Kittiwake: **Negligible** adverse Lesser black-b'd gull: **Negligible** adverse Great black-b'd gull: **Negligible** adverse Herring gull: **Negligible** adverse	N/A	Gannet: **Negligible** adverse Kittiwake: **Negligible** adverse Lesser black-b'd gull: **Negligible** adverse Great black-b'd gull: **Negligible** adverse Herring gull: **Negligible** adverse
Decommissioning			

Description of impact	Impact	Possible mitigation measures	Residual impact
Direct disturbance and displacement	Red-throated diver: **Minor** adverse Razorbill: **Negligible** adverse Guillemot: **Negligible** adverse	N/A	Red-throated diver: **Minor** adverse Razorbill: **Negligible** adverse Guillemot: **Negligible** adverse
Indirect impacts through effects on habitats and prey species	All seabirds: **Negligible** adverse	N/A	All seabirds: **Negligible** adverse
Cumulative effects			
Offshore cables construction phase direct disturbance and displacement	Red-throated diver: **Negligible** adverse Razorbill: **Negligible** adverse Guillemot: **Negligible** adverse	N/A	Red-throated diver: **Negligible** adverse Razorbill: **Negligible** adverse Guillemot: **Negligible** adverse
Offshore wind farms O&M phase direct disturbance and displacement	Red-throated diver: **Minor** to **Moderate** adverse (but no material contribution from Thanet Extension) Razorbill: **Negligible** adverse Guillemot: **Negligible** adverse	N/A	Red-throated diver: **Minor** to **Moderate** adverse (but no material contribution from Thanet Extension) Razorbill: **Negligible** adverse Guillemot: **Negligible** adverse
Offshore wind farms O&M phase collision risk	Gannet: **Minor** adverse Kittiwake: **Negligible** adverse Lesser black-b'd gull: **Negligible** adverse Great black-b'd gull: **Moderate** adverse Herring gull: **Negligible** adverse Note: no material contribution from Thanet Extension	If the impact of Thanet Extension were to be removed from this cumulative assessment, a Moderate and Minor adverse effect would still be predicted for Gannet and Great black-b'd gull respectively based on the levels of impact from the other projects considered. It is not possible to apply project specific mitigation that would decrease this below Moderate and Minor. Therefore, the project's contribution to the cumulative impact is considered to be Negligible for Gannet and Great black-b'd gull.	Gannet: **Negligible** adverse Kittiwake: **Negligible** adverse Lesser black-b'd gull: **Negligible** adverse Great black-b'd gull: **Negligible** adverse Herring gull: **Negligible** adverse

4.18 References

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