East Anglia Offshore Wind

VATTENFALL

SCOTTISHPOWER RENEWABLES

East Anglia THREE

Appendix 13.1

Offshore Ornithology Evidence Plan

Volume 3
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East Anglia Three Limited
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13.1 OFFSHORE ORNITHOLOGY - EVIDENCE PLAN

13.1.1 Introduction

1. This appendix contains the Evidence Plan Documents submitted for discussion with Natural England, the RSPB and Suffolk County Council and the agreed meeting minutes following each Evidence Plan meeting. This also includes documents discussion and draft sections of the Environmental Assessment which were submitted prior to each Evidence Plan meeting for discussion. It should be noted, however, that in order to reduce unnecessary repetition, and due to revisions conducted during the assessment process, certain documents which were included with the original Evidence Plan meeting documents have been omitted from this appendix (13.1). This applies to documents which:

- Are included within *Appendix 13.2* (Technical Appendix); or
- Are sections extracted from a draft version of the Environmental Statement Chapter 13 Offshore Ornithology.

2. The following table (*Table 13.1*) identifies these documents and provides a guide to where they can be found.

3. It should be noted that these documents are as close to their original form as possible and have not been updated as projects have developed. Therefore the timelines and parameters given in the method statements, are now out of date. Furthermore, some of the documents within this appendix refer to the proposed East Anglia FOUR project, which at the time of writing was being progressed in parallel with the proposed East Anglia THREE project; it should be noted that this is no longer the case.

Table 13.1. Guide to documents submitted during the Evidence Plan Process which are included in the East Anglia THREE Assessment in different locations (indicated). Documents not listed here are included with the Evidence Plan documents in this appendix (13.1) as per the original submissions. This includes all documents presented at meetings 1, 2 and 4.

Evidence Plan meeting when document first presented	Original document title	Final document title (if different)	Location in assessment
Meeting 3	Population estimates and densities for East Anglia THREE	Annex C: Species-specific Monthly Abundance Estimates and Densities for East Anglia THREE Site plus 4km Buffer after Attribution of Unidentified Species	Appendix 13.2

Evidence Plan meeting when document first presented	Original document title	Final document title (if different)	Location in assessment
	Percentage of birds flying at potential collision height	Annex E: Species-specific Bird Behaviour Information	Appendix 13.2
	Screening for migropath modelling of migrant birds associated with UK SPAs	East Anglia THREE Windfarm Migropath and Collision Risk Modelling Report for Non-seabirds	Appendix 13.1 (Meeting 4)
	Migropath output – numbers of migrants passing through the East Anglia THREE area	East Anglia THREE Windfarm Migropath and Collision Risk Modelling Report for Non- seabirds	Appendix 13.1 (Meeting 4)
	Collision risk model outputs for a range of model options and avoidance rates	Collision Risk Modelling Methodology and Predictions	Appendix 13.3
	HRA screening report		Appendix 13.1 (Meeting 6) and Information for Habitats Regulations Assessment
Meeting 5	Assessing Northern gannet avoidance of offshore windfarms	No change	Appendix 13.1 (Meeting 4)
	Monthly mean abundance estimates and densities	Annex B: Monthly Abundance Estimates for East Anglia THREE Birds (raw counts, confidence limits, precision and densities) before Attribution of Unidentified Birds	Appendix 13.2
	Common guillemot and razorbill new site boundary corrected abundance estimates and densities	Annex D: Monthly Abundance Estimates and Densities for Red-throated diver, Guillemot and Razorbill (latter two species corrected) in the East Anglia THREE Site plus 1km, 2km and 4km Buffers	Appendix 13.2
	Work request 07: East Anglia THREE new boundary revised collision risk modelling for Band options 1,2 and 3	Collision Risk Modelling Methodology and Predictions	Appendix 13.3
	Nocturnal flight activity levels in seabirds	Sensitivity analysis of collision mortality in relation to nocturnal activity factors and wind	Appendix 13.1 (Meeting 6)

Evidence Plan meeting when document first presented	Original document title	Final document title (if different)	Location in assessment
		farm latitude	
	HRA screening: report on ornithology (final screening)	No change	Appendix 13.1 (Meeting 6) and Information for Habitats Regulations Assessment
Meeting 6	Gannet cumulative impact assessment (extracted from the ES chapter)	N/A	Environmental Statement Chapter 13: Offshore Ornithology
	Kittiwake cumulative impact assessment (extracted from the ES chapter)	N/A	Environmental Statement Chapter 13: Offshore Ornithology
	Kittiwake demographic rates for use in PVA (sent to Natural England on 5th June 2015) and preliminary model outputs	North Sea Kittiwake Population Viability Analysis	Appendix 13.4
	Example of evidence base for current cumulative collisions being lower than previously consented levels	N/A	Environmental Statement Chapter 13: Offshore Ornithology

13.1.2 Ornithology ETG Meeting 1 Background Paper

4. Provided below is the background paper that was circulated prior to the first Ornithology ETG meeting

East Anglia Offshore Wind

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East Anglia THREE and East Anglia FOUR

Ornithology

Evidence Plan

Expert Topic Group Meeting 1

30th September 2013 (updated 29th October 2013)

Document Reference – 512608/670-OETG-1

Author – APEM & Royal HaskoningDHV

East Anglia Offshore Wind Limited

Date – October 2013

Revision History –Post Meeting Final

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1 EVIDENCE PLAN PROCESS

1.1 Outline of this Document

1. This document provides an updated record of the information for the ornithology expert topic group (ETG) meeting held on 30th September 2013. Those updates follow from comments received from Natural England. They are limited to matters of record and do not seek to revise text to record matters of agreement or disagreement (that is the purpose of the document attached to the minutes of the meeting).

2. It provides a brief overview of the objectives of the Evidence Plan process, an introduction to the project and the project timeline.

3. It details various aspects of the approach to the ornithology baseline and impact assessment. It is hoped that where a detailed approach is described then that can be agreed at this meeting, or if more information or clarification is required, then the scope of such information can be discussed and agreed; including a timetable for sign-off. In a number of cases only an outline approach is described for this first meeting in recognition that the detail and discussion on it will take place at a future meeting.

4. In accordance with the way in which the agendas for the Ornithology ETG are organised, this document provides separate sections for offshore receptors (from low water mark out to the wind turbines) and onshore receptors (from low water mark at Bawdsey and within the Deben Estuary estuarine closing line to terrestrial along the onshore cable route).

1.2 Objectives of the Evidence Plan Process

5. These are described fully in the Evidence Plan document itself but in brief the aims are as follows.

6. The Plan will reduce the risk of the Projects being delayed by issues relating to the EIA and HRA regulations during the evolution of a proposed Development Consent Order (DCO) application, by:

- Giving greater certainty to all parties that the amount and range of evidence the Applicants (East Anglia Three Ltd and East Anglia Four Ltd) have collected (the surveys having been mostly completed) is sufficient and suitable for its purpose;

- Helping address and agree issues earlier on in pre-application so robust, streamlined decisions can be taken;
- Focusing the evidence requirements so they are proportionate to the Projects' potential impacts and costs to the Applicant are minimised; and
- Time and resource requirements are optimised for all parties.

1.3 Project Introduction

7. East Anglia THREE covers an area of approximately 370km^2 and is situated 79km from its central point to the port of Lowestoft.

8. East Anglia FOUR covers an area of approximately 359km^2 and is situated approximately 91km from its central point to the port of Lowestoft.

9. It is anticipated that each Project would consist of the following infrastructure:

- Offshore wind turbines and associated foundations (anticipated to be up to maximum of 240 wind turbines, each having a rated capacity of between 5MW and 10MW, with an installed capacity of up to 1,200 MW);
- Scour protection around foundations and on inter-array and export cables as required;
- Offshore collector and converter stations platforms with foundations (up to five);
- Subsea cables between the wind turbines and substation platforms
- Subsea export cables to transmit electricity from the offshore platforms to shore; and
- Landfall at Bawdsey with onshore transition pits to connect the offshore and onshore cables.
- Onshore cable route (37km long) between the landfall at Bawdsey and the Converter Station site adjacent to an existing substation near Bramford.

10. The draft DCO for the East Anglia ONE Offshore Windfarm comprises its offshore and onshore export cables, the converter station at Bramford and the onshore cable ducts for East Anglia THREE and East Anglia FOUR. To minimise disruption to local communities, it is hoped it will be possible to install this ducting at the same time as the cables are laid for East Anglia ONE. However, this is subject to consent and to

the final investment decision (FID) made by the company. Therefore, for the purposes of EIA for East Anglia THREE and East Anglia FOUR two options will be assessed – open trenching (assumes all trenching, HDD etc. will be required for each project) and use of pre-installed ducts (assumes that cables will be laid in existing ducts, HDD already undertaken).

1.4 Indicative Project Timelines

Date	Event
August 2013	**Final EA 3 site specific surveys**
30th September 2013	Ornithology ETG meeting 1 Project Introduction Evidence Plan Process Methodologies (survey, desk study, analyses, impact assessment) Statement of Common Ground (SoCG)
November 2013	Baseline offshore survey reports (EA 3 complete, EA 4 partial)
	Ornithology ETG meeting 2: Baseline survey results Approach to HRA screening Approach to cumulative impact assessment Transboundary assessment Modelling methods SoCG
December 2013	HRA screening
February 2014	**Final EA 4 site specific surveys**
February 2014	Ornithology ETG meeting 3 Impact assessment criteria SoCG
April 2014	HRA draft report EA 3 & EA 4
May 2014	**PEI submission (draft ES) EA 3 & EA 4**
August 2014	HRA final report EA 3
Summer 2014	Ornithology ETG meeting 4 PEI feedback DCO conditions SoCG
Autumn 2014	Ornithology ETG meeting 5 Resolution of PEI comments Mitigation Monitoring SoCG
November 2014	**DCO application EA 3**
Spring 2015	**DCO application EA 4**

2 EXISTING ENVIRONMENT

2.1 Offshore

2.1.1 Baseline Information Gathering: Survey

11. The primary data source for each project is the aerial digital surveys conducted by APEM. These surveys were carried out over the following periods:

- East Anglia THREE specific aerial digital surveys. Carried out monthly over the period September 2011 to August 2013 using a 500m grid and a 4km buffer. The images will be analysed to generate project specific estimates of abundance and densities for each bird species and, for flying birds, record a number of flight specific parameters. Further detail on these analyses is given in a later section.

- East Anglia FOUR specific aerial digital surveys. To be carried out monthly over the period March 2012 until February 2014 using a 500m grid and a 4km buffer. The images will be analysed to generate project specific estimates of abundance and densities for each bird species and, for flying birds, record a number of flight specific parameters. Further detail on these analyses is given in a later section.

12. A summary of the high resolution digital aerial survey method is attached as Appendix 1. This is the same aerial survey method that was used for East Anglia ONE.

13. In addition to these aerial surveys, relevant contextual data including those from surveys undertaken for East Anglia ONE and the East Anglia Zone will also be used.

14. Additional surveys along the offshore cable route from array to landfall are not proposed as the information available from existing survey sources has proven sufficient to assess the potential impact of East Anglia ONE on non-breeding red-throated diver. That assessment concluded that there is no significant impact in EIA terms. It has also been agreed between EAOL, Natural England and JNCC that the East Anglia ONE "*project alone and in combination with other plans and projects has no LSE on the Outer Thames Estuary SPA [interest feature - red-throated diver]*" (East Anglia ONE SoCG Ornithology, Marine and Coastal: Row 6h). East Anglia THREE and East Anglia FOUR will use an almost identical offshore cable route and there is no evidence based reason to not come to the same conclusion as was drawn in East Anglia ONE.

15. Data analysis will be completed by APEM using the methods described below.

2.1.2 Baseline Information Gathering: Desk Study

16. The site specific surveys will be supplemented by published and other available data sources where appropriate. Appendix 2 contains a list of published and other available data sources that will be used in the desk study. This list is not exhaustive and it will be added to, including as new information becomes available.

2.1.3 Baseline Information Analysis: Biological Periods

17. In the analysis of the baseline information and in the impact assessment, each bird species or species group is considered (provided sufficient data is available or it is relevant) both throughout the year and within four biological periods. This is to account for potentially different bird behaviour and the presence of different populations across a calendar year. The four biologically relevant periods in to which the year will be divided for each species or species group are:

- Wintering;
- Spring migration;
- Breeding season; and
- Post breeding dispersal / autumn migration.

18. For each species or species group the biological periods will be determined from published literature, including both standard reference texts (see Appendix 2) and species specific research publications.

19. Appendix 3 presents the biological periods that were used in the assessment of the potential impacts of East Anglia ONE. Where new information on bird biology and ecology becomes available then these biological periods will be adjusted as necessary.

2.1.4 Baseline Information Analysis: Bio-geographic Populations

20. As part of the assessment process bird populations are identified for specified bio-geographic regions. The bio-geographic region is particular to each bird species and depends upon its biology, behaviour, distribution and division, where relevant, in to sub-species or races. A technical note on species specific bio-geographic populations will be provided subsequent to the Ornithology ETG meeting 1.

2.1.5 Baseline Information Analysis: Population Estimates

21. For East Anglia ONE the approach to population estimation was to use a design-based abundance estimates and this approach will be used for East Anglia THREE and East Anglia FOUR. This method is set out in Appendix 4.

22. APEM adopts a process of continually improving its analysis methods. As part of this APEM will be testing the complex region spatial smoother (CReSS) generalized estimating equation (GEE) method developed by the University of St Andrews' Centre for Research into Ecological and Environmental Modelling (CREEM). This method will be tested to ensure that we are following best practice in modelling of species distribution across the survey areas and of population estimation. This method would be subject discussion at a future meeting of the Ornithology ETG.

2.1.6 Baseline Information Analysis: Flight Direction

23. For East Anglia THREE and East Anglia FOUR the same method of bird flight direction determination will be applied as for East Anglia ONE.

24. Bird flight direction is determined using the information held within, and associated with, each image. Each of the images taken and examined by APEM's Bird ID team has an associated file containing geographic information including aircraft location, aircraft orientation, direction of flight and image resolution. This allows the image to be orientated correctly and the bespoke APEM software then automatically records each bird's heading (direction) relative to the image. This is then combined with the geographic information in the associated file to generate the bird's true flight direction.

2.1.7 Baseline Information Analysis: Flight Height

25. For East Anglia THREE and East Anglia FOUR the same method of bird flight height determination will be applied as for East Anglia ONE.

26. Bird flight height is determined using bespoke APEM software that applies a set of rules developed in-house and trigonometry to provide an estimate of flight height to within 1-5 m. The trigonometric calculation is based on species-specific bird measurements, image ground sample distance (GSD) (the distance between pixel centres) and the known height of the aircraft as that image was taken. These parameters are entered into APEM's flight height calculator to estimate the height of each individual bird captured in survey images. Flight height estimates are less reliable for birds that are diving or turning sharply (this affects the measurement of body length and wing span from the image) and so such birds are removed from the sample used to calculate flight heights.

27. For bird species that occur at low density flying within each survey area it is quite possible that the aerial surveys of that area will not detect a sufficient number of flying birds that the sample size is considered to be adequate to determine the proportion that fly at the potential collision height (PCH). In this circumstance consideration will be given to pooling the observations from the surveys carried out

in the East Anglia Zone (ie surveys from East Anglia One, East Anglia THREE and East Anglia FOUR). If the sample size is still not sufficient to enable a site specific proportion that fly at PCH to be determined then that figure will be taken from the report of the relevant Strategic Ornithological Support Services (SOSS) project (Cook *et al*., 2012) or any revision to that or in light of any new empirical evidence that may come to light in the near future.

2.1.8 Species to be Considered: Species Observed in Surveys

28. A list of all bird species observed during the aerial digital surveys of the East Anglia THREE and East Anglia FOUR offshore sites and survey buffer is included as Appendix 5. At this stage of the project the data have not been analysed to produce population estimates. When that information is available it will be provided to the ETG either directly as part of an ETG meeting or supplied when the PEI report is produced.

29. Based on the data collected from the site specific surveys for East Anglia ONE, the species most likely to occur in greater than negligible numbers (that is the project area population estimate was of regional importance or greater) in the East Anglia THREE and East Anglia FOUR offshore sites are identified in Table 2.1.

Table 2.1: Seaduck and Seabird Species Present in East Anglia ONE Offshore Site and Geographical Scale of Importance of Population

Species	Geographic scale of importance in the non-breeding season	Geographic scale of importance in the breeding season
Common scoter	< Regional	< Regional
Red-throated diver	Regional	< Regional
Fulmar	Regional	< Regional
Gannet	< Regional	< Regional
Great skua	< Regional	< Regional
Kittiwake	Regional	Regional
Black-headed gull	< Regional	< Regional
Common gull	< Regional	< Regional
Lesser black-backed gull	Regional	Regional
Herring gull	< Regional	< Regional
Great black-backed gull	< Regional	< Regional
Guillemot	Regional	< Regional
Razorbill	Regional	< Regional

Species	Geographic scale of importance in the non-breeding season	Geographic scale of importance in the breeding season
Puffin	< Regional	< Regional

2.1.9 Species to be Considered: Selecting Species to Assess

30. A series of criteria have been used to select those species that will be taken through the assessment process. Only one of these criteria has to be satisfied for a species to be selected. By definition, all other species that do not satisfy one or more of these criteria will have been deemed to have been screened out. The criteria used to select the species are:

- Species whose populations in the East Anglia THREE or East Anglia FOUR offshore site (including the relevant buffer), as estimated from the aerial surveys, are of regional importance or greater;
- Seabird species of which adult birds occur in the breeding season in the East Anglia THREE or East Anglia FOUR offshore site (including the relevant buffer) and are within the maximum foraging distance (Thaxter *et al*., 2012) from a SPA or SSSI where that species is a listed interest feature or assemblage component;
- Species that occur in numbers of regional importance or greater (as determined by the migration modelling for East Anglia THREE or East Anglia FOUR); and
- Species that are listed interest features or assemblage components of SPAs and whose numbers have been estimated through migration modelling (Migropath) to pass through the East Anglia THREE or East Anglia FOUR offshore site in numbers that are 1% or greater of the population of the relevant SPAs.

2.2 Onshore

2.2.1 Baseline Information Gathering: Survey

31. The primary data sources for each project will be from the non-breeding season surveys of the Deben Estuary and its surrounding low lying agricultural land conducted by APEM in 2011-12 (East Anglia ONE ES Volume 3 Chapter 24 Appendix 24-11) and the terrestrial ecology surveys, including surveys for the presence of breeding birds, conducted by RSK in 2012 (East Anglia ONE ES Volume 3 Chapter 24 Appendix 24-12). It was agreed by Natural England in the East Anglia ONE onshore SoCG in relation to sufficient information being provided to conclude that the project

alone has no LSE on the interest features of the Deben Estuary SPA that "Sufficient information has now been presented that, should it have been provided in the form of an HRA, it is likely that the conclusion reached would have been no adverse effect on site integrity" (East Anglia ONE Onshore SoCG: Biodiversity, Biological Environment and Ecology, Row 4.14). East Anglia THREE and East Anglia FOUR will use the same onshore cable route and there is no evidence based reason to not come to the same conclusion as was drawn in East Anglia ONE. Accordingly no further baseline surveys for brent goose, avocet and other waterbirds feeding in intertidal habitats are proposed.

32. A targeted survey of brent goose distribution will take place in the winter of 2013-14. This will update our understanding of brent goose distribution along the onshore cable route. It will also record the existing disturbance produced by farmers protecting their crops and by public access along rights of way. This will inform proposed mitigation actions for East Anglia THREE and East Anglia FOUR. Further detail of the proposed method is in Appendix 6.

2.2.2 Baseline Information Gathering: Desk Study

33. The site specific surveys will be supplemented by published and other available data sources where appropriate. These will include (but may not be limited to):

- WeBS Core (high tide) and Low Tide counts for the Deben Estuary; and
- The Ecological Background Data Search produced by RSK in 2012 (East Anglia ONE ES Volume 3 Chapter 24 Appendix 24-1).

2.2.3 Species to be Considered: Species Observed in Surveys

34. Based on the data collected from the site specific surveys for East Anglia ONE, the species likely to occur in the in the area of the East Anglia THREE and East Anglia FOUR onshore cable route are presented in Appendix 7 for non-breeding waterbirds and raptors birds and Appendix 8 for breeding birds of particular conservation concern (Annex 1, Schedule 1, BoCC Red and Amber List, UKBAP and Suffolk BAP).

2.2.4 Species to be considered: Selecting species to assess

35. A series of criteria have been used to select those species that will be taken through the assessment process. Only one of these criteria has to be satisfied for a species to be selected. By definition, all other species that do not satisfy one or more of these criteria will have been deemed to have been scoped out. The criteria used to select the species are:

- Species that are listed interest features or assemblage components of the Deben Estuary SPA and SSSI.
- Species that are Schedule 1 species and occur along the onshore cable route in the breeding season or within an agreed distance outside the defined cable route.

36. Consideration of species in relation enhancement under the biodiversity duty applying to decision makers and best practice to avoid infringement of the law in relation to all nesting birds will be carried out as a separate process to the species selection described above.

2.3 Proposed Action / Agreement

37. It is expected that:

- The sources of baseline information for the offshore and onshore receptors to be agreed in ETG meeting 1.
  This includes:
  - The use of the same aerial survey method that was used for East Anglia ONE.
  - No additional baseline surveys along the offshore and onshore cable routes.
- The process for identifying biological periods to be agreed in ETG meeting 1.
- The process for identifying bio-geographic populations for offshore receptors to be discussed in outline in ETG meeting 1, a technical note on species specific bio-geographic populations to be provided subsequent to the Ornithology ETG meeting 1 and those species specific bio-geographic populations to be agreed in ETG meeting 2.
- The methods for determining population estimates and flight parameters (direction and height) from the aerial surveys to be agreed in ETG meeting 1.
- The process for selecting the list of species to be taken through the impact assessment process for offshore and onshore receptors to be discussed in ETG meeting 1 and species agreed in ETG meeting 2.
- The proposed targeted survey of brent goose distribution to be discussed and agreed at ETG meeting 1.
  This will enable the first survey visits to be conducted in October 2013.

3 POTENTIAL IMPACTS

3.1 Offshore

38. The following list of potential impacts, as set out in the East Anglia THREE and East Anglia FOUR Scoping Reports (EAOW 2012a and 2012b) will be considered, with those listed below divided by stage of implementation of the project.

39. Potential indirect effects are to be assessed at the receptor level and information on predicted impacts presented in the relevant receptor section and not in a freestanding chapter on the topic of indirect effects. Assessment of such potential indirect effects will be treated as equivalent to the assessment of 'interrelationships' that is sought by PINS (as referred to in the guidance on the Rochdale Envelope). Accordingly interrelationships will be assessed at the receptor level and not in a freestanding chapter on the topic of interrelationships. The ornithology ES chapter will contain a section on interrelationships that will signpost how they have been assessed.

3.1.1 During Construction

40. The potential impacts that have been included within the scope of the assessment are:

- Disturbance / Displacement
- Indirect impacts through effects on habitats and prey species

3.1.2 During Operation

41. The potential impacts that have been included within the scope of the assessment are:

- Disturbance / Displacement
- Indirect impacts through effects on habitats and prey species
- Collision risk
- Barrier effect

3.1.3 During decommissioning

42. The potential impacts that have been included within the scope of the assessment are:

- Disturbance / Displacement

- Indirect impacts through effects on habitats and prey species

3.1.4 Impacts Scoped Out

43. No specific potential impacts on offshore ornithology receptors were scoped out of the assessment as a result of the scoping report.

3.2 Onshore

44. The following list of potential impacts, as set out in the East Anglia THREE and East Anglia FOUR Scoping Reports (EAOW 2012a and 2012b) will be considered, with those listed below divided by stage of implementation of the project.

45. Potential indirect effects are to be assessed at the receptor level and information on predicted impacts presented in the relevant receptor section and not in a freestanding chapter on the topic of indirect effects. Assessment of such potential indirect effects will be treated as equivalent to the assessment of 'interrelationships' that is sought by PINS (as referred to in the guidance on the Rochdale Envelope). Accordingly interrelationships will be assessed at the receptor level and not in a freestanding chapter on the topic of interrelationships. The ornithology ES chapter will contain a section on interrelationships that will signpost how they have been assessed.

3.2.1 During Construction

46. The potential impacts that have been included within the scope of the assessment are:

- Disturbance / Displacement

47. The scale of such disturbance / displacement effects will depend on the method of onshore cable installation that is used - open trenching or use of pre-installed ducts (see the explanation of why there are two options to be assessed in the 'Project Introduction' section above). The key differences between the two options are described in Appendix 9.

3.2.2 During Operation

48. None have been identified other than the small scale, temporary disturbance and displacement effects that would result from the necessity to replace a failed cable section. These effects are similar to those of the construction phase but due to their localised nature and the short period over which works could be conducted (replacement being by cable pulling through a duct and not new trenching) are not considered to be of a scale and nature to require screening in for assessment.

49. It is recognised that any cable replacement works would have to follow the good practice to avoid disturbance to breeding Schedule 1 birds and non-breeding SPA and SSSI interest features of the Deben Estuary established by the Outline Landscape and Ecological Management Plan for East Anglia ONE.

3.2.3 During Decommissioning

50. The potential impacts that have been included within the scope of the assessment are:

- Disturbance / Displacement

51. It is likely that the jointing bays and ducts will be left in situ but the cables will be de-energised and removed and therefore this will be assessed in the EIA as the worst case. As a result, the potential effects of decommissioning are similar to those of the construction phase for the option where ducts will already have been installed during the installation of the cable for East Anglia ONE. This means that potential effects will be localised and occur over a short period. These potential effects are not considered to be of a scale and nature to require screening in for assessment.

52. It is recognised that such decommissioning works would have to follow the best practice to avoid disturbance to breeding Schedule 1 birds and non-breeding SPA and SSSI interest features of the Deben Estuary established by the Outline Landscape and Ecological Management Plan for East Anglia ONE.

3.2.4 Impacts Scoped Out

53. As identified above, potential impacts during the operational phase and during the decommissioning phase on onshore ornithology receptors have been scoped out.

3.3 Proposed Action / Agreement

54. It is expected that:

- The types of potential impact to be assessed in relation to offshore and onshore receptors to be discussed and agreed in ETG meeting 1.
- The types of potential impact that will be scoped out from further assessment in relation to offshore and onshore receptors to be discussed and agreed in ETG meeting 1.
  At present this relates only to potential impacts of the onshore component of the development.

4 APPROACH TO IMPACT ASSESSMENT

4.1 The EIA Process

4.1.1 The Approach to Assessment

55. The assessment approach will use the conceptual 'source-pathway-receptor' model. The model identifies likely environmental impacts resulting from the proposed construction, operation and decommissioning of the windfarm and its supporting transmission infrastructure. This process provides an easy to follow assessment route between impact sources and potentially sensitive receptors ensuring a transparent impact assessment. The parameters of this model are defined as follows:

- Source – the origin of a potential impact (noting that one source may have several pathways and receptors) i.e. an activity such as cable installation and a resultant effect e.g. re-suspension of sediments.
- Pathway – the means by which the effect of the activity could impact a receptor e.g. for the example above, re-suspended sediment could settle and smother the seabed.
- Receptor – the element of the receiving environment that is impacted e.g. for the above example, bird prey species living on or in the seabed.

4.1.2 Defining and Assessing Impacts

56. The guidance issued by IEEM for the assessment of impacts on marine and coastal receptors (IEEM, 2010) will be used as the basis for the steps in the assessment process and the definitions that are used in that process.

57. The value of ornithological receptors will be evaluated according to the following scale:

- International
- National
- Regional
- Local (within the zone of influence of the project only)

58. The sensitivity of ornithological receptors will be defined for each species and related to sensitivities to specific impact types using guidance published that

specifically relates to renewable energy developments (Furness and Wade,2012; Garthe and Hüppop, 2004; Langston, 2010 and Maclean *et al*., 2009).

59. It should be noted that high value and high sensitivity are not necessarily linked within a particular impact. A receptor could be of high value (e.g. Annex 1 species) but have a low or negligible physical/ecological sensitivity to an effect and vice versa. Potential impact significance will not be inflated simply because a feature is 'valued'. Similarly, potentially highly significant impacts will not be deflated simply because a feature is not "valued". The narrative behind the assessment is important here; the value of an ornithological receptor can be used where relevant as a modifier for the sensitivity (to the effect) already assigned to the receptor.

60. The potential magnitude of effect will be described for permanent and temporary effects, as detailed in Table 4.1. The thresholds for each category defining the potential magnitude of effect that can occur from a source have been determined using expert judgement and current scientific understanding of bird population biology.

Table 4.1: Definition of Magnitude of Effects

Magnitude	Definition
High	Fundamental, permanent / irreversible changes, over the whole receptor, and / or fundamental alteration to key characteristics or features of the particular receptors character or distinctiveness.
Medium	Considerable, permanent / irreversible changes, over the majority of the receptor, and / or discernible alteration to key characteristics or features of the particular receptors character or distinctiveness.
Low	Discernible, temporary (throughout project duration) change, over a minority of the receptor, and / or limited but discernible alteration to key characteristics or features of the particular receptors character or distinctiveness.
Negligible	Discernible, temporary (for part of the project duration) change, or barely discernible change for any length of time, over a small area of the receptor, and/or slight alteration to key characteristics or features of the particular receptors character or distinctiveness.
No change	No loss of extent or alteration to characteristics, features or elements.

61. The significance of impacts will be assessed using the matrix presented in Table 4.2. Impacts shaded red or orange represent those with the potential to be significant in EIA terms.

Table 4.2: Impact Matrix

Receptor sensitivity	Magnitude of effect High	Medium	Low	Negligible
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Minor
Low	Moderate	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

62. It is important that the matrix (and indeed the definitions of sensitivity and magnitude) is seen as a framework to aid understanding of how a judgement has been reached from the narrative of each impact assessment and **it is not a prescriptive formulaic method**. Expert judgement will be applied to the assessment of likelihood and ecological significance of a predicted impact. For the purpose of this assessment we will follow the IEEM (2010) guidance which states:

'An ecologically-significant impact is defined by IEEM (2010) guidelines as 'an impact that has a negative, or positive, effect on the integrity[1] *of a site or ecosystem and/or the conservation objectives for habitats or species populations within a given geographical area. In this way significant impacts are distinguished from other, lesser (and, in the context of EIA, unimportant) effects'*

4.1.3 Rochdale Envelope

63. The 'Rochdale Envelope' approach to impact assessment is being used because the definitive project details are not yet known and a number of options will remain under consideration until further geotechnical investigations, economic assessments and the procurement processes have taken place.

4.1.4 Worst Case Scenario (WCS)

64. From within the Rochdale Envelope the WCS will be defined for each source of effect e.g. a separate WCS will be prepared and described in the ES chapter for collision mortality and barrier effect. A rationale for the selection of the WCS for each source of effect will be explained and summarised in tabular form in the offshore and onshore ornithology chapters.

[1] The integrity of a site is the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified.

4.1.5 Embedded Mitigation

65. Embedded mitigation (i.e. design decisions taken which avoid or reduce particular types of impact) will be described in the ES. The impact assessment will take into account all embedded and other forms of mitigation that will be delivered.

4.1.6 Cumulative and In-combination Impacts

66. The ES will provide an assessment of the potential for cumulative impacts both within and outwith the East Anglia Zone.

67. The approach to the assessment of cumulative impacts on birds will follow the process that has been applied by Ministers when consenting offshore wind farms and confirmed in very recent consent decisions including for Galloper and Triton Knoll. It also follows the approach set out in recent guidance from PINS (Planning Inspectorate, 2012a) and from the renewables industry (renewableUK, 2013).

4.1.7 Transboundary

68. The potential for transboundary impacts will be identified by consideration of potential linkages to non-UK protected sites and sites with large concentrations of breeding, migratory or wintering birds (including by the use of available information on tagged birds).

4.2 Assessment Methodologies

69. The following assessment methodologies will be discussed (based on a method statement or briefing for each provided by EAOL) at Ornithology ETG meeting 2:

- Migration modelling
- Collision risk modelling
- Displacement effects
- Population modelling (PVA / PBR)

4.3 Proposed Action / Agreement

70. It is expected that:

- The approach to assessment described in Sections 4.1.1 to 4.1.5 above to be discussed and agreed at ETG meeting 1.
- The approach to the cumulative assessment for EIA purposes to be discussed at ETG meeting 2 and agreed in ETG meeting 3.

- The approach to the transboundary assessment to be discussed at ETG meeting 2 and agreed in ETG meeting 3.
- The detailed impact assessment methodologies relating to migration modelling, collision risk modelling, displacement effects and population modelling to be discussed in ETG meeting 2 and agreed in ETG meeting 3.

5 HABITATS REGULATIONS ASSESSMENT

5.1 HRA Process

71. The approach to the HRA will follow the staged approach set out in existing procedural guidance (European Commission, 2001; DCLG, 2006; Planning Inspectorate, 2012b), involving the key steps of:

- Screening
- Appropriate Assessment
- IROPI and Alternatives
- Compensatory Measures

72. The assessment will be carried out on the project alone and in-combination with other plans and projects.

73. With regard to the in-combination assessment and the approach to project selection for assessment, this follows available industry guidance which supports the concept of taking a clear and practical approach to in-combination assessment and the incorporation of information only where there is a reasonable degree of certainty. It also follows the process that has been applied by Ministers when consenting offshore wind farms and confirmed in very recent consent decisions including for Galloper and Triton Knoll.

5.2 HRA Specific Methods

74. There are some specific methods that apply to HRA that are not used in EIA either because they relate specifically to the assessment of European and Ramsar sites or because NE and / or JNCC have produced specific guidance that relates only to HRA. Such HRA specific methods will be discussed (based on a method statement or briefing for each provided by EAOL) at Ornithology ETG meeting 2. Those that have been identified are:

- Apportionment to SPAs
- Biologically Defined Minimum Population Scale

75. The current existence of guidance on other HRA specific methods and the prospects of NE and / or JNCC producing revised or new guidance on HRA specific methods in a timescale relevant to East Anglia THREE and East Anglia FOUR will be discussed at Ornithology ETG meeting 1.

5.3 Proposed Action / Agreement

76. It is expected that:

- Current, revised and new guidance on HRA specific methods will be discussed at Ornithology ETG meeting 1.
- The detailed HRA specific methodologies relating to apportionment to SPAs and determination of BDMPS to be discussed in ETG meeting 2 and agreed in ETG meeting 3.
- The HRA screening outputs to be discussed in ETG meeting 2 and agreed in ETG meeting 3.
- The approach to in-combination assessment to be discussed at ETG meeting 2 and agreed in ETG meeting 3.

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APPENDIX 1: METHOD STATEMENT – AERIAL SURVEY

Overview

APEM carries out its aerial surveys using high resolution (HR) digital still imagery and a grid sampling design. This acquires a series of independent images with a randomised starting point throughout the study area. High Definition (HD) video methods, in contrast, typically collect a continuous stream of data along line transects which run in parallel across the survey region. Both methods allow the production of population estimates with a given level of precision. The statistical power is generally lower with the continuous sampling HD video method due to a lower number of spatially independent 'samples' collected during a survey. Furthermore, digital still images reduce 'motion blur' so that image clarity is increased. For these reasons APEM has chosen to select the HR digital still imagery method in preference to the HD video method.

Survey Design and Planning

The aerial survey will use a grid sampling design. This involves flying along lines spaced at a set distance (500m apart in this instance) and taking still images at set distances (500m apart in this instance). This creates a systematic grid of coverage. This ensures that survey effort is evenly distributed. The coverage is based on classical biological sampling (e.g. quadrat sampling). The grid generates a large number of independent samples which means that population estimates can be obtained for which the standard error is low and precision is high. It also generates data suitable for analytical methods such as density surface modelling.

Obtaining images to the survey design with a high degree of accuracy is ensured through flight planning software that is used to program the survey flight lines, the on-board GPS systems and the camera triggering. The flight planning software defines the required flying altitude and speed according to the camera, lens and required pixel resolution.

All flights are carried out by APEM owned aircraft (a fleet of three Vulcanair P68 survey aircraft) based at Hawarden Airport near Chester and crewed by APEM's employed pilots and camera technicians.

Image processing

Photographs are imported as georeferenced images (WGS 84 projection) into ArcView 9.2 (ESRI) allowing the spatial location of birds and marine mammals to be accurately determined. The following metadata are routinely recorded as a minimum:

- Species (or group) identification
- Count (number of individuals)
- Position (eastings, northings)

In-house trained observers examine the images on screen, using a bespoke user interface designed and created by APEM. Targets are identified through an automated process and all birds and mammals are geo-referenced and identified to the lowest taxonomic level possible by a person. Supplementary data including flight height, flight direction and behaviour is routinely recorded, whilst age and sex information is noted when possible.

Example images of seabirds are provided below.

Quality Assurance (QA) Procedure

APEM are the first and only company to receive UKAS (United Kingdom Accreditation Service) accreditation of 'Bird Identification & Enumeration from Aerial Photographs'. This allows APEM to provide an assurance of the quality of our results, ensures clients have reproducibility and traceability and drives continuous improvements in our systems and staff.

Both internal and external quality assurance (QA) are carried out on each survey. Images are assessed in batches with a different staff member responsible for each batch. Each image containing birds and / or marine mammals is reviewed and checked by APEM's dedicated QA Manager, ensuring that 100% of birds found are subject to internal QA. Images containing no birds and / or marine mammals are removed and kept separately for further internal QA. Of these 'blank' images, 10% are randomly selected for QA by an independent reviewer. If there is less than 90% agreement, the entire batch of fifty images is re-analysed.

Upon completion of the internal QA, 20% of the birds located in each survey are subject to external QA by an independent organisation. The appointed auditors for birds are the British Trust for Ornithology (BTO). The images sent for external QA are selected at random using a random number generator. Upon completion, a confusion matrix is created to show the proportion of agreement between the BTO and APEM, and to identify areas of potential misidentification. At least 90% agreement is required. Any disagreements are reviewed and if the 90% threshold is still not reached then a further 20% of images are assessed by the BTO. If 90% agreement is not achieved after secondary assessment, then the entire batch of images is required to be reassessed and the QA process repeated.

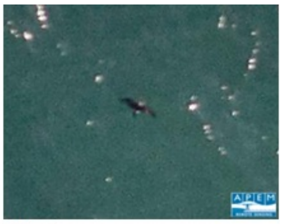
Example images of seabirds

Note that actual image quality is far superior to these examples that have, through the necessity of the process of incorporation in to this document, been compressed and cropped


Flying guillemot

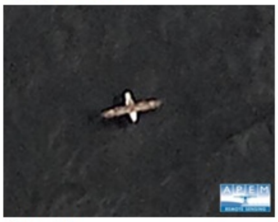

Juvenile kittiwake


Flying herring gull


Flying shearwater


Sitting razorbills

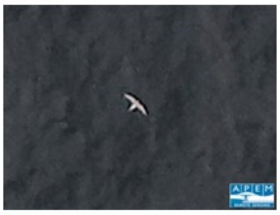

Sitting puffins


Flying fulmar


Flying gannet


Flying great black-backed gull


Flying lesser black-backed gull


Flying tern


Flying common gull

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APPENDIX 3: BIOLOGICAL PERIODS FOR SEADUCKS, DIVERS AND SEABIRDS USED IN THE ASSESSMENT OF EAST ANGLIA ONE

Species	January	February	March	April	May	June	July	August	September	October	November	December
Common scoter	Wintering	Spring Migration	Spring Migration	Spring Migration	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Red-throated diver	Wintering	Wintering	Spring Migration	Spring Migration	Spring Migration	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Fulmar	Wintering	Wintering	Spring Migration	Spring Migration	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Gannet	Wintering	Wintering	Spring Migration	Spring Migration	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Great skua	Wintering	Wintering	Spring Migration	Spring Migration	Spring Migration	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Kittiwake	Wintering	Wintering	Spring Migration	Spring Migration	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Black-headed gull	Wintering	Wintering	Spring Migration	Spring Migration	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering	Wintering
Common gull	Wintering	Wintering	Spring Migration	Spring Migration	Spring Migration	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Lesser black-b'd gull	Wintering	Wintering	Spring Migration	Spring Migration	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Herring gull	Wintering	Wintering	Spring Migration	Spring Migration	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Great black-b'd gull	Wintering	Wintering	Spring Migration	Spring Migration	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Guillemot	Wintering	Spring Migration	Spring Migration	Spring Migration	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering	Wintering
Razorbill	Wintering	Spring Migration	Spring Migration	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering	Wintering
Puffin	Wintering	Spring Migration	Spring Migration	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering	Wintering

Key:

Blue	Wintering
Green	Spring Migration
Yellow	Breeding Season
Red	Post-breeding Dispersal / Autumn Migration

APPENDIX 4: ESTIMATION OF BIRD POPULATIONS WITHIN THE SURVEY AREA

Bird population estimates for the survey area were generated using design-based population estimates. The process was to total the raw counts from the geo-referenced images and divide this number by the total number of images to give the mean number of birds per image (i). Relative population estimates (N) for each survey month were then generated by multiplying the mean number of birds per image by the total number of images required to cover the entire study area (A). This is analogous to the abundance estimation method outlined in Borchers *et al*. (2002).

$$N = i\ A$$

Non-parametric bootstrap methods were used for variance estimation. A variability statistic was generated by re-sampling 999 times with replacement from the raw count data. The statistic was evaluated from each of these 999 bootstrap samples and upper and lower 95% confidence intervals of these 999 values taken as the variability of the statistic over the population (Efron & Tibshirani 1993).

Measures of precision were calculated using a negative binomial estimator, suitable for a pseudo-Poisson over dispersed distribution. This produced a CV (coefficient of variation) based on the relationship of the standard error to the mean.

All analysis and data manipulation was conducted in the R programming language (R Development Core Team) and non-parametric 95% confidence intervals were generated using the 'boot' library of functions (Canty & Ripley 2010).

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APPENDIX 5: LIST OF BIRD SPECIES OBSERVED IN EAST ANGLIA THREE AND EAST ANGLIA FOUR OFFSHORE SITE AREA AND BUFFER

Species / Group	Recorded in East Anglia THREE Aerial Surveys	Recorded in East Anglia FOUR Aerial Surveys	Main Period(s) When Observed (if applicable)	Notes
Guillemot	✓	✓	Breeding, passage & wintering	Observed in all months in both project areas. Highest numbers recorded in January 2013 for both project areas.
Razorbill	✓	✓	Breeding, passage & wintering	Observed in all months in both project areas.
Guillemot / Razorbill	✓	✓	Breeding, passage & wintering	
Puffin	✓	✓	Breeding, passage & wintering	
Little Auk	✓	✓	Wintering	
Cormorant		✓	Passage	Observed in April 2012 and April 2013 in East Anglia FOUR survey area.
Diver spp	✓	✓	Passage, wintering	Highest number recorded in March 2012 in East Anglia THREE survey area.
Red-throated Diver	✓	✓	Passage, wintering	
Black-throated Diver	✓	✓	Passage, wintering	
Great Northern Diver	✓	✓	Passage, wintering	
Large gull spp	✓	✓		
Black-backed gull spp	✓		Breeding, passage & wintering	
Lesser Black-backed Gull	✓	✓	Breeding, passage & wintering	
Great Black-backed Gull	✓	✓	Breeding, passage & wintering	
Herring Gull	✓	✓	Breeding, passage & wintering	
Small gull spp	✓	✓	Breeding, passage & wintering	
Black-headed Gull	✓	✓	Breeding, passage & wintering	

Species / Group	Recorded in East Anglia THREE Aerial Surveys	Recorded in East Anglia FOUR Aerial Surveys	Main Period(s) When Observed (if applicable)	Notes
Common Gull	✓	✓	Breeding, passage & wintering	
Black-legged Kittiwake	✓	✓	Breeding, passage & wintering	
Little Gull	✓	✓	Passage	Highest number recorded in May 2013 in East Anglia THREE survey area.
Sabine's Gull	✓		Passage	Observed in November 2011 in East Anglia THREE survey area.
Skua spp	✓		Passage	
Arctic Skua	✓	✓	Passage	
Great Skua	✓	✓	Passage	
Pomarine Skua		✓	Passage	
Long-tailed Skua	✓		Passage	Single bird observed in September 2011 in East Anglia THREE survey area.
Northern Fulmar	✓	✓	Breeding, passage & wintering	
Northern Gannet	✓	✓	Breeding, passage & wintering	
Shelduck	✓		Passage	Observed in February 2013 in East Anglia THREE survey area.
Scaup	✓		Wintering	Observed in January 2013 in East Anglia THREE survey area.
Red-breasted Merganser		✓	Passage	Observed in October 2012 in East Anglia FOUR survey area.
Pink-footed Goose		✓	Passage	Observed in April 2013 in East Anglia FOUR survey area.
Tern spp	✓			
'Commic' Tern	✓	✓	Breeding	Highest number observed in May 2013 in East Anglia THREE survey area.
Little Tern		✓	Breeding	Observed in May 2012 in East Anglia FOUR survey area.
Total Species	**24**	**25**		A total of 29 species across both areas (includes counting 'comic' tern as two species and excludes other grouped species categories).

Species presence / absence based on the analysis of the images from East Anglia THREE over the months September 2011 to August 2013 and from East Anglia FOUR over the months March 2012 to July 2013.

APPENDIX 6: SURVEY OF BRENT GOOSE DISTRIBUTION IN WINTER 2013-14

This survey aims to gain a better understanding of the distribution of brent geese where the onshore cable route crosses the Ramsholt and Falkenham Marshes and runs close to and crosses under the main estuarine channel (ie not including the Martlesham Creek). It will also record brent goose responses to the existing disturbance produced by farmers protecting their crops and public access along rights of way. This will inform proposed mitigation actions.

The survey method uses a single observer to map the location, number and behaviour (e.g. feeding, alert, flying away etc.) of all brent geese within groups of fields selected from within a survey area that focuses on where large brent goose numbers were observed along and adjacent to the onshore cable route in 2011-12*. A group of fields is observed for a set period of time (e.g. four hours from dawn, two hours either side of high tide etc.) and then another group of fields selected for observation with that process repeated until all of the survey area has been covered within the course of a month. That is repeated each month from October to March inclusive. As well as brent goose observations, records are made for each group of fields on the day of survey of the crop (type and sward height) and the causes of recorded disturbance, including where possible the distance between the cause of disturbance and the goose response (e.g. alert, flying away etc.). Observations will be made using binoculars (10 x 42) and a telescope (25-50x) and recorded on paper maps and specifically designed behaviour recording forms. Mapped information will be subsequently transferred to a GIS system either as a precise location for single or small counts or an area for large flocks.

Since the method does not provide a whole area count on a single day or over a short period, it is necessary that this survey of distribution and behaviour is complemented by such a whole area count. The existing monthly WeBS count will be used as that whole area count. It is understood, but final confirmation not yet received, that monthly low tide counts are to be carried out in the winter of 2013-14 by the existing WeBS volunteer team.

* On this basis areas such as the Martlesham Creek crossing would not be included.

APPENDIX 7: LIST OF NON-BREEDING WATERBIRDS AND RAPTORS OBSERVED IN EAST ANGLIA THREE AND EAST ANGLIA FOUR ONSHORE CABLE ROUTE IN THE AREA OF THE DEBEN ESTUARY

The species listed below are those waterbird and raptor species identified during the non-breeding season bird surveys in 2011-12 within and adjacent to the Deben Estuary.

English Name				
Mute swan	Pintail	Great crested grebe	Grey plover	Greenshank
Bewick's swan	Pochard	Slavonian grebe	Lapwing	Redshank
Greylag goose	Tufted duck	Marsh harrier	Knot	Turnstone
Canada goose	Common scoter	Hen harrier	Dunlin	Black-headed gull
Red-breasted goose	Goldeneye	Peregrine	Snipe	Common gull
Dark-bellied brent goose	Red-breasted merganser	Water rail	Woodcock	Lesser black-backed gull
Shelduck	Goosander	Moorhen	Black-tailed godwit	Herring gull
Wigeon	Cormorant	Oystercatcher	Bar-tailed godwit	Great black-backed gull
Gadwall	Little egret	Avocet	Curlew	Short-eared owl
Teal	Grey heron	Ringed plover	Green sandpiper	Kingfisher
Mallard	Little grebe	Golden plover	Spotted redshank	

APPENDIX 8: LIST OF BREEDING BIRD SPECIES OF CONSERVATION CONCERN OBSERVED ALONG THE EAST ANGLIA THREE AND EAST ANGLIA FOUR ONSHORE CABLE ROUTE

The species listed below are those breeding bird species particular conservation concern (Annex 1, Schedule 1, BoCC Red and Amber List, UKBAP and Suffolk BAP) identified during the breeding season bird surveys in 2012.

English Name	EU Birds Directive Annex 1	WCA 1981 Schedule 1	BoCC	UKBAP	LBAP	Breeding Status
Shelduck			Amber			Confirmed Breeding
Teal			Amber			Possible Breeding
Mallard			Amber			Confirmed Breeding
Pochard			Amber			Confirmed Breeding
Tufted Duck			Amber			Possible Breeding
Grey Partridge			Red	UKBAP	LBAP	Possible Breeding
Little Grebe			Amber			Possible Breeding
Little Egret	✓		Amber			Non Breeding
Marsh Harrier	✓	✓	Amber			Confirmed Breeding
Kestrel			Amber			Probable Breeding
Hobby		✓				Possible Breeding
Oystercatcher			Amber			Non Breeding
Lapwing			Red	UKBAP	LBAP	Probable Breeding
Black-tailed Godwit		✓	Red	UKBAP		Non Breeding
Eurasian Curlew			Amber	UKBAP	LBAP	Non Breeding
Spotted Redshank			Amber			Non Breeding
Redshank			Amber			Non Breeding
Black-headed Gull			Amber			Non Breeding
Common Gull			Amber			Non Breeding
Lesser Black-backed Gull			Amber			Non Breeding – flyover only
Herring Gull			Red	UKBAP	LBAP	Non Breeding – flyover only
Great Black-backed Gull			Amber			Non Breeding
Little Tern	✓	✓	Amber		LBAP	Non Breeding – flyover only
Common Tern	✓		Amber			Non Breeding – flyover only
Stock Dove			Amber			Confirmed Breeding
Turtle Dove			Red	UKBAP	LBAP	Possible Breeding
Cuckoo			Red	UKBAP	LBAP	Probable Breeding
Barn Owl		✓	Amber			Possible Breeding
Swift			Amber			Non Breeding – flyover only
Kingfisher	✓	✓	Amber			Non Breeding – flyover only
Green Woodpecker			Amber			Probable Breeding
Skylark			Red	UKBAP	LBAP	Probable Breeding

English Name	EU Birds Directive Annex 1	WCA 1981 Schedule 1	BoCC	UKBAP	LBAP	Breeding Status
Sand Martin			Amber			Non Breeding – flyover only
Swallow			Amber			Non Breeding – flyover only
House Martin			Amber			Non Breeding – flyover only
Meadow Pipit			Amber			Possible Breeding
Yellow Wagtail			Red	UKBAP	LBAP	Confirmed Breeding
Grey Wagtail			Amber			Possible Breeding
Dunnock			Amber	UKBAP	LBAP	Probable Breeding
Nightingale			Amber			Possible Breeding
Song Thrush			Red	UKBAP	LBAP	Probable Breeding
Mistle Thrush			Amber			Probable Breeding
Cetti's Warbler		✓				Probable Breeding
Whitethroat			Amber			Confirmed Breeding
Willow Warbler			Amber			Possible Breeding
Marsh Tit			Red	UKBAP	LBAP	Probable Breeding
Starling			Red	UKBAP	LBAP	Possible Breeding
House Sparrow			Red	UKBAP	LBAP	Possible Breeding
Linnet			Red	UKBAP	LBAP	Confirmed Breeding
Common Crossbill		✓				Non Breeding
Bullfinch			Amber	UKBAP	LBAP	Probable Breeding
Yellowhammer			Red	UKBAP	LBAP	Probable Breeding
Reed Bunting			Amber	UKBAP	LBAP	Probable Breeding

APPENDIX 9: WORST CASE CHARACTERISTICS OF CABLE INSTALLATION OPTION 1 AND OPTION 2 FOR EAST ANGLIA THREE AND EAST ANGLIA FOUR

	Option 1: Open trenching	Option 2: Pre-Installed Ducts
Footprint at each jointing pit	Jointing pits within the cable working width Estimate ~60m^3 spoil	Each jointing pit requires 10 × 3m area Estimate ~60m^3 spoil
Lay down Area	Laydown area is included in working width of 31m	300m^2 × 40 locations
Number of Jointing pits	40 locations × 2 cables per pit = 80 jointing pits	40 locations × 2 cables per pit = 80 jointing pits
Trenching	37km×6m	0
CSS sites	Up to 9 sites (2 primary and 7 secondary)	0
Overall footprint	37km×31m Area of HDD rig site/exits not contained within working width 114.7ha	10km × 31m 300m^2 × 40 locations 30m^2 × 80 jointing pits 32.44ha
Spoil	Cable trench spoil + jointing pit spoil	Jointing pit spoil only
Access	Reinstatement of 37km of haul road, would require some removal of hedgerows (31m width)	All jointing pits would be constructed in fields adjacent to public roads and would need hedgerows removed where present (6m width). Less than 10km of haul road required in areas of difficult access (Ramsholt Marsh / East of the Deben). . Future works to be undertaken to determine whether track matting is possible
HDDs required	10 locations – would be contained mostly within working width Rig site - 2500m^2 Exit - 750m^2	0 locations
Cable pulling	Up to 80 operations	Up to 80 operations
Total time period of works	Up to 44 weeks spread across a period of two calendar years	Up to 28 weeks spread across a period of one calendar year
Equipment needed	Tracked or wheeled excavator Dumper	Tracked or wheeled excavator Dumper

	Option 1: Open trenching	Option 2: Pre-Installed Ducts
	Concrete truck (about $4m^3$ required per base) Generator and lights Tractor and trailer for cable drum Winch Wheeled 20T capacity vehicles for delivery of sand and removal of excess spoil Hi-ab equipped lorry for delivery of materials 4x4 pickup, covered van, or similar vehicles for construction workers	Concrete truck (about $4m^3$ required per base) Generator and lights Tractor and trailer for cable drum Winch Wheeled 20T capacity vehicles for delivery of sand and removal of excess spoil Hi-ab equipped lorry for delivery of materials 4x4 pickup, covered van, or similar vehicles for construction workers
Vehicle movements	Seven CCS sites would need to be re-established. Apart from at the primary CCS sites extra traffic is not significant	No CCS sites. Delivery of materials from existing yards via A12 or A14.

APPENDIX 10: CHANGES MADE TO THIS DOCUMENT FROM PREVIOUS VERSION

Paragraph	Change	Suggested by
1	Text added to reflect updates tot the paper	EAOW
6	Text updated to reflect fact that surveys are complete (East Anglia THREE) or nearly complete East Anglia FOUR	NE (RC 9/10/13)
27	Text added *“Or any revision to that or in light of any new empirical evidence that may come to light in the near future”*	NE (RC 9/10/13)
30	Text added to clarify *“Including relevant buffer”* and *“assemblage components”*	NE (RC 9/10/13), this was discussed at ETG1
35	Bullet 1 - *“assemblage components”* added Bullet 2 “*or within an agreed distance outside the defined cable route”* added	NE (RC 9/10/13) NE (RC 9/10/13)
36	Paragraph added to clarify the position	EAOW
40 - 42	Text added *“habitats”*	NE (RC 9/10/13)
54	Text added “*non-breeding*” in relation to comment	NE (RC 9/10/13)
59	Text added *“Similarly, potentially highly significant impacts will not be deflated simply because a feature is not “valued”.”* And *“ornithological receptor”*	NE (RC 9/10/13)

13.1.3 Minutes of Ornithology ETG 1 Meeting

5. Provided below are the minutes of the first Ornithology ETG meeting

EAOW Round 3 Offshore Programme East Anglia THREE & FOUR, Ornithology ETG Meeting 1			
Date of Meeting:	30.09.2013	**Venue:**	Tudor Street

Attendees

Name	Initials	Organisation
Keith Morrison	KM	EAOW
Mandy Gloyer	MG	EAOW
Marcus Cross	MC	EOAW
Richard Saunders	RS	Natural England
Richard Caldow	RC	Natural England
John Jackson	JJ	Natural England
Roger Covey	RCo	Natural England
Alex Cooper	AC	RSPB
Roger Buisson	RB	APEM
Paolo Pizzolla	PP	Royal HaskoningDHV
Document Ref:		**Issue Date:** 30/9/13

10:00-1400

ITEM	DESCRIPTION	ACTION
1	Health and Safety – KM Introductions - All	
2	**Project and Evidence Plan Process** PP – introduction to the two projects, the EP process and progress to date with the Steering Group and other ETGs (i.e. benthic, fish, mammals and physical processes) Discussion on the ducting option – PP explained the current situation with regard to ducting for future projects. EA ONE DCO includes provision for ducts as associated development, if consent granted EAOW has committed to installing these for future projects (subject to those projects being consented). The ES will therefore undertake assessment of 2 scenarios for the onshore works 1) full open-trenching and 2) cable pulling and jointing using pre-installed ducts. RC – asked what mechanism was sought for the sign off of decisions as he was not aware that NE had finalised its process for sign-off. RC said that he could provide indicative advice at the meeting but could not provide a formal NE agreement at this stage. PP/KM - this process is new and it is up to all of us to develop relevant and practical ways of working. For example the other groups have been sent minutes of the meetings for comment and sign-off. In addition there is the Steering Group which can provide guidance or arbitration if required. It was agreed that RC could provide comments on the background paper and minutes ideally within two weeks of this meeting but in practice three weeks is more likely. An absolute last date would be by the end of October, recognising that some NE staff may yet be drawn in to detailed work on other offshore wind farms that have just been accepted for examination.	**ACTION** NE (RCo?) to inform EAOW and the Evidence Plan Steering Group on the procedure that NE will adopt for sign-off **ACTION** RC to provide comments on the background paper and minutes
3	**Onshore** **Baseline data** RB explained that the aim is to use the existing data that was agreed to be satisfactory for the EA ONE application. The WeBS counts conducted this winter would provide additional context. **Management of potential construction disturbance** RB explained that the current position reached for EA ONE (detailed in a Mitigation Plan and secured through the DCO) would be the default starting point for discussions for EA THREE and FOUR. RS – raised the question of mitigation through providing a disturbance free	

ITEM	DESCRIPTION	ACTION
	goose refuge zone and suggested that it may be helpful to begin such discussions with NE and landowners early.	
	KM – EAOW are currently trying to understand if such mitigation does not necessarily need to fall within the order limits but could be secured under separate agreements with landowners.	**ACTION** KM to provide feedback on that legal advice
	Additional brent goose survey RB – described proposal to undertake further work this winter to examine brent goose distribution and behaviour (see Appendix 6 of Background Paper), including responses to existing disturbance (farmers deliberately scaring geese from crops and inadvertent disturbance by people using rights of way). RC – What question does the geese behavioural surveys seek to answer? RB – Several – where do the geese occur, what is the nature of current disturbance and how do the geese respond. This can inform any proposed mitigation and management AC – Survey work last winter by Nick Mason identified Ramsholt Marshes as a roost site (see www.bto.org/sites/default/files/u196/downloads/rr622.pdf) RC – Experience from Exe Estuary is that brent geese will roost on the estuary (i.e. on the water) and not on the fields where they will feed. [see post meeting footnote[1] about this issue of 'roosting' geese referred to in Nick Mason's survey report] RC – can we split the WeBS sectors down to get more detail of where the birds are? RB – for the 'core' high tide counts cannot be done after the results gathered by volunteers and submitted to BTO. Unlikely to be able to influence the volunteers to gather the detailed field-by-field and behavioural information that the APEM proposal on brent geese will deliver. Low tide counts only within estuary therefore no problem with knowing where the birds are. RC – For EA ONE avocet and brent goose were the key issues – for EA THREE & FOUR it is likely to be the same situation. Key issue was impacts on brent geese foraging on the cable route itself. RC would like to see surveys 2 hrs either side of high tide, targeted to those areas which are known to be used – this would clarify how important those areas of potential impact are RC – can we ask WeBS volunteer counters to improve the detail of their recording where the birds are exactly (in relation to the tide) as this would be the solution?	**ACTION** JJ to ask Nick Mason if the high tide count team could be record bird locations in more detail If agreed PP & JJ to liaise over recording materials
	Species to be considered in assessment [Birds observed in EA ONE surveys listed in Appendix 7 & 8] AC – are wintering black tailed-godwit included? RB – these were observed in the surveys but not noted in large aggregations near to where the HDD passed under the estuary, therefore not predicted to be disturbed. Also all management measures designed to avoid disturbance of avocet would cover the other SSSI species. In the assessment of the two projects and the two cable scenarios all SSSI species would be considered. JJ – black tailed-godwit is present within the estuary in internationally important numbers, likely to be included within the SPA review and hence in future would be an interest feature.	

[1] The report text states in Section 3.3.2: "*Dark-bellied Brent Geese roost along both banks of the southern part of the estuary near the mouth and also at Ramsholt Marshes (see Fig. 5). Unlike the Avocets which are confined to the estuary, Brent Geese also make extensive use of the surrounding agricultural land for roosting and feeding, mainly using the estuary itself for loafing and bathing (N.Mason pers comm).*" All the surveys reported on were carried out in daylight hours and as such the use of the term 'roosting' by Nick Mason may not be as used by RC or APEM which refers to the specific behaviour at night where they move from terrestrial habitats to the intertidal in order to reduce the risk of night-time predation by ground predators such as foxes. Daytime periods of non-feeding by geese are usually referred to as 'resting' or 'loafing' rather than 'roosting'.

ITEM	DESCRIPTION	ACTION
	RC – the result of that process is that we will need to agree, when documents are available, what are the cited spp are for the different designations. MC – that SPA information is needed in time for the HRA screening **Potential types of impacts** It was discussed that the focus of the assessment would be on construction and decommissioning impacts as there are unlikely to be sources and pathways for significant impact during operation. It was agreed that rather than scope out operational impacts it would be better (ie more transparent) to assess but keep that brief. RCo – OK with the concept that operational impacts will have a brief assessment (and can be quantified to some extent in terms of estimated servicing operations per year). AC – agree RB – contractors will abide by the ecological management plan (EMP) which will be developed and agreed with stakeholders RC – onshore impacts (construction/decommissioning) – agreed no LSE for EA ONE as a result of measures in EMP	**ACTION** JJ will provide update on status of the SPA review with regard to the Deben
4	**<u>Areas for agreement – onshore</u>** [see attached sheet for organisations to give their responses on the areas identified for agreement] The areas for agreement related to onshore receptors were: 1 – no additional baseline data collection required 2 – WeBS counts to support baseline information 3 – WeBS of greater value if collect finer detail 4 – Agree value in targeted brent goose survey 5 – non-breeding season species selection – SPA & SSSI features (need to ensure up to date wrt SPA review 6 – breeding season species selection - key species are Schedule 1: Cetti's warbler & marsh harrier 7 – impacts to be assessed – operational impacts assessment to be brief and proportionate	**ACTION** Use attached sheet to give position on areas of agreement
5	**<u>Offshore</u>** **Survey data** 24 months survey – aerial, digital stills as described in Appendix 1 AC- asked how existing Zone/EA ONE data would be used as context – noting that EA ONE assessment had not used zone data MC – we can use the zone/EA1 information if required where there are gaps (e.g. flight heights) or for wider context – in addition there is also scope for use of EA THREE & EA FOUR data sets to inform the assessment of the other site RC – zonal information on bird density could be more useful for baseline context than the older ESAS data for the North Sea. RC – advised that with regard to the analysis and methodology EAOW should revisit the representations from NE and JNCC on EA ONE and ensure that all these concerns are met RB – correction for 'availability' of diving birds (i.e. estimates of sub-surface birds) will be covered at a future meeting RCo – approach to flight heights and the use of flight height bands in CRM RB – whether the 'extended' (Option 3 &4) Band method is to be used has still to be determined and that will be influenced by the result of the review that it is understood that the SNCBs have underwayTBD RC – need to see a validated methodology for flight height determination – is particularly important if site-specific data flight height data and the 'extended' band model is to be used. RB – offshore cable route – same route as EA ONE therefore EAOW do not	**ACTION** APEM to provide validation of method to this

ITEM	DESCRIPTION	ACTION
	propose to undertake additional survey with regard to red-throated diver (RTD) distribution and potential disturbance RC – NE have additional, more recent information on RTD distribution in the Outer Thames Estuary SPA from work contracted to APEM that would inform the assessment. Will need to give permission to APEM for use of NE contracted data. **Analysis of acquired data** *Bio-periods* RB – appendix 3 presents the bio-periods used for EA ONE and proposal is to use those unless NE can identify evidence based revisions RB – with regard to the two assessments (EIA/HRA) generic exercise on the bio-periods for EIA purposes, but there may be a need for site-specific refinement of the bio-periods for the HRA ie ensuring that breeding season applies to breeding birds from SPA colony within mean-maximum foraging range but for sites outside that range recognise that such birds would be migrants and not breeding RC – no problem with this concept RC/AC – [suggested several changes to the bio-periods listed in Appendix 3, this to be confirmed in writing by NE] *Bio-geographic populations* RB – This will be a subject of a method paper in time for next meeting. RCo – would the EIA/HRA populations be different? RB – what do NE think? RC – unlikely to be different *Transboundary assessment* MG – EAOW have approached SNH through MS, need to set up meeting MC – we would potentially like a letter of support from NE for transboundary approaches RB – Concerned that changing responsibilities of NE and JNCC means that will receive less advice on transboundary issues RCo -Awaiting confirmation of the official line on where NE/JNCC responsibilities lie under new delegation of responsibilities agreement *Population estimates – see App 4* [The method of carrying out population estimates is given in Appendix 4] RC – design-based pop estimates for everything? RB – Yes, but if sufficient data are available it will also be possible to use appropriate advanced methods (eg GEEs). RC – CREEM road-testing these methods, the results will be available soon in a MS report *Flight parameters – flight height* RB – will provide validation of methodology as discussed above **Species considered (App 5)** [Appendix 5 lists those species observed in surveys] RB – described the process for including/excluding species from consideration within the assessment. There would be a number of factors determining which species are taken forward. 1) Whether the numbers exceed a particular threshold of importance - once population estimate complete (& compared with suitable biogeographic population) will then look at whether this is analysed further. 2) seabirds within foraging distances of the site (assessment based on relevant periods) 3) migration modelling – will then determine if numbers significant (irrespective of collision risk). If a species falls under any one of these criteria it will be taken forward in the assessment RC – if a species is seen in one site but not the other would you consider including it? RB – yes, judgement would be used in those cases where the chances of seeing a species are particularly low RC – how will turnover be dealt with? RB – this should be covered by migration modelling. This will be discussed in the next meeting	group **ACTION** NE to provide permission for use of data from NE commissioned survey **ACTION** RC to provide list of suggested revisions to the bio-periods shown in Appendix 3 **ACTION** NE to inform group when there is confirmation of new division of roles between NE and JNCC

ITEM	DESCRIPTION	ACTION
	RC – advised that the assessment should include assemblage components as well as species listed as individual site features RB – that approach will be taken RC – Migration modelling should be used for in-combination assessment in addition to project alone RC – When reporting on HRA screening it needs to be obvious what has been screened out – i.e. this should be clearly stated up front rather than needing to be found within the body of the text RB – what species groupings should be screened out from migration modelling? RC – worth looking at Hornsea & Dogger approach. Beyond seabirds, waders and wildfowl need to consider raptors and if nightjar is relevant. Would also like to see 'exemplar passerine included. For modelling would look at the narrowest migration path with smallest population **Potential types of impacts** RC – approach to barrier effects RB – consider two types of effect – on migratory species (twice a year) and on breeding species (repeated on foraging flights) RC – potentially look at the Firth of Forth work for approach to barrier effects **Avoidance rate** RC – not sure of timescale for contracted report on addressing areas of uncertainty on avoidance rates with switch from Band Option 1 to 3. If use fitted function derived from either SOSS or site base data then should present confidence intervals to acknowledge the uncertainty in the modelling	**ACTION** RC to advise on species inclusion consistent with advice to Hornsea and Dogger
6	**Areas for agreement – offshore** [see attached sheet for organisations to give their responses on the areas identified for agreement] The areas for agreement related to offshore receptors were: 1 - Baseline – 24 months of data sufficient 2 - No additional cable route survey (use NE RTD data if can be made available) 3 - Bio-periods – NE to feedback on suggested changes on a species basis 4 - Bio-geographic populations – EAOW will produce paper for the next ETG meeting 5 - Population estimates – design based or latest accepted modelling method will be used where applicable and data sufficient 6 - Flight height validation - EAOW will produce paper for the next ETG meeting 7 - Species selection – include the assemblage species as well as named features 8 - Impacts list – the impacts listed were agreed	**ACTION** Use attached sheet to give position on areas of agreement
7	**Impact Assessment Methods** RCo - No concerns with regard to the impact assessment methodology per se RC – Would like to see a more focused definition of parameters such as sensitivity and magnitude PP – are looking at potential to separate out value and ecological sensitivity as that in the past has created anomalies in assessments	**ACTION** PP to provide example of definitions and value (inc from other ES chapters)
8	**AoB** RB – horizon scanning – what up-coming advice is there likely to be produced by SNCBs? Aware that an advice note on seabird sensitivities to collision and displacement is being drafted for England, when will that	**ACTION** – RC

ITEM	DESCRIPTION	ACTION
	appear? RC - Seabird sensitivity report contracted to Furness likely to be released in November 2013. NE is also tendering a contract to review data for the determination of bio-periods. In the longer term are considering how cumulative displacement impacts might be assessed but that is not yet a contract. RC – Overall Advice: The best way to understand NE's likely position on particular matters is to review the Relevant Representation submitted for East Anglia ONE **Next steps** PP – Seek feedback on the Background Paper and on areas of agreement – see attached table for this RC – providing feedback on the Background Paper would be made quicker if it could be done as track change and comments on to a MSWord version of that paper. **Next meeting** The provisional date for the next meeting was set as Monday 11th November 2013	to check on the progress of this advice and to update regularly on any new projects & timings **ACTION** PP to send RC a word version of the Background Paper for comment **ACTION -** RC to return comments in 2-3 weeks

ID	Issue on which EAOW THREE and FOUR seek agreement on	NE Position	RSPB Position
1	**ONSHORE**		
	Data		
	Sufficient baseline survey data have been collected to inform the assessment		No the RSPB considers that further survey work will be required in regard to Brent Geese.
	No additional survey required for the cable route		The RSPB supports NE's position on this issue.
	Existing baseline data will be augmented with new WeBS data		The RSPB supports the use of the latest WeBS data to augment the baseline data.
	If possible new WeBS data to include greater detail on location of birds within the large WeBS count sectors		The RSPB agrees in principle that a more detailed understanding of the location of birds on the Deben is essential. However, we will need to see the details of what has been agreed with the BTO before we can make any further comments. *
	EAOW to undertake additional brent goose survey (winter 2013/2014)		The RSPB supports the additional Brent Goose survey being undertaken during the winter of 2013/14.
	Species		
	Likely species for assessment listed in App 7 & 8		The RSPB agrees with NE's advice on this issue.
	Species to be selected for assessment on basis that are listed features of Deben Estuary SPA and SSSI or are Schedule 1 breeding species		The RSPB supports this approach
	Assessment will include both listed features and relevant assemblage species		The RSPB supports this approach
	Impacts		

	The following impacts will be assessed
	• Construction
	    • Disturbance / Displacement
	• Operation
	    • High-level assessment
	• Decommissioning
	    • Disturbance / Displacement
			The RSPB agrees that the impacts proposed for assessment are appropriate.

2	**OFFSHORE**		

	Data		
	Sufficient baseline survey data have been collected to inform the assessment (24 months of aerial for each site)		The RSPB agrees that 24 months of aerial surveys will provide sufficient baseline data, provided that the data set is continuous and there are no gaps.
	No additional survey required for the cable route		The RSPB supports NE's position on this issue
	NE's Outer Thames Estuary RTD survey data will be used if it can be made available		The RSPB supports the use of the Red Throated Diver survey data
	EA ONE and Zone data will be used as contextual information where relevant		The RSPB agrees that using EA1 and zone data as contextual information could be useful.
	Data analysis		
	Population estimates will be design based but more sophisticated modelling will be applied if the data warrants it and the modelling approach is acceptable		The RSPB supports this approach
	Flight parameters [awaits information on how flight height method has been validated]		The RSPB supports NE's position on this issue.
	Species		
	Species specific bio-periods [awaits feedback from NE to create new bio-period table]		The RSPB supports NE's advice on the bio-period table
	If a species falls under any one of these criteria it will be taken forward in the assessment: 1) population of regional importance or greater. 2) adult seabirds within maximum foraging distance of SPA or SSSI with that species as interest feature 3) migration modelling shows connectivity and numbers occurring are significant (irrespective of collision risk).		The RSPB agrees in principle that the criteria being used are appropriate, However, we would like clarification about point 3, in particular how 'significant' is being defined.
	Impacts		

	The following impacts will be assessed
	• Construction
	    • Disturbance / Displacement
	    • Indirect through prey species
	• Operation
	    • Disturbance / Displacement
	    • Indirect through prey species
	    • Collision risk
	    • Barrier effect
	• Decommissioning
	    • Disturbance / Displacement
	    • Indirect through prey species
			The RSPB seeks clarification about whether the assessment will include cumulative, in-combination and transboundary impacts.
			Once this has been clarified then we will be able to provide our position.

* The RSPB's position is made in relation to the information available to us at this time. However, we reserve the right to alter our position to East Anglia 3 & 4 should new information (i.e research and data) become available which significantly alters the situation.

13.1.4 Ornithology ETG Meeting 2 Background Paper

6. Provided below is the background paper that was circulated prior to the second Ornithology ETG meeting

East Anglia
Offshore Wind

VATTENFALL

SCOTTISHPOWER RENEWABLES

East Anglia THREE and East Anglia FOUR

Ornithology

Evidence Plan

Expert Topic Group Meeting 2

11th November 2013

Document Reference – 512608/670-OETG-2

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Revision History –Final for Meeting 2

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1 INTRODUCTION

1.1 Purpose of this Document

1. The purpose of thiss document is to provide technical information to support the discussions to be held at the second ornithology expert topic group (OETG) meeting to be held on 11th November 2013.

2. It contains information that updates that presented at the first Ornithology Expert Technical Group meeting (OETG Mtg 1) held in September 2013 and provides more detailed information on a series of topics related to offshore and onshore ornithology and assessment processes. In some cases an outline approach is described in this paper in recognition that the detail and discussion on it will take place at a future meeting.

3. The record of the discussion at OETG Mtg 1 and the schedule of topic areas on which agreement is sought, with the current position of Natural England and RSPB, is contained within the minutes of that first meeting.

1.2 Structure of this Document

4. In accordance with the way in which parts of the agendas for the OETG meetings are organised, this document provides separate sub-sections for offshore receptors (from low water mark out to the wind turbines) and onshore receptors (from low water mark at Bawdsey and within the Deben Estuary estuarine closing line to terrestrial along the onshore cable route).

2 PROGRESS WITH EVIDENCE PLAN DOCUMENTS SINCE OETG MTG 1

2.1 Revisions to Background Paper from OETG Mtg 1

5. A revised version of the Background Paper that was supplied for the OETG MTg 1 has been prepared and circulated to OETG members (document reference: 512608/670-OETG-1 Post Meeting Final - updated 29th October 2013). That revision sought to account for those comments received from Natural England that relate to correcting the account. The Background Paper has not been revised to account for on-going discussions on matters that are, or are not agreed, since that is the purpose of the agreement schedule attached to the minutes.

2.2 Project timetable

6. The indicative project timeline that was presented in tabulated form in Section 1.4 of the Background Paper to OETG Mtg 1 remains the best available information. No revisions need to be brought to the attention of the attendees of OETG Mtg 2.

2.3 Project description

7. The project description given in Section 1.3 of the Background Paper to OETG Mtg 1 remains the best available information. No revisions need to be brought to the attention of the attendees of OETG Mtg 2.

3 EXISTING ENVIRONMENT

3.1 Offshore

3.1.1 Update to Baseline Information Gathering: Survey

8. Monthly aerial digital surveys for East Anglia THREE finished in August 2013 completing a series of 24 consecutive monthly surveys. No more baseline information is being gathered currently or is proposed in the future for the area where the turbines are proposed plus a 4km buffer.

9. Monthly aerial digital surveys for East Anglia FOUR are on-going in order to provide two years of data and will be completed in February 2014. No further baseline information is proposed in the future for the area where the turbines are proposed plus a 4km buffer.

10. In addition to these aerial surveys, relevant contextual data including those from surveys undertaken for East Anglia ONE and the East Anglia Zone will also be used.

11. No additional surveys will be carried out along the offshore cable route from array to landfall. Existing baseline information from surveys for East Anglia ONE and of the Outer Thames Estuary SPA (the latter being received as a mean surface density map prodcued by JNCC from a collation of aerial visual surveys undertaken in winter (October – March) between 2001/01 and 2009/10) will be used for the assessment. The latest SPA survey data will be used for the assessment subject to it being made available by Natural England. For that latest SPA survey data to inform fully the assessment, permission for APEM to use it is sought by January 2014.

12. The bird observations gathered by the aerial digital surveys up to and including August 2013 (ie the full East Anglia THREE programme and the majority of the East Anglia FOUR programme) have been analysed to produce population estimates for the survey area.

13. Appendix 1 provides for East Anglia THREE the month by month peak population estimates for each species observed in the site and its 4 km buffer.

14. Appendix 2 provides for East Anglia FOUR the month by month peak population estimates for each species observed in the site and its 4 km buffer. The data set for East Anglia FOUR is incomplete as the aerial digital surveys continue to February 2014.

15. It is because the second year of counts is incomplete for East Anglia FOUR that month by month peak population estimates are presented for East Anglia THREE and

East Anglia FOUR in the appendices. The assessment of impact in the PEI and ES will be carried out on the mean peaks of the full two year data sets.

16. The full data set containing the raw counts by month, the confidence intervals on the population estimates and the density of birds per square kilometre will form part of a technical report appended to the PEI Report.

3.1.2 Update to Baseline Information Gathering: Desk Study

17. The list of published and other available data sources that will be used in the desk study that was included in Appendix 2 of the Background Paper supplied for OETG Mtg 1 has been expanded following feedback from that meeting. It will be maintained as a live document (but not provided to the OETG meetings unless specifically requested) and updated as and when new information becomes available.

3.1.3 Update to Baseline Information Analysis: Biological Periods

18. A set of species specific biological periods was proposed for use in the analysis of the baseline data acquired for East Anglia THREE and East Anglia FOUR. This proposal, presented to ETG Mtg 1 as Appendix 3 to the Background Paper, was based on the biological periods that had been used in the EIA for East Anglia ONE.

19. There was detailed discussion at OETG Mtg 1 and Natural England agreed to supply written comments after the meeting. Those written comments have been received. The main change proposed by Natural England to the biological periods is to extend the length of the period during which birds are allocated to the ‘breeding season’, mainly in the spring in order to account for when birds might be associated with their breeding colony but have not yet laid eggs.

20. A revised proposal for biological periods for specific bird species has been produced for discussion at OETG Mtg 2 and this is provided as Appendix 3.

21. This revised proposal introduces a new category of biological period that accounts for the overlapping period when some populations of birds are moving on spring migration to more northerly breeding grounds and other populations of birds are associated with local breeding colonies in the southern North Sea. In this new period there will need to be a process of apportioning the population estimates between birds on migration and birds already associated with breeding colonies. Natural England, in their comments, recognises that this attribution process will need to be carried out in relation to the HRA process, as it was done for East Anglia ONE. That attribution was carried out in order to distinguish between birds on spring migration to more northerly latitudes and those birds associated with

breeding colonies that are SPAs in the southern North Sea. It is important to recognise that due to the distance between the proposed projects and the SPA seabird breeding colonies it cannot be assumed that birds present within the windfarm boundary during the early part of the breeding period are part of the population that is associated with those SPA seabird breeding colonies.

22. The information contained in Appendix 1 and 2 (the population estimates for East Anglia THREE and East Anglia FOUR respectively) already show how this issue will arise and will have to be addressed in the assessment – most of the population estimates for fulmar, gannet, guillemot and razorbill in spring exhibit peaks in April or May. These peaks indicate that passage is taking place and the numbers cannot realistically be attributed solely to local breeding colonies. Smaller numbers have been observed for these species in June and July when any spring migration of more northerly breeding birds will have finished. This is recognised in the document received from Natural England (R. Caldow *in litt* 18th October 2013) that states when discussing the parallel case at the end of the breeding season overlapping with autumn migration "*For example, site specific peaks in abundance at EA3&4 in August following lows in May-July could indicate an influx of birds from other distant colonies. In that case, attributing all mortality in August to the local breeding colony (to which mortality in May-July has been entirely attributed) would be inappropriate.*".

23. An approach is proposed for those months when there is evidence that local breeders will be associated with the breeding colony and that spring migration or autumn migration is taking place that attributes part of the population to the breeding colony and part to the migratory population. Population estimates determined for the late spring and summer when migration is known to have ceased will be used to calculate the apportionment.

3.1.4 Update to Baseline Information Analysis: Flight Direction

24. A comment was received from Natural England following OETG Mtg 1 about the potential use of flight direction information.

25. Flight direction information is used to increase the body of knowledge about the behaviour of the birds in the proposed windfarm area. In particular it is used inform the judgements being made about whether or not the majority of a particular species observed are in the process of making an oriented flight movement. The most likely types of oriented flight movement that could be encountered are directed flights to and from a breeding colony (which in the circumstance of the southern North Sea could be east-west oriented) and migratory movements to and

from breeding grounds (which in the circumstance of the southern North Sea could be north-south oriented). In contrast active foraging behaviour might be expected to show a much less oriented flight behaviour as birds circle and search for food. This information could be used for example to evidence that the attribution of birds to the 'breeding season' may not be appropriate in early spring when there could be large scale northward migration taking place (this issue of potential mis-attribution having been raised above in relation to the future HRA).

3.1.5 Update to Baseline Information Analysis: Flight Height

26. A comment was received from Natural England following OETG Mtg 1 about the process that APEM has used to validate its method for flight height determination. There is an on-going process of communication about the amount and nature of information that Natural England expects to receive as evidence of validation as there are commercial sensitivities over some aspects of the method. When that has been resolved a document will be provided either between OETG meetings or for a future OETG meeting.

3.2 Onshore

3.2.1 Update to Baseline Information Gathering: Survey

27. There was detailed discussion at OETG Mtg 1 about the degree to which the understanding of the location of birds that are interest features of the Deben Estuary SPA and SSSI is sufficient to enable avoidance and mitigation measures to be implemented.

28. The outcome of the discussions is that in the winter of 2013-14 there will be two components to additional information gathering by survey. These are:

    a) Request for more detailed recording of the location of waterbirds by the volunteer team carrying out the monthly WeBS surveys; and

    b) Targeted survey of brent goose distribution as described in Appendix 6 of the Background Paper to OETG Mtg 1.

29. The more detailed recording of the location of waterbirds commenced with the WeBS survey in October 2013. That survey identified only small numbers of brent geese being present across the whole of the Deben Estuary survey area and none using the farmland. As a result of this finding and advice from Nick Mason the targeted survey will not commence until the beginning of November 2013 at the earliest.

3.3 Proposed Action / Agreement

30. Agreement, based on the information supplied at OETG Mtg 1, is sought on:

- Sufficient offshore and onshore baseline survey data has been collected to inform the assessment.
- No additional survey required for the offshore or onshore cable route (the additional targeted brent goose surveys are not related to baseline information gathering).
- Existing onshore data will be augmented with new WeBS data recorded at greater spatial detail and an additional brent goose survey.
- Natural England to supply (if it can be made available) its Outer Thames Estuary RTD survey data to augment the existing offshore cable route data.

31. Agreement, based on the updated information supplied at OETG Mtg 2, is sought on:

- Biological periods

4 POTENTIAL IMPACTS

4.1 Update to Consideration of Potential Impacts: Offshore

32. The list of potential impacts was discussed at OETG Mtg 1 and written comment received from Natural England after the meeting. This comment related to noting that indirect impacts might occur through effects on habitats as well as on prey species.

33. An amendment to the types of impacts included within the scope of the assessment has been made with the result that they will be:

- During Construction
  - Disturbance / Displacement
  - Indirect impacts through effects on habitats and prey species
- During Operation
  - Disturbance / Displacement
  - Indirect impacts through effects on habitats and prey species
  - Collision risk
  - Barrier effect
- During decommissioning
  - Disturbance / Displacement
  - Indirect impacts through effects on habitats and prey species

4.2 Update to Consideration of Potential Impacts: Onshore

34. The list of potential impacts was discussed at OETG Mtg 1 and it was recognised that a revised approach should be taken with regard to operational impacts. This was that rather than scope out operational impacts it would be better (i.e. more transparent) to assess those potential impacts but that the assessment could be brief and proportionate.

35. An amendment to the types of impacts included within the scope of the assessment has been made with the result that they will be:

- During Construction
  - Disturbance / Displacement
- During Operation
  - Disturbance / Displacement
- During Decommissioning
  - Disturbance / Displacement

4.3 Proposed Action / Agreement

36. Agreement, based on the revision to the types of potential impact to be assessed, is sought at OETG Mtg 2.

5 APPROACH TO IMPACT ASSESSMENT

5.1 The EIA Process

5.1.1 Update to Defining and Assessing Impacts

37. The process of defining and assessing impacts was discussed at OETG Mtg 1 and written comment received from Natural England after the meeting. This comment related to Table 4.1 Definition of Magnitude of Effects and Table 4.2 Impact Matrix. On the former Natural England had concerns that the definitions created the potential to underestimate the magnitude of damage to protected sites and their interest features. On the latter, Natural England sought that there be consideration of a 'very high' sensitivity category.

38. A proposal for a revised set of definitions for the magnitude of effect is given below for discussion at OETG Mtg 2. This revised set of definitions focuses specifically on changes to bird populations (EIA generic definitions were presented at OTEG Mtg 1).

Table 5.1: Proposed Revised Definition of Magnitude of Effects

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 is 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 related activity.
No change	No loss of, or gain in, size or extent of distribution of the relevant biogeographic population or the population that is the interest features of a specific protected site.

39. With respect to Table 2, the Impact Matrix, the addition of a 'very high' sensitivity category is not considered to make any material difference to the outcome of the assessment and accordingly it is considered unnecessary to include it. Any impact of magnitude greater than 'negligible' to a 'high' sensitivity receptor will be identified as significant in EIA terms. The same would be true for any 'very high' sensitivity receptor. Given that the assessment is judgement based and that the categories are broad, EAOW believes that this approach is robust.

5.1.2 Update to Cumulative and In-combination Impacts

40. The approach to the assessment of cumulative and in-combination impacts was discussed at OETG Mtg 1. Written comment was received from Natural England after the meeting that related to the application of a 'tiered approach' to the presentation of impacts from offshore windfarms.

41. East Anglia THREE and East Anglia FOUR will both present cumulative and in-combination impacts in a tiered form. However, the EAOL position and concerns on the 'tiered approach' are as submitted in October 2013 to the Examining Authority for East Anglia ONE as part of the summary to the Issue Specific Hearings . This highlighted concerns about the 'tiered approach' including those relating to the inclusion of quantitative predictions for other developments over which there was uncertainty and how the projects included in lower order tiers (ie Tiers 4 to 6) were accounted for, or not, in the decision making process.

5.2 Detailed Assessment Methodologies

5.2.1 Migration modelling

42. To enable an assessment of the risks of impact to migratory birds, whose numbers at the project level can potentially be underestimated by snapshot survey methods, migration modelling will also be carried out.

43. Migration modelling is carried out using a model developed by APEM. This model is conceptually the same as that produced by the British Trust for Ornithology (BTO) under their Strategic Ornithological Support Services (SOSS) contract to The Crown Estate but it contains a number of additional elements to improve its specificity for the assessment of potential impacts on birds associated with SPAs.

44. Species are selected for modelling through a screening exercise. This seeks to identify any migrating species that might encounter the proposed windfarm during their migration flights across or through the relevant area of sea, to and from their breeding colonies and wintering grounds. This screening is informed by the broad front migration routes illustrated and described in the SOSS 05 Report (Wright et al.,

2012), a review of the results of any site-specific boat and / or aerial surveys and the ornithological literature.

45. The model applies the migration pathways that were published in the SOSS 05 report (Wright *et al*., 2012). It operates on the assumption of straight line migration between the European coastline and UK SPAs. The European coastline is split into 1 km segments and each segment is joined to each SPA within the UK to form the migration lines. The migration lines that fall only within the migration boundary of the species of interest are included. SPAs are only included if the species being assessed is associated with them as an interest feature. Significant staging areas can also be incorporated where applicable. Migration lines are identified as being within or outwith the windfarm development area of interest. Species numbers are randomly assigned across the migration lines to identify the proportion that would pass through the windfarm area. This is repeated by the model many times to account for uncertainty and to calculate 95% confidence intervals. Bird numbers travelling along migration lines that fall within the windfarm area are calculated and this number used as the input to a collision risk model.

46. Further details of the method are provided in Appendix 4.

47. Discussion is proposed on this migration modelling method for assessment at the project level at OETG Mtg 2.

48. The approach to migration modelling will focus on the proposed East Anglia THREE and East Anglia FOUR and will not be used to carry out an assessment of the combined impacts on windfarms constructed or proposed in Rounds 1, 2 and 3 and Scottish Territorial Waters. EAOW believe that such work is a strategic level assessment that is the responsibility of Government and not an individual project developer.

5.3 Proposed Action / Agreement

49. Agreement based on the revision to Table 4.1 (now Table 5.1 above) and the lack of need to revise Table 4.2 from OETG Mtg 1, that are part of the proposed EIA methodology, is sought at OETG Mtg 2.

50. It is expected that:

- The detailed impact assessment methodology relating to migration modelling is discussed in OETG Mtg 2 and agreed in OETG Mtg 3.
- The approach to the cumulative assessment for EIA purposes, in the light of current positions adopted for East Anglia ONE, to be discussed at OETG Mtg 2.

6 HABITATS REGULATIONS ASSESSMENT

6.1 HRA Screening Process

51. The key factors that will applied during the HRA screening process are:

- Distance between the proposed development and SPAs (for seabirds in the breeding season this will be informed by published information on foraging ranges e.g. Thaxter *et al*., 2012).
- Likelihood of migratory routes to and from SPAs passing through the proposed development (this will be informed by published information on migration routes e.g. Wright *et al*., 2012).

52. The approach to the HRA screening process will be an iterative one that is undertaken during the pre-submission phases of the application for East Anglia THREE and East Anglia FOUR. It is planned that the major iterations will be:

a) Initially at a high level and undertaken in a very precautionary manner. This would screen out only those potential impacts, sites and interest features that can with certainty be screened out without the detailed information that derives from the baseline report for ornithology and marine mammals and the bird specific analysis and modelling (as described above and in the Background Paper from OETG Mtg 1) that follows on from those baseline reports. It would though be informed by the HRA Report and RIES matrices that have been produced for East Anglia ONE. This high level screening will be undertaken between OETG Mtg 2 and OETG Mtg 3 and discussed at OETG Mtg 3. It will also be discussed at the marine mammal ETG.

b) An iteration after the marine mammal and ornithology baseline reports have been produced along with the additional detailed analysis and modelling. At this stage there will be more detailed information available on specific bird species that may be at risk. This will take place in the spring of 2014.

c) A final iteration that will take place as part of the process of preparing the screening matrices that will accompany the submission. This will take place in the summer of 2014.

53. In view of the different timescales for submission of application for consent for East Anglia THREE and East Anglia FOUR, the iterations (b) and (c) will be conducted to separate timelines.

54. Involvement of relevant consultees will be sought at each iteration.

6.2 Assessment of In-combination Impacts

55. The approach as set out in the section above in relation to cumulative impacts for EIA purposes and the 'tiered approach' applies equally to the assessment of in-combination impacts for HRA purposes.

6.3 Proposed Action / Agreement

56. It is expected that:

- The approach to HRA screening be discussed in OETG Mtg 2.
- The initial high level HRA screening report be discussed in OETG Mtg 3.

57. It is expected that:

- The approach to the in-combination assessment for HRA purposes, in the light of current positions adopted for East Anglia ONE, to be discussed at OETG Mtg 2.

7 REFERENCES

Thaxter, C.B., Lascelles, B., Sugar, K., Cook, A.S.C.P., Roos, S., Bolton, M., Langston, R.H.W. & Burton, N.H.K. (2012). Seabird Foraging Ranges as a Preliminary Tool for Identifying Candidate Marine Protected Areas. *Biological Conservation* 156: 53-61.

Wright, L.J., Ross-Smith, V.H., Massimino, D., Dadam, D., Cook, A.S.C.P. & Burton, N.H.K. (2012). *Assessing the risk of offshore wind farm development to migratory birds designated as features of UK Special Protection Areas (and other Annex I species)*. Strategic Ornithological Support Services. Project SOSS-05. BTO Research Report No. 592. BTO, Thetford.

APPENDIX 1: EAST ANGLIA THREE PEAK POPULATION ESTIMATES BY MONTH

This table provides for East Anglia THREE the month by month peak population estimates for each species observed in the site and its 4 km buffer.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Shelduck	11	0	0	0	0	0	0	0	0	0	0	0
Scaup	73	0	0	0	0	0	0	0	0	0	0	0
Red-throated diver	24	11	90	78	32	0	0	0	0	0	63	62
Black-throated diver	0	0	13	0	0	0	0	0	0	0	0	0
Great Northern diver	0	0	51	13	0	0	0	0	25	0	0	0
Diver species	0	39	512	91	40	0	0	0	0	97	63	0
Fulmar	356	339	1,136	743	1,871	720	651	1,483	2,379	1,217	340	3,073
Gannet	158	57	38	827	32	115	25	73	514	152	2,284	992
Arctic skua	0	0	0	0	0	0	13	0	29	0	0	0
Long-tailed skua	0	0	0	0	0	0	0	0	13	0	0	0
Great skua	0	0	0	0	0	0	0	0	138	178	0	12
Sabine's gull	0	0	0	0	0	0	0	0	0	0	16	0
Kittiwake	1,962	1,436	230	538	469	525	25	114	132	126	1,819	4,999
Black-headed gull	0	0	0	39	0	0	42	0	0	65	16	0
Little gull	73	0	38	39	825	0	0	12	15	0	16	0
Common gull	171	90	0	13	0	0	0	0	0	16	0	25
Small gull species	85	0	64	0	54	0	564	0	38	130	127	167
Lesser black-backed gull	134	34	26	248	279	146	73	330	150	195	79	198
Herring gull	536	192	77	130	40	12	21	621	138	195	221	1,435
Great black-backed gull	1,426	543	13	78	133	37	52	469	59	162	308	1,225
Black-backed gull species	0	0	13	0	0	0	0	0	13	32	12	0

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Large gull species	16	0	13	0	40	0	42	0	0	32	16	0
'Commic' tern	0	0	0	52	906	0	0	13	29	16	0	0
Common guillemot	5,119	3,133	3,535	4,211	615	68	200	570	1,903	783	1,313	2,574
Razorbill	1,865	3,510	1,659	2,777	825	45	52	76	689	1,444	2,768	2,319
Guillemot / Razorbill	826	626	26	13	0	0	0	24	100	227	142	299
Little auk	49	11	0	0	0	0	0	0	0	0	81	24
Puffin	243	113	89	289	113	0	13	51	73	164	459	111

APPENDIX 2: EAST ANGLIA FOUR PEAK POPULATION ESTIMATES BY MONTH

This table provides for East Anglia FOUR the month by month peak population estimates for each species observed in the site and its 4 km buffer. The data set for East Anglia FOUR is incomplete as the aerial digital surveys continue to February 2014.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pink-footed goose	0	0	0	13	0	0	0	0	0	0	0	0
Red-breasted merganser	0	0	0	0	0	0	0	0	0	12	0	0
Red-throated diver	91	12	239	104	73	0	0	0	0	0	30	72
Black-throated diver	0	0	63	31	0	0	0	0	0	0	0	0
Great Northern diver	0	0	252	10	0	0	0	0	0	0	0	12
Diver species	0	0	201	125	12	0	0	0	0	0	0	0
Fulmar	326	216	313	39	1,343	548	371	988	1,483	129	320	423
Gannet	208	96	13	529	199	173	104	487	465	164	3,110	48
Cormorant	0	0	0	39	0	0	0	0	0	0	0	0
Pomarine skua	0	12	0	0	0	0	0	0	0	0	0	0
Arctic skua	0	0	0	0	0	0	17	14	45	0	0	0
Great skua	0	0	0	0	0	0	0	0	0	23	0	0
Kittiwake	2,371	240	255	322	713	101	456	174	180	93	869	811
Black-headed gull	13	0	13	0	12	0	52	0	0	0	15	0
Little gull	65	12	0	0	110	0	0	181	0	0	76	0
Common gull	78	0	0	0	0	0	0	14	0	0	0	35
Small gull species	169	0	75	0	62	0	197	0	0	0	0	0
Lesser black-backed gull	13	12	88	42	12	0	322	431	45	0	61	242
Herring gull	534	36	151	62	50	0	31	14	0	0	46	435
Great black-backed gull	1,016	276	35	65	18	0	10	348	75	12	442	785

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Large gull species	0	0	0	0	0	0	21	0	0	0	0	0
'Commic' tern	0	0	0	26	410	0	0	79	75	0	0	0
Common guillemot	6,618	2,003	2,923	3,948	1,079	72	456	868	1,424	935	915	1,775
Razorbill	1,693	864	1,206	1,006	932	101	101	852	1,199	1,052	518	857
Guillemot / Razorbill	0	0	38	10	373	0	0	47	0	0	15	0
Little auk	26	12	0	0	0	0	0	0	0	0	198	0
Puffin	104	60	70	90	146	0	84	142	150	82	396	97

APPENDIX 3: BIOLOGICAL PERIODS FOR SEADUCKS, DIVERS AND SEABIRDS PROPOSED TO BE USED IN THE ASSESSMENT OF EAST ANGLIA THREE AND FOUR

Species	January	February	March	April	May	June	July	August	September	October	November	December
Common scoter	Wintering	Spring Migration	Spring Migration	Spring Migration	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Red-throated diver	Wintering	Wintering	Spring Migration	Spring Migration	Spring Migration	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Fulmar	Wintering	Spring Migration	Spring migration and breeding season concurrent	Spring migration and breeding season concurrent	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Gannet	Wintering	Spring Migration	Spring migration and breeding season concurrent	Spring migration and breeding season concurrent	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Great skua	Wintering	Wintering	Spring Migration	Spring Migration	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Kittiwake	Wintering	Spring Migration	Spring migration and breeding season concurrent	Spring migration and breeding season concurrent	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Black-headed gull	Wintering	Wintering	Spring Migration	Spring migration and breeding season concurrent	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Common gull	Wintering	Wintering	Spring Migration	Spring migration and breeding season concurrent	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Lesser black-b'd gull	Wintering	Wintering	Spring Migration	Spring migration and breeding season concurrent	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Herring gull	Wintering	Wintering	Spring Migration	Spring migration and breeding season concurrent	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Great black-b'd gull	Wintering	Wintering	Spring Migration	Spring migration and breeding season concurrent	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering
Guillemot	Wintering	Spring Migration	Spring migration and breeding season concurrent	Spring migration and breeding season concurrent	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering	Wintering
Razorbill	Wintering	Spring Migration	Spring migration and breeding season concurrent	Spring migration and breeding season concurrent	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering	Wintering
Puffin	Wintering	Spring Migration	Spring Migration	Spring migration and breeding season concurrent	Breeding Season	Breeding Season	Breeding Season	Breeding Season	Post-breeding Dispersal / Autumn Migration	Post-breeding Dispersal / Autumn Migration	Wintering	Wintering

Key:

(blue)	Wintering
(green)	Spring Migration
(yellow, crossed)	Spring migration and breeding season concurrent for different populations, requires apportionment
(yellow)	Breeding Season
(red)	Post-breeding Dispersal / Autumn Migration

APPENDIX 4: METHOD STATEMENT: MIGRATION MODELLING

INTRODUCTION

The presence of offshore windfarms on the migratory routes of birds presents the risk of adverse impacts through collision with the windfarm infrastructure, principally the moving turbine blades. As part of the consideration of an application made for the consent for an offshore windfarm this risk of adverse impact has to be assessed through the impact assessment process (EIA for all bird receptors and HRA for birds that are SPA and Ramsar site interest features).

The number, timing, frequency and nature of bird surveys traditionally conducted to inform the consenting process (boat or aerial based) run the risk of underestimating or missing migrant birds because migrant birds can move through in short pulses, in poor weather or at night or at high altitudes. Their behaviour is also likely to change between the generally good weather when surveys take place and adverse weather conditions, potentially migrating at lower heights in poor conditions.

One solution to the limitations of the traditional survey methods is to model migratory bird movements. APEM has developed a tool to carry out such modelling - Migropath. This makes it possible to estimate the number (with confidence intervals) of migrating birds passing through windfarm development sites. The model is set up to focus on species that are associated with Special Protection Areas (SPAs). The model assumes point to point migration within a broad front from continental Europe to and from the UK.

The alternative model to Migropath was developed by the British Trust for Ornithology (BTO) as part of the SOSS 05 programme of work. SOSS 05 involved a number of projects, aimed at aiding the process of assessing the risk of offshore windfarm developments to migratory birds, particularly those birds that are the interest features of UK SPAs and/or species listed in Annex 1 of the Birds Directive. The SOSS-05 programme included as an output the SOSSMAT migration model. The SOSSMAT model was based extensively on Migropath but contained a number of simplifications and hence its outputs are more limited. Migropath provides a more refined modelling approach through the use of species specific migration routes based on associations between species that are interest features of SPAs and relevant UK SPAs. This approach allows a more tailored approach to be followed and also allows additional modelling to be undertaken on specific SPAs if required.

METHODOLOGY

Selection of Migrant Birds for Modelling

A screening exercise is first carried out to identify any migrating species that might encounter the proposed windfarm during their migration flights across or through the relevant area of sea to and from their breeding colonies and wintering grounds. This screening is carried out through a review of the results of any site-specific boat and aerial survey data, site specific migration surveys, local bird reports, ornithological literature and the broad front migration routes illustrated and described in the SOSS 05 Report (Wright *et al*., 2012).

Defining relevant populations

Populations of birds over-wintering or breeding on UK SPAs can be obtained from the relevant Natura 2000 data sheets and populations of waterbirds on a UK and regional basis taken from the results of the annual Wetland Bird Survey (WeBS) - 'Waterbirds in the UK' (Holt *et al*., 2012). This information can be supplemented by that from occasional surveys and/or irregular surveys such as the Non-Estuarine Waterbird Survey and surveys of inshore waters for concentrations of seaduck, divers and seabirds.

Technical method

The centrepoint of each SPA is calculated using the geometry function within ESRI® ArcMap™ 9.2. The coastline of Continental Europe is split into 1 km segments, and each segment labelled with a unique ID. Using the ET Geowizard tool each segment along the European coast is joined to the centre of each SPA (an example is illustrated in Figure 1), with each line classified as either passing within or out from the windfarm under investigation.

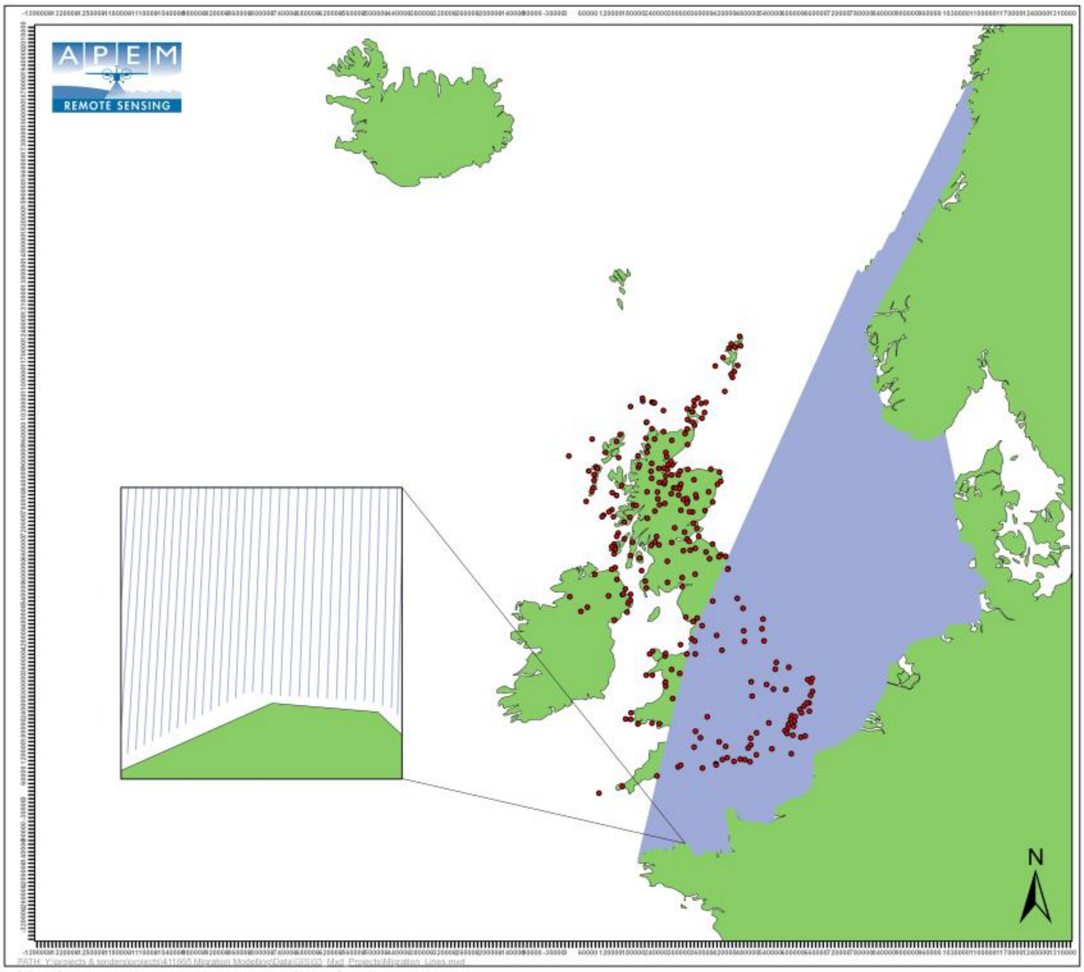


Figure 1: Example migration lines for a hypothetical species that would migrate from the European coast to the Ribble and Alt Estuaries SPA. Red dots represent the centre of each SPA in the UK. The inset shows a section of the 1 km spaced migration lines starting from Brittany.

A list of SPAs that each of the species is associated with is collated (JNCC, various; Stroud *et al,.* 2001). This information, along with the SPA line associations and migratory pathways, is then fed into the statistical package 'R' (R Development Core Team, 2012).

Within R, a list of SPAs associated with a species is extracted and the relevant data loaded. Data contained within the migratory pathway are then extracted and collated. A random percentage of birds are assigned to each migratory route, and percentages within the windfarm development area are summed to produce the output. Where sufficient information exists on staging areas, the percentage of the population utilising these areas are incorporated. The model output provides a sum of the percentage of birds passing through the windfarm development area within one migration period (i.e. spring migration). For an estimate of the total number of birds passing through the area within one year, these outputs would need to be multiplied by the relevant number of migration periods. Where staging areas are incorporated, percentages migrating to/from may vary with migration season. Therefore differing proportions of the population may pass through a particular windfarm on outward and return migration flights.

Outputs from the model

The outputs from the model are the numbers of birds of particular species passing through the area of the windfarm under investigation each year (or season). That number can feed in to a collision risk model to provide an estimate of the numbers of migrant birds at risk.

Assumptions

Migropath inevitably makes several assumptions. Chief amongst these is the assumption that migration is in a straight line between the SPA of interest and a given point (or defined area) out from the UK. This may suggest migration routes across land, something that not all species my do and which might require specific alteration to the modelling. Another key assumption is that all migration of a particular species to a particular suite of SPAs can be defined within a set corridor. These corridors are derived from the report of the SOSS-05 programme of work (detailed above) and it is assumed that they do represent the broad front area across which birds move.

References

Holt, C., Austin, G., Calbrade, N., Mellan, H., Hearn, R., Stroud, D., Wotton, S and Musgrove, A (2012). *Waterbirds in the UK 2010/11, The Wetland Bird Survey*. BTO, RSPB and JNCC in association with the WWT, Thetford.

JNCC (various). *Natura 2000 Standard Data Forms* : From JNCC web site.

Stroud, D.A., Chambers, D., Cook, S., Buxton, N., Fraser, B., Clement, P., Lewis, I., McLean, I., Baker, H. & Whitehead, S. (Eds.) (2001). *The UK SPA Network: its scope and content*. Vols 1 – 3. JNCC, Peterborough.

Wright, L.J., Ross-Smith, V.H., Massimino, D., Dadam, D., Cook, A.S.C.P. & Burton, N.H.K. (2012). *Assessing the risk of offshore wind farm development to migratory birds designated as features of UK Special Protection Areas (and other Annex I species)*. Strategic Ornithological Support Services. Project SOSS-05. BTO Research Report No. 592. BTO, Thetford.

13.1.5 Minutes of Ornithology ETG 2 Meeting

7. Provided below are the minutes of the second Ornithology ETG meeting

EAOW Round 3 Offshore Programme East Anglia THREE & FOUR, Ornithology ETG Meeting 2			
Date of Meeting:	11/11/2013	**Venue:**	Tudor Street

Attendees

Name	**Initials**	**Organisation**
Keith Morrison	KM	EAOW
Mandy Gloyer	MG	EAOW
Marcus Cross	MC	EOAW
Richard Caldow	RCa	Natural England
John Jackson	JJ	Natural England
Roger Covey	RCo	Natural England
Claire Ludgate	CL	Natural England
Alex Cooper	AC	RSPB
Benedict Gove	BG	RSPB
Roger Buisson	RB	APEM
Paolo Pizzolla	PP	Royal HaskoningDHV

Document Ref:		**Issue Date:**	22/11/13

10:00-1400

ITEM	**DESCRIPTION**	**ACTION**
1	Health and Safety – KM Introductions - All	
2	**Summary of previous actions** After meeting EAOW circulated updated OETG1 paper (with changes in line with NE comments) changes listed as Appendix 10 to the OETG1 paper. This paper is now finalised. Signoff – RSPB position noted in the agreement schedule attached to these minutes, no further update from NE. NE – comments received on OETG1 paper relating to biological periods. RCa had not provided comments on the minutes. KM – legal feedback still to be received on any requirement for mitigation to be delivered only inside the Red Line boundary. Methods for onshore surveys– RS and PP contacted Nick Mason, as a result the WeBS survey recording has been refined (to record brent geese within field boundaries rather than larger sectors) and onshore behavioural study methodology defined. JJ – Deben Estuary SPA review on-going – no deadline available RCo –JNCC unlikely to be involved in EA3&4, subject to confirmation of an agreement on delegation between NE & JNCC. Marine Renewables Ornithologists' Group (MROG) will be the forum at which strategic issues are discussed with JNCC. Agreement onshore – see table below *Note that it was expected that Richard Saunders would call in to contribute to the NE position but that did not happen.*	No further comments to be actioned on this OETG1 paper, any remaining issues to be addressed in minutes, meetings or additional papers. Agreement table completed in this meeting **ACTION – KM to determine** **ACTION - the role of JNCC to be discussed at Steering Group meeting (12/11/13**)

ITEM	DESCRIPTION	ACTION
	Agreement offshore – see table below	
3	**Offshore** <u>Baseline survey results</u> RB - See App 1 & 2 of OETG2 paper for species occurrence and numbers in EA3&4. Population estimates are the peak by month (as EA4 surveys not completed cannot produce mean). RCa – noted that there were no peaks in the breeding season. Mean peak population estimates by month or season will be key number used in the assessment. RCa – will want to see all counts as a large disparity between years will affect the mean peak. Seek to understand what causes such variation between years. BG – agree, wish to see all counts. There is the potential to miss a peak of passage migrants. RB - EA3&4 in general the results of baseline surveys are not dissimilar to EA1 – in both numbers and seasonal patterns. RCa – comparative table or chart of the results from EA1/3/4 would be useful. BG – RSPB would like table/graphs of comparison between 3 projects. RB - am able to supply a number of comparative graphs that have already been prepared, subject to providing some context. <u>Biological periods</u> RCa - have provided feedback in writing. BG – will review with colleagues and provide feedback. RB –a nuanced approach to the biological periods is required due to the potential, highlighted by RCa in his written comments, to overestimate the population by including migrants in the breeding season estimates. A method for this has been proposed in OETG2 paper to create a new biological period that identifies this overlap of spring migration and breeding / colony attendance (see App 3). This may also be relevant to autumn migration. In the overlap period require apportionment of migrant and local breeding birds. RCa – subtracting mid-summer estimates from the spring estimates gives a measure of the passage population. RB – The proposed apportionment would be carried out in such a manner but it would need to be on a spp by spp approach. The apportioned population estimates would then carry through to the assessment phase. BG – largely in agreement, do need to look spp by spp and apportion. RB – is there any species for which this approach wouldn't work? [no suggestions received] RCa – look at the survey information for EA3&4 together to build an understanding of the pattern of seasonal occurrence. RCa – specific text change - para 21 of the OETG2 paper – add the word 'all' such that middle part of last sentence reads ".. it cannot	**AGREED (dependent upon variations)** **ACTION – RB to circulate figures after meeting** **AGREE – general principle NE/RSPB** **ACTION – look at this on spp by spp and look at how this works, look at EA3&4 together and EA1, recognising that the latter is closer to the English coast.**

ITEM	DESCRIPTION	ACTION
	be assumed that *all* birds present within the wind farm boundary ..” <u>Flight direction</u> RB – this aids understanding of behaviour by looking at overall orientation e.g. can inform identifying if birds are on migration, commuting back and forth to coast or searching for food. RCa – potentially important in the apportioning exercise discussed earlier. <u>Flight height</u> To be discussed outside of the EP process, as this is technical matter about validating an APEM method that is being applied to several developments and NE has a requirement for assurance relating to all those developments. Once NE happy with validation, we should note this acceptance as part of EP schedule of agreement. MC – plan to have have flight heights for the more numerous seabird species on a site specific basis rather than use the SOSS average figures. RCa – where site specific flight height differs markedly from the SOSS average figure would expect to see discussion of why there are differences, particularly if it is as a result of only one large event that biases the overall picture. **Onshore** <u>Surveys</u> PP - The first WeBS using the new detailed recording had been completed but it was too early in the season for the first brent goose behavioural survey to be undertaken. That will be started as soon as numbers of brent geese arrive. <u>Areas of agreement / not agreement</u> Within OETG Paper 2 specific sections were agreed, as initially identified in the paragraphs / sections listed in the Action column:	**RB to correspond with RCa outside of EP process** **Para 30 – AGREED** **Para 31 – AGREED in principle** **Section 4 - AGREED**
4	**Methodologies** <u>Definitions of magnitude</u> RCa – wording of these definitions requires careful consideration eg a significant level of additional mortality may reduce the “equilibrium” population size without altering its long-term viability ie it the population will persist albeit it at a lower level. That would be assessed as of medium magnitude at present but that seems highly questionable. Further consideration on wording needed. RCa – noted that for some assessments accompanying development applications where impacts on certain species had been deemed negligible / screened out this created a problem for future CIA by other developers as there was no data available. Clearly there would have been some level of impact. BG – agree.	**ACTION – EAOW to look at wording of definitions again**

ITEM	DESCRIPTION	ACTION
	Categories of sensitivity Use of the 'very high' category was discussed. PP - EAOW believe it adds little value given that assessment is expert judgement based and narrative is important RCa - concurred on the basis that ultimately will look at the bird numbers predicted to be affected rather than taking the stated impact significances at face value	**AGREED – very-high category not to be included**
5	**Approach to CIA** There was a discussion on the approach to CIA, the key points were: • All accept that some sort of tiered assessment is necessary in consideration of CIA (tiers based on place in planning process and information qualified by data confidence) • EAOW has legal advice that only those consented and constructed projects need to be considered, but clearly there are other projects on the horizon and how these are dealt with clearly needs to be standardised to ensure a level playing field • All agreed that there is a requirement for strategic work outside of the individual project level – this would prevent deadlock agreeing assessments at the project level • Ideally a coordinated approach between NE/RSPB/Industry to DECC, Defra etc needed to force the issue – this is a key topic for the DECC 'coping strategy'	**ACTION – take to coping strategy meetings – migration modelling relatively generic. CRM bigger job** **ACTION – MC raise this at ORJIP 2nd Dec, waders and wildfowl,** **MG joint submission NE/RSPB/RUK to DECC**
6	**Modelling methods** Migration RB – are all comfortable on APEM migration modelling? It is more sophisticated than the BTO model – looks at individual SPA populations as opposed to the strategic level. The key assumption is coast to coast / SPA migration. Is able to include staging points on migration e.g. Wadden Sea. Marine Scotland is developing a method better suited to seabird passage parallel with coast. RCa – for seabird passage spp. will EAOW use the new MS model? RB – the method is in draft and subject to review by SNCBs. If it is accepted by SNCBs will use it. MC – will need to consider the population estimates that we use for migrating birds - do we use modelled or survey based site-specific estimates for seabirds? RB – still seeking (6+months) the gannet tracking data from DECC (the work contracted to RSPB by DECC and not the general FAME data) to explore how that informs breeding versus migration movements and timing.	**AGREED – Migration modelling is an appropriate approach for selected species.** **ACTION – NE/RSPB look at the MS paper if they have access to the draft. Views on its applicability to the southern N Sea welcomed** **ACTION – If anyone has means to pressure DECC to release the data, please do so.**
7	**HRA approach** RB - A stepwise approach will be used: • 1st stage screening – high level on basis of foraging distance and migration modelling, screen out clearly unlinked sites, habitats and species	**AGREE high-level approach for screening 1st stage**

ITEM	DESCRIPTION	ACTION
	• 2nd stage informed by detailed assessments and focus on specific interest features • 3rd stage – those species for which no LSE cannot be concluded using information and assessment by time of PEI • Aim at 1st stage it to reduce padding – all happy that publicly available information(i.e. Natura 200 citation forms) do not need to be reproduced as 'evidence'	
8	**Transboundary** MC – considering UK sites for HRA, will use available non-UK information in CIA. RCa – will need to look at potential effects upon non-UK sites. RB – Potential spp. at issue are wide ranging spp eg gannet, gulls, skuas. Also wintering auks esp with Brown Ridge pSPA nearby - already aware of potential Dutch Govt interest. RCa – need to ensure that there is a match between suite of plans/projects considered in combination and population scales being considered (cannot mix and match) – must be appropriate. MC – north sea is a relevant/robust study area with tiered approach to project data. RCa – However, noted that there may be a need to consider non UK windfarms and all windfarms on ALL coasts of the UK for assessment under EIA at international/ national population scales, and also to consider windfarms outside N Sea for in combination assessments for several species from many SPAs	**ACTION – EAOW to develop thinking on scale for transboundary and CIA considerations and discuss at future OETG Mtg.**
9	**SoCG**	See schedule of agreement attached to minutes
10	**Issues for Steering Group** • Scottish engagement • CIA – strategic issue • Sign-off • JNCC role	**ACTION – to discuss at Steering Group on 12/11/13 and feedback to OETG.**
11	**Horizon Scan** NERC – have funded project reviewing CR models, potential to develop a new model – starting Dec 2013 – 12 month grant (Liz Masden). Initial report Feb 2014. MS – contracted BTO to review avoidance rates, critique and definition – report March 2014 SNH – commissioned similar for onshore (to Natural Research) ORJIP – post-construction monitoring – expected to award Dec 2013 and runs for several years. NE funded project on non-breeding season population size estimates – report March 2014 RCa – will provide update on other NE R&D projects. RSPB – working with MROG on uncertainty around CRM (potential funding from TCE) RSPB – have masters student reviewing cumulative impact assessments	

ITEM	DESCRIPTION	ACTION
	RSPB – have internal project reviewing PBR/PVA models. RB – lot of projects that focus on collision risk modelling. Any that at a late stage informed avoidance rates could be incorporated in to assessment in summer 2014 but new modelling approaches are difficult to incorporate as require wholesale reworking of assessment.	**ACTION – All to share outputs at an early stage to enable consideration of their inclusion in the assessment as early as possible**
12	**AoB** Next meeting will be late Feb 2014 RCo - Make sure that the minutes and agreement schedule reference specific parts of papers (paragraph and section numbers) so that they can be carried forward to SoCG document. Paper for prior to OETG3 to include EA1/3/4 – comparisons Bio-periods	

ID	Issue on which EAOW THREE and FOUR seek agreement on	NE Position	RSPB Position
	OETG2		
1	**From OETG2 Paper** **Para 30**. Agreement, based on the information supplied at OETG Mtg 1, is sought on: • Sufficient offshore and onshore baseline survey data has been collected to inform the assessment. • No additional survey required for the offshore or onshore cable route (the additional targeted brent goose surveys are not related to baseline information gathering). • Existing onshore data will be augmented with new WeBS data recorded at greater spatial detail and an additional brent goose survey. • Natural England to supply (if it can be made available) its Outer Thames Estuary RTD survey data to augment the existing offshore cable route data (**Note for inclusion in PEI these data must be supplied by January 2014**)	Agree Agree – with exception of additional brent goose work Agree TBC	*Agree that 18 months of continuous survey data are sufficient.* *Agree that sufficient baseline information already exists* *Agree that this approach is acceptable* *Support the use of NE RTD data within assessment*
	Para 31. Agreement, based on the updated information supplied at OETG Mtg 2, is sought on: • Biological periods – agreed in principle subject to working up the figures	Need for nuanced approach agreed in principle.	*We are satisfied in principle with the revised Biological periods table supplied for OETG Mtg 2*
2	**Section 4** Agreement of the impacts to be assessed as listed in Section 4.1 (offshore) and 4.2 (onshore)	Agreed	*We support the change to the impacts in Section 4.1 suggested by NE. The operational impacts will also need to include in-combination/ cumulative impacts.*
3	**Data** Mean peaks shall be used unless there is great disparity between years, in which case contextual data will be consulted for justification of numbers used	Agree in principle but note requirement to present each year's monthly peaks separately (in appendix?) to enable any large discrepancies between years to be identified	*This approach is acceptable.*

ID	Issue on which EAOW THREE and FOUR seek agreement on	NE Position	RSPB Position
4	**Data** Flight height methodology Agree that the methodology for determining flight height from aerial imagery is a general matter outside of the EP process, NE and APEM to discuss outwith EP meetings	Agree	*We would like to be consulted on any methodology for flight height agreed between NE and APEM.*
5	**Assessment methodologies – terminology** EAOW will look again at magnitude definitions, but this is not critical to agreement All accept that 'very high' category for sensitivity/magnitude adds little to assessment and this will not be used	Agree to need for further consideration of wording to define categories of magnitude. Agree	*We consider revised magnitude definitions are a major improvement. However, they still require some refinement in line with comments of NE and RSPB at OETG Mt 2.*
	OETG1	*Note that NE did not provide responses to the minutes prior to OETG2, these responses were added in OETG2*	*Responses provided – 9/11/13* *The RSPB's position is made in relation to the information available to us at this time. However, we reserve the right to alter our position to East Anglia 3 & 4 should new information (i.e research and data) become available which significantly alters the situation.*
1	**ONSHORE**		
	Data		
	Sufficient baseline survey data have been collected to inform the assessment	Happy with approach in document, that is when these 5 onshore elements are taken together	No the RSPB considers that further survey work will be required in regard to Brent Geese.
	No additional survey required for the cable route	Happy with approach in document, that is when these 5 onshore elements are taken together	The RSPB supports NE's position on this issue.
	Existing baseline data will be augmented with new WeBS data	Happy with approach in document, that is when these 5 onshore elements are taken together	The RSPB supports the use of the latest WeBS data to augment the baseline data.

ID	Issue on which EAOW THREE and FOUR seek agreement on	NE Position	RSPB Position
	If possible new WeBS data to include greater detail on location of birds within the large WeBS count sectors	Happy with approach in document, that is when these 5 onshore elements are taken together	The RSPB agrees in principle that a more detailed understanding of the location of birds on the Deben is essential. However, we will need to see the details of what has been agreed with the BTO before we can make any further comments. *
	EAOW to undertake additional brent goose survey (winter 2013/2014)	Happy with approach in document, that is when these 5 onshore elements are taken together	The RSPB supports the additional Brent Goose survey being undertaken during the winter of 2013/14.
	Species		
	Likely species for assessment listed in App 7 & 8	OK	The RSPB agrees with NE's advice on this issue.
	Species to be selected for assessment on basis that are listed features of Deben Estuary SPA and SSSI or are Schedule 1 breeding species	OK	The RSPB supports this approach
	Assessment will include both listed features and relevant assemblage species	OK	The RSPB supports this approach
	Impacts		

	The following impacts will be assessed
	• Construction
	    • Disturbance / Displacement
	• Operation
	    • High-level assessment
	• Decommissioning
	    • Disturbance / Displacement
		OK	The RSPB agrees that the impacts proposed for assessment are appropriate.

2	**OFFSHORE**		
	Data		
	Sufficient baseline survey data have been collected to inform the assessment (24 months of aerial for each site)	OK	The RSPB agrees that 24 months of aerial surveys will provide sufficient baseline data, provided that the data set is continuous and there are no gaps.
	No additional survey required for the cable route	OK	The RSPB supports NE's position on this issue
	NE's Outer Thames Estuary RTD survey data will be used if it can be made available	RC happy in principle	The RSPB supports the use of the Red Throated Diver survey data

ID	Issue on which EAOW THREE and FOUR seek agreement on	NE Position	RSPB Position
	EA ONE and Zone data will be used as contextual information where relevant	OK	The RSPB agrees that using EA1 and zone data as contextual information could be useful.
	Data analysis		
	Population estimates will be design based but more sophisticated modelling will be applied if the data warrants it and the modelling approach is acceptable	OK	The RSPB supports this approach
	Flight parameters [awaits information on how flight height method has been validated]	Not part of EP process (APEM and NE, RSPB to deal with)	The RSPB supports NE's position on this issue.
	Species		
	Species specific bio-periods [awaits feedback from NE to create new bio-period table]	For OETG2	The RSPB supports NE's advice on the bio-period table
	If a species falls under any one of these criteria it will be taken forward in the assessment: 1) population of regional importance or greater. 2) adult seabirds within maximum foraging distance of SPA or SSSI with that species as interest feature 3) migration modelling shows connectivity and numbers occurring are significant (irrespective of collision risk).	*The proposal will not screen out spp prior to migration modelling, model run using BTO/SoSS and screen on that list* *Assumption <1% of regional population = not significant, based upon the BTO approach to definition of migrant populations (waders/waterfowl), still need to define for seabirds – modified migration method approach (awaiting the Scottish methods)* ***Action for NE (RC) to look at SNH project and feedback as to whether appropriate***	The RSPB agrees in principle that the criteria being used are appropriate, However, we would like clarification about point 3, in particular how 'significant' is being defined.
	Impacts		

ID	Issue on which EAOW THREE and FOUR seek agreement on	NE Position	RSPB Position

	The following impacts will be assessed
	• Construction
	  • Disturbance / Displacement
	  • Indirect through prey species
	• Operation
	  • Disturbance / Displacement
	  • Indirect through prey species
	  • Collision risk
	  • Barrier effect
	• Decommissioning
	  • Disturbance / Displacement
	  • Indirect through prey species
		OK	The RSPB seeks clarification about whether the assessment will include cumulative, in-combination and transboundary impacts.
			Once this has been clarified then we will be able to provide our position.

13.1.6 Ornithology ETG Meeting 3 Background Paper

8. Provided below is the background paper that was circulated prior to the third Ornithology ETG meeting

East Anglia Offshore Wind

VATTENFALL

SCOTTISHPOWER RENEWABLES

East Anglia THREE and East Anglia FOUR

Ornithology

Evidence Plan

Expert Topic Group Meeting 3

28th March 2014

Document Reference – 512608/670-OETG-3

Author – APEM & Royal HaskoningDHV
East Anglia Offshore Wind Limited
Date – March 2014
Revision History –Second draft for Meeting 3

Table of Contents

1 INTRODUCTION

1.1 Purpose of this Document

1. The purpose of this document is to provide technical information to support the discussions to be held at the third ornithology expert topic group (OETG) meeting to be held on 28th March 2014.

2. It contains information that updates that presented at the first and second Ornithology Expert Technical Group meetings (OETG Mtg 1 and 2) held in September and November 2013. It provides more detailed information on a series of topics related to offshore and onshore ornithology and assessment processes. In some cases an outline approach is described in this paper in recognition that the detail and discussion on it will take place at a future meeting.

3. The record of the discussion at OETG Mtg 1 and 2 and the schedule of topic areas on which agreement is sought, with the current position of Natural England and RSPB, are contained within the respective minutes of those meetings.

1.2 Structure of this Document

4. In accordance with the way in which parts of the agendas for the OETG meetings are organised, this document provides separate sub-sections for offshore receptors (from low water mark out to the wind turbines) and onshore receptors (from low water mark at Bawdsey and within the Deben Estuary estuarine closing line to terrestrial along the onshore cable route).

2 PROGRESS WITH EVIDENCE PLAN DOCUMENTS SINCE OETG MTG 2

2.1 Project Timetable

5. The indicative project timeline that was presented in tabulated form in Section 1.4 of the Background Paper to OETG Mtg 1 remains the best available information. No revisions need to be brought to the attention of the attendees of OETG Mtg 3.

2.2 Project Description

6. The project description given in Section 1.3 of the Background Paper to OETG Mtg 1 now requires revision with a decision having been made about the turbine array that in particular changes the 'Rochdale Envelope' for the impact assessment. This is that the array will consist of between 100 and 172 turbines of 12MW to 7MW respectively.

7. As a result, the first bullet point of Section 1.3 of the Background Paper to OETG Mtg 1 changes from:

- Offshore wind turbines and associated foundations (anticipated to be up to maximum of 240 wind turbines, each having a rated capacity of between 5MW and 10MW, with an installed capacity of up to 1,200MW);

8. To:

- Offshore wind turbines and associated foundations (anticipated to be up to maximum of 172 wind turbines, each having a rated capacity of between 7MW and 12MW, with an installed capacity of up to 1,200MW);

9. This affects the 'worst case' scenario, derived from the Rochdale Envelope, for use in particular in the collision risk modelling. That worst case that will be modelled is set out in Table 2.1.

Table 2.1: Wind turbine parameters for modelling of collision risk for worst case within the Rochdale Envelope

Wind Turbine Parameter	Magnitude
Rated capacity	7MW
Maximum number of WTG in site	172
Number of blades	3
Blade length	75m
Blade chord	5.0m
Blade pitch	10 degrees
Minimum blade clearance (air draught)	22m above MHWS
Maximum rotor diameter	154m
Maximum hub height	99m
Maximum tip height	178m
Operating wind speed range (cut in / cut out)	3 / 25m/s
Operating speed range (min to max)	5 – 11rpm

3 EXISTING ENVIRONMENT

3.1 Offshore

3.1.1 A Comparison of the Seabird Assemblages using East Anglia ONE, East Anglia THREE and East Anglia FOUR

10. At OETG Mtg 2 there was discussion of a comparison between East Anglia ONE, East Anglia THREE and East Anglia FOUR of the seabird assemblages and their seasonal pattern of occurrence.

11. Appendix 1 provides pie charts showing the relative contribution, calculated from monthly peak data, that seabird species, or groups of species, make to the seabird assemblage for East Anglia ONE, East Anglia THREE and East Anglia FOUR.

12. Appendix 2 provides bar graphs showing the monthly pattern of occurrence as percentages across the year, calculated from monthly peak data, for seabird species, or groups of species, for the seabird assemblage for East Anglia ONE, East Anglia THREE and East Anglia FOUR.

13. In summary, the similarities and differences between East Anglia ONE, East Anglia THREE and East Anglia FOUR are:

- Species composition of the assemblage differs between near shore (East Anglia ONE) and far offshore (East THREE and East Anglia FOUR): There is a greater proportion of auks and fulmars far offshore.

- Monthly and seasonal occurrence differs between near shore (East Anglia ONE) and far offshore (East Anglia THREE and East Anglia FOUR): Near shore the peak is during autumn migration; far offshore the peak is in winter. This difference in seasonal occurrence is driven by the autumn passage of kittiwake and large gulls near shore (the peak is in November) versus the winter peak in numbers of gulls and auks far offshore.

- An autumn (November) peak in gannet occurrence is seen across East Anglia ONE, East Anglia THREE and East Anglia FOUR.

- Kittiwake peaks in autumn (November) near shore (East Anglia ONE) and in winter (December or January) far offshore (East Anglia THREE and East Anglia FOUR).

3.1.2 Update to Baseline Information Gathering: Survey

14. The monthly aerial digital surveys for East Anglia THREE were completed in August 2013 and the monthly aerial digital surveys for East Anglia FOUR were completed in February 2014.

3.1.3 Update to Baseline Information Gathering: Desk Study

15. Natural England has recently granted permission for the use of, as part of this application, the latest red-throated diver survey information of the Outer Thames Estuary SPA. That information will be used to estimate the density of red-throated diver along the offshore cable route. That density will be compared to the density known from the previous set of data compiled by JNCC. If the density is the same as, or lower than, the density used for the assessment of the impact of the construction of East Anglia ONE on red-throated diver then the conclusion of no significant impact in EIA terms and no likely significant effect in HRA terms can be drawn for the project alone without further quantitative assessment. For the cumulative and in-combination assessments, drawing this conclusion depends on the contribution from other plans and projects as well as the contribution from the project.

3.1.4 Update to Baseline Information Analysis: Population Estimates and Densities

16. The information on the population estimates and densities provided for East Anglia THREE and East Anglia FOUR in Appendix 1 and 2 respectively of the paper provided for OETG Mtg 2 was on the basis of unidentified birds not having been attributed to specific species and on the basis of no correction to the razorbill and guillemot populations for the lack of their detection when underwater foraging (an ‘availability’ correction). The result was that those Appendices contained estimates for ‘diver species’, ‘small gull species’, ‘large gull species’ and ‘guillemot / razorbill’. The process of attribution of unidentified birds and correction for razorbill and guillemot ‘availability’ has now been carried out.

17. The method by which the attribution of unidentified birds to specific species has been carried out is described in Appendix 3.

18. Appendix 4 provides the population estimates and densities for East Anglia THREE after the attribution of unidentified birds and correction for the ‘availability’ of razorbill and guillemot. This Appendix also provides a summary of the method used to apply the ‘availability’ correction for razorbill and guillemot.

19. The full data set containing the raw counts by month for all species, including separate tables before and after the attribution of unidentified birds and the correction for the ‘availability’ of razorbill and guillemot, the confidence intervals on

the population estimates and the density of birds will, as a matter of best practice, be presented in a technical report appended to the PEI Report.

20. The calculation of the population estimates and densities for East Anglia FOUR after the attribution of unidentified birds and correction for the 'availability' of razorbill and guillemot is running to a slightly later timetable than East Anglia THREE and the information is not available for OETG Mtg 3.

3.1.5 Update to Baseline Information Analysis: Biological Periods

21. The set of species specific biological periods that will be used in the analysis of the baseline data acquired for East Anglia THREE and East Anglia FOUR will be based on that presented to ETG Mtg 2 as Appendix 3. The determination of the biological periods has been informed by the input from Natural England and RSPB at OETG Mtg 2. It includes recognition of those periods in the spring when some populations of birds are moving to more northerly breeding grounds and other populations of birds are associated with local breeding colonies in the southern North Sea. Apportionment of the population estimates between birds on migration and birds already associated with breeding colonies will be carried out for fulmar, gannet, kittiwake, black-headed gull, common gull, lesser black-backed gull, herring gull, great black-backed gull, guillemot, razorbill and puffin. Population estimates determined for the late spring and summer when migration is known to have ceased will be used to calculate the apportionment.

22. The method that will be followed is illustrated by the following worked example that uses a set of figures set out in Table 3.1 that represents a pattern of occurrence observed but the numbers are illustrative, rounded figures and not drawn directly from the baseline data.

Table 3.1: Worked Example of Apportioning Birds During Overlapping Biological Periods of Migration and Breeding.

Month	J	F	M	A	M	J	J	A	S	O	N	D
Number of birds	900	400	600	600	200	200	200	200	700	800	900	900

23. The pattern of the distribution of the un-named bird in the illustrative example in Table 3.1 can be described as follows:

i. High numbers occur in winter;

ii. there is a fall in early spring;

iii. that is followed by a rise for the remaining part of spring;

iv. before falling away to a steady, lower number of birds through the remainder of the breeding season;

v. and then increasing again in autumn to a winter high.

24. The pattern in spring and early summer is considered to be created by the overlapping occurrence of two different populations – a spring migratory population and a local breeding population.

25. The apportionment that is proposed can be described quantitatively as follows:

- The population estimates for May, June, July and August indicate that the local breeding population contributes an average of 200 birds in the survey area;
- Subtracting this population number from the population occurring in the overlap period of March and April results in the quantification of a spring migratory population of 400 birds in the survey area and
- Biological period peak populations can be now be quantified as 400 in spring migration and 200 in the breeding season.

26. These population estimates can then be used in collision risk modelling and in displacement matrices dependent on the species that is being considered. These population estimates can also be used in that part of the HRA that considers attribution to SPAs. In this example a population of 400 would be attributed to the migratory population that comes from a large bio-geographic area such as the North Sea and a population of 200 attributed to those SPAs within the mean maximum foraging range. Without this process of attribution there would be a falsely high attribution of a population of 600 birds to those SPAs within the mean maximum foraging range.

27. This apportionment of migratory birds out of the breeding season biological period is the identified approach for assessment and will be presented in the PEI Report. Monthly population estimates that have not been apportioned within biological periods will, as a matter of best practice, be presented in a technical report appended to the PEI Report.

3.1.6 Update to Baseline Information Analysis: Flight Height

28. The information obtained on flight heights from the aerial surveys has been analysed to calculate the percentage of birds flying at potential collision height (PCH). This information is presented in Appendix 5.

29. Those seabird species with a large sample size of flying birds (>100) for which there can be greater confidence in the calculated site based percentage at PCH are:

- Fulmar;
- Gannet;
- Kittiwake; and
- Great black-backed gull.

30. For the remaining seabird species for which collision risk modelling will be carried out it is proposed to use the generic flight height information determined from the BTO contacted SOSS-02 project.

3.1.7 Update to Baseline Information Analysis: Migration Modelling

31. The paper presented to the OETG Mtg 2 provided in Section 5.2 a summary of the migration modelling approach applied by APEM with further detail in Appendix 4.

32. Appendix 6 provides the results of the screening exercise to identify which migrant bird species associated with SPAs in the United Kingdom will be run through the model.

33. Appendix 7 provides the results of the estimation of the numbers of the screened in migrant species that will pass through the proposed East Anglia THREE and hence be at risk of collision.

34. Quantification of the risk of collision is a subsequent step to be carried out using the Band collision risk model. The results of this modelling will be reported in the PEI Report.

3.1.8 Update to Baseline Information Analysis: Collision Risk Modelling

35. The outputs from the collision risk modelling of seabirds are presented in Appendix 8. Modelling was carried out using:

- Band CRM Options 1 with site-specific PCH;
- Band Option 1 with generic PCH from SOSS-02; and
- Band Option 3.

36. Each of the three options is presented with outputs derived from the application of an avoidance rate of 98%, 99% and 99.5%. Predictions are presented both as annual totals and monthly. The worst case scenario applied for this modelling has been

described in Table 2.1 above. The PCH figures applied in the modelling that have been derived from the site based aerial surveys are listed in Appendix 5.

37. It is proposed that for the assessment presented in the PEI Report that the predictions for Band Option 3 with an avoidance rate of 98% will be used. This will be supported by an evidence base including that information recently submitted to the Hornsea Project 1 Hearing.

38. As a matter of best practice collision predictions based on the full range of options and parameter values that are presented in Appendix 8 will be provided in a technical report appended to the PEI Report.

3.1.9 Update to Baseline Information Analysis: Displacement

39. The cumulative and in-combination assessment of the effect of displacement when the potential impacts of East Anglia ONE were assessed was constrained by the lack of availability of displacement data from other OWFs that had been consented. As a result of the submissions made for the for Hornsea Project 1 and Dogger Bank Creyke Beck OWFs additional project specific displacement impact predictions have become available. That data will be used in the assessment of East Anglia THREE and East Anglia FOUR.

3.2 Onshore

3.2.1 Update to Baseline Information Gathering: Survey

40. Following the discussions and agreement at OETG Mtg 1, information has been gathered in the winter of 2013-14 on the distribution of brent geese across low-lying fields that are close to the Deben Estuary and on the numbers of waterbirds using the Deben Estuary and adjacent land through the monthly WeBS surveys.

41. Appendix 9 provides a summary of the brent goose survey and a map that summarises goose distribution.

42. This survey information shows use of land along the route of the onshore cable by brent geese. The application for East Anglia ONE contained a commitment to a management plan to reduce disturbance to brent geese to below significant levels. Discussions are continuing within EAOW as to the potential mechanisms for delivering mitigation within the applications for East Anglia THREE and East Anglia FOUR, if this is required.

43. Appendix 10 provides a summary of waterbird numbers divided by the standard count sectors used for the Deben Estuary WeBS survey.

44. This survey information shows use of the Deben Estuary in the count sectors where the onshore cable route is to pass beneath the estuary. The application for East Anglia ONE contained a commitment to a management plan to reduce disturbance to waterbirds to below significant levels. Discussions are continuing within EAOW as to the potential mechanisms for delivering mitigation within the applications for East Anglia THREE and East Anglia FOUR, if this is required.

3.3 Proposed Action / Agreement

45. Agreement, based on the updated information supplied is sought on:

- The method by which the attribution of unidentified birds to specific species has been carried out, as described in Appendix 3;
- The method by which a correction is applied to the aerial survey data to account for razorbill and guillemot spending a proportion of their time when at sea foraging underwater, as summarised in Appendix 4;
- The method for apportioning migrating and breeding bird populations between biological periods when there is overlapping occurrence of breeding and migratory populations in the survey area, as described in Section 3.1.5;
- The use of site specific PCH information in collision risk modelling in preference to 'generic' PCH information where the sample size is large enough; and
- The results of the screening of species for input in to the MigroPath, as presented in Appendix 6.

46. Further discussion, since it is an existing area of non-agreement, is sought on collision risk modelling options and parameters.

4 POTENTIAL IMPACTS

4.1 Potential Impacts: Offshore

47. The list of potential impacts discussed at OETG Mtg 1 and 2 and that will be taken forward for assessment and reported in the PEIR remain as:

- During Construction
  - Disturbance / Displacement
  - Indirect impacts through effects on habitats and prey species
- During Operation
  - Disturbance / Displacement
  - Indirect impacts through effects on habitats and prey species
  - Collision risk
  - Barrier effect
- During Decommissioning
  - Disturbance / Displacement
  - Indirect impacts through effects on habitats and prey species

4.2 Potential Impacts: Onshore

48. The list of potential impacts discussed at OETG Mtg 1 and 2 and that will be taken forward for assessment and reported in the PEI remain as:

- During Construction
  - Disturbance / Displacement
- During Operation
  - Disturbance / Displacement
- During Decommissioning
  - Disturbance / Displacement

5 APPROACH TO IMPACT ASSESSMENT

5.1 Reporting on the EIA Process

5.1.1 Analysis, Assessment and Presentation Where Methods and Parameters are Not Agreed

49. This Evidence Plan process provides the opportunity for detailed technical discussion about analysis techniques, modelling and the application of specific parameters. Following those discussions agreement is sought on the application of those matters within the EIA process. It is possible that circumstances might arise that prevents agreement between EAOW and Natural England and / or the RSPB in the pre-application phase for East Anglia THREE and East Anglia FOUR.

50. It is proposed that in such circumstances the EIA will be conducted on the basis of the method or parameters that EAOW, following advice from its technical consultants, considers most appropriate. This approach will be used for the production of the PEI Report. Natural England, the RSPB and other consultees will have a formal opportunity to respond to the approach taken in such circumstances through the statutory consultation process on the PEI Report.

51. As a matter of best practice and in response to the guidance papers issued by the statutory agencies, where there are widely used alternative methods or parameters then the results of applying those alternatives will be presented in a technical report appended to the PEI Report.

5.2 Proposed Action / Agreement

52. Agreement, based on the information supplied about the approach to EIA is sought on:

- The PEI Report containing an assessment based on the suite of selected methods, techniques and parameters selected by EAOW with a technical report appended to the PEI Report containing additional methods, techniques and parameters including those raised by the consultees through the evidence plan process for which agreement could not be obtained.

6 HABITATS REGULATIONS ASSESSMENT

6.1 HRA Screening Process

53. Section 6.1 of the paper supplied for the OETG Mtg 2 described the iterative approach to be taken to the HRA screening process.

54. The initial, high level screening (described in Section 52a) has been carried out and that is reported in a specific HRA screening document. That document has been supplied separately to the OETG Mtg 3 for discussion, and if appropriate, agreement.

6.2 HRA Screening: Deben Estuary HRA Supporting Habitat Features

55. As part of the papers for the Onshore Ecology ETG, reference was made to screening out the Deben SPA supporting habitat features as there would be no direct impacts upon them (the idea was to clearly focus any HRA considerations on the birds rather than other elements of the SPA which would not be affected).

56. Natural England (in an email dated 10th January 2014) stated:

> "We find it confusing to separate 'habitat' and species features when talking about SPAs, as the 'habitat' features are only important in so far as they support the birds -
>
> So saying:
>
> *'(Page 21) 51: Deben Estuary SPA, Ramsar, SSSI…… Use of direct drill under the estuary will prevent the potential for direct impacts to the site and its features.'*
>
> This is not correct, as Brent Geese which are a feature of all these designations, are present outside the designated habitat area, in an area likely to be disturbed by drilling. Therefore there is likely to be a direct impact on these features, and therefore these sites.
>
> and
>
> *'(Page 24) 65: Given that there are no direct overlaps with statutory sites ,[and assuming mitigation for EA ONE] there will be no pathways for LSE in the HRA context or adverse effects on EPS.'*
>
> This is not correct as there is a pathway for LSE because Brent Geese which are a feature of the SPA, Ramsar and SSSI, are present on fields outside the area of the designated site and could be directly affected."

57. EAOW would like therefore to confirm that the intention was not to screen out brent geese from consideration in the HRA and that these will be considered further with respect to the effects of East Anglia THREE and East Anglia FOUR.

58. The conservation objectives of the Deben estuary SPA are:

"Avoid the deterioration of the habitats of the qualifying features, and the significant disturbance of the qualifying features, ensuring the integrity of the site is maintained and the site makes a full contribution to achieving the aims of the Birds Directive.

Subject to natural change, to maintain or restore:

- The extent and distribution of the habitats of the qualifying features;
- The structure and function of the habitats of the qualifying features;
- The supporting processes on which the habitats of the qualifying features rely;
- The populations of the qualifying features;
- The distribution of the qualifying features within the site."

59. Therefore with regard to the above, EAOW believe that the first three bullets are covered by the use of HDD which avoids impacts upon the habitats and these impacts will be screened out.

6.3 Proposed Action / Agreement

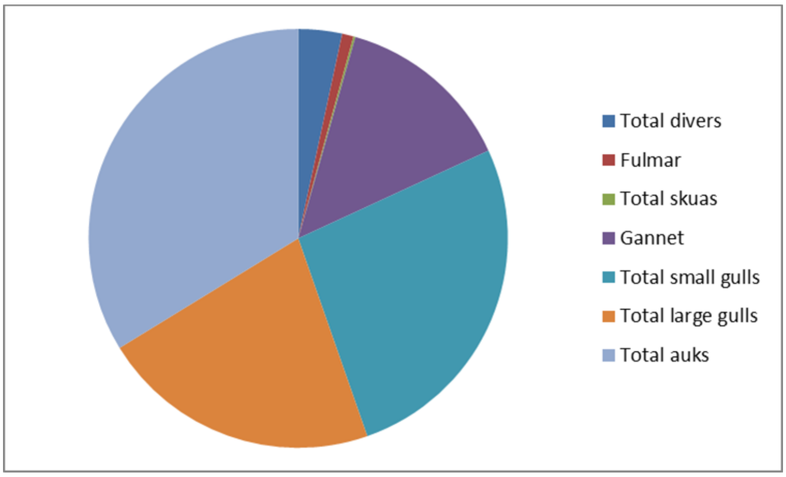
60. Agreement is sought on:

- The initial high level HRA screening process; and
- The results of the initial high level HRA screening.

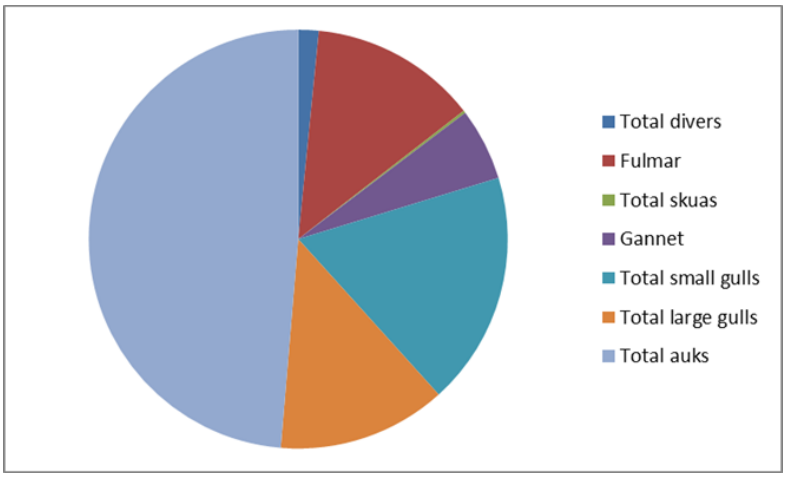
APPENDIX 1: COMPARISON OF SEABIRD ASSEMBLAGES FOR EAST ANGLIA ONE, EAST ANGLIA THREE AND EAST ANGLIA FOUR

Appendix 1: Comparison of the Seabird Assemblage Recorded for East Anglia ONE, East Anglia THREE and East Anglia FOUR

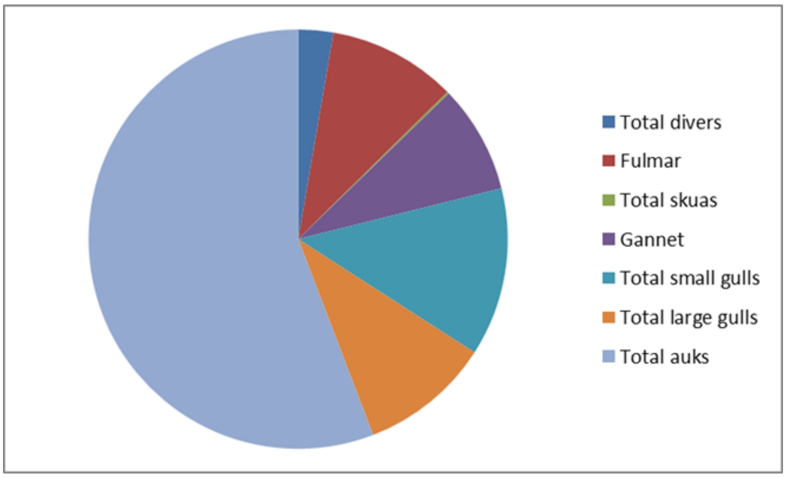
East Anglia ONE



East Anglia THREE



East Anglia FOUR

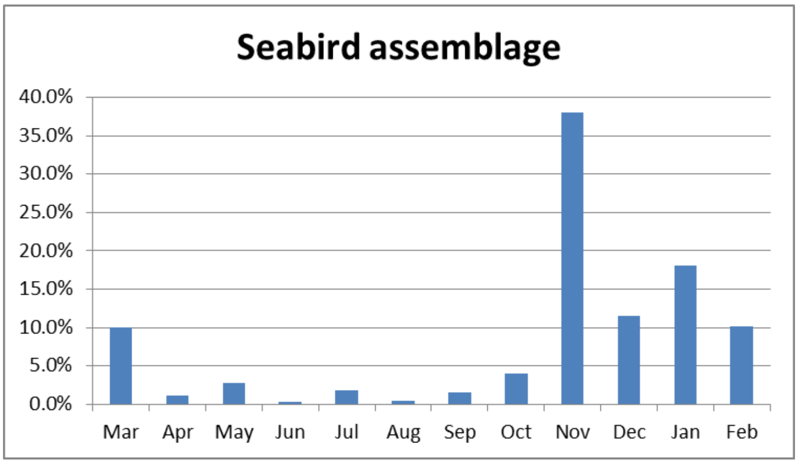


APPENDIX 2: PATTERN OF SEASONAL OCCURRENCE OF SEABIRDS FOR EAST ANGLIA ONE, EAST ANGLIA THREE AND EAST ANGLIA FOUR

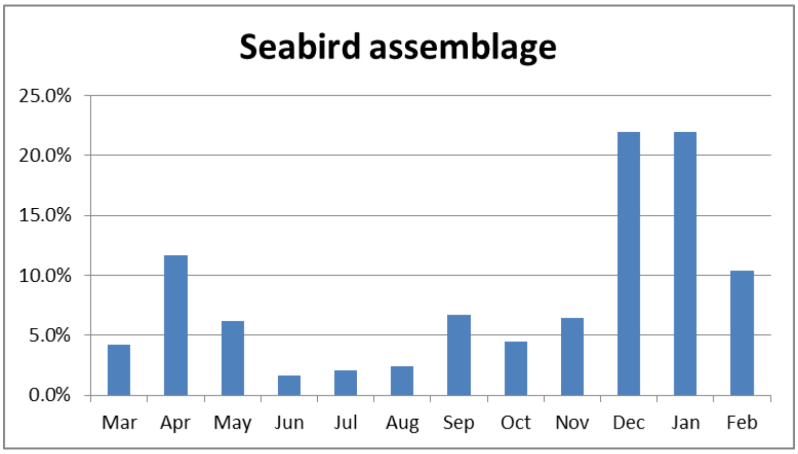
Appendix 2: Comparison of the Monthly Occurrence of Seabirds Recorded for East Anglia ONE, East Anglia THREE and East Anglia FOUR

Seabird assemblage

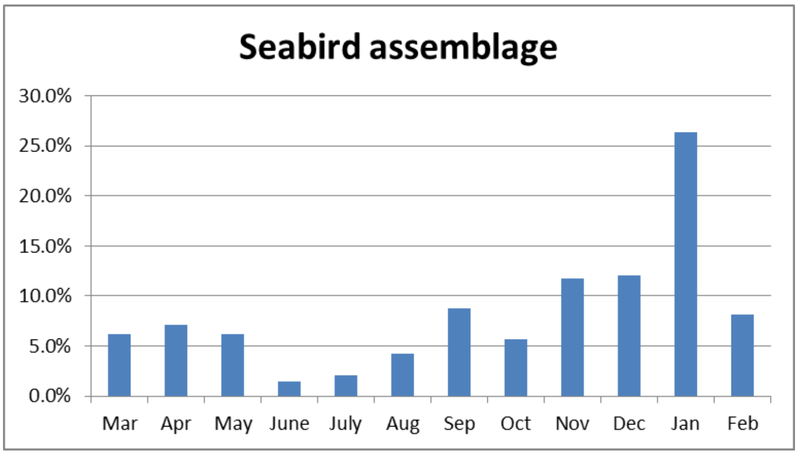
East Anglia ONE



East Anglia THREE

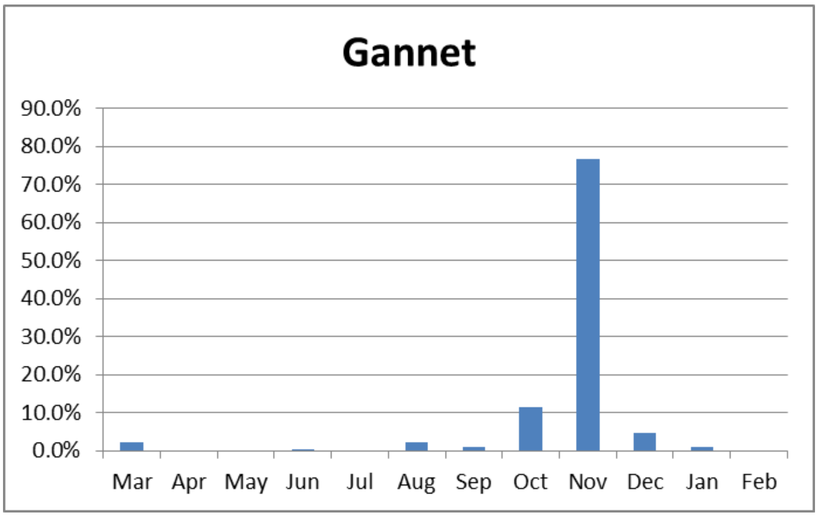


East Anglia FOUR

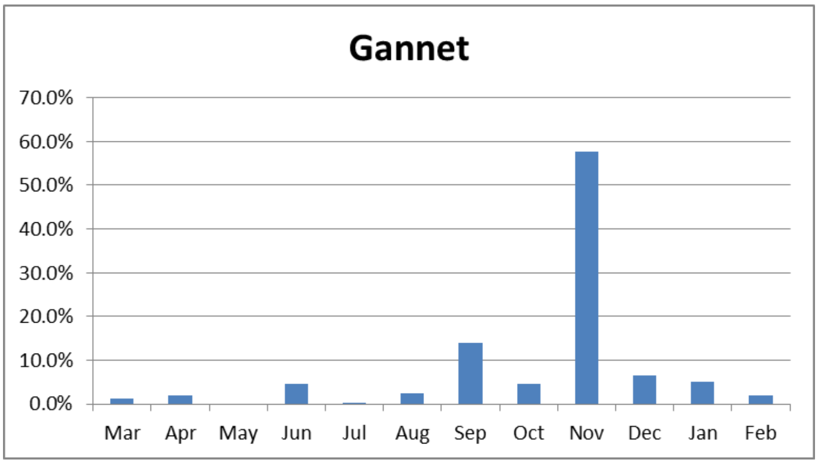


Gannet

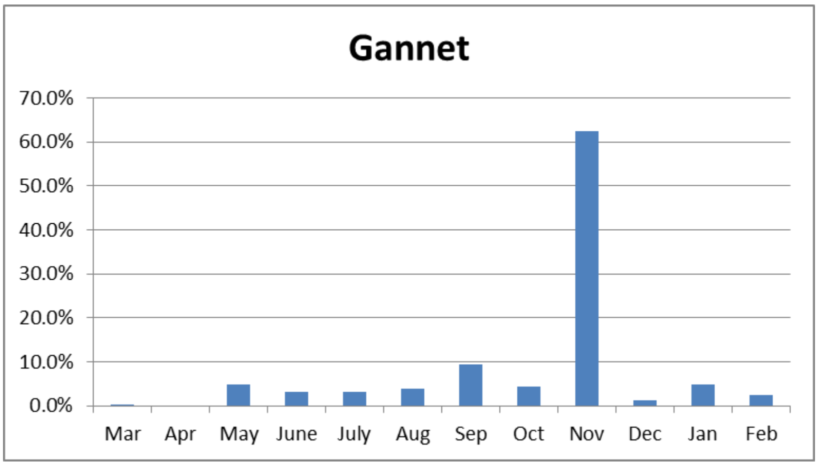
East Anglia ONE



East Anglia THREE

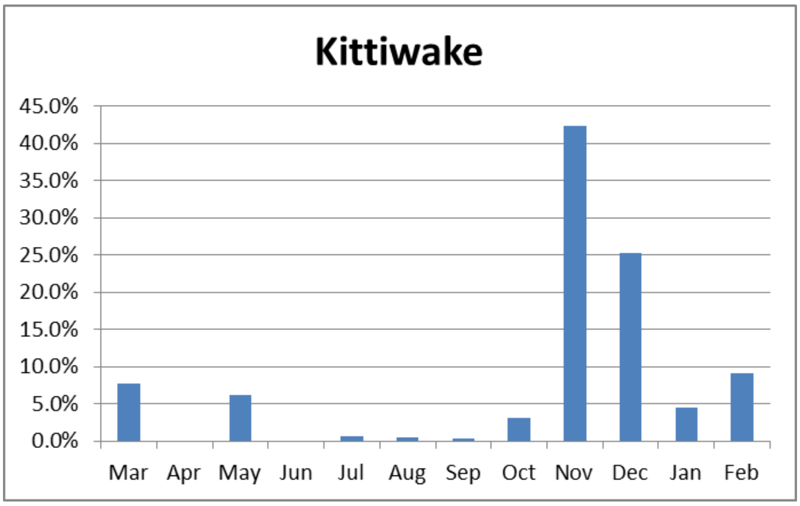


East Anglia FOUR

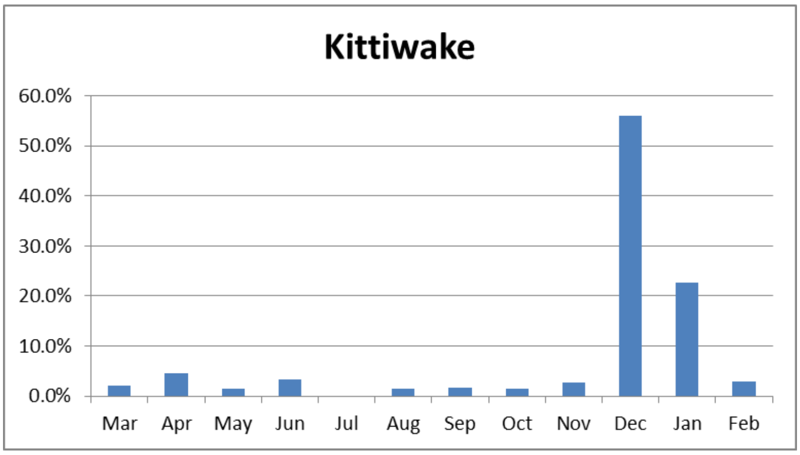


Kittiwake

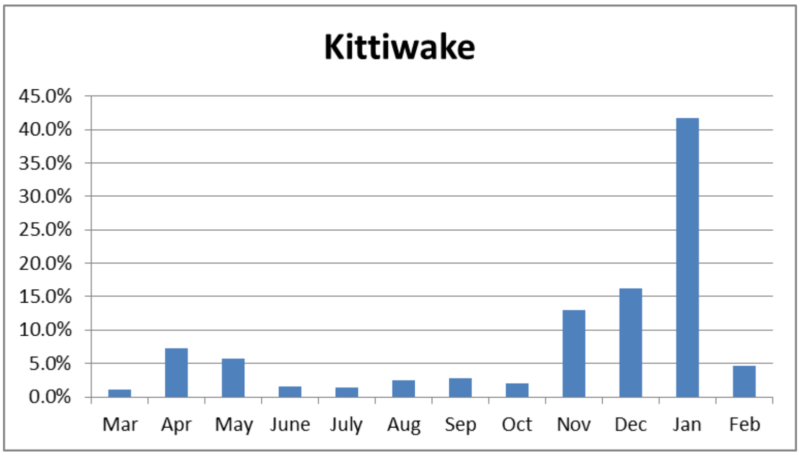
East Anglia ONE



East Anglia THREE

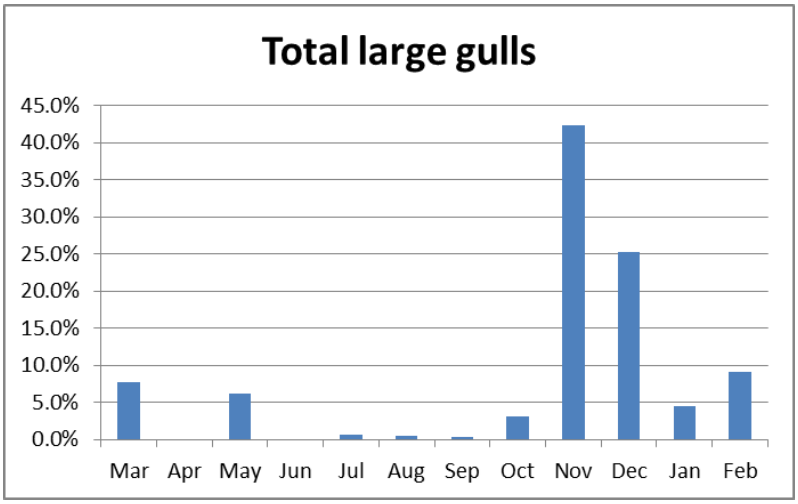


East Anglia FOUR

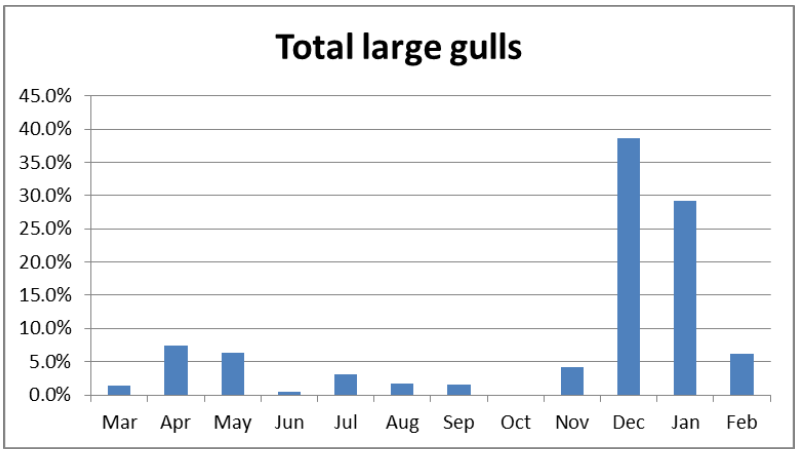


Total large gulls

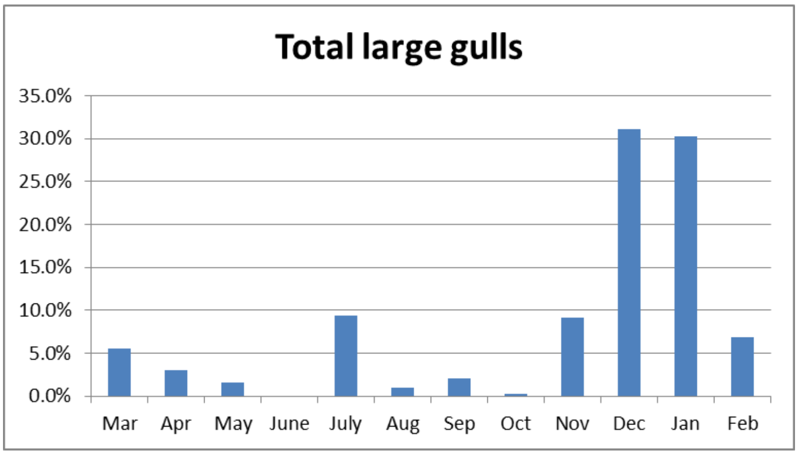
East Anglia ONE



East Anglia THREE

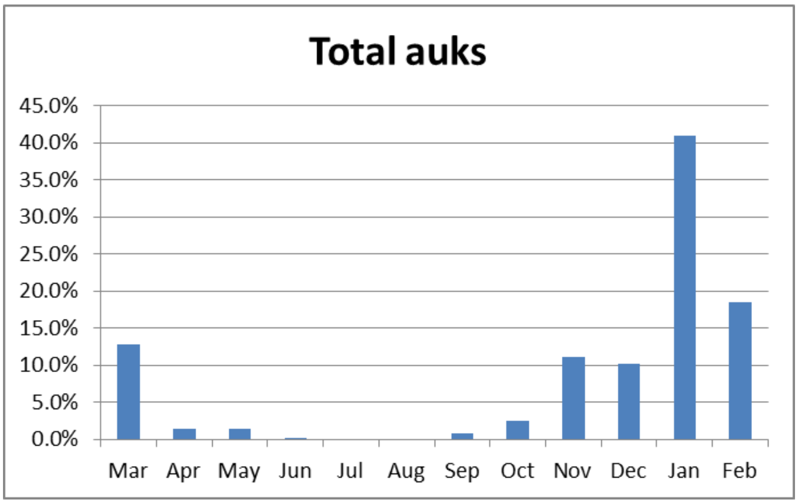


East Anglia FOUR

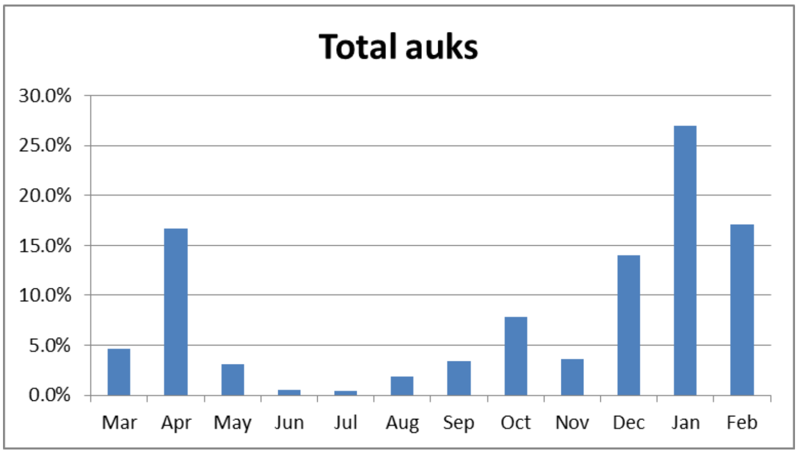


Total auks

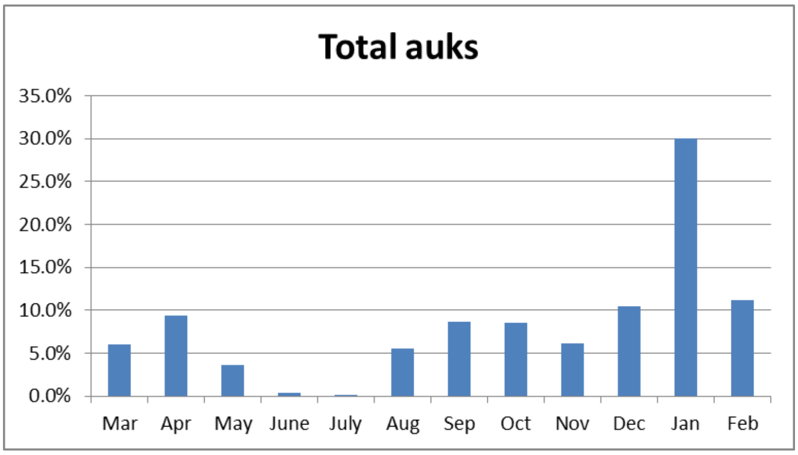
East Anglia ONE



East Anglia THREE



East Anglia FOUR



APPENDIX 3: METHOD OF ATTRIBUTION OF UNIDENTIFIED BIRDS

Appendix 3: Method for the Attribution of Unidentified Birds

There are occasions when it is not possible to identify a particular bird on the aerial survey image to the species level and the image is identified as belonging to a higher level group e.g. 'small gulls' or 'black-backed gulls'. To avoid producing what could be an underestimate of the population of a particular species, those birds that are unidentified to a group level go through a process of attribution to a specific species based on the relative abundance of identified species. The possible groups and the individual species that are included in the groups are listed in Table A3.1.

Table A3.1: Bird species that are included in the unidentified groups

<table>
<tr><th>Species</th><th>Unidentified Group 1</th><th>Unidentified Group 2</th></tr>
<tr><td>Red-throated diver
Black- throated diver
Great northern diver</td><td>Divers</td><td>Divers</td></tr>
<tr><td>Common gull
Black-headed gull
Kittiwake</td><td>Small gulls</td><td rowspan="3">Gulls</td></tr>
<tr><td>Lesser black-backed gull
Great black-backed gull</td><td>Black-backed gulls</td></tr>
<tr><td>Herring gull
Lesser black-backed gull
Great black-backed gull</td><td>Large gulls</td></tr>
<tr><td>Common tern
Arctic tern</td><td>'Commic' Tern</td><td>Terns</td></tr>
<tr><td>Guillemot
Razorbill</td><td>Guillemot / Razorbill</td><td>Auks</td></tr>
</table>

The number of unidentified birds in a group is proportioned to the specific species that are contained within that group based on the relative abundance of the positively identified species in that month's survey. For example, in the case of kittiwake, the count consists of:

> Positively identified kittiwake + proportion of unidentified small gulls + proportion of unidentified gulls

For common tern and Arctic tern no species specific identification is possible (size and plumage features are so close that it is impossible to separate them) and as a result there is no information on which to apportion these two species. They remain grouped in the data as 'commic' tern.

The ability to identify bird images to the species level has advanced considerably in recent years with advances in technology. The result is that for the surveys for East Anglia THREE the unidentified groups contained within the data set were:

- Unidentified divers
- Unidentified small gulls

- Unidentified black-backed gulls
- Unidentified large gulls
- ‘Commic’ tern
- Guillemot / razorbill

There were no images that were categorised as:

- Unidentified gulls
- Unidentified terns
- Unidentified auks

APPENDIX 4: POPULATION ESTIMATES AND DENSITIES FOR EAST ANGLIA THREE

This section has been updated and is presented in Technical Appendix 13.2.

APPENDIX 5: PERCENTAGE OF BIRDS FLYING AT POTENTIAL COLLISION HEIGHT

This section has been updated and is presented in Technical Appendix 13.2.

APPENDIX 6: SCREENING FOR MIGROPATH MODELLING OF MIGRANT BIRDS ASSOCIATED WITH UK SPAS

This section was updated and presented as Appendix 1 to Evidence Plan Meeting 4 of Technical Appendix 13.1.

APPENDIX 7: MIGROPATH OUTPUT – NUMBERS OF MIGRANTS PASSING THROUGH THE EAST ANGLIA THREE AREA

This section was updated and presented as Appendix 1 to Evidence Plan Meeting 4 of Technical Appendix 13.1.

APPENDIX 8: COLLISION RISK MODEL OUTPUTS FOR A RANGE OF MODEL OPTIONS AND AVOIDANCE RATES

This section has been updated and is presented in Technical Appendix 13.2.

APPENDIX 9: SUMMARY OF THE BRENT GOOSE SURVEY 2013-14

Appendix 9: Summary of the Brent Goose Survey 2013-14

This appendix provides a summary of the surveys carried out by the local WeBS count co-ordinator, Nick Mason, of brent goose occurrence around the lower part of the Deben Estuary in the winter 2013-14.

Method

The survey area was from Bawdsey to Ramsholt on the east side of Deben Estuary and the Falkenham and Corporation Marshes on the west side of Deben Estuary.

The survey programme was for visits spanning the period October 2013 to March 2014 (this summary is based on counts received to the end of February 2014).

Observations and mapped records were made of the presence, numbers and behaviour of any brent geese found within the survey area. A number of practices were implemented to ensure that the brent geese were not disturbed during the survey. At the start of an observation period an initial scan to locate the presence of brent geese was made at a distance, from the hill at Ramsholt (TM308415, 18m asl) and from the road at Bawdsey (TM345391). This allowed the Ramsholt Marshes, Falkenham Marshes and Corporation Marshes to be scanned for the presence of geese. If geese were present then the seawall was used to give a closer approach. Care was taken not to disturb the geese by staying off the wall at important points. This would mean crawling up on top of the seawall to observe and count. Observations were made with binoculars and telescope and recorded in a notebook.

A crop survey was undertaken early in the survey programme to determine whether brent geese were feeding on any particular crop.

Results

Overall brent goose distribution

Set out below is a description of the occurrence and distribution of brent geese over the survey period. The overall distribution from the programme of visits is totalled in Figure A9.1.

Brent geese arrived on the Deben Estuary in October 2013, numbers built up in November, with a maximum WeBS count of 1,588 on December15th.

No brent geese were observed on the Bawdsey, Alderton or Ramsholt Marshes, on the east of the river, until November 19th 2013. Approximately 120 were seen from the Bawdsey Road but had moved off by the time that closer observations were made form the seawall.

No brent geese were seen in the Corporation Marshes area, on the west of the river, throughout the whole reported survey period October 2013 to February 2014.

Brent geese regularly used the Felixstowe Marshes e.g. 123 on November 12th 2013 and 230 on December 3rd 2013. This is not part of the study area.

Observations of brent geese using the fields

In December 2013 brent geese were recorded on the fields on two occasions, 8 only on December 3rd and 235 on December 11th.

In January 2014 brent geese started using the fields more often, on Ramsholt Marshes in particular. The feeding area was quite a restricted area of three or four winter wheat fields. The highest number recorded was 950 on at least two occasions.

On February 11th 2014 215 brent geese flew from the mud edge on to Alderton Marshes where they fed on winter wheat for an hour and a half at least before recording ceased.

No Brent Geese were observed on the fields after February 11th.

Throughout the study period Brent Geese regularly used the mud at TM325388 for loafing and the mud or saltmarsh at (centred on) TM310400 for loafing and feeding.

Behavioural observation of brent geese

The behavioural observations made are presented in Table A9.1.

Also of note was that 2013 appeared to be a successful breeding season with a good number of young in the wintering population.

Table A9.1: Brent goose behavioural and other observations

Date	Survey	Observations
Oct 20th	WeBS	No birds in area. 125 Brent on river in total. 58 in section 1, but on mud and saltmarsh. (R Johnson). Brent on Ramsholt/Alderton Marshes once this autumn to date (Harbourmaster at Ramsholt).
Nov 12th	Crop	Crop survey. At 13:20hr 123 Brent flew from upriver, circled and then flew over to Felixstowe Marshes.
Nov 17th	WeBS	Total 931 Brent on river. 262 in section 1 centred on TM310400 where cable will go under river. Feeding on saltmarsh and loafing. (R Johnson) 370 Brent in section 8 on Kirton and Corporation Marshes at TM300410. Flares used by farmer in section 9 to scare Brent off seawall. (P Whittaker)
Nov 19th	Brent	Approx 120 Brent seen on Alderton Marshes as I approached Bawdsey. By time I had walked out along seawall they had all left. No birds on other side of river around Falkenham Creek. Winter wheat is still quite short. Brent appear to be feeding on mud and saltmarsh.
Dec 3rd	Brent	8 Brent flew upriver from Ramsholt Marshes. No other birds on east or west of river. Went down to Felixstowe Marshes where counted 230 Brent feeding on winter wheat.

Date	Survey	Observations
Dec 11th	Brent	10:25hr – 235 Brent on oil seed rape and winter wheat over two fields (centred at TM320396). Away from edge of field with bird scarer. 36 young Brent counted which is 15%, a good number from this sample. 10.55hr – 120 Brent flew over wall on to saltmarsh and water's edge where they fed and washed. 11:15hr – Brent returned to field (up to 235 again). 11:40hr – all Brent flew off, probably because of bird scarer, some to water's edge and c 150 over river towards Felixstowe Marshes. None returned before 12:00hr. Whilst feeding one in 10/11 birds had head up "on guard" at any one time. Constant low-level contact calls. Birds did not like bird scarer. Birds initially unsettled when I arrived but soon settled as I sat in grass on river wall.
Dec 15th	WeBS	Total 651 Brent in section 1. All on saltmarsh and water's edge until tide too high. Half feeding others washing and loafing (R Johnson).
Dec 27th	Brent	35 Brent on mud near Bawdsey – TM325389, loafing. 62 Brent on saltmarsh at Green Point – TM310397, feeding.
Jan 10th 2014	Brent	7 Brent on mud just north of Bawdsey at TM325389 at 11:30hr. 560 Brent on Ramsholt and Alderton Marshes at 12:00hr. By 14:30 they were all on Ramsholt Marshes at TM316405 feeding on wheat. At 12:00hr there were small groups (one of 15 and one of 12 birds and some singletons) scattered on fields on Alderton and Ramsholt Marshes. They gradually all moved up to the main feeding flock. All 560 still in flock when I left at 15:00hr.
Jan 15th	Brent	c.550 Brent feeding in same region (TM316405) seen from Ramsholt.
Jan 19th	WeBS	980 Brent feeding on fields at TM313397 (L Potter).
Jan 24th	Brent	Approached from Ramsholt end as Brent nearer. 12:15hr - 950 Brent TM313397 – TM315398. Tightly packed feeding flock in same place as recorded in WeBS count on 19th January. One in ten again with head up while others feeding. Continuous feeding with little alarm. At 14:30 the 1500+ Lapwing and 650+ Golden Plover nearby all went up. Couldn't see what caused it. All the Brent alerted. All birds settled. At 14:45 all the Lapwing and Golden Plovers went up again in mass alarm. Flew off. Again couldn't see what caused alarm (possibly a fox?). Brent started to follow until they all upped and went over the seawall onto the mud and water. Stayed over wall for 10 minutes and then started to come back in small groups of 20 or so. Not all came back. Birds from mud flew over river to the west. All remaining birds on fields followed.
Feb 3rd	Brent	Surveyed from Ramsholt. Approx. 475 Brent at TM315405. Feeding.
Feb 11th	Brent	565 Brent at TM325388 at 13:45hr. At 14:10 c.350 flew west over river towards Felixstowe Marshes. 215 flew on to Alderton Marshes at TM330397, where they fed until I left (15:40hr).
Feb 16th	WeBS	385 Brent Geese on saltmarsh at TM310400 at high tide.
Feb 19th	Brent	No Brent inside seawall as seen from Ramsholt or Bawdsey. C500 Brent at TM325388 loafing at water's edge. Seems to be a favourite spot recently (R Clarke pers comm.). Went round to Hemley to check Kirton Marshes at TM300410. Mostly unplanted. No Brent seen.

Observer related disturbance

Apart from one occasion when all the heads of the geese went up (showing some alarm) there was no discernible disturbance created by this survey.

Cropping in the survey area

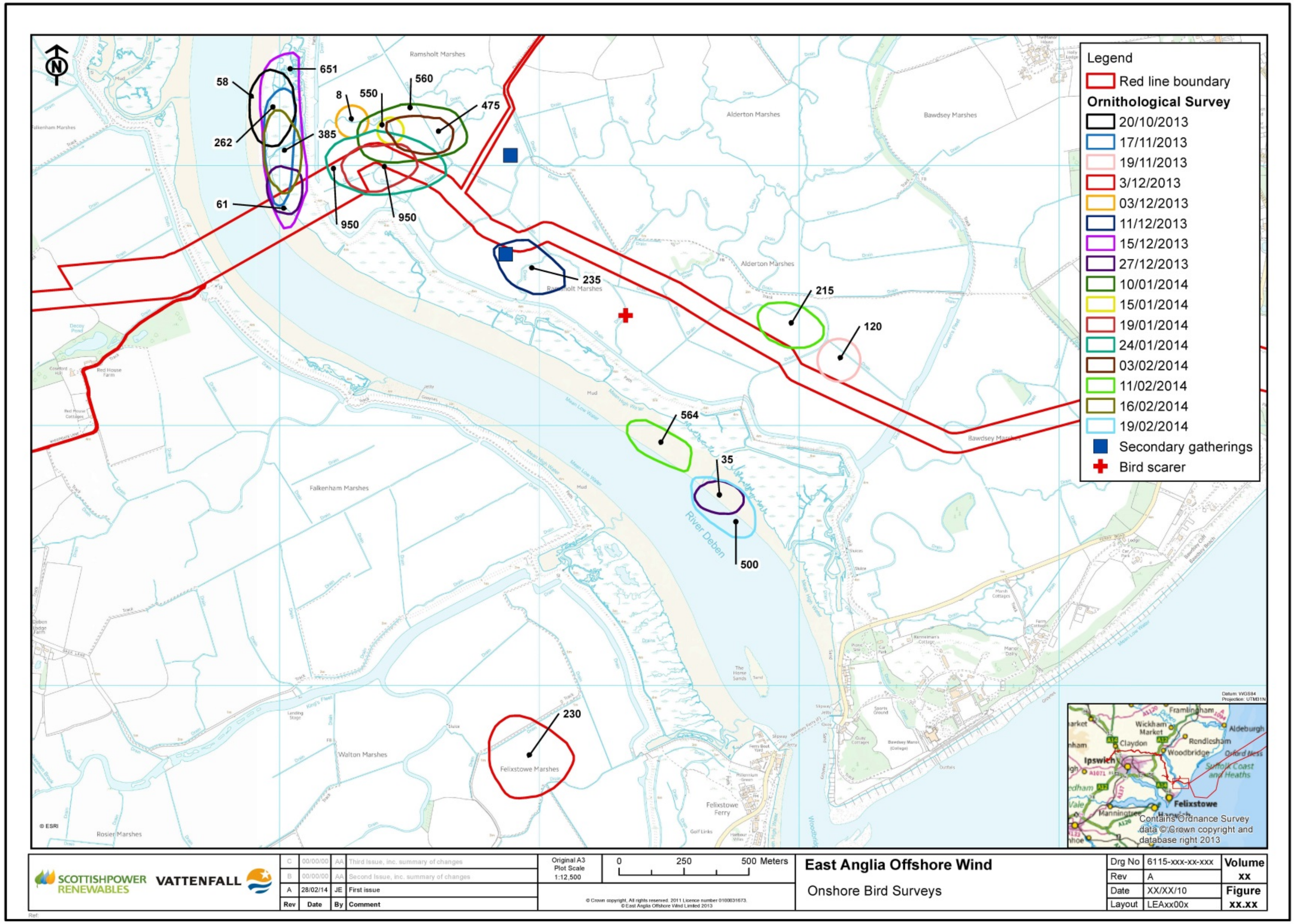
Only two crops were recorded between Bawdsey and Ramsholt – winter wheat and oil seed rape. One field was left untilled until December 2014.

On the Falkenham Marshes there was some winter wheat but most was untilled. Most of the Corporation Marshes was ploughed in December [crop information not yet supplied].

<u>Comparative information</u>

The numbers of brent geese recorded during these surveys can be compared with the total brent goose population as recorded by the WeBS surveys of the Deben Estuary in 2013-14. This information can be found in Appendix 10.

Figure A9.1: The Overall Distribution of Brent Geese across the Survey Area



APPENDIX 10: SUMMARY OF WATERBIRD NUMBERS FROM THE WEBS COUNTS 2013-14

Appendix 10: Summary of the Waterbird Numbers from the WeBS Counts 2013-14

This appendix provides a summary of the waterbird numbers recorded in the Deben Estuary in the winter 2013-14. The waterbird numbers have been provided by the local Wetland Bird Survey (WeBS) count co-ordinator, Nick Mason.

Method

The WeBS survey of the Deben Estuary is part of the national WeBS programme organised by the British trust for Ornithology (BTO). This includes the monthly 'core counts' over the period September to March. Those 'core counts' have a set method described in detail here http://www.bto.org/volunteer-surveys/webs/taking-part/core-counts-methods. In summary it involves counting all the waterbirds (divers, grebes, cormorants, herons, spoonbill, swans, geese, ducks, rails, cranes, waders and kingfisher with counts of gulls and terns being optional) in the whole of a predefined wetland area. For estuaries the counts are made at high tide. Large sites are divided into count sectors and a local organiser provides co-ordination of the volunteer counters to reduce the occurrence of counts occurring on different days within a site in order to reduce errors in the count.

This summary is based on numbers recorded in the 'core counts' for the months September 2013 to January 2014 received direct from Nick Mason and prior to validation and QA by the BTO.

The onshore cable route passes across and under the lower part of the Deben Estuary within count sectors 1 and 9 and accordingly this summary provides information in particular on those sectors. The species that are the named interest features of the Deben Estuary SPA, Ramsar site and SSSI are brent goose, shelduck, avocet, redshank and black-tailed godwit and accordingly this summary provides information in particular on those species.

Results

Waterbird assemblage

The monthly totals for the waterbird assemblage and for the sectors 1 and 9 of the Deben Estuary are presented in Table A10.1. The peak total for the waterbird assemblage occurred in December 2013. The peak total for Sector 1 occurred in December 2013 and for Sector 9 occurred in January 2014.

Table A10.1: Monthly totals for the waterbird assemblage

Month	Waterbird assemblage	Sector 1	Sector 9
September 2013	5,942	598	1,106
October 2013	7,722	983	727
November 2013	10,005	1,240	895
December 2013	17,123	5,323	1,138
January 2014	14,069	2,682	1,788

Brent goose

The monthly totals for brent goose in the Deben estuary and its count Sectors 1 and 9 are presented in Table A10.2. The peak total for brent goose in the Deben Estuary occurred in December 2013, in Sector 1 occurred in January 2014 and in Sector 9 occurred in December 2013.

Table A10.2: Monthly totals for brent goose

Month	Deben Estuary	Sector 1	Sector 9
September 2013	33	1	0
October 2013	125	58	1
November 2013	931	262	42
December 2013	1,588	651	531
January 2014	984	980	1

Shelduck

The monthly totals for shelduck in the Deben estuary and its count Sectors 1 and 9 are presented in Table A10.3. The peak total for shelduck in the Deben Estuary occurred in January 2014, in Sector 1 occurred in January 2014 and in Sector 9 occurred in October 2013.

Table A10.3: Monthly totals for shelduck

Month	Deben Estuary	Sector 1	Sector 9
September 2013	26	0	0
October 2013	82	5	3
November 2013	225	2	1
December 2013	329	52	0
January 2014	370	57	0

Avocet

The monthly totals for avocet in the Deben estuary and its count Sectors 1 and 9 are presented in Table A10.4. The peak total for avocet in the Deben Estuary occurred in November 2013, in Sector 1 occurred in December 2013 and in Sector 9 occurred in November 2013.

Table A10.4: Monthly totals for avocet

Month	Deben Estuary	Sector 1	Sector 9
September 2013	71	1	64
October 2013	135	135	0
November 2013	328	90	110
December 2013	242	208	1
January 2014	168	168	0

Redshank

The monthly totals for redshank in the Deben estuary and its count Sectors 1 and 9 are presented in Table A10.5. The peak total for redshank in the Deben Estuary occurred in December 2013, in Sector 1 occurred in September 2013 and in Sector 9 occurred in November 2013.

Table A10.5: Monthly totals for redshank

Month	Deben Estuary	Sector 1	Sector 9
September 2013	1,221	110	37
October 2013	814	13	44
November 2013	1,358	34	246
December 2013	1,538	28	88
January 2014	797	43	148

Black-tailed godwit

The monthly totals for black-tailed godwit in the Deben estuary and its count Sectors 1 and 9 are presented in Table A10.6. The peak total for black-tailed godwit in the Deben Estuary occurred in September 2013, in Sector 1 occurred in October 2013 and in Sector 9 occurred in October 2013.

Table A10.6: Monthly totals for black-tailed godwit

Month	Deben Estuary	Sector 1	Sector 9
September 2013	311	3	2
October 2013	196	6	23
November 2013	231	0	7
December 2013	213	1	0
January 2014	226	0	0

13.1.7 Minutes of Ornithology ETG 3 Meeting

9. Provided below are the minutes of the third Ornithology ETG meeting

Please note – these minutes were reviewed by Natural England and RSPB and their comments have been incorporated. Due to a change in the project programme the final minutes were not circulated, however outstanding aspects were discussed in subsequent Evidence Plan Meetings.

East Anglia Offshore Wind Limited East Anglia THREE/FOUR

East Anglia THREE & FOUR, Ornithology ETG Meeting 3 – 28/3/14

Attendees		
Name	**Initials**	**Organisation**
Keith Morrison	KM	EAOW
Mandy Gloyer	MG	EAOW
Marcus Cross	MC	EAOW
Kathy Wood	KW	EAOW
Richard Caldow	RCa	Natural England
Tim Frayling	TF	Natural England
Claire Ludgate	CL	Natural England
Richard Saunders	RS	Natural England
Francesca Shapland	FS	Natural England
Alex Cooper	AC	RSPB
Benedict Gove	BG	RSPB
Sue Hooton	SH	Suffolk County Council
Roger Buisson	RB	APEM
Sean Sweeney	SS	APEM
Paolo Pizzolla	PP	Royal HaskoningDHV
Apologies	Michael Wilks, SCC	

AGENDA		
Item	**Description**	**Action**
1	Health and Safety – KM Introductions - All	n/a
2	Review of previous minutes / actions Goose refuge areas KM - complex, difficult to tie-in to DCO, in principle agreement with EAOW engineers to accept a condition on the types of work to be carried out in the winter RS – Has had discussions internally on potential mechanisms for securing mitigation. NE legal would be happy to advise JNCC role	ACTION - RS – will pass on details of legal contact

	RCa - NE & JNCC have met to formally hand-over of involvement in projects. Comparison of seabird numbers across EA1, 3, 4 RB – circulated comparative figures across EA1, 3, 4 as part of appendices for this mtg. APEM flight height methodology RB – (discussion outwith EP process) – APEM to have workshop with NE to explain methodology to derive flight heights from aerial survey photographs. RSPB would be interested in such a workshop. Assessment definitions RB – any updates to the impact assessment definitions (i.e. sensitivity and magnitude) will be included within PEIR DECC Coping strategy Large strategic issues, on-going discussions to resolve key issues (migration, cumulative) MC has put forward project to ORJIP for cumulative migration work (extension of MSS project methodology)- TBC DECC Bempton cliff gannet data Mark Rehfisch (APEM) chasing agreement on how these data can be used Transboundary RB – first stage (biogeographic range) within HRA screening document (i.e. designated sites included) EP Steering Group MG on-going discussion – 4 points from last time	ACTION – SS taking forward ACTION MC to take forward ACTION - APEM chasing [Note subsequent to meeting – APEM & RSPB have signed data access agreement] MG – setting up meeting, likely to be late April/early May
3	Project updates KM – project update. EA3 on target programme (PEI, DCO). Key change is that EA3 has moved to 7 – 12MW wind turbines. This means reduced number of turbines overall RB – 7 – 12MW wind turbine parameters embedded in the results contained in the papers from this meeting, particularly relevant to collision risk. KM –EAOW looking at the programme for EA4 for PEI, DCO application. KM will inform all parties of any programme changes to ensure early warning and enable stakeholders to plan resourcing. RCa – will we have further opportunities between PEI & DCO submission to meet and review the assessment? RCa concerned that there is a need for	ACTION – KM to communicate any project programme changes.

	further discussion to agree as much as possible prior to DCO submission RCa – key point is to capture the issues which will need further explanation/presentation of options and alternatives PP/KM – intention is to continue these discussions and hold series of workshops CL – please let us know schedule for projects Going forward, NE can plan resourcing.	ACTION – PP/KM set up series of meetings (workshops), within/post-PEI and set out the timeline for any 'cut-offs'. ACTION – record those elements which will need to be dealt with post-PEI
4	Onshore <u>Data update in OETG3 paper section 3.2 and Appendices 9 & 10</u> RB – Appendices 9 & 10 summarise the data. Brent goose surveys summarised in the figure (Oct '13 – Feb '14), use of site intertidal and on fields. The mapping shows that the birds are clearly using the fields all around the cable crossing point. RS – would like to see the presented 13/14 map combined with previous data to show all years RB/PP – may be more effective to re-circulate summary map from previous surveys as combining all data from two winter surveys on one map will be difficult to interpret. RB – WeBS results. See appendix 10. No comparison with previous years as full winter data set unavailable at time of writing. Initial results suggest that no change in position from EA ONE – therefore will propose similar mitigation to EA ONE management measures KM – having discussed options with EAOW engineers, they are prepared to accept a timing restriction on works within the winter period. This would be avoidance of impact on the geese and simpler to undertake than 3rd party agreements on a refuge area to deliver mitigation. MC – if EAOW accepts a winter restriction at the Deben then no need to undertake further analysis of geese data or look further into potential mitigation, if EAOW requires flexibility then further analysis required KM – there is a need to clarify exactly what actions would be included in any timing restriction (i.e. 'works' likely to include HDD operations, but not traffic	ACTION – RB - reproduce and circulate the two summary goose maps (incl. all flocks) ACTION – KM to clarify the final scenarios for onshore works at the crossing. ACTION – RS to provide contact for NE legal for EAOW to follow up.

	movements) MC – proposed site visit to discuss the issue and potential mitigation. AC/SH/RS – welcomed opportunity RS – NE would like assurances that there will be enough time to discuss mitigation if need be? MC/PP – as part of the post-PEI meetings we need to discuss potential DCO conditions (this will include management and mitigation) as draft-DCO will be included in EA3 DCO application in November RS – concerned about where non-SPA birds, i.e. schedule 1 birds are captured RB – schedule 1 birds are part of this Technical Group's work. Surveys for schedule 1 birds was discussed in OETG meeting 1, there is to be no new survey for EA3, use of existing data from EA ONE and note that EA ONE consent would require pre-construction surveys. RS – concern over the potential 6 year construction over multiple winters. NE concerns over this repeated activity. Few unresolved issues with the non-SPA spp cumulatively. RB – can wrap these discussions into proposed site visit and discussion of habitat management. To be continued in post-PEI mitigation and management discussions <u>OETG3 paper section 4</u> RB – previously agreed impacts that will be assessed, no update <u>OETG3 paper section 6</u> RB - HRA Screening Report provided by EAOW as a separate paper to OETG Mtg paper. PP - provided clarification on previous NE comments on screening for the Deben. The discussion at the onshore ecology group now superceded by the statements within the OETG3 paper. EAOW intended only to state that SPA supporting features (i.e. habitats) would not be affected by the project as HDD avoids direct impact on the habitats within the SPA, geese using fields outwith SPA will be assessed. RS – content with this clarification All – discussion on screening out of the Alde-Ore Estuaries SPA. It was decided that the screening document would be amended to screen in the Alde-Ore and then screen out at the next stage. This was a	ACTION - EAOW – to propose dates for site visit ACTION – PP to circulate email stating that the OETG3 text supersedes that from the ecology paper. ACTION – APEM - For

	process issue. It was agreed that effect (i.e. noise disturbance) unlikely to be an issue due to distance, this was the case presented for EA ONE RCa – screening out of south coast SPAs used by brent geese – flight lines. It is likely that some of those flight lines would be across EA3 & 4 and as a result those sites should stay screened in.	completeness further detail should be included on the distance of SPA from landfall works and likely noise Action – APEM – South coast sites to stay screened in at this high level stage
5	Relationship between NE and WWT RCa – WWT to provide support to NE, but no clear definition as yet as to what this will involve. It is reasonable that WWT would not revisit any issues previously agreed by at these meetings. It is likely that if WWT attend these meetings NE would attend also.	
6	Offshore RB – Appendices 1 & 2. These figures were produced at request of NE as a high level indicator of key differences between assemblages across the three projects (EA ONE, THREE and FOUR). Appendix 1 – nearshore to offshore. Greater number auks and fulmars. Appendix 2- seasonal differences – EA1 peak earlier (autumn migration, kittiwake and large gulls) EA3&4 winter peak (gulls and auks). Gannet – peak is consistent in November. Kittiwake mid-winter peak for EA3&4 AC – what species at risk? RB – gannet, small and large gulls in flight, collision risk is main issue. The seasonal information informs the HRA in terms of life-stage and therefore the reference population for that assessment – results suggest focus should be away from breeding birds to non-breeding and passage seabirds. RCa – what is the feeling on absolute numbers SS – apart from fulmar and gannet outside foraging range RB – we are not looking at high risk to breeding birds – impacts on non-breeding/migratory birds RCa – figures suggest apportionment will be different from EA1 SS – update on baseline. EA4 aerial survey completed. Data to be QA'd MC – No surveys missed so validation of the survey strategy SS – APEM commissioned to undertake red-throated diver (RTD) survey for NE for the Outer Thames Estuary SPA. NE agreed to allow use of the density	

	data to update cable route assessments for EA THREE, but to not reference the SPA abundance as a whole, as paper concerning this is pending publication. From a preliminary look at the data it is likely that the impact from EA THREE cabling activities would be less than that assessed for EA ONE (as data suggest densities in that area relatively lower than previously thought). RCa – provided some suggestions for data assessment for cable route impacts (27/3/14)	ACTION – APEM to update the cable route assessment based on new data and suggestions received from RCa (27/3/14)
	SS – went through Appendix 3 and explained the process for attribution of unidentified birds. Unidentified birds in groups are apportioned by % of the identified species on month by month basis RCa/BG – this seems reasonable.	
	RCa – provided suggestions on the use of correction factors for diving birds. There were several options for this methodology discussed for EA ONE; the method for EA THREE should follow final EA ONE advice.	ACTION – All to check on which method used and final advice. The correction factor for PEI will be completed as EA ONE was, which may be subject to change dependent for the Final ES.
	SS – Bioperiods were given in the last paper, these will be updated slightly for PEI to reflect the passage movements in spring and autumn that overlapped the previously agreed 'wintering' and 'breeding' seasons. RCa – MacArthur Green currently undertaking a project including some work on bio-periods. SS – noted that it is too late to incorporate into PEI assessment, but if useful could be used for final ES.	ACTION – RCa to chase up this project and provide – see if any differences
	RB – explained worked example, bio-periods and apportionment SS – this approach has now been used for EA THREE PEI assessment, but this not yet supplied for this meeting as not available in time. RCa –there needs to be a clear audit trail in the PEI/ES to link any apportionment through the various assessment so it is easy to follow and transparent.	AGREE – NE agree in principle with approach. Prefer this to assumption that no birds are local. Need to clearly show the link between figures and assumptions used.
	All – there was a discussion on further refinements of assessments to reflect breeding period behaviour (i.e. only 1 of a given pair at sea foraging at any given time).	ACTION – it was agreed that further refinement may be required dependent upon the significance of the impact. If not significant little value in further iteration. Assessment should be kept as simple as possible
	Collision Risk Modelling – SS – talked through Appendix 5 flight heights BG – highlighted difference between table 2.1 max tip height (178m) and assessed in CRM (176m)	ACTION – APEM check figures
	BG – noted discrepancy when he tried to work through	

	gannet numbers RB – may be version control, will check. BTO warned not to use old versions of the SoSS 02 report RCa –Need to ensure it is clear which figures (Johnson or Cook) are used for generic flight heights. • In addition, where site specific flight heights are used there needs to be some narrative on why there are differences. • It would be useful to present consistency of flight height across 24 months. Important in use of the extended model – need to demonstrate consistent pattern. • Error bars, it would be good to look at variation in data – BTO looking at sensitivity of avoidance rates for MS All – it was agreed to revert to generic flight heights in those cases where there are <100 data points. RCa had no preference on whether Cook or Johnson used RCa – suggested data could be presented in matrices (i.e. of flight heights and avoidance rate) to show sensitivities of assessment to values selected. This allows transparency. RB – we are providing the different options, question is how to distil this and follow through the logic – and for how many spp. SS – Appendix 8 - annual and monthly CRM tables. It is currently the intention to use Band 3 at 98%, but all values and model outputs will be presented in a separate CRM appendices. Some numbers may be adjusted for apportionment during passage periods, but this will not be completed in the PEI. BG – there is a high degree of uncertainty around Band 3 option. RSPB do not believe avoidance rates used for Band 1 & 2 appropriate for use in Band 3. This will be position until there is more evidence. RCa – NE & JNCC in same position, i.e that until such time as the MSS Avoidance Rate Project reports, NE (JNCC) will continue to advise the presentation of collision risk impact assessment against both the 'basic' and 'extended' Band model options and against a range of ARs. Draft report comments gone back to MSS. KW – EAOW/APEM undertaking some studies with empirical data for key spp for band models RCa – what about Band 4? RB – There is a data issue, few spp. with enough data to justify Band 4 use. If any spp would be gannet and kittiwake for which we have a sufficient data set.	ACTION – ensure consistent use of SoSS software ACTION – APEM to look presentation of flight height data to ensure consistency and transparency

	RCa – gannet, kittiwake, GBBG, LBBG are the issues – 3 out of 4 spp EIA issues for Rampion, and EA1 RB – for in-combination assessment will need to look to see if any updated CRM information has been published alongside the consent given for Beatrice and Moray OWFs. Update on migration (Appendix 6 and Appendix 7) SS – Appendix 6 Migropath Screening Matrix – flight path/partial flight path, flight height info (Cook et al), pooled all EAOW data. Screened out those species which EA1 had no issues for. RCa – could we provide confidence limits? SS – APEM are able to provide confidence limits and that will form part of the Migropath report, which will be an appendix within the ES, but not likely to form part of the PEI appendices. BG – no comment on the tables SS – provided clarifications of questions from RCa feedback, shelduck (EA1 screen out) whooper swan, light-bellied brent goose not known geographically in area, whimbrel – not appropriate for Migropath. BG – agree that Migropath inappropriate for birds such as terns and skuas RB – will have to look at broad front migration model, for 2 terns and 2 skuas through broad front models. SS – The broad front will not be completed in a complex modelling manner. The best way to compelte this is to simulate passage as a broad front to test if any concerns warrant more complex modelling or thought. MC – proposed ORJIP project would look at cumulative case as suggested by RCa SS – displacement – method would be similar to EA ONE –matrices with range of buffers, EA3 razorbills and guillemots. Hornsea followed a different approach to what EA THREE are proposing, but that is geographically relevant to them as they are closer to breeding locations and within foraging range. For our assessment will use those data now available for Dogger and Hornsea at face value (i.e. will not recalculate other project values) RCa – not clear on Hornsea matrix, some tweaks. RCa – cumulative assessment. How do you work out % mortality for any given biological season? SS – add up wintering period numbers, will assess at 1% level mortality, which has been presented in other OWF applications.	ACTION – APEM - provide confidence limits ACTION – follow up on this – NE and APEM to review Dogger and Hornsea submissions and discussions on displacement.

	MC – need to agree the methodologies, and deal with significances later. Present in a matrix. RCa – running the backwards model – have we reached 1% background mortality yet? Could apply to displacement as well. If this number is outside the values presented anywhere in the cumulative matrix then we know this is not a problem BG – this would be a reasonable approach All – discussion on position of inclusion of operational sites within the baseline for cumulative assessment. It was agreed that whilst clarity is needed on the NE position, this is unlikely to affect the assessment outcome (as key potential cumulative impacts from future projects).	
5	HRA Screening RB – wildfowl, wader etc all screened in awaiting further work RCa – max foraging range, during breeding season may prefer to use mean max to cut out west coast sites. RB – 5 south coast sites are screened out – these sites were added in for EA1 for brent geese RCa – interested in knowing what is the impact at the individual SPA level as there may be disproportionate effect on some sites that is not shown up by the current modelling at the national level.	ACTION – put these back in and then rule out with the migropath ACTION – APEM consider how migropath works and whether modelling individual SPA population through site is useful and report to NE.
6	SOCG Agree that the process of the high level screening is OK Agree to re-insert those 6 sites screened out Agree it may be useful to compile a list of running issues for resolution post-PEI to include in the PEIR	ACTION – minutes plus papers
7	Issues to be carried up to steering group Steering group meeting TBC – likely end April/early May	
8	Horizon scan Avoidance evidence – EAOW/APEM project MacArthur Green – bioperiods MSS – Avoidance rate CEH – displacement modelling auks Forewind/SmartWind – Avoidance rate work – track progress/acceptance through Hornsea/Dogger	

	examinations Liz Masden – CRM SNH – Alex Robbins – diving parameters Joris Everaert – micro-avoidance in Belgium [Post meeting note, the statutory agencies are seeking budget for two projects: Investigation of the comparability of flight height data collected from boat-based versus digital aerial survey data A 'ground-truthing' exercise to complement the flight height comparability project - will seek to identify the degree of accuracy and/or any biases associated with boat-based observer methods.	

ID	Issue on which EAOW THREE and FOUR seek agreement on	NE Position	RSPB Position
	OETG3		
	See agenda item 6 that states: **Agree that the process of the high level screening is OK** **Agree to re-insert those 6 sites screened out** **Agree it may be useful to compile a list of running issues for resolution post-PEI to include in the PEIR**		*Was the approach adopted to a high level HRA for EA3/4 consistent with that adopted for EA1?* *We assume list of running issues will be the most contentious ones i.e. in-combination/transboundary impacts which have not been agreed yet?*
	OETG2		
1	**From OETG2 Paper** **Para 30**. Agreement, based on the information supplied at OETG Mtg 1, is sought on: • Sufficient offshore and onshore baseline survey data has been collected to inform the assessment. • No additional survey required for the offshore or onshore cable route (the additional targeted brent goose surveys are not related to baseline information gathering). • Existing onshore data will be augmented with new WeBS data recorded at greater spatial detail and an additional brent goose survey. • Natural England to supply (if it can be made available) its	Agree Agree – with exception of additional brent goose work Agree TBC	*Agree that 18 months of continuous survey data are sufficient.* *Agree that sufficient baseline information already exists* *Agree that this approach is acceptable* *Support the use of NE RTD data within assessment*

	Outer Thames Estuary RTD survey data to augment the existing offshore cable route data (**Note for inclusion in PEI these data must be supplied by January 2014**)		
	Para 31. Agreement, based on the updated information supplied at OETG Mtg 2, is sought on: • Biological periods – agreed in principle subject to working up the figures	Need for nuanced approach agreed in principle.	*We are satisfied in principle with the revised Biological periods table supplied for OETG Mtg 2*
2	**Section 4** Agreement of the impacts to be assessed as listed in Section 4.1 (offshore) and 4.2 (onshore)	Agreed	*We support the change to the impacts in Section 4.1 suggested by NE. The operational impacts will also need to include in-combination/ cumulative impacts.*
3	**Data** Mean peaks shall be used unless there is great disparity between years, in which case contextual data will be consulted for justification of numbers used	Agree in principle but note requirement to present each year's monthly peaks separately (in appendix?) to enable any large discrepancies between years to be identified	*This approach is acceptable.*
4	**Data** Flight height methodology Agree that the methodology for determining flight height from aerial imagery is a general matter outside of the EP process, NE and APEM to discuss outwith EP meetings	Agree	*We would like to be consulted on any methodology for flight height agreed between NE and APEM.*
5	**Assessment methodologies – terminology** EAOW will look again at magnitude definitions, but this is not critical to agreement All accept that 'very high' category for sensitivity/magnitude adds little to assessment and this will not be used	Agree to need for further consideration of wording to define categories of magnitude. Agree	*We consider revised magnitude definitions are a major improvement. However, they still require some refinement in line with comments of NE and RSPB at OETG Mt 2.*
	OETG1	*Note that NE did not provide*	*Responses provided – 9/11/13*

		responses to the minutes prior to OETG2, these responses were added in OETG2	*The RSPB's position is made in relation to the information available to us at this time. However, we reserve the right to alter our position to East Anglia 3 & 4 should new information (i.e research and data) become available which significantly alters the situation.*
1	**ONSHORE**		
	Data		
	Sufficient baseline survey data have been collected to inform the assessment	Happy with approach in document, that is when these 5 onshore elements are taken together	No the RSPB considers that further survey work will be required in regard to Brent Geese.
	No additional survey required for the cable route	Happy with approach in document, that is when these 5 onshore elements are taken together	The RSPB supports NE's position on this issue.
	Existing baseline data will be augmented with new WeBS data	Happy with approach in document, that is when these 5 onshore elements are taken together	The RSPB supports the use of the latest WeBS data to augment the baseline data.
	If possible new WeBS data to include greater detail on location of birds within the large WeBS count sectors	Happy with approach in document, that is when these 5 onshore elements are taken together	The RSPB agrees in principle that a more detailed understanding of the location of birds on the Deben is essential. However, we will need to see the details of what has been agreed with the BTO before we can make any further comments. *
	EAOW to undertake additional brent goose survey (winter 2013/2014)	Happy with approach in document, that is when these 5 onshore elements are taken together	The RSPB supports the additional Brent Goose survey being undertaken during the winter of 2013/14.
	Species		
	Likely species for assessment listed in App 7 & 8	OK	The RSPB agrees with NE's advice on this

			issue.
	Species to be selected for assessment on basis that are listed features of Deben Estuary SPA and SSSI or are Schedule 1 breeding species	OK	The RSPB supports this approach
	Assessment will include both listed features and relevant assemblage species	OK	The RSPB supports this approach
	Impacts		

	The following impacts will be assessed
	• Construction
	    • Disturbance / Displacement
	• Operation
	    • High-level assessment
	• Decommissioning
	    • Disturbance / Displacement
		OK	The RSPB agrees that the impacts proposed for assessment are appropriate.

2	**OFFSHORE**		
	Data		
	Sufficient baseline survey data have been collected to inform the assessment (24 months of aerial for each site)	OK	The RSPB agrees that 24 months of aerial surveys will provide sufficient baseline data, provided that the data set is continuous and there are no gaps.
	No additional survey required for the cable route	OK	The RSPB supports NE's position on this issue
	NE's Outer Thames Estuary RTD survey data will be used if it can be made available	RC happy in principle	The RSPB supports the use of the Red Throated Diver survey data
	EA ONE and Zone data will be used as contextual information where relevant	OK	The RSPB agrees that using EA1 and zone data as contextual information could be useful.
	Data analysis		
	Population estimates will be design based but more sophisticated modelling will be applied if the data warrants it	OK	The RSPB supports this approach

	and the modelling approach is acceptable		
	Flight parameters [awaits information on how flight height method has been validated]	Not part of EP process (APEM and NE, RSPB to deal with)	The RSPB supports NE's position on this issue.
	Species		
	Species specific bio-periods [awaits feedback from NE to create new bio-period table]	For OETG2	The RSPB supports NE's advice on the bio-period table
	If a species falls under any one of these criteria it will be taken forward in the assessment: 1) population of regional importance or greater. 2) adult seabirds within maximum foraging distance of SPA or SSSI with that species as interest feature 3) migration modelling shows connectivity and numbers occurring are significant (irrespective of collision risk).	*The proposal will not screen out spp prior to migration modelling, model run using BTO/SoSS and screen on that list* *Assumption <1% of regional population = not significant, based upon the BTO approach to definition of migrant populations (waders/waterfowl), still need to define for seabirds – modified migration method approach (awaiting the Scottish methods)* ***Action for NE (RC) to look at SNH project and feedback as to whether appropriate***	The RSPB agrees in principle that the criteria being used are appropriate, However, we would like clarification about point 3, in particular how 'significant' is being defined.
	Impacts		

	The following impacts will be assessed
	• Construction
	    • Disturbance / Displacement
	    • Indirect through prey species
	• Operation
	    • Disturbance / Displacement
	    • Indirect through prey species
	    • Collision risk
		OK	The RSPB seeks clarification about whether the assessment will include cumulative, in-combination and transboundary impacts. Once this has been clarified then we will be able to provide our position.

	• Barrier effect • Decommissioning • Disturbance / Displacement • Indirect through prey species		

13.1.8 Ornithology ETG Meeting 4 Background Paper

10. Provided below is the background paper that was circulated prior to the forth Ornithology ETG meeting

East Anglia Offshore Wind

VATTENFALL

SCOTTISHPOWER RENEWABLES

East Anglia THREE

Ornithology

Evidence Plan

Expert Topic Group Meeting 4

2nd July 2014

Document Reference – 512608/670-OETG-4

Author – APEM & Royal HaskoningDHV
East Anglia Offshore Wind Limited
Date – June 2014
Revision History –Final for Meeting 4

Table of Contents

1 INTRODUCTION

1.1 Purpose of this Document

1. The purpose of this document is to provide technical information to support the discussions to be held at the fourth ornithology expert topic group (OETG) meeting to be held on 2nd July 2014.

2. The fourth OETG meeting is being held on the same day as the Preliminary Environmental Information Report (PEIR) workshop. The intention is that wherever possible there is clarity over which issues fall to which part of the discussions on the day. There is a separate agenda for the PEIR workshop and the OETG meeting and separate minutes of each will be prepared. The guiding principle for the separation is that the OETG meeting will predominantly be looking forward to consider what additional analysis and evidence is being prepared to support the final submission for the proposed East Anglia THREE windfarm and to support the assessment of the impacts of the proposed East Anglia FOUR windfarm.

3. This document contains information that updates that presented at the first three Ornithology Expert Technical Group meetings (OETG Mtg 1, 2 and 3) held in September and November 2013 and March 2014. It provides more detailed information on a series of topics related to offshore and onshore ornithology and assessment processes. In some cases an outline approach is described in this paper in recognition that the detail and discussion on it will take place at a future meeting.

4. The record of the discussions at the previous three OETG meetings and the schedule of topic areas on which agreement is sought, with the current position of Natural England and RSPB, are contained within the respective minutes of those meetings.

1.2 Structure of this Document

5. In accordance with the way in which parts of the agendas for the OETG meetings are organised, this document provides separate sub-sections for offshore receptors (from low water mark out to the wind turbines) and onshore receptors (from low water mark at Bawdsey and within the Deben Estuary estuarine closing line to terrestrial along the onshore cable route).

2 PROGRESS WITH EVIDENCE PLAN DOCUMENTS SINCE OETG MTG 3

2.1 Project Timetable

6. The indicative project timeline has changed with a rescheduling of the programme for East Anglia FOUR. That timeline places the DCO application for East Anglia FOUR in 2015.

7. One consequence of the rescheduling of East Anglia FOUR is that it has been decided that this OETG meeting in July 2014 and the subsequent two meetings proposed in August and September 2014 will focus solely on evidence and information issues relating to East Anglia THREE.

8. The project timeline for East Anglia THREE is presented in Table 2.1.

Table 2.1: Project Timeline for East Anglia THREE

Date	Event
August 2013	Final East Anglia THREE site specific surveys
30th September 2013	Ornithology ETG meeting 1
11th November 2013	Ornithology ETG meeting 2
March 2014	Draft High Level HRA Screening Report for East Anglia THREE
28th March 2014	Ornithology ETG meeting 3
27th May 2014	Start of consultation period for East Anglia THREE PEI High Level HRA Screening Report for East Anglia THREE provided alongside PEI
2nd July 2014	PEIR Workshop Agenda sets out issues to be covered
2nd July 2014	Ornithology ETG meeting 4 Agenda sets out issues to be covered
8th July 2014	End of consultation period for East Anglia THREE PEI
August 2014 [ideally week commencing 11th August]	Ornithology ETG meeting 5 Progress toward ES for submission - revisions to assessments to account for PEI consultation responses and ETG meeting 4 Final HRA Screening Report and progress in addressing sites and interest features for which LSE was determined (including any completed draft assessments) Draft SoCG
September 2014 [first half]	Ornithology ETG meeting 6 Draft of submission ES containing EAOW position on non-agreed issues that will carry forward to submission ES Draft HRA Report and its summary in RIES matrices Draft DCO Draft SoCG
November 2014	DCO application East Anglia THREE

2.2 Project Description

9. The project description has not changed since OETG Mtg 3 when it was advised in the Background Paper that array will consist of between 100 and 172 turbines of 12MW to 7MW respectively. This also results in a change in the 'worst case' scenario, derived from the Rochdale Envelope, for use in particular in the collision risk modelling.

10. The 'worst case' modelled for the prediction of collision risk in the Preliminary Environmental Information Report was the same as that set out in Table 2.1 of the Background Paper for OETG Mtg 3. This means that the 'worst case' collision risk modelling was carried out on the specification of 172 wind turbines of 7MW with a 154m rotor diameter.

3 EXISTING ENVIRONMENT

3.1 Offshore: Additional studies undertaken

3.1.1 Migrant collision risk modelling

11. A two part study has been undertaken on migrant collision risk modelling. The first part applies the APEM Migropath model to predict the numbers of selected wildfowl and wader species that might pass across the proposed East Anglia THREE windfarm. The second part applies the 'Migrant' component to the Band collision risk model to these predicted numbers of wildfowl and waders to produce a prediction of the potential number of collisions and that is assessed for significance against relevant biogeographic populations. A copy of this study is included as Appendix 1.

12. The results of this study will inform the impact assessment. In particular it will be used in the second iteration of the HRA Screening Report to remove many of the coastal wetland SPA and Ramsar sites that were included in the 'screened in' list of sites in the absence of a quantitative assessment of collision risk to migrant waterfowl, waders and marsh harrier crossing the North Sea.

3.1.2 Gannet windfarm avoidance

13. A study has been undertaken using aerial survey of a constructed windfarm in the southern North Sea to gather evidence for the extent that gannets take avoiding action. The study focuses on macro-avoidance, that is gannets avoiding entering the windfarm. A copy of this study is included as Appendix 2.

14. The results of this study will inform the impact assessment and collision risk modelling for gannet. In particular the evidence that it provides, taken together with previous studies, suggests that an avoidance rate of 99.5%, at least for autumn passage gannets, is appropriately precautionary for use in collision risk modelling using the Basic Band model (i.e. Option 1 and Option 2). Use of this avoidance rate in the Extended Band Model, including the incorporation of suitable micro-avoidance rates, requires further consideration.

3.1.3 Post-breeding movements of gannets in the southern North Sea

15. A study has been undertaken of the movements that gannet undertake in the post-breeding period in the central and southern North Sea using data from the tagging study that the RSPB has been carrying out at Bempton Cliffs as part of DECC funded research. It focuses on evidence to establish a period during which gannets undertake dispersal within the central and southern North Sea and for the initiation of a subsequent period in which they migrate out of the North Sea. This is to inform

a consideration of any refinement of the procedures for collision risk modelling of migrant seabirds. A copy of this study is included as Appendix 3.

16. The results of this study will inform the consideration of any refinement to the impact assessment and collision risk modelling through providing an additional evidence base for the migrant seabird apportionment method described below.

3.1.4 Migrant seabird collision risk modelling

17. A study has been undertaken to develop a methodology for apportioning the density and / or flux of seabirds in the southern North Sea between birds that are resident there either in the breeding season or in the winter and birds that are passing through on passage. The intention of this was to enable a refined and evidence based process of collision risk modelling to be undertaken. However, due to time constraints of gathering and assessing the evidence and undertaking the revised modelling, a copy of this proposed methodology is not now included as an Appendix to this background paper, but the initial findings will be discussed in brief at OETG Mtg 4.

18. The results of this study, if and when completed, may be used inform the impact assessment and collision risk modelling through the conduct of an assessment of collision risks that recognises that some populations of seabirds contain a significant component that is not resident in the North Sea but passes through on migration. Such birds are not exposed to collision risk to the same extent as resident birds. Current assessment methods do not recognise this.

3.2 Onshore

19. No topics are proposed, the issues concerning the onshore engineering works raised at the site visit on 19th June 2014 will have been covered during the PEI workshop.

3.3 Proposed Action / Agreement

20. Agreement, based on the updated information supplied, is sought on:

- The results and application of the migrant collision risk modelling; and
- The results and application of the gannet windfarm avoidance study.

4 APPROACH TO IMPACT ASSESSMENT

4.1 Offshore

4.1.1 Collision risk modelling: Band Option 4

21. Discussion is sought with the OETG attendees on the strengths and weaknesses of the Extended Band collision risk model (Option 4) that uses site derived seabird flight height distribution curves. In particular EAOW seeks to identify if the concerns that have been expressed are:

- With the concept of applying a flight height distribution curve;
- With the identification of an appropriate avoidance rate to use in the Extended model;
- Both these issues; and / or
- Other issues not identified.

4.1.2 Collision risk modelling: Elements of precaution in using the density estimate for all birds and flying birds only

22. Discussion is sought with the OETG attendees on the different elements of precaution that are built in to collision risk modelling by:

- Using the density estimate for all birds; or
- Using the density estimate for flying birds only.

4.2 Onshore

23. No topics are proposed, the issues concerning the assessment of the onshore engineering works raised at the site visit on 19th June 2014 will have been covered during the PEI workshop.

4.3 Proposed Action / Agreement

24. Agreement, based on the information supplied and the discussion held at the OETG Mtg 4, is sought on:

- The approach to collision risk modelling with Band Option 4;
- The elements of precaution to be included in collision risk modelling.

5 HABITATS REGULATIONS ASSESSMENT

5.1 HRA High Level Screening

25. Section 6.1 of the paper supplied for the OETG Mtg 2 described the iterative approach to be taken to the HRA screening process. The process includes a first screening of sites at a high level.

26. The draft of the high level screening document for East Anglia THREE was provided for, and discussed at, the OETG Mtg 3. The comments received informed the document *East Anglia THREE - HRA Screening: Report on High Level Screening* that was made available alongside the PEIR and hence has been available for public consultation.

27. Comments from the members of the OETG on the *East Anglia THREE - HRA Screening: Report on High Level Screening* will be addressed as part of the PEI Workshop.

28. The full HRA Screening Report will be issued in late July 2014. The most significant change between the two documents will be the additional depth of screening that is now possible that the migrant waterfowl collision risk modelling has been carried out (as described above in Section 3.1.1 and included as Appendix 1). The high level screening approach left a very large number of coastal wetland SPA and Ramsar sites screened in given the absence of that information on migration collision risk. The full screening report will consider a smaller number of sites to have been screened in on the basis of the potential for a likely significant effect.

5.2 Proposed Action / Agreement

29. Progressing the preparation of the HRA Screening Report and HRA Report will have been informed by the discussions at the PEI workshop and the actions agreed as part of those discussions and matters of agreement recorded in the draft SoCG.

APPENDIX 1: MIGROPATH AND COLLISION RISK MODELLING REPORT FOR NON-SEABIRDS

East Anglia THREE Windfarm Migropath and Collision Risk Modelling Report for Non-seabirds

East Anglia Offshore Wind Ltd

APEM Ref: 512608

June 2014

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Revision and Amendment Register

Version Number	Date	Section(s)	Page(s)	Summary of Changes	Approved by
1.00	02/06/2014	All	All	Creation of first draft	SS
1.A	12/06/2014	All	All	Result of review prior to issue	RB
1.B	16/06/2014	All	All	Issue of First Draft to client	SS
2.A	17/06/2014	All	All	Revisions in response to comments from client	SS

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1. Executive Summary

Further to consultation with Natural England and the RSPB through the Evidence Plan process, East Anglia Offshore Wind (EAOW) recognised that an assessment was required to consider the possibility that some bird species may encounter the East Anglia THREE Site during their migration flights across or through the southern North Sea to and from their breeding colonies (that tend to be to the north) and wintering grounds (that tend to be further south). A simple scoping and species selection exercise was completed to identify any migrating species that may fall into this category. Twenty-three bird species, not recorded in significant numbers through the survey programme, were identified as potential migrants through the Site.

Estimates of the international population size and the most relevant migratory populations into and out from Great Britain and Ireland for each species was obtained from the SOSS-05 report (Wright *et al*., 2012). Wright *et al.* (2012) was selected as the most appropriate source for the total flyway population estimates used for modelling through Migropath. It was also used as the source for all Great Britain and Ireland population estimates.

The number of species estimated to pass through the Site, from Migropath, reached the 1% threshold for national importance for 22 out of the 23 species. The number of species estimated to pass through the Site reached international importance for only 10 out of 23 species modelled. The Migropath output estimates for each species were placed into the Band collision risk model Option 1 using the Migrant sheet to calculate the number of potential collisions in each migration season. The total number of collisions was predicted during spring, autumn and annually for each species, assuming an avoidance rate of 98%.

Of the 23 species assessed for collision risk, 17 are estimated to be subject to zero or one collision per annum. Of the remaining six species a further three are estimated to be subject to fewer than five collisions per annum. Therefore, for these species no material impacts are predicted from the proposed East Anglia THREE due to collision risk.

Only three species are predicted to be subject to five or more collision mortalities per annum (dark-belled brent goose, golden plover and dunlin). However, the predicted level of any potential impacts resulting from collision mortality for all three of these species is negligible when assessed relative to the national and international baseline mortality rates. Therefore, no migrant species of bird predicted to fly through the proposed East Anglia THREE windfarm will be subject to significant impacts and migrant species will not be assessed further in either the Environmental Impact Assessment or the Habitats Regulations Assessment.

2. Introduction

2.1 Background

Offshore windfarm development is underway around the coast of the UK, with the Round 3 windfarms set to deliver more energy from larger turbines, erected in larger arrays that extend to areas of sea further offshore than Rounds 1 and 2.

Monthly field surveys conducted for large offshore windfarm projects can provide information on the likely abundance and distribution of key seabird species for each biological season with one important proviso. No existing generally applied survey methods are guaranteed to provide reliable estimates of bird numbers during the migration season. This is due to some birds moving through in short pulses, in poor weather or at night (when no surveys take place), or at high altitudes, which makes recording their numbers extremely complex using standard methods. However, it is important to present information to the competent authority on the likely origins and numbers of the migratory birds that may pass through a proposed offshore windfarm development's site footprint (Site). This is evident from the low incidence of encounter rates for migrant birds, with only a small number of species recorded in very low numbers during the site-specific aerial surveys.

One solution is to model migratory bird movements. APEM has developed a tool to carry out such modelling - Migropath. This makes it possible to estimate the number (with confidence intervals) of migrating birds passing through windfarm development sites. The model is set up to focus on species that are associated with Special Protection Areas (SPAs). The model assumes point to point migration within a broad front from continental Europe to and from the UK.

The alternative model to Migropath was developed by the British Trust for Ornithology (BTO) as part of the SOSS-05 programme of work. SOSS-05 involved a number of projects, aimed at aiding the process of assessing the risk of offshore windfarm developments to migratory birds, particularly those birds that are the interest features of UK SPAs and/or species listed in Annex 1 of the Birds Directive. The SOSS-05 programme included as an output the SOSSMAT migration model. The SOSSMAT model was based extensively on Migropath, but contained a number of simplifications and hence its outputs were limited. Migropath provides a more refined modelling approach through the use of species specific migration routes based on associations between species that are interest features of SPAs and relevant UK SPAs. This approach allows a more tailored approach to be followed and also allows additional modelling to be undertaken on specific SPAs if required.

This report describes the use of Migropath to estimate bird migration through the proposed Site. The information from this modelling exercise will ensure that the East Anglia THREE Environmental Impact Assessment (EIA) and Habitats Regulations Assessment (HRA) offer a genuine and more precautionary assessment of the potential collision risk faced by migrant birds than if survey data alone was relied upon to assess migrant birds.

2.2 Selection of Migrant Birds for Modelling

Further to consultation with Natural England and the RSPB through the Evidence Plan process, East Anglia Offshore Wind (EAOW) recognised that an assessment was required to consider the possibility that some bird species may encounter the Site during their migration flights across or through the southern North Sea to and from their breeding colonies (that tend to be to the north) and wintering grounds (that tend to be further south). A simple scoping and species selection exercise was completed to identify any migrating species that may fall into this category. A review of site-specific aerial survey data, East Anglia Zonal survey data, the flight paths within the SOSS-05 Report (Wright *et al*., 2012), previous migration modelling reports for offshore windfarms in the southern North Sea, and other ornithological literature on collision risk such as Langston *et al.* (2010) and Furness and Wade (2013) helped identify the birds most likely to be at risk from those identified and reported on within the SOSS-05 Report (Wright *et al*., 2012).

Twenty-three bird species, not recorded in significant numbers through the survey programme, were identified as potential migrants through the Site. The process of, and evidence base for, the species selection process is set out in the migrant species selection matrix that is included as Annex 1. The 23 species, identified as being potentially at risk, placed through Migropath, are:

- Dark-bellied brent goose, *Branta bernicla bernicla*;
- Wigeon, *Anas penelope*;
- Gadwall, *Anas strepera*;
- Teal, *Anas crecca*;
- Pintail, *Anas acuta*;
- Shoveler, *Anas clypeata*;
- Pochard, *Aythya ferina*;
- Tufted duck, *Aythya fuligula*;
- Common scoter, *Melanitta nigra*;
- Goldeneye, *Bucephala clangula*;
- Marsh harrier, *Bucephala clangula*;
- Oystercatcher, *Haemotopus ostralegus*;
- Ringed plover, *Charadrius hiaticula*;
- Golden plover, *Pluvialis apricaria*;
- Grey plover, *Pluvialis fulva*;
- Lapwing, *Vanellus vanellus*;
- Knot, *Calidris canutus*;
- Sanderling, *Calidris alba*;
- Dunlin, *Calidris alpina alpina*;
- Bar-tailed godwit, *Limosa lapponica*;
- Curlew, *Numenius arquata*;
- Redshank, *Tringa totanus, Tringa britannica, Tringa robusta* and
- Turnstone, *Arenaria interpres*.

The 23 species of bird modelled through Migropath will subsequently be assessed for collision risk later in this document and that information will inform the EIA and HRA for the proposed East Anglia THREE.

3. Methodology

3.1 Approach

The non-breeding waterbird populations of UK SPAs (Natura 2000 sites) are regularly surveyed annually by the Wetland Bird Survey (WeBS). Occasional surveys of non-breeding seabirds have been carried out e.g. the inshore 2000/2001 JNCC Seaduck Survey, whilst each SPA has a population figure associated with its original classification. We thus have information on the numbers of birds over-wintering or breeding on these sites. From ringing / tagging data, as well as other literature, we also have information on the likely origin of some or all of these populations, including trans-boundary migrations (Wernham *et al*., 2002). We can therefore define a broad-front migration area for a given number (population) of birds. Furthermore, data from continental sites (e.g. staging posts, observatories) can be used to further refine the likely fronts, as well as provide information on temporal components of migration (for example, daily passage rate and duration of migration events). This work was progressed by the SOSS-05 project (Wright *et al.,* 2012) and the results of that work feed in to this report.

It is therefore possible to estimate the proportion of the population of a bird species encountering a windfarm of interest. Furthermore, it will be possible to estimate the numbers of birds associated with one SPA, with a defined group of SPAs, or with a regional suite of SPAs that will encounter one or more windfarms by feeding in the appropriate count data and defining appropriate migratory corridors. Flight height data gathered from the individual windfarm surveys, or literature, can be used to estimate the proportion of the individuals of each species of bird that would be at risk of collision with turbine rotors. In combination with the estimates of numbers of birds passing through a windfarm provided by Migropath, the flight height information makes it possible to estimate the number of potential collisions.

The approach is a relatively uncomplicated method to answer a pressing set of questions. In order to develop more complex models simulating bird movement, additional environmental variables such as weather and photoperiod, and biological factors such as flight speed, energy budget, flocking behaviour and manoeuvrability would need to be considered. APEM has been involved in similar simulations for fish passage at tidal barrage locations (Willis and O'Keeffe, *in prep*.), using hydrodynamic and behavioural modelling, but at present no such models exist for UK birds.

3.2 Assumptions

Migropath inevitably makes several assumptions. Chief amongst these is the assumption that migration is in a straight line between the SPA of interest and a given point (or defined area) out from the UK. This may suggest migration routes across land, something that not all species may do and which might require specific alteration to the modelling.

It is also assumed that all migration of a particular species to a particular suite of SPAs can be defined within a set corridor. This corridor should aim to realistically represent the broad front area across which birds must move. These corridors are derived from the report of the SOSS-05 programme of work (detailed above) and it is assumed that they do represent the broad front area across which birds move.

Not all birds are from or going to UK SPAs, and thus we have used Migropath to estimate the number of birds from a continental area/location flying through or across the southern North Sea, the known migration corridors of the study species.

Birds migrating between continental areas and UK SPAs that do not pass through the Site are not considered to be at collision risk from the proposed development, based on the assumption of straight-line migration. Such no-risk movements can be factored in to estimate proportions of birds arriving on / departing from SPAs (or other continental areas) but not encountering the Site.

3.3 Technical Method

3.3.1 Migropath

The centrepoint of each SPA was calculated using the geometry function within ESRI® ArcMap™ 9.2. The coastline of Continental Europe was split into 1 km segments, and each segment labelled with a unique ID. Using the ET Geowizard tool each segment along the European coast was joined to the centre of each SPA, with each line classified as either passing within or out from each offshore development area (Figure 1).

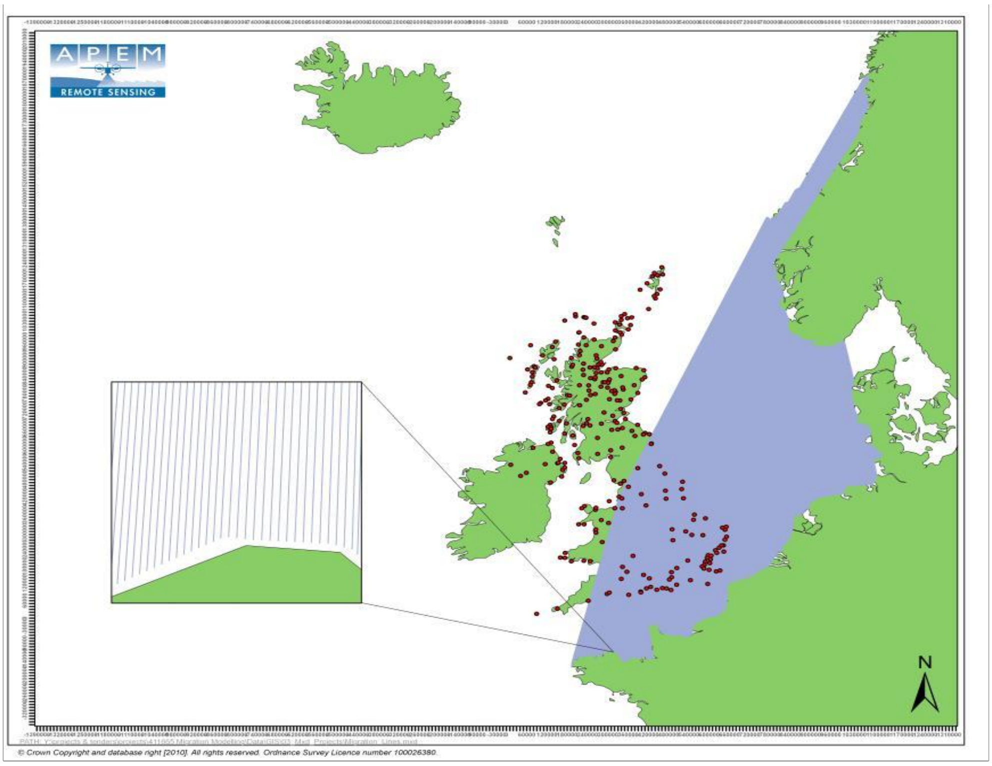

Figure 1 Example migration lines for a hypothetical species that would migrate from the European coast to the Ribble and Alt Estuaries SPA. Red dots represent the centre of each SPA. The inset shows a section of the 1 km spaced migration lines starting from Brittany.

A list of SPAs that each of the species is associated with was collated (JNCC, 2011; Stroud *et al.,* 2001). This information, along with the SPA line associations and migratory pathways, were then fed into R (R Development Core Team, 2012).

Within R, a list of SPAs associated with a species is extracted and the relevant data loaded. Data contained within the migratory pathway are then extracted and collated. A random percentage of birds are assigned to each migratory route, and percentages within each wind farm development area are summed to produce the output. Where sufficient information exists on staging posts, the percentage of the population utilising these posts are incorporated. The model output provides a sum of the percentage of birds passing through the Site within one migration season (i.e. spring migration). For an estimate of the total number of birds passing through the Site within one year, these outputs would need to be multiplied by the relevant number of migration season. Where staging posts are incorporated, percentages migrating to/from may vary dependant upon the specific migration season. Therefore, differing proportions of the population may pass through a particular Site on outward and return migration flights.

3.3.2 Collision Risk Modelling (CRM)

In addition the number of birds estimated to pass through the Site from Migropath has been fed into the Band CRM, using the ‘Migrant Sheet’ option. Estimates of the flyway population and Great Britain and Ireland populations and other relevant populations were obtained from the SOSS-05 project (Wright *et al*., 2012) to use to assess the subsequent CRM mortality rates against, where appropriate.

The CRM methodology outlined by Band (2012) has been followed for the modelling and assessment of impacts predicted for the proposed East Anglia THREE windfarm (the Project). This most recent iteration of the Band model includes a number of options that differ in the way that information on the flight heights of birds is incorporated in to the model. In this instance Band CRM Option 1 was used with the outputs from the ‘Migrant Sheet’.

3.3.2.1 Band CRM Option 1 ’Migrant Sheet’ with generic flight heights

CRM was carried out using the basic Band model that applies a uniform distribution of bird flights between the lowest and the highest levels of the rotors. The percentage of bird flights passing between the lowest and the highest levels of the rotors (i.e. birds at potential collision height (PCH)) is determined from a number of literature sources, including but not limited to the SOSS-02 project (Band, 2012). The literature sources used in the CRM for each species are presented in Table 5. The parameters for the windfarm used in the Band CRM are presented in Section 4.1.

The Band Model (2012) assumes an equal and additive risk of collision with each individual turbine within a windfarm development. Therefore the risk of collision is the sum of the risk from each rotor passage.

3.4 Species (and populations)

A species selection matrix (Annex 1) was completed to select species for the migration modelling. This matrix includes and assesses a long list of species most of which are not carried forward to the migration modelling stage. This scoping stage was completed to provide the Statutory Nature Conservation Agencies with a robust qualitative process that is applied to all species identified as migrating broadly through the Site and whether they require further assessment or not.

The species selection matrix identified 23 bird species (12 waders, 10 wildfowl and one raptor) as most suitable/appropriate for modelling purposes. These species showed a relatively high proportion of birds occurring within the regional SPAs (along the East Anglia coast) or had flight paths associated with the southern North Sea, therefore potentially encountering the Site during migration. The most appropriate population for each species or race was selected for use in the modelling to estimate the likely maximum numbers passing through the Site. These populations are presented in Table 1 along side the total flyway populations from the SOSS-05 report (Wright *et al.* 2012).

Table 1 Relevant Species-specific Populations run through Migropath in comparison to the International Population Size for all species modelled

Species common name	Breeding/Non-breeding	International Population Size (Individuals) (SOSS-05)	Relevant Migrant population flying into or out from GB and Ireland (Individuals) run through Migropath[1]
Dark-bellied brent goose	Non-breeding	200,000 – 280,000	91,000 (GB population)
Wigeon	Non-breeding	1,500,000 (NW Europe non-breeding)	522,370 (GB & Ireland non-breeding)
Gadwall	Non-breeding	60,000 (NW Europe)	25,630 (UK/GB & Ireland non-breeding)
Teal	Non-breeding	500,000 (NW Europe non-breeding)	255,010 (GB & Ireland non-breeding)
Pintail	Non-breeding	60,000 (NW Europe non-breeding)	30,235 (GB & Ireland non-breeding)
Shoveler	Non-breeding	40,000 (NW & central Europe non-breeding)	20,545 (GB & Ireland non-breeding)
Pochard	Non-breeding	300,000 (NE & NW Europe non-breeding)	75,780 (GB & Ireland non-breeding)
Tufted duck	Non-breeding	1,200,000 (NW Europe non-breeding)	146,610 (GB & Ireland non-breeding)
Common Scoter	Non-breeding	550,000 (*nigra* non-breeding)	123,190 (GB & Ireland non-breeding)
Goldeneye	Non-breeding	1,000,000 – 1,300,000 (NW & central Europe non-breeding)	29,665 (GB & Ireland non-breeding)
Marsh Harrier	Breeding	93,000 – 140,000 (pairs) or 186,000 – 280,000 (breeding individuals)	201 (females)
Oystercatcher	Non-breeding	820,000 (*ostralegus*, N, W & central Europe	200,000 (GB & Ireland non-breeding)
	Breeding		113,000 (half of GB breeding)

[1] Wright *et al.* 2012.

Species common name	Breeding/Non-breeding	International Population Size (Individuals) (SOSS-05)	Relevant Migrant population flying into or out from GB and Ireland (Individuals) run through Migropath[1]
Ringed Plover	Non-breeding	73,000 (Europe & N Africa non-breeding)	48,580 (GB & Ireland non-breeding)
Golden Plover	Non-breeding	1,570,000 – 2,140,000 (*apricaria*, NW Europe and *altifrons*, Iceland, Faeroes, N Europe & Siberia)	566,700 (GB & Ireland non-breeding)
	Breeding		45,200 (GB breeding)
Grey Plover	Non-breeding	250,000 (East Atlantic non-breeding)	49,315 (GB & Ireland non-breeding)
Lapwing	Non-breeding	5,500,000 – 9,500,000 (Europe & W Asia breeding)	465,000*
Knot	Non-breeding	450,000 (*islandica*)	338,970 (GB & Ireland non-breeding)
Sanderling	Non-breeding	120,000 (E Atlantic non-breeding)	22,680 (GB & Ireland non-breeding)
Dunlin	Non-breeding	1,330,000 (*alpina*)	438,480 (GB & Ireland non-breeding)
Bar-tailed godwit	Non-breeding	120,000 (*lapponica*)	54,280 (GB & Ireland non-breeding)
Curlew	Non-breeding	700,000 – 1,000,000 (*arquata*)	124,650**
Redshank	Non-breeding	200,000 – 300,000 (*totanus*)	25,000 (GB non-breeding)
	Breeding	38,800 (*britannica*)	38,800 (GB & Ireland breeding)
	Non-breeding	150,000 – 400,000 (*robusta*)	150,000 (GB & Ireland non-breeding)
Turnstone	Non-breeding	145,000 – 320,000 (NE Canada & Greenland and Northern Europe)	48,000 (GB non-breeding)

Table Note: * Lapwing. Wright *et al* (2012) suggests few breeding birds migrate out of UK, but mostly go south if they do migrate. An assumption of all adults (approx. 300,000 in GB alone) remain in GB and 150,000 juvs (based on approx. one juv per pair in GB) migrate out for winter then GB breeders wintering in UK must be joined by 320,000 migrants from Europe to total the 620,000 GB non-breeding population. That makes the migrant population ~75% of non-breeding numbers in GB, so 465,000 birds. **Curlew. Using Wright *et al* (2012) the migration population is estimated to be made up of half the GB population non-breeding population (70,000 non-breeding individuals) and all Irish birds (as most Irish birds are migrants, as very few breed there). Therefore, 70,000 plus 54,650 equals 124,650.

Estimates of the international population size and the most relevant migratory populations into and out from Great Britain and Ireland for each species was obtained from the SOSS-05 report (Wright *et al*., 2012). Wright *et al.* (2012) was selected as the most appropriate source for the total flyway population estimates used for modelling through Migropath. It was also used as the source for all Great Britain and Ireland population estimates. Whilst it is recognised that the more recently published Musgrove *et al.* (2013) paper provides an alternative source for UK population estimates, it was identified that many of the source estimates, censuses and surveys are the same in the two publications that were produced only a short time apart and as a result the population estimates do not differ between them other than where they have been rounded up or down from the original source estimates.

Therefore the base populations used in the calculations of the proportion of birds flying through the Site are from a single, unified source - those presented in Wright *et al.* (2012).

4. Migropath Model Results

4.1 Migropath Outputs

APEM's Migropath model was used to provide a detailed and consistent method for estimating turnover for 23 bird species during the spring and autumn migration seasons. These 23 species were identified as potentially flying through the Turbine Area during migration seasons in large numbers in the SOSS-05 report (Wright *et al*., 2012); analysis of the survey data suggested that under-recording of these species was likely to have occurred.

Table 2 presents the results of the Migropath modelling for each species alongside upper and lower confidence limits for each estimate. The migrant estimate is the number of birds predicted to fly through the Site during an individual migration season (e.g. spring or autumn), allowing for species' turnover. In the case of a number of species, for example dark-bellied brent goose, the estimates for each migration season may differ due to the species using staging posts on route to or from Great Britain and Ireland.

Table 2 Numbers estimated to be migrating through the Site during a single migration season.

Species common name	Breeding/Non-breeding	Percentage of flyway population staging at the Wadden Sea[2] (and season)	Migrant estimate	Lower confidence limit	Upper confidence limit
Dark bellied brent goose	Non-breeding	99.8% (Spring)	19,133	18,910	19,372
	Non-breeding	41.6% (Autumn)	9,484	9,364	9,602
Wigeon	Non-breeding		12,861	12,570	13,172
Gadwall	Non-breeding		991	941	1,040
Teal	Non-breeding		4,615	4,471	4,746
Pintail	Non-breeding		576	556	592
Shoveler	Non-breeding		661	631	688
Pochard	Non-breeding		2,488	2,373	2,598
Tufted duck	Non-breeding		4,775	4,536	5,023
Common Scoter	Non-breeding		2,072	2,013	2,130
Goldeneye	Non-breeding		553	522	581
Oystercatcher	Non-breeding		5,764	5,617	5,907
	Breeding		0	0	0
Ringed Plover	Non-breeding		1,624	1,600	1,646
Golden Plover	Non-breeding		33,943	32,774	35,186
	Breeding		0	0	0
Grey Plover	Non-breeding		1,979	1,957	2,004

[2] Laursen *et al.*, 2010.

Species common name	Breeding/Non-breeding	Percentage of flyway population staging at the Wadden Sea[2] (and season)	Migrant estimate	Lower confidence limit	Upper confidence limit
Lapwing	Non-breeding		11,001	10,683	11,282
Knot	Non-breeding	75% (Spring)	4,657	4,401	4,905
	Non-breeding	79.7% (Autumn)	4,423	4,164	4,702
Sanderling	Non-breeding		328	312	345
Dunlin	Non-breeding	71.2% (Spring)	42,408	41,949	42,884
	Non-breeding	86.8% (Autumn)	49,074	48,542	49,665
Bar-tailed godwit	Non-breeding	58% (Spring)	696	677	718
	Non-breeding	25.3% (Autumn)	1,242	1,211	1,279
Curlew	Non-breeding		2,502	2,432	2,575
Redshank	Non-breeding		439	426	451
	Breeding		951	892	1,008
	Non-breeding		4,167	4,044	4,283
Turnstone	Non-breeding		681	651	710

4.2 Proportion of Populations Flying Through East Anglia THREE

In order to help define the importance of the Site for each of the 23 species modelled it is important to assess the model outputs against different populations. For the purpose of this assessment, the number of birds estimated to fly through the Site in a single migration season have been compared to the relevant Great Britain and Ireland populations input into Migropath and also the International population sizes, both having been derived from Wright *et al.* (2012).

The number of species estimated to pass through the Site reached the 1% threshold for national importance for 22 out of the 23 species, Table 3, with only marsh harrier not reaching national importance. The number of species estimated to pass through the Site reached international importance for only 10 out of 23 species modelled (Table 4).

Table 3 Numbers estimated to be migrating through the Site (as a proportion of the relevant GB & Ireland Population run through Migropath)

Species common name	Breeding/Non-breeding	Relevant GB and Ireland population run through Migropath[3]	Migrant estimate	Percentage of GB & Ireland population passing through East Anglia THREE	National Importance (Over 1% threshold)
Dark bellied brent goose	Non-breeding	91,000	19,133	21.0%	Yes
	Non-breeding		9,484	10.4%	Yes
Wigeon	Non-breeding	522,370	12,861	2.5%	Yes
Gadwall	Non-breeding	25,630	991	3.9%	Yes
Teal	Non-breeding	255,010	4,615	1.8%	Yes
Pintail	Non-breeding	30,235	576	1.9%	Yes
Shoveler	Non-breeding	20,545	661	3.2%	Yes
Pochard	Non-breeding	75,780	2,488	3.4%	Yes
Tufted duck	Non-breeding	146,610	4,775	3.3%	Yes
Common Scoter	Non-breeding	123,190	2,072	1.7%	Yes
Goldeneye	Non-breeding	29,665	553	1.9%	Yes
Marsh Harrier	Breeding	201 females	0	0%	No
Oystercatcher	Non-breeding	200,000	5,764	2.9%	Yes
	Breeding	226,000	0	0%	No
Ringed Plover	Non-breeding	48,580	1,624	3.3%	Yes
Golden Plover	Non-breeding	566,700	33,943	6.0%	Yes
	Breeding	45,200	0	0%	No
Grey Plover	Non-breeding	49,315	1,979	4.0%	Yes
Lapwing	Non-breeding	465,000	11,001	2.$%	Yes
Knot	Non-breeding	338,970	4,657	1.4%	Yes

[3] Wright *et al.,* 2012.

Species common name	Breeding/Non-breeding	Relevant GB and Ireland population run through Migropath[3]	Migrant estimate	Percentage of GB & Ireland population passing through East Anglia THREE	National Importance (Over 1% threshold)
	Non-breeding		4,423	1.3%	Yes
Sanderling	Non-breeding	22,680	328	1.5%	Yes
Dunlin	Non-breeding	438,480	42,408	9.7%	Yes
	Non-breeding		49,074	11.2%	Yes
Bar-tailed godwit	Non-breeding	54,280	696	1.3%	Yes
	Non-breeding		1,242	2.3%	Yes
Curlew	Non-breeding	124,650	2,502	2.0%	Yes
Redshank	Non-breeding	25,000	439	1.8%	Yes
	Breeding	38,800	951	2.5%	Yes
	Non-breeding	150,000	4,167	2.8%	Yes
Turnstone	Non-breeding	48,000	681	1.4%	Yes

Table 4 **Numbers estimated to be migrating through the Site (as a proportion of the International Population)**

Species common name	Breeding/Non-breeding	International Population	Migrant estimate	Percentage of International population passing through East Anglia THREE	International Importance (Over 1% threshold)
Dark bellied brent goose	Non-breeding	200,000 – 280,000	19,133	6.8 – 9.6%	Yes
	Non-breeding		9,484	3.4 – 4.7%	Yes
Wigeon	Non-breeding	1,500,000	12,861	0.9%	No
Gadwall	Non-breeding	60,000	991	1.7%	Yes
Teal	Non-breeding	500,000	4,615	0.9%	No
Pintail	Non-breeding	60,000	576	1.0%	Yes
Shoveler	Non-breeding	40,000	661	1.7%	Yes
Pochard	Non-breeding	300,000	2,488	0.8%	No
Tufted duck	Non-breeding	1,200,000	4,775	0.4%	No
Common Scoter	Non-breeding	550,000	2,072	0.4%	No
Goldeneye	Non-breeding	1,000,000 – 1,300,000	553	<0.1 – 0.1%	No
Marsh Harrier	Breeding	186,000 – 280,000	0	0%	No
Oystercatcher	Non-breeding	820,000	5,764	0.7%	No
	Breeding		0	0%	No
Ringed Plover	Non-breeding	73,000	1,624	2.2%	Yes
Golden Plover	Non-breeding	1,570,000 – 2,140,000	33,943	1.6 – 2.2%	Yes
	Breeding		0	0%	No

Species common name	Breeding/Non-breeding	International Population	Migrant estimate	Percentage of International population passing through East Anglia THREE	International Importance (Over 1% threshold)
Grey Plover	Non-breeding	250,000	1,979	0.8%	No
Lapwing	Non-breeding	5,500,000 – 9,500,000	11,001	0.1 – 0.2%	No
Knot	Non-breeding	450,000	4,657	1.0%	Yes
	Non-breeding		4,423	1.0%	Yes
Sanderling	Non-breeding	120,000	328	0.3%	No
Dunlin	Non-breeding	1,330,000	42,408	3.2%	Yes
	Non-breeding		49,074	3.7%	Yes
Bar-tailed godwit	Non-breeding	120,000	696	0.6%	No
	Non-breeding		1,242	1.0%	Yes
Curlew	Non-breeding	700,000 – 1,000,000	2,502	0.3 – 0.4%	No
Redshank	Non-breeding *tetanus*	200,000 – 300,000	439	0.1 – 0.2%	No
	Breeding *britannica*	38,800	951	2.5%	Yes
	Non-breeding *robusta*	150,000 – 400,000	4,167	1.0% - 2.8%	Yes
Turnstone	Non-breeding	145,000 – 320,000	681	0.2 – 0.5%	No

5. Collision Risk Modelling (CRM)

5.1 CRM Parameters

Table 5 presents the CRM species input parameters for each migrant bird run through the Band CRM. Species biometrics were obtained from Robinson (2005) and the nocturnal activity rate was based on a 1 to 5 scoring index for each species in Garthe and Hüppop (2004), with the spreadsheet converting these factors into daytime activity as follows; 1 = 0%, 2 = 25%, 3 = 50%, 4 = 75%, 5 = 100%. The number of available daylight hours is calculated within the CRM spreadsheet (Band, 2012) based on the latitude of the wind park development.

With regard to the PCH to be applied in the CRM, Wright *et al*. (2012) gives a range of suggested values for the PCH based predominantly on expert judgement and not site based studies. These values are presented for a number of species groupings including geese, ducks, raptors and waders – these groups include those species run through the Migropath model. Wright *et al*. (2012) also provides a specific set of values for common scoter a species for which there has been a large number of site based flight studies that were drawn together in Cook *et al*. (2012).

The PCH for each species group or species and the ranges recommended in Wright *et al*. (2012) are:

Geese: 30% (5 to 75%)

Ducks: 15% (0.1 to 60%), except for:

Common scoter: 1% (<0.1 to 17%)

Raptors: 50% (25 to 100%)

Waders: 25% (5 to 75%)

For this assessment the mid-range value for the PCH has been applied. It is recognised that a level of precaution has been built in to the expert judgement that prepared these figures and that includes the PCH being based on a turbine specification that has an air draft of 20m. This is lower than the Worst Case Scenario for proposed East Anglia THREE wind turbines and hence will include a greater percentage of birds than a figure derived specifically for East Anglia THREE. If a prediction of no significant effect at the population level is identified on this basis then it gives confidence that the assessment does not run the risk of inadvertently failing to identify an effect that should be accounted for in the decision making process.

Table 5 Migrant species CRM input parameters

Species	Bird length (m)	Wingspan (m)	Flight speed (m/sec)	Nocturnal activity factor*	Flight type	PCH (%)
Dark-bellied brent goose	0.58[4]	1.15[4]	17.7[5]	5[g]	Flapping	30[h]
Wigeon	0.48[4]	0.80[4]	17.1[6]	5[g]	Flapping	15[h]
Gadwall	0.51[4]	0.9[4]	16.9[a]	5[g]	Flapping	15[h]
Teal	0.36[4]	0.61[4]	16.9[a]	5[g]	Flapping	15[h]
Pintail	0.58[4]	0.88[4]	16.6[a]	5[g]	Flapping	15[h]
Shoveler	0.48[4]	0.77[4]	16.9[a]	5[g]	Flapping	15[h]
Pochard	0.46[4]	0.77[4]	21.2[b]	5[g]	Flapping	15[h]
Tufted duck	0.44[4]	0.70[4]	21.2[b]	5[g]	Flapping	15[h]
Common scoter	0.49[4]	0.84[4]	22.1[5]	3[7]	Flapping	1[8]
Goldeneye	0.46[4]	0.72[4]	21.2[b]	5[9]	Flapping	15[h]
Marsh Harrier	0.52[4]	1.22[4]	12[10]	3[11]	Flapping/gliding	50[h]
Oystercatcher	0.42[4]	0.83[4]	13.9[c]	5[g]	Flapping	25[h]

[4] Robinson, R.A. (2005) BirdFacts: profiles of birds occurring in Britain & Ireland (BTO Research Report 407). BTO, Thetford (http://www.bto.org/birdfacts, accessed on 02/06/2014).
[5] Alerstam, T., Rose'n, M., Ba¨ckman, J., Ericson, P.G.P. & Hellgren, O. (2007) Flight speeds among bird species: Allometric and phylogenetic effects. *PLoS Biol* **5** (8): e197. Doi:10.1371/journal.pbio.0050197.
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[9] No value in literature, so assumed to be the same as tufted duck, as also a diving duck.
[10] Bruderer, B. & Boldt, A. (2001) Flight characteristics of birds: I. radar measurements of speeds. *Ibis* **143**: 178-204.
[11] No value in literature, so assumed to be medium value, as raptors rely on thermals to aid migration and so unlikely to migrate principally by night.

Species	Bird length (m)	Wingspan (m)	Flight speed (m/sec)	Nocturnal activity factor*	Flight type	PCH (%)
Ringed plover	0.19[4]	0.52[4]	10.6[8]	5[g]	Flapping	25[h]
Golden plover	0.28[4]	0.72[4]	17.9[d]	5[g]	Flapping	25[h]
Grey plover	0.28[4]	0.77[4]	17.9[5]	5[g]	Flapping	25[h]
Lapwing	0.30[4]	0.84[4]	11.9[8]	5[g]	Flapping	25[h]
Knot	0.24[4]	0.59[4]	20.1[5]	5[g]	Flapping	25[h]
Sanderling	0.20[4]	0.42[4]	17.7[e]	5[g]	Flapping	25[h]
Dunlin	0.18[4]	0.40[4]	15.3[5]	5[g]	Flapping	25[h]
Bar-tailed godwit	0.38[4]	0.75[4]	18.3[5]	5[e]	Flapping	25[h]
Curlew	0.55[4]	0.90[4]	13.9[7]	5[e]	Flapping	25[h]
Redshank	0.28[4]	0.62[4]	18.3[f]	5[e]	Flapping	25[h]
Turnstone	0.23[4]	0.54[4]	17.7[e]	5[e]	Flapping	25[h]

[*] The CRM spreadsheet converts this factor from 1 to 5 into 0% / 25% / 50% / 75% / 100% daytime activity respectively.
[a] No data available on flight speed, so assumed that flight speed is the average of wigeon and pintail flight speeds (dabbling ducks).
[b] No data available on flight speed, so assumed that flight speed is the average of eider (20.2[6])and common scoter flight speeds (diving ducks).
[c] No data available on flight speed, so assumed the same as curlew.
[d] No data available on flight speed, so assumed the same as grey plover.
[e] No data available on flight speed, so assumed that flight speed is the average of knot and dunlin flight speeds.
[f] No data available on flight speed, so assumed the same as bar-tailed godwit.
[g] No data available on nocturnal flight activity, assumed to be worst case scenario of 5.
[h] Wright *et al* (2012). *Assessing the risk of offshore wind farm development to migratory birds designated as features of UK Special Protection Areas (and other Annex I species).* Strategic Ornithological Support Services. Project SOSS-05. BTO Research Report No. 592., as described in Section 5.1.

5.1.1 Avoidance Rates

A bird's ability to avoid colliding with a wind turbine's rotating blades is a critical factor in predicting mortality rates. This ability will vary between species and is a measure of how sensitive each species is to those turbines and the windfarm in its entirety.

CRM following the standard Band model (Band, 2012) is carried out using a default and precautionary 98% avoidance rate unless there is evidence from post-construction monitoring to support the use of a higher or lower value. Reviews and studies (e.g. Maclean *et al*., 2009, Krijgsveld *et al*., 2011) identify differing levels of avoidance that may be more appropriately assigned to different species to provide a more evidence based avoidance rate. The CRM for East Anglia THREE used the precautionary value of 98% avoidance for all the migrant species within this report.

5.1.2 CRM Outputs

The Migropath output estimates for each species were placed into Band CRM Option 1 models using the Migrant sheet to calculate the number of potential collisions in each migration season. Table 6 presents the total number of collisions during spring, autumn and annually for each species, assuming an avoidance rate of 98%.

Table 6 Estimated Number of Collision for each species during the Spring and Autumn (and total Annual figure)

Species common name	No. Collisions in Spring	No. Collisions in Autumn	Total Annual No. of Collisions
Dark bellied brent goose	4	2	6
Wigeon	1	1	2
Gadwall	0	0	0
Teal	0	0	1
Pintail	0	0	0
Shoveler	0	0	0
Pochard	0	0	0
Tufted duck	0	0	1
Common Scoter	0	0	0
Goldeneye	0	0	0
Marsh Harrier	n/a	n/a	n/a
Oystercatcher (non-breeding)	1	1	2
Oystercatcher (breeding)	n/a	n/a	n/a
Ringed Plover	0	0	0
Golden Plover (non-breeding)	5	5	10
Golden Plover (breeding)	n/a	n/a	n/a
Grey Plover	0	0	0
Lapwing	1	1	3
Knot	1	1	1

Species common name	No. Collisions in Spring	No. Collisions in Autumn	Total Annual No. of Collisions
Sanderling	0	0	0
Dunlin	5	5	10
Bar-tailed godwit	0	0	0
Curlew	0	0	1
Redshank (non-breeding *totanus*)	0	0	0
Redshank (breeding *britannica*)	0	0	0
Redshank (non-breeding *robusta*)	1	1	1
Turnstone	0	0	0

5.1.3 Assessment of Annual Mortality Rates

Of the 23 species assessed for collision risk, 17 are estimated to be subject to zero or one collision per annum (Table 6). These species are gadwall, teal, pintail, shoveler, pochard, tufted duck, common scoter, goldeneye, marsh harrier, ringed plover, grey plover, knot, sanderling, bar-tailed godwit, curlew, redshank and turnstone. Of the remaining six species a further three species (wigeon, oystercatcher and lapwing) are estimated to be subject to fewer than five collisions per annum. Therefore, for these species no material impacts are predicted from the proposed East Anglia THREE due to collision risk and they are not considered further within this report.

The only species considered for assessing the potential impact from collision on their national and international populations are those species where five birds or over are subject to mortality per annum. The three species with five collisions or more estimated per annum are dark-belled brent goose, golden plover and dunlin. These three species are accounted for in the assessment below.

5.1.3.1 Dark-bellied brent goose

Dark-bellied brent geese are estimated to have a baseline mortality rate of 10% (Robinson, 2005). Using this level of baseline mortality, it is estimated to be 9,100 birds per annum within the national population and between 20,000 and 28,000 birds per annum within the international population.

The predicted number of collisions for dark-bellied brent goose is 6 birds per annum, which when assessed against the national population is predicted to lead to an increase of 0.07% relative to the baseline mortality rate. The same number of collisions per annum when assessed against the international population is predicted to lead to an increase of between 0.02 and 0.03% relative to baseline mortality. As the predicted increases in mortality relative to baseline mortality at both the national and international levels are below 1% any level of effect and subsequent magnitude of impacts resulting from the proposed East Anglia THREE windfarm will be negligible.

5.1.3.2 Golden plover

Golden plover are estimated to have a baseline mortality rate of 27% (Robinson, 2005). Using this level of baseline mortality, it is estimated to be 153,009 birds per annum within the national population and between 423,900 and 577,800 birds per annum within the international population.

The predicted number of collisions for golden plover is 10 birds per annum, which when assessed against the national population is predicted to lead to an increase of under 0.01% relative to the baseline mortality rate. The same number of collisions per annum when assessed against the international population is also predicted to lead to an increase of under 0.01% relative to baseline mortality. The predicted increases in mortality relative to baseline mortality at both the national and international levels are well below 1%. This level of effect and subsequent magnitude of impact resulting from the proposed East Anglia THREE windfarm will be negligible.

5.1.3.3 Dunlin

Dunlin are estimated to have a baseline mortality rate of 26% (Robinson, 2005). Using this level of baseline mortality, it is estimated to be 114,005 birds per annum within the national population and 345,800 birds per annum within the international population.

The predicted number of collisions for dunlin is 10 birds per annum, which when assessed against the national population is predicted to lead to an increase of under 0.01% relative to the baseline mortality rate. The same number of collisions per annum when assessed against the international population is predicted to lead to an increase of under 0.01% relative to baseline mortality. The predicted increases in mortality relative to baseline mortality at both the national and international levels are well below 1%. This level of effect and subsequent magnitude of impact resulting from the proposed East Anglia THREE windfarm will be negligible.

6. Discussion

To inform the assessment for the proposed East Anglia THREE windfarm, 23 migratory species (10 waders, 12 wildfowl and one harrier) have been assessed utilising the migration model, Migropath. For each of the species the full migration pathways as defined by Wright *et al.* (2012) have been used. Migropath predicted that the number of species estimated to pass through the Site reached the 1% threshold for national importance for 22 out of the 23 species (Table 3). The number of species estimated to pass through the Site reached international importance for 10 out of 23 species modelled (Table 4).

Of the 23 species assessed, the highest number as a proportion of the Great Britain and Ireland populations predicted to pass through the Turbine Area is that of dark-bellied brent geese during spring with 21.0% (Table 3). The dunlin autumn population had the second greatest percentage with 11.2%, whilst dark-bellied brent geese during autumn was third highest with 10.4%.

All 23 species have been assessed for collision risk using the Band CRM model (Band, 2012) within this report. Of the 23 species assessed for collision risk, 17 are estimated to be subject to zero or one collision per annum (Table 6). Of the remaining sixe species a further three are estimated to be subject to fewer than five collisions per annum. Therefore, for these species no material impacts are predicted from the proposed East Anglia THREE due to collision risk and they are not considered further within this report.

Only three species are predicted to be subject to over five collision mortalities per annum (dark-belled brent goose, golden plover and dunlin). However, the predicted level of any potential impacts resulting from collision mortality for all three of these species is negligible when assessed relative to the national and international baseline mortality rates. Therefore, no migrant species of bird predicted to fly through the proposed East Anglia THREE windfarm will be subject to significant impacts and will not be assessed further in either the EIA or HRA.

7. References

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Appendix 1: Migropath Species Screening Matrix for East Anglia THREE

APPENDIX 6 - Migropath Species Screening Matrix for EAST ANGLIA THREE EIA

Notes on Matrix

The selection of migratory bird species for modelling through Migropath (APEM's bespoke migration modelling tool) is based broadly on the SOSS 05 Project (Wright *et* al., 2012), which presents 101 species and sub-species linked to UK SPAs that have flight paths through, around and over the UK to and from Europe and further afield that may be at risk from the development of offshore wind farms. For the purpose of this assessment a selection of the SOSS 05 species and sub-species deemed most likely to interact with the East Anglia THREE's development site (the Site) were selected to run through Migropath. The matrix below presents the selection process undertaken to account for species and sub-species that have the potential to migrate through the Site. This screening stage acts as a qualification process for all species and sub-species identified as migrating broadly through the Site and whether they require further assessment or not. As a precautionary measure, the selection process has been based upon the 101 species and sub-species within the SOSS 05 Report (Wright *et al*. 2012), but also includes a desk based study of all Site-specific East Anglia Zone survey data in order to offer as robust a case as possible for each species or sub-species. The following reports / survey data were used to aid the selection process (numbers correspond to numbered column headers in matrix):

1. The SOSS 05 Report (Wright *et al*., 2012) – This publication contains all species and sub-species that are available for modelling through Migropath. A simple high level first assessment identified whether the main, partial or no flight paths within this report passed over the Site. Those species with a no flight paths over the Site or that were already assessed within the ES Chapter were screened out.
2. Observations from surveys – In order to make use of the large amount of site-specific boat-based and aerial-based survey data from EA ONE, TWO, THREE, FOUR and ZONE surveys this Project screened all data to identify species that migrated through or near to the Site.
3. SOSS 02 Flight Heights (Cook et al., 2012) – The Cook *et al* (2012) report modelled the proportion of bird flights within a standard collision risk window for offshore wind turbines. This allows a generic risk from collisions to be considered for species of birds that were the focus of this research. The report presents a percentage of birds found to be flying at collision risk height, or PCH (birds flying with the rotor swept area of a turbine, or at Potential Collision Height) from multiple bird surveys. The PCH is presented within this matrix and the confidence level also presented. Those birds found to have a very low PCH are less likely to be at risk from collisions.
4. Species of collision risk concern (SOSS 03 Annex) – This was small piece of research completed for the SOSS 03 Project to identify any particular species that may be of high risk from offshore wind farms during their spring or autumn migration flights. Those species identified through this report are highlighted in this matrix, particularly if relevant to the southern North Sea or more specifically the Site or the East Anglia ZONE.
5. Perceived Risk from Collision – Langston *et al* (2010) identified bird species which were most likely to be priorities for data collection or likely focal species for risk assessment in potential Round 3 development zones. The report also ranked and scored species for their sensitivity towards different potential impacts from the construction and operation of offshore wind farms, for example collision risk from turbines or displacement due to construction activities. The more recent Furness & Wade (2012) report on the vulnerability of Scottish seabirds to offshore wind turbines presents a similar scoring and ranking for bird species to the different potential impacts associated with wind farms. The scores presented within this matrix are from these two reports, where applicable.
6. Additional Comments – These comments are intended to collate the overall risk level of the species or sub-species, based upon the data input into the matrix, which culminates in a species or sub-species being selected to be run through Migropath.

Key to colour coding of species rows in Matrix	
	Flight path not over Site
	Assessed in Baseline/EIA for EA THREE project
	Species modelled and assessed as very low risk for collisions in East Anglia ONE EIA, so dropped for East Anglia THREE due to low risk.
	Main flight path may includes Site, but species not selected as deemed at low risk from Project due to SPAs being further north, species occurring in very low numbers in UK or not suitable for Migropath modelling
	Modelling Completed, as species identified as potentially at risk of collision from Project.

No.	Species / Sub-Species	Scientific Name	1.Flight Path CEC		2.Observations from surveys						3.SOSS 02 Flight Heights		4.Species of CRM Concern (SOSS)		5.Perceived Risk from Collision		6.Comments
			Main	Partial	EA Zone Aerial Surveys	EA ONE Boat surveys	EA ONE Aerial Surveys	EA TWO aerial surveys	EA Three Aerial Surveys	EA Four Aerial Surveys	Percentage of Birds flying at Potential Collision Height (PCH)	Confidence Level attached to PCH	Spring	Autumn	Langston, R.H.W. (2010) **Offshore wind farms and birds: Round 3 zones, extensions to Round 1 & Round 2 sites & Scottish Territorial Waters.** RSPB Research Report No. 39.	Furness, B. & Wade, H. (2012) **Vulnerability of Scottish Seabirds to Offshore Wind Turbines.** Report for Marine Scotland, The Scottish Government.	
1	Bewick's Swan	*Cygnus columbianus bewickii*	Yes														Only 1 bird predicted to be subject to mortality in EA ONE assessment, so deemed to have no material impact and not modelled for EA THREE.
2	Whooper Swan	*Cygnus cygnus*	No	Yes													
3	Bean Goose	*Anser fabalis*	Yes														Zero collisions predicted for EA ONE assessment, so deemed to not be at risk of impact from EA THREE, so not modelled.
4	Pink-footed Goose	*Anser brachyrhynchus*	No	No						yes							This species was observed on a single survey, but despite this the main flight path does not go over the Site, so is not able to be modelled in Migropath.
5	European White-fronted Goose	*Anser albifrons albifrons*	No	No							n/a	n/a	low	low	mod	n/a	
6	European White-fronted Goose	*Anser albifrons flavirostris*	Yes														Only 1 bird predicted to be subject to mortality in EA ONE assessment, so deemed to have no material impact and not modelled for EA THREE.
7	Icelandic Greylag Goose	*Anser anser*	No	No													
8	Greenland Barnacle Goose	*Branta leucopsis*	No	No													
9	Svalbard Barnacle Goose	*Branta leucopsis*	No	No													

10	Dark-bellied Brent Goose	*Branta bernicla bernicla*	Yes			yes					n/a	na	low	mod	mod	n/a	Selected for modelling due to being a key species. Large populations in East Anglia that have staging posts in the Wadden Sea, meaning concentrated flights across the southern North Sea.
11	Canadian Light-bellied Brent Goose	*Branta bernicla hrota*	No	No													
12	Svalbard Light-bellied Brent Goose	*Branta bernicla hrota*	No	Yes													
13	Shelduck	*Tadorna tadorna*	Yes						yes		n/a	n/a	mod	mod	n/a	n/a	Only 11 birds predicted to be subject to mortality in EA ONE assessment, so deemed to have no material impact and not modelled for EA THREE.
14	Wigeon	*Anas penelope*	Yes								n/a	n/a	mod	mod	n/a	n/a	
15	Gadwall	*Anas strepera*	Yes								n/a	n/a	mod	mod	n/a	n/a	
16	Teal	*Anas crecca*	Yes								n/a	n/a	mod	mod	n/a	n/a	
17	Mallard	Anas platyrhynchos	Yes								n/a	n/a	mod	mod	n/a	n/a	
18	Pintail	*Anas acuta*	Yes								n/a	n/a	mod	mod	n/a	n/a	
19	Shoveler	*Anas clypeata*	Yes								n/a	n/a	mod	mod	n/a	n/a	
20	Pochard	*Aythya ferina*	Yes								n/a	n/a	mod	mod	n/a	n/a	
21	Tufted Duck	*Aythya fuligula*	Yes														
22	Scaup	*Aythya marila*	No	Yes					yes								
23	Eider	*Somateria mollissima*	No	Yes													
24	Long-tailed Duck	*Clangula hyemalis*	No	Yes													
25	Common Scoter	*Melanitta nigra*	Yes		yes	yes					1.0 (<0.1 - 17.0)	very high	mod	mod	low	low	
26	Velvet Scoter	*Melanitta fusca*	Yes								n/a	n/a	mod	mod	low	low	
27	Goldeneye	*Bucephala clangula*	Yes								n/a	n/a	mod	mod	low	low	
28	Smew	*Mergus albellus*	No	Yes													
29	Red-breasted Merganser	*Mergus serrator*	No	Yes						ye s							
30	Goosander	*Mergus merganser*	No	Yes							n/a	n/a	n/a	n/a	n/a	n/a	
31	Red-throated Diver	*Gavia stellata*	Yes		yes		yes	yes	yes	ye s	n/a	n/a	n/a	n/a	low	mod	Reliable survey data used in EIA for this species. Does not require modelling and is considered in main ES Chapter
32	Black-throated Diver	*Gavia arctica*	n/a	n/a				yes	yes	ye s							
33	Fulmar	*Fulmarus glacialis*	Yes		yes		yes	yes	yes	ye s							Reliable survey data used in EIA for this species. Does not require modelling and is considered in main ES Chapter
34	Manx Shearwater	*Puffinus puffinus*	Yes			yes											Survey data found that use of Site during migration periods does not occur for this species.
35	Storm Petrel	*Hydrobates pelagicus*	Yes														Survey data found that use of Site during migration periods does not occur for this species.
36	Leach's Petrel	*Oceanodroma leucorhoa*	Yes														Survey data found that use of Site during migration periods does not occur for this species.
37	Gannet	*Morus bassanus*	Yes		yes	yes	yes		yes	ye s							Reliable survey data used in EIA for this species. Does not require modelling and is considered in main ES Chapter
38	Cormorant	*Phalacrocorax carbo*	Yes		yes					ye s							Survey data found that use of Site during migration periods does not occur for this species.

39	Shag	*Phalacrocorax aristotelis*	Yes		yes												Survey data found that use of Site during migration periods does not occur for this species.
40	Bittern	*Botaurus stellaris*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	
41	Little Egret	*Egretta garzetta*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	
42	Great Crested Grebe	*Podiceps cristatus*	Yes								n/a	n/a	n/a	n/a	n/a	low	
43	Slavonian Grebe	*Podiceps auritus*	Yes	No							n/a	n/a	n/a	n/a	low	mod	
44	Honey-buzzard	*Pernis apivorus*	No								n/a	n/a	n/a	n/a	n/a	n/a	
45	White-tailed Eagle	*Haliaeetus albicilla*	n/a	n/a													
46	Marsh Harrier	*Circus aeruginosus*	No								n/a	n/a	n/a	n/a	n/a	n/a	
47	Hen Harrier	*Circus cyaneus*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	
48	Montagu's Harrier	*Circus pygargus*	No								n/a	n/a	n/a	n/a	n/a	n/a	
49	Osprey	*Pandion haliaetus*	No								n/a	n/a	n/a	n/a	n/a	n/a	
50	Merlin	*Falco columbarius*	No								n/a	n/a	n/a	n/a	n/a	n/a	
51	Spotted Crake	*Porzana porzana*	n/a	n/a													
52	Corncrake	*Crex crex*	No								n/a	n/a	low	low	high	n/a	
53	Coot	*Fulica atra*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	
54	Oystercatcher	*Haematopus ostralegus*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	
55	Avocet	*Recurvirostra avosetta*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	Only 4 birds predicted to be subject to mortality in EA ONE assessment, so deemed to have no material impact and not modelled for EA THREE.
56	Stone-curlew	*Burhinus oedicnemus*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	
57	Ringed Plover	*Charadrius hiaticula*	No	Yes							n/a	n/a	n/a	n/a	n/a	n/a	
58	Dotterel	*Charadrius morinellus*	No								n/a	n/a	n/a	n/a	n/a	n/a	
59	Golden Plover	*Pluvialis apricaria*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	
60	Grey Plover	*Pluvialis squatarola*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	
61	Lapwing	*Vanellus vanellus*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	
62	Knot	*Calidris canutus*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	
63	Sanderling	*Calidris alba*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	
64	Purple Sandpiper	*Calidris maritima*	No	No													
65	Dunlin (breeding and passage populations)	*Calidris alpina schinzii and arctica*	No	Yes							n/a	n/a	n/a	n/a	n/a	n/a	
66	Dunlin (wintering population)	*Calidris alpina alpina*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	
67	Ruff	*Philomachus pugnax*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	Only very low numbers of this species occur in the UK
68	Snipe	*Gallinago gallinago*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	
69	Black-tailed Godwit (breeding population)	*Limosa limosa limosa*	No								n/a	n/a	n/a	n/a	n/a	n/a	
70	Black-tailed Godwit (Icelandic)	*Limosa limosa islandica*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	Only 11 birds predicted to be subject to mortality in EA ONE assessment, so deemed to have no material impact and not modelled for EA THREE.
71	Bar-tailed Godwit	*Limosa lapponica*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	
72	Whimbrel	*Numenius phaeopus*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	SPA's in Scotland, as no wintering SPAs for this species, so not suitable for modelling purposes.
73	Curlew	*Numenius arquata*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	
74	Greenshank	*Tringa nebularia*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	Very few SPAs for this species, so not suitable for modelling.
75	Wood Sandpiper	*Tringa glareola*	No								n/a	n/a	n/a	n/a	n/a	n/a	
76	Redshank	*Tringa totanus*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	
77	Turnstone	*Arenaria interpres*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	
78	Red-necked Phalarope	*Phalaropus lobatus*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	SPA's in Scotland, as no wintering SPAs for this species, so not suitable for modelling purposes.

79	Arctic Skua	*Stercorarius parasiticus*	Yes					yes	yes	yes	3.8 (<0.1 - 15.7)	mod	low	mod	mod	high	Migropath not most suitable option for estimating migrant numbers for this species.
80	Great Skua	*Stercorarius skua*	Yes		yes		yes		yes	yes	4.3 (1.2 - 28.4)	high	low	mod	mod	high	Migropath not most suitable option for estimating migrant numbers for this species.
81	Kittiwake	*Rissa tridactyla*	Yes		yes		yes	yes	yes	yes							Reliable survey data used in EIA for this species. Does not require modelling and is considered in main ES Chapter
82	Black-headed Gull	*Chroicocephalus ridibundus*	No	No	yes		yes		yes	yes							Reliable survey data used in EIA for this species. Does not require modelling and is considered in main ES Chapter
83	Mediterranean Gull	*Larus melanocephalus*	Yes								n/a	n/a	n/a	n/a	mod	n/a	Survey data found that use of Site during migration periods does not occur for this species.
84	Common Gull	*Larus canus*	No	No	yes		yes	yes	yes	yes							Reliable survey data used in EIA for this species. Does not require modelling and is considered in main ES Chapter
85	Lesser Black-backed Gull	*Larus fuscus*	Yes		yes		yes	yes	yes	yes							Reliable survey data used in EIA for this species. Does not require modelling and is considered in main ES Chapter
86	Herring Gull	*Larus argentatus*	Yes		yes		yes	yes	yes	yes							Reliable survey data used in EIA for this species. Does not require modelling and is considered in main ES Chapter
87	Great Black-backed Gull	*Larus marinus*	Yes		yes		yes	yes	yes	yes							Reliable survey data used in EIA for this species. Does not require modelling and is considered in main ES Chapter
88	Little Tern	*Sternula albifrons*	Yes								n/a	n/a	low	low	low	mod	
89	Black Tern	*Childonias niger*	Yes								n/a	n/a	low	low	n/a	n/a	
90	Sandwich Tern	*Sterna sandvicensis*	Yes								3.6 (0.7 - 34.9)	mod	low	low	mod	high	
91	Common Tern	*Sterna hirundo*	Yes				yes	yes	yes	yes	12.7 (6.0 - 18.7)	low	low	low	mod	mod	Migropath not most suitable option for estimating migrant numbers for this species.
92	Roseate Tern	*Sterna dougallii*	Yes								n/a	n/a	low	low	mod	mod	
93	Arctic Tern	*Sterna paradisaea*	Yes				yes	yes	yes	yes	2.8 (<0.1 - 23.4)	mod	low	low	mod	mod	Migropath not most suitable option for estimating migrant numbers for this species.
94	Guillemot	*Uria aalge*	Yes		yes		yes	yes	yes	yes							
95	Razorbill	*Alca torda*	Yes		yes		yes	yes	yes	yes							
96	Puffin	*Fratercula arctica*	Yes		yes		yes	yes	yes	yes							
97	Short-eared Owl	*Asio flammeus*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	
98	Nightjar	*Caprimulgus europaeus*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	
99	Woodlark	*Lullula arborea*	Yes								n/a	n/a	n/a	n/a	n/a	n/a	
100	Dartford Warbler	*Sylvia undata*	No								n/a	n/a	n/a	n/a	n/a	n/a	
101	Aquatic Warbler	*Acrocephalus paludicola*	?								n/a	n/a	n/a	n/a	n/a	n/a	

APPENDIX 2: ASSESSING NORTHERN GANNET AVOIDANCE OF OFFSHORE WINDFARMS

ASSESSING NORTHERN GANNET AVOIDANCE OF OFFSHORE WINDFARMS

EAST ANGLIA OFFSHORE WIND LTD

Final

DATE: 20 June 2014

APEM REF: 512775

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Revision and Amendment Register

Version Number	Date	Section(s)	Page(s)	Summary of Changes	Signed off by
Draft Final	28/04/2014	5	12	Initial Release	M Rehfisch
Final	09/06/2014	5	26	Second draft release	M Rehfisch
Final	17/06/2014	5	26	Final release	M Rehfisch

Contents

EXECUTIVE SUMMARY

1. A novel approach is presented for estimating northern gannet *Morus bassanus* macro- and micro-avoidance of offshore windfarms from high resolution digital images gathered from aerial survey. This approach calculates macro- and micro-avoidance based on the measured change in gannet density at a distance from the windfarm and inside the windfarm.

2. Four aerial surveys of the built Greater Gabbard offshore windfarm (GGOWF) were carried out between 30 October 2014 and 23 November 2014, a period of high gannet autumn passage off the East Anglian coast and in the southern North Sea.

3. Digital images were collected by planes flying at over 300 m leading to no observable disturbance to the birds and thus minimising any bias in the data. Each survey consisted of between 14 and 20 pseudo-randomly generated transects, with the caveat that each transect had to either cross or abut the windfarm. Each transect started and ended 10 km before and after the GGOWF, respectively. In total the four surveys covered 320% and 75% of the windfarm footprint and buffer areas, respectively, with 570 m wide transects.

4. In total 336 gannets were recorded in the images during the four autumn passage surveys of which eight and 328 were recorded within and outside the GGOWF footprint, respectively. The gannets had a minimum recorded approach distance of 443 m and 359 m away from the nearest turbine within and outside the footprint, respectively.

5. A zero-inflated negative binomial model is used to describe the relationship between the distance to the nearest turbine and gannet counts outside of the GGOWF footprint.

6. The model suggests that gannet numbers change with distance to the built windfarm (P=0.0518). Gannet counts increase from zero close to the turbines to reach a "background at sea" plateau two kilometres away from the nearest turbine. The lower density within two kilometres of the windfarm is likely to reflect gannets avoiding the vicinity of the GGOWF.

7. A macro-avoidance value of 95.02% has been calculated for gannets as the percentage change from their background at sea density 4 km or more outside of the GGOWF compared to their density within the GGOWF footprint. A distance of 4 km outside the GGOWF is used rather than 2 km to ensure that a robust background gannet density is used. Observing no birds closer than 359 m to a turbine suggests 100% micro-avoidance and an overall avoidance value of 100%.

8. In conclusion, the results of this study strongly suggest that northern gannets avoid the close proximity of built windfarms, at least during the autumn passage period and they support previous studies that also showed strong avoidance. A 95.02% macro-avoidance value, a 100% micro-avoidance value and a 100% total avoidance value is indicated by the data. Based on the published offshore micro-avoidance value of 97.6% we estimate total avoidance to be 99.9%. It is therefore not unreasonable from the evidence of this study, taken together with previous studies, to suggest that an avoidance rate of 99.5%, at least for autumn passage gannets, may be appropriately precautionary for use in collision risk modelling.

1. Introduction

1. In the UK the prediction of the possible numbers of flying birds that collide with the moving blades of a windfarm is usually carried out using the Band collision risk model (CRM). This model was originally developed for onshore windfarms (Band 2000) and has been revised and refined over the years to include a model for specific application to offshore wind farms (Band, 2012). The model carries out a staged series of calculations starting from the flux of birds passing through the windfarm, as determined by site-specific surveys undertaken before the windfarm is constructed. Each stage of the model reduces, based on the characteristics of each bird species and the parameters of the wind farm, the number of birds that might be at risk of collision. Currently there are two types of Band CRM; the Basic Band Model and the Extended Band Model. The main difference between these models is that the Extended model uses information on the distribution of the proportion of birds flying at different heights within the upper and lower swept height limits[1] when predicting the number of birds that make a transit through the rotor swept area, whereas the Basic model assumes a uniform distribution of birds within the upper and lower swept height limits (ie at potential collision height). The output of both models in the penultimate stage is a prediction of the number of birds that collide assuming that each bird has taken no avoiding action. The final stage of the modelling process is to apply an avoidance factor. This single figure accounts for the behaviour that a flying bird might exhibit when encountering the constructed windfarm in order to avoid colliding with the turbines. Such avoiding actions might be taken at some distance from the windfarm, on a close approach to the outside of the windfarm, or on a close approach to the moving turbine blades.

2. The post-construction monitoring of onshore windfarms has allowed the theoretical avoidance factor to be replaced, for some species, with a correction factor that has been determined from the comparison of the number of birds killed by the operating windfarm (with suitable adjustment for the undetected corpses) with the number predicted to collide by the Band CRM from pre-construction flight activity information. This correction factor, like the theoretical avoidance factor, combines the avoiding actions that might be taken by a bird at some distance from the windfarm, on a close approach to the outside of the windfarm, or on a close approach to the moving turbine blades.

3. As the collection of the corpses resulting from any collisions at constructed offshore windfarms is very difficult an alternative approach has been taken to produce empirical measures of bird avoidance actions. The approach used has been to track bird flights using radar or cameras or observers or a combination of tracking methods and to record any avoiding action observed. The results of this tracking method have been expressed as the percentage of birds having taken 'macro-avoidance' or 'micro-avoidance'. A recent definition of these terms is provided in Cook *et al*. (2012) that states:

Macro-avoidance	Avoidance of the whole wind farm
Micro-avoidance	Avoidance of individual turbines within a wind farm

[1] For seabirds this is either derived from the BTO modelling of a large number of boat-based baseline surveys [model Option 3] or from surveys of bird flight heights at the specific site for which the CRM is being carried out [model Option 4]

4. Macro- and micro-avoidance values can be combined to produce an overall figure for avoidance that can be used in the Band CRM.

5. An example of this bird tracking method are the visual observation and radar studies in The Netherlands that provided evidence that northern gannets *Morus bassanus* strongly avoid built offshore windfarms (Krijgsveld *et al*. 2011). "*The high proportion of gannets outside the wind farm corresponds with birds flying in a wide range around the wind farm, not even passing the edge*" and "*deflection*" away from the wind farm "*was highest in gannets, that approached the wind farm closely before changing direction*" (Krijgsveld *et al*. 2011: pp 175 & 193, respectively). However this behavioural information has not yet been accepted as providing sufficient evidence to depart from the 'default' and precautionary value of a 98% avoidance rate for seabirds to be applied in Band CRM in offshore windfarm Environmental Impact Assessments (EIAs) submitted as part of applications for consent. This 'default' 98% avoidance rate for seabirds is likely to overestimate the number of predicted collisions. What is a problem for a single site becomes a major consenting issue at the in-combination stage when what could be a series of overly precautionary collision estimates are summed leading to cumulative mortality estimates that if true could lead to gannet population declines at various spatial scales.

6. This report describes how gannet avoidance of offshore windfarms during the autumn passage period was explored empirically using a novel approach that is able to determine values for macro-avoidance and micro-avoidance.

7. Specifically for this study, the definitions of Cook *et al*. (2012) of macro- and micro-avoidance have been developed to describe both the gannet behaviour and how the changed distribution resulting from that behaviour can be measured and analysed:

   Macro-avoidance is defined in behavioural terms as:

   The gannet does not enter the area that is bounded by the outer turbines of the array

   Macro-avoidance is defined in measurable terms as:

   A change in gannet background at sea density relative to its density within the windfarm.

8. With regard to defining the area within which micro-avoidance will be measured in this study, accounting for rotor radius (53.5 m from 4C (2014)), bird wingspan (ca 2 m) and vortex effects (of uncertain size but presumed to be in the order of 20 m) it would seem reasonable to expect micro-avoidance to occur within less than 75 m of each turbine hub.

9. A hypothesis-testing approach was taken predicting before data collection that gannet densities would be lowest adjacent to the windfarm rising rapidly to reach a background at sea density (Figure 1).

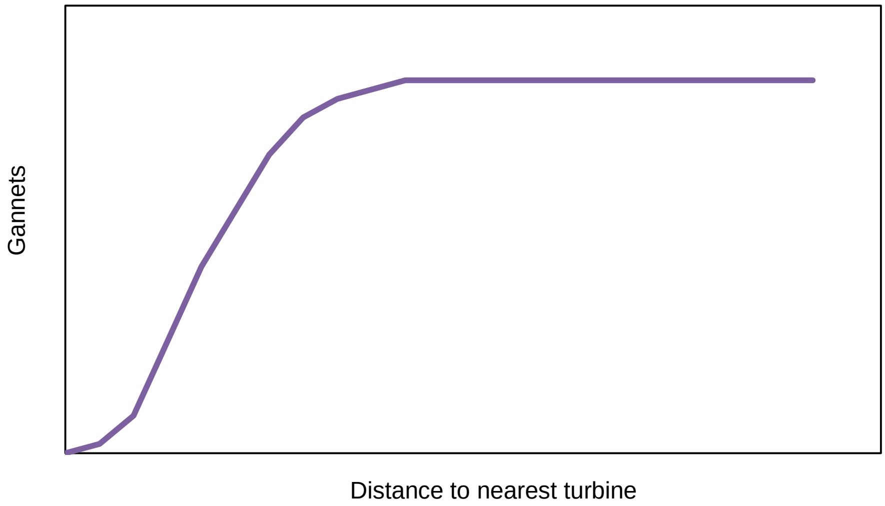


Figure 1 Diagrammatic conceptual presentation of how gannet numbers could change with distance to the nearest turbine proposed by the authors. Krijgsveld *et al*. (2011) suggest 5 km avoidance for many seabirds and "deflectance" for gannets at 500 m. If deflectance were to occur this conceptual curve would be expected to feature a "hump" on it to reflect the extent of the deflectance. Please note that this graph could include birds inside the windfarm footprint.

10. This novel approach to assessing seabird avoidance relies on high quality, unbiased high resolution digital images obtained using aerial survey that due to the flight height of the survey platform minimises disturbance to the birds.

2. Methods

2.1 Approach

11. The methodological approach taken is in two stages. First, the distance at which gannets start reacting to a built windfarm is estimated by modelling gannet density with distance to windfarm. Beyond this distance is where we can expect to record background at sea gannet densities where the birds are not affected by the windfarm.

12. Second, any change in gannet densities between the background at sea and the within windfarm footprint provides an estimate of macro-avoidance. Any further decline in gannet density within 75 m of all hubs (see paragraph 7 in Introduction for further details) provides an estimate of micro-avoidance.

13. As described by Cook *et al*. (2012) total avoidance is calculated as follows:

(1 – Total Avoidance) = (1 – Macro-avoidance) ✕ (1 – Micro-avoidance)

2.2 Data collection

14. Following discussions with the windfarm operator, APEM completed 4 aerial survey campaigns to sample gannet distributions in the footprint area of the Greater Gabbard offshore wind farm (GGOWF) and its vicinity using digital imagery.

15. To determine in a statistically defensible manner any relationship between gannet numbers or density and distance to an offshore wind farm during migration the study aimed to record the location of a minimum of 200 gannets over a period of four days to allow for possible differences in behaviour with weather. A sample of 200 was predicted to be sufficient to identify a strong relationship between animal numbers and a “factor”. If no relationship were to be observed between gannet numbers or density and distance to windfarm from 200 birds it is unlikely that a less clear relationship would be strong enough to lead to a substantial change in gannet avoidance rate.

16. It was estimated that four flights each comprising ten quasi-randomly selected transects (Figure 2) should obtain the target 200 records of individual gannets. Each straight line transect would start 10 km away from the nearest point of the GGOWF, cross or abut the GGOWF, and finish 10 km on the other side of the nearest point of the GGOWF. The sampling effort of 1000 km^2 of images required was estimated from known densities of over 0.2 gannets / km^2 passing through this part of the North Sea during the peak autumn passage period of October to November (Stone *et al*. 1995, 2008-2010 GGOWF survey information). By each transect crossing or abutting the GGOWF a high proportion of the imagery was collected in the windfarm footprint or near the turbines, the key areas where collisions could occur.

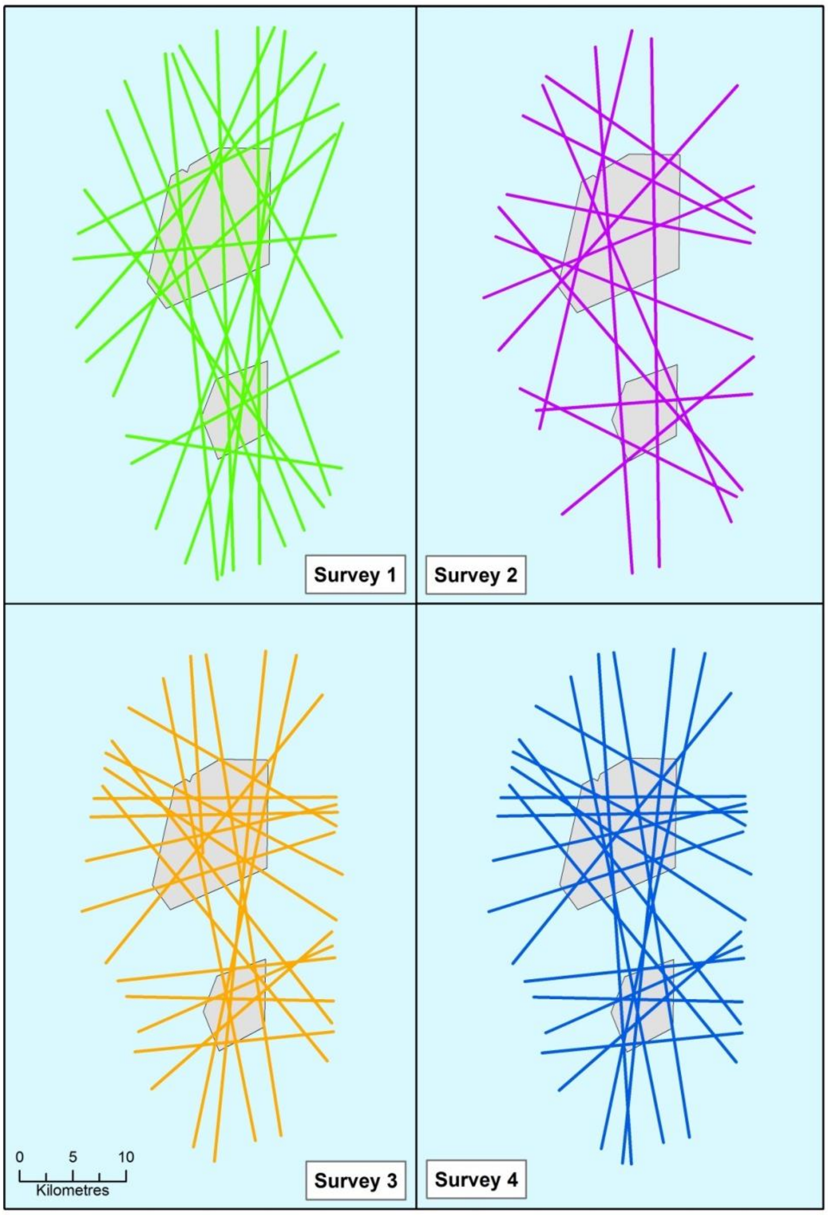


Figure 2 Gannet survey of the Greater Gabbard windfarm using quasi-random transects. The outlines of the Greater Gabbard windfarm footprints are shown in grey.

17. The four aerial surveys of the GGOWF were carried out between 30 October 2014 and 23 November 2014, a period of high gannet autumn passage off the East Anglian coast and in the southern North Sea. The four flights collected images from 19, 14, 20 and 20 transects. The flights were undertaken using Vulcanair P68 twin-engine survey aircraft. The digital still images were collected using a GPS-linked bespoke flight management system from a height of over 1,000 feet to help ensure minimal disturbance. The data were captured along a continuous transect ca 570 m wide. The crew noted any vessels in the survey area.

18. Gannets identified from the images were 'snagged' (i.e. located within the images) and Quality Assured (QA) internally by the APEM UKAS-accredited ornithology team. Each gannet was georeferenced with an accuracy of 20 m or less.

2.3 Data analysis

19. The dataset consists of 34,497 individual observations (images) each representing an aerial photograph of the survey area (Tables 2 and 3). Between one and five gannets were present in 260 images. The 73 transects led to a total image coverage of 1,459 km^2, equating to 320% and 75% of the windfarm footprint and buffer areas, respectively.

Table 1 Structure of the Gannet dataset used in the analysis. "Rank" is the observation number, "GannCount" (or "GannCount01") is the number of gannets counted in each photograph (response variable), and all other variables were used to try and explain the observed gannet numbers.

Variable name	Type	Comment
Rank	Integer	34,497 observations / images
GannCount	Integer	Number of gannets - range 0 to 5
GannCount01	Numerical	Presence / absence of gannets
TurbineDist	Numerical	Distance to turbine (m)
SQRTurbineDist	Numerical	Square root of distance to turbine (m)
fSurvey	Factor	4 levels representing 4 survey days
Footprint	Factor	2 levels: 1 = within and 0 = without

20. Only images taken outside of the GGOWF footprint were included in the modelling. The explanatory variable (GannCount) was characterised by a large proportion of zero counts (98.9%). This is a common problem for the analysis of ecological datasets where the subjects of interest have a low probability of capture or detection. Zero-inflated (ZI) count models have been used to investigate the underlying distribution patterns under such conditions (Jackman 2012). The ZI approach consists of two parts: a binary (probability) model to account for the excess zeros (overdispersion) and a count model to evaluate the effect of the covariates on the response variable. Both are fitted simultaneously using a range of explanatory variables.

21. The gannet counts were modelled using distance to the nearest turbine on the windfarm periphery as the main explanatory variable. The model allowed for differences in migrating gannet numbers that could be brought about by weather or other stochastic / random variables on individual survey dates. This was done by having a "Survey" variable (fSurvey) that could account for unexplained survey-specific factors affecting gannet counts, such as differences in weather between survey days that could lead to the increased presence of migrating birds. The initial data exploration and model selection approach are presented in Appendix 1.

22. The expectation was to find gannet counts increasing with turbine distance (proxy for distance to the windfarm) if gannets actively avoid the windfarm area. Conversely, the expectation would be that at a certain distance threshold from the nearest turbine, gannet counts would remain broadly constant as representing normal 'gannet at sea' density.

3. Results

3.1 Gannet distributions

23. In total 336 gannets were recorded in the 34,497 survey images during the four autumn passage surveys (Table 2, Figure 3, Appendix 1). The four surveys collected 12,979, 2,900, 9,140 and 9,478 images, respectively. Of these gannets, 328 were outside the windfarm. It is important to note that a proportionally high survey effort was close to the turbines adding confidence that birds near the turbines would not be missed (Table 2). For example, 39% (13,456) of the images were gathered within 1 km of a turbine.

Table 2 Number of digital images collected according to distance to nearest turbine. Note uneven divisions of distances to nearest turbine to provide more detail of image and gannet numbers close to turbines.

Distance to nearest turbine *km*	Number of digital images inside and outside windfarm footprint			Gannets		
	Inside	Outside	Total	Inside	Outside	Total
0 - 0.25	2,065	65	2130	0	0	0
0.25 – 0.5	5,645	418	6063	2	2	4
0.5-0.75	2,683	836	3519	3	6	9
0.75-1	777	967	1744	2	12	14
1-1.25	142	952	1094	1	11	12
1.25-1.5		955	955		8	8
1.5 - 1.75		873	873		6	6
1.75 - 2		961	961		15	15
2 - 2.5		1862	1862		47	47
2.5 - 3		1732	1732		28	28
3 - 4		3390	3390		45	45
4 - 5		2536	2536		46	46
5 - 6		2476	2476		32	32
6 - 7		2412	2412		25	25
7 - 8		1264	1264		22	22
8 - 9		789	789		12	12
9 - 10		521	521		7	7
10+		178	178		4	4
TOTAL	11,311	23,186	34,497	8	328	336

24. Up to a distance of two kilometres, both inside and outside of the GGOWF, the density of gannets decreased strongly as turbines became closer (Table 3). This decrease was especially strong within the windfarm footprint providing evidence that birds are actively avoiding turbines and do not get disorientated within a windfarm. The proportionally high survey effort close to the turbines adds confidence that the birds are avoiding the turbines.

Figure 3 Distribution of gannets around Greater Gabbard Offshore Windfarm

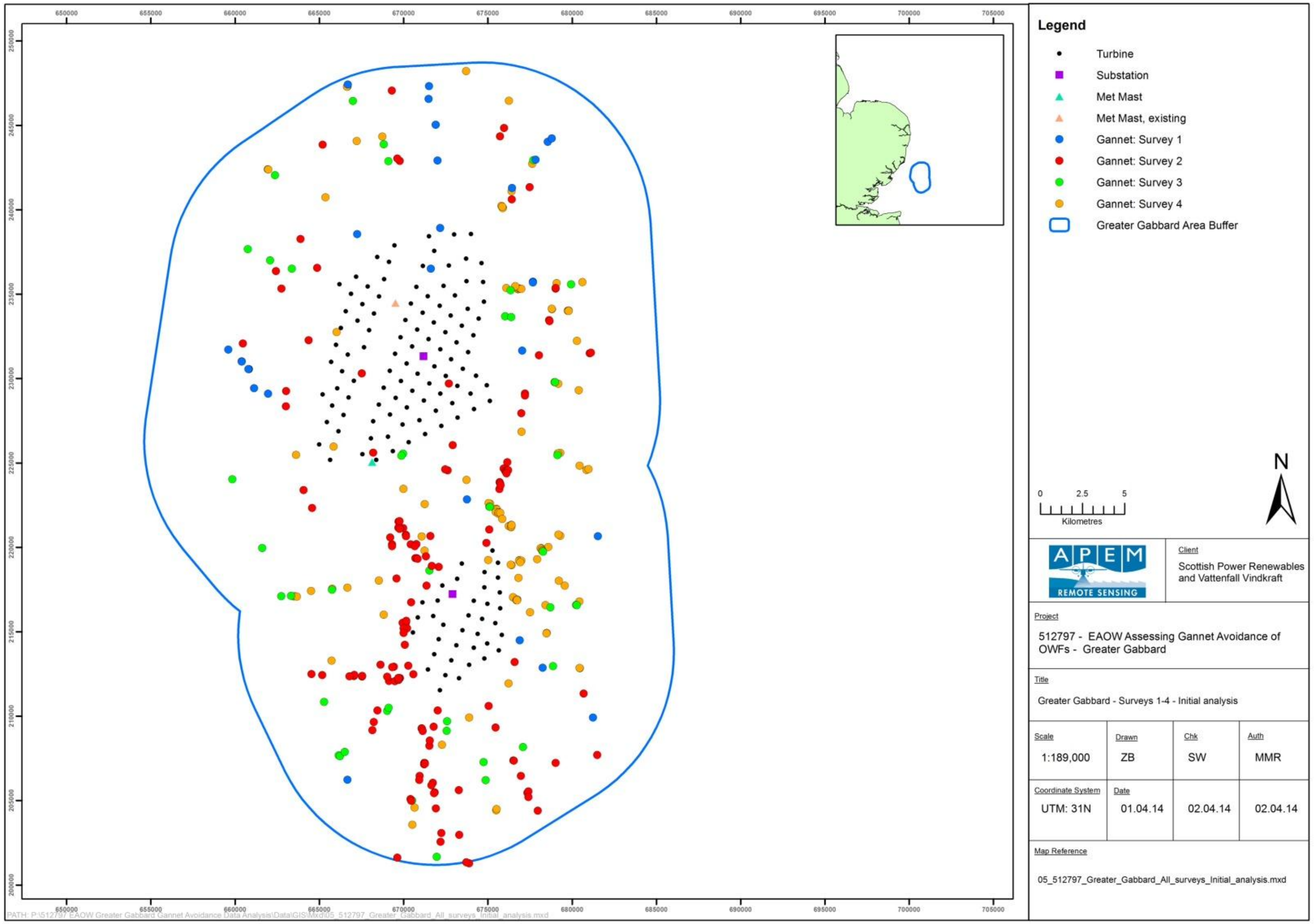
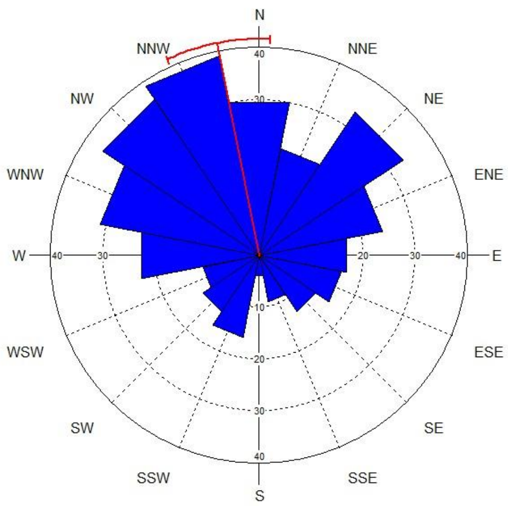


Table 3 Density of gannets inside and outside the GGOWF footprint according to distance to nearest turbine.

Distance to nearest turbine *km*	Gannet densities inside and outside windfarm footprint km^{-2}	
	Inside	Outside
0 - 0.25	0	0
0.25 – 0.5	0.0085	0.1138
0.5-0.75	0.0261	0.1647
0.75-1	0.0615	0.2927
1-1.25	0.1611	0.2782
1.25-1.5		0.1979
1.5 - 1.75		0.1598
1.75 - 2		0.377
2 - 2.5		0.5946
2.5 - 3		0.3836
3 - 4		0.3146
4 - 5		0.4294
5 - 6		0.3094
6 - 7		0.2427
7 - 8		0.3938
8 - 9		0.3413
9 - 10		0.3027
10+		0.4803

25. The nearest gannets to a turbine within and without the windfarm footprint were 443 m and 359 m away from the device, respectively.

Figure 4 Flight direction of gannets around GGOWF (mean and standard deviation in red).



26. Most gannets during the four surveys were recorded flying in a northerly direction (Figure 4). This matches observations made at Thorpeness, Suffolk in November 2013 and recorded on Trektellen (eg 17 and 23 November).

3.2 Change in gannet counts with distance to turbine

27. The count model evaluated takes the following form:

Logit (GannCount) = Intercept + b1 (SQRTurbineDist)

where b1 is a constant

28. The count model was implemented with a negative binomial where the Logit of the outcome is predicted with the explanatory variable distance to the nearest turbine. The model was constructed and evaluated using R (library pscl) (Table 4).

Table 4 Syntax and model summary. Under the zero inflation approach two models are fit simultaneously. The count model (top) accounts for the probability of excess zeroes and the zero-inflation model (bottom) predicts the response variable according to the selected covariates. The model was constructed with a binomial fit to estimate the zero-inflation coefficients and a negative binomial fit for the count model coefficients.

<table>
<tr><td colspan="6">Model = zeroinfl(formula = GannCount ~ SQRTurbineDist + fSurvey | SQRTurbineDist, data = GannetDataframe, dist = "negbin", link = "logit")</td></tr>
<tr><td></td><td>Estimate</td><td>Std. Error</td><td>z value</td><td>Pr(>|z|)</td><td></td></tr>
<tr><td colspan="6">Count model coefficients (negative binomial with logit link):</td></tr>
<tr><td>(Intercept)</td><td>-5.397419</td><td>0.464961</td><td>11.608</td><td>-< 2e-16</td><td>***</td></tr>
<tr><td>SQRTurbineDist</td><td>-0.00198</td><td>0.005854</td><td>-0.339</td><td>0.7342</td><td></td></tr>
<tr><td>fSurvey2</td><td>2.953604</td><td>0.225161</td><td>13.118</td><td>< 2e-16</td><td>***</td></tr>
<tr><td>fSurvey3</td><td>0.732523</td><td>0.243202</td><td>3.012</td><td>0.0026</td><td>*</td></tr>
<tr><td>fSurvey4</td><td>1.606030</td><td>0.214037</td><td>7.504</td><td>6.21e-14</td><td>***</td></tr>
<tr><td>Log(theta)</td><td>-2.900140</td><td>0.179019</td><td>-16.200</td><td>< 2e-16</td><td>***</td></tr>
<tr><td colspan="6">Zero-inflation model coefficients (binomial with logit link):</td></tr>
<tr><td>(Intercept)</td><td>3.30936</td><td>1.60727</td><td>2.059</td><td>0.0395</td><td>*</td></tr>
<tr><td>SQRTurbineDist</td><td>-0.12218</td><td>0.06282</td><td>-1.945</td><td>0.0518</td><td>(*)</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">Theta = 0.055
Number of iterations in BFGS optimization: 52
Log-likelihood: -1456 on 8 Df

*** P<0.001 ** P<0.01 * P<0.05 (*) P<0.10</td></tr>
</table>

29. Survey day (fSurvey) has a strong effect in the count model suggesting that gannet counts vary across survey events. This is almost certainly due to the fact that migrating bird numbers can vary from day to day, with high migration intensity often being associated with good weather conditions. The level of significance in the zero-inflation model (Table 4)

suggests that the number of gannets changes with distance. The model estimates show a sharp increase in gannet counts with distance that peaks at approximately 2,000 m from the nearest turbine (Figure 5). The model estimates are supported by the observed gannet densities (Table 3). This trend being shared across surveys increases confidence that the general pattern of distribution has an ecological meaning (Figure 6). Further from this point the members are relatively constant and probably reflect normal gannet abundance at offshore locations away from the turbine or background at sea numbers.

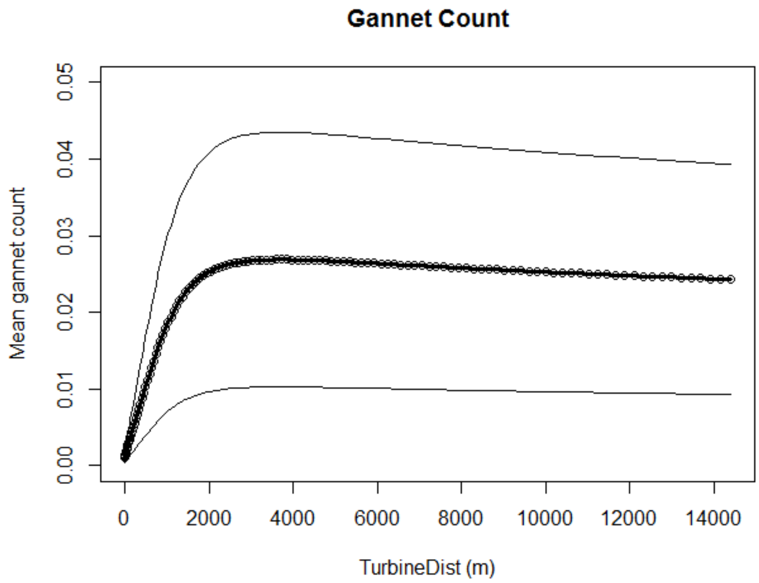


Figure 5 Graphical output of the ZI gannet count model. The figure presents the mean predicted gannet counts (middle line) and the standard error (top and bottom lines) of the four survey event. "Mean gannet count" represents the number of gannets predicted per image.

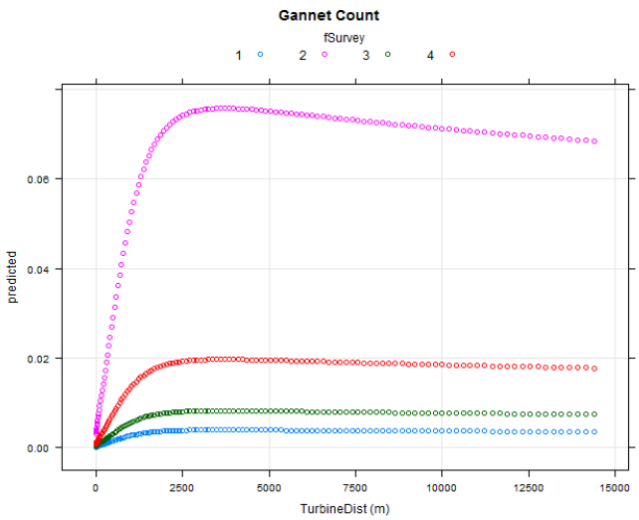


Figure 6 Graphical output of the ZI gannet count model for each separate survey. "Predicted" represents the number of gannets predicted per image.

3.3 Macro- and micro-avoidance calculations

30. Macro-avoidance is estimated to be 95.02% based on the change in density between the background at sea density of gannets and the density of gannets recorded within the windfarm footprint (Table 5). Although the model suggests that the gannet at sea densities start some 2 km from the GGOWF, only gannet densities greater than 4 km from the GGOWF have been used to help ensure that the background density used only comprises birds far enough away from the windfarm that they should be unaffected by it.

Table 5 Macro avoidance parameters and calculation.

	Gannet *numbers*	Area surveyed *km*^{2}	Mean density *km*$^{-2}$		Avoidance *%*
Footprint	8	473.1040	0.01691	A	
4-11 km outside (background at sea density)	148	435.9712	0.33947	B	
Macro-avoidance (1 – A / B)					95.02%

31. No birds were recorded closer than 359 m to a turbine. As a result the density of birds at the distance at which micro-avoidance could be occurring can only be calculated as 0 birds per km^2. As a result the evidence available is that there is 100% micro-avoidance occurring.

32. The few micro-avoidance estimates have been made using radar and / or visual observations (Krijgsveld *et al*. 2012, Desholm & Kahlert 2005) and it is Krijgsveld et al. (2012) who have generated the greatest number of species-specific estimates. However these were based on a single constant micro-avoidance rate measured using radar that will have been influenced by the large number of passerines in the sample. This is possibly unfortunate as the avoidance behaviour of passerines may be different to that of gannets. In this study, having sampled proportionally most in the areas adjacent to the turbines and yet observed no birds closer than 359 m to a turbine the evidence points to 100% micro-avoidance.

33. As the evidence points to 100% micro-avoidance, clearly the overall avoidance would also be 100%.

4. Discussion

34. The distribution of gannets in the vicinity of the GGOWF is represented diagrammatically in Figure 3 and Appendix 1. Only eight of the 336 gannets recorded were within the turbine array. The nearest gannets to a turbine hub were 443 m and 359 m away within and without the GGOWF footprint, respectively.

35. For simplicity and ease of interpretation no extra covariates have been added to the models and all of the data have been pooled into a single analysis. It is important to note that the spatial location of the observation (image) with respect to the windfarm or the observed gannet(s) flight direction is not considered in the model.

36. The model describes gannet counts increasing with distance outside of the windfarm for about 2 km indicating a strong avoidance reaction (Figures 5 and 6). This increase is apparent when looking at the change in gannet density with distance to turbines both within and without the footprint (Table 3). The model then describes gannet counts reaching a plateau of about 0.025 gannets per image before starting a very slow gradual decline. This gradual decline is especially clear for the second survey that recorded the highest gannet counts (Figure 6). This gannet peak at about 2 km may reflect a change in behaviour by the birds when they become aware of the offshore windfarm. If the gannets were to spend more time at that distance while considering how to respond to the potential hazard this would lead to an apparent slight increase in their presence and thus density at that distance. This sort of behaviour has been called "deflectance" by Krijgsveld et al. (2012). The pattern is consistent across surveys and appears to be independent of absolute gannet counts, although part of the similarity may be due to the type of curve fit to the data. The consistent pattern between surveys demonstrates that the results are robust. The distribution of gannet counts is as hypothesized at the start of the study, allowing for some deflectance, and therefore is consistent with the presumption that gannets strongly avoid windfarms.

Table 6 A comparison of gannet avoidance rates.

Site	Avoidance rate (%)			Approach	Study
	Macro-	Micro-	Total		
Greater Gabbard (this study)	95.02	*100* [1]	*100*	Digital aerial images	This study
		97.6 [2]	99.88	Digital aerial images	This study & Krijgsveld *et al.* 2011
Egmond aan Zee	72			Visual observations	Christensen *et al*. 2004 in Cook *et al*. 2012
Egmond aan Zee	64	97.6 [2]	99.1	Visual with radar	Krijgsveld *et al.* 2011
Horns Rev 2	86 [3]			Radar / range-finder	Skov *et al*. 2011

[1] Estimate based on no gannets being seen closer than 359 m from a turbine.

[2] It is important to note that this constant micro-avoidance rate used for all species was measured using radar and may be influenced by the large number of passerines that were tracked.

[3] In this study the total number of tracks is determined and the percentage of the number of tracks that entered the wind farm is calculated and this is subtracted from 100%. As the report does not state how the number of relevant tracks is estimated and from what area it is not possible to assess the validity of the results.

37. The survey data collected as part of this project strongly suggests that gannets avoid the immediate proximity of built windfarms and this confirms previous findings (Table 6, Krijgsveld *et al*. 2012). The gannet distribution data gathered for this project make it possible to estimate macro-avoidance to be 95.02%, at least during autumn passage, the highest macro-avoidance value that the authors have come across for any species (see, for example, Cook *et al*. 2012).

38. The macro-avoidance rate determined from this study of gannets flying outside of and within the GGOWF is equally applicable to the Basic and Extended Band collision risk models, providing as a starting point, a minimum value for use in both models. This macro-avoidance rate though is only one component of the overall avoidance rate needed for both the Basic and Extended Band collision risk models. A suggestion for calculating an overall avoidance rate has been made by combining this macro-avoidance figure with the micro-avoidance figure from the Egmond aan Zee study (Krijgsveld *et al*. 2011). The Basic and Extended Band models differ in the way that they calculate bird flights close to the sweep of the turbine blades in what from observations is considered to be in the micro-avoidance zone. This is stated in Band 2012 Paragraph 61(ii) as "*If most of the birds flying at risk height (ie above the minimum level of the rotor) do so at a level not far above the bottom edge of the rotor, the probability of passing through the rotor disc is relatively small, simply because the rotor circle occupies less width at that level than, for example, at the midpoint of its diameter. Therefore the expected number of rotor transits is reduced. For some species the reduction may be 50% or more, reducing the collision risk in proportion*." It is considered that this additional degree of avoidance in the Extended model is not included in the Basic model and has to be accounted for by a reduction in the overall avoidance rate to be applied in the Extended model compared to the Basic model. It is not clear to what extent the fine detail of flight paths was recorded in the Egmond aan Zee study that would match the differences in the Basic and Extended Band model and as a result the extent to which their derived micro-avoidance rate can be applied equally to the Basic and Extended Band model. This means that the uncertainty in determination of overall avoidance rate rests at the micro- level.

5. Conclusions

39. The results of this study strongly suggest that northern gannets avoid the close proximity of built windfarms, at least during the autumn passage period. The results also support previous studies that showed strong avoidance.

40. A 95% macro-avoidance value can be determined from the data.

41. The data indicate a 100% micro-avoidance value along with a 100% total avoidance value.

42. Using the Krijgsveld *et al.* 2011 generic micro-avoidance rate of 97.6% a total avoidance rate of 99.9% is estimated.

43. The macro-avoidance rate determined from this study is considered equally applicable to the Basic and Extended Band collision risk models but uncertainty arises over applicability when it is combined with micro-avoidance values derived from other studies to calculate an overall avoidance rate. This is because of differences in the way in which the Basic and Extended Band models treat flights close to the rotor sweep in the micro-avoidance zone.

44. It is not unreasonable from the evidence of this study, taken together with previous studies, to suggest an avoidance rate of 99.5%, at least for autumn passage gannets, may be appropriately precautionary for use in collision risk modelling.

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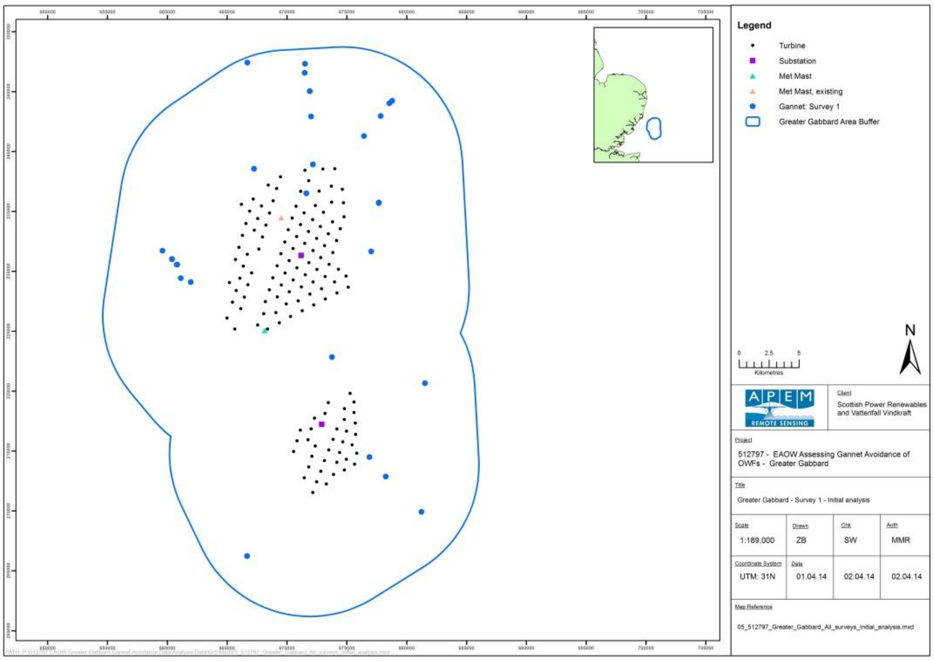
Acknowledgements

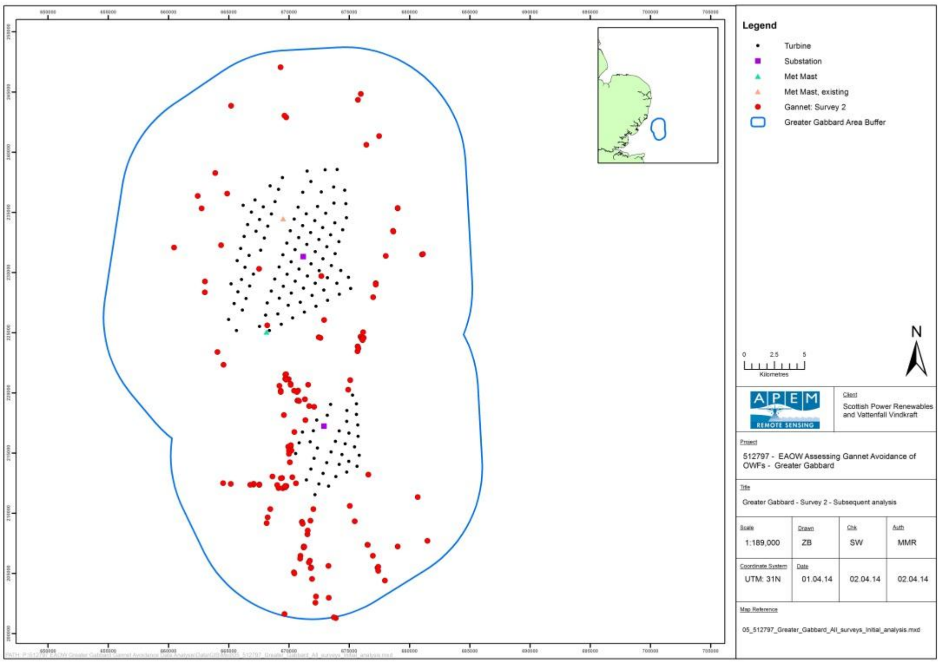
Thanks are due to EAOW for funding this study. Thanks are also due to Sam Andrews, Laura Brown and Beth Goddard who helped produce the figures.

Appendix 1 Individual survey maps showing gannet distribution in the context of the Greater Gabbard Offshore Windfarm.

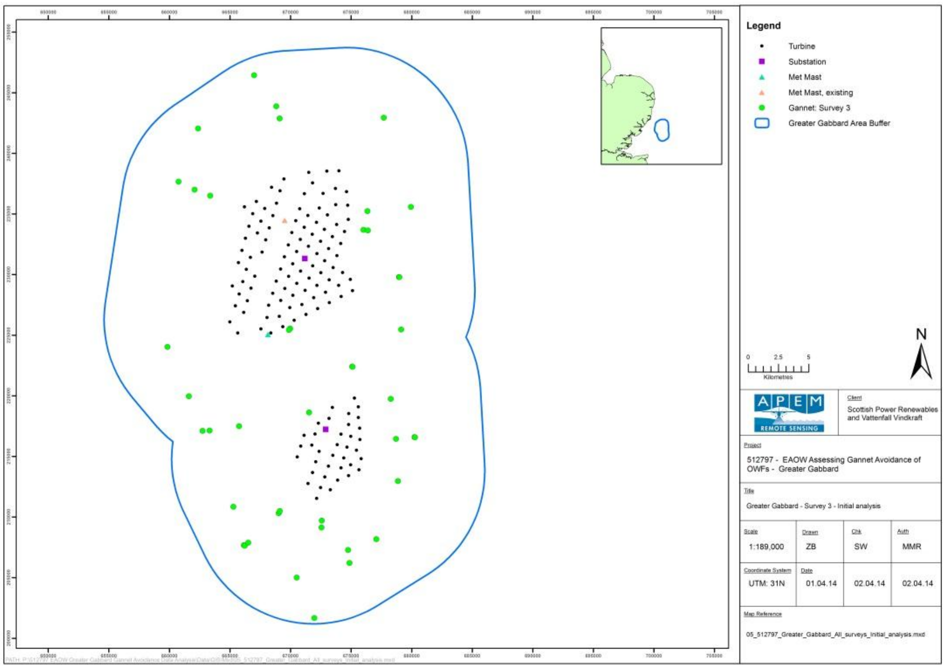
a) Survey 1



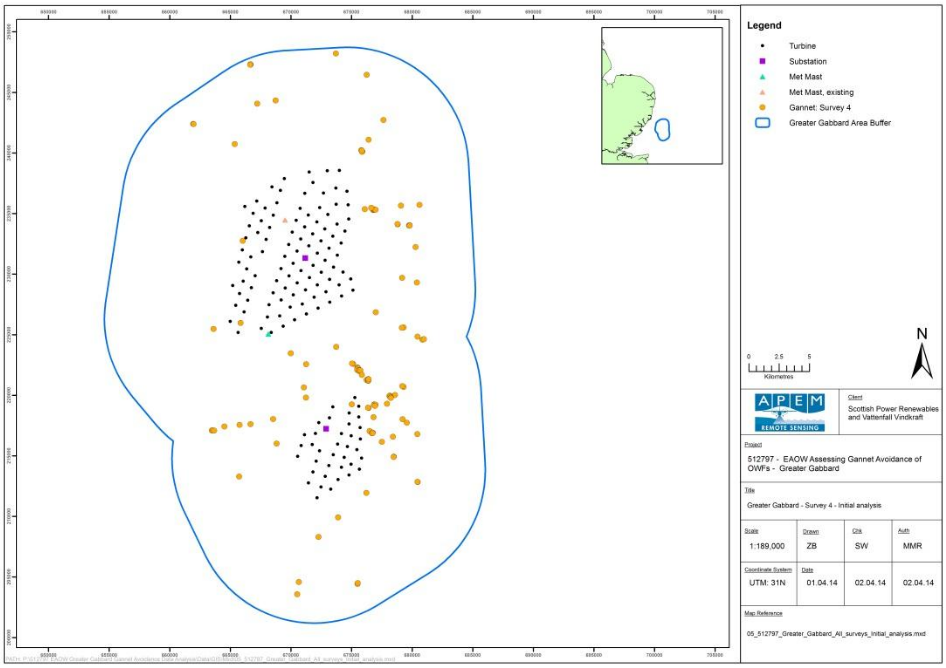
b) Survey 2



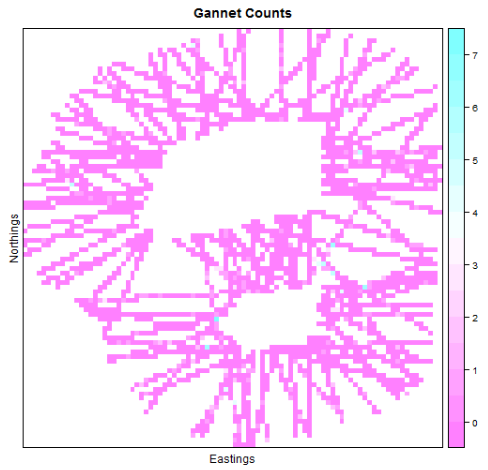
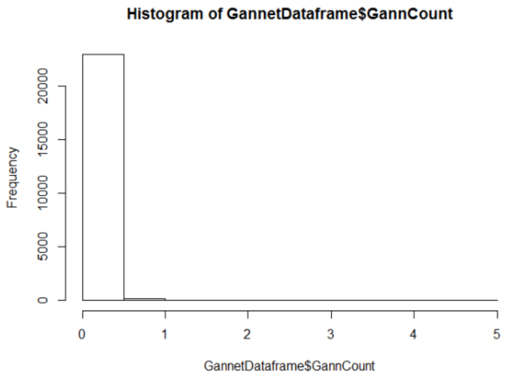
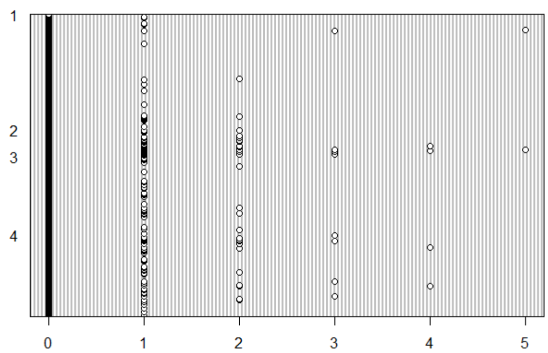
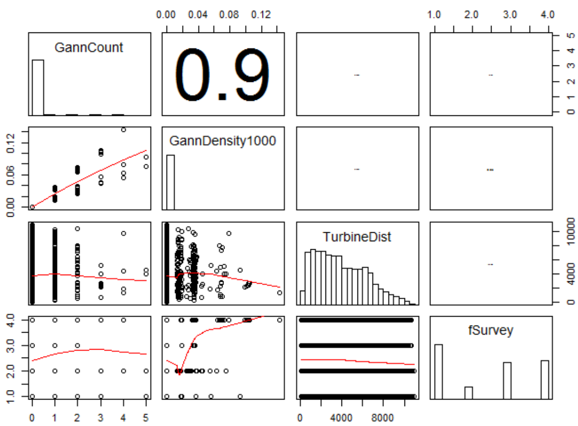
c) Survey 3

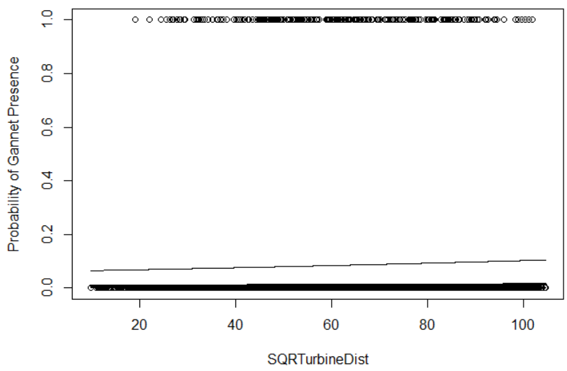
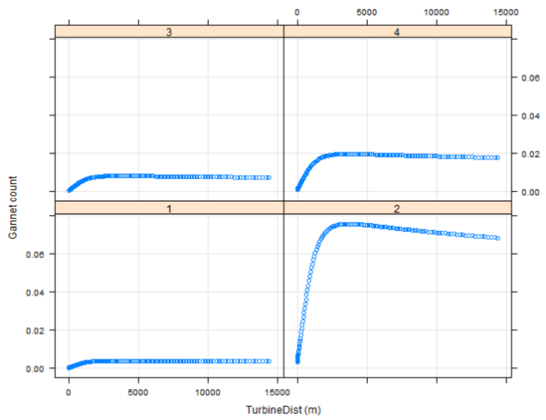


d) Survey 4



Appendix 2 Initial data exploration and model approach selection.

Analysis +code	Plots
Import; > names(GannetDataframe) "Rank" "TurbineDist" "GannCount" "Survey" "TurbineID" "FootprintArea" "GannDensity" "GannDensity1000" "DistBand500" "DistBand250m" "Eastings" "Northings" "TurbFootprint"	Data level plot illustrating the images used in the analysis and the large amount of zeroes in the dataset. 
Histogram of gannet counts per image 	Gannet count per image (x-axis)by survey (y-axis) 
Note: The only practical explanatory variable is distance. Density and counts are highly correlated both could be used as response variable.	Correlation plots between variables with correlation coefficients and frequency histograms. 

Generalised Linear mixed-effects model (GLMM)	
library (MASS) M.glmm<- glmmPQL(GannCount01 ~ SQRTurbineDist, random = ~1|fSurvey, family = binomial, data = GannetDataframe) summary(M.glmm) Linear mixed-effects model fit by maximum likelihood Data: GannetDataframe Random effects: Formula: ~1 | fSurvey (Intercept) Residual StdDev: 1.088474 0.9841691 Variance function: Structure: fixed weights Formula: ~invwt Fixed effects: GannCount01 ~ SQRTurbineDist Value Std.Error DF t-value p-value (Intercept) -4.853849 0.5813948 23182 -8.348629 0.0000 SQRTurbineDist 0.005510 0.0031019 23182 1.776255 0.0757 Correlation: (Intr) SQRTurbineDist -0.329 Standardized Within-Group Residuals: Min Q1 Med Q3 Max -0.26774588 -0.11365471 -0.08314414 -0.05528594 20.97518383 Number of Observations: 23187 Number of Groups: 4	Visualizing the model  **The GLMM model was greatly influenced by the large amount of zeroes in the dataset.**
Zero Inflated model	
zinb zinb = zeroinfl(GannCount ~ SQRTurbineDist + fSurvey | SQRTurbineDist, data=GannetDataframe,dist="negbin",link="logit") summary(zinb) Call: zeroinfl(formula = GannCount ~ SQRTurbineDist + fSurvey | SQRTurbineDist, data = GannetDataframe, dist = "negbin", link = "logit") Pearson residuals: Min 1Q Median 3Q Max -0.17795 -0.11810 -0.08294 -0.06016 76.97009 <u>Count model</u> coefficients (negbin with log link): Estimate Std. Error z value Pr(>|z|) (Intercept) -5.397419 0.464961 -11.608 < 2e-16 *** SQRTurbineDist -0.00198 0.005854 -0.339 0.7342	Visualizing the model 

fSurvey2 2.953604 0.225161 13.118 < 2e-16 ***

fSurvey3 0.732523 0.243202 3.012 0.0026 **

fSurvey4 1.606030 0.214037 7.504 6.21e-14 ***

Log(theta) -2.900140 0.179019 -16.200 < 2e-16 ***

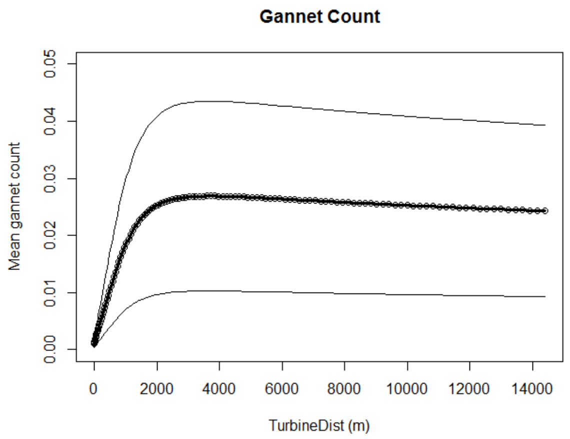
Zero-inflation model coefficients (binomial with logit link):
Estimate Std. Error z value Pr(>|z|)
(Intercept) 3.30936 1.60727 2.059 0.0395 *

SQRTurbineDist -0.12218 0.06282 -1.945 0.0518

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Theta = 0.055
Number of iterations in BFGS optimization: 52
Log-likelihood: -1456 on 8 Df

The Zero Inflated model greatly conforms the a-priory assumptions expecting reduced gannet count near the windfarm and a plateau further away indicative of gannets not affected by the presence of the turbines.



APPENDIX 3: ANALYSIS OF GANNET MOVEMENTS IN THE NORTH SEA FROM THE POST-BREEDING PERIOD

Analysis of Gannet Movements in the North Sea from the Post-breeding Period

East Anglia Offshore Wind Ltd

APEM Ref: 512832-WR2

June 2014

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Revision and Amendment Register

Version Number	Date	Section(s)	Page(s)	Summary of Changes	Approved by
1.A	16/06/2014	All	All	Initial report creation	RB
1.B	24/06/14	3,4 & Appx	-	Review following addition of summary movements, conclusions and figures	RB
2.A	25/06/14	1 & 4	-	Revisions following client feedback	RB
2.B	25/06/14			Final for issue to attendees of OETG Mtg 4	MC

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1. Introduction

1.1 Aim of this study

The aim of this study is to assess the satellite tag data produced by gannets, tagged at Bempton Cliffs in the breeding season, as they move away from the breeding site during the post-breeding period and review if the information is sufficient to inform the quantitative assessment of the potential impacts from the East Anglia THREE offshore wind farm.

1.2 Background

Gannets that occur in the southern North Sea at different periods of the year can be present because they are:

- Associated with a local breeding colony;
- Passing through on passage between a wintering area and a breeding area;
- Wintering in the area; or
- A combination of these.

The assessment of the potential impacts of the proposed East Anglia THREE windfarm has taken account of these different uses of the southern North Sea at different times of year through the seasonal (bio-periods) approach to the evaluation of gannet numbers and distribution. The collision risk modelling (CRM) that has been carried out to assess the potential impacts of the proposed East Anglia THREE windfarm has also been undertaken for each season (bio-period). The modelling method that was applied did not account for the potential differences in behaviour between individuals in the population that were resident in the area for prolonged periods (either in the breeding season or in the winter) and individuals that were passing through on migration. A bird that passes through on migration may only be exposed to collision risk once each passage period whereas a bird that uses the area in the breeding season or in the winter may be exposed to collision risk many times.

The Band CRM is set up in its 'standard' form for offshore wind farms (Band, 2012) to allow predictions of mortality based on a steady density of birds moving through the wind farm on a daily basis over a set period from which the number of transits of the rotor is calculated. The Band CRM also has an additional 'Migrant Collision Risk' prediction method (described in Annex 6 of Band, 2012) that has been produced in recognition that birds might be passing through the wind farm area on migration rather than occupying it throughout a month or season. It is possible to run the model to calculate the separate contributions from birds that are occupying the sea space continuously and from birds occupying the sea space when on migration. This requires an estimate to be made of the period over which migration is occurring and the numbers that are undertaking migration. That estimation can be informed by the analysis of information derived from tagged birds described here.

1.3 The gannet tag data provided by the RSPB

The analysis is based on the recorded movements of adult breeding gannets fitted with satellite tags at Bempton Cliffs as part of a DECC funded study. That study, and particularly the breeding season data, has been reported in Langston *et al*. (2013) with that report providing a description of the tags used and the processing of the tag data (methods, interpretation of data, ARGOS location quality etc) as well as the analysis of the within breeding season movements.

The adult gannets were captured at the Bempton Cliffs colony part way through the breeding season in the years 2010, 2011 and 2012. The received position information from the tags can cover the remaining part of the breeding season and the post-breeding period as long as the tag continues operating. The result is that the number of operating tags reduces as the year progresses. The number of tags that did continue in to the post-breeding period (with that decision on when the breeding season ended for each bird being made by the RSPB) was 4, 7 and 7 for the years 2010, 2011 and 2012 respectively. A summary of the information about those tagged gannets is provided in Tables 1 to 3.

The tags were programmed to transmit location data in a cycle, either operating on a continuous cycle in which location data was transmitted over a six hour period each day or operating on a variable duty cycle in which location data was transmitted over a six hour period on one day and then there was a gap of 24 or 48 hours before the next period of transmission. This approach was used to seek to extend battery life and hence the length of the total period over which location information was received.

Table 1 Summary of the supplied tag data for 2010

Tag ID	60509	60510	60516	60517
Tag type	PTT	PTT	PTT	PTT
Cycle for transmission of location	continuous	continuous	continuous	continuous
Inferred last date of chick rearing period	30/09	24/09	25/08	08/08
Last record date	01/10	01/10	26/08	14/08
Elapsed days (inclusive)	2	8	2	7

Table 2 Summary of the supplied tag data for 2011

Tag ID	110467	110468	110469	110470	110473	110475	110476
Tag type	PTT	PTT	PTT	PTT	PTT	PTT	PTT
Cycle for transmission of location	continuous	continuous	continuous	continuous	variable	variable	variable
Inferred last date of chick rearing period	29/09	17/09	25/09	03/10	26/09	16/09	30/09
Last record date	16/10	12/10	11/10	17/10	27/09	17/10	19/10
Elapsed days (inclusive)	18	26	17	15	2	32	20

Table 3 Summary of the supplied tag data for 2012

Tag ID	60513	107214	107222	107223	110471	118972	118974
Tag type	PTT	PTT	PTT	PTT	PTT	PTT	PTT
Cycle for transmission of location	continuous	continuous	variable	variable	continuous	continuous	continuous
Inferred last date of chick rearing period	23/09	02/10	15/09	21/09	03/10	19/09	24/09
Last record date	05/10	10/10	24/11	06/10	08/10	28/09	30/09
Elapsed days (inclusive)	13	9	71	16	6	10	7

2. Methods

2.1 Processing of individual gannet location records

The individual gannet location records (i.e. each position) from the RSPB supplied data sub-set 'post-breeding' have been processed to draw out the following information:

- Geographical location throughout the duration of tag transmission
- Elapsed time between each location record
- Distance between each location record
- Direction of movement between each location record
- Location record comes from a transmission in light or darkness

These have been carried out as described below.

2.1.1 Geographical location throughout the duration of tag transmission

For each tagged gannet the location has been plotted on a map using ArcGIS.

2.1.2 Elapsed time between each location record

For each tagged gannet the time between adjacent records has been calculated using MSExcel, noting that because individual gannets were tagged with a transmitter operating on a continuous or a variable duty cycle (see Tables 1-3) the elapsed time records for the latter will include elapsed times of over 24 or 48 hours.

2.1.3 Distance between each location record

The distance between each location record has been calculated using ArcGIS, noting that for location records from tags operating in a variable duty cycle this will include distances moved over a 24 or 48 hour period as well as the series of locations within the six hour transmission period.

2.1.4 Direction of movement between each location record

The direction of movement between each location record has been calculated using ArcGIS, noting that for location records from tags operating in a variable duty cycle this will include the direction for a movement over a 24 or 48 hour period as well as the series of movements within the six hour transmission period.

2.1.5 Location record comes from a transmission in light or darkness

The time of each location record was compared to civil twilight for that date and location (taken from http://aa.usno.navy.mil/data/docs/RS_OneYear.php) in order identify if the transmission was made when it was light or dark.

2.2 Classification of the records in to annual stages

Each gannet will be moving through a series of life stages in the course of a year and this will in the second half of the year encompass breeding, post-breeding dispersal (called 'premigratory movements' by Klaassen *et al*. 2011), active migration and wintering. The identification of the first of these life stages, breeding, has already been carried out by the RSPB prior to the provision of the location records to APEM. The RSPB has, based on its knowledge of the attendance of each tagged gannet at the breeding colony, removed the breeding period data and supplied to APEM a worksheet titled <Post breeding> containing that data after the last date of chick rearing.

Of the three subsequent life stages, it is possible that the stage that each gannet is at could be identified from the tag location data. The following characteristics will be used to identify the life stages:

Post-breeding dispersal:	The bird does not return again that autumn to Bempton Cliffs or if it does, it is only erratically, indicating that it no longer has a chick to feed.
Active migration:	The bird is moving in a consistent direction that takes it out of the North Sea or if data points relate only to the bird in the North Sea then the rate of movement is consistent with migration and not local foraging.
Wintering:	The bird has moved out of the North Sea and is no longer moving each day in a consistent direction. It may have reach a stopover location or its long term wintering site

It is recognised that for most birds the tag will have ceased to function before the final 'wintering' stage is reached.

2.3 Synthesis of records within a life stage

Following assessment of the information on an individual bird basis, that information was then examined for commonality between birds in order to explore it for typical patterns of behaviour. Of particular interest are:

- Evidence for a consistent period of time between finishing the chick rearing stage and undertaking active migration.
- Evidence for a consistent date at which active migration out of the North Sea takes place.
- Evidence for a consistent period of time over which migration out of the North Sea takes place.

3. Results

3.1 Summary description of the movements of each tagged gannet

3.1.1 Gannet tag ID 60509 (2010)

The record of movements begins on 30th September 2010 close to the Flamborough coast, the tag provides locations for two days, ceasing on the 1st October 2010 at a location east of Spurn Point. The duration of information on movements was not sufficient to inform the analysis of post-breeding movements. The map of the movements is Figure 1 in the Appendix of Figures. The tag operated on a continuous cycle programme.

3.1.2 Gannet tag ID 60510 (2010)

The record of movements begins on 24th September 2010 close to the Flamborough coast, the tag provides locations for eight days, ceasing on the 1st October 2010 at a location in the North Sea approximately midway between northern Scotland and Norway. Its movements took it rapidly in to the middle of the North Sea before moving northwards, steadily at first, then with a large north-south loop and finally steadily toward the north east Scottish coast. The overall movement is suggestive of a bird that will leave the North Sea via the north of Scotland. The map of the movements is Figure 2 in the Appendix of Figures. The tag operated on a continuous cycle programme.

3.1.3 Gannet tag ID 60516 (2010)

The record of movements begins on 25th September 2010 close to the Flamborough coast, the tag provides locations for two days, ceasing on the 26th September 2010 at a location north of Flamborough head and level with Newcastle upon Tyne. The duration of information on movements was not sufficient to inform the analysis of post-breeding movements. The map of the movements is Figure 3 in the Appendix of Figures. The tag operated on a continuous cycle programme.

3.1.4 Gannet tag ID 60517 (2010)

The record of movements begins on 8th August 2010 close to the Flamborough coast, the tag provides locations for seven days, ceasing on the 14th August 2010 at a location off the Flamborough coast. The RSPB brief on the data (Langston *in litt*) noted that this gannet “left Bempton earlier than would be expected for a successful breeder”. The average date for the end of the breeding period for the other three birds in 2012 was 16th September, some five weeks later than this bird. The map of the movements is Figure 4 in the Appendix of Figures. The tag operated on a continuous cycle programme.

3.1.5 Gannet tag ID 110467 (2011)

The record of movements begins on 29th September 2011 close to the Flamborough coast, the tag provides locations for 18 days, ceasing on the 16th October 2011 at a location on the eastern side of the North Sea at a level with Denmark. As part of its movements this bird made a long loop over seven days from a level with Denmark in to the southern North Sea, passing to the east of the East Anglia Zone and turning round at about the level of East Anglia ONE. The map of the movements is Figure 5 in the Appendix of Figures. The tag operated on a continuous cycle programme.

3.1.6 Gannet tag ID 110468 (2011)

The record of movements begins on 17th September 2011 close to the Flamborough coast, the tag provides locations for 26 days, ceasing on the 12th October 2011 at a location in French coastal waters off the mouth of the Gironde Estuary. The bird spent eight days off the Flamborough Coast before flying north, past the Orkney Isles, round the western side of the Outer Hebrides and round the western side of Ireland before heading south east to French coastal waters where it spent five days before the tag ceased to function. The migratory flight from the Flamborough coast to the French coast took 13 days. The map of the movements is Figure 6 in the Appendix of Figures. The tag operated on a continuous cycle programme.

3.1.7 Gannet tag ID 110469 (2011)

The record of movements begins on 25th September 2011 close to the Flamborough coast, the tag provides locations for 17 days, ceasing on the 11th October 2011 at a location off the coast of eastern England. In that time the bird spent a day close to the Flamborough coast before it moved out in to the central North Sea, on a level with Denmark, where it stayed for 12 days. It then returned toward the English coast for four days, on a level with Spurn Point. The map of the movements is Figure 7 in the Appendix of Figures. The tag operated on a continuous cycle programme.

3.1.8 Gannet tag ID 110470 (2011)

The record of movements begins on 3rd October 2011 close to the Flamborough coast, the tag provides locations for 15 days, ceasing on the 17th October 2011 at a location on the Humberside coast. In that time the bird spent two days off the Flamborough coast before moving in to the southern North Sea where over a period of six days it entered the East Anglia Zone and specifically entered East Anglia THREE and East Anglia FOUR on one day and East Anglia ONE on another day and overnight. It then moved north east to return closer to the Flamborough coast for four days before making another south east and southward movement that took it back to the East Anglia Zone for two days before heading rapidly back to the Yorkshire and Humberside coast for one day when the tag ceased to transmit. The map of the movements is Figure 8 in the Appendix of Figures. The tag operated on a continuous cycle programme.

3.1.9 Gannet tag ID 110473 (2011)

The record of movements begins on 26th September 2011 in the east-central North Sea on a level with Flamborough Head, the tag provides locations for two days, ceasing on the 27th September 2011 at a location close to the Flamborough coast. The duration of information on movements was not sufficient to inform the analysis of post-breeding movements. The map of the movements is Figure 9 in the Appendix of Figures. The tag operated on a continuous cycle programme.

3.1.10 Gannet tag ID 110475 (2011)

The record of movements begins on 16th September 2011 close to the Flamborough coast, the tag provides locations for 32 days, ceasing on the 17th October 2011 at a location off the coast of Africa (Western Sahara). In that time the bird spent two days off the Flamborough coast before moving north and east offshore where it spent seven days before moving rapidly south over a period of four days that took it past the East Anglia Zone (a straight line of flight would have taken it through the East Anglia Zone but no locations were received from within the Zone) and in to the English Channel. Over a period of 10 days it moved through the English Channel, round the north-west tip of France, across the Bay of Biscay and down the Iberian west coast. It took five days moving down the north-west African coast and spent a further four days in an area off the coast of Western Sahara before the tag ceased to transmit. These final locations are in the same area that tagged bird 107222 occurred at the end of its southward migratory flight. The map of the movements is Figure 10 in the Appendix of Figures. The tag operated on a variable duty cycle programme.

3.1.11 Gannet tag ID 110476 (2011)

The record of movements begins on 30th September 2011 close to the Flamborough coast, the tag provides locations for 20 days, ceasing on the 19th October 2011 at a location within the boundary of East Anglia ONE. In that time the bird spent one day off the Flamborough coast before moving in to the central North Sea where it spent 14 days and ranged widely, including in to Dutch waters but moving no further south than level with the Lincolnshire coast. The tag was operated on a variable cycle and in a 48 hour transmission gap the bird moved to the southern North Sea and in the last day on which the tag ceased to transmit it entered the East Anglia Zone and was recorded on one occasion specifically within East Anglia ONE. The map of the movements is Figure 11 in the Appendix of Figures. The tag operated on a variable duty cycle programme.

3.1.12 Gannet tag ID 60513 (2012)

The record of movements begins on 23rd September 2012 close to the Flamborough coast, the tag provides locations for 13 days, ceasing on the 5th October 2012 at a location in the central North Sea on a level with the northern tip of Denmark. In that time the bird spent three days off the Flamborough coast before moving north east in to the central North Sea where it spent the remaining 10 days in a relatively restricted area before the tag ceased to transmit. The map of the movements is Figure 12 in the Appendix of Figures. The tag operated on a continuous cycle programme.

3.1.13 Gannet tag ID 107214 (2012)

The record of movements begins on 2nd October 2012 off the Flamborough coast, the tag provides a further 10 locations over nine days, ceasing on the 10th October 2012 at a location in the central North Sea. The RSPB brief on the data (Langston *in litt*) noted that this tag “returned only intermittent records”. The map of the movements is Figure 13 in the Appendix of Figures. This tag was operated on a continuous cycle programme but it only provided intermittent records.

3.1.14 Gannet tag ID 107222 (2012)

The record of movements begins on 15th September 2012 close to the Flamborough coast, the tag provides locations for 71 days, ceasing on the 24th November 2012 at a location off the coast of Africa (Western Sahara). In that time the bird spent three days off the Flamborough coast before ranging further offshore in English waters between a level with North Yorkshire and North Norfolk over a period of 15 days. It then flew south east and spent a period of four days in, and around, the East Anglia Zone including entering East Anglia ONE twice on one day. It then moved north in to the central North Sea for 13 days.

The tag was operated on a variable cycle and in a 48 hour transmission gap the bird moved from a location off the north-east Norfolk coast to north of the Cherbourg Peninsula, the route over the sea would have taken it past (or through) the East Anglia Zone and through the Strait of Dover. Over a period of 15 days it moved round the north-west tip of France, across the Bay of Biscay and down the Iberian west coast. It took nine days moving from Portugal down the north-west African coast and spent a further 12 days in an area off the coast of Western Sahara before the tag ceased to transmit. These final locations are in the same area that tagged bird 110475 occurred at the end of its southward migratory flight. The map of the movements is Figure 14 in the Appendix of Figures. The tag operated on a variable duty cycle programme.

3.1.15 Gannet tag ID 107223 (2012)

The record of movements begins on 21st September 2012 off the Flamborough coast, the tag provides locations for 16 days, ceasing on the 6th October 2012 at a location in the central North Sea. In that period the bird ranged in the central North Sea from a level in the south with the Yorkshire coast and in the north with a line from eastern Scotland to the northern tip of Denmark. The map of the movements is Figure 15 in the Appendix of Figures. The tag operated on a variable duty cycle programme.

3.1.16 Gannet tag ID 110471 (2012)

The record of movements begins on 3rd October 2012 close to the Flamborough coast, the tag provides locations for six days, ceasing on the 8th October 2012 with a location in the Strait of Dover and then near Lille. In that time the bird moved over a period of three days south-eastward, entering the East Anglia Zone and staying within it for just over 24 hours with one location recorded in the East Anglia ONE site in this period. The bird then moved south and west over a period of two days, reaching the Strait of Dover. The subsequent and last locations were over France but as these were at the point that the tag was ceasing to function they may not be reliable. The map of the movements is Figure 16 in the Appendix of Figures. The tag operated on a continuous cycle programme.

3.1.17 Gannet tag ID 118972 (2012)

The record of movements begins on 19th September 2012 off the Flamborough coast, the tag provides locations for 10 days, ceasing on the 28th September 2012 at a location off the Flamborough coast. In that time the bird spent a little over a day day off the Flamborough coast before ranging for four days over an area relatively close to the English coast between Teesside and Lincolnshire. It then made a southward fight around the East Anglian coast that took it through the East Anglia Zone and specifically one location within East Anglia ONE and down to the Strait of Dover in a period of just over 24 hours. Within the Strait of Dover it turned around and made the same journey back north, slightly west of its southward track, passing through the western extremity of the East Anglia Zone and back to the coastal area between Teesside and Lincolnshire, the journey taking 36 hours. It then spent a further three days off the coast between Teesside and Lincolnshire before the tag ceased to operate. The map of the movements is Figure 17 in the Appendix of Figures. The tag operated on a continuous cycle programme.

3.1.18 Gannet tag ID 118974 (2012)

The record of movements begins on 24th September 2012 close to the Flamborough coast, the tag provides locations for seven days, ceasing on the 30th September 2012 at a location ca 90km off the Yorkshire coast. In that time the bird ranges north to a level with Teesside and south to a level with Spurn point and no further than ca 100km from the English coast. The map of the movements is Figure 18 in the Appendix of Figures. The tag operated on a continuous cycle programme.

3.2 Synthesis of the information

3.2.1 Contribution of individual tags to a consistent data set

Three tags only operated for two days in to the post-breeding period with the location records all being close to the Flamborough coast. Whilst this does show that these birds did not make a migratory movement immediately after they had finished breeding, the information contributes little to that on post-breeding movements and migratory timing and is not considered further in this synthesis.

One tag operated intermittently but as it operated for ten days it does contribute information towards the synthesis of movement information.

The synthesis is based on the information provided by the remaining 15 tags.

3.2.2 Duration in the North Sea prior to active migration

Three of the 15 tagged birds were recorded undertaking active migration which took them out of the North Sea. The number of days between the finish of breeding and the start of active migration for these three birds was:

110468	8 days
110475	9 days
107222	35 days

In addition gannet 110471 flew to the Strait of Dover but the tag ceased operating in that area and as a result it is not known if that bird would have continued migration south or, in the same manner as gannet 118972, turned around and returned to the North Sea. If it was migrating further south then the number of days between the finish of breeding and the start of active migration was less than a full day.

Of the remaining 11 birds whose tags provided information for more than two days but which did not undertake active migration out of the North Sea while the tags were still operating, it is potentially possible that each might have migrated out of the North Sea on the day after the tag ceased. In that circumstance a minimum duration of the period between the finish of breeding and the start of migration can be defined. For those 11 birds that minimum period ranged from 8 to 21 days with an average of 14 days.

3.2.3 Date on which active migration out of the North Sea was initiated

Three of the 15 tagged birds were recorded undertaking active migration which took them out of the North Sea. Active migration was initiated on the following dates for these three birds:

110468 24th September 2011

110475 25th September 2011

107222 19th October 2012

In addition gannet 110471 flew to the Strait of Dover but the tag ceased operating in that area and as a result it is not known if that bird would have continued migration south or, in the same manner as gannet 118972, turned around and returned to the North Sea. If it was migrating further south then it initiated active migration on 3rd October 2012.

Of the remaining 11 birds whose tags provided information for more than two days but which did not undertake active migration out of the North Sea while the tags were still operating, it is potentially possible that each might have migrated out of the North Sea on the day after the tag ceased. In that circumstance the earliest date on which active migration was initiated can be defined. For those 11 birds the earliest date was 14th August 2010 but that individual was identified by the RSPB as finishing breeding unusually early for a successful breeder. Of the remaining 10 birds the earliest date was 28th September 2012 and the latest of those earliest possible dates was 19th October 2011.

3.2.4 Duration of movement through the southern North Sea

Of the three birds that migrated out of the North Sea one departed via the north of Scotland (gannet 110468). For the remaining two birds a duration of movement through the southern North Sea can be defined from the date and time of the location when they started moving southward to undertake the journey that took them in to the English Channel, with the end point for that measure of duration being the date and time of the passage through the Strait of Dover.

For gannet 110475 that duration for the journey taking place between the 26th and the 29th September 2011 was 54 hours 34 minutes, equivalent to 2.3 days.

For gannet 107222 that duration cannot be defined as precisely as the tag was operating under a variable duty cycle. The southward journey was initiated to the north of the Norfolk coast on 19th October 2012 but in the early evening the tag entered the off cycle and did not resume until the early evening of the 21st October 2012 when the bird was located north of the Cherbourg Peninsula. A route over the sea would mean that the Strait of Dover would have been reached within two days.

3.2.5 Summary synthesis

Table 4 provides a summary of this synthesis of the information for each tagged gannet that migrated out of the North Sea (including gannet 110471 over which there is uncertainty as to whether or not it continued southward from the Strait of Dover area where the tag ceased).

Table 5 provides a summary of this synthesis of the information for each tagged gannet for which evidence of migration out of the North Sea was not recorded. The calculation of the minimum duration in the North Sea before migrating accounts for one day to travel through the southern North Sea to the Strait of Dover (noting the evidence above that it most probably takes two days).

Gannet 110471 appears in both tables on account of the uncertainty as to whether it proceeded southward from the Strait of Dover.

Three gannets whose tag had a post-breeding duration of only two days are not included in these tables.

Table 4 Summary of the synthesis of information on tagged gannets that migrated out of the North Sea

Tag ID	Year	Tag duration (days)	Recorded duration in the North Sea prior to migration (days)	Date on which active migration initiated	Duration of movement through the southern North Sea (days)
110468	2011	26	8	24/09/2011	n/a
110475	2011	32	9	25/09/2011	2.3
107222	2012	71	35	19/10/2012	<2
110471	2012	6	[0]	[03/10/2012]	[5.0]

Table 5 Summary of the synthesis of information on tagged gannets for which evidence of migration out of the North Sea was not recorded

Tag ID	Year	Tag duration (days)	Minimum duration in the North Sea if the bird migrated after tag ceased (days)	Earliest date on which active migration initiated if that occurred immediately after tag ceased
60510	2010	8	9	01/10/2010
60517	2010	7	8	14/08/2010
110467	2011	18	19	16/10/2011
110469	2011	17	18	11/10/2011
110470	2011	15	16	17/10/2011
110476	2011	20	21	19/10/2011
60513	2012	13	14	05/10/2012
107214	2012	9	10	10/10/2012
107223	2012	16	17	06/10/2012
110471	2012	6	[7]	[08/10/2012]
118972	2012	10	11	28/09/2012
118974	2012	7	8	30/09/2012

4. Conclusions

From the evidence provided by this analysis of the movement of gannets tagged as breeding birds at the Bempton Cliffs site it can be concluded that in the post breeding period:

- Birds migrate out of the North Sea by both the English Channel and around the northern tip of Scotland.
- Only a proportion of birds (4 out of the 15 that provided substantive information) were observed within the East Anglia Zone as part of their post-breeding dispersal phase of movements. The large majority of birds (13 out of the 15 that provided substantive information) spent all or the majority of their recorded time in the central North Sea. This suggests that the East Anglia Zone in the southern North Sea is not a regularly and consistently important area for gannet from the Bempton Cliffs colony during their post-breeding dispersal.
- Only a proportion of birds (2 out of the 15 that provided substantive information) passed through the East Anglia Zone during their active migratory period of southward movement out of the North Sea through the Strait of Dover.
- Birds that are known to migrate out of the North Sea spend 8 to 35 days in the post-breeding period in the North Sea before migration.
- The southward movement through the southern North Sea to the Strait of Dover is completed within 3 days and appears it can be undertaken in less than two days.

With regard to the assessment of the potential impacts of the proposed East Anglia THREE offshore windfarm:

- The data provides contextual behavioural information on the movements of gannet in the North Sea from the Bempton Cliffs breeding colony but it is insufficient to alter the current approach to the quantitative assessment of the potential impacts of the proposed East Anglia THREE offshore windfarm.

5. References

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Langston, R.H.W., Teuten, E. and Butler, A. (2013). *Foraging ranges of northern gannets* Morus bassanus *in relation to proposed offshore wind farms in the UK: 2010-2012.* RSPB report to Department of Energy & Climate Change (DECC URN: 13D/306). RSPB, Sandy.

Appendix of Figures

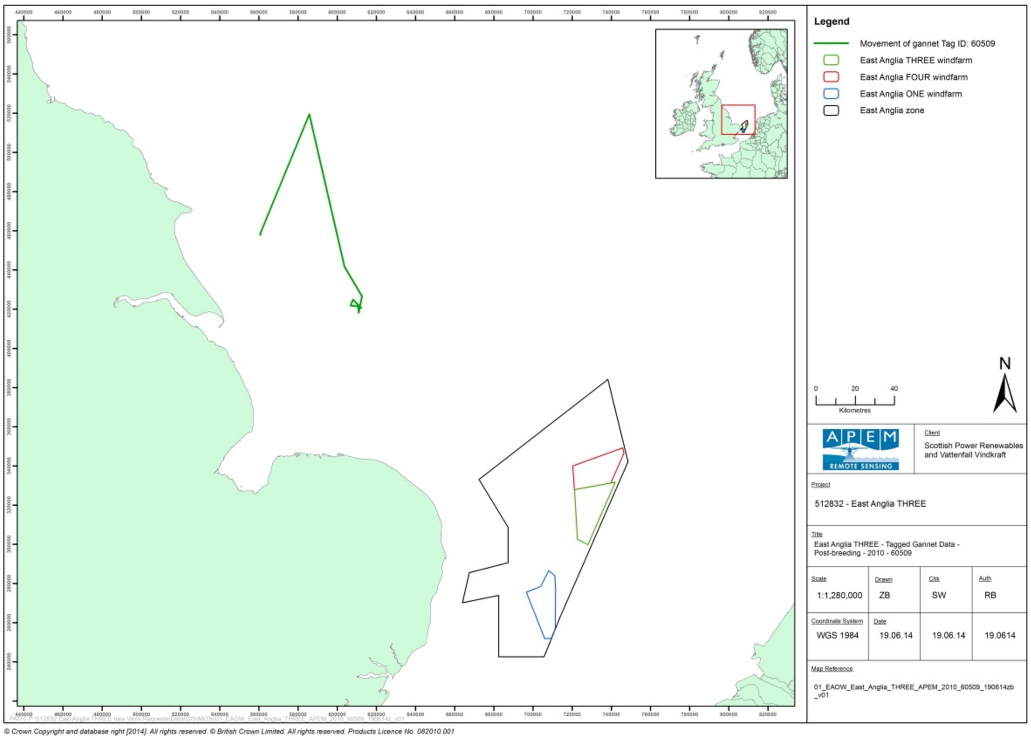

Figure 1 **Movements of gannet tag ID 60509 (2010)**

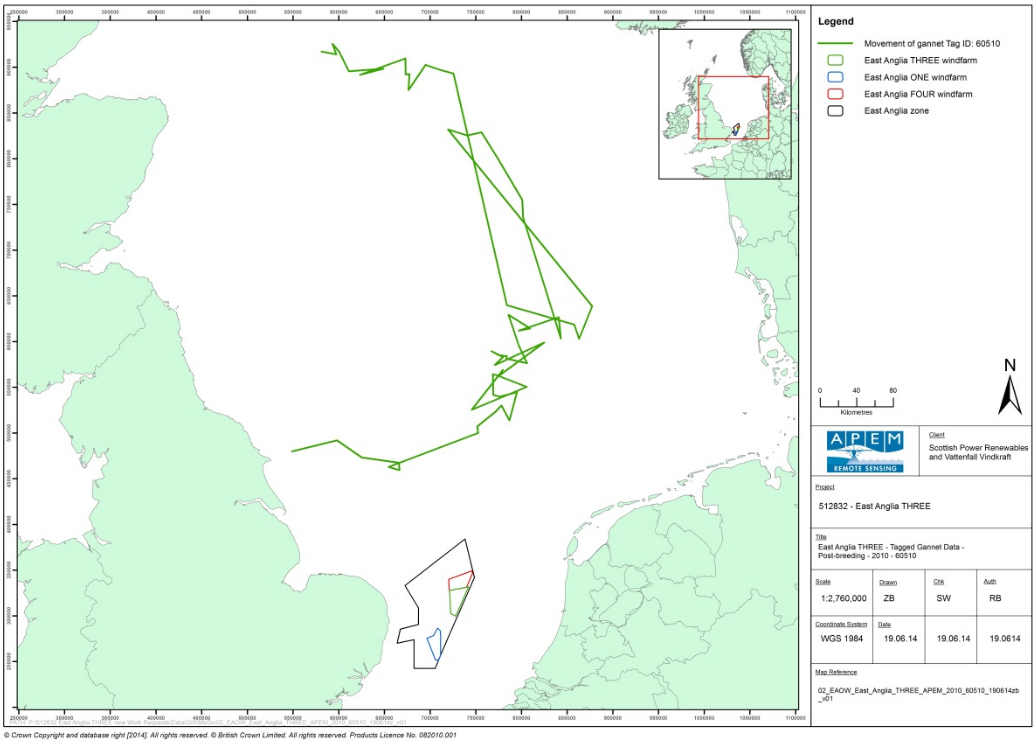

Figure 2 **Movements of gannet tag ID 60510 (2010)**

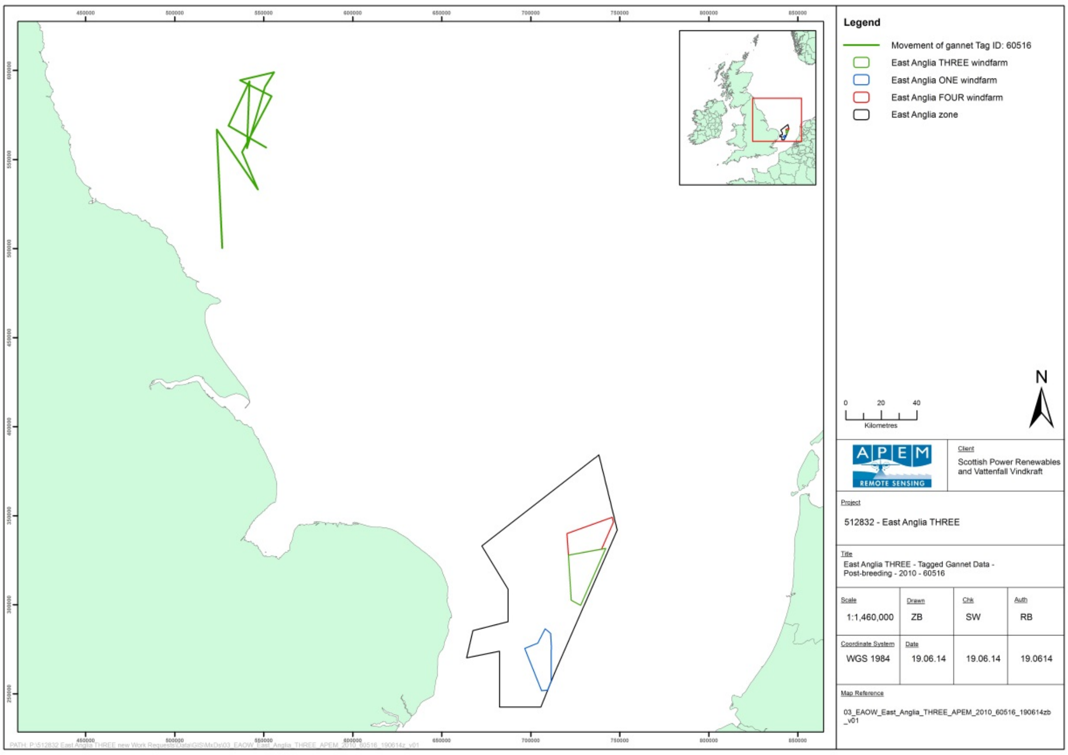

Figure 3 Movements of gannet tag ID 60516 (2010)

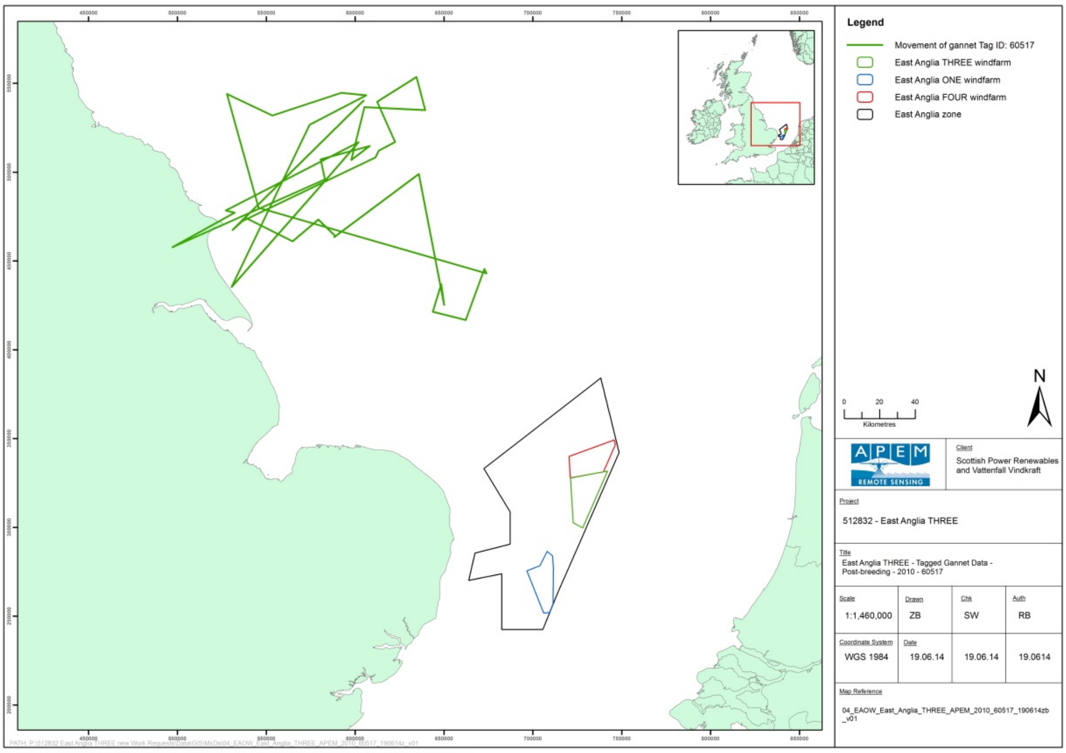

Figure 4 Movements of gannet tag ID 60517 (2010)

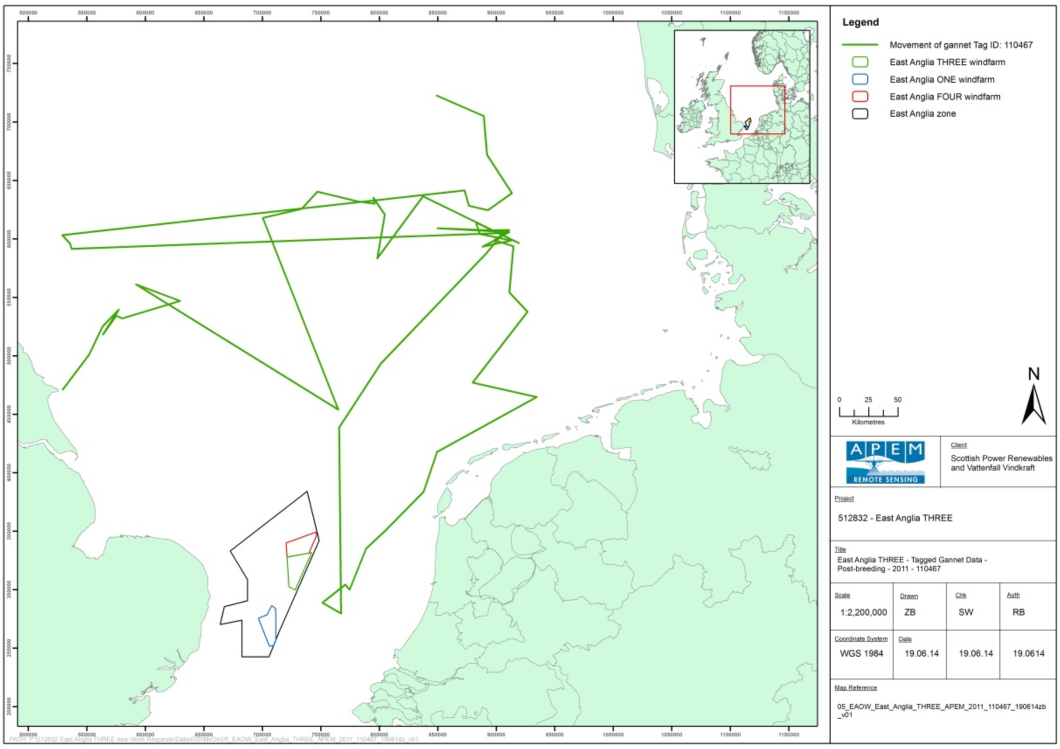

Figure 5 Movements of gannet tag ID 110467 (2011)

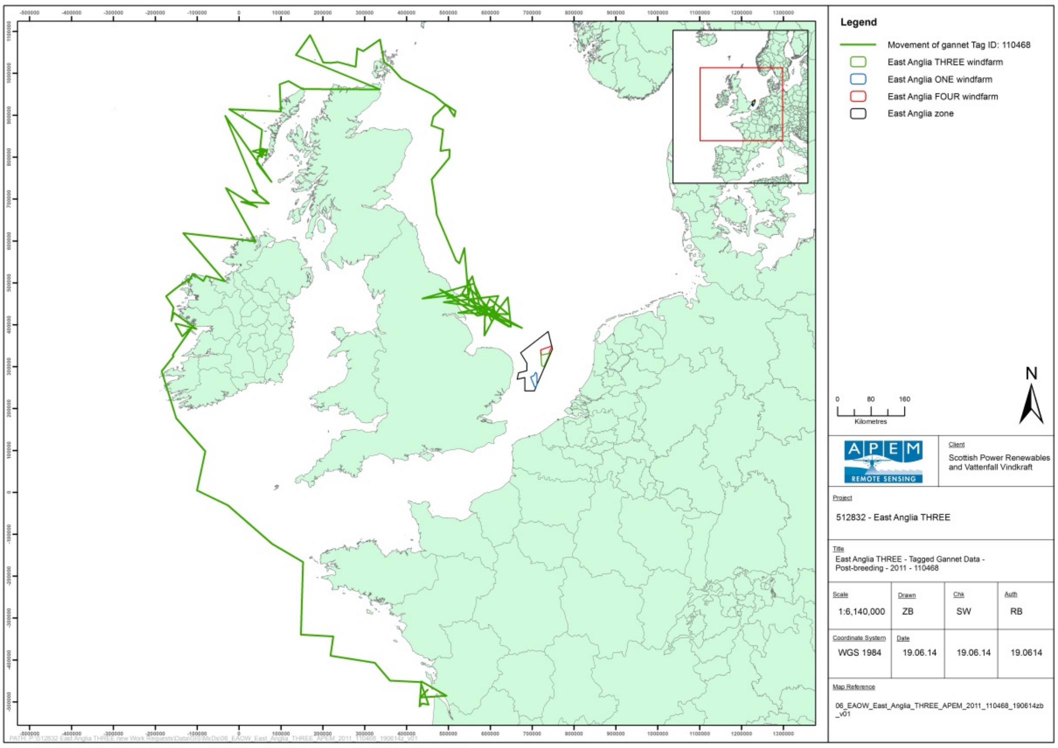

Figure 6 Movements of gannet tag ID 110468 (2011)

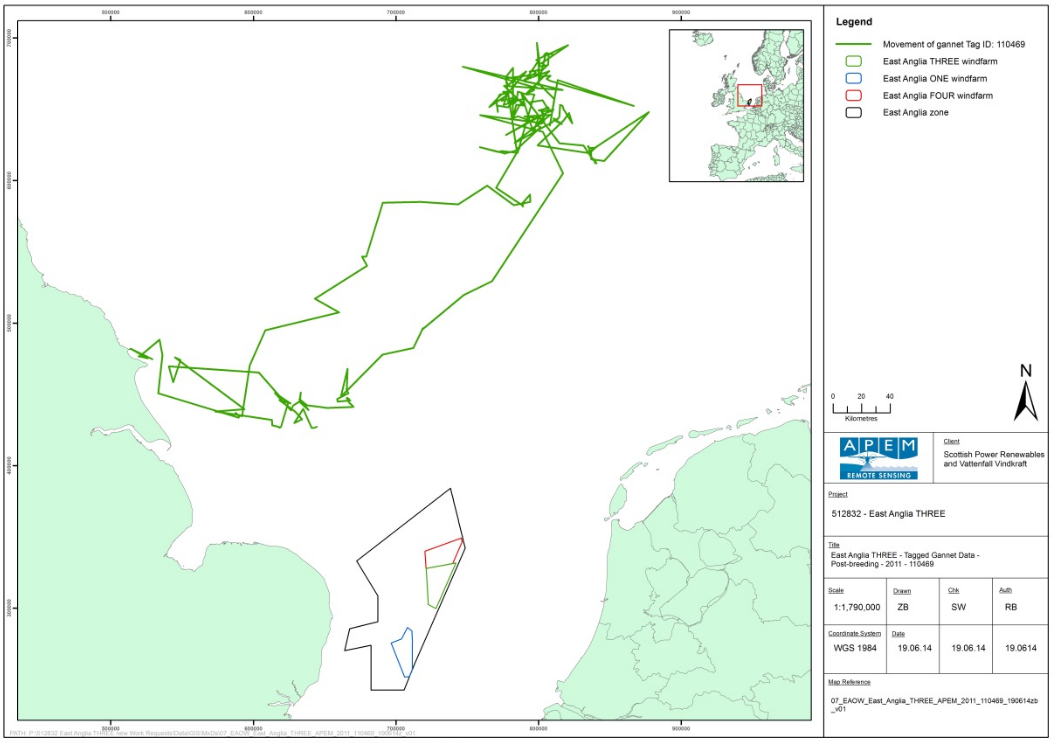

Figure 7 Movements of gannet tag ID 110469 (2011)

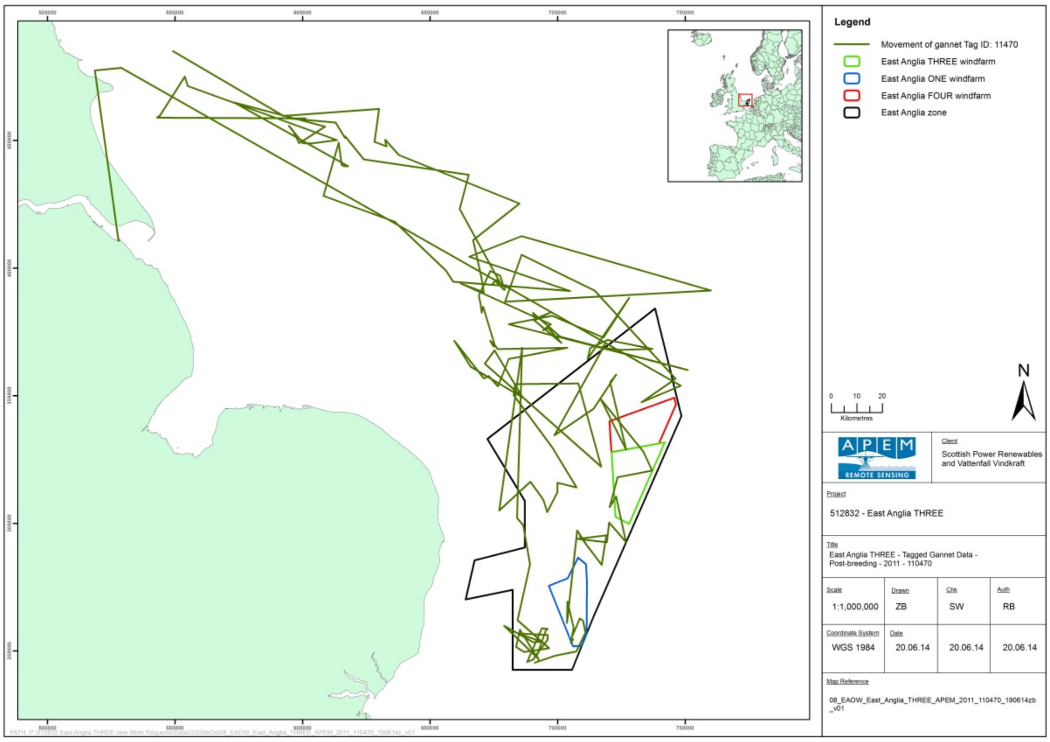

Figure 8 Movements of gannet tag ID 110470 (2011)

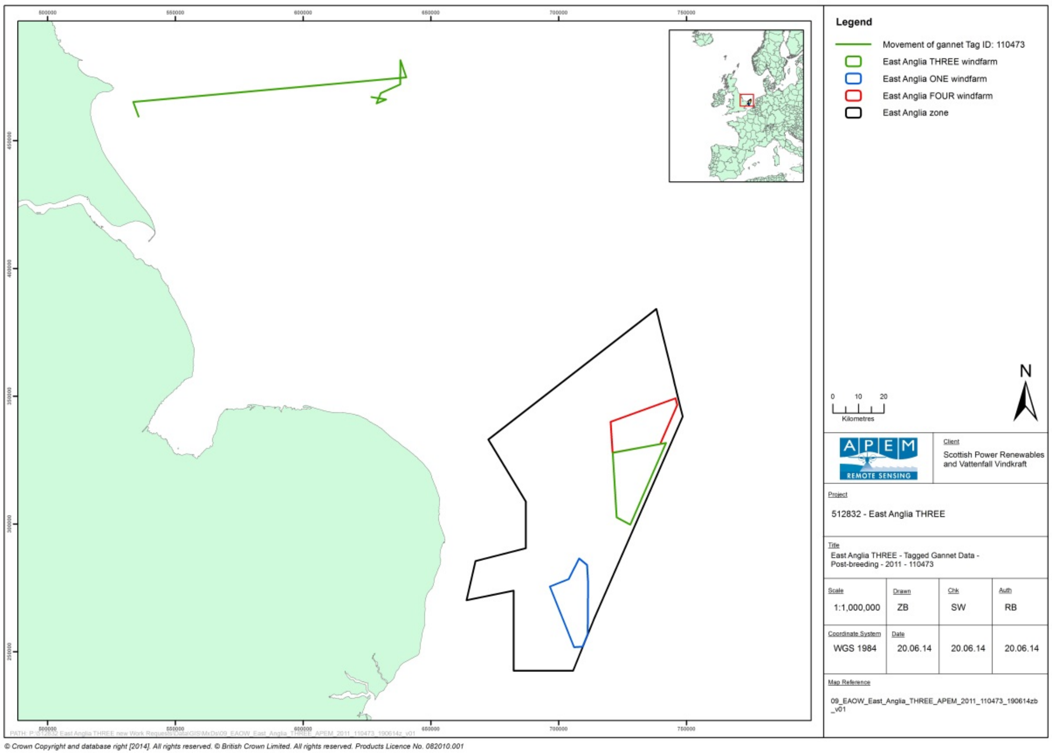

Figure 9 Movements of gannet tag ID 110473 (2011)

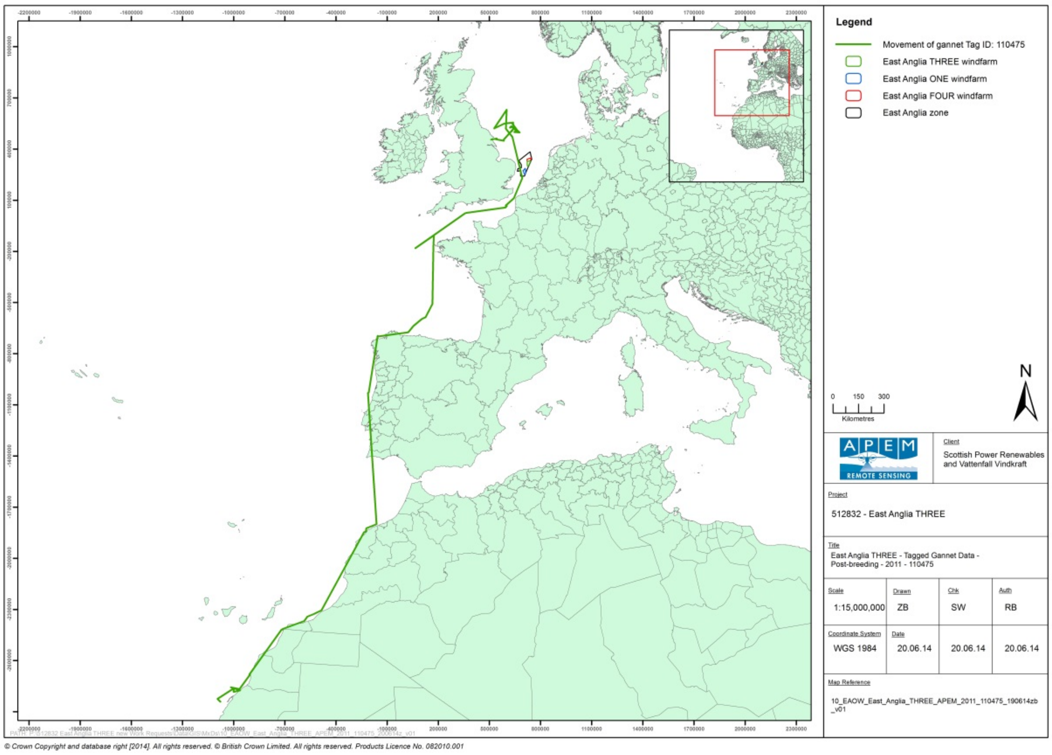

Figure 10 Movements of gannet tag ID 110475 (2011)

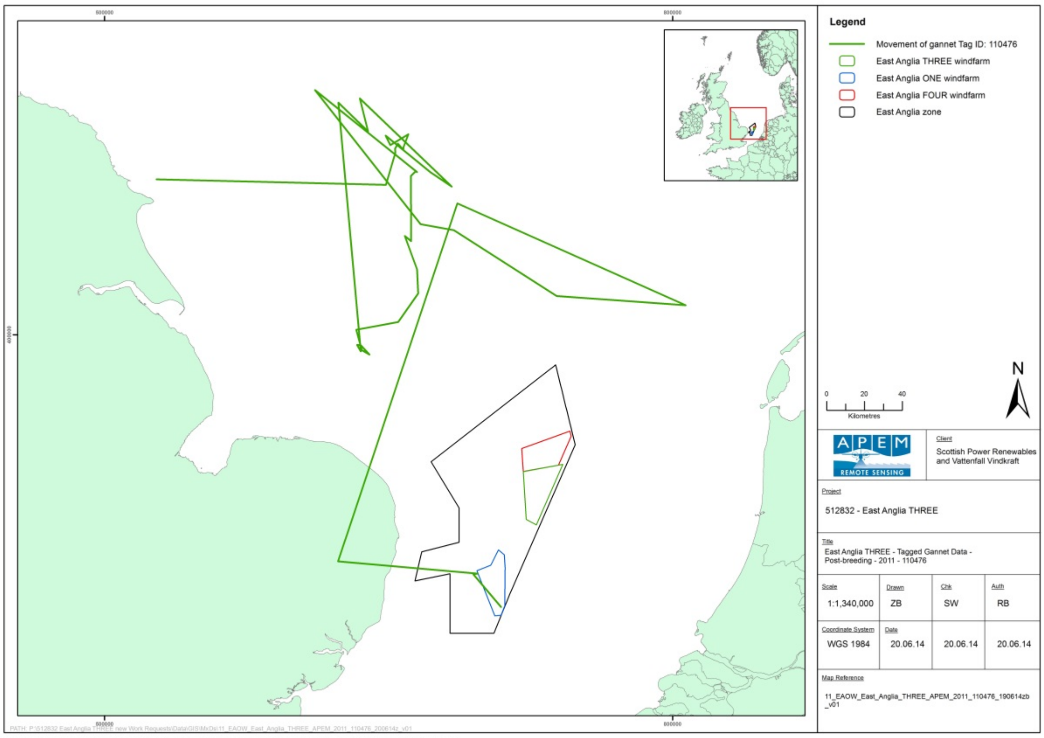

Figure 11 Movements of gannet tag ID 110476 (2011)

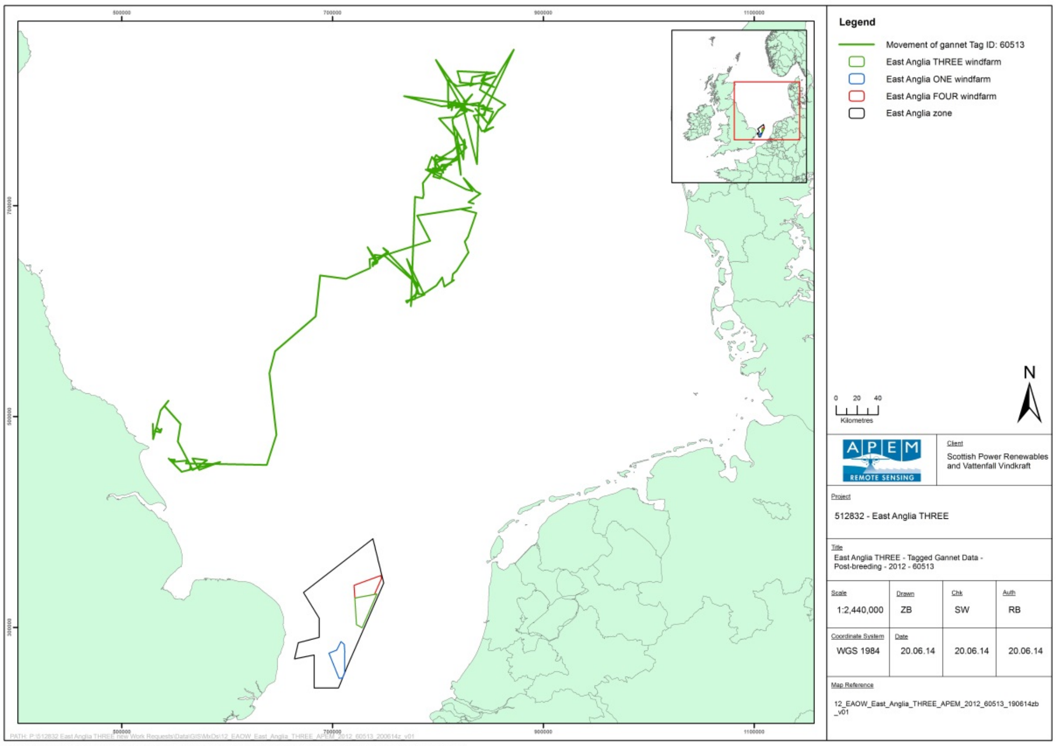

Figure 12 Movements of gannet tag ID 60513 (2012)

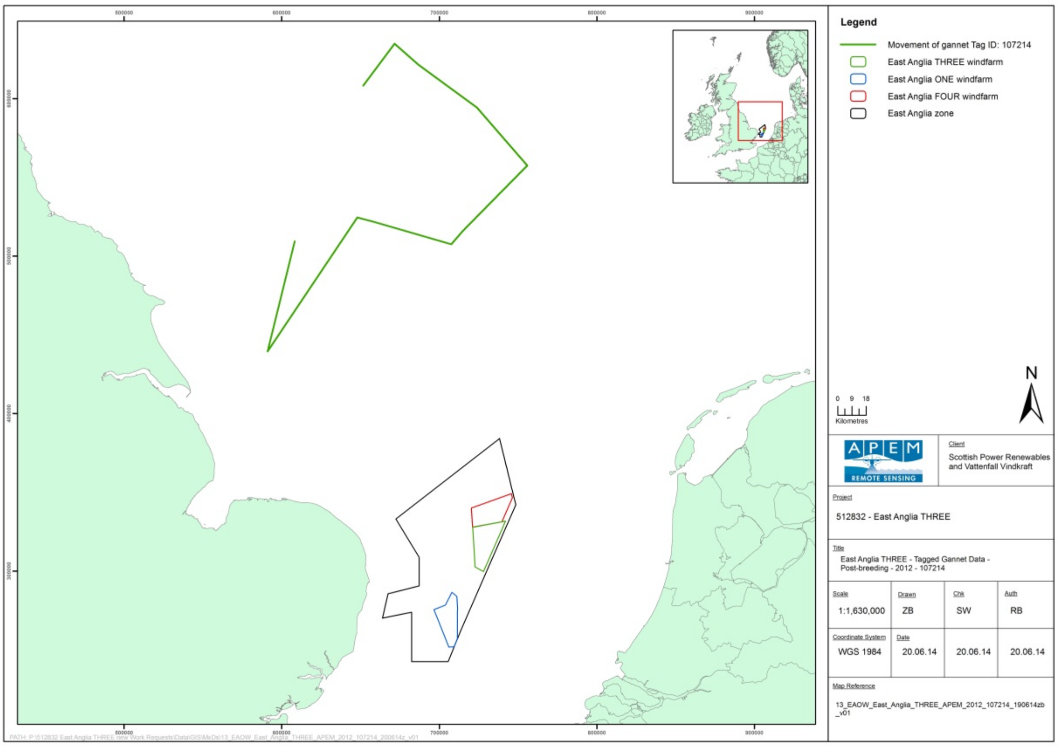

Figure 13 Movements of gannet tag ID 107214 (2012)

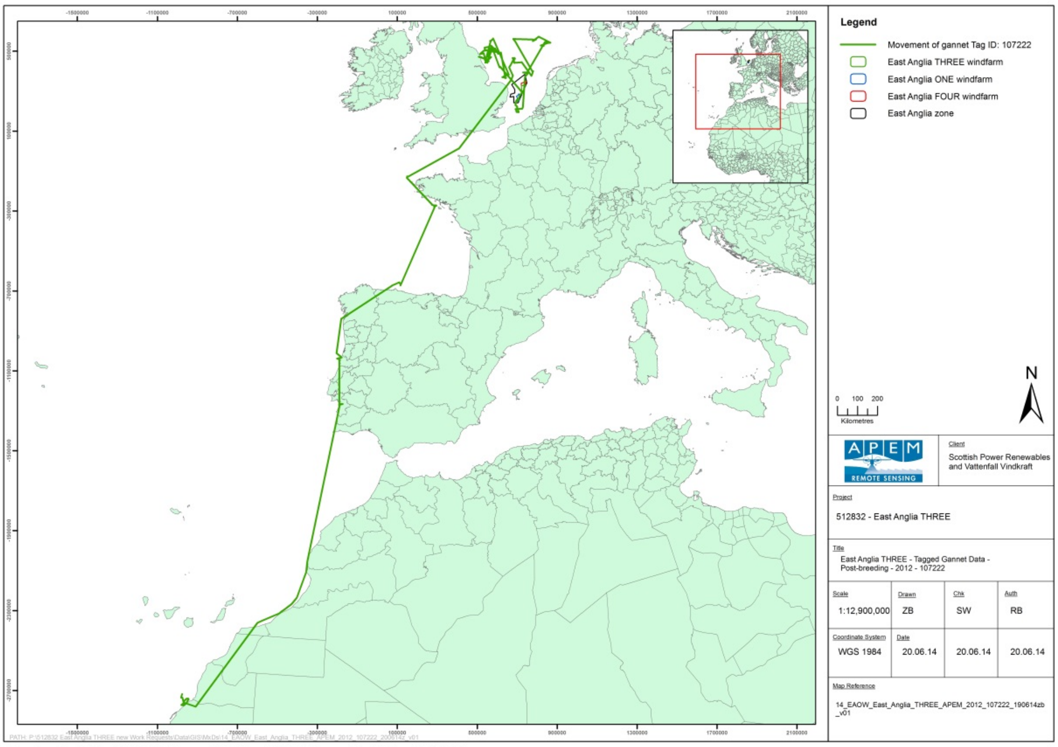

Figure 14 Movements of gannet tag ID 107222 (2012)

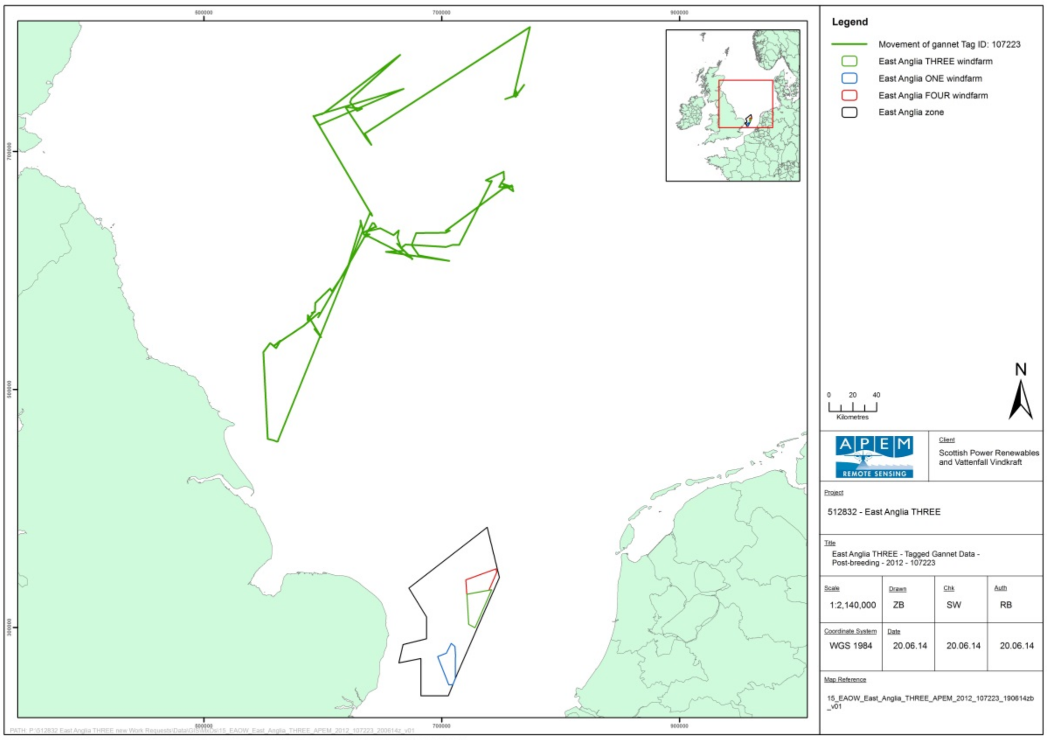

Figure 15 Movements of gannet tag ID 107223 (2012)

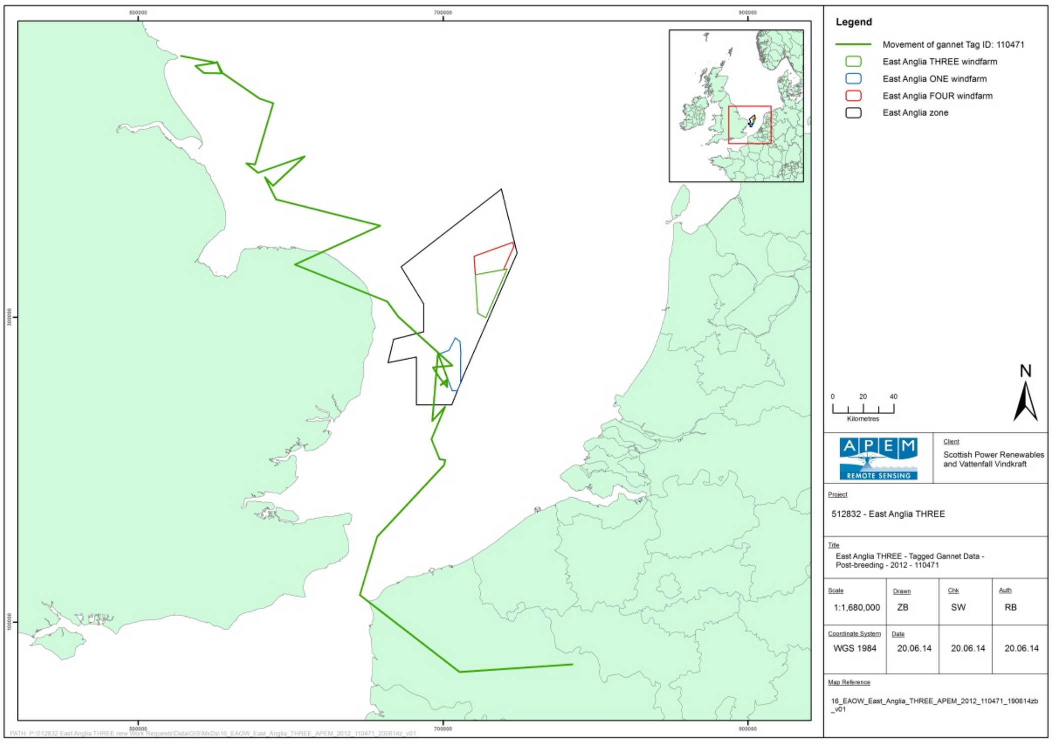

Figure 16 Movements of gannet tag ID 110471 (2012)

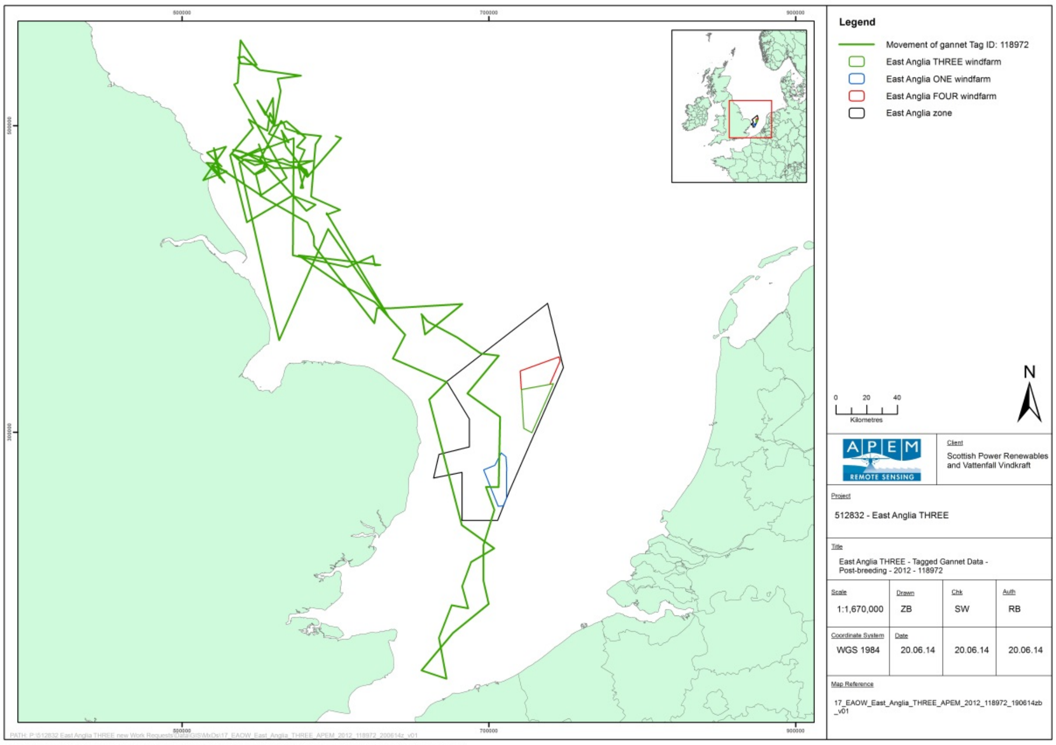

Figure 17 Movements of gannet tag ID 118972 (2012)

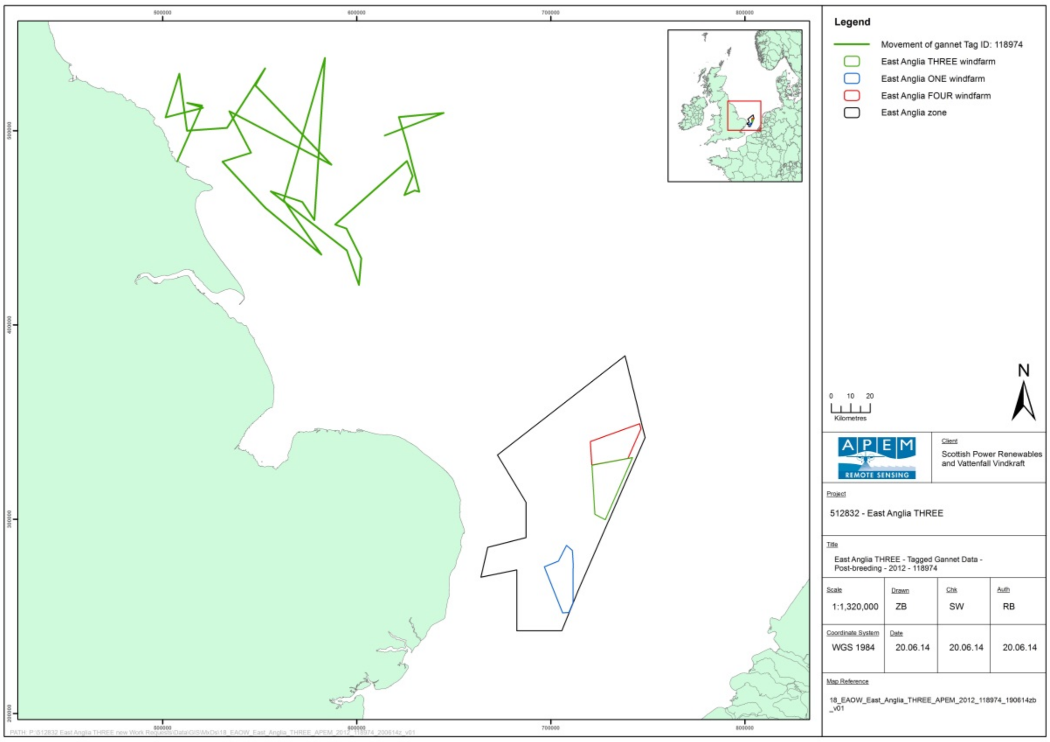

Figure 18 Movements of gannet tag ID 118974 (2012)

13.1.9 Evidence Plan Log to inform Offshore Ornithology Statement of Common Ground

11. Provided below is the Evidence plan log which was used to inform dicussions about the Offshore Ornithology Statement of Common Ground

EVIDENCE PLAN LOG TO INFORM OFFSHORE ORNITHOLOGY STATEMENT OF COMMON GROUND

1.1 Evidence Plan Log to Inform Offshore Ornithology Statement of Common Ground

1.2 Chapter 13

ID	Issue on which EATL seek agreement	EATL Comment	SNCB Comment	Agreed Position
Data Collection and Description of Baseline Environment				
1ai	The Environmental Statement adequately characterises the baseline relevant to offshore ornithology. [Section 13.5 and Appendix 13.1 of the PEIR]	24 months of offshore digital aerial survey data collected for the 'Site' and a 4km buffer. Used to characterise bird distributions and estimate populations. This is sufficient for the assessment.	Agreed at ETG Mtg 2	
1aii		No additional surveys have been conducted of the offshore cable route. It is sufficient to rely on the information provided for the EA ONE application (now consented) and NE's latest population data on Red-throated Diver in the Outer Thames Estuary SPA.	Agreed at ETG Mtg 1	
1bi	The methods and techniques used to analyse offshore ornithological data are appropriate for characterising bird distributions and estimating populations. [Appendix 13.1 of the PEIR]	Population estimates for the Site and relevant buffers using design based estimates is an appropriate method.	Agreed at ETG Mtg 1	
1bii		The method used to correct for non-detection of diving auks (the 'correction factor' or 'availability bias') is an appropriate method.	NE seeking further clarity on Methods A, B and C – to be provided by EAOW and discussed by end July 2014 [ETG Mtg 4]	[no current agreed position]
1biii		The method used to determine flight heights is an appropriate method.	Further information sought on validation of method for flight heights. [ETG Mtg 3] SNCB comment on validation will be addressed at visit to APEM 04/07/14	[no current agreed position]
1biv		The method used to proportion unidentified birds is an appropriate method.	Agreed at ETG Mtg 4	

ID	Issue on which EATL seek agreement	EATL Comment	SNCB Comment	Agreed Position
Impact Assessment Methodology				
2a	The impact assessment methodology – specifically the definitions of sensitivity and magnitude and the use of the impact matrix approach - is adequate and appropriate. [Section 13.4.3 of the PEIR]	The impact assessment method described in Section 13.4.3 of the PEIR is an appropriate method. [PEIR wording had updated text following ETG Mtg 2 and agreement on this will be sought at PEIR workshop]	Agreed at ETG Mtg 4	
2b	The potential impacts assessed during construction, operation and decommissioning are appropriate [Section 13.6 of the PEIR]	The potential impacts set out in Section 13.6 of the PEIR are the appropriate ones to be assessed.	Agreed at ETG Mtg 1	[PEIR Table 13.1 says the impacts to be assessed are agreed– this should be confirmed at the PEIR Workshop 02/07/14]
2c	Cumulative and in-combination assessments will include sites operational, built and consented. [Section 13.4.5 of the PEIR]	Approach provided in Section 13.4.5 of the PEIR. Based on approach applied by Ministers when consenting offshore windfarms and confirmed in recent consent decisions including for Galloper, Triton Knoll and EAONE.	NE wish to see 'all foreseeable' presented in 'tiered tables' and will continue to advise PINS that a strategic approach is required	[no current agreed position]
2d	The potential for transboundary impacts has been identified at the following SPA: Bruine Bank (Brown Ridge) pSPA. [Section 13.9 of the PEIR]	Information provided in Section 13.9 of the PEIR. Sites identified through consideration of foraging range, connectedness and distribution and through consultation with relevant EU Member States.	NE will not comment on non-UK SPAs; Scottish sites to be considered in cumulative assessment and HRA work	[position would need to be agreed with Dutch Government]
2e	The biological periods utilised for the assessment are appropriate. [App 3 ETG Mtg 2]	The biological periods set out in Appendix 3 of ETG Mtg 2 are appropriate for application in the impact assessment	Agreed at ETG Mtg 2	

ID	Issue on which EATL seek agreement	EATL Comment	SNCB Comment	Agreed Position
2f	It is appropriate to apportion migratory and resident birds within the CR assessment in the autumn and spring passage period, with resident birds run through the CR model as densities and migratory birds as a flux.	Discussed at ETG 2 and 3. APEM analysis of the post breeding season information arising from the DECC funded RSPB tagging study at Bempton Cliffs presented at ETG 4 with focus on qualitative information only. Methods not sufficiently developed for further consideration at this stage.	Agreed in principle at ETG Mtg 3 but subject to a clear audit trail of the apportionment process	[no final agreed position]
2g	It is appropriate to provide results from all Band Model Options at relevant avoidance rates. [Section 13.7.2 of the PEIR and Appendix 13.4]	Section 13.7.2 of the PEIR provided Band Option 3 outputs at 98% avoidance rate and Appendix 13.4 provided Band option 1, 2 and 3 outputs of avoidance rates of 98%, 99% and 99.5%.	At ETG Mtg 4 NE requested that the outputs from all Options be presented alongside each other in the main ES, along with a range of avoidance rates	[no current agreed position]
2h	The use of the Band Option 4 model to assess collision risk is appropriate given a suitable site based sample size and will be presented with Options 1 -3. [not yet documented]	Suitable flight height sample size for FU, GX, KI & GB. Recognise NE's concern over not having seen validation of flight heights (hence APEM arranging aerial survey methods workshop on 4th July 2014 to explain methods used). Recognise that suitable avoidance rates to apply in Option 4 are yet to be agreed.	At ETG Mtg 4 NE agreed to provide their concerns in relation to the use of the extended Band Model. NE agreed that pooling flight height data from EA3 and EA4 was acceptable for use for both projects	[no current agreed position]
2i	The use of an avoidance rate of greater than 99% (exact figure to be discussed) in Band Options 1 and 2 is acceptable for gannets. ETG 4 Appendix 2]	New evidence provided in Gannet Avoidance paper provided at ETG 4 that extends evidence for 99% submitted with EA ONE.	The use of a 99.5% avoidance rate for migratory gannet agreed in principle at ETG 4 (subject to peer review)	[no current agreed position]

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ID	Issue on which EATL seek agreement	EATL Comment	SNCB Comment	Agreed Position
EIA				
3a	The screening matrix adequately identifies those species at risk of disturbance and displacement during construction - red-throated diver (for offshore cable corridor only), guillemot and razorbill.	Provided as Table 13.14 of the PEIR.	Re- inclusion of puffin required to provide audit trail (ETG 4)	[no current agreed position]
3b	During construction, impacts on the species identified are of at most minor significance.	Information provided in Section 13.7.1 of the PEIR.	[no comment available until final ES submitted]	[no current agreed position]
3c	The screening matrix adequately identifies those species at risk of disturbance and displacement during operation – gannet, guillemot and razorbill.	Provided as Table 13.15 of the PEIR.	Inclusion of puffin and RTD required to provide audit trail (ETG 4)	[no current agreed position]
3d	During operation, impacts on the species identified are at most of minor significance.	Information provided in Section 13.7.2. of the PEIR.	[no comment available until final ES submitted]	[no current agreed position]
3e	During construction and operation, indirect impacts on habitats and prey are of at most minor significance.	Information provided in Section 13.7.1 and 13.7.2 of the PEIR.	[no comment available until final ES submitted]	[no current agreed position]
3f	Collision risk impacts have been considered for fulmar, gannet, kittiwake, lesser black backed gull, herring gull and great black backed gull. When considering the project alone, collision risk impacts are at most minor.	Information provided in Section 13.7.2. of the PEIR.	[no comment available until final ES submitted]	[no current agreed position]
3g	The impact significance of the barrier effect for all species assessed is negligible.	Information provided in Section 13.7.2. of the PEIR.	[no comment available until final ES submitted]	[no current agreed position]

ID	Issue on which EATL seek agreement	EATL Comment	SNCB Comment	Agreed Position
3h	Impacts on Great Skua, Artic Skua, common tern and artic tern do not require further consideration for this project.	Information provided in Section 13.7.2.3.9 and Appendix 13.4 of the PEIR.	Further information required on PCH used for these species required (ETG 4)	[no current agreed position]
3i	Impacts on auks at Bruine Bank are at most minor.	Information provided in Section 13.9 of the PEIR.	[no comment available until final ES submitted]	[no current agreed position]
3j	The impacts on migrating waders and wildfowl, and marsh harrier, are not significant. [ETG 4 Appendix 1]	An assessment of collision risk to migrant waders and wildfowl and marsh harrier was carried out using Migropath and the Band Migrant variant of the standard model. This was provided to NE after the consultation on the PEIR and discussed at ETG 4.	NE agreed to provide update on their position following ETG 4	[no current agreed position]
Cumulative Assessment: Full cumulative assessment to be provided at ETG5.				
4a	The screening matrix adequately identifies potential cumulative impacts of the proposed project (disturbance and displacement and collision risk) and the species at risk (gannet, kittiwake, gbbg and lbbg).	Provided as Table 13.35 of the PEIR.	[no comment available until final ES submitted]	[no current agreed position]
4b	The projects list for inclusion is complete.	Provided as Table 13.36 of the PEIR.	Comments on this to be provided in the PEIR response.	[no current agreed position]
4c	Cumulative impacts are… [these were not resolved in the PEIR]		[no comment available until final ES submitted]	[no current agreed position]

ID	Issue on which EATL seek agreement	EATL Comment	SNCB Comment	Agreed Position
HRA Screening				
5a	The high level screening report includes all potentially relevant European sites. [draft at ETG 3, final made available alongside PEIR]	The draft HRA High Level Screening Report was discussed at ETG 3. The concern of NE about the screening out of six sites in the draft was recognised by EATL and they were re-inserted for the final version that was circulated alongside the PEIR.	ETG Mtg 3: Six sites that have been screened out should be re-inserted and the screening re-assessed when the migrant CRM output is available. [From this comment it is implicit that all potentially relevant European sites were included but that statement was not recorded]	[no current agreed position]
5b	As a result of the migropath modelling, further SPAs supporting waders and wildfowl and marsh harrier can be screened out from further assessment as no likely significant effect has been identified [ETG 4 Appendix 1 and to be listed in the final HRA Screening Report.	Migropath report (ETG 4 App 1) and draft final HRA Screening Report provided at ETG 4.	NE agreed to provide update on their position following ETG 4	[no current agreed position]
HRA: HRA Report to be provided for discussion at ETG5.				
6a	The project alone has …on the Alde-Ore Estuary SPA and Ramsar.	[Report not yet provided to NE on the assessment of potential adverse impacts on conservation status and integrity of interest features for which likely significant effect identified in HRA Screening Report]	[no comment available as information not yet seen by NE]	[no current agreed position]
6b	The project in combination with other plans and projects has … on the Alde-Ore Estuary SPA and Ramsar.	[Report not yet provided to NE on the assessment of potential adverse impacts on conservation status and integrity of interest features for which likely significant effect identified in HRA Screening Report]	[no comment available as information not yet seen by NE]	[no current agreed position]

ID	Issue on which EATL seek agreement	EATL Comment	SNCB Comment	Agreed Position
6c	The project alone and in combination with other plans and projects has no LSE on the Outer Thames Estuary SPA. [Interest feature red-throated diver]	[Report not yet provided to NE on the assessment of potential adverse impacts on conservation status and integrity of interest features for which likely significant effect identified in HRA Screening Report]	[no comment available as information not yet seen by NE]	[no current agreed position]
6d	The project alone has … on Flamborough Head and Bempton Cliffs SPA.	[Report not yet provided to NE on the assessment of potential adverse impacts on conservation status and integrity of interest features for which likely significant effect identified in HRA Screening Report]	[no comment available as information not yet seen by NE]	[no current agreed position]
6e	The project in combination with other plans and projects has … on Flamborough Head and Bempton Cliffs SPA.	[Report not yet provided to NE on the assessment of potential adverse impacts on conservation status and integrity of interest features for which likely significant effect identified in HRA Screening Report]	[no comment available as information not yet seen by NE]	[no current agreed position]
6f	The project alone has … on Flamborough and Filey Coast pSPA.	[Report not yet provided to NE on the assessment of potential adverse impacts on conservation status and integrity of interest features for which likely significant effect identified in HRA Screening Report]	[no comment available as information not yet seen by NE]	[no current agreed position]
6g	The project in combination with other plans and projects has … on Flamborough and Filey Coast pSPA.	[Report not yet provided to NE on the assessment of potential adverse impacts on conservation status and integrity of interest features for which likely significant effect identified in HRA Screening Report]	[no comment available as information not yet seen by NE]	[no current agreed position]

ID	Issue on which EATL seek agreement	EATL Comment	SNCB Comment	Agreed Position
DCO: Draft DCO to be provided for discussion at ETG6.				
7a	Given the impacts of the project in terms of offshore ornithology, the conditions provided within the deemed marine licence are considered appropriate and adequate			

13.1.10 Ornithology ETG Meeting 5 Background Paper

12. Provided below is the background paper that was circulated prior to the fifth Ornithology ETG meeting

East Anglia Offshore Wind

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East Anglia THREE

Ornithology

Evidence Plan

Expert Topic Group Meeting 5

3rd June 2015

Document Reference – ETG 5.1

Author – MacArthur Green
East Anglia Offshore Wind Limited
Date – May 2015
Revision History –First draft for Meeting 5

East Anglia Offshore Wind

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Table of Contents

1 INTRODUCTION

1.1 Purpose of this Document

1. The purpose of this document is to provide technical information to support the discussions to be held at the fifth ornithology expert topic group (OETG) meeting to be held on 3rd June 2015.

2. The focus of this meeting will be on offshore ornithological issues. Onshore issues relating to the cable installation and possible disturbance effects on brent geese in the Deben Estuary will be discussed at a later meeting when more detailed information on the proposed construction timetable will be available.

3. This document contains information that updates that presented at the first four OETG meetings held in September and November 2013, and March and July 2014. It provides more detailed information on a series of topics related to offshore and onshore ornithology and assessment processes. In some cases an outline approach is described in this paper in recognition that the detail and discussion on it will take place at a future meeting. Background papers supporting this Evidence Plan are provided as Appendices 1 to 7. Please note that the titles of the individual documents (some of which include the word 'Appendix') refer to their expected inclusion in the final application and hence these do not match the Appendix numbering used in this Evidence Plan.

4. The record of the discussions at the previous four OETG meetings and the schedule of topic areas on which agreement is sought, with the current position of Natural England and Royal Society for the Protection of Birds (RSPB), are contained within the respective minutes of those meetings.

2 PROJECT TIMETABLE AND DESCRIPTION

2.1 Project Timetable

5. An updated project timeline for East Anglia THREE is presented in Table 2.1.

Table 2.1: Project Timeline for East Anglia THREE

Date	Event
August 2013	Final East Anglia THREE site specific surveys
30th September 2013	Ornithology ETG meeting 1
11th November 2013	Ornithology ETG meeting 2
February 2014	Final East Anglia FOUR site specific surveys
March 2014	Draft High Level HRA Screening Report for East Anglia THREE
28th March 2014	Ornithology ETG meeting 3
27th May 2014	Start of consultation period for East Anglia THREE PEI (under Section 42 of the Planning Act 2008) High Level HRA Screening Report for East Anglia THREE provided alongside PEI
2nd July 2014	PEIR Workshop, attended by East Anglia Offshore Wind, Natural England, RSPB, APEM, Royal Haskoning DHV
2nd July 2014	Ornithology ETG meeting 4
8th July 2014	End of consultation period for East Anglia THREE PEI (under Section 42 of the Planning Act 2008)
3rd June 2015	Ornithology ETG meeting 5
11th June 2015	Start of Phase III consultation period for East Anglia THREE (under section 42 of the Planning Act 2008)
16th July 2015	End of Phase III consultation period for East Anglia THREE (under section 42 of the Planning Act 2008)
July 2015	*Ornithology ETG meeting 6 (TBC)*
September 2015	*Ornithology ETG meeting 7 (TBC)*
November 2015	DCO application East Anglia THREE

2.2 Project Description

6. It is now intended that the East Anglia THREE array will consist of a maximum of 172 turbines of 7MW, with a hub height of between 99 and 150m, in a windfarm area of 305km^2. Construction may be phased, with two 600MW phases constructed, works on the second phase will commence no later than 18 months after the commencement of the onshore construction of the first phase.

7. Cables for the proposed East Anglia THREE project will be installed by pulling through ducts that will have been installed by East Anglia ONE. This will be accompanied by the installation of cable jointing pits.

8. With regards the potential for ornithological impacts due to construction, offshore it is expected that there will be little difference between the Single and Two Phased approaches as the key impacts are during the operational phase and under either a Single Phase or Two Phased approach the maximum capacity of the proposed East Anglia THREE project is the same.

3 ORNITHOLOGY REPORTS

3.1 Cumulative impact assessment methods

9. The key outputs from the impact assessment are included as tables in an annex (Section 5) to this document and summarised in the following sections. These include displacement matrices for the proposed East Anglia THREE project and cumulative collision estimates (proposed East Anglia THREE project alone collision estimates and density estimates are provided in the APEM technical reports detailed below).

10. The cumulative displacement assessment approach taken for the proposed East Anglia THREE project is summarised as follows:
    a. Screening of species at risk of cumulative effect (i.e. those assessed for the proposed East Anglia THREE project).
    b. Identification of seasons when the proposed East Anglia THREE project is likely to contribute to a cumulative effect, and hence the appropriate Biologically Defined Minimum Population Scale (BDMPS; Furness 2015) and other projects for inclusion in the cumulative impact assessment (CIA).
    c. Combination of displacement figures across projects.
    d. Construction of displacement matrix using ranges advised by Natural England.
    e. Consideration of most likely rates within matrix for each species in each season.
    f. Assessment of impact on BDMPS.

11. The cumulative collision assessment approach taken for the proposed East Anglia THREE project is summarised as follows:
    a. Screening of species at risk of cumulative effect (i.e. those assessed for the proposed East Anglia THREE project).
    b. Identification of seasons, appropriate BDMPS and other projects for inclusion in CIA. Projects listed in tier order.
    c. Collision estimates extracted and summed from relevant projects, updated for new avoidance rates (but <u>not</u> for changes in windfarm design)
    d. Identification of cumulative mortality for built and consented projects and highlighting how this has reduced from original values due to methodological updates (e.g. avoidance rates).
    e. Calculation of additional mortality for not consented projects (Dogger Bank Teesside, Hornsea P2, Navitus Bay and the proposed East Anglia THREE

project) and illustration that this is less than previously consented number due to method updates.

f. A summary of the cumulative collisions for the key risk species is provided in Table 3.1. With the exception of kittiwake the summed tier 4 and 5 windfarm collisions are less than the summed mortality for all previously consented windfarms (i.e. up to and including all tier 3 projects) and therefore none of these collision totals represents a concern. For kittiwake the proposed East Anglia THREE project contributes less than 4% to the total (Dogger Bank Creyke Beck Teesside A and B account for 73% of the total).

Table 3.1. Annual cumulative collision mortality estimates under previous and current avoidance rates and headroom for projects not yet consented. All estimated used Band model option 1.

Species	Previous avoidance rate (option 1)	Current avoidance rate (option 1)	Cumulative collisions for consented windfarms (Tiers1-3) at previous avoidance rate	Cumulative collisions for consented windfarms (Tiers1-3) at current avoidance rate	Headroom for Tier 4&5 windfarms (not yet consented)	Cumulative collisions for Tier 4&5 windfarms (not yet consented)
Gannet	98	98.9	5524	3353	2171	351
Kittiwake	98	98.9	5175	4460	715	3515
Lesser black-backed gull	98	99.5	1828	513	1315	69
Herring gull	98	99.5	2716	693	2023	56
Great black-backed gull	98	99.5	3304	965	2339	166

12. On review of the CIA tables for displacement and collision mortality in the annex East Anglia THREE Limited (EATL) are keen to understand if

- Natural England and the RSPB agree with the proposed approaches and agree that the impacts due to the proposed East Anglia THREE project alone and cumulatively are not of concern?

- In addition, as the magnitude of impacts is small (and below previously consented levels) it is not currently anticipated that Potential Biological Removal (PBR) or Population Viability Analysis (PVA) will be required to provide context to impacts. EATL would like to know if Natural England and the RSPB agree with this position?

3.2 Gannet windfarm avoidance

13. A study has been undertaken by APEM using aerial survey of a constructed windfarm in the southern North Sea to gather evidence for the extent that gannets take avoiding action. The study focuses on macro-avoidance, that is gannets avoiding entering the windfarm. A copy of this study is included as Appendix 1.

14. This report was presented for discussion at ETG 4 and Natural England was supportive of its use and encouraged wider dissemination. As the results are of relevance to the collision risk modelling (CRM) EATL are keen to agree a strategy for taking this forward. The results of this work make it clear that the current guidance on avoidance rates for gannet (98.9% with Option 1) remains precautionary and that actual avoidance by this species is very likely to be in excess of 99%. EATL would like to know if Natural England the RSPB are considering increasing the gannet avoidance rate on the back of this study?

3.3 Monthly mean abundance of seabirds in the East Anglia THREE site

15. Monthly mean abundance estimates and densities of seabirds in the East Anglia THREE site have been assessed by APEM. The technical report is included as Appendix 2 (the document title is **Appendix 3: Monthly mean abundance estimates and densities** and is dated April 2015). These density estimates underpin the displacement assessment through use of displacement / mortality matrices. Figures in the assessment will be based on the advised ranges of 30 - 70% displacement and 1 - 10% mortality. For red-throated divers a graded buffer up to 4km has been applied (following Pizzolla 2011) and for auks a 2km ungraded one has been used.

3.4 Common guillemot and Razorbill abundance estimates

16. APEM have reported on the abundances of common guillemots and razorbills corrected for birds underwater during aerial photography. The technical report is included as Appendix 3 (the document title is Appendix 4: Common Guillemot and Razorbill New Site Boundary Corrected Abundance Estimates and Densities and is dated April 2015). Report on seabird collision numbers estimated at the East Anglia THREE site

17. APEM have produced a technical report tabulating predicted collision numbers for seabirds at the East Anglia THREE site for Band Options 1, 2 and 3. These totals follow the recommendations on appropriate avoidance rates to use in collision risk modelling for key species (Cook et al. 2014; JNCC et al. 2014). The technical report is included as Appendix 4 (the document title is **Work Request 07: East Anglia THREE New Boundary Revised Collision Risk Modelling for Band Options 1, 2 and 3** and is dated April 2015). Annual figures are provided in Table 1.

3.5 Report on updated seabird collision numbers estimated at East Anglia ONE

18. APEM have produced a technical report tabulating predicted collision numbers for seabirds at East Anglia ONE following an update in their methods (excluding birds on the water) for Band Options 1, 2 and 3. These totals follow the recommendations on appropriate avoidance rates to use in collision risk modelling for key species (Cook et al. 2014; JNCC et al 2014). The technical report is included as Appendix 5 (the document title is **East Anglia ONE Windfarm Collision Risk Modelling Methodology**and is dated May 2015).

19. Annual totals extracted from this report are presented below (Table 3.2) alongside the original estimates presented in the East Anglia ONE Environmental Statement. For ease of comparison the values presented are all from Option 1 of the Band Model and use the current recommended avoidance rates (98.9% for gannet and kittiwake, 99.5% for lesser black-backed gull, herring gull and great black-backed gull).

Table 3.2. Annual collision mortality estimates for East Anglia ONE (original and revised) and the East Anglia THREE site. All values estimated using Band model Option 1

Species	Avoidance rate (%)	Original East Anglia ONE collision estimates	Revised East Anglia ONE collision estimates	East Anglia THREE collision estimates
Gannet	98.9	467	213	17
Kittiwake	98.9	580	314	147
Lesser black-backed gull	99.5	98	61	20
Herring gull	99.5	57	41	19
Great black-backed gull	99.5	124	71	55

3.6 Review of nocturnal flight activity of seabirds

MacArthur Green have carried out a review of evidence on the amount of nocturnal flight activity of seabird species of highest concern regarding collision risk. This review indicates that the levels of nocturnal flight activity determined by deployment of loggers are much lower than the values derived from Garthe and Hüppop (2004) which have become accepted for collision risk modelling. Consequently collision estimates derived following the accepted approach are highly precautionary, and could be revised taking account of evidence. The report is included as Appendix 6. A summary table illustrating the differences is provided below (Table 3.3).

Table 3.3. Current nocturnal activity factors used in collision risk modelling and evidence based recommended values.

Species	Current accepted percentage nocturnal activity rate	Evidence based Nocturnal flight activity as % of daylight flight activity by non-breeding birds	Nocturnal flight activity as % of daylight flight activity by breeding birds
Gannet	25	2	0
Kittiwake	50	12	0
Large gulls	50	25	25*

*Precautionary value that probably overestimates nocturnal flight activity but is suggested because there is a lack of empirical data to give a more appropriate value.

3.7 Band option 1 sensitivity to estimated nocturnal flight activity of seabirds

20. APEM have recalculated collision numbers using lower estimates of nocturnal flight activity of seabirds to indicate the extent to which outputs are influenced by this parameter value. The report is included as Appendix 7. As an approximate guide, reducing the nocturnal percentage by 25% reduces the estimated number of collisions by a similar amount.

21. EATL are keen to discuss this with Natural England and the RSPB with a view to updating the collision risk assessment in line with this evidence based correction.

3.8 HRA Screening report

22. An assessment of the SPA sites and features that should be screened in, or screened out, for Habitats Regulations Assessment (HRA) for the proposed East Anglia THREE project (alone and in-combination) is presented as Appendix 8.

23. We propose that HRA is required for:

- Deben Estuary SPA (dark-bellied brent goose);

- Outer Thames Estuary SPA (red-throated diver);
- Alde-Ore Estuary SPA (lesser black-backed gull);
- Flamborough and Filey Coast pSPA (gannet).

24. We propose that due to a lack of breeding season connectivity, mixing of populations outside the breeding season, low numbers and small assessed impact, there is a good case to scope out:
    - Alde-Ore Estuary SPA (herring gull);
    - Flamborough and Filey Coast pSPA (kittiwake, common guillemot, razorbill, puffin).

25. We propose that all other SPA populations elsewhere in the UK and in other Member States can be screened out.

3.9 Key points for discussion and agreement

Table 3.4. Summary of key points on which EATL seeks agreement with NE and RSPB

Item	Summary points for discussion and agreement
1	That potential phasing of construction of offshore components has little / no bearing on assessment
2	That approach for assessing displacement (alone and cumulative) is appropriate and outputs do not indicate significant impacts
3	That approach for assessing collision risk (alone and cumulative) is appropriate and outputs do not indicate significant impacts
4	That impacts are of such small magnitude that population modelling (PBR or PVA) is unnecessary
5	That gannet avoidance rate is likely to be >98.9% and this should be reflected in the assessment
6	That revised collision estimates for East Anglia ONE should be used in the CIA
7	That nocturnal activity factor used in CRM is overestimated and that use of evidence based values is appropriate for the assessment.
8	That the SPA features identified in the screening report are the only ones for which HRA will be required.

4 REFERENCES

Cook, A.S.C.P., Humphries, E.M., Masden, E.A., and Burton, N.H.K. 2014. *The avoidance rates of collision between birds and offshore turbines*. BTO research Report No 656 to Marine Scotland Science

Furness, R.W. 2015. *Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS).* Natural England Commissioned Report Number 164. 389 pp.

Garthe, S and Hüppop, O. 2004. Scaling possible adverse effects of marine windfarms on seabirds: developing and applying a vulnerability index. *Journal of Applied Ecology* 41: 724-734.

JNCC, Natural England, NIEA, NRW, SNH 2014. Joint Response from the Statutory Nature Conservation Bodies to the Marine Scotland Science Avoidance Rate Review

Pizzolla, P. (2011) Kentish Flats Offshore Wind Farm Extension: Habitats Regulations Assessment Report. Draft report to Vattenfall Wind Power Limited, London.

5 EAST ANGLIA THREE ASSESSMENT TABLES

26. The following tables have been copied from the draft offshore ornithology chapter therefore table numbering matches the chapter to allow consistency and ease of cross referencing.

5.1 Displacement assessment – East Anglia THREE alone

Table 13.15 Distance zones within the 4km buffer and their corresponding areas (km^2), percentage changes in abundance from Pizzolla (2011) and predicted numbers of red-throated divers affected. Note that data were not available for the 0-0.5km and the 2-3km bands. To estimate the number at risk of displacement a precautionary approach has been adopted: it was assumed that half of the total found in the following band were present in the missing ones.

Zone	Percentage change	Area (km^2)	Autumn migration (Sep-Nov)		Midwinter (Dec-Jan)		Spring migration (Feb-Apr)	
			Peak mean number recorded	Number predicted to be displaced	Peak mean number recorded	Number predicted to be displaced	Peak mean number recorded	Number predicted to be displaced
Site	-94	304.92	25	23.5	17	15.98	106	99.6
0-0.5km buffer	-83	41.63	0	0	0.5	0.415	4	3.32
0.5-1.0km buffer	-77	42.83	0	0	0.5	0.385	4	3.08
1.0-2.0km buffer	-59	91.42	16	9.44	0	0	43	25.37
2.0-3.0km buffer	0	96.96	3.5	0	6	0	20	0
3.0-4.0km buffer	0	103.81	3.5	0	6	0	19	0
Total	NA	NA		32.94		16.78		131.41

Table 13.16 Displacement matrix presenting the number of gannets in the East Anglia THREE site during the wintering season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)											
	0	1	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	1	2	2	3	3	4	4	5	5
10	0	1	5	11	16	22	27	33	38	44	49	55
20	0	1	11	22	33	44	55	65	76	87	98	109
30	0	2	16	33	49	65	82	98	114	131	147	164
40	0	2	22	44	65	87	109	131	153	174	196	218
50	0	3	27	55	82	109	136	164	191	218	245	273
60	0	3	33	65	98	131	164	196	229	262	294	327
70	0	4	38	76	114	153	191	229	267	305	343	382
80	0	4	44	87	131	174	218	262	305	349	392	436
90	0	5	49	98	147	196	245	294	343	392	441	491
100	0	5	55	109	164	218	273	327	382	436	491	545

Table Notes: a) Green shaded cells highlight most likely displacement range of 60% to 80% as appropriate from the evidence base; b) Pink shaded cells represent the most likely range of mortality associated with displaced birds (0% to 1%) during the wintering season.

Table 13.17 Displacement matrix presenting the number of guillemots in the East Anglia THREE site and 2km buffer during the breeding season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)											
	0	1	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	2	3	5	7	8	10	12	13	15	17
10	0	2	17	33	50	67	83	100	117	134	150	167
20	0	3	33	67	100	134	167	200	234	267	300	334
30	0	5	50	100	150	200	250	300	350	401	451	501
40	0	7	67	134	200	267	334	401	467	534	601	668
50	0	8	83	167	250	334	417	501	584	668	751	835
60	0	10	100	200	300	401	501	601	701	801	901	1001
70	0	12	117	234	350	467	584	701	818	935	1051	1168
80	0	13	134	267	401	534	668	801	935	1068	1202	1335
90	0	15	150	300	451	601	751	901	1051	1202	1352	1502
100	0	17	167	334	501	668	835	1001	1168	1335	1502	1669

Table Notes: a) Green shaded cells highlight most likely displacement range of 30% to 70% as appropriate from the evidence base; b) Pink shaded cells represent the most likely range of mortality associated with displaced birds (1% to 10%) during the breeding season.

Table 13.18 Displacement matrix presenting the number of guillemots in the East Anglia THREE site and 2km buffer during the wintering season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)											
	0	1	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	3	6	9	11	14	17	20	23	26	29
10	0	3	29	57	86	114	143	172	200	229	257	286
20	0	6	57	114	172	229	286	343	400	457	515	572
30	0	9	86	172	257	343	429	515	600	686	772	858
40	0	11	114	229	343	457	572	686	801	915	1029	1144
50	0	14	143	286	429	572	715	858	1001	1144	1287	1430
60	0	17	172	343	515	686	858	1029	1201	1372	1544	1715
70	0	20	200	400	600	801	1001	1201	1401	1601	1801	2001
80	0	23	229	457	686	915	1144	1372	1601	1830	2058	2287
90	0	26	257	515	772	1029	1287	1544	1801	2058	2316	2573
100	0	29	286	572	858	1144	1430	1715	2001	2287	2573	2859

Table Notes: a) Green shaded cells highlight most likely displacement range of 30% to 70% as appropriate from the evidence base; b) Pink shaded cells represent the most likely range of mortality associated with displaced birds (1% to 10%) during the wintering season.

Table 13.19 Displacement matrix presenting the number of razorbills in the East Anglia THREE site and 2km buffer during the breeding season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)											
	0	1	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	2	4	5	7	9	11	13	14	16	18
10	0	2	18	36	54	72	90	108	126	145	163	181
20	0	4	36	72	108	145	181	217	253	289	325	361
30	0	5	54	108	163	217	271	325	379	434	488	542
40	0	7	72	145	217	289	361	434	506	578	651	723
50	0	9	90	181	271	361	452	542	632	723	813	904
60	0	11	108	217	325	434	542	651	759	867	976	1084
70	0	13	126	253	379	506	632	759	885	1012	1138	1265
80	0	14	145	289	434	578	723	867	1012	1156	1301	1446
90	0	16	163	325	488	651	813	976	1138	1301	1464	1626
100	0	18	181	361	542	723	904	1084	1265	1446	1626	1807

Table Notes: a) Green shaded cells highlight most likely displacement range of 30% to 70% as appropriate from the evidence base; b) Pink shaded cells represent the most likely range of mortality associated with displaced birds (1% to 10%).

Table 13.20 Displacement matrix presenting the number of razorbills in the East Anglia THREE site and 2km buffer during the autumn season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)											
	0	1	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	2	3	4	6	7	8	9	10	11
10	0	1	11	22	34	45	56	67	79	90	101	112
20	0	2	22	45	67	90	112	135	157	180	202	224
30	0	3	34	67	101	135	168	202	236	269	303	337
40	0	4	45	90	135	180	224	269	314	359	404	449
50	0	6	56	112	168	224	281	337	393	449	505	561
60	0	7	67	135	202	269	337	404	471	539	606	673
70	0	8	79	157	236	314	393	471	550	628	707	785
80	0	9	90	180	269	359	449	539	628	718	808	898
90	0	10	101	202	303	404	505	606	707	808	909	1010
100	0	11	112	224	337	449	561	673	785	898	1010	1122

Table Notes: a) Green shaded cells highlight most likely displacement range of 30% to 70% as appropriate from the evidence base; b) Pink shaded cells represent the most likely range of mortality associated with displaced birds (1% to 10%).

Table 13.21 Displacement matrix presenting the number of razorbills in the East Anglia THREE site and 2km buffer during the midwinter season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)										
	0	1	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	3	4	6	7	9	10	12	13	15
10	0	1	15	30	45	60	75	90	105	120	135	150
20	0	3	30	60	90	120	150	180	210	240	270	300
30	0	4	45	90	135	180	225	270	315	360	405	450
40	0	6	60	120	180	240	300	360	420	480	540	600
50	0	7	75	150	225	300	375	450	525	600	675	750
60	0	9	90	180	270	360	450	540	630	720	809	899
70	0	10	105	210	315	420	525	630	735	839	944	1049
80	0	12	120	240	360	480	600	720	839	959	1079	1199
90	0	13	135	270	405	540	675	809	944	1079	1214	1349
100	0	15	150	300	450	600	750	899	1049	1199	1349	1499

Table Notes: a) Green shaded cells highlight most likely displacement range of 30% to 70% as appropriate from the evidence base; b) Pink shaded cells represent the most likely range of mortality associated with displaced birds (1% to 10%).

Table 13.22 Displacement matrix presenting the number of razorbills in the East Anglia THREE site and 2km buffer during the spring season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)										
	0	1	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	2	3	5	6	8	9	11	12	14	15
10	0	2	15	30	46	61	76	91	107	122	137	152
20	0	3	30	61	91	122	152	183	213	244	274	305
30	0	5	46	91	137	183	229	274	320	366	411	457
40	0	6	61	122	183	244	305	366	427	488	549	610
50	0	8	76	152	229	305	381	457	533	610	686	762
60	0	9	91	183	274	366	457	549	640	732	823	914
70	0	11	107	213	320	427	533	640	747	853	960	1067
80	0	12	122	244	366	488	610	732	853	975	1097	1219
90	0	14	137	274	411	549	686	823	960	1097	1234	1372
100	0	15	152	305	457	610	762	914	1067	1219	1372	1524

Table Notes: a) Green shaded cells highlight most likely displacement range of 30% to 70% as appropriate from the evidence base; b) Pink shaded cells represent the most likely range of mortality associated with displaced birds (1% to 10%).

Table 13.23 Displacement matrix presenting the number of puffins in the East Anglia THREE site during the breeding season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)											
	0	1	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	1	1	1	1	1	1
10	0	0	1	2	3	4	5	6	8	9	10	11
20	0	0	2	4	6	9	11	13	15	17	19	22
30	0	0	3	6	10	13	16	19	23	26	29	32
40	0	0	4	9	13	17	22	26	30	35	39	43
50	0	1	5	11	16	22	27	32	38	43	49	54
60	0	1	6	13	19	26	32	39	45	52	58	65
70	0	1	8	15	23	30	38	45	53	60	68	76
80	0	1	9	17	26	35	43	52	60	69	78	86
90	0	1	10	19	29	39	49	58	68	78	87	97
100	0	1	11	22	32	43	54	65	76	86	97	108

Table Notes: a) Green shaded cells highlight most likely displacement range of 30% to 70% as appropriate from the evidence base; b) Pink shaded cells represent the most likely range of mortality associated with displaced birds (1% to 10%).

Table 13.24 Displacement matrix presenting the number of puffins in the East Anglia THREE site during the nonbreeding season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)											
	0	1	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	1	1	1	1	1	2	2	2
10	0	0	2	4	6	8	10	12	14	16	18	20
20	0	0	4	8	12	16	20	23	27	31	35	39
30	0	1	6	12	18	23	29	35	41	47	53	59
40	0	1	8	16	23	31	39	47	55	62	70	78
50	0	1	10	20	29	39	49	59	68	78	88	98
60	0	1	12	23	35	47	59	70	82	94	105	117
70	0	1	14	27	41	55	68	82	96	109	123	137
80	0	2	16	31	47	62	78	94	109	125	140	156
90	0	2	18	35	53	70	88	105	123	140	158	176
100	0	2	20	39	59	78	98	117	137	156	176	195

Table Notes: a) Green shaded cells highlight most likely displacement range of 30% to 70% as appropriate from the evidence base; b) Pink shaded cells represent the most likely range of mortality associated with displaced birds (1% to 10%).

5.2 Cumulative collision assessment

Table 13.30. Cumulative Collision Risk Assessment for Gannet

Tier	Windfarm (source of annual data / source of autumn data)	Predicted collisions (@ 98.9% avoidance rate, Band Model option 1 or 2)			
		Annual	Annual Cumulative total	Autumn migration	Autumn migration Cumulative total
1	Beatrice Demonstrator [1 / A]	2.2	2.2	0.5	0.5
1	Greater Gabbard [1 / B]	27.5	29.7	9.0	9.6
1	Gunfleet Sands [1 / A]	0.0	29.7	0.0	9.6
1	Kentish Flats [1 /B]	3.3	33.0	0.0	9.6
1	Lincs [3 / A]	4.9	37.9	1.2	10.8
1	London Array (Phase 1) [2 / B]	5.5	43.4	1.0	11.8
1	Lynn and Inner Dowsing [3 / A]	0.550	44.0	0.0	11.8
1	Scroby Sands [1 / A]	0.0	44.0	0.0	11.8
1	Sheringham Shoal [2 / B]	17.6	61.6	1.6	13.4
1	Teesside [2 / B]	6.6	68.2	1.7	15.1
1	Thanet [2 / B]	1.1	69.3	1.1	16.2
2	Humber Gateway [3 / A]	4.4	73.7	1.0	17.2
2	Westermost Rough [2 / A]	0.5	74.2	0.1	17.3
3	Beatrice [3 / C]	95.7	169.9	56.1	73.4
3	Blyth (NaREC Demonstration) [3 / C]	8.0	177.9	2.0	75.4
3	Dogger Bank Creyke Beck A & B [1 / B]	218.3	396.3	7.0	82.4
3	Dudgeon [1 / C]	79.7	476.0	37.7	120.1
3	East Anglia ONE [3 / C]	467.5	943.5	169.0	289.1
3	EOWDC (Aberdeen OWF) [3 / B]	4.9	948.5	2.7	291.8
3	Firth of Forth Alpha and Bravo [3 / B]	915.7	1864.2	50.0	341.8
3	Galloper [3 / A]	61.6	1925.8	15.4	357.2
3	Hornsea Project 1 [2 / C]	66.0	1991.8	31.0	388.2
3	Inch Cape [1 / B]	360.8	2352.6	29.0	417.2
3	Moray Firth (EDA) [1 / C]	124.8	2477.5	57.2	474.4
3	Neart na Goithe [1 / B]	525.2	3002.7	16.5	490.9
3	Race Bank [3 / B]	108.9	3111.6	12.0	502.9
3	Rampion [1 / A]	101.4	3213.1	46.1	549.0

Tier	Windfarm (source of annual data / source of autumn data)	Predicted collisions (@ 98.9% avoidance rate, Band Model option 1 or 2)			
		Annual	Annual Cumulative total	Autumn migration	Autumn migration Cumulative total
3	Triton Knoll [1 / B]	140.2	3353.3	48.0	597.0
4	Dogger Bank Teesside A & B [1 / B]	211.2	3564.5	9.0	606.0
4	Hornsea Project 2 [2 / C]	41.8	3606.3	53.0	659.0
4	Navitus Bay [1 / C]	81.4	3687.7	13.2	672.2
5	East Anglia THREE [3 / C]	17.0	3704.8	11.0	683.2
	Total	3704.8		683.2	

Annual data sources: 1 = Natural England (2013) submission for Rampion gannet assessment; 2 = Hornsea Project 2 submission; 3 = Developer assessment
Autumn data sources: A = no seasonal data, collisions apportioned equally among months; B = Hornsea Project 2 submission; C = Developer assessment

Table 13.31. Cumulative Collision Risk Assessment for kittiwake

Tier	Windfarm (source of annual data / source of autumn data)	Predicted collisions (@ 98.9% avoidance rate, Band Model option 1 or 2)					
		Annual	Annual migration Cumulative total	Spring migration	Spring migration Cumulative total	Autumn migration	Autumn migration Cumulative total
1	Beatrice Demonstrator [1 / A]	4.9	4.9	2.5	2.5	0.6	0.6
1	Greater Gabbard [1 / B]	27.5	32.4	11.0	13.5	15.0	15.6
1	Gunfleet Sands [1 / A]	0.0	32.4	0.0	13.5	0.0	15.6
1	Kentish Flats [1 / C]	2.2	34.6	1.1	14.6	1.1	16.7
1	Lincs [1 / A]	2.7	37.4	1.4	16.0	0.3	17.1
1	London Array (Phase 1) [1 / B]	5.5	42.9	2.7	18.7	2.7	19.8
1	Lynn and Inner Dowsing [1 / A]	0.000	42.9	0.0	18.7	0.0	19.8
1	Scroby Sands [1 / A]	0.0	42.9	0.0	18.7	0.0	19.8
1	Sheringham Shoal [1]	0.0	42.9	0.0	18.7	0.0	19.8

Tier	Windfarm (source of annual data / source of autumn data)	Predicted collisions (@ 98.9% avoidance rate, Band Model option 1 or 2)					
		Annual	Annual migration Cumulative total	Spring migration	Spring migration Cumulative total	Autumn migration	Autumn migration Cumulative total
	/ A						
1	Teesside 1 / B	77.0	119.9	15.0	33.7	24.0	43.8
1	Thanet 1 / B	1.1	121.0	0.0	33.7	0.0	43.8
2	Humber Gateway 1 / A	7.7	128.7	3.8	37.5	1.0	44.8
2	Westermost Rough 1 / B	0.5	129.2	0.0	37.5	0.0	44.8
3	Beatrice 1 / C	144.6	273.9	38.5	76.0	38.5	83.3
3	Blyth (NaREC Demonstration) 1 / B	0.0	273.9	2.0	78.0	2.0	85.3
3	Dogger Bank Creyke Beck A & B 1 / B	2572.9	2846.8	363.0	441.1	135.0	220.3
3	Dudgeon 1 / B	0.0	2846.8	0.0	441.1	0.0	220.3
3	East Anglia ONE 1 / C	580.8	3427.6	290.4	731.4	290.4	510.7
3	EOWDC (Aberdeen OWF) 1 / B	0.0	3427.6	1.0	732.4	6.0	516.7
3	Firth of Forth Alpha and Bravo 1 / B	714.4	4142.0	248.0	980.4	313.0	829.7
3	Galloper 1 / A	81.4	4223.4	40.7	1021.2	10.2	839.8
3	Hornsea Project 1 1 / C	123.7	4347.2	54.0	1075.2	54.0	893.8
3	Inch Cape 1 / C	301.4	4648.6	86.9	1162.1	200.7	1094.6
3	Moray Firth (EDA) 1 / C	82.5	4731.1	11.5	1173.6	11.5	1106.2
3	Neart na Goithe 1 / C	49.5	4780.6	2.7	1176.4	26.9	1133.1
3	Race Bank 1 / B	31.3	4811.9	6.0	1182.4	24.0	1157.1
3	Rampion 1 / A	121.5	4933.5	60.8	1243.1	15.2	1172.3
3	Triton Knoll 1 / B	242.0	5175.5	38.0	1281.1	104.0	1276.3
4	Dogger Bank Teesside A & B 1 / B	1409.6	6585.1	79.0	1360.1	79.0	1355.3

Tier	Windfarm (source of annual data / source of autumn data)	Predicted collisions (@ 98.9% avoidance rate, Band Model option 1 or 2)					
		Annual	Annual migration Cumulative total	Spring migration	Spring migration Cumulative total	Autumn migration	Autumn migration Cumulative total
4	Hornsea Project 2 1 / C	340.4	6925.6	19.0	1379.1	28.0	1383.3
4	Navitus Bay 1 / C	36.8	6962.4	17.6	1396.7	18.1	1401.4
5	East Anglia THREE 3 / C	147	7109.4	48.4	1445.1	90.2	1491.6
	Total	7109.4		1445.1		1491.6	

Annual data sources: 1 = Natural England (2013) submission for Rampion gannet assessment;
Spring and Autumn data sources: A = no seasonal data, collisions apportioned equally among months;
B = Hornsea Project 2 submission; C = Developer assessment

Table 13.32. Cumulative Collision Risk Assessment for Lesser black-backed gull

Tier	Windfarm (source of annual data / source of autumn data)	Predicted collisions (@ 99.5% avoidance rate, Band Model option 1 or 2)			
		Annual	Annual Cumulative total	Nonbreeding	Nonbreeding Cumulative total
1	Beatrice Demonstrator 1 / A	0.0	0.0	0.0	0.0
1	Greater Gabbard 1 / B	62.0	62.0	49.6	49.6
1	Gunfleet Sands 1 / A	0.0	62.0	0.0	49.6
1	Kentish Flats 1 /B	1.6	63.6	1.3	50.9
1	Lincs 3 / A	8.5	72.1	6.8	57.7
1	London Array (Phase 1) 2 / B	0.0	72.1	0.0	57.7
1	Lynn and Inner Dowsing 3 / A	0.0	72.1	0.0	57.7
1	Scroby Sands 1 / A	0.0	72.1	0.0	57.7
1	Sheringham Shoal 2 / B	8.3	80.3	6.6	64.3
1	Teesside 2 / B	0.0	80.3	0.0	64.3
1	Thanet 2 / B	16.0	96.3	12.8	77.1
2	Humber Gateway 3 / A	1.3	97.7	1.1	78.1
2	Westermost Rough 2 / A	0.3	98.0	0.3	78.4
3	Beatrice 3 / C	0.0	98.0	0.0	78.4

Tier	Windfarm (source of annual data / source of autumn data)	Predicted collisions (@ 99.5% avoidance rate, Band Model option 1 or 2)			
		Annual	Annual Cumulative total	Nonbreeding	Nonbreeding Cumulative total
3	Blyth (NaREC Demonstration) 3 / C	0.0	98.0	0.0	78.4
3	Dogger Bank Creyke Beck A & B 1 / B	18.7	116.7	15.0	93.4
3	Dudgeon 1 / C	76.5	193.2	61.2	154.6
3	East Anglia ONE 3 / C	98.5	291.7	78.8	233.4
3	EOWDC (Aberdeen OWF) 3 / B	0.0	291.7	0.0	233.4
3	Firth of Forth Alpha and Bravo 3 / B	10.5	302.2	8.4	241.8
3	Galloper 3 / A	112.5	414.7	90.0	331.8
3	Hornsea Project 1 2 / C	21.8	436.4	17.4	349.2
3	Inch Cape 1 / B	0.0	436.4	0.0	349.2
3	Moray Firth (EDA) 1 / C	0.0	436.4	0.0	349.2
3	Neart na Goithe 1 / B	0.5	436.9	0.4	349.6
3	Race Bank 3 / B	32.0	468.9	25.6	375.2
3	Rampion 1 / A	7.9	476.8	6.3	381.4
3	Triton Knoll 1 / B	37.0	513.8	29.6	411.0
4	Dogger Bank Teesside A & B 1 / B	18.1	531.9	14.5	425.6
4	Hornsea Project 2 2 / C	16.5	548.4	13.2	438.8
4	Navitus Bay 1 / C	15.0	563.4	12.0	450.8
5	East Anglia THREE 3 / C	19.8	583.2	15.8	466.6
	Total	583.2		466.6	

Table 13.33. Cumulative Collision Risk Assessment for herring gull

Tier	Windfarm (source of annual data / source of autumn data)	Predicted collisions (@ 99.5% avoidance rate, Band Model option 1 or 2)			
		Annual	Annual Cumulative total	Nonbreeding	Nonbreeding Cumulative total
1	Beatrice Demonstrator 1 / A	0.0	0.0	0.0	0.0
1	Greater Gabbard 1 / B	0.0	0.0	0.0	0.0
1	Gunfleet Sands 1 / A	0.0	0.0	0.0	0.0
1	Kentish Flats 1 /B	2.2	2.2	1.7	1.7

Tier	Windfarm (source of annual data / source of autumn data)	Predicted collisions (@ 99.5% avoidance rate, Band Model option 1 or 2)			
		Annual	Annual Cumulative total	Nonbreeding	Nonbreeding Cumulative total
1	Lincs 3 / A	0.0	2.2	0.0	1.7
1	London Array (Phase 1) 2 / B	0.0	2.2	0.0	1.7
1	Lynn and Inner Dowsing 3 / A	0.0	2.2	0.0	1.7
1	Scroby Sands 1 / A	0.0	2.2	0.0	1.7
1	Sheringham Shoal 2 / B	0.0	2.2	0.0	1.7
1	Teesside 2 / B	43.2	45.3	34.5	36.3
1	Thanet 2 / B	24.5	69.8	19.6	55.9
2	Humber Gateway 3 / A	1.3	71.2	1.1	56.9
2	Westermost Rough 2 / A	0.1	71.2	0.1	57.0
3	Beatrice 3 / C	246.8	318.0	197.4	254.4
3	Blyth (NaREC Demonstration) 3 / C	2.7	320.7	2.2	256.5
3	Dogger Bank Creyke Beck A & B 1 / B	0.0	320.7	0.0	256.5
3	Dudgeon 1 / C	0.0	320.7	0.0	256.5
3	East Anglia ONE 3 / C	57.5	378.2	46.0	302.5
3	EOWDC (Aberdeen OWF) 3 / B	4.8	382.9	3.8	306.3
3	Firth of Forth Alpha and Bravo 3 / B	31.0	413.9	24.8	331.1
3	Galloper 3 / A	27.2	441.2	21.8	352.9
3	Hornsea Project 1 2 / C	14.5	455.7	11.6	364.5
3	Inch Cape 1 / B	13.5	469.2	10.8	375.3
3	Moray Firth (EDA) 1 / C	52.0	521.2	41.6	416.9
3	Neart na Goithe 1 / B	17.8	538.9	14.2	431.1
3	Race Bank 3 / B	0.0	538.9	0.0	431.1
3	Rampion 1 / A	155.0	693.9	124.0	555.1
3	Triton Knoll 1 / B	0.0	693.9	0.0	555.1
4	Dogger Bank Teesside A & B 1 / B	0.0	693.9	0.0	555.1
4	Hornsea Project 2 2 / C	23.8	717.7	19.0	574.1
4	Navitus Bay 1 / C	13.3	730.9	10.6	584.7
5	East Anglia THREE 3 / C	19.3	750.2	19.3	604.0
	Total	750.2		604.0	

Table 13.34. Cumulative Collision Risk Assessment for great black-backed gull

Tier	Windfarm (source of annual data / source of autumn data)	Predicted collisions (@ 99.5% avoidance rate, Band Model option 1 or 2)			
		Annual	Annual Cumulative total	Nonbreeding	Nonbreeding Cumulative total
1	Beatrice Demonstrator 1 / A	0.0	0.0	0.0	0.0
1	Greater Gabbard 1 / B	75.0	75.0	60.0	60.0
1	Gunfleet Sands 1 / A	0.0	75.0	0.0	60.0
1	Kentish Flats 1 /B	0.3	75.3	0.2	60.2
1	Lincs 3 / A	0.0	75.3	0.0	60.2
1	London Array (Phase 1) 2 / B	0.0	75.3	0.0	60.2
1	Lynn and Inner Dowsing 3 / A	0.0	75.3	0.0	60.2
1	Scroby Sands 1 / A	0.0	75.3	0.0	60.2
1	Sheringham Shoal 2 / B	0.0	75.3	0.0	60.2
1	Teesside 2 / B	43.6	118.8	34.8	95.1
1	Thanet 2 / B	0.5	119.3	0.4	95.5
2	Humber Gateway 3 / A	6.3	125.7	5.1	100.5
2	Westermost Rough 2 / A	0.2	125.8	0.1	100.7
3	Beatrice 3 / C	151.0	276.8	120.8	221.5
3	Blyth (NaREC Demonstration) 3 / C	6.3	283.2	5.1	226.5
3	Dogger Bank Creyke Beck A & B 1 / B	29.1	312.3	23.3	249.9
3	Dudgeon 1 / C	0.0	312.3	0.0	249.9
3	East Anglia ONE 3 / C	124.0	436.3	99.2	349.1
3	EOWDC (Aberdeen OWF) 3 / B	3.0	439.3	2.4	351.5
3	Firth of Forth Alpha and Bravo 3 / B	66.8	506.1	53.4	404.9
3	Galloper 3 / A	26.0	532.1	20.8	425.7
3	Hornsea Project 1 2 / C	85.8	617.8	68.6	494.3
3	Inch Cape 1 / B	36.8	654.6	36.8	531.0
3	Moray Firth (EDA) 1 / C	139.0	793.6	25.5	556.5
3	Neart na Goithe 1 / B	4.5	798.1	3.6	560.1
3	Race Bank 3 / B	0.0	798.1	0.0	560.1
3	Rampion 1 / A	26.0	824.1	20.8	580.9
3	Triton Knoll 1 / B	140.8	964.8	112.6	693.5

Tier	Windfarm (source of annual data / source of autumn data)	Predicted collisions (@ 99.5% avoidance rate, Band Model option 1 or 2)			
		Annual	Annual Cumulative total	Nonbreeding	Nonbreeding Cumulative total
4	Dogger Bank Teesside A & B [1 / B]	31.9	996.7	25.5	719.0
4	Hornsea Project 2 [2 / C]	62.7	1059.4	50.2	769.2
4	Navitus Bay [1 / C]	16.3	1075.7	13.0	782.2
5	East Anglia THREE [3 / C]	55.0	1130.7	48.0	830.2
	Total	1130.7		830.2	

East Anglia THREE

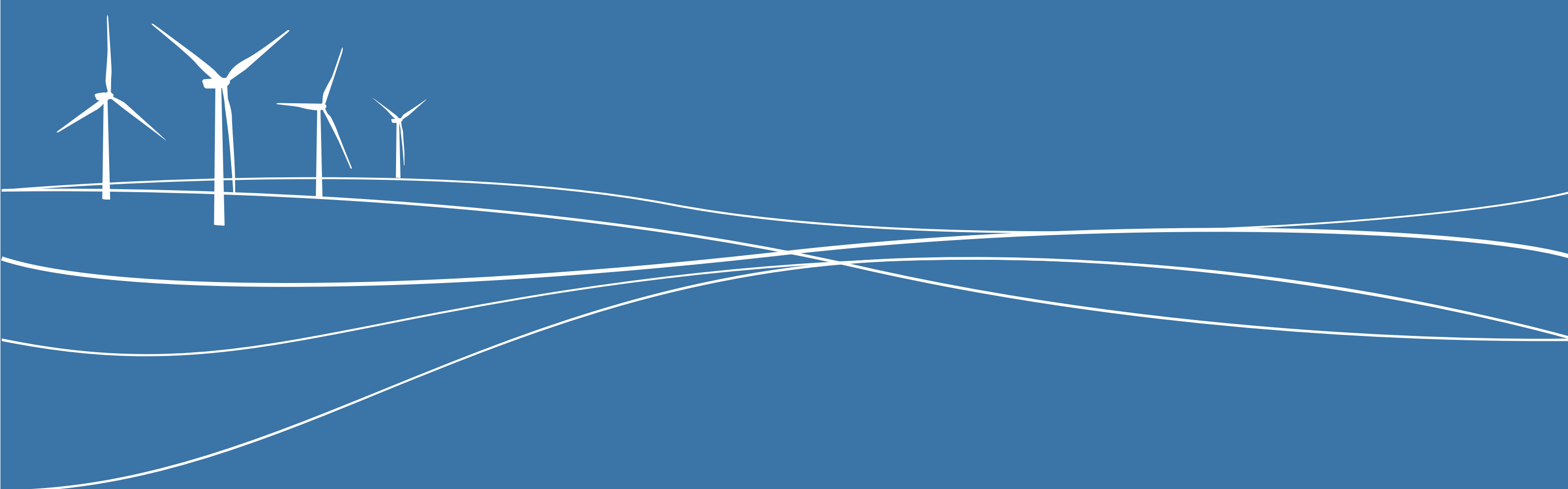
Ornithology Evidence Plan

Appendices

Expert Topic Group Meeting 5

3rd June 2015

Author – Various
East Anglia Offshore Wind Limited
Date – June 2015



1 INTRODUCTION

1. This document contains the background technical papers for discussion at the Ornithology Evidence Plan Meeting 5 as follows:

   a. Appendix 1:

      Assessing northern gannet avoidance of offshore windfarms

   b. Appendix 2:

      Appendix 3: Monthly mean abundance estimates and densities

   c. Appendix 3:

      Appendix 4: Common Guillemot and Razorbill New Site Boundary Corrected Abundance Estimates and Densities

   d. Appendix 4:

      Work Request 07: East Anglia THREE New Boundary Revised Collision Risk Modelling for Band Options 1, 2 and 3

   e. Appendix 5:

      Appendix 13.1 Collision Risk Modelling Methodology
      East Anglia ONE Windfarm Collision Risk Modelling Methodology

   f. Appendix 6:

      Nocturnal Flight Activity Levels in Seabirds

   g. Appendix 7:

      HRA Screening: Report on Ornithology (Final Screening)

APPENDIX 1: ASSESSING NORTHERN GANNET AVOIDANCE OF OFFSHORE WINDFARMS

This section was presented at Evidence Plan Meeting 4 and is included as an appendix to that Meeting in Technical Appendix 13.1.

APPENDIX 2: MONTHLY MEAN ABUNDANCE ESTIMATES AND DENSITIES

This section was presented at Evidence Plan Meeting 5 and is included as part of Technical Appendix 13.2.

APPENDIX 3: COMMON GUILLEMOT AND RAZORBILL NEW SITE BOUNDARY CORRECTED ABUNDANCE ESTIMATES AND DENSITIES

This section was presented at Evidence Plan Meeting 5 and is included as part of Technical Appendix 13.2.

APPENDIX 4: WORK REQUEST 07: EAST ANGLIA THREE NEW BOUNDARY REVISED COLLISION RISK MODELLING FOR BAND OPTIONS 1, 2 AND 3

This section was presented at Evidence Plan Meeting 5 and is included as part of Technical Appendix 13.3.

APPENDIX 5: COLLISION RISK MODELLING OF THE CONSENTED EAST ANGLIA ONE OWF

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Report Contributors: **Laura Brown, Natasha Rowlands & Sean Sweeney**

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Table of Contents

1 INTRODUCTION

1. The main potential risks to birds from offshore windfarms are collision, disturbance or displacement, barrier to movement, and habitat change or loss. There is an increase in potential risk of collision with wind turbines if they are located in areas in which there is a high level of flight activity. That high level of flight activity can be associated with locations where food supplies are concentrated or with areas where there is a high turnover of individuals (possibly commuting daily between nesting and feeding areas or passing through the area on seasonal migrations). That collision risk can be quantified using collision risk modelling (CRM).

2. A revision to the collision risk modelling has been carried out for the recently consented East Anglia ONE offshore windfarm project (the proposed project) to provide information for six seabird species, using the most recent version of the Band CRM (Band 2012) that has been designed specifically for application to offshore windfarm developments. The purpose of the revision is to provide predicted mortality estimates based on a revision to the turbine array. The predicted mortalities will provide the relevant information for consideration in cumulative and in-combination environmental impact assessments for the proposed East Anglia THREE offshore windfarm project.

3. For the six seabirds modelled for this report, the CRM is based upon the mean density of flying birds per month derived from the aerial surveys carried out between 2011 and 2013.

4. Three Band CRM modelling options have been used for this report:

- Basic Band CRM Option 1, using site-specific data for the percentage of birds flying at potential collision height (PCH);
- Basic Band CRM Option 2, using generic data for the percentage of birds flying at PCH; and
- Extended Band CRM Option 3, using flight height distribution data for the percentage of birds flying at PCH.

5. A brief explanation of each of the three Band CRM Options (options 1, 2 and 3) and the referenced data sources for each is provided in Section 2. Within this report the outputs from all three Band CRM Options have been presented with a range of avoidance rates shown in Table 1. The avoidance rates that have been selected for use in the CRM following the guidance from Cook et al. (2014) and from the

Statutory Nature Conservation Bodies (SNCBs) review of avoidance rates to be applied in the Band models (JNCC et al. 2014 in response to Cook et al. 2014).

6. The numbers of birds that are predicted to be subject to mortality as a result of colliding with the wind turbines per annum from each of the Band CRM Options are presented in section 3 (Tables 5, 6 and 7).

2 METHODOLOGY

7. The methodology outlined by Band (2012) has been followed for the CRM, which can be used to estimate the potential impacts predicted from the proposed project. The options that were applied in the CRM for the proposed project were:

- Basic Band CRM Option 1 with site-specific flight heights
  CRM was carried out using the Basic Band model that applies a uniform distribution of bird flights between the lowest and the highest levels of the rotors. The percentage of bird flights passing between the lowest and the highest levels of the rotors (i.e. birds at PCH) is determined from the observations of bird flight heights made during the boat-based site specific surveys. Site-specific PCH was calculated using flight height data from birds in flight in the East Anglia ONE site.

- Basic Band CRM Option 2 with generic flight heights
  CRM was carried out using the Basic Band model that applies a uniform distribution of bird flights between the lowest and the highest levels of the rotors. The proportion of birds flying between the lowest and the highest levels of the rotors (i.e. at PCH) was determined from the results of the SOSS-02 project (Cook et al. 2012) that analysed the flight height measurements taken from boat surveys conducted around the UK. The project was updated following Johnston et al. (2014), and the revised published spreadsheet (filename: "Final_Report_SOSS02_FlightHeights2014") was used to determine the 'generic' percentage of flights at PCH for each species based on the proposed project's wind turbine parameters.

- Extended Band CRM Option 3
  CRM was carried out using the Extended Band model that accounts for the skewed vertical distribution of bird flight heights between the lowest and the highest levels of the rotors. Most seabird species are observed flying more frequently at the lower level of the rotor swept height (i.e. closer to the sea surface) than at heights equivalent to the rotor hub height or at the upper levels of the rotor and the probability of being struck by the moving rotor varies with vertical position. Extended Band Option 3 uses the data spreadsheet ("…FlightHeights2014") that accompanies the SOSS-02 report that is the result of a statistical analysis of a large number of boat surveys across multiple study sites. This data is fed into the Band model in order to allow for the flight distribution to be calculated based upon the windfarm parameters of the proposed project.

8. The parameters used in the Band CRM are presented in Section 3.1. Table 1 relates the Band Options to the species specific avoidance rates that were applied in the modelling. The avoidance rates that have been selected for use in the CRM follow the guidance from Cook et al. (2014) and in relation to the Statutory Nature Conservation Bodies (SNCBs) review of avoidance rates to be applied in the Band models (JNCC et al. 2014 in response to Cook et al. 2014).

9. The avoidance rates (± 2SD) were based on those supported by the SNCBs for the relevant species and Band CRM option. A range of avoidance rates were used for species which lack species-specific data.

Table 1. Collision risk models with associated avoidance rates for the East Anglia ONE windfarm

Species	Band Option 1 - Basic Model	Band Option 2 - Basic Model	Band Option 3 - Extended Model
	Site-specific PCH	"…FlightHeights2014" distribution data (Johnston et al. 2014)	"…FlightHeights2014" distribution data (Johnston et al. 2014)
Fulmar	0.950, 0.980, 0.990, 0.995	0.950, 0.980, 0.990, 0.995	0.950, 0.980, 0.990, 0.995
Gannet	0.987, 0.989, 0.991	0.987, 0.989, 0.991	0.950, 0.980, 0.990, 0.995
Kittiwake	0.987, 0.989, 0.991	0.987, 0.989, 0.991	0.950, 0.980, 0.990, 0.995
LBB gull	0.994, 0.995, 0.996	0.994, 0.995, 0.996	0.987, 0.989, 0.991
Herring gull	0.994, 0.995, 0.996	0.994, 0.995, 0.996	0.988, 0.990, 0.992
GBB gull	0.994, 0.995, 0.996	0.994, 0.995, 0.996	0.987, 0.989, 0.991

3 COLLISION RISK MODELLING METHODOLOGY

3.1 Collision risk modelling input parameters

10. Table 2 presents the CRM species input parameters for the six selected seabirds. The proportion at PCH is also provided in Table 2 and is based on site-specific data. Species biometrics were obtained from Robinson (2005) and the nocturnal activity rate was based on a 1 to 5 scoring index for each species in Garthe and Hüppop (2004) or King et al. (2009), with the spreadsheet converting these factors into daytime activity as follows; 1 = 0%, 2 = 25%, 3 = 50%, 4 = 75%, 5 = 100%. The number of available daylight hours is calculated within the CRM spreadsheet (Band 2012) based on the latitude of the windfarm development.

Table 2. Species biometrics used in the collision risk modelling of the East Anglia ONE windfarm

Species	Body Length (m)	Wingspan (m)	Flight Speed (ms^{-1})	Nocturnal Activity Factor (1 to 5) [5]	Flight type	Proportion at potential collision height (%)
Fulmar	0.48 [1]	1.07 [1]	13.0 [2]	4 [4]	Gliding	0.50
Gannet	0.94 [1]	1.72 [1]	14.9 [2]	2 [4]	Gliding	25.17
Kittiwake	0.39 [1]	1.08 [1]	13.1 [2]	3 [4]	Flapping	21.27
LBB gull	0.58 [1]	1.42 [1]	13.1 [3]	3 [4]	Flapping	26.30
Herring gull	0.60 [1]	1.44 [1]	12.8 [3]	3 [4]	Flapping	29.38
GBB gull	0.71 [1]	1.58 [1]	13.7 [3]	3 [4]	Flapping	23.33

[1] Robinson (2005)
[2] Pennycuick (1997)
[3] Alerstam (2007)
[4] Garthe & Hüppop (2004)
[5] The CRM spreadsheet converts this factor from 1 to 5 into 0% / 25% / 50% / 75% / 100% daytime activity respectively.

11. The determination of the rotor strike probability for each species, that is part of the overall CRM process, is calculated in the CRM spreadsheet (Band 2012) based on each species flying in a straight line along the longest length of the windfarm. It incorporates the calculation of rotor strike probability for both upwind and downwind flights and the associated change in mortality risks.

12. Input parameters for the wind turbine specifications used within the CRM are shown in Tables 3 and 4. East Anglia ONE Limited provided the data on theoretical maximum operational times for the proposed project's wind turbines (Table 3), which have been incorporated into the CRM for this report. These operational times represent a theoretical maximum or Worst Case Scenario (WCS), as they do not

account for any downtime that may be necessary during unplanned servicing or maintenance of wind turbines.

Table 3. Theoretical operational time of East Anglia ONE windfarm turbines

Month	Operational Time (%)
January	95.23
February	93.65
March	92.30
April	91.04
May	91.78
June	88.86
July	90.00
August	89.60
September	92.20
October	94.29
November	95.40
December	95.03

Table 4. Wind turbine specification for the East Anglia ONE windfarm (22-176m)

Item	Value	Parameter assumptions
Turbine Model	5MW	Provided by EAOW.
Number of turbines	240	Provided by EAOW.
No. of blades	3	Provided by EAOW.
Rotation speed (rpm)	11	Provided by EAOW.
Rotor radius (m)	67.5	Half the rotor diameter (135m), provided by EAOW.
Hub height (m)	99.65	Measured against mean sea level. Provided by EAOW.
Max. blade width (m)	4.8	Provided by EAOW.
Pitch (degrees)	15	Provided by EAOW.
Tidal offset (m)	0	Taken into account in hub height.
Width of windfarm (km)	52.27	Based on the East Anglia ONE Site.
Latitude (degrees)	34.179	Based on the East Anglia ONE Site.

4 SUMMARY OF COLLISION RISK MODELLING

13. To estimate the mortality rates for the six selected seabird species that have been modelled through the CRM the mean abundance and associated densities of flying birds have been calculated per month based on the 2011 to 2013 aerial survey data. These estimates have been used to calculate the predicted annual mortality rates for a range of avoidance rates and are presented in Tables 5, 6 and 7.

Table 5. Summary of annual mortality rates for six key seabirds for Band Option 1 and associated avoidance rates

Species	Avoidance Rate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annum
Fulmar	0.950	0	0	1	0	0	0	0	0	0	0	0	0	2
	0.980	0	0	0	0	0	0	0	0	0	0	0	0	1
	0.990	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.995	0	0	0	0	0	0	0	0	0	0	0	0	0
Gannet	0.987	2	0	3	0	0	0	0	6	9	41	184	7	251
	0.989	2	0	2	0	0	0	0	5	7	35	156	6	213
	0.991	1	0	2	0	0	0	0	4	6	28	127	5	174
Kittiwake	0.987	35	20	28	0	0	0	2	0	0	3	163	120	371
	0.989	30	17	24	0	0	0	2	0	0	3	138	101	314
	0.991	24	14	20	0	0	0	2	0	0	2	113	83	257
LBB gull	0.994	15	2	1	0	1	0	9	0	5	14	25	0	73
	0.995	13	1	1	0	1	0	7	0	4	12	21	0	61
	0.996	10	1	1	0	1	0	6	0	3	10	17	0	49
Herring gull	0.994	3	3	2	0	1	0	0	0	2	0	30	8	49
	0.995	3	3	2	0	1	0	0	0	2	0	25	7	41
	0.996	2	2	1	0	1	0	0	0	1	0	20	5	33
GBB gull	0.994	0	1	6	0	0	2	0	0	1	0	73	2	85
	0.995	0	1	5	0	0	1	0	0	1	0	61	1	71
	0.996	0	1	4	0	0	1	0	0	1	0	49	1	57

Table 6. Summary of annual mortality rates for six key seabirds for Band Option 2 and associated avoidance rates

Species	Avoidance Rate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annum
Fulmar	0.950	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.980	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.990	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.995	0	0	0	0	0	0	0	0	0	0	0	0	0
Gannet	0.987	0	0	0	0	0	0	0	1	1	6	25	1	35
	0.989	0	0	0	0	0	0	0	1	1	5	21	1	29
	0.991	0	0	0	0	0	0	0	1	1	4	18	1	24
Kittiwake	0.987	7	4	6	0	0	0	0	0	0	1	35	26	79
	0.989	6	4	5	0	0	0	0	0	0	1	29	22	67
	0.991	5	3	4	0	0	0	0	0	0	1	24	18	55
LBB gull	0.994	7	1	0	0	1	0	4	0	2	7	12	0	35
	0.995	6	1	0	0	0	0	3	0	2	6	10	0	29
	0.996	5	1	0	0	0	0	3	0	2	5	8	0	23
Herring gull	0.994	2	2	1	0	0	0	0	0	1	0	16	4	26
	0.995	1	1	1	0	0	0	0	0	1	0	14	4	22
	0.996	1	1	1	0	0	0	0	0	1	0	11	3	18
GBB gull	0.994	0	1	4	0	0	1	0	0	1	0	55	1	64
	0.995	0	1	4	0	0	1	0	0	1	0	46	1	54
	0.996	0	1	3	0	0	1	0	0	1	0	37	1	43

Table 7. Summary of annual mortality rates for six key seabirds for Band Option 3 and associated avoidance rates

Species	Avoidance Rate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annum
Fulmar	0.950	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.980	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.990	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.995	0	0	0	0	0	0	0	0	0	0	0	0	0
Gannet	0.950	0	0	0	0	0	0	0	1	2	7	34	1	46
	0.980	0	0	0	0	0	0	0	0	1	3	13	0	18
	0.990	0	0	0	0	0	0	0	0	0	1	7	0	9
	0.995	0	0	0	0	0	0	0	0	0	1	3	0	5
Kittiwake	0.950	9	5	7	0	0	0	1	0	0	1	40	30	92
	0.980	3	2	3	0	0	0	0	0	0	0	16	12	37
	0.990	2	1	1	0	0	0	0	0	0	0	8	6	18
	0.995	1	0	1	0	0	0	0	0	0	0	4	3	9
LBB gull	0.987	7	1	0	0	1	0	4	0	2	7	12	0	34
	0.989	6	1	0	0	0	0	3	0	2	6	10	0	29
	0.991	5	1	0	0	0	0	3	0	2	5	8	0	24
Herring gull	0.988	2	2	1	0	0	0	0	0	1	0	17	4	27
	0.990	1	1	1	0	0	0	0	0	1	0	14	4	22
	0.992	1	1	1	0	0	0	0	0	1	0	11	3	18
GBB gull	0.987	0	1	5	0	0	2	0	0	1	0	64	1	74
	0.989	0	1	4	0	0	1	0	0	1	0	54	1	63
	0.991	0	1	3	0	0	1	0	0	1	0	44	1	51

5 REFERENCES

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APPENDIX 6: NOCTURNAL FLIGHT ACTIVITY LEVELS IN SEABIRDS

This section was updated for Evidence Plan Meeting 6 and is included as an appendix to that meeting in Technical Appendix 13.1.

APPENDIX 7: HRA SCREENING: REPORT ON ORNITHOLOGY (FINAL SCREENING)

This section was updated for Evidence Plan Meeting 6 and is included as an appendix to that meeting. It is also included in the Habitats Regulations Assessment.

13.1.11 Minutes of Ornithology ETG 5 Meeting

13. Provided below are the minutes of the fifth Ornithology ETG meeting

East Anglia Offshore Wind Limited - East Anglia THREE

East Anglia THREE, Ornithology ETG Meeting 5 – 03/06/14

Attendees		
Name	**Initials**	**Organisation**
Keith Morrison	KM	EAOW
Marcus Cross	MC	EAOW (video)
Holly Cartwright	HC	EAOW
Claire Ludgate	CL	Natural England
Lou Burton	LB	Natural England (phone)
Tim Frayling	TF	Natural England
Roger Covey	RC	Natural England
Rachel Hoskin	RH	Natural England
Jacqui Miller	JM	RSPB
Sarah Lee	SL	RSPB
Mark Trinder	MT	MacArthur Green
Bob Furness	BF	MacArthur Green
Paolo Pizzolla	PP	Royal HaskoningDHV
Apologies		

AGENDA		
Item	**Description**	**Action**
1	Health and Safety – KM Introductions - All	n/a
2	MC – did everyone get documentation to be discussed at today's meeting? All parties confirmed that they received documents	n/a
3	KM – gave a project update – the key points were: • Project development design envelope finalised • This includes the potential to build the project in two phases • The offshore and onshore Red Line Boundaries have been finalised • Project submission date remains 18th November 2015. • Chapters finalised by end of July 15 prior to internal / legal sign-off during August/September • Currently drafting, reviewing and finalising ES chapters • Drafting DCO, DML and supporting	None

	documentation/plans/drawings • S42 and s47 consultation exercise soon to begin (19th July for 35 days) • S42 Phase III consultation is mainly to cover potential community concerns regarding phasing. Whilst ornithology is covered, this is at a high level only. Details of assessments will be presented in the ES • Evidence plan process underway again – steering group meeting was held on 2/6/15 • Ornithology ETG to be held on 03/06/15	
4	BDMPS (slide 3) MT – presented the BDMPS parameters for relevant species. Note that these have been updated since PEIR and are now the BDMPS as presented in Furness (2015) MT – is the use of season definitions and minimum population sizes appropriate? All: Agreement that the information presented was the most appropriate for use in the impact assessment	ACTION – the seasons and populations presented will be the basis of the assessments for the species listed
5	Phasing (slide 4) MT – presented the design changes and the indicative phasing schedule. MT – assumption for assessment is that key impacts are operational therefore there are limited implications for the ornithology assessment. TF – Agreed Note – RSPB state that "Having now seen the Phase 3 consultation document, we understand there will be some changes which could affect the degree of disturbance (particularly to red-throated diver) caused during construction, e.g. an increase in vessel numbers. We would like to see further detail about these changes before we can agree to this assumption."	ACTION – the assessment will proceed on this basis. Clearly where phasing has differences (i.e. potentially for the export cables) this will be discussed in the impact narrative ACTION – EATL to provide more detail on the works within the SPA at OETG6
6	Displacement assessment (slide 5) MT – Displacement is assessed using BDMPS seasons and populations, with displacement and mortality ranges as per NE guidance MT - Is approach acceptable? TF – generally acceptable. However, TF would like the full range of displacement for cumulative assessment also to be shown in tables rather than just summarised in the text.	ACTION – MT will put this information in full in a table in the ES chapter

	TF – raised the question of how to assess an overall annual mortality from displacement MT/BF – discussed potential ways of showing this and there was a general discussion on the problems of how to sum mortality across seasons when the members of the populations involved overlap to an unknown extent. The question was also raised about what mortality level is appropriate in each season. TF – For the red throated diver assessment EATL have used a gradient for displacement across the buffer. The NE guidance says to use a flat rate to 4km MT – can present both but differences likely to be trivial SL – Asked about whether EATL would consider Sizewell C shipping within the cumulative impact assessment (CIA) of displacement? PP – stated that any impact would be minor as there are a low number of EA THREE vessels operating and Sizewell traffic likely to be episodic rather than constant MT – agreed that larger part of any cumulative impact would stem from Sizewell	ACTION - TF to look back at how this was addressed for Hornsea P1 and/or Dogger Bank ACTION – BF/MT to provide a short note on potential methods for showing annual rates with commentary on problems, preferably after briefing from NE on how this was addressed for recent projects. ACTION – present gradient & the flat rate in the ES ACTION – EATL to include this in the CIA for completeness with publically available information
7	Collision risk (slide 7) MT – key points on the assessment • Assessed using BDMPS seasons and populations • Other projects included in Tiers • Mortality updated for avoidance rates (ARs) but not for windfarm changes (i.e. where it is known that build out likely to be smaller EATL has retained the numbers for the full consented capacity) • Current total mortality < previous total due to reduced ARs (except kittiwake) TF – Numbers in the CIA tables seem to be different from Dogger Teesside MT – EATL have used option 1 (DB Teesside used option 3). Gannet & Kittiwake EATL have used NE Rampion tables MT - Fewer predicted cumulative collisions for all species (except kittiwake) at new avoidance rate than previous ones and hence new total is lower than previously consented totals (but note that updates to	ACTION – MT to forward links on the TF for the data sources used in the table ACTION – TF to provide links to data used to confirm ACTION – Ensure that the narrative fully references the information sources (i.e. previous Secretary of State decisions) upon which this

	kittiwake tables are expected to alter this situation). Therefore this implies that cumulatively the numbers are not significant. Are NE happy with this logic? RC - content with the logic, but concerned that this needs to be backed up explicitly with evidence and audit trail for the Examiner to understand It was agreed that EATL would include full referencing and sign-posting to support the argument. MT - <u>Due to low predicted impacts there is no requirement for additional PBR or PVA. Does NE agree?</u> TF – uncomfortable with suggesting no population modelling is required. MT – did not believe this was necessary as results would be in line with previous PVAs PP – EATL would prefer not to undertake new modelling as this has implications for the programme TF – accepted likely result but considers bespoke PVA will provide more comfort to NE and Examiner MT/BF – discussed possible inputs for new PVAs MT – for gannet assessment will be using the SOSS-04 report, therefore not possible to provide CPS25 style outputs as these were not included. Instead, effects will be discussed in relation to changes in population growth rate and risk of population decline. TF – advice needs to be consistent with NE advice to Hornsea P2 JM – RSPB welcome the commitment to carry out PVA for gannet and kittiwake. Ideally we prefer CPS25 style outputs as they provide a clearer indication of likely impact significance.	conclusion is based. ACTION – Assessment in relation to PVA required for gannet and kittiwake. For gannet the SOSS-04 model report will be used. For kittiwake MT to forward proposed model parameters onto TF to agree prior to running. ACTION – TF to check
8	Gannet (slide 10) MT - Gannet avoidance is likely to be >98.9% which should be reflected in the assessment. This was the original question, however, after receipt of the NE feedback on the APEM gannet paper, EATL do not intend to use this in the assessment except to indicate precaution in recommended AR TF: Highlighted the potential benefits of this study design for monitoring purposes but not sufficient to increase current recommended AR MC – EATL are now not looking to challenge the 98.9% rate for gannet	None – EATL welcome the acknowledgement from NE that this is a useful piece of work and may be the basis of further investigation.
9	EA1 CRM (slide 11)	

<table>
<tr><td></td><td>MT – EATL have updated the collision risk mortality figures for EA1 based on the consented 240 wind turbines and removing birds on the water. It is proposed to use these revised figures in the CIA

TF – agreed it was appropriate to use the updated figures</td><td>ACTION – updated figures for EA1 to be used in CIA</td></tr>
<tr><td>10</td><td>Nocturnal activity (slide 12)

MT – nocturnal activity is overestimated
• Nocturnal activity factors appear to be too high compared with empirical data from logger deployments. CRM should use lower values as indicated in reporting.
• Evidence indicates that the values above should be adopted
Need to agree how to apply this to existing projects
TF – agree that the activity factors appeared to be precautionary and the evidence base seems to support this
MT – proposed that as no agreed activity values are likely to be available, this will just add to the narrative around precaution of collision risk numbers rather than trying to rework existing projects figures

JM - Agree that this may provide useful context within the narrative, but have the following comments on the report:
• More detail is required regarding sample sizes, quantity and quality of data
• The estimates of nocturnal flight activity for large gulls are rather poorly supported (paucity of data)

MC – highlighted that the project may wish to look into the use of this cumulative in more detail.</td><td>ACTION – TF would like to talk to other SNCBs for longer-term approach to nocturnal activity and will update the group.

ACTION – EATL will provide more detail on suggested use of this information at OETG6</td></tr>
<tr><td>11</td><td>HRA – SPA

Does everyone agree with above list and that all other SPA populations elsewhere in the UK and in other Member States can be screened out?

• Screening identified following for which possible likely significant effect (LSE):
  • Deben Estuary SPA (dark-bellied brent goose);
  • Alde-Ore Estuary SPA (lesser black-backed gull);
  • Flamborough and Filey Coast pSPA (gannet).</td><td></td></tr>
</table>

	• Excluded (due to - no connectivity, low nos., small impacts, large BDMPS): • Alde-Ore Estuary SPA (herring gull); • Flamborough and Filey Coast pSPA (kittiwake, common guillemot, razorbill, puffin). • Outer Thames Estuary SPA (red-throated diver); TF/SL – would prefer if red throated diver was retained in the HRA (although acknowledged that the data are already available that suggest no AEOI) BF – this will be included TF – add back in kittiwake at Flamborough and Filey BF – discussed the reasons why EATL believe it is justified to exclude Flamborough and Filey kittiwake JM – made the point that if the justification needed to screen kittiwake out is reasonably complex then makes sense to conclude potential LSE and include in the HRA MT – confirmed that impacts upon razorbill & guillemot are EIA issues not HRA issues	ACTION – agreed to revise the screening to keep red throated diver screened in at this stage ACTION – agreed to revise the screening to keep kittiwake screened in at this stage ACTION – update the screening report to reflect the discussed changes and circulate as final. There were no other issues raised with the report methodology, format or conclusions
12	Statement of Common Ground (SoCG) PP – EATL would like to have SoCG prepared prior to DCO application submission. We would like to have something quite high level rather than highly detailed to cover most of what is agreed CL – as discussed at the steering group, we only really need the detail on those issues which may be contentious / where we know from previous examinations that questions will arise	ACTION – PP to pull together a draft for discussion at the next OETG meeting
13	Next meeting – 6th / 13th July full day (marine mammals /onshore & offshore)	ACTION – PP to circulate invites
	<u>AOB</u> None raised	

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Agreement log

ID	Issue on which EATL seek agreement on	NE Position	RSPB Position
	OETG5		
	That use of season definitions and minimum population sizes is appropriate	*Agree*	*Agree*
	That potential phasing of construction of offshore components has little / no bearing on assessment	*Agree*	*Would like to see more detail re factors which could increase displacement of red-throated diver, e.g. increase in vessel numbers (as noted in the Phase 3 consultation)*
	That approach for assessing displacement (alone and cumulative) is appropriate and outputs do not indicate significant impacts	*Agree – noting the caveats in (6) above namely* • *EATL to include full tables of ranges of displacement* • *There needs to be a consideration of how to determine annual mortalities* • *Red throated diver assessment to use a flat displacement rate across buffer*	*Agree – subject to caveats noted by NE (as left)* • *EATL to include consideration of Sizewell C in CIA for red-throated diver*
	That approach for assessing collision risk (alone and cumulative) is appropriate and outputs do not indicate significant impacts	*Agree with following caveats* • *EATL to provide confirmation of source of cumulative numbers* • *If the argument is made that impacts below previously consented totals are acceptable, the full referencing /audit trail must be provided*	*We will comment on this point once we have seen the PVA outputs for gannet and kittiwake. We also support NE's comments (as left)*
	That impacts are of such small magnitude that population modelling (PBR or PVA) is unnecessary **EATL will undertake PVA for kittiwake and use SOSS-04**	*Agree with following caveats* • *PVA required for gannet & kittiwake*	*Agree that PVA is required for gannet and kittiwake*

	gannet report		
	That gannet avoidance rate is likely to be >98.9% and this should be reflected in the assessment **EATL is no longer challenging the 98.9% AR**	*Advise continue to use 98.9% AR for gannet with Basic Band Model Option 1 and 2 , and outputs calculated using i) mean AR and ± 2 SD and ii) mean, upper and lower 95% CLs of flight density data by month;*	*N/A*
	That revised collision estimates for East Anglia ONE should be used in the CIA	*Agree*	*Agree*
	That nocturnal activity factor used in CRM is overestimated and that use of evidence based values is appropriate for the assessment. However, the intention is not to re-work the CRM figures but to provide additional text	*Agree – NE will discuss this matter further with SNCBs if nocturnal activity factors are amended*	*Cannot agree at this stage. We agree that this may provide useful context within the narrative (as noted in the minutes), but consider that it is too early to use this in the assessment.*
	That the SPA features identified in the screening report are the only ones for which HRA will be required.	*Agree with following caveats* • *Red throated diver (Outer Thames Estuary SPA) screened in* • *Kittiwake (Flamborough and Filey Coast) screened in*	*Agree with following caveats* • *Red throated diver (Outer Thames Estuary SPA) screened in* • *Kittiwake (Flamborough and Filey Coast) screened in*
	OETG4		
	Discussions focussed on points raised on the detail of the PEIR assessments, the meeting worked through points provided as a draft response to the PEIR by Natural England.	*All points were captured in the final Natural England response to the Section 42 consultation (8th July 2014).*	

	OETG3		
	Discussion surrounded detail of assessments, no agreement as continuing actions.		
	OETG2		
1	**From OETG2 Paper** **Para 30**. Agreement, based on the information supplied at OETG Mtg 1, is sought on: • Sufficient offshore and onshore baseline survey data has been collected to inform the assessment. • No additional survey required for the offshore or onshore cable route (the additional targeted brent goose surveys are not related to baseline information gathering). • Existing onshore data will be augmented with new WeBS data recorded at greater spatial detail and an additional brent goose survey. • Natural England to supply (if it can be made available) its Outer Thames Estuary RTD survey data to augment the existing offshore cable route data (**Note for inclusion in PEI these data must be supplied by January 2014**)	Agree Agree – with exception of additional brent goose work Agree TBC	*Agree that 18 months of continuous survey data are sufficient.* *Agree that sufficient baseline information already exists* *Agree that this approach is acceptable* *Support the use of NE RTD data within assessment*
	Para 31. Agreement, based on the updated information supplied at OETG Mtg 2, is sought on: • Biological periods – agreed in principle subject to working up the figures	Need for nuanced approach agreed in principle.	*We are satisfied in principle with the revised Biological periods table supplied for OETG Mtg 2*

2	**Section 4** Agreement of the impacts to be assessed as listed in Section 4.1 (offshore) and 4.2 (onshore)	Agreed	*We support the change to the impacts in Section 4.1 suggested by NE. The operational impacts will also need to include in-combination/ cumulative impacts.*
3	**Data** Mean peaks shall be used unless there is great disparity between years, in which case contextual data will be consulted for justification of numbers used	Agree in principle but note requirement to present each year's monthly peaks separately (in appendix?) to enable any large discrepancies between years to be identified	*This approach is acceptable.*
4	**Data** Flight height methodology Agree that the methodology for determining flight height from aerial imagery is a general matter outside of the EP process, NE and APEM to discuss outwith EP meetings	Agree	*We would like to be consulted on any methodology for flight height agreed between NE and APEM.*
5	**Assessment methodologies – terminology** EAOW will look again at magnitude definitions, but this is not critical to agreement All accept that 'very high' category for sensitivity/magnitude adds little to assessment and this will not be used	Agree to need for further consideration of wording to define categories of magnitude. Agree	*We consider revised magnitude definitions are a major improvement. However, they still require some refinement in line with comments of NE and RSPB at OETG Mt 2.*
	OETG1	*Note that NE did not provide responses to the minutes prior to OETG2, these responses were added in OETG2*	*Responses provided – 9/11/13* *The RSPB's position is made in relation to the information available to us at this time. However, we reserve the right to alter our position to East Anglia 3 & 4 should new information (i.e research and data) become available which significantly alters the situation.*

1	**ONSHORE**		
	Data		
	Sufficient baseline survey data have been collected to inform the assessment	Happy with approach in document, that is when these 5 onshore elements are taken together	No the RSPB considers that further survey work will be required in regard to Brent Geese.
	No additional survey required for the cable route	Happy with approach in document, that is when these 5 onshore elements are taken together	The RSPB supports NE's position on this issue.
	Existing baseline data will be augmented with new WeBS data	Happy with approach in document, that is when these 5 onshore elements are taken together	The RSPB supports the use of the latest WeBS data to augment the baseline data.
	If possible new WeBS data to include greater detail on location of birds within the large WeBS count sectors	Happy with approach in document, that is when these 5 onshore elements are taken together	The RSPB agrees in principle that a more detailed understanding of the location of birds on the Deben is essential. However, we will need to see the details of what has been agreed with the BTO before we can make any further comments. *
	EAOW to undertake additional brent goose survey (winter 2013/2014)	Happy with approach in document, that is when these 5 onshore elements are taken together	The RSPB supports the additional Brent Goose survey being undertaken during the winter of 2013/14.
	Species		
	Likely species for assessment listed in App 7 & 8	OK	The RSPB agrees with NE's advice on this issue.
	Species to be selected for assessment on basis that are listed features of Deben Estuary SPA and SSSI or are Schedule 1 breeding species	OK	The RSPB supports this approach
	Assessment will include both listed features and relevant assemblage species	OK	The RSPB supports this approach
	Impacts		
	The following impacts will be assessed	OK	The RSPB agrees that the impacts proposed for

	• Construction
	  • Disturbance / Displacement
	• Operation
	  • High-level assessment
	• Decommissioning
	  • Disturbance / Displacement
			assessment are appropriate.

2	**OFFSHORE**		
	Data		
	Sufficient baseline survey data have been collected to inform the assessment (24 months of aerial for each site)	OK	The RSPB agrees that 24 months of aerial surveys will provide sufficient baseline data, provided that the data set is continuous and there are no gaps.
	No additional survey required for the cable route	OK	The RSPB supports NE's position on this issue
	NE's Outer Thames Estuary RTD survey data will be used if it can be made available	RC happy in principle	The RSPB supports the use of the Red Throated Diver survey data
	EA ONE and Zone data will be used as contextual information where relevant	OK	The RSPB agrees that using EA1 and zone data as contextual information could be useful.
	Data analysis		
	Population estimates will be design based but more sophisticated modelling will be applied if the data warrants it and the modelling approach is acceptable	OK	The RSPB supports this approach
	Flight parameters [awaits information on how flight height method has been validated]	Not part of EP process (APEM and NE, RSPB to deal with)	The RSPB supports NE's position on this issue.
	Species		
	Species specific bio-periods [awaits feedback from NE to create new bio-period table]	For OETG2	The RSPB supports NE's advice on the bio-period table
	If a species falls under any one of these criteria it will be taken forward in the assessment: 1) population of regional importance or greater. 2) adult seabirds within maximum foraging distance of SPA	*The proposal will not screen out spp prior to migration modelling, model run using BTO/SoSS and screen on that list*	The RSPB agrees in principle that the criteria being used are appropriate, However, we would like clarification about point 3, in particular how

	or SSSI with that species as interest feature 3) migration modelling shows connectivity and numbers occurring are significant (irrespective of collision risk).	*Assumption <1% of regional population = not significant, based upon the BTO approach to definition of migrant populations (waders/waterfowl), still need to define for seabirds – modified migration method approach (awaiting the Scottish methods)* ***Action for NE (RC) to look at SNH project and feedback as to whether appropriate***	'significant' is being defined.
	Impacts		

	The following impacts will be assessed
	• Construction
	  • Disturbance / Displacement
	  • Indirect through prey species
	• Operation
	  • Disturbance / Displacement
	  • Indirect through prey species
	  • Collision risk
	  • Barrier effect
	• Decommissioning
	  • Disturbance / Displacement
	  • Indirect through prey species
		OK	The RSPB seeks clarification about whether the assessment will include cumulative, in-combination and transboundary impacts.
			Once this has been clarified then we will be able to provide our position.

13.1.12 Ornithology ETG Meeting 6 Background Paper

14. Provided below is the background paper that was circulated prior to the sixth Ornithology ETG meeting

East Anglia Offshore Wind

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East Anglia THREE

Ornithology

Evidence Plan

Expert Topic Group Meeting 6

6th July 2015

Document Reference – ETG 6.1

Author – MacArthur Green
East Anglia Offshore Wind Limited
Date – June 2015
Revision History –First draft for Meeting 6

Table of Contents

1 INTRODUCTION

1.1 Purpose of this Document

1. The purpose of this document is to provide technical information to support the discussions to be held at the sixth ornithology expert topic group (OETG) meeting to be held on 6th July 2015.

2. This meeting will cover ornithological issues both onshore and offshore.

3. This document contains information that updates that presented at the first five OETG meetings held in September and November 2013, March and July 2014 and May 2015. It provides more detailed information on a series of topics related to offshore and onshore ornithology and assessment processes. In some cases an outline approach is described in this paper in recognition that the detail and discussion on it will take place at a future meeting. Background papers supporting this Evidence Plan are provided as Appendices 1 to 7.

4. The record of the discussions at the previous five OETG meetings and the schedule of topic areas on which agreement is sought, with the current position of Natural England and Royal Society for the Protection of Birds (RSPB), are contained within the respective minutes of those meetings.

2 PROJECT TIMETABLE AND DESCRIPTION

2.1 Project Timetable

5. An updated project timeline for East Anglia THREE is presented in Table 2.1.

Table 2.1: Project Timeline for East Anglia THREE

Date	Event
August 2013	Final East Anglia THREE site specific surveys
30th September 2013	Ornithology ETG meeting 1
11th November 2013	Ornithology ETG meeting 2
February 2014	Final East Anglia FOUR site specific surveys
March 2014	Draft High Level HRA Screening Report for East Anglia THREE
28th March 2014	Ornithology ETG meeting 3
27th May 2014	Start of consultation period for East Anglia THREE PEI (under Section 42 of the Planning Act 2008) High Level HRA Screening Report for East Anglia THREE provided alongside PEI
2nd July 2014	PEIR Workshop, attended by East Anglia Offshore Wind, Natural England, RSPB, APEM, Royal Haskoning DHV
2nd July 2014	Ornithology ETG meeting 4
8th July 2014	End of consultation period for East Anglia THREE PEI (under Section 42 of the Planning Act 2008)
3rd June 2015	Ornithology ETG meeting 5
11th June 2015	Start of Phase III consultation period for East Anglia THREE (under section 42 of the Planning Act 2008)
16th July 2015	End of Phase III consultation period for East Anglia THREE (under section 42 of the Planning Act 2008)
6th July 2015	Ornithology ETG meeting 6
September 2015	*Ornithology ETG meeting 7 (TBC)*
November 2015	DCO application East Anglia THREE

3 ORNITHOLOGY REPORTS

3.1 Onshore ornithology update

6. Onshore construction for the proposed East Anglia THREE project will involve pulling cables through pre-installed ducts (installed as part of East Anglia ONE works). In relation to East Anglia THREE this work will be subject to restrictions during the winter to minimise potential disturbance to dark bellied brent geese in the Deben Estuary SPA. The details of this restriction are being discussed with the construction engineers and will be provided at or before the Ornithology ETG meeting 6.

3.2 HRA Screening Report

7. An assessment of the SPA sites and features that should be screened in, or screened out, for Habitats Regulations Assessment (HRA) for the proposed East Anglia THREE project (alone and in-combination) was presented in advance of OETG 5 and discussed at that meeting.

8. Following the meeting it was agreed that as well as the species originally identified for inclusion in the HRA, the following would be added:

- Flamborough and Filey Coast pSPA (kittiwake).
- Outer Thames Estuary SPA (red-throated diver);

9. The updated HRA screening report reflecting these additional SPA features is attached as Appendix 1 (in tracked changes form to aid review).

3.3 Gannet cumulative impact assessment – use of SOSS-04 Gannet PVA report

10. Following recommendations from Natural England at OETG5, the reported mortalities at other wind farms in the cumulative assessment have been updated using the figures reported in the Dogger Bank Teesside A & B HRA (Forewind 2014).

11. It was also agreed at OETG5 that the potential impacts of cumulative mortality on the BDMPS population would be considered using the SOSS-04 gannet population report (WWT 2012).

12. Both the above aspects have been incorporated into the gannet cumulative assessment section of the Environmental Statement. This section is attached as Appendix 2.

13. Following these updates and using the SOSS-04 model outputs to assess cumulative mortality, the potential impacts on the population are considered to be minimal and not significant.

3.4 Kittiwake cumulative impact assessment and development of PVA

14. Following recommendations from Natural England at OETG5, the reported mortalities at other wind farms in the cumulative assessment have been updated using the figures reported in the Dogger Bank Teesside A & B HRA (Forewind 2014).

15. This update has been incorporated into the kittiwake cumulative assessment section of the Environmental Statement. This section is attached as Appendix 3.

16. It was also agreed at OETG5 that a population model would be developed to use in the kittiwake cumulative collision mortality assessment. The demographic rates used in the model were sent to Natural England (5^{th} June 2015) for review and are included in Appendix 4. This note has been updated to include preliminary model outputs in an annex to the note. These results are summarised below.

17. Two different sets of demographic rates have been used, simulated both with and without density dependent regulation of reproduction and using the spring and autumn BDMPS population estimates as the starting size (giving 2x2x2 = 8 simulation scenarios). In addition, the annual mortality was assessed against the autumn population size, generating a further 4 simulation outputs.

18. The modelling indicates that irrespective of the demographic rates or presence of density dependence, the impacts due to East Anglia THREE alone will have a very small (and probably undetectable) effect on the population. At an annual mortality of 250 (the lowest value simulated, which considerably exceeds the estimated East Anglia THREE annual mortality of 149), no model scenario resulted in more than a 1% difference in population size after 25 years.

19. Demographic parameter set 2 generated lower predicted baseline population growth rates than set 1 (density independent: 1.4% pa compared with 3.6% pa), although the difference between the two was reduced in the presence of density dependent regulation (density dependent: 0.9% pa compared with 1.3% pa). However, the most robust approach for interpreting model outputs is to compare the baseline and impacted outputs, rather than the absolute predictions of growth.

20. On this basis, considering the counterfactual of population size after 25 years (CPS25) and the cumulative seasonal mortality against the appropriate BDMPS populations, the greatest reduction in population size was obtained from the less realistic density independent simulations using parameter set 2. In both spring and autumn a maximum relative reduction in population size of approximately 2-3% was obtained (after 25 years).

21. A precautionary approach was adopted for assessing annual cumulative collision mortality for all windfarms. In these simulations, the total mortality was assessed against the autumn BDMPS (on the basis that this is the larger BDMPS and therefore more appropriate when considering the maximum impact level). In these simulations, the maximum reduction in population size (for the unrealistic density independent models) was approximately 7.6%. In the presence of density dependence this reduction was approximately 2.8%. (Table 3.1)

Table 3.1 Counterfactuals of population size for kittiwake BDMPS populations. The mortality levels in the table were selected due to their close proximity to the cumulative totals for each period (actual annual total: 4,041, actual spring total: 1,345, actual autumn total: 1,551) and therefore suitably representative (note full outputs will be provided in the assessment, and figures are presented in Appendix 4). Annual simulations used the autumn BDMPS as the initial population size while autumn and spring simulations used the BDMPS appropriate to those seasons.

Demographic rate set	Density dependent	Period	Mortality	Counterfactual of population size in year:				
				5	10	15	20	25
1	No	Annual	4000	0.988	0.972	0.954	0.932	0.924
1	Yes	Annual	4000	0.993	0.980	0.979	0.970	0.972
1	No	Autumn	1500	0.997	0.989	0.999	0.982	0.979
1	Yes	Autumn	1500	0.992	0.993	0.984	0.989	1.000
1	No	Spring	1500	0.997	0.996	0.988	0.981	0.972
1	Yes	Spring	1500	0.990	0.996	0.991	0.992	0.994
2	No	Annual	1500	0.988	0.972	0.965	0.951	0.930
2	Yes	Annual	1500	0.995	0.984	0.975	0.976	0.975
2	No	Autumn	1500	0.991	0.985	0.977	0.974	0.969
2	Yes	Autumn	1500	0.994	0.995	0.989	0.992	0.990
2	No	Spring	1500	1.003	0.988	0.982	0.985	0.974
2	Yes	Spring	1500	0.998	0.992	0.989	0.988	0.987

22. Overall, the conclusions of the modelling indicate that even with the maximum predicted cumulative mortality and the most precautionary modelling assumptions (density independence, parameters set 2) the magnitude of population impacts is expected to be small. Under more realistic assumptions (e.g. including density dependence) the population impacts are even smaller and can be considered as negligible.

3.5 Evidence basis for cumulative collisions being lower than recent consents

23. Following discussions at OETG5, where appropriate the cumulative collision assessments will include reviews of the consent decisions for recent windfarms made on the basis of the previously used (lower) avoidance rates. This adds to the evidence base that due to modifications in assessment methods (primarily the

increase in collision avoidance rates) the current cumulative mortality estimates are below the levels on which previous consent decisions have been granted, even with the inclusion of additional windfarms.

24. An example of the text to be included in the cumulative sections of the Environmental Statement is provided for great black-backed gull in Appendix 5.

3.6 Combining seasonal displacement mortality

25. Following discussion at OETG5, consideration has been given to the question of how to combine seasonal mortality due to displacement to arrive at an annual estimate. A report detailing this work is provided in Appendix 6.

26. The conclusions of this exercise are that the current approach of assessing displacement mortality using the season with the highest abundance is more precautionary than distributing mortality across all seasons. A possible but simple refinement to this would be to allocate the displacement mortality to the season during which the numbers represent the highest proportion of the seasonal BDMPS population rather than the highest absolute mean number in the survey area. That would retain the present precautionary nature of the matrix approach but assess against the population which would experience the highest impact.

3.7 Nocturnal activity factor – collision risk modelling sensitivity analysis

27. Following discussion at OETG5, a sensitivity analysis has been conducted to provide an understanding of how varying the nocturnal activity factor used in collision risk modelling alters the monthly collision risk estimates for wind farm sites located at northerly and southerly latitudes (e.g. Moray Firth and the English Channel).

28. This analysis has been added to the review of nocturnal activity submitted at ETG5 (Furness 2015) and the updated report is provided in Appendix 7.

29. In summary the results indicate that the effect of reducing nocturnal flight activity scores on collision mortality is greatest in mid-winter and least in mid-summer, reflecting the relative contribution of night across the annual cycle. Therefore the season when birds are present will affect the extent of collision reduction observed at any given windfarm. The latitude of the windfarm has a smaller influence, although the difference between mid-summer and mid-winter is greater for northern locations. There is no difference in the magnitude of reduction for different species, however a reduction from a nocturnal activity score of 2 to 1 (25% to 0%) has a greater effect than from 3 to 2 (50% to 25%). This is due to the interplay of day

and night length across the year, and hence this difference is most pronounced in mid-winter and virtually absent in mid-summer.

30. The smallest mortality reduction was observed in mid-summer (7%) for the northern windfarm site for both a reduction from 2 to 1 and 3 to 2. Therefore, as a precautionary first step, it would be appropriate to reduce collision mortality for all species at all windfarms by 7%. Further reductions, reflecting windfarm latitude and seasonality of bird abundance could be applied to further reduce the overall mortality.

3.8 Key points for discussion and agreement

Table 3.4. Summary of key points on which EATL seeks agreement with NE and RSPB

Item	Summary points for discussion and agreement
1	The SPAs and features screened in for HRA are now agreed.
2	The updated gannet collision numbers are correct for the cumulative assessment and the SOSS-04 Gannet PVA is suitable for assessing cumulative gannet impacts and assessment in this manner indicates that cumulative gannet mortality will not have a significant effect on the population.
3	The updated kittiwake collision numbers are correct for the cumulative assessment and the proposed kittiwake modelling approach is suitable and the results provide comfort that cumulative kittiwake mortality will not have a significant effect on the population.
4	The evidence base for the cumulative collision assessments provides the appropriate level of comfort for NE to conclude that the current total mortality is below that previously consented.
5	Attempting to combine mortality across seasons is unlikely to alter conclusions and introduces considerable complication due to variable degrees of overlap in the relevant populations to be assessed. A possible refinement would be to base assessments on the season when the highest *proportion* of the BDMPS population is considered at risk rather than the one when the highest *absolute* number is at risk. However, following a review of methods and options, the current approach for assessing auk mortality due to displacement across seasons is considered to be appropriate and generates robust precautionary conclusions.
6	The results of the collision risk modelling nocturnal activity factor sensitivity analysis indicate that a minimum reduction in collision risk for all wind farms of 7% for all species is both evidence based and precautionary and therefore appropriate.

4 REFERENCES

Forewind (2014) Dogger Bank Teesside A & B Deadline VI Final HRA ornithology in-combination tables.

http://infrastructure.planningportal.gov.uk/wp-content/ipc/uploads/projects/EN010051/2.%20Post-Submission/Representations/ExA%20Questions/20-11-2014%20-%20ExA%20Second%20Written%20Questions/Forewind%20-%20Final%20HRA%20In-combination%20ornithology%20tables.pdf

Furness, B. (2015). Nocturnal Flight Activity Levels in Seabirds. Report prepared for East Anglia THREE and submitted for discussion at Ornithology Evidence Technical Group Meeting 5.

WWT (2012). SOSS-04 Gannet population viability analysis: demographic data, population model and outputs.

APPENDIX 1: HRA SCREENING REPORT ON ORNITHOLOGY (FINAL SCREENING)

East Anglia Offshore Wind

VATTENFALL

SCOTTISHPOWER RENEWABLES

East Anglia THREE

HRA Screening

Report on Ornithology (Final Screening)

Author – MacArthur Green
East Anglia Offshore Wind Limited
Date – May 2015
Revision History – Revision C

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1 INTRODUCTION

1.1 Purpose of this document

1. With regard to the proposed East Anglia THREE project, this document considers the Special Protection Areas (SPAs) (some of which are also Ramsar sites) and their features that were included in the high level screening by APEM and Royal HaskoningDHV (2014). It lists those sites that can clearly be screened out of any Likely Significant Effect (LSE) from the proposed East Anglia THREE project, and identifies those SPAs and features requiring further consideration because LSE cannot be ruled out at this stage.

2. Shortly after completion of this report, we were informed by Natural England that they are working to identify a possible extension to the Outer Thames SPA designation to include both little tern and common tern. Work is also being undertaken to identify a possible site in the Greater Wash to include little tern, common tern, Sandwich tern, common scoter, red throated diver and little gull. A post-script to this Screening document has been prepared and is included in Appendix 1.

2 SCREENING SPA SITES AND FEATURES

2.1 High level screening summary

3. A High-Level Screening Report was provided by APEM and Royal HaskoningDHV (2014). That report listed Special Protection Areas (SPAs) that were initially screened in for consideration (Table 2.1), but provided no consideration of the individual listed sites.

2.2 Full Screening

4. Here we indicate the sites from this initial list that can be screened out because no LSE is possible on the basis of impacts either from the proposed East Anglia THREE project alone or in-combination with other plans or projects (summarised in Table 2.1 and discussed where relevant in greater detail in this report).

Table 2.1: List of SPA and Ramsar sites with their respective categories of bird interest feature and summarised screening decisions. Sites screened in are shown in bold text.

SPA or Ramsar site	Category of interest feature	Screening decision	Distance (km)*	Reason for screening decision – further consideration provided in this document where appropriate
Abberton Reservoir SPA and Ramsar	Wintering and passage waterbirds	Out	165	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Alde-Ore Estuary SPA and Ramsar	**Breeding seabirds and breeding, wintering and passage waterbirds**	**IN**	**109**	**Lesser black-backed gull breeding population may have connectivity with the East Anglia THREE site. This SPA holds the closest large colony of the species to East Anglia THREE. Some birds from that SPA may pass through East Anglia THREE site during migration.**
Baie de Seine Occidentale SPA	Breeding, wintering and passage waterbirds	Out	447	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Benfleet & Southend Marshes SPA and Ramsar	Wintering and passage waterbirds	Out	196	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.

SPA or Ramsar site	Category of interest feature	Screening decision	Distance (km)*	Reason for screening decision – further consideration provided in this document where appropriate
Blackwater Estuary SPA and Ramsar	Wintering and passage waterbirds	Out	173	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Borkum-Riffgrund SPA	Non-breeding seabirds	Out	272	Migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration relative to the size of Biologically Defined Minimum Population Scale (BDMPS) regional populations.
Breydon Water SPA and Ramsar	Wintering and passage waterbirds	Out	82	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Broadland SPA and Ramsar	Wintering and passage waterbirds	Out	89	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Bruine Bank (Brown Ridge) pSPA (Netherlands)	Non-breeding seabirds	Out	n/a	Migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration relative to the size of BDMPS regional populations.
Buchan Ness to Collieston Coast SPA	Breeding seabirds	Out	606	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Calf of Eday SPA	Breeding seabirds	Out	810	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Chesil Beach & The Fleet SPA	Migratory waterbirds	Out	437	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Chichester & Langstone Harbour SPA	Migratory waterbirds	Out	334	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.

SPA or Ramsar site	Category of interest feature	Screening decision	Distance (km)*	Reason for screening decision – further consideration provided in this document where appropriate
Colne Estuary SPA and Ramsar	Wintering and passage waterbirds	Out	159	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Copinsay SPA	Breeding seabirds	Out	775	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Coquet Island SPA	Breeding seabirds	Out	414	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Cromarty Firth SPA	Wintering and passage waterbirds	Out	715	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Crouch & Roach Estuary SPA and Ramsar	Wintering and passage waterbirds	Out	186	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Deben Estuary SPA and Ramsar	**Wintering and passage waterbirds**	**IN**	**124 [0.0]**	**Dark-bellied brent goose could be disturbed by construction work on both banks of the Deben Estuary where onshore power cables are placed in pre-installed ducts. Other features such as avocet remain on the intertidal areas behind the sea wall and so would not be at risk of disturbance from construction work.**
Dengie SPA and Ramsar	Wintering and passage waterbirds	Out	169	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Dornoch Firth and Loch Fleet SPA	Wintering and passage waterbirds	Out	725	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.

SPA or Ramsar site	Category of interest feature	Screening decision	Distance (km)*	Reason for screening decision – further consideration provided in this document where appropriate
East Caithness Cliffs SPA	Breeding seabirds	Out	735	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Exe Estuary SPA	Migratory waterbirds	Out	490	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Fair Isle SPA	Breeding seabirds	Out	813	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Falaise du Bessin Occidental SPA	Breeding seabirds	Out	451	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Farne Islands SPA	Breeding seabirds	Out	441	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Fetlar SPA	Breeding seabirds	Out	913	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Firth of Forth SPA	Wintering and passage waterbirds	Out	546	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Firth of Tay & Eden Estuary SPA	Wintering and passage waterbirds	Out	563	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.

SPA or Ramsar site	Category of interest feature	Screening decision	Distance (km)*	Reason for screening decision – further consideration provided in this document where appropriate
Flamborough and Filey Coast pSPA	**Breeding seabirds**	**IN**	**257**	**Uncertain proportions of the kittiwake, gannet, common guillemot, razorbill and puffin populations most likely migrate through the East Anglia THREE site. Only gannet has potential for connectivity during the breeding season based on maximum foraging range although tracking data suggest no connectivity of breeding gannets but the site is included based on the precautionary principal.**
Forth Islands SPA	Breeding seabirds	Out	528	Tracking data show breeding gannets from Bass Rock do not commute to East Anglia THREE site although the site is just within maximum foraging range. Except for gannet, SPA is far beyond maximum foraging range of other designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Foula SPA	Breeding seabirds	Out	885	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Foulness SPA and Ramsar	Wintering and passage waterbirds	Out	180	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Fowlsheugh SPA	Breeding seabirds	Out	573	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Frisian Front SPA	Non-breeding seabirds	Out	n/a	Migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration relative to the size of BDMPS regional populations.
Gibraltar Point SPA and Ramsar	Wintering and passage waterbirds	Out	176	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.

SPA or Ramsar site	Category of interest feature	Screening decision	Distance (km)*	Reason for screening decision – further consideration provided in this document where appropriate
Great Yarmouth and North Denes SPA	Breeding seabirds	Out	77	SPA is beyond maximum foraging range of designated seabird species (little tern) and little tern foraging tends to be coastal so has no breeding season connectivity. Proportions of this populations migrating through the East Anglia THREE site are likely to be small as the species is thought to remain close to shore during much of its migration through UK waters.
Hamford Water SPA and Ramsar	Wintering and passage waterbirds	Out	141	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Hermaness, Saxa Vord and Valla Field SPA	Breeding seabirds	Out	937	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Hornsea Mere SPA	Wintering and passage waterbirds	Out	246	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Hoy SPA	Breeding seabirds	Out	791	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Humber Estuary SPA and Ramsar	Wintering and passage waterbirds	Out	226	Survey data show little or no evidence of SPA features occurring in the East Anglia THREE site and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
Imperial Dock Lock, Leith SPA	Breeding seabirds	Out	538	SPA is far beyond maximum foraging range of designated seabird species (common tern) so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Inner Moray Firth SPA	Wintering and passage waterbirds	Out	705	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.

SPA or Ramsar site	Category of interest feature	Screening decision	Distance (km)*	Reason for screening decision – further consideration provided in this document where appropriate
Lindisfarne SPA and Ramsar	Wintering and passage waterbirds	Out	453	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Littoral Seino-Marin SPA	Breeding seabirds	Out	350	The East Anglia THREE site is within the theoretical maximum foraging range of breeding gannets from this SPA, but tracking data show that breeding gannets from the SPA do not reach the East Anglia THREE site. The SPA is far beyond maximum foraging range of other designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are likely to be extremely small relative to BDMPS.
Loch of Strathbeg SPA	Wintering and passage waterbirds	Out	629	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Marwick Head SPA	Breeding seabirds	Out	815	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Medway Estuary & Marshes SPA and Ramsar	Wintering and passage waterbirds	Out	206	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Minsmere - Walberswick SPA and Ramsar	Breeding, wintering and passage waterbirds	Out	94	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Montrose Basin SPA	Wintering and passage waterbirds	Out	568	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.

SPA or Ramsar site	Category of interest feature	Screening decision	Distance (km)*	Reason for screening decision – further consideration provided in this document where appropriate
Moray and Nairn Coast SPA	Wintering and passage waterbirds	Out	690	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Mousa SPA	Breeding seabirds	Out	853	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
North Caithness Cliffs SPA	Breeding seabirds	Out	771	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
North Norfolk Coast SPA and Ramsar	Wintering and passage waterbirds	Out	142	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Northumbria Coast SPA and Ramsar	Wintering and passage waterbirds	Out	414	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Noss SPA	Breeding seabirds	Out	866	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Östliche Deutsche Bucht SPA	Non-breeding seabirds	Out	398	Migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration relative to the size of BDMPS regional populations.
Outer Thames Estuary SPA	**Wintering marine birds**	**In**	**123 [0.0]**	**Boat activity for sub-sea cable-laying work through part of the SPA could cause temporary displacement of a small number of red-throated divers within part of this SPA.**
Papa Stour SPA	Breeding seabirds	Out	899	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.

SPA or Ramsar site	Category of interest feature	Screening decision	Distance (km)*	Reason for screening decision – further consideration provided in this document where appropriate
Papa Westray (North Hill and Holm) SPA	Breeding seabirds	Out	827	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Pentland Firth Islands SPA	Breeding seabirds	Out	768	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Portsmouth Harbour SPA	Migratory waterbirds	Out	343	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Ramsar-Gebiet S-H Wattenmeer und angrenzende Küstengebiete SPA	Breeding, wintering and passage waterbirds	Out	425	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Ronas Hill - North Roe and Tingon SPA	Breeding seabirds	Out	916	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Rousay SPA	Breeding seabirds	Out	814	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Seevogelschutzgebiet Helgoland SPA	Breeding seabirds	Out	425	Tracking data from gannets breeding on Helgoland show these birds do not travel in the direction of or as far as the East Anglia THREE site despite this site being within theoretical maximum foraging range of gannet. The East Anglia THREE site is beyond the maximum foraging range of other seabird species at Helgoland. Proportions of these populations migrating through the East Anglia THREE site are likely to be very small relative to BDMPS regional populations.
Solent & Southampton Water SPA	Migratory waterbirds	Out	359	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.

SPA or Ramsar site	Category of interest feature	Screening decision	Distance (km)*	Reason for screening decision – further consideration provided in this document where appropriate
St Abbbs Head to Fast Castle SPA	Breeding seabirds	Out	489	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Stour & Orwell Estuaries SPA and Ramsar	Wintering and passage waterbirds	Out	134	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Sumburgh Head SPA	Breeding seabirds	Out	840	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Sylter Auβenriff SPA	Non-breeding seabirds	Out	381	Migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration relative to the size of BDMPS regional populations.
Teesmouth and Cleveland Coast SPA and Ramsar	Wintering and passage waterbirds	Out	345	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Thames Estuary and Marshes SPA and Ramsar	Wintering and passage waterbirds	Out	204	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Thanet Coast and Sandwich Bay SPA and Ramsar	Wintering and passage waterbirds	Out	181	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
The Swale SPA	Wintering and passage waterbirds	Out	199	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
The Wash SPA and Ramsar	Wintering and passage waterbirds	Out	176	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE site and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.

SPA or Ramsar site	Category of interest feature	Screening decision	Distance (km)*	Reason for screening decision – further consideration provided in this document where appropriate
Troup, Pennan and Lion`s Heads SPA	Breeding seabirds	Out	647	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Voordelta SPA	Wintering and passage waterbirds	Out	117	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
Waddenzee (Wadden Sea) SPA	Wintering and passage waterbirds	Out	192	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.
West Westray SPA	Breeding seabirds	Out	825	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through the East Anglia THREE site are small relative to BDMPS.
Ythan Estuary, Sands of Forvie and Meikle Loch SPA	Wintering and passage waterbirds	Out	605	Survey data show little or no evidence of SPA features occurring in the proposed East Anglia THREE project and migrations of birds from this SPA are likely to result in negligible numbers passing through the East Anglia THREE site during migration.

*Distance measured from the closest point of the East Anglia THREE site (i.e. the windfarm site) to the closest point of the SPA site rounded to the nearest kilometre except for those additional values in parentheses – [ ] – that are from the closest point of any of the proposed project (including onshore and sub-sea cable) to the closest point of the SPA and rounded to one decimal place.

2.2.1 Migratory birds and trans-boundary considerations

5. Many SPA sites within the UK and in neighbouring Member States can be screened out of HRA as there is no connectivity between the SPA site and the proposed project area in terms of populations of birds that are features of the SPAs. Therefore, LSE can be ruled out. This applies to most SPAs that are distant from the proposed project. However, some bird species are highly mobile and may interact with projects because they range over considerable distances. This applies especially to seabirds.

6. Migratory birds may move into areas where there are projects and so may interact during their migration. From an initial consideration of all SPAs in the UK and in neighbouring Member States that were listed in APEM and Royal HaskoningDHV

(2014), we have scoped out those for which connectivity with the proposed East Anglia THREE project can be ruled out or assessed as negligible. This applies to most of the SPAs in those territories, including all SPAs in Member States on the European mainland designated for coastal birds / waterbirds / seabirds (Table 2.1).

7. Birds of some species that are SPA features, such as shorebirds, may migrate from the mainland of Europe to eastern England (for example from SPAs in Netherlands to the Wash or Thames estuaries) so these birds need to be considered. Migrating shorebirds and other coastal birds tend to fly high when weather conditions are favourable for migration, and normally set off on a migratory flight under such weather conditions, and so are rarely recorded to be collision victims at offshore windfarms, where passerines are the group most at risk of collision (Hüppop et al. 2006). Indeed, Hüppop et al. (2006) reported that only six out of 442 collision carcasses in their study were non-passerine birds. Assessments of collision risk of migrating coastal birds at offshore windfarms in UK waters also indicate that risk is low and for most species does not represent a hazard that would require HRA assessment (Wright et al. 2012; WWT 2013).

8. The Netherlands Ministry of Infrastructure and the Environment stated in a letter of 7 July 2014 that they had a concern that the proposed project could have an effect on the seabirds of Bruine Bank pSPA. The non-breeding seabirds that are the interest feature of the Bruine Bank (Brown Ridge) pSPA are primarily auks. An assessment of potential impacts on auks has been conducted as part of the East Anglia THREE EIA (MacArthur Green 2015, sections 13.7.1.1 and 13.7.2.1, Appendix 2) in relation to construction and operational disturbance and displacement. In all cases impacts were found to be minor or negligible (based on BDMPS populations in UK North Sea waters, Furness 2015). Assessment of impacts over the whole North Sea (i.e. including non UK waters) would greatly increase the estimated seabird population sizes and only slightly increase cumulative impacts (because most offshore windfarms are in UK waters). Accordingly a likely significant effect on the Bruine Bank (Brown Ridge) pSPA can be screened out.

9. The Netherlands Ministry of Infrastructure and the Environment also stated in their letter of 7 July 2014 'on-shore bird colonies in the Netherlands are all situated more than 100km from the Dutch-UK border, so no effects are to be expected there'. We agree with that interpretation (with one exception discussed below), particularly since the seabirds that breed in the Netherlands are predominantly species with coastal and relatively short foraging ranges, such as terns, cormorants and gulls, and there is no evidence that breeding birds from those populations cross into the UK while they are breeding. However, lesser black-backed gulls breed in large numbers

in The Netherlands. Between 32,000 and 57,000 pairs were estimated to breed in The Netherlands in 1992-97 (Mitchell et al. 2004) and the numbers subsequently increased to a peak of over 90,000 pairs in 2005 (Camphuysen 2013). With a maximum foraging range of 181km from breeding colonies (Thaxter et al. 2012a), there is theoretical potential for connectivity between some colonies in The Netherlands and the proposed East Anglia THREE project. However, extensive colour ringing and tracking of breeding lesser black-backed gulls from multiple colonies in The Netherlands has found no evidence for connectivity during the breeding season between birds breeding in those colonies and the UK, and also that there is remarkably little migration of birds from the colonies in The Netherlands through UK waters outside the breeding season (Camphuysen 2013). Not only do breeding adult lesser black-backed gulls from colonies in The Netherlands normally remain on the continental side of the North Sea while breeding, but 95% of foraging trips were less than 135km from those colonies in studies in the 1990s and 2000s (Camphuysen 1995, 2013), while tracking in recent years showed that 95% of foraging trips were within 60.5km of the colony (Camphuysen et al. 2015), so could not reach the East Anglia THREE site. These studies therefore rule out any transboundary impacts of the proposed East Anglia THREE project on any of these breeding lesser black-backed gull populations.

10. Similarly, impacts on seabird breeding populations in Germany, Belgium and France can be screened out due to the distance of colonies in those countries from the proposed project (Table 2.1), which, with two exceptions, exceeds maximum foraging ranges of breeding seabirds (Thaxter et al. 2012a).

11. There are breeding gannets at colonies where the East Anglia THREE site lies within the reported maximum foraging range of breeding gannets (590km, Thaxter et al. 2012a). These colonies are at Seevogelschutzgebiet Helgoland SPA (Germany) and Littoral Seino-Marin SPA (France). However, tracking studies of breeding adults at each of these colonies show that birds from those colonies do not travel into the East Anglia THREE site but forage relatively close to their breeding colonies (Stefan Garthe, pers. comm., Wakefield et al. 2013, Amelineau et al. 2014).

12. Therefore, **no trans-boundary issues are screened in to this assessment**.

2.2.2 Examples set by East Anglia ONE

13. Ornithological interests of the proposed East Anglia THREE project are closely similar to those of the preceding and consented East Anglia ONE Project (APEM 2012), and therefore it is likely that HRA concerns around the proposed East Anglia THREE project will be very similar to those raised during the Scoping and Assessment of East Anglia ONE.

14. The initial East Anglia ONE screening listed a large number of SPA populations to be considered, but these were reduced following agreement with Natural England (EAOL 2013).

15. The HRA assessment for East Anglia ONE considered that there was potential for sufficient connectivity between that proposed project and the SPA features listed in Table 2.2 to require an assessment of interactions with sites and species. Based on a robust assessment in line with duties under Regulation 25, with regard to East Anglia ONE offshore windfarm, LSE was ruled out by the Secretary of State (SoS) for most of the SPA features assessed (Table 2.2, DECC 2014).

Table 2.2. SPAs and features initially screened in for East Anglia ONE assessment and decisions on LSE.

SPA	Feature	LSE features ruled out by SoS
Benfleet & Southend Marshes SPA	Brent goose	All
Blackwater Estuary SPA	Brent goose	All
Chesil Beach & The Fleet SPA	Brent goose	All
Chichester & Langstone Harbour SPA	Brent goose	All
Colne Estuary SPA	Brent goose	All
Crouch & Roach Estuary SPA	Brent goose	All
Exe Estuary SPA	Brent goose	All
Foulness SPA	Brent goose	All
Hamford Water SPA	Brent goose	All
Lough Foyle SPA	Brent goose	All
Medway Estuary & Marshes SPA	Brent goose	All
North Norfolk Coast SPA	Brent goose	All
Portsmouth Harbour SPA	Brent goose	All
Solent & Southampton Water SPA	Brent goose	All
Stour & Orwell SPA	Brent goose	All
The Swale SPA	Brent goose	All
The Wash SPA	Brent goose	All
Deben Estuary SPA	Brent goose and avocet	Avocet
Outer Thames Estuary SPA	Red-throated diver	All
Firth of Forth Islands SPA	Gannet	All

SPA	Feature	LSE features ruled out by SoS
Hermaness Saxa Vord and Valla Field SPA	Gannet and great skua	All
Noss SPA	Gannet and great skua	All
Fair Isle SPA	Gannet and great skua	All
Fetlar SPA	Great skua	All
Foula SPA	Great skua	All
Hoy SPA	Great skua	All
Flamborough Head and Bempton Cliffs SPA	**Kittiwake**	**None**
Flamborough and Filey Coast pSPA	**Kittiwake, gannet, herring gull, common guillemot, razorbill**	**Herring gull, common guillemot, razorbill**
Alde-Ore Estuary SPA	**Lesser black-backed gull**	**None**

16. Therefore, following advice from the Planning Inspectorate (Planning Inspectorate 2013), the SoS concluded that for East Anglia ONE offshore windfarm, LSE could not be ruled out for:

- Lesser black-backed gull, at Alde-Ore Estuary SPA and Ramsar Site due to cumulative collision impacts,
- Gannet and kittiwake at Flamborough and Filey Coast pSPA and at Flamborough Head and Bempton Cliffs SPA due to cumulative collision impacts.

17. Since cumulative collision impacts were the main issue requiring Appropriate Assessment for these populations in relation to the East Anglia ONE planning application, we give particular consideration to the cumulative collision impacts relating to these same species in the context of the proposed East Anglia THREE project.

18. Species considered by the East Anglia ONE project were:

- Dark-bellied brent goose,

- Avocet,
- Red-throated diver,
- Gannet,
- Great skua,
- Kittiwake,
- Herring gull,
- Lesser black-backed gull,
- Common guillemot, and
- Razorbill.

19. Since the range of birds recorded in the East Anglia THREE site is similar to that recorded in East Anglia ONE site (and the sites are roughly comparable in area at 305km^2 and 300km^2 for East Anglia THREE and East Anglia ONE respectively), we consider the same bird species here. These species are considered in turn in relation to the East Anglia THREE site in the following sections of this report. Part of the assessment considers estimated foraging ranges (Table 2.3) for each species and how these relate to distances to SPA colonies.

Table 2.3. Summary of the distances of key SPA breeding populations of seabirds from the East Anglia THREE site and the foraging ranges of those species from colonies as summarised by Thaxter et al. (2012a). Shading (green) indicates those species whose foraging range(s) do not overlap with the East Anglia THREE site and for which connnectivity during the breeing period is therefore likely to be negligible.

SPA name	Minimum distance to site (km)	Breeding feature	Maximum range (km)	Mean maximum range (km)	Mean range (km)
Alde-Ore Estuary	105	Lesser black-backed gull	181	141	72
		Herring gull	92	61	11
Flamborough & Filey Coast	250	Gannet	590	229	93
		Kittiwake	120	60	25
		Common guillemot	135	84	38
		Razorbill	95	49	24
		Puffin	200	105	4

20. Each section includes a summary of the species account as presented in the East Anglia ONE HRA, the final conclusions from the Planning Inspectorate examination, and discussion of the implications for the proposed East Anglia THREE project HRA.

2.2.3 Dark-bellied brent goose

21. Natural England agreed with the Applicant that impacts of the East Anglia ONE project on all of the SPAs for dark-bellied brent goose listed in Table 2.2 except Deben Estuary SPA could be ruled out. This was also the view of the Secretary of State (DECC 2014).

22. Since the proposed East Anglia THREE project involves much more limited onshore activity, making use of infrastructure previously developed and constructed as part of the East Anglia ONE project, it is logical that impacts of the proposed East Anglia THREE project on SPAs other than the Deben Estuary can also be ruled out. Therefore, all except Deben Estuary SPA are screened out of further consideration for the proposed East Anglia THREE project.

23. **It is proposed that the Deben Estuary SPA dark-bellied brent goose population is screened in for HRA since that component of East Anglia THREE construction work are adjacent to the boundary of the Deben Estuary SPA and have the potential to cause disturbance to brent geese that are qualifying features of the Deben Estuary SPA.**

2.2.4 Avocet

24. Natural England concluded that the East Anglia ONE project would have no adverse effect on the avocet population of Deben Estuary SPA because those birds remain on the mud flats of the SPA and would not be at risk of disturbance by activities onshore behind the sea wall (Calbrade and Mason 2012).

25. Since this applies also for the proposed East Anglia THREE project, and the level of activity onshore in the proposed East Anglia THREE project is considerably less than for the East Anglia ONE project, **it is proposed that the avocet feature of Deben Estuary SPA is scoped out of HRA for the proposed East Anglia THREE project**.

2.2.5 Gannet and great skua

26. The East Anglia ONE HRA considered possible collision impacts on gannets and great skuas from SPA populations in Scotland. Natural England agreed with the Applicant that impacts of the East Anglia ONE project on all of the SPAs for gannets and great skuas in Scotland could be assessed as negligible, as the East Anglia ONE site lies far beyond the foraging range of breeding birds from those SPA populations, and

numbers of gannets and great skuas observed in the East Anglia ONE site did not suggest that a significant effect could occur on these populations during their migrations. It is therefore relevant to compare numbers of gannets and great skuas recorded in the East Anglia THREE site compared to numbers previously recorded in the East Anglia ONE site. Numbers of gannets and great skuas recorded in the East Anglia ONE site and East Anglia THREE site are compared in Table 2.4.

Table 2.4. Mean numbers of gannets and great skuas in the windfarm site each season (seasons as defined in East Anglia ONE EIA for ease of comparison). Data for the summer season, which is the period when apportioning to SPA populations might be most appropriate, are shown in bold, indicating the close similarity between East Anglia ONE and East Anglia THREE for these two species at that time of year, with very small numbers of birds present.

Species	Winter		Spring		Summer		Autumn	
	East Anglia ONE	East Anglia THREE	East Anglia ONE	East Anglia THREE	East Anglia ONE	East Anglia THREE	East Anglia ONE	East Anglia THREE
Gannet	27	76	17	36	**10**	**10**	688	224
Great skua	0	0	0	0	**0**	**0**	5	20

27. Since numbers of gannets and great skuas recorded in the East Anglia THREE site are fairly similar to numbers previously reported in the East Anglia ONE site, the same conclusion will apply for the the proposed East Anglia THREE project with regard to HRA Scoping.

28. Even in autumn, when mean numbers recorded within the East Anglia THREE site peaked at 224 gannets and 20 great skuas, these totals are extremely small in the context of the SPA population sizes of these species in Scotland. Latest counts at gannet colonies (Murray et al. 2015) indicate a breeding population of about 240,000 gannets at Scottish North Sea colonies with an associated population of about 190,000 immature birds, so a total population of about 430,000 birds. The mean of 224 gannets in autumn within the East Anglia THREE site represents about 0.05% of this population.

29. Latest counts at great skua colonies (JNCC Seabird Colony Register database) indicate a breeding population of about 8,000 great skuas at Scottish North Sea colonies with an associated population of about 10,000 immature birds, so a total population of about 18,000 birds. The mean of 20 great skuas in autumn within the East Anglia THREE site represents about 0.1% of this population.

30. Therefore, the following can be screened out of HRA for the proposed East Anglia THREE project:

- Firth of Forth Islands SPA (gannet),
- Hermaness Saxa Vord and Valla Field SPA (gannet and great skua),
- Noss SPA (gannet and great skua),
- Fair Isle SPA (gannet and great skua),
- Fetlar SPA (great skua),
- Foula SPA (great skua), and
- Hoy SPA (great skua).

31. Impacts on these populations are more appropriately assessed in relation to seasonal BDMPS populations (Furness 2015), since gannets migrating through the East Anglia THREE site in autumn and spring and overwintering in the area are likely to originate from many different colonies in east Scotland, Orkney, Shetland, Faroe Islands, Iceland and Norway, so any impact would be apportioned over the large numbers in those SPAs and non-SPA populations.

32. The precautionary Collision Risk Model (CRM) (Band 2000, 2012) indicates few gannet collisions during the entire year predicted for the proposed East Anglia THREE site: 17 using Band Option 1 and 80 using Band Option 2 (Band 2012) with avoidance rate 0.989, with two-thirds of these during post-breeding migration (MacArthur Green 2015). Apportioning those to individual SPA populations, non-SPA UK populations and overseas populations would reduce the numbers apportioned to individual SPA populations to levels that would add a negligible increase to annual mortality of gannets.

33. On the basis of the higher annual estimate of 80, even if as many as 50% of these were apportioned to Flamborough and Filey Coast pSPA (which is an unrealistically high proportion), and those 40 birds were considered to all be adults, 40 adults from the 11,061 pairs of gannets at that colony would represent an additional 0.18% mortality. Since natural mortality is 8% for adults (WWT 2012), an additional 0.18% mortality relative to a baseline mortality of 8 - 58% per annum represents a negligible increase to natural mortality even in this highly precautionary scenario.

34. When considering breeding season impacts, the closest gannet SPA colony (Flamborough and Filey Coast pSPA) is >250km away. Therefore, this is likely to be

the only gannet colony with the potential for breeding season connectivity to the East Anglia THREE site (on the basis of estimates of breeding season foraging range of gannets (maximum 590km, mean maximum 229km, Thaxter et al. 2012a) and tracking studies (RSPB 2012; Wakefield et al. 2013), and it is an SPA where cumulative impacts should be considered due to the proximity of several consented or constructed offshore windfarms.

35. **Therefore, gannet from Flamborough and Filey Coast pSPA is screened in for HRA on the basis of potential for in-combination impacts.**

36. Similarly, great skuas migrating through the East Anglia THREE site in autumn are likely to originate from many different colonies in Orkney and Shetland, from Faroe Islands, Iceland and Norway. Impacts would therefore be more appropriately assessed in the context of the relevant BDMPS population.

37. The East Anglia ONE HRA concluded no LSE for great skuas. **Therefore based on the similar numbers in East Anglia THREE assessment, it is proposed great skua is screened out for HRA for the proposed East Anglia THREE project alone and in-combination.**

2.2.6 Red-throated diver

38. Mean numbers of red-throated divers in the East Anglia THREE site are consistently lower than the numbers in the East Anglia ONE site, which is most likely due to a tendency for red-throated diver at-sea density to decline with increasing distance further offshore in the region off the East Anglia coast (Webb et al. 2009; O'Brien et al. 2012). Numbers counted show a similar seasonal pattern in the East Anglia ONE site and East Anglia THREE site, with highest numbers in spring and lowest numbers in summer (Table 2.5). In all cases many fewer were recorded within the East Anglia THREE site than within the East Anglia ONE site.

Table 2.5. Mean numbers of red-throated divers in the East Anglia ONE and East Anglia THREE sites each season. For this comparison, seasons are as defined in the East Anglia ONE EIA to allow comparability between Project data sets.

Species	Winter		Spring		Summer		Autumn	
	East Anglia ONE	East Anglia THREE	East Anglia ONE	East Anglia THREE	East Anglia ONE	East Anglia THREE	East Anglia ONE	East Anglia THREE
Red-throated diver	45	14	119	42	**0**	**0**	74	16

39. Since diver numbers are smaller in the East Anglia THREE site than in the East Anglia ONE site, displacement by the proposed East Anglia THREE project will be less than displacement by the East Anglia ONE project. Displacement of birds from the East Anglia ONE and East Anglia THREE sites could possibly result in a marginal (and probably undetectable) increase in numbers within the Outer Thames Estuary SPA.

40. Nevertheless, the principal consideration in relation to HRA will be whether displacement of red-throated divers may result from sub-sea cable laying activities within the Outer Thames Estuary SPA.

41. 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 et al. 2013; Bradbury et al. 2014).

42. There is potential for disturbance and displacement of non-breeding red-throated divers resulting from the presence of a vessel installing the offshore cable through the Outer Thames Estuary SPA. **Therefore, red-throated diver at Outer Thames Estuary SPA is screened in for HRA.**

2.2.7 Gulls

43. Mean numbers of kittiwakes, lesser black-backed gulls and herring gulls in the East Anglia THREE site are broadly similar to numbers reported in the East Anglia ONE site during the same season, and the seasonal patterns for these species are also similar between the two sites (Table 2.6). All three species were present in the East Anglia THREE site throughout the year, but numbers of kittiwakes were lowest in summer and highest in winter, numbers of lesser black-backed gulls were lowest in spring and highest in autumn, and numbers of herring gulls were low in spring and autumn and highest in winter.

Table 2.6. Mean numbers of kittiwakes, lesser black-backed gulls, and herring gulls. For this comparison, seasons are as defined in the East Anglia ONE EIA to allow comparability between project data sets.

Species	Winter		Spring		Summer		Autumn	
	East Anglia ONE	East Anglia THREE	East Anglia ONE	East Anglia THREE	East Anglia ONE	East Anglia THREE	East Anglia ONE	East Anglia THREE
Kittiwake	424	1045	110	123	47	60	397	133
Lesser black-backed gull	126	23	8	12	59	18	113	69
Herring gull	53	267	49	32	4	82	63	25

2.2.7.1 Kittiwake

44. The SoS was unable to conclude for the East Anglia ONE project that there would be no LSE for cumulative impact of collision mortality on Flamborough and Filey Coast pSPA kittiwake population (DECC 2014). However, since that assessment, SNCBs have reviewed the appropriate avoidance rate for kittiwake in CRM and have raised that value from 0.98 to 0.989, which approximately halves the estimated numbers likely to be killed by collisions, bringing the cumulative numbers in autumn migration season well below the Potential Biological Removal (PBR) threshold (MacArthur Green 2015).

45. Kittiwake numbers in the East Anglia THREE site in the breeding season are relatively low (mean count of 60 birds), but impacts on the population of Flamborough and Filey Coast pSPA (and its predecessor Flamborough Head and Bempton Cliffs SPA) could possibly be screened in for HRA because it is the closest large colony of kittiwakes despite this colony being well outside the maximum foraging range of breeding kittiwakes. Tracking data from Flamborough suggest that breeding birds from that colony may travel unusually long distances, although probably not as far as the 250km between Flamborough and Filey Coast pSPA and the East Anglia THREE site (RSPB FAME and STAR projects, unpublished data; see also Table 2.3).

46. **Therefore, kittiwake at Flamborough and Filey Coast pSPA is screened in for HRA on the basis of potential for in-combination impacts.**

47. Other kittiwake SPA populations are **screened out** as being far too distant to have significant connectivity with the East Anglia THREE site during the breeding season (the next nearest SPAs with kittiwake as a breeding feature being Farne Islands SPA, St Abbs Head to Fast Castle SPA, and Forth Islands SPA, which are between 400km and 500km from the East Anglia THREE site, so considerably beyond the maximum foraging range of this species during the breeding season (which is 120km, Thaxter et al. 2012a). Due to the high mobility of kittiwakes during the migration seasons when birds from many populations are thoroughly mixed at sea, cumulative/in combination assessments for SPA populations in Scotland or north-east England would apportion mortality pro rata in relation to population sizes, such that estimated individual population-level impacts would be equivalent to that assessed for the BDMPS population. Numbers during migration and winter are therefore more appropriately considered in relation to BDMPS populations since at those times of year kittiwakes in the East Anglia THREE site are likely to originate from many different populations, including from overseas populations.

2.2.7.2 Lesser black-backed gull

48. Lesser black-backed gull numbers on the East Anglia THREE site in the breeding season are relatively low (mean count of 18 birds).

49. The East Anglia THREE site is approximately 105-130km from the Alde-Ore Estuary SPA where lesser black-backed gull is a breeding feature. This is within the maximum foraging range of breeding lesser black-backed gulls (181km, Thaxter et al. 2012a; see also Table 2.3), and tracking studies indicate some connectivity between this SPA population and the East Anglia THREE site, although connectivity varies seasonally and between years (Thaxter et al. 2012b; Thaxter et al. 2015).

50. **It is proposed that the lesser black-backed gull population of the Alde-Ore Estuary SPA is screened in for HRA, including in terms of cumulative/in combination impacts.**

51. A population viability analysis (PVA) has been carried out on this SPA population and is available to inform impact assessment (Trinder 2012).

52. The Alde-Ore Estuary is the only SPA in the UK with breeding lesser black-backed gulls as a feature that is located within the maximum recorded foraging range for the species so all other UK lesser black-backed gull populations are screened out of HRA. Colonies in The Netherlands have already been screened out (see paragraph 8) because although some are within 181km, tracking and colour ringing studies show that breeding adults from those colonies do not forage in UK waters during the breeding season, and very few of those birds migrate through UK waters during the nonbreeding season.

2.2.7.3 Herring gull

53. Herring gull numbers in the breeding season are moderate (mean count of 82 birds). The East Anglia THREE site is greater than 105km from the Alde-Ore Estuary SPA where herring gull is a feature as a named member of the breeding seabird assemblage. Since this is the closest large colony of herring gulls to the East Anglia THREE site this SPA population could possibly be considered for HRA, despite being slightly further away than the longest recorded foraging range of herring gulls from breeding sites. This is the only SPA with breeding herring gulls as a feature that is located close to the maximum recorded foraging range for the species (92km, Thaxter et al. 2012a; see also Table 2.3) so all other herring gull populations are screened out of HRA.

54. **On the basis that:**

- Numbers in the East Anglia THREE site are relatively low except in winter when migrants arrive from northern populations (Furness 2015),

- The East Anglia THREE site is at least 13km beyond the maximum foraging range of breeding herring gulls from the Alde-Ore Estuary SPA (based on Thaxter et al. 2012a) so can be considered not to have any connectivity,

- Birds at the East Anglia THREE site in summer may be from numerous non-SPA colonies elsewhere in East Anglia (particularly including urban 'roof-top nesting' gulls whose numbers increased as numbers at the Alde-Ore declined (Mitchell et al. 2004; Brown & Grice 2005) and are now numerous in Great Yarmouth, Lowestoft, Felixstowe, Ipswich, Mendlesham, Bungay, Aldeby and Beccles) rather than from the Alde-Ore Estuary SPA,

- Many of the birds within the East Anglia THREE site in summer may be nonbreeding birds from many different populations, including populations from north Norway and Russia (Furness 2015),

- Precautionary CRM results indicate no herring gull collisions during the breeding season (Band Option 2 with avoidance rate 0.995 indicates no collisions in March - October, with collisions predicted only during November - February when the birds present include large numbers wintering in the area from colonies in north Norway and Russia),

- Cumulative / in-combination assessment of collision risk for herring gulls in the regional BDMPS population concluded that the cumulative impact on herring gulls in the nonbreeding season is of low magnitude (MacArthur Green 2015). Apportioning this to individual SPA populations would be difficult due to the mobility of herring gulls in the nonbreeding season, but would imply an impact of low magnitude on all individual SPA populations that are components of the regional BDMPS population,

- The SoS concluded there was no LSE for herring gull at Alde-Ore Estuary SPA due to the East Anglia ONE project (DECC 2014), and since that assessment the SNCBs have advised an increase in the appropriate avoidance rate for herring gull from 0.98 to 0.995, which reduces the estimated numbers of collisions by a factor of four.

55. **It is proposed that the herring gull feature of the Alde-Ore Estuary SPA is <u>screened out</u> of the HRA.**

2.2.8 Auks

56. Mean numbers of common guillemots, razorbills and puffins in the East Anglia THREE site during summer were considerably higher than the numbers that had been

recorded in the East Anglia ONE site, and this was also true in spring, autumn and winter (Table 2.7).

Table 2.7. Mean numbers of common guillemots, razorbills, and puffins in the East Anglia ONE and East Anglia THREE sites each season (corrected means, allowing for birds underwater when photographs were taken). For this comparison, seasons are as defined in the East Anglia ONE EIA to allow comparability between project data sets.

Species	Winter		Spring		Summer		Autumn	
	East Anglia ONE	East Anglia THREE	East Anglia ONE	East Anglia THREE	East Anglia ONE	East Anglia THREE	East Anglia ONE	East Anglia THREE
Common guillemot	687	875	461	775	18	91	24	343
Razorbill	150	798	145	664	9	356	15	297
Puffin	17	80	4	6	0	32	4	38

57. It is unclear at this stage whether this is due to natural year-to-year variation, or to differences in habitat quality for auks between the East Anglia ONE and East Anglia THREE sites. The relatively high numbers in the East Anglia THREE site in summer are difficult to attribute to breeding colonies since the nearest SPA populations of auks (and the only large populations of auks in the region) are at Flamborough and Filey Coast pSPA which is >250km distant. This is the closest colony of auks to the East Anglia THREE site, and other large colonies are much further away.

58. **On the basis that:**

- Maximum foraging ranges of these three auk species are all considerably less than the distance between the East Anglia THREE site and Flamborough and Filey Coast pSPA, so that the foraging range data (Table 2.3) appear to exclude the possibility that the birds observed in the East Anglia THREE site in summer are birds that are breeding at Flamborough and Filey Coast pSPA,

- Since the windfarm site is beyond the maximum foraging range of these species, the birds in the East Anglia THREE site in summer are more likely to be nonbreeding (possibly mainly immature) birds from a variety of populations from east England to Norway (Furness 2015),

- There is evidence that many younger immature birds remain in their winter quarters through their first summer (Furness 2015), and many immature birds from northern populations are known to winter in the southern North Sea, so these birds are likely to be predominantly immatures from northern populations rather than adults from the Flamborough and Filey Coast pSPA. It would, therefore, be more appropriate to assess auk displacement impacts through the EIA process considering appropriate BDMPS,

- Screening out would be consistent with the conclusion for the East Anglia ONE project that LSE on auks could be ruled out (DECC 2014).

59. **It is proposed that common guillemot, razorbill and puffin are screened out of the HRA at all SPAs.**

2.3 Conclusions

60. Decisions about screening in or out SPA bird populations are summarised in Table 2.8.

Table 2.8. Decisions on screening in or out SPA bird populations for HRA for East Anglia THREE

SPA	Feature	East Anglia ONE	East Anglia THREE	Reason for change from East Anglia ONE, if any
Deben Estuary	Dark-bellied brent goose	In	In	Consistent (but no LSE concluded for East Anglia ONE following mitigation plan; Planning Inspectorate 2013)
Deben Estuary	Avocet	Out	Out	Consistent
Outer Thames Estuary	Red-throated diver	Out	In	It is considered appropriate to assess whether LSE may occur as a result of displacement due to cable laying.
Alde-Ore Estuary	Lesser black-backed gull	In	In	Consistent (though SNCB advice on increased avoidance rate (JNCC et al. 2014) reduces impact compared with previous decision)
Alde-Ore Estuary	Herring gull	Out	Out	Consistent (though SNCB advice on increased avoidance rate (JNCC et al. 2014) reduces impact compared with previous decision)
Scottish SPAs	Great skua	Out	Out	Consistent
Scottish SPAs	Gannet	Out	Out	Consistent
Flamborough & Filey Coast	Gannet	In	In	Consistent (though SNCB advice on increased avoidance rate (JNCC et al. 2014) reduces impact compared with previous decision)

SPA	Feature	East Anglia ONE	East Anglia THREE	Reason for change from East Anglia ONE, if any
Flamborough & Filey Coast	Kittiwake	**In**	**In**	Consistent, but SNCB advice to increase avoidance rate (JNCC et al. 2014) reduces impact
Flamborough & Filey Coast	Common guillemot, razorbill and puffin	Out	Out	Consistent

61. In summary, this leaves four SPAs and five features requiring HRA for the proposed East Anglia THREE project on the basis of potential impacts either alone or in-combination with other plans or projects (Table 2.9):

Table 2.9. SPAs and features for which HRA will be required in relation to potential impacts from the proposed East Anglia THREE project alone or in-combination with other plans or projects.

SPA	Feature	Potential impact
Deben Estuary	Dark-bellied brent goose	Construction disturbance (project alone and in-combination)
Outer Thames estuary	Red-throated diver	Construction disturbance: displacement caused by cable laying (project alone and in-combination)
Alde-Ore Estuary	Lesser black-backed gull	In-combination collision risk
Flamborough & Filey Coast	Gannet	In-combination collision risk
Flamborough & Filey Coast	Kittiwake	In-combination collision risk

3 REFERENCES

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4 APPENDIX 1

HRA Screening - Report on Ornithology (Final Screening) - Postscript

62. Shortly after completion of this report, we were informed by Natural England that they are working to identify a possible extension to the Outer Thames SPA designation to include both little tern and common tern. Work is also being undertaken to identify a possible site in the Greater Wash to include little tern, common tern, Sandwich tern, common scoter, red throated diver and little gull. We assume that the terns will be added as breeding features of these SPAs and that common scoter, red-throated diver and little gull will be added as nonbreeding features (those details not being provided in the email of 15 May from Natural England).

63. It has been assumed at this stage that the East Anglia THREE site does not overlap with either SPA, although the cable route will cross the Outer Thames Estuary SPA.

64. Maximum foraging ranges of breeding terns from their colonies are short (maximum range 54km for Sandwich tern, 30km for common tern, 11km for little tern; Thaxter et al. 2012a) and so none would have connectivity with the East Anglia THREE site. Furthermore, foraging by these tern species tends to follow coastlines and be in shallow water, so the East Anglia THREE site is not optimal habitat for tern foraging. Terns (identified as either common or Arctic) were recorded in the East Anglia THREE site in only four of the 24 surveys, all during migration periods, so we conclude no LSE for these proposed additional breeding features (terns) of the Outer Thames Estuary SPA and Greater Wash SPA.

65. Common scoter was not recorded in the East Anglia THREE site so we conclude no LSE for that feature.

66. Red-throated diver was present in small numbers in the East Anglia THREE site during the nonbreeding season, especially in spring. Due to the high sensitivity of this species to disturbance the red-throated diver feature of the Outer Thames Estuary SPA was screened in for assessment in relation to cable laying activities within the SPA boundary. However, due to the relatively small numbers and low population density present in East Anglia THREE site and no obvious connectivity with the proposed Greater Wash SPA, no LSE is predicted in relation to the Greater Wash SPA.

67. Little gull is a species about which very little is known. The main breeding population is in central Asia, but extends to western Europe where it has been increasing in numbers in recent decades. BirdLife International (2004) suggest that about 24,000

to 58,000 pairs breed in Europe and that this represents 25 to 49% of the global population, which implies a global population of 49,000 to 232,000 pairs.

68. Considerably increasing numbers pass through UK waters on migration, perhaps reflecting a more westerly migration route developing in this species as well as increasing breeding numbers particularly in Finland (del Hoyo et al. 1996; Brown and Grice 2005). Musgrove et al. (2013) and BTO BirdFacts were unable to give an estimate of numbers occurring in the UK, but Skov et al. (2007) estimated that 5,400 birds winter in the North Sea although this represents only a small fraction of the numbers passing though on migration.

69. Brown and Grice (2005) report that the little gull is most numerous in English waters during spring and autumn migration and that 'numbers passing through England have increased enormously since the 1950s'. They report also that 'outside the breeding season, little gulls are largely coastal'.

70. Large numbers may occur on passage. For example, 4,100 were seen at Flamborough Head on 21 September 1995, 5,413 passed Flamborough Head between 24 September and 7 October 1982 (Brown and Grice 2005), and 10,000 were seen off Spurn on 11 September 2003 (Hartley 2004). The species is recorded along the entire English coastline in autumn, winter and spring, with largest counts in autumn, and often associated with onshore gales (Balmer et al. 2013).

71. In most aerial surveys in the East Anglia THREE site no little gulls were present. However, over the 24 aerial surveys one large flock of little gulls was recorded, in May 2013. This is consistent with spring migration passage of birds. Given the high variation in numbers of little gulls seen on the English coast from day to day and year to year, the presence of a flock in the East Anglia THREE site on only one occasion is not unexpected; little gulls may occur anywhere along the English east coast and in highly variable numbers (Balmer et al. 2013).

72. Little gulls tend to fly low over the water, with none flying at collision risk height (Johnston et al. 2014). The only flock recorded by the aerial surveys in the East Anglia THREE site was of birds that were mostly sitting on the sea, so were presumably resting. The empirical data translate into a negligible collision risk because very few little gulls were observed in flight in the East Anglia THREE site even when birds were present, and that, combined with absence of little gulls in the East Anglia THREE site in most surveys, and lack of any specific connectivity between the East Anglia THREE site and the Greater Wash SPA, and the fact that no birds of this species flew at collision risk height in generic studies, indicates no LSE for this proposed additional SPA feature as a consequence of collisions.

73. There is very little consistent evidence regarding displacement of little gulls by offshore wind farms. Leopold et al. (2011) found significant displacement of little gulls by Dutch offshore windfarms in one survey but not in six other surveys at the same windfarms. Petersen et al. (2006) tentatively suggest that little gulls were attracted by Horns Rev offshore windfarm after construction, but the data appear somewhat inconclusive. Vanermen et al. (2012) present evidence that little gull numbers increased significantly at Thorntonbank offshore windarm post-construction, but that there was no change in little gull numbers at Blighbank offshore windfarm post-construction. Displacement of little gulls by offshore wind farms would therefore appear to be negligible, indicating no LSE for this proposed additional SPA feature as a consequence of displacement.

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5 APPENDIX 2

Auk disturbance and displacement assessment – extracted from ES Chapter 13 Offshore Ornithology

13.7.1 Potential Impacts during Construction

13.7.1.1 Impact 1: Direct Disturbance and Displacement

58. The construction phase of the proposed project has the potential to affect bird populations in the marine environment through disturbance due to construction activity leading to displacement of birds from construction sites. This would effectively result in temporary habitat loss through reduction in the area available for feeding, loafing and moulting. The worst case scenario, outlined in Table 13.2, describes the elements of the proposed project considered within this assessment.

59. The maximum duration of offshore construction for the proposed project would be 2.5 years which would overlap with a maximum of two breeding seasons, two winter periods and up to five migration periods.

60. The construction phase would require the mobilisation of vessels, helicopters 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 wind turbines and the offshore cable corridor. 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 2.5 year construction period.

61. Any impacts resulting from disturbance and displacement from construction activities are considered likely to be short-term, temporary and reversible in nature, lasting only for the duration of construction activity, with birds expected to return to the area once construction activities have ceased. Construction related disturbance and displacement is most likely to affect foraging birds.

62. Some species are more susceptible to disturbance than others. 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 windfarm (GGOWL 2011) and close to active foundation piling activity at the Egmond aan Zee (OWEZ) windfarm, where they showed no noticeable reactions to the works (Leopold and Camphuysen 2007). However, species such as divers and scoters have been noted to avoid shipping

by several kilometres (Mitschke et al. 2001 from Exo et al. 2003; Garthe and Hüppop 2004).

63. 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 windfarm. Garthe and Hüppop (2004) developed a scoring system for such disturbance factors, which is used widely in offshore windfarm EIAs. Furness and Wade (2012) developed disturbance ratings for particular species, alongside scores for habitat flexibility and conservation importance. 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.

64. Birds recorded during the species specific spring and autumn migration periods are assumed to be moving through the area between breeding and wintering areas. As these individuals will be present in the site for a short time and the potential zone of construction displacement will be comparatively small (that located around two construction vessels) it has been assumed that there are negligible risks of impact at these times of year. Consequently the following assessment considers the breeding and nonbreeding periods only (seasons following Furness 2015).

Guillemot

74. Guillemots have been recorded in the East Anglia THREE site year round, with numbers peaking in January (mean density on the East Anglia THREE site alone $5.92/km^2$) and at their lowest in June (mean density on the East Anglia THREE site alone $0.047/km^2$). Guillemots are considered to have a 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), Furness et al. (2013) and Bradbury et al. (2014).

75. There is potential for disturbance and displacement of guillemots due to construction activity, including wind turbine construction and associated vessel traffic. However, construction will not occur across the whole of the East Anglia THREE site simultaneously or every day but will be phased, with a maximum of two foundations expected to be installed simultaneously. Consequently the effects will occur only in the areas where vessels are operating at any given point and not the entire East Anglia THREE site.

76. During the nonbreeding season, at a mean peak density of $5.92/km^2$ and with a highly precautionary 2km radius of disturbance around each construction vessel, 148

individuals (5.92 x 12.56 x 2) could be at risk of displacement. The nonbreeding season BDMPS for common guillemot is 1.6 million birds (Furness 2015). Displacement of 148 birds will have a negligible influence on population density in areas outwith the site of displacement, and therefore an impact on 148 individuals during the nonbreeding season will be negligible.

77. The construction works are temporary and localised in nature and the magnitude of effect has been determined as negligible. As the species is of low to medium sensitivity to disturbance, the impact significance is negligible.

78. During the breeding season the maximum mean peak density on the site was 3.016/km^2 (March) which suggests that 76 individuals (3.016 x 12.56 x 2) could be at risk of displacement. There are no breeding colonies for guillemot within foraging range of the East Anglia THREE site, therefore it is reasonable to assume that individuals seen during the breeding season are nonbreeding (e.g. immature birds). Since immature seabirds are known to remain in wintering areas, the number of immature birds in the relevant population during the breeding season may be estimated as 43% (the proportion of the population that is of immature status) of the total wintering BDMPS population (Furness 2015). This gives a breeding season population of 695,441 (BDMPS for the UK North Sea and Channel, 1,617,306 x 43%). Therefore an impact on 76 (likely immature) individuals during the breeding season will be negligible.

79. The construction works are temporary and localised in nature and the magnitude of effect has been determined as negligible. As the species is of low to medium sensitivity to disturbance, the impact significance is negligible.

Razorbill

80. Razorbills have been recorded in the East Anglia THREE site year round, with numbers peaking in January (mean density on the East Anglia THREE site alone 4.42/km^2) and at their lowest in June (mean density on the East Anglia THREE site alone 0.022/km^2). Razorbills are considered to have a Low to Medium general sensitivity to disturbance and displacement, based on their sensitivity to ship and helicopter traffic in Garthe and Hüppop (2004) and Furness and Wade (2012).

81. There is potential for disturbance and displacement of razorbills due to construction activity, including wind turbine construction and associated vessel traffic. However, construction will not occur across the whole of the East Anglia THREE site simultaneously or every day but will be phased with a maximum of two foundations expected to be installed simultaneously. Consequently the effects will occur only in

the areas where vessels are operating at any given point and not the entire East Anglia THREE site.

82. During the nonbreeding season, at a mean peak density of 2.74/km^2 and with a highly precautionary 2km radius of disturbance around each construction vessel, 69 individuals (2.74 x 12.56 x 2) could be at risk of displacement. The nonbreeding season BDMPS for razorbill is 218,622 (Furness 2015), therefore an impact on this many individuals during the nonbreeding season will be negligible.

83. The construction works are temporary and localised in nature and the magnitude of effect has been determined as negligible. As the species is of low to medium sensitivity to disturbance, the impact significance is negligible.

84. During the breeding season the maximum mean peak density on the site was 4.35/km^2 (April) which suggests that 109 individuals (4.35 x 12.56 x 2) could be at risk of displacement. There are no breeding colonies for razorbill within foraging range of the East Anglia THREE site, therefore it is reasonable to assume that individuals seen during the breeding season are nonbreeding (e.g. immature birds). Since immature seabirds are known to remain in wintering areas, the number of immature birds in the relevant population during the breeding season may be estimated as 43% of the total wintering BDMPS population (Furness 2015). This gives a breeding season population of 94,007 (BDMPS for the UK North Sea and Channel, 218622 x 43%). Therefore an impact on 109 (likely immature) individuals during the breeding season will be negligible.

85. The construction works are temporary and localised in nature and the magnitude of effect has been determined as negligible. As the species is of low to medium sensitivity to disturbance, the impact significance is negligible.

Puffin

86. Puffins have been recorded in the East Anglia THREE site in low numbers in most months, with numbers peaking in November (mean density on the East Anglia THREE site alone 0.63/km^2) and with none present in June and September. Puffins are considered to have a Low to Medium general sensitivity to disturbance and displacement, based on their sensitivity to ship and helicopter traffic in Garthe and Hüppop (2004) and Furness and Wade (2012).

87. There is potential for disturbance and displacement of puffins due to construction activity, including wind turbine construction and associated vessel traffic. However, construction will not occur across the whole of the East Anglia THREE site simultaneously or every day, but will be phased with a maximum of two foundations

expected to be installed simultaneously. Consequently the effects will occur only in the areas where vessels are operating at any given point and not the entire East Anglia THREE site.

88. During the nonbreeding season, at a mean peak density of 0.63/km^2 and with a highly precautionary 2km radius of disturbance around each construction vessel, 16 individuals (0.63 x 12.56 x 2) could be at risk of displacement. The nonbreeding season BDMPS for puffin is 231,957 (Furness 2015), therefore an impact on this many individuals during the nonbreeding season will be negligible.

89. The construction works are temporary and localised in nature and the magnitude of effect has been determined as negligible. As the species is of low to medium sensitivity to disturbance, the impact significance is negligible.

90. During the breeding season the maximum mean peak density on the site was 0.35/km^2 (April) which suggests that 9 individuals (0.35 x 12.56 x 2) could be at risk of displacement. There are no breeding colonies for puffin within foraging range of the East Anglia THREE site, therefore it is reasonable to assume that individuals seen during the breeding season are nonbreeding (e.g. immature birds). Since immature seabirds are known to remain in wintering areas, the number of immature birds in the relevant population during the breeding season may be estimated as 45% of the total wintering BDMPS population (Furness 2015). This gives a breeding season population of 104,381 (BDMPS for the UK North Sea and Channel, 231,957 x 45%). Therefore an impact on 9 (likely immature) individuals during the breeding season will be negligible.

91. The construction works are temporary and localised in nature and the magnitude of effect has been determined as negligible. As the species is of low to medium sensitivity to disturbance, the impact significance is negligible.

13.7.2 Potential Impacts during Operation

13.7.2.1 Impact 3: Direct Disturbance and Displacement

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

97. Seabird species vary in their reactions to the presence of operational infrastructure (e.g. wind turbines, 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 windfarm EIAs. As offshore windfarms 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.

98. Natural England and JNCC issued a joint Interim Displacement Guidance Note (Natural England and JNCC 2012), which provides recommendations for presenting information to enable the assessment of displacement effects in relation to offshore windfarm developments. This guidance note has shaped the assessment provided below.

99. There are a number of different measures used to determine bird displacement from areas of sea in response to activities associated with an offshore windfarm. 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.

100. Both the presence of the infrastructure and the operational activities associated with the proposed project 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. This would be unlikely for seabirds that have large areas of alternative habitat available, but would be more likely to affect seabirds with highly

specialised habitat requirements that are limited in availability (Furness and Wade 2012; Bradbury et al. 2014).

101. The methodology presented in the Natural England / JNCC joint Interim Advice Note (Natural England and JNCC 2012) recommends a matrix is presented for each key species showing bird losses at differing rates of displacement and mortality. This assessment uses the range of predicted losses, in association with the scientific evidence available from post-construction monitoring studies, to quantify the level of displacement and the potential losses as a consequence of the proposed project. These losses are then placed in the context of international, national and regional population estimates to determine the magnitude of effect.

102. Birds are considered to be most at risk from operational disturbance and displacement effects when they are resident (e.g. during the breeding season or wintering season). The small risk of impact to migrating birds is better considered in terms of barrier effects, which are discussed in the following section.

103. Following installation of the offshore cable, the required operational and maintenance activities (in relation to the cable) may have short-term and localised disturbance and displacement impacts on birds using the Site. However, disturbance from operational activities would be temporary and localised, and is unlikely to result in detectable effects at either the local or regional population level. Therefore no impact due to cable operation and maintenance is predicted. The focus of this section is therefore on the disturbance and displacement of birds due to the presence and operation of wind turbines, other offshore infrastructure and any maintenance operations associated with them.

104. 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 13.15), focussing on the main species described in the Baseline Offshore Ornithology Technical Report (Appendix 13.1). The species identified as at risk were then assessed within the biological seasons within which effects were potentially likely to occur. Any species with a low sensitivity to displacement, or recorded only in very small numbers within the East Anglia THREE site during the breeding and wintering seasons, was screened out of further assessment. As described above, any effects from displacement during the migration seasons are covered through an assessment of the barrier effect, which is discussed in the following sections.

Auks (Guillemot, Razorbill and Puffin)

116. Auks have been recorded in the East Anglia THREE site in regionally important numbers (during the breeding season for guillemot and for the spring migration, breeding and wintering seasons for razorbill). They are also 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) species concern index value in the context of disturbance and/or displacement from a habitat.

117. Displacement of foraging seabirds due to the presence of turbines cannot readily be assessed from observing birds in flight as only a very small proportion of flying seabirds land in any particular location. There is not yet very much empirical data on displacement of foraging seabirds from offshore windfarms with the consequence that assessment of the amount of displacement arising from developments is somewhat speculative. Available pre- and post-construction data have yielded variable results, but indicate that auks may be displaced to some extent by some windfarms, but is partial and apparently negligible at others.

118. Common guillemots were displaced at Blighbank (Vanermen et al. 2012), were displaced only in a minority of surveys at two Dutch windfarms (OWEZ and PAWP; Leopold et al. 2011, Krijgsveld et al. 2011), but were not significantly displaced at Horns Rev (although the data suggest that slight displacement was probably occurring; Petersen et al. 2006) or Thorntonbank (Vanermen et al. 2012). Razorbills were displaced in one out of six surveys at two Dutch windfarms (OWEZ and PAWP; Leopold et al. 2011, Krijgsveld et al. 2011), but not at Horns Rev (Petersen et al. 2006), Thorntonbank or Blighbank (Vanermen et al. 2012).

119. In line with guidance (Natural England and JNCC 2012) the abundance estimates for the most relevant biological periods have each been placed into individual displacement matrices. Each displacement matrix completed for this assessment has been prepared to present the abundances of each auk species within the East Anglia THREE site and a 2km buffer only.

120. Each matrix displays displacement rates and mortality rates for each species (Tables 13.17 to 13.24). For the purpose of this assessment a displacement rate range of 30-70% and a mortality rate range of 1-10% are highlighted in each matrix, as recommended by Natural England, with the 70%/10% representing the worst case scenario.

121. There are no breeding colonies for any of these species within foraging range of the East Anglia THREE site, therefore it is reasonable to assume that individuals seen during the breeding season are nonbreeding (e.g. immature birds). Since immature

seabirds are known to remain in wintering areas, the number of immature birds in the relevant populations during the breeding season may be estimated as 43% of the total wintering BDMPS population for guillemot and razorbill and 45% for puffin (Furness 2015). This gives breeding season populations of nonbreeding individuals of 695,441 guillemot (BDMPS for the UK North Sea and Channel, 1,617,306 x 43%), 94,007 razorbills (BDMPS for the UK North Sea and Channel, 218622 x 43%) and 104,381 puffins (BDMPS for UK North Sea and Channel, 231,957 x 45%). For guillemot and puffin there is only one defined nonbreeding season (Aug-Feb and mid-August to March respectively), while for razorbill there are three (Aug-Oct, Nov-Dec and Jan-Mar; Table 13.12). The number of birds which could potentially be displaced has been estimate for each species specific relevant season.

Guillemot

122. The estimated number of guillemots subject to mortality during the breeding period (Table 13.17) is between 5 and 117 individuals (from 30%/1% to 70%/10%). From a breeding season BDMPS of 695,441 this represents a maximum loss of 0.01% which is not considered to cause any real change to the population level. Therefore, during the breeding season, even though the species is considered to be low to medium sensitivity, the impact significance of displacement is negligible.

123. The estimated number of guillemots subject to mortality during the wintering period (Table 13.18) is between 9 and 200 individuals (from 30%/1% to 70%/10%). From a nonbreeding season BDMPS of 1,617,306 this represents a maximum loss of 0.01% which is not considered to cause any real change to the population level. Therefore, during the nonbreeding season, even though the species is considered to be low to medium sensitivity, the impact significance of displacement is negligible.

Table 13.17 Displacement matrix presenting the number of guillemots in the East Anglia THREE site and 2km buffer during the breeding season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)											
	0	1	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	2	3	5	7	8	10	12	13	15	17
10	0	2	17	33	50	67	83	100	117	134	150	167
20	0	3	33	67	100	134	167	200	234	267	300	334
30	0	5	50	100	150	200	250	300	350	401	451	501
40	0	7	67	134	200	267	334	401	467	534	601	668
50	0	8	83	167	250	334	417	501	584	668	751	835
60	0	10	100	200	300	401	501	601	701	801	901	1001
70	0	12	117	234	350	467	584	701	818	935	1051	1168
80	0	13	134	267	401	534	668	801	935	1068	1202	1335
90	0	15	150	300	451	601	751	901	1051	1202	1352	1502
100	0	17	167	334	501	668	835	1001	1168	1335	1502	1669

Table Notes: a) Green shaded cells highlight most likely displacement range of 30% to 70% as appropriate from the evidence base; b) Pink shaded cells represent the most likely range of mortality associated with displaced birds (1% to 10%) during the breeding season.

Table 13.18 Displacement matrix presenting the number of guillemots in the East Anglia THREE site and 2km buffer during the wintering season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)											
	0	1	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	3	6	9	11	14	17	20	23	26	29
10	0	3	29	57	86	114	143	172	200	229	257	286
20	0	6	57	114	172	229	286	343	400	457	515	572
30	0	9	86	172	257	343	429	515	600	686	772	858
40	0	11	114	229	343	457	572	686	801	915	1029	1144
50	0	14	143	286	429	572	715	858	1001	1144	1287	1430
60	0	17	172	343	515	686	858	1029	1201	1372	1544	1715
70	0	20	200	400	600	801	1001	1201	1401	1601	1801	2001
80	0	23	229	457	686	915	1144	1372	1601	1830	2058	2287
90	0	26	257	515	772	1029	1287	1544	1801	2058	2316	2573
100	0	29	286	572	858	1144	1430	1715	2001	2287	2573	2859

Table Notes: a) Green shaded cells highlight most likely displacement range of 30% to 70% as appropriate from the evidence base; b) Pink shaded cells represent the most likely range of mortality associated with displaced birds (1% to 10%) during the wintering season.

Razorbill

124. The estimated number of razorbills subject to mortality during the breeding period (Table 13.19) is between 5 and 126 individuals (from 30%/1% to 70%/10%). From a breeding season BDMPS of 94,007 this represents a maximum loss of 0.13% which is not considered to cause any real change to the population level. Therefore, during the breeding season, even though the species is considered to be low to medium sensitivity, the impact significance of displacement is negligible.

125. The estimated number of razorbills subject to mortality during the autumn migration period (Table 13.20) is between 3 and 79 individuals (from 30%/1% to 70%/10%). From an autumn season BDMPS of 591,874 this represents a maximum loss of 0.01% which is not considered to cause any real change to the population level. Therefore, during the autumn season, even though the species is considered to be low to medium sensitivity, the impact significance of displacement is negligible.

126. The estimated number of razorbills subject to mortality during the midwinter period (Table 13.21) is between 4 and 105 individuals (from 30%/1% to 70%/10%). From a midwinter season BDMPS of 218,622 this represents a maximum loss of 0.04% which is not considered to cause any real change to the population level. Therefore, during the midwinter season, even though the species is considered to be low to medium sensitivity, the impact significance of displacement is negligible.

127. The estimated number of razorbills subject to mortality during the spring migration period (Table 13.22) is between 5 and 107 individuals (from 30%/1% to 70%/10%). From a spring season BDMPS of 591,874 this represents a maximum loss of 0.02% which is not considered to cause any real change to the population level. Therefore, during the spring season, even though the species is considered to be low to medium sensitivity, the impact significance of displacement is negligible.

Table 13.19 Displacement matrix presenting the number of razorbills in the East Anglia THREE site and 2km buffer during the breeding season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)											
	0	1	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	2	4	5	7	9	11	13	14	16	18
10	0	2	18	36	54	72	90	108	126	145	163	181
20	0	4	36	72	108	145	181	217	253	289	325	361
30	0	5	54	108	163	217	271	325	379	434	488	542
40	0	7	72	145	217	289	361	434	506	578	651	723
50	0	9	90	181	271	361	452	542	632	723	813	904
60	0	11	108	217	325	434	542	651	759	867	976	1084
70	0	13	126	253	379	506	632	759	885	1012	1138	1265
80	0	14	145	289	434	578	723	867	1012	1156	1301	1446
90	0	16	163	325	488	651	813	976	1138	1301	1464	1626
100	0	18	181	361	542	723	904	1084	1265	1446	1626	1807

Table Notes: a) Green shaded cells highlight most likely displacement range of 30% to 70% as appropriate from the evidence base; b) Pink shaded cells represent the most likely range of mortality associated with displaced birds (1% to 10%).

Table 13.20 Displacement matrix presenting the number of razorbills in the East Anglia THREE site and 2km buffer during the autumn season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)											
	0	1	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	2	3	4	6	7	8	9	10	11
10	0	1	11	22	34	45	56	67	79	90	101	112
20	0	2	22	45	67	90	112	135	157	180	202	224
30	0	3	34	67	101	135	168	202	236	269	303	337
40	0	4	45	90	135	180	224	269	314	359	404	449
50	0	6	56	112	168	224	281	337	393	449	505	561
60	0	7	67	135	202	269	337	404	471	539	606	673
70	0	8	79	157	236	314	393	471	550	628	707	785
80	0	9	90	180	269	359	449	539	628	718	808	898
90	0	10	101	202	303	404	505	606	707	808	909	1010
100	0	11	112	224	337	449	561	673	785	898	1010	1122

Table Notes: a) Green shaded cells highlight most likely displacement range of 30% to 70% as appropriate from the evidence base; b) Pink shaded cells represent the most likely range of mortality associated with displaced birds (1% to 10%).

Table 13.21 Displacement matrix presenting the number of razorbills in the East Anglia THREE site and 2km buffer during the midwinter season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)											
	0	1	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	3	4	6	7	9	10	12	13	15
10	0	1	15	30	45	60	75	90	105	120	135	150
20	0	3	30	60	90	120	150	180	210	240	270	300
30	0	4	45	90	135	180	225	270	315	360	405	450
40	0	6	60	120	180	240	300	360	420	480	540	600
50	0	7	75	150	225	300	375	450	525	600	675	750
60	0	9	90	180	270	360	450	540	630	720	809	899
70	0	10	105	210	315	420	525	630	735	839	944	1049
80	0	12	120	240	360	480	600	720	839	959	1079	1199
90	0	13	135	270	405	540	675	809	944	1079	1214	1349
100	0	15	150	300	450	600	750	899	1049	1199	1349	1499

Table Notes: a) Green shaded cells highlight most likely displacement range of 30% to 70% as appropriate from the evidence base; b) Pink shaded cells represent the most likely range of mortality associated with displaced birds (1% to 10%).

Table 13.22 Displacement matrix presenting the number of razorbills in the East Anglia THREE site and 2km buffer during the spring season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)											
	0	1	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	2	3	5	6	8	9	11	12	14	15
10	0	2	15	30	46	61	76	91	107	122	137	152
20	0	3	30	61	91	122	152	183	213	244	274	305
30	0	5	46	91	137	183	229	274	320	366	411	457
40	0	6	61	122	183	244	305	366	427	488	549	610
50	0	8	76	152	229	305	381	457	533	610	686	762
60	0	9	91	183	274	366	457	549	640	732	823	914
70	0	11	107	213	320	427	533	640	747	853	960	1067
80	0	12	122	244	366	488	610	732	853	975	1097	1219
90	0	14	137	274	411	549	686	823	960	1097	1234	1372
100	0	15	152	305	457	610	762	914	1067	1219	1372	1524

Table Notes: a) Green shaded cells highlight most likely displacement range of 30% to 70% as appropriate from the evidence base; b) Pink shaded cells represent the most likely range of mortality associated with displaced birds (1% to 10%).

Puffin

74. The estimated number of puffins subject to mortality during the breeding period (*Table 13.23*) is between 0 and 8 individuals (from 30%/1% to 70%/10%). From a breeding season BDMPS of 104,381 this represents a maximum loss of 0.007% which is not considered to cause any real change to the population level. Therefore, during the breeding season, even though the species is considered to be low to medium sensitivity **no impact** would occur as a result of displacement.

75. The estimated number of puffins subject to mortality during the midwinter period (*Table 13.24*) is between 1 and 14 individuals (from 30%/1% to 70%/10%). From a midwinter season BDMPS of 231,957 this represents a maximum loss of 0.006% which is not considered to cause any real change to the population level. Therefore, during the midwinter season, even though the species is considered to be low to medium sensitivity, **no impact** would occur as a result of displacement.

Table 13.23 Displacement matrix presenting the number of puffins in the East Anglia THREE site during the breeding season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)											
	0	1	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	1	1	1	1	1	1
10	0	0	1	2	3	4	5	6	8	9	10	11
20	0	0	2	4	6	9	11	13	15	17	19	22
30	0	0	3	6	10	13	16	19	23	26	29	32
40	0	0	4	9	13	17	22	26	30	35	39	43
50	0	1	5	11	16	22	27	32	38	43	49	54
60	0	1	6	13	19	26	32	39	45	52	58	65
70	0	1	8	15	23	30	38	45	53	60	68	76
80	0	1	9	17	26	35	43	52	60	69	78	86
90	0	1	10	19	29	39	49	58	68	78	87	97
100	0	1	11	22	32	43	54	65	76	86	97	108

Table Notes: a) Green shaded cells highlight most likely displacement range of 30% to 70% as appropriate from the evidence base; b) Pink shaded cells represent the most likely range of mortality associated with displaced birds (1% to 10%).

Table 13.24 Displacement matrix presenting the number of puffins in the East Anglia THREE site during the nonbreeding season that may be subject to mortality (highlighted in pink)

Displacement (%)	Mortality Rates (%)											
	0	1	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	1	1	1	1	1	2	2	2
10	0	0	2	4	6	8	10	12	14	16	18	20
20	0	0	4	8	12	16	20	23	27	31	35	39
30	0	1	6	12	18	23	29	35	41	47	53	59
40	0	1	8	16	23	31	39	47	55	62	70	78
50	0	1	10	20	29	39	49	59	68	78	88	98
60	0	1	12	23	35	47	59	70	82	94	105	117
70	0	1	14	27	41	55	68	82	96	109	123	137
80	0	2	16	31	47	62	78	94	109	125	140	156
90	0	2	18	35	53	70	88	105	123	140	158	176
100	0	2	20	39	59	78	98	117	137	156	176	195

77. Table Notes: a) Green shaded cells highlight most likely displacement range of 30% to 70% as appropriate from the evidence base; b) Pink shaded cells represent the most likely range of mortality associated with displaced birds (1% to 10%).

13.8.1.4 Cumulative Assessment of Operation Displacement Risk

78. Guillemot

79. The East Anglia THREE site is located beyond the mean maximum foraging range of any guillemot breeding colonies. Outside the breeding season, guillemots disperse from their breeding sites with an overall southward trend. Thus large numbers are found throughout the North Sea in the nonbreeding season (defined as August to February). Consequently it was during this period that numbers peaked on the East Anglia THREE site (plus 2km buffer), with a mean maximum of 2,859 individuals.

80. In the recent cumulative assessment for the Hornsea 2 project (Smart Wind 2015) an estimate of the impact on nonbreeding guillemots was presented for 23 of the windfarms listed in Table 13.29 (exceptions were: Gunfleet Sands, Kentish Flats, Lynn and Inner Dowsing, Scroby Sands, Rampion, Blyth, Navitus Bay and the possible future Round 3 developments). The collated data were presented on the basis of a displacement rate of 30% and mortality of 1%, giving rise to a total nonbreeding mortality of 189 individuals (Smart Wind 2015). Back calculating from the windfarm values presented (dividing by 0.003; 0.01 x 0.3) gives the total number of birds at risk of displacement as 63,000 across the North Sea, to which the proposed East Anglia THREE project adds 2,859. While this omits the windfarms listed above, this is also likely to over-estimate the number present due to the use of peak numbers at each site which probably leads to double counting as birds move through the North Sea.

81. The figure of 198 (189 plus the proposed East Anglia THREE project's contribution of 9) represents the lower boundary defined by the range of displacement (30-70%) and mortality levels (1-10%) advised by Natural England. The upper boundary, calculated for 65,859 individual is 4,610 (70% displacement, 10% mortality). Thus the key question for assessing the impact is where within this range (198 to 4,610) is the most realistic value.

82. Post-construction monitoring of nonbreeding season auks has found evidence of windfarm avoidance behaviour, with indications that turbine density may affect the magnitude of avoidance (Leopold et al. 2011; Krijgsveld et al. 2011). The estimated guillemot avoidance rate from these studies was around 68%, although it should be noted that this was based on observations of flying birds and this value may not be appropriate for swimming birds. Furthermore these studies were conducted at sites with relatively closely spaced turbines (e.g. 550m) which is in the region of half that at windfarms currently being developed. Thus, a figure of 70% displacement represents a precautionary estimate.

83. The pressures on nonbreeding birds in terms of energy requirements are lower outside the breeding season when they only need to obtain sufficient food to maintain their own survival. In addition, for species such as auks they can remain at sea for extended periods and thus flight costs are minimised. Recoveries of ringed guillemots have indicated a wide distribution in winter, with birds spread throughout the North Sea (Furness 2015). This pattern has received further support from recent studies using geolocator tags, which have revealed that birds from Scottish colonies spread out through much of the North Sea (S. Wanless pers. comm.). These studies have also found quite marked levels of variation between years, which suggests that birds are relatively flexible in terms of where they spend the winter and are not dependent on particular foraging locations. Hence, the consequence of winter displacement from windfarms in terms of increased mortality is likely to be minimal. Given that, even when fish stocks have collapsed, adult survival rates have shown declines of no more than 6-7% (e.g. kittiwake, Frederiksen et al. 2004) an increase in mortality due to displacement from windfarm sites seems likely to be at the low end of the proposed 1-10% range, and a value of 1% when combined with the precautionary 70% displacement rate is considered appropriate. On this basis a precautionary cumulative nonbreeding displacement figure of 461 is obtained (65,859 x 0.7 x 0.01).

84. The nonbreeding guillemot BDMPS is 1,617,306 (Furness 2015). Additional mortality of 461 individuals from this population is a loss of only 0.03% of the population.

85. Consequently, the potential for the proposed East Anglia THREE project to contribute to a significant displacement effect on guillemot during migration is considered to be very small and the impact significance of cumulative displacement is negligible.

Razorbill

86. The East Anglia THREE site is located beyond the mean maximum foraging range of any razorbill breeding colonies. Outside the breeding season razorbills migrate southwards in a similar manner to guillemots, although they tend to move further south. Three nonbreeding seasons were identified for razorbill (spring and autumn migration and winter), with numbers in the North Sea during the migration period estimated to be 591,874 and in midwinter 218,622.

87. At these times the total numbers on the East Anglia THREE site (and 2km buffer) were 1,122, 1,499 and 1,524 respectively.

88. In the recent cumulative assessment for the Hornsea 2 project (Smart Wind 2015) an estimate of the impact on nonbreeding razorbills was presented for 23 of the windfarms listed in Table 13.29 (exceptions were: Gunfleet Sands, Kentish Flats, Lynn and Inner Dowsing, Scroby Sands, Rampion, Blyth, Navitus Bay and the possible future Round 3 developments). The collated data were presented on the basis of a displacement rate of 40% and mortality of 2% (migration seasons) and 1% (midwinter), giving rise to respective total mortality estimates of 211, 54 and 160 for each period (Smart Wind 2015). Back calculating from the windfarm values presented (dividing by 0.008; 0.02 x 0.4 and 0.004; 0.01 x 0.4) gives the seasonal total number of birds at risk of displacement as 23,375, 13,500 and 20,000 across the North Sea, to which the numbers for the proposed East Anglia THREE project can be added (1,122, 1,499 and 1,524 respectively) giving cumulative totals of 27,497, 14,999 and 21,524 for each season. While these omit the windfarms listed above, they are also likely to over-estimate the number present due to the combination of peak numbers at each site which probably leads to double counting as birds move through the North Sea.

Autumn migration period

89. The figure of 220 (211 plus the proposed East Anglia THREE project's contribution of 9 at a 40%/2% rate) is slightly more than double the lower boundary value of 82 calculated using a 30% displacement (range 30-70%) and 1% mortality rate (range 1-10%) as advised by Natural England. The equivalent upper boundary, calculated for 27,497 individuals is 1,925 (70% displacement, 10% mortality). Thus the key question for assessing the impact is where within this range is the most realistic value.

90. The evidence for displacement and consequent mortality is based on the same observations made for guillemot (see above). Therefore the same precautionary rates (70% displacement and 1% mortality) have been applied. On this basis a precautionary cumulative autumn migration displacement figure of 192 is obtained (27,497 x 0.7 x 0.01).

91. The autumn migration nonbreeding razorbill BDMPS is 591,874 (Furness 2015). Additional mortality of 192 individuals from this population is a loss of only 0.03% of the population. Consequently, the potential for the proposed East Anglia THREE project to contribute to a significant displacement effect on razorbill during autumn migration is considered to be very small and the impact significance of cumulative displacement is negligible.

Midwinter period

92. The figure of 60 (54 plus the proposed East Anglia THREE project's contribution of 6 at a 40%/1% rate) is slightly higher than the lower boundary value of 45 calculated using a 30% displacement (range 30-70%) and 1% mortality rate (range 1-10%) as advised by Natural England. The equivalent upper boundary, calculated for 14,999 individuals is 1,050 (70% displacement, 10% mortality). Thus the key question for assessing the impact is where within this range is the most realistic value.

93. The evidence for displacement and consequent mortality is based on the same observations made for guillemot (see above). Therefore the same precautionary rates (70% displacement and 1% mortality) have been applied. On this basis a precautionary cumulative autumn migration displacement figure of 105 is obtained (14,999 x 0.7 x 0.01).

94. The midwinter nonbreeding razorbill BDMPS is 218,622 (Furness 2015). Additional mortality of 105 individuals from this population is a loss of only 0.05% of the population. Consequently, the potential for the proposed East Anglia THREE project to contribute to a significant displacement effect on razorbill during the midwinter period is considered to be very small and the impact significance of cumulative displacement is negligible.

Spring migration period

95. The figure of 172 (160 plus the proposed East Anglia THREE project's contribution of 12 at a 40%/2% rate) is almost three times the lower boundary value of 65 calculated using a 30% displacement (range 30-70%) and 1% mortality rate (range 1-10%) as advised by Natural England. The equivalent upper boundary, calculated for 21,524 individuals is 1,507 (70% displacement, 10% mortality). Thus the key question for assessing the impact is where within this range is the most realistic value.

96. The evidence for displacement and consequent mortality is based on the same observations made for guillemot (see above). Therefore the same precautionary rates (70% displacement and 1% mortality) have been applied. On this basis a precautionary cumulative autumn migration displacement figure of 151 is obtained (21,524 x 0.7 x 0.01).

97. The autumn migration nonbreeding razorbill BDMPS is 591,874 (Furness 2015). Additional mortality of 151 individuals from this population is a loss of only 0.03% of the population. Consequently, the potential for the proposed East Anglia THREE project to contribute to a significant displacement effect on razorbill during autumn migration is considered to be very small and the impact significance of cumulative displacement is negligible.

Complete nonbreeding period

98. Overall the impact of cumulative displacement on the nonbreeding razorbill population mortalities together (weighted average) amounts to a loss of 0.03% of the population. Consequently, the potential for the proposed East Anglia THREE project to contribute to a significant displacement effect on razorbill during the complete nonbreeding season is considered to be very small and the impact significance of cumulative displacement is negligible.

Puffin

99. The East Anglia THREE site is located beyond the mean maximum foraging range of any puffin breeding colonies. Outside the breeding season puffins disperse from their breeding sites with an overall southward trend. Thus large numbers are found throughout the North Sea in the nonbreeding season (defined as August to February). Consequently it was during this period that numbers peaked on East Anglia THREE with a mean maximum of 195 individuals.

100. In the recent cumulative assessment for the Hornsea 2 project (Smart Wind 2015) an estimate of the impact on nonbreeding puffins was presented for 23 of the windfarms listed in Table 13.29 (exceptions were: Gunfleet Sands, Kentish Flats, Lynn and Inner Dowsing, Scroby Sands, Rampion, Blyth, Navitus Bay and the possible future Round 3 developments). The collated data were presented on the basis of a displacement rate of 40% and mortality of 1%, giving rise to a total nonbreeding mortality of 51 individuals (Smart Wind 2015). Back calculating from the windfarm values presented (dividing by 0.004; 0.01 x 0.4) gives the total number of birds at risk of displacement as 12,750 across the North Sea, to which the proposed East Anglia THREE project adds 195 giving a cumulative total of 12,945. While this omits the windfarms listed above, this is also likely to over-estimate the number present due to the use of peak numbers at each site which probably leads to double counting as birds move through the North Sea.

101. The figure of 52 (51 plus the proposed East Anglia THREE project's contribution of 1 at a 40%/1% rate) is slightly higher than the lower boundary value of 39 calculated using a 30% displacement (range 30-70%) and 1% mortality rate (range 1-10%) as advised by Natural England. The equivalent upper boundary, calculated for 12,945 individuals is 906 (70% displacement, 10% mortality). Thus the key question for assessing the impact is where within this range is the most realistic value.

102. The evidence for displacement and consequent mortality is based on the same observations made for guillemot (see above). Therefore the same precautionary

rates (70% displacement and 1% mortality) have been applied. On this basis a precautionary cumulative autumn migration displacement figure of 91 is obtained (12,945 x 0.7 x 0.01).

103. The nonbreeding puffin BDMPS is 231,957 (Furness 2015). Additional mortality of 91 individuals from this population is a loss of only 0.04% of the population.

104. Consequently, the potential for the proposed East Anglia THREE project to contribute to a significant displacement effect on puffin during the nonbreeding season is considered to be very small and the impact significance of cumulative displacement is negligible.

6 APPENDIX 3

Kittiwake cumulative collision risk assessment – extracted from ES Chapter 13 Offshore Ornithology

Kittiwake

105. The cumulative kittiwake collision risk prediction is set out in the form of a 'tiered approach' in *Table 13.36*. This table collates collision predictions from other windfarms which may contribute to the cumulative total. This table includes revised estimates for East Anglia ONE following a revision to the analysis (Appendix 13.#).

106. Seasonal kittiwake collisions at the East Anglia THREE site only exceeded 10 during spring and autumn migration (breeding season 8, autumn migration 90, spring migration 49). Therefore the project mainly contributes to a cumulative impact during the migration periods. The collision values listed in *Table 13.36* include annual, spring and autumn period collisions. The data have been obtained from recent windfarm submissions (e.g. Teesside A & B, Forewind 2014) and Natural England responses (e.g. Natural England 2013c).

107. The original assessments were conducted using a range of avoidance rates and alternative collision model options. In order to simplify interpretation of the data across sites and also to bring these assessments up to date with the current Natural England Advice the values in *Table 13.36* are those estimated using the Band model Option 1 (or 2, if that was the one presented) at an avoidance rate of 98.9%.

Table 13.36. Cumulative Collision Risk Assessment for kittiwake. Shaded cells indicate all projects up to Tier 3.

Tier	Windfarm (source of annual data / source of autumn data)	Predicted collisions (@ 98.9% avoidance rate, Band Model option 1 or 2)					
		Annual	Annual migration Cumulative total	Spring migration	Spring migration Cumulative total	Autumn migration	Autumn migration Cumulativ e total
1	Beatrice Demonstrator 1 / A	4.9	4.9	1.6	1.6	2.1	2.1
1	Greater Gabbard 2 / B	27.5	32.4	11.4	13.1	15.0	17.1
1	Gunfleet Sands 2 / B	0.0	32.4	0.0	13.1	0.0	17.1
1	Kentish Flats 2 / B	0.0	32.4	0.0	13.1	0.0	17.1
1	Lincs 2 / B	2.7	35.2	0.9	14.0	1.2	18.2
1	London Array (Phase 1) 2 / B	5.5	40.7	1.8	15.9	2.3	20.5

1	Lynn and Inner Dowsing 2 / B	0.0	40.7	0.0	15.9	0.0	20.5
1	Scroby Sands 2 / B	0.0	40.7	0.0	15.9	0.0	20.5
1	Sheringham Shoal 2 / B	0.0	40.7	0.0	15.9	0.0	20.5
1	Teesside 2 / B	77.0	117.7	15.0	30.8	24.0	44.5
1	Thanet 2 / B	1.1	118.8	0.4	31.2	0.4	45.0
2	Humber Gateway 2 / B	7.7	126.5	2.6	33.7	3.2	48.1
2	Westermost Rough 2 / B	0.5	127.0	0.2	33.9	0.2	48.4
3	Beatrice 2 / B	145.2	272.2	39.8	73.7	10.7	59.1
3	Blyth (NaREC Demonstration) 2 / B	5.5	277.7	1.8	75.5	2.3	61.4
3	Dogger Bank Creyke Beck A & B 2 / B	718.3	996.0	362.4	437.9	135.1	196.5
3	Dudgeon 2 / B	0.0	996.0	0.0	437.9	0.0	196.5
3	East Anglia ONE 1 / C	314.0	1310.0	71.0	508.9	242.0	438.5
3	EOWDC (Aberdeen OWF) 2 / B	18.7	1328.7	1.1	510.0	5.9	444.4
3	Firth of Forth Alpha and Bravo 2 / B	715.0	2043.7	247.6	757.6	313.1	757.5
3	Galloper 2 / B	66.0	2109.7	31.8	789.5	27.8	785.3
3	Hornsea Project 1 2 / B	123.2	2232.9	24.7	814.2	53.9	839.2
3	Inch Cape 2 / B	301.4	2534.3	63.5	877.7	224.8	1064.0
3	Moray Firth (EDA) 2 / B	82.5	2616.8	35.0	912.7	3.9	1067.9
3	Neart na Goithe 2 / B	93.5	2710.3	4.4	917.1	56.6	1124.5
3	Race Bank 2 / B	31.3	2741.7	5.6	922.7	23.9	1148.4
3	Rampion 2 / B	121.0	2862.7	29.7	952.4	37.4	1185.8
3	Triton Knoll 2 / B	209.0	3071.7	50.2	1002.7	138.9	1324.7
4	Dogger Bank Teesside A & B 2 / B	444.4	3516.1	256.6	1259.3	90.7	1415.4
4	Hornsea Project 2 3 / C	340.4	3856.5	19.0	1278.3	28.0	1443.4
4	Navitus Bay 2 / B	38.5	3895.0	17.6	1295.9	18.1	1461.6
5	East Anglia THREE 3 / C	146.3	4041.3	49.0	1344.9	90.0	1551.6
	Total	4041.3		1344.9		1551.6	

Annual data sources: 1 = Natural England (2013) submission for Rampion kittiwake assessment; 2 = Teesside A & B submission;3 = Developer Assessment;
Spring and Autumn data sources: A = no seasonal data, collisions apportioned equally among months; B = Teesside A & B submission; C = Developer assessment

108. On the basis of the values in *Table 13.36*, the cumulative kittiwake annual migration mortality is 4,041, of which the proposed East Anglia THREE project contributes 146. Note, however that many of the collision estimates were calculated for larger windfarms than have been built or are planned to be built. Therefore this value is an overestimate of the total risk. All but four of the windfarms in *Table 13.36* are either operational, under construction or consented. The cumulative annual mortality for these windfarms (up to tier 3) is 3,072. The four tier 4 and 5 projects contribute an additional 970 to this, of which 15% is attributable to the proposed East Anglia THREE project.

109. Previous kittiwake collision assessments were made on the basis of Band model option 1 and an avoidance rate of 98%, with the change to 98.9% dating from November 2014 (JNCC et al. 2014). Therefore, projects consented prior to this date were done so on the basis of a cumulative collision mortality 1.8 times that presented in *Table 13.36*. The only projects consented after November 2014 were Hornsea Project 1 (123 annual collisions at 98.9%) and Dogger Bank Creyke Beck A&B (718 annual collisions at 98.9%). Therefore the previous cumulative annual collision total (at 98%) excluding these two projects would have been 4,016 (3,072 - (123 + 718) x 1.8). The current cumulative total of 4,041, including all consented and still to be consented projects, is therefore only slightly higher than the previously accepted cumulative total.

110. Furthermore, with the recently applied update to the East Anglia ONE collision assessment (with the removal of birds on the water from the calculation the annual East Anglia ONE mortality decreased from 580 to 314 at an avoidance rate of 98.9%; this change is reflected in *Table 13.36*) the cumulative annual total decreased by 266 which is 1.8 times bigger than the contribution from the proposed East Anglia THREE project.

111. On the basis of the values in *Table 13.36*, the cumulative kittiwake spring migration mortality is 1,345, of which the proposed East Anglia THREE project contributes 49 (although many of the collision estimates were calculated for larger windfarms than have been built or are planned to be built). All but four of the windfarms in *Table 13.36* are either operational, under construction or consented. The cumulative spring mortality for these windfarms (up to tier 3) is 1,003. The four tier 4 and 5 projects contribute an additional 342 to this, of which approximately 14% is attributable to the proposed East Anglia THREE project. With the recently applied correction to the East Anglia ONE collision assessment the cumulative total decreased from 290 to 71, which is 1.4 times higher than the contribution from the proposed East Anglia THREE project.

112. On the basis of the values in *Table 13.36*, the cumulative kittiwake autumn migration mortality is 1,552, of which the proposed East Anglia THREE project contributes 90 (although many of the collision estimates were calculated for larger windfarms than have been built or are planned to be built). All but four of the windfarms in *Table 13.36* are either operational, under construction or consented. The cumulative autumn mortality for these windfarms (up to tier 3) is 1,325. The four tier 4 and 5 projects contribute an additional 227 to this, of which approximately 40% is attributable to the proposed East Anglia THREE project.

113. A review of nocturnal activity in seabirds has indicated that the value currently used for this parameter (50%) to estimate collision risk at night for kittiwake is almost certainly an overestimate, possibly by as much as a factor of 4 (i.e. study data suggest that 12.5% is more appropriate). Even reducing the nocturnal activity factor to 25% reduces collision estimates at East Anglia THREE by around 20% (note this reduction varies depending on the time of year and wind farm latitude due to the consequent effects on the balance of day and night). A correction along these lines would reduce the overall collision estimate by a significant amount (e.g. in the region of 20%) for all windfarm estimates.

114. Recent windfarm assessments have included use of Potential Biological Removal (PBR) to identify mortality impacts which exceed allowable thresholds during particular periods of the year (e.g. Smart Wind 2015).

115. During the autumn migration period the BDMPS for kittiwake is 829,937 and during spring is 627,816 (Furness 2015). A PBR conducted by Smart Wind (2015) on a population of 843,077 (i.e. very similar to the autumn BDMPS) indicated that even with precautionary parameters the PBR estimate of allowable mortality would exceed the cumulative collision total of 4,041 (e.g. at f=0.2, PBR=10,316). The same conclusion was reached on the basis of calculations conducted for a spring migration population of 639,742 (i.e. very similar to the spring BDMPS), which revealed a precautionary mortality threshold of 7,828 (f=0.2). The smallest of these seasonal thresholds (7,828) is greater than the maximum annual mortality (4,041), and this is based on a BDMPS population size which cannot be smaller than that against which the total annual collisions would be assessed. Therefore the cumulative annual total remains below the level identified by PBR as the threshold for allowable mortality.

116. *TO BE INSERTED – CONCLUSIONS FROM PVA*.

117. [To be updated following PVA conclusions] In conclusion, the proposed East Anglia THREE project contributes a relatively small amount to the cumulative total for this species and the cumulative impacts on the kittiwake population due to annual and

seasonal collisions are considered to be of low magnitude, resulting in impacts of **minor** adverse significance.

6.1 References

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APPENDIX 2: GANNET CUMULATIVE IMPACT ASSESSMENT

This section was taken from the draft Environmental Statement. It is included in Chapter 13, Offshore Ornithology.

APPENDIX 3: KITTIWAKE CUMULATIVE IMPACT ASSESSMENT

This section was taken from the draft Environmental Statement. It is included in Chapter 13, Offshore Ornithology.

APPENDIX 4: KITTIWAKE PVA

This section included preliminary results from the Kittiwake PVA which was subsequently updated and is included as Technical Appendix 13.4.

APPENDIX 5: EXAMPLE OF CUMULATIVE COLLISION ASSESSMENT

This section was extracted from the draft Environmental Statement. The final assessment is included in Chapter 13, Offshore Ornithology.

APPENDIX 6: SEASONAL CONSIDERATIONS REGARDING SEABIRD DISPLACEMENT AND INFERRED MORTALITY CONSEQUENCES

East Anglia Offshore Wind

VATTENFALL

SCOTTISHPOWER RENEWABLES

East Anglia THREE

Ornithology Evidence Plan

Expert Topic Group Meeting 6

Appendix 6 - Seasonal considerations regarding seabird displacement and inferred mortality consequences

6th July 2015

Author – MacArthur Green

East Anglia Offshore Wind Limited

Date – July 2015

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1 INTRODUCTION

1. There is only a very incomplete and poorly quantified evidence base for the extent of displacement of seabirds by offshore windfarm structures. Furthermore, there is no evidence at all to support the suggestion that any birds displaced by offshore windfarms are subject to any increased risk of mortality. Therefore, the matrix approach developed by Natural England to assess possible impacts of seabird displacement by offshore windfarms is a precautionary assessment that is not evidence-based, but considers a somewhat arbitrary set of assumptions in order to achieve a precautionary assessment. Practice in recent assessments has been to consider a matrix of displacement rates from 0% to 100% and consequent mortality from 0% to 100%, taking the affected population as the mean peak count of birds present in the season with highest numbers present on the project area plus buffer. This normally represents a ‘worst case scenario’ because numbers present at other times of year are, by definition, smaller than the mean peak number used in the matrix calculations.

2. Natural England wish to explore whether this approach can be refined to consider seasonal numbers present and then to sum impacts across seasons (a ‘seasonally disaggregated’ approach), rather than using the mean peak numbers alone. This paper explores some aspects of a seasonally disaggregated approach as an alternative to the presently accepted matrix method based on mean peak numbers.

2 HYPOTHETICAL SCENARIOS

3. Consider a model (hypothetical) scenario as follows. Auks are present in a development area at different abundances in four seasons of equal duration: spring (1000 birds), summer (200 birds), autumn (2000 birds) and winter (400 birds). Therefore, the annual mean number present is 900 birds. For the annual mean number of 900 birds present, a 50% displacement and 10% mortality of displaced birds would result in 450 birds being displaced and a consequent 45 hypothetical deaths.

4. If the assumed 10% mortality in the year is split equally across the four seasons, then there would be 2.5% mortality of displaced birds in each season. The allocation of 2.5% mortality in each of the four seasons against mean numbers present in each season also results in the same estimate, of 45 deaths over the year (Table 1). This annual mortality estimate could be split in many different ways among seasons, the equal attribution suggested just being the most parsimonious and simplest approach. One immediate problem with this suggested approach is a lack of evidence on which to base seasonal splitting of mortality (limited evidence for which is discussed later).

5. However, application of a 50% displacement and 10% mortality to the peak mean seasonal total: 2000 in autumn, so 1000 displaced and 100 deaths (Table 1), and ignoring numbers present at other times of year when numbers are smaller, provides a precautionary assessment by loading all mortality onto the seasonal peak number rather than spreading the mortality pro rata across the seasons. That approach essentially allocates all of the 10% mortality to the season with the highest numbers and allocates 0% to the other seasons. The case for following such an approach is that it is broadly precautionary to impose all of the (annual) mortality onto the largest number of birds present at any time of the year, rather than following what would appear to be a biologically more realistic approach of allocating the mortality equally across time periods. While it may seem appropriate to sum the mortality in each season (e.g. a total of 180 for the example in Table 1.1), this actually introduces considerable complications due to the different populations present in each season which are also likely to overlap in terms of the members of those populations to a variable degree. Consequently, summing in this manner will introduce an unknown degree of double counting to the assessment.

Table 1.1. Hypothetical scenario of auk displacement assessment.

Season	Period	Mean number present	Displaced (50%)	Deaths (10%)	Deaths (2.5%)
Spring	Mar-May	1000	500	50	12.5
Summer	Jun-Aug	200	100	10	2.5
Autumn	Sep-Nov	2000	1000	100	25
Winter	Dec-Feb	400	200	20	5
Annual mean		900	450	45	

6. A model applying all displacement mortality to the peak seasonal numbers will always result in a higher assessed impact than a model applying the same annual mortality rate to a mean combining all seasons of the year. Furthermore, the greater the seasonal variation in numbers of birds present, the greater the discrepancy will be between a model that applies all the displacement mortality on the seasonal peak numbers rather than equally across the seasons. Note that a model with seasons of differing duration (so more realistic) gives the same conclusions but the arithmetic becomes more complex so it is a less convenient example to consider.

Given that the mortality rates being applied are entirely arbitrary, and not evidence-based, the established approach of loading the mortality entirely onto the peak numbers rather than allocating it uniformly across the year, is apparently as appropriate a scenario as any other, and is clearly precautionary if applied to the numbers present in the context of the appropriate reference population scale. However, it invites some consideration of whether or not that approach is consistent with any existing evidence. That is discussed in the following section.

3 EVIDENCE FOR SEASONAL VARIATION IN MORTALITY RATES OF SEABIRDS

7. In many species of seabirds, there is high mortality of juveniles during the first autumn of their life, which is likely to relate mainly to their inexperience and consequent poor foraging success (Greig et al. 1983) but may also relate to their lack of experience of migration (Wernham et al. 2002), and lack of experience in avoiding hazards. For example, juvenile seabirds are more likely than adults to drown due to entanglement and are at higher risk of being killed by hunting (Wernham et al. 2002). They are also more likely than adults to be attracted to and killed by collision with lights (Rodriguez and Rodriguez 2009).

8. Coulson et al. (1983) noted that herring gull ring recoveries of adults and immatures mainly occurred in April to September, which is the time of year when the body mass of the birds is lowest, suggesting that mortality of herring gulls occurs mainly in summer rather than in winter. However, ring recovery rates may be affected by seasonal variation in habitat use by herring gulls and by human seasonal activity patterns in areas where dead gulls might be found, so there may be bias in the recovery data that obscure seasonality of mortality in this species (Wernham et al. 2002).

9. Based on direct observations of individually colour-ringed birds, Coulson (2011) reported that in his kittiwake study population in NE England, 81% of adults which disappeared and were presumed to have died, did so between September and March (7 months). Only 19% disappeared between April and August (i.e. during the 5 month breeding season). However, Oro and Furness (2002) found that sandeel stock biomass and breeding success of great skuas were the main factors determining annual survival rates of adult kittiwakes at a Shetland colony. These two factors act during the breeding season, so suggest that Shetland kittiwake mortality was mainly determined by events during the breeding season rather than during winter, although possibly involving carry-over effects between seasons. It is unclear whether the seasonal patterns therefore differ between kittiwake populations in Shetland and NE England but the latter are not exposed to predation by great skuas, and have not been affected as much by declines in sandeel abundance as the birds in Shetland.

10. Nettleship and Birkhead (1985) reported that auks in their first year of life tend to be found dead mostly in September to November, whereas peak mortality of adults occurs between January and March. Harris and Wanless (2011) found that ring recoveries indicate puffins from colonies in the North Sea mostly died in January and February, whereas most recoveries from west coast colonies were in summer.

Supporting their conclusion, one-third of colour-ringed adult puffins that disappeared from Skomer did so between April and July whereas virtually none of the colour-ringed adults at the Isle of May disappeared during those months (Harris and Wanless 2011). Beached bird surveys on southern North Sea coasts find dead seabirds washed up in all months of the year, but with more dead seabirds in winter than in summer (Camphuysen and Heubeck 2001). However, this is at least in part a reflection of the fact that there are more seabirds at sea in the southern North Sea in winter than in summer (Camphuysen and Heubeck 2001). Nevertheless, the numbers of carcasses increase more in winter than numbers of seabirds at sea, supporting the suggestion that seabird mortality tends to be higher in winter, but possibly only slightly so.

11. The limited evidence regarding seasonal variation in mortality rates of UK seabirds suggests that there may be some seasonality, but that the patterns may differ between populations of a species as well as between species. There may be a tendency for juvenile mortality to peak in autumn (particularly because newly-fledged independent young have to learn to forage and are much less successful than adults until they gain experience; e.g. Greig et al. 1983). There may be a general tendency for mortality to peak during late winter in adult seabirds, but the seasonal variation appears to be no more than moderate, and at least in some species and populations there is evidence for higher mortality during the breeding season, and so a model assuming that mortality is apportioned equally across the seasons may be a reasonable first approximation.

4 SEASONAL BDMPS POPULATIONS

12. Any assessment that considers mortality in separate seasons would need not only to apportion annual mortality into seasons, but would also need to assess the estimated seasonal mortality against the appropriate seasonal population scale (BDMPS population size; Furness 2015). This becomes difficult where the BDMPS population size differs between seasons. For example, razorbill BDMPS in the UK North Sea and Channel is about 590,000 birds during the migration seasons but only 219,000 in winter (Furness 2015). It is not clear how impacts could be added across seasons when the population against which the impact has to be assessed is different in the different seasons.

5 CONCLUSION

13. Given the uncertainty about the seasonality of mortality, and the lack of evidence to quantify mortality associated with displacement, it seems sensible to retain the current precautionary approach which assumes that mortality will be loaded onto the seasonal peak numbers rather than equally spread across the seasons, particularly since summing estimates of mortality across seasons would be made more difficult by the seasonal variation in appropriate population scales against which to apply mortality in any assessment. A possible but simple refinement to this would be to allocate the displacement mortality to the season during which the numbers represent the highest proportion of the seasonal BDMPS population rather than the highest absolute mean number in the survey area. That would retain the present precautionary nature of the matrix approach but assess against the population which would experience the highest impact.

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APPENDIX 7: SENSITIVITY ANALYSIS OF COLLISION MORTALITY IN RELATION TO NOCTURNAL ACTIVITY FACTORS AND WIND FARM LATITUDE

East Anglia Offshore Wind

VATTENFALL

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Appendix 7 - Sensitivity analysis of collision mortality in relation to nocturnal activity factors and wind farm latitude

6th July 2015

Author – MacArthur Green
East Anglia Offshore Wind Limited
Date – July 2015

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1 INTRODUCTION

1. Surveys of seabird fluxes at proposed offshore wind farm sites only record numbers of birds flying through the area during daylight. When using the Band model, this requires some estimate of nocturnal flight activity to be made to estimate total collision risk of seabirds. In the absence of empirical data, it has been suggested that nocturnal flight activity of seabirds should be incorporated into CRM by taking the nocturnal flight activity scores given by Garthe and Hüppop (2004) on a 1 to 5 scale, and transcribing these into 0%, 25%, 50%, 75% and 100% of daytime flight activity level to provide a factor representing the unknown nocturnal flight activity of seabirds as a percentage of the observed daytime level (e.g. as done by APEM 2015).

2. This approach was not anticipated by Garthe and Hüppop (2004), who considered that their 1 to 5 scores were simply categorical, and were not intended to represent a scale of 0 to 100% of daytime activity (not least because the lowest score given by Garthe and Hüppop (2004) was 1 and not 0). This is clear from their descriptions of the scores: for example for score 1 'hardly any flight activity at night'. It is also clear from the highly nonlinear scoring that they used for other factors in their analysis (for example biogeographic population size).

3. Recently however, a number of studies have deployed loggers on seabirds, and data from those studies can provide empirical evidence of the actual flight activity level. Table 1 provides a summary of the tag derived observations with further details provided in the following sections.

Table 1. Hypothetical scenario of auk displacement assessment.

Species	Study	Season	Flight during night (% of time at sea)	Flight during day (% of time at sea)	Nocturnal activity as % of daytime rate	Standard CRM value
Gannet	Garthe et al. 1999	Breeding	0%	55%	0%	25%
	Hamer et al. 2000	Breeding	0%	50%	0%	25%
	Hamer et al. 2007	Breeding	0%	50%	0%	25%
	Garthe et al. 2012	Autumn	0.5-0.8%	30-40%	2%	25%
	Garthe et al. 2012	Winter	<0.5%	26%	<2%	25%
Kittiwake	Hamer et al. 1993	Breeding	0%	-	-	
	Daunt et al. 2002	Breeding	0%	60%	0%	50%
	Kotzerka et	Breeding	0%	35%	0%	50%

Species	Study	Season	Flight during night (% of time at sea)	Flight during day (% of time at sea)	Nocturnal activity as % of daytime rate	Standard CRM value
	al. 2010					
	Orben et al. 2015	Winter	<5%	40%	12%	50%
Lesser black-backed gull	Klaassen et al. 2012	Migration	12%	48%	25%	50%

2 GANNETS

2.1 Autumn and winter

4. Garthe et al. (2012) deployed geolocator loggers on breeding adult gannets on the Bass Rock in 2002, 2003, and 2008. During the peak of autumn migration, in October, birds that were going to remain overwinter in the North Sea or Channel spent a mean of 0.5% of the night in flight. Birds that were migrating to winter off West Africa spent a mean of 0.8% of the night in flight. In autumn, flight activity was highest immediately after sunrise (50% of time in flight) and lowest immediately before sunset (20% of time in flight), with flight activity decreasing approximately linearly over the daylight period. In winter, birds spent even less of the dark period in flight, with a mean of slightly less than 0.5% of the night spent flying.

5. During daylight hours, birds spent more time flying in autumn than in winter, and birds that were migrating to West Africa spent more time flying (40% of daylight hours) than birds that wintered in UK waters (30% of daylight hours flying). In winter, birds spent on average 26% of daylight hours in flight, but with considerable variation between winters and with less flight activity off West Africa than in wintering areas in Europe.

6. From these data we can compare flight activity in gannets at night with the level during the day.

- During autumn migration, flight activity at night (<0.8% of night) compares with 35% of daylight hours in flight; flight activity at night was therefore about 2.3% of flight activity during daylight in autumn.
- Flight activity in winter revealed <0.5% of the night spent in flight, compared with flight activity 26% of daylight hours in winter; flight activity at night was therefore about 1.9% of the level of flight activity during daylight in winter.

7. Flight activity at night of about 2% of the daytime level is considerably lower than the standard rate applied in CRM of 25% based on the Garthe and Hüppop (2004) score of 2 for gannet nocturnal flight activity. The logger data indicate that CRM will overestimate collision numbers when taking 25% as the correction for nocturnal flight when empirical evidence indicates a correction of around 2% for gannets.

8. The logger data from non-breeding adult gannets are considered robust as they are from a large sample size over several winters. The geolocator loggers used are small so are unlikely to have any influence on bird behaviour, and all loggers were recovered from birds that bred successfully in the season following logger

deployment. The low level of flight activity shown by the loggers is consistent with the understanding of gannet natural history; as a visual hunter gannets will not be able to locate fish on which to plunge-dive during hours of darkness, and in the non-breeding season will not need to fly at night to return to nest sites. Gannet migrations are slow compared to migrations of other seabird species (Fifield et al. 2014) and so birds are not under any pressures to migrate during the night.

2.2 Breeding season

9. Garthe et al. (1999) deployed data loggers on chick-rearing gannets in Shetland. The data showed that there was no flight activity during the hours of darkness, but that during daylight hours birds at sea spent 55% of the time in flight and 45% on the sea surface. Hamer et al. (2000) deployed satellite transmitters on chick-rearing gannets at the Bass Rock and also found that there was no flight activity by birds at sea during the hours of darkness. They reported that during daylight hours the birds spent 50% of the time in flight and 50% on the water. Exactly the same results were obtained by deployment of GPS loggers on birds by Hamer et al. (2007).

10. The complete lack of any flight activity at night by birds foraging for chicks was despite the fact that birds were apparently working at maximum capacity and were occasionally leaving chicks unattended, increasing risk of chick mortality (Hamer et al. 2007). Empirical evidence therefore indicates that no adjustment should be made to account for flight activity by gannets at night during the breeding season. This is supported by the latest study reporting on logger deployments on breeding adult gannets. Warwick-Evans et al. (2015) reported on activity of birds from Alderney. They reported that gannets showed some surface-based activity during darkness that they interpreted as foraging while swimming, but that no plunge-diving behaviour was recorded during dark. However, high levels of plunge-diving activity started before sunrise (but after daylight had become available to allow visual foraging). Their results therefore further support the evidence that gannets do not normally fly during the dark, but will fly before sunrise once daylight is becoming available. So definition of 'night' would more appropriately be the hours of darkness rather than time of sunset to time of sunrise.

11. The logger data from breeding adult gannets are considered robust as they are from a large sample size over several years and several different colonies. GPS loggers provide accurate data on position, giving reliable data on flight speed (Hamer et al 2007). It may at first seem odd that gannets show less flight activity during darkness in summer than in winter, since breeding gannets may be under greater pressures to forage and provision their chick. However, darkness during summer is short, and flight is energetically expensive. Therefore, breeding gannets are likely to be at a

metabolic limit when foraging for much of the day. Since they cannot increase flight activity beyond their metabolic limit, it would make sense to fly when foraging success will be high and avoid flight costs at times when foraging success will be low. Therefore, there may be an energetic constraint on flight activity of breeding adults that does not apply during winter. This would explain lower levels of flight activity during dark by breeding birds compared to non-breeding birds either in summer or during winter.

12. The standard rate applied in CRM of 25% of daylight level based on the Garthe and Hüppop (2004) score of 2 for gannet nocturnal flight activity is inappropriate for breeding gannets.

3 KITTIWAKES

3.1 Breeding season

13. From radio-tracking studies of breeding kittiwakes in Shetland in a period when food supply was poor and adults were working to their maximum capacity to feed chicks, Hamer et al. (1993) inferred that adults on foraging trips were roosting on the sea throughout the hours of darkness and displaying no flight activity at night. Daunt et al. (2002) deployed activity loggers on breeding kittiwakes in June at the Isle of May and reported that 'birds did not fly at all during the darkest part of the night', but that during daylight hours the birds at sea spent about 60% of the time flying and 40% on the water. Kotzerka et al. (2010) reported that breeding kittiwakes carrying GPS loggers spent 35% of daylight hours at sea in flight, but that birds on long foraging trips and away from the colony overnight spent 100% of the period of darkness at night resting on the sea surface.

14. Empirical evidence therefore indicates that no adjustment is required to account for flight activity by kittiwakes at night during the breeding season. The standard rate applied in CRM of 50% of daylight level based on the Garthe and Hüppop (2004) score of 3 for kittiwake nocturnal flight activity is inappropriate for breeding kittiwakes, as the empirical evidence indicates 0% flight activity during darkness by breeding kittiwakes.

3.2 Autumn and winter

15. Orben et al. (2015) provide the first published data on kittiwake activity budgets during migration and winter, based on deployment of geolocator data loggers on a large sample of breeding adults at a colony in the Pacific (the study was of both red-legged kittiwakes and black-legged kittiwakes but only the data from the latter species are reported here). Birds spent less than 5% of darkness in flight, and the little flight activity that did occur at night was more often on nights with bright moonlight. During daylight, birds spent about 40% of the time in flight, equivalent to 15% of the 24-hour day. The rest of the time was spent on the water. Nocturnal flight activity of kittiwakes studied by Orben et al. (2015) was therefore very considerably less than the 50% of daylight level used as the standard rate applied in CRM as based on the Garthe and Hüppop (2004) score of 3 for kittiwake nocturnal flight activity.

16. There is some possibility that behaviour of kittiwakes in the Pacific may differ from behaviour of kittiwakes in the Atlantic, so the data from Orben et al. (2015) should be used with caution. However, since the cloud cover over the North Atlantic in

winter is likely to be thicker than over the North Pacific, and since kittiwakes in Orben's study were less active at night when there was little or no moonlight, the flight activity of kittiwakes over the Atlantic in winter is more likely to be lower, rather than higher than reported by Orben et al. (2015).

17. The logger data from breeding adult kittiwakes are considered robust as they are from a large sample size, from several different colonies in different marine regions, in different years. The data from non-breeding birds are also considered robust as they are from a large sample size, although from the Pacific Ocean where environmental conditions could make behaviour differ from that of conspecifics wintering in the North Sea. It may at first seem odd that kittiwakes show less flight activity during darkness in summer than in winter, since breeding kittiwakes may be under greater pressures to forage and provision their chicks. However, darkness during summer is short, and flight is energetically expensive. Therefore, breeding kittiwakes are likely to be at a metabolic limit when foraging for much of the day (as reported for example by Daunt et al. 2002). Since they cannot increase flight activity beyond their metabolic limit, it would make sense to fly when foraging success will be high and avoid flight costs at times when foraging success will be low. Therefore, there may be an energetic constraint on flight activity of breeding adults that does not apply during winter. This would explain lower levels of flight activity during dark by breeding birds compared to non-breeding birds either in summer or during winter.

4 LESSER BLACK-BACKED GULLS

4.1 During migration

18. From a project funded by DECC, the BTO hold data on flight activity of lesser black-backed gulls equipped with GPS loggers at nests in Suffolk and tracked while breeding, as well as throughout their migrations and winter. Flight activity during the day and at night has been examined. However, those data have not yet been published and BTO are unwilling to make the data available until after publication (Chris Thaxter pers. comm.).

19. Klaassen et al. (2012) reported on the migration behaviour of lesser black-backed gulls equipped with GPS satellite transmitters. During migration, birds spent an average of 48% of daylight hours in flight, and 12% of the night in flight. Flight activity decreased from about 25% of the time early and late during the night to zero at the darkest period of the night. Flight activity was lowest on days when the migration distance travelled was least, and was highest when birds made long migratory flights. This would suggest that flight activity at night would be likely to be lower when the birds are not migrating, but the same is probably true of daytime flight activity. Flight activity at night averaged 25% of the level seen in the same birds during daylight. Nocturnal flight activity of lesser black-backed gulls studied by Klaassen et al. (2012) was therefore considerably less than the standard rate applied in CRM of 50% of daylight level based on the Garthe and Hüppop (2004) score of 3 for lesser black-backed gull nocturnal flight activity.

20. Our biological understanding of nocturnal flight activity of large gulls is not good. It is known that breeding gulls tend to sleep at night at their breeding territory. This even applies in Arctic colonies where there is daylight during the night. Larus gulls can be active at night when feeding on storm petrels or Manx shearwaters, although that activity may be mainly close to sunset and sunrise. Larus gulls tend to roost at night, either on the sea surface or on remote (predator-free) islands. However, they may fly around fishing vessels at night during winter, perhaps especially when those vessels have lights to allow them to feed visually by artificial light.

5 HERRING GULL AND GREAT BLACK-BACKED GULL

21. There have been surprisingly few studies that have deployed loggers or GPS tracking devices on herring gulls or great black-backed gulls and apparently no relevant activity data have been published. Analysis of raw data (if available) to derive flight activity data would require a non-trivial amount of work and time (probably taking at least a year to complete). However, as a first approximation, the relationship between nocturnal and daytime flight activity of herring gulls and great black-backed gulls is likely to be similar to that in lesser black-backed gulls, as all three species forage in broadly similar ways. All three were given the same nocturnal flight activity score (of 3) in Garthe & Hüppop (2004) and Furness et al. (2013).

6 CONCLUSIONS OF NOCTURNAL ACTIVITY REVIEW

22. We consider that it would be more appropriate to carry out Collision Risk Modelling using the empirical data on nocturnal flight activity reviewed above, rather than the arbitrary percentages previously suggested by Natural England. We recommend use of the values in Table 2.

Table 2. Recommended nocturnal flight activity percentages for use in collision risk modelling.

Species	Nocturnal flight activity as % of daylight flight activity by non-breeding birds	Nocturnal flight activity as % of daylight flight activity by breeding birds
Gannet	2%	0%
Kittiwake	12%	0%
Large Larus gulls	25%	25%*

*Precautionary value that probably overestimates nocturnal flight activity but is suggested because there is a lack of empirical data to give a more appropriate value.

23. We would welcome dialogue as to how this could be applied across other projects to inform cumulative/in combination assessments.

7 COLLISION MODELLING SENSITIVITY ANALYSIS

24. To aid understanding of how reductions in nocturnal activity affect collision mortality estimates in relation to month and latitude a sensitivity analysis was conducted as follows:

- Seabird density was kept at a constant value in all months;
- Two wind farm locations were used, located in the Moray Firth (58.25°N) and adjacent to the Isle of Wight (50.45°N);
- The same wind farm parameters were used in both locations;
- Three species were simulated (gannet, kittiwake and great black-backed gull);
- Nocturnal activity scores were adjusted down by 1 point on the 1-5 scale used in the collision model;
- All other parameters were kept at fixed values throughout.

25. The results of this analysis are presented in Figure 1 and Table 3 and are summarised as follows:

- The reduction in collision mortality observed with a reduction in nocturnal flight activity is due solely to the reduced amount of time birds are at risk, therefore the effect is consistent across species (i.e. bird size and percentage at flight height have no effect on the results);
- The reduction in collision mortality with reducing nocturnal flight activity is greatest in mid-winter and least in mid-summer, reflecting the relative durations of day and night;
- The difference between wind farms located in the north of Scotland and the south of England is smaller than that for month, although the difference between summer and winter is greater for northern sites;
- Reducing flight activity from class 2 to 1 (25% to 0%) has a greater reductive influence than from class 3 to 2 (50% to 25%), although this difference is most pronounced in mid-winter and virtually absent in mid-summer. This is due to the seasonal variation of adding variable day length to the reciprocal period of night multiplied by a constant proportion (of nocturnal activity).

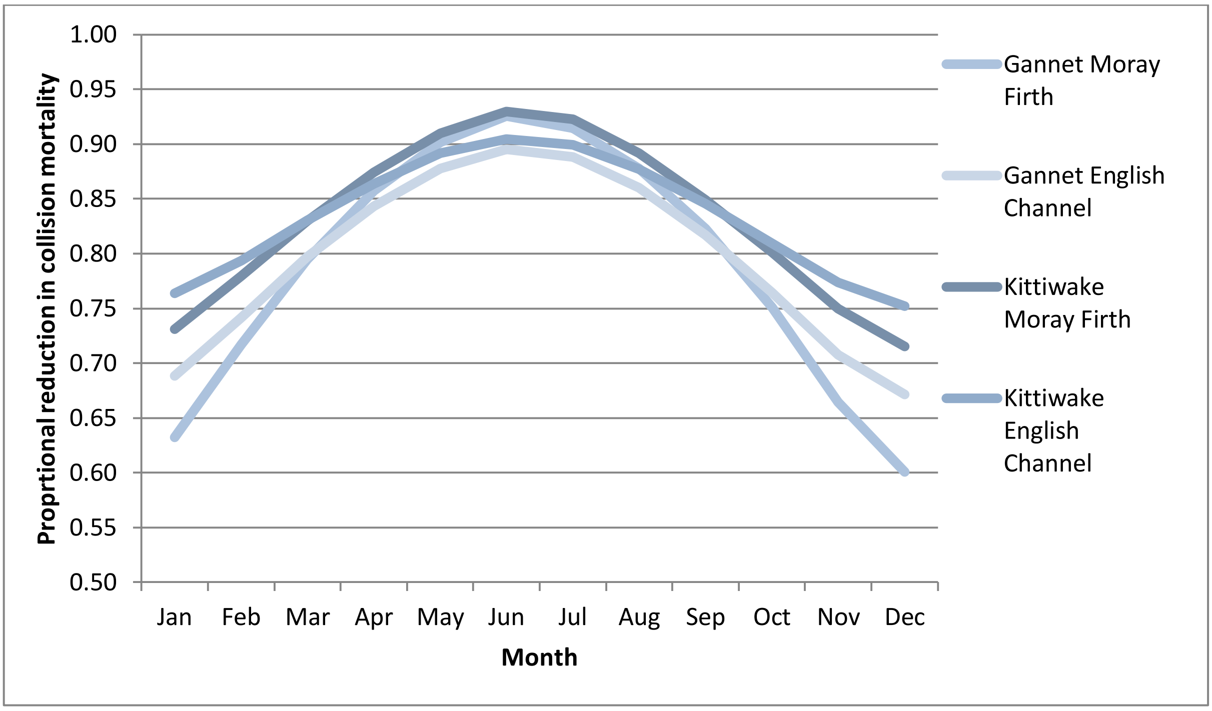

Figure 1. Ratio of collision estimates obtained using current nocturnal flight activity scores (gannet: 2, kittiwake: 3) to those obtained with scores reduced by 1 (gannet: 1, kittiwake: 2) at simulated wind farms in the Moray Firth and the English Channel. Results for great black-backed gull are not shown to aid clarity as these overlap with those for kittiwake (ratio 1:2) and gannet (ratio 2:3; see Table 3).

26. The magnitude of reduction in collision risk obtained with reduced nocturnal flight activity is most dependent on the time of year when birds are present, with the effect greatest when the night is longest (i.e. mid-winter). Therefore, to calculate annual collisions at a lower rate requires a monthly breakdown of collision estimates. However, as a precautionary first step the minimum collision mortality reduction observed during mid-summer (e.g. 7%) could be applied to all wind farm collision estimates to reflect a reduction of 1 point on the 1 to 5 score.

Table 3. Comparison of monthly collision mortality estimates at different nocturnal flight activity scores. In all cases the wind farm data remained the same. The ratio of the lower score to the higher is provided. For gannet and kittiwake 2 rates are presented (2 and 1, 3 and 2 respectively). For great black-backed gull rates of 3, 2 and 1 are presented.

Species	Region	Latitude	NAF	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gannet	Moray Firth	58.25	2	419	431	545	596	682	697	704	645	558	506	426	401
			1	265	309	433	511	615	645	644	566	459	380	283	241
			Ratio (1:2)	0.632	0.717	0.794	0.857	0.902	0.925	0.915	0.878	0.823	0.751	0.664	0.601
	English Channel	50.45	2	456	449	547	581	647	650	661	621	552	518	455	444
			1	314	333	436	490	568	582	587	534	451	396	322	298
			Ratio (1:2)	0.689	0.742	0.797	0.843	0.878	0.895	0.888	0.860	0.817	0.764	0.708	0.671
Kittiwake	Moray Firth	58.25	3	621	598	711	738	810	811	825	783	710	683	615	607
			2	454	466	590	645	737	754	761	698	603	547	461	434
			Ratio (2:3)	0.731	0.779	0.830	0.874	0.910	0.930	0.922	0.891	0.849	0.801	0.750	0.715
	English Channel	50.45	3	647	611	713	727	784	777	795	766	706	692	636	638
			2	494	485	592	628	699	703	715	672	597	560	492	480
			Ratio (2:3)	0.764	0.794	0.830	0.864	0.892	0.905	0.899	0.877	0.846	0.809	0.774	0.752
Great black-backed gull	Moray Firth	58.25	3	1663	1603	1906	1978	2170	2172	2212	2100	1903	1830	1648	1628
			2	1216	1249	1580	1729	1976	2020	2039	1870	1616	1466	1235	1162
			1	768	895	1254	1480	1782	1869	1866	1641	1330	1102	821	697
			Ratio (2:3)	0.731	0.779	0.829	0.874	0.911	0.930	0.922	0.890	0.849	0.801	0.749	0.714
			Ratio (1:2)	0.632	0.717	0.794	0.856	0.902	0.925	0.915	0.878	0.823	0.752	0.665	0.600
	English Channel	50.45	3	1734	1637	1910	1947	2102	2081	2130	2053	1892	1854	1705	1711
			2	1323	1300	1586	1683	1874	1884	1916	1800	1600	1501	1320	1287
			Ratio (2:3)	0.763	0.794	0.830	0.864	0.892	0.905	0.900	0.877	0.846	0.810	0.774	0.752

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13.1.13 Minutes of Ornithology ETG 6 Meeting

15. Provided below are the minutes of the sixth Ornithology ETG meeting

East Anglia Offshore Wind Limited - East Anglia THREE

East Anglia THREE, Ornithology ETG Meeting 6 – 06/07/15

Attendees		
Name	**Initials**	**Organisation**
Marcus Cross	MC	EAOW (video)
Holly Cartwright	HC	EAOW
Claire Ludgate	CL	Natural England
Lou Burton	LB	Natural England (phone)
Tim Frayling	TF	Natural England
Jacqui Miller	JM	RSPB (phone)
Sarah Lee	SL	RSPB
Sue Hooton	SH	SCC (phone / joined section 2 and 10)
Mark Trinder	MT	MacArthur Green
Paolo Pizzolla	PP	Royal HaskoningDHV
Apologies	Keith Morisson	

AGENDA		
Item	**Description**	**Action**
1	Health and Safety – HC Introductions - All	n/a
2	Finalised onshore construction mitigation provides required clarity and detail for Natural England to agree no risk of significant impacts will occur. (Slide 3) MC – this restriction would be captured in SoCG and would be a condition within the DCO TF – this is welcomed. 1) are these dates appropriate? 2) is intrusive activities adequate? MC – intrusive seems to cover any actual construction LB – from the EA1 hearings there was an understanding that there would no be works over consecutive winters, NE position hasn't changed. EATL need to set parameters around this to clarify what will and will not be undertaken in consecutive winters. JM – (*post-meeting clarification*) also concerned about this issue; a commitment to avoid consecutive winter work in the section between the east bank of the Deben and Queens Fleet may provide some comfort. Can this or a similar commitment be made? MC: Highlighted that this was not EAOW understanding prior to the hearings and we never agreed with NE position	

	SH – could we use the definition of activity from EA1? *"If potentially disturbing construction works take place within all or part of the period September to March inclusive then the two additional measures set out below will be implemented. Potentially disturbing construction works are defined as those operations during the construction phase that produce percussive noises (short, sharp, loud and resembling gunshot) such as earth moving and tipping and/or require construction workers to operate from outside of vehicles potentially in sight of Brent Geese. Operations excluded from that definition include the use of the haul road to transport workers and materials between locations along the route of the onshore works."* MC – the only activities we propose undertaking during the restricted period would be walk-over surveys that would potentially be excluded if we accepted the EAOL condition. PP – could we turn this around, defining what we *can* do e.g. 'no works would be permitted other than vehicular access and walk-over survey" JM - (*post-meeting clarification*) support the proposed time period for the restriction in this definition, but agree that consideration should be given to whether it is preferable to define allowable activities, and all other activities would be excluded, as discussed below. LB – can we define the number of visits? MC – EATL will need to discuss this with the project engineers and will look at potential re-wording TF – are the dates for the proposed restriction appropriate (i.e. November to the end of February) MC – looking at the site specific evidence, yes the dates are appropriate TF - agreed	ACTION – EATL to look at the definition of the potential activity again ACTION – All agree that the dates proposed will be used for the restriction
3	SPA features identified in the updated screening report are the only ones for which HRA will be required. (slide 5) MT – EATL have added back in the two features as discussed at the last meeting (i.e. red throated diver (Outer Thames estuary) and kittiwake (Flamborough and Filey)) TF – agreed the SPA features identified screen into the HRA are appropriate	ACTION – All agree the following features and sites are screened into to HRA • **Deben Estuary SPA** (dark-bellied brent goose); • **Outer Thames Estuary** SPA (**red-throated diver**); • **Alde-Ore Estuary SPA** (lesser black-backed gull);

	JM – noted that the Screening document needs to be updated in all cases to reflect the change for consistency (para 66, appendix 1) and agree with the SPA features identified as screened into the HRA.	• **Flamborough and Filey Coast pSPA** (gannet, **kittiwake**). ACTION – ensure HRA screening is consistent
4	Updated gannet collision nos. are correct, use of SOSS-04 Gannet PVA report is appropriate and cumulative mortality is not significant. (Slide 6 - 10) TF – is this the correct figure for EA3? Does EATL have confidence in the flight heights? (this is in reference to the point made in the letter sent with response to OETG5 minutes) – need to justify the PCH figure MT – EATL have been in touch with Apem, a response will be sent through covering all the points in the letter TF – appreciate the figures are being updated and this is unlikely to materially change the assessment as EA3 makes a small contribution to the cumulative total. TF – broadly agreed with the collision figures, would like to see the excel band model spreadsheet for the various options JM (*post-meeting clarification*) Whilst the RSPB accept the recently recommended amendment to gannet avoidance rate (from 98% to 98.9%) for non-breeding birds, we do not agree that this figure should be applied to the breeding season due to the lack of available evidence relating to breeding birds. We therefore consider that an AR of 98% should be presented (alongside a range of figures from 95% to 98.9%). MT – SOSS gannet PVA was used to look at significance. Key output is that 95% of simulations had positive growth until additional mortality >3,500 which is higher than the revised cumulative total that we currently have for collisions. In addition the PVA is based on the 2004 population, the population is now known to be 30% larger – therefore the threshold at which additional mortality will cause the lower 95% confidence interval to reach 1 will now be up to a third higher. Therefore cumulative impact is not significant. 1 – does this make sense? TF – understands the logic, in principle this is correct. MT – this shows that there is little justification for undertaking any new modelling TF – NE would not request any new modelling JM – logic straight-forward	ACTION – EATL to respond to NE letter of 26th June ACTION – circulate the spreadsheet covering all Band models AGREED – no requirement for new modelling

	2 – do you agree on the significance TF - Agree project alone is not significant, not sure that the cumulative can be ruled out JM - (*post-meeting clarification*) **Project alone impacts** - Due to the low number of birds present at EA3 in the breeding season position remains that collision mortality is unlikely to be significant for EA3 alone in terms of the population considered under EIA. JM - *(post-meeting clarification)* **In-combination impacts -** We note that ARs have been altered retrospectively for other OWFs. As noted above, we do not agree with the change to AR for birds present in the breeding season, however, based on the figures presented, it is unclear whether this affects the figures significantly. We would therefore like to see in–combination mortality figures presented for the breeding season, as well as the autumn period, so that the contribution of the different seasons to total annual mortality can be determined. JM - (*post-meeting clarification*) **HRA -** For clarity we note that we our comments at this stage relate to significance of effects on populations considered under EIA. As stated at the meeting, we are keen to see collision mortality, both for the project alone and in-combination, attributed to SPAs. Our position on significance of effects on these populations will be determined following provision of the relevant data.	
5	Updated kittiwake collision numbers are correct, proposed PVA methods are appropriate and preliminary results indicate that cumulative mortality is not significant. (Slide 11 – 15) MT – do you agree with the figures TF – NE would like to review figures, does not agree that cumulative impact is not significant MT – has used BDMPS seasons which may account for differences in numbers from Dogger Bank Teesside. JM - (*post-meeting clarification*) there is inadequate empirical basis for the density dependent model to *replace* the density independent model and instead we recommend that both are presented and assessed. MT – outlined the PVA he has developed for interpreting impact a the BDMPS scale and note that the figures have been updated (presentation correct, papers have been corrected)	ACTION – check definition Assessment methods indicate the following summary of impact assessment:

	1 – Does logic make sense? TF - understands the logic, in principle this is correct. 2 – do you agree on the significance SL – RSPB would find the worst case worrying. MC – this is highly unlikely TF – NE find 2-3% potentially worrying, MT – most of this impact is already happening as it is due to other projects and EA3 contribution alone is negligible. TF – cannot say that the cumulative impact is not significant. Confident that alone this is not significant. MC – need to check back with regard to what we have said 'significant' will be within the EIA methodology TF - Agree that the project alone is not significant but have some concerns about concluding non-significant cumulatively JM – cannot agree that cumulative impacts are not significant at this stage MC: We will consider the appropriate wording and make suggestions in the SoCG JM – will the impact be apportioned to SPAs for the HRA? MC – will have to apportion for the in-combination MC – do you have general concern regarding kittiwake JM – not for EA3 only, in-combination looks like it could be a concern – for the Flamborough colony TF – Flamborough kittiwake are screened in therefore this will be addressed in the HRA	**Sensitivity -** rank derives from tolerance to disturbance: High = very limited tolerance Medium = limited tolerance Low = some tolerance **Conclude – low to medium sensitivity.** **Conservation value** - rank derives from SPA connectivity: High = clear connectivity Medium = probable connectivity, but non-SPA connected too Low = no SPAs for species or no predicted connectivity **Conclude – Medium conservation value.** **Magnitude** – rank derives from population impact High = irreversibly alter population and alter long term viability, >5 yrs to recover Medium = no effect on long term viability, recovery with 5 years Low = no long term harm, <1 year to recover **Conclude – Medium magnitude** **Combined these give an impact due to cumulative mortality of minor to moderate significance.**
6	Evidence base for cumulative gull collisions provides appropriate level of comfort to conclude that current totals are below previously consented levels. MT – slide 16 provides a summary of the cumulative totals for 4 gull species (sources and numbers).	

	Comparing the consented totals and EA3 totals, all current totals are below what has been agreed. TF – yes this makes sense and follow logic of the argument JM – yes, subject to confirming the numbers	
7	Following a review of methods, it is concluded that the existing approach for assessing displacement (based on peak season) remains precautionary and appropriate. Alternatives introduce considerable uncertainty due to population overlaps, although could base on highest proportional abundance rather than highest absolute abundance. (Slide 17) MT – has TF position changed on this? TF – recognises the points made and that summing seasons precautionary and involves double counting. However, NE would still like EATL to provide an annual figure by summing across seasons and use the highest BDMPS population MT – if we do this the population against which considered should be the biogeographic population not the highest BDMPS, to avoid risk of double counting TF – will consider which population against which impacts should be measured further MT – which mortality levels should be used? TF – there is no evidence for what should be used, therefore present a matrix with a range JM/SL -(*post-meeting clarification*) agree that mortality should be loaded onto seasonal peak numbers, for species present primarily during non-breeding periods. However, this approach should be considered on a species by species basis. For example, where reasonable numbers of an individual species are present during the breeding season it may be appropriate to consider the potential impacts on these birds (and their survival/productivity) even if this does not represent the highest proportion of the seasonal BDMPS population.	ACTION – TF to consider which baseline population is appropriate for this assessment
8	Nocturnal activity factor sensitivity review indicates a precautionary minimum reduction of 7% should be applied to all collision mortalities for a reduction of 1 level (e.g. from level 3 to 2). MT – it would be possible to recalculate collision for all spp. at all sites LB – have any other OWFs done this? MT – this was an exercise undertaken by McArthur Green	

	TF – how do EATL intend to use this information – will it be added to the narrative or will the collision numbers be reduced? MT – the report will be a technical appendix, this will be referred to in ES as context for why the cumulative collision numbers are precautionary MC – EATL have not yet decided how to present this information in the ES. It is worth considering that if CIA is majorly influenced by wintering impacts that this could be very important – i.e. longer nights in winter TF – would like to get a joint SNCB position MC – The technical report can be circulated to SNCBs MC – EATL reserve right to use this in the ES JM - (*post-meeting clarification*) For gannet and kittiwake, the sample size is reasonably large and uses data from more than one study. An adjustment in nocturnal activity rates (breeding/non-breeding) is justified for these species. For large gulls, the sample size is small (14 individuals) and uses data from just one study for one species (LBBG). An adjustment in nocturnal activity rate is NOT justified for large gulls. JM - (*post-meeting clarification*) We cannot agree the proposed reduction in flight activity of 7% for gannet and kittiwake at this stage. The derivation of this figure should be more clearly supported before it can be used. As the degree of adjustment for large gulls is not supported by a strong evidence base we do not consider it will be possible to apply any reduction in collision estimates for these species.	ACTION – TF to circulate the report within the SNCBs (Mig-bird)
9	SL – RSPB noted from the s42 Phase III report that there may be increased vessel numbers with a Two phased approach to construction PP – The point about vessel numbers is that if the Two Phased approach is taken there will be losses of economies of scale and it is likely that many more trips overall would be required to construct the project (7600 trips for Two Phased compared to 5700 trips for Single Phase) however the majority of this difference would be within the windfarm. For the cable route, however, under either approach the cabling operations last for a total of 22 months (or 2 x 11 months) and each approach would have two vessels laying cables at any one time. Therefore with regard to the SPA there would be little difference in any disturbance effects from cabling laying vessels	ACTION – explain the vessel numbers within the ES
10	**Document review** EATL will supply the HRA documents by 27th July – NE	

	to return by 14th August – there is no time to review the ES chapter. DML / DCO – potential for workshop w/c 10th August **Evidence plan documents** PP – suggested that for the presentation of the evidence plan documentation we include the overarching paper from each meeting together with the finalised minutes. Appendices will only be included if these are not reproduced in some form within the ES or HRA documents. There will be a cover sheet explaining that Appendices have been a work in progress and these have been updated with agreed figures/baseline populations etc and are included in the ES chapter appendices. This will reduce the materials submitted and prevent confusion over superseded parts of the assessment. LB / SL - Agreed	
11	AOB None raised	

Agreement log

ID	Issue on which EATL seek agreement on	NE Position	RSPB Position	SCC
	OETG6			
	That the wording of the proposed restriction at the Deben is appropriate No intrusive construction activities between the Queens Fleet and the HDD compound on the east bank of the Deben Estuary crossing. Intrusive activities are those that are directly required to construct or reinstate the haul road, jointing pit and use of plant associated with the pull-through. Activities excluded from this restriction include walk over site investigation works and vehicle access.	*Clearer wording required particularly with regard to activities over multiple winters*	*Work in consecutive winters should be avoided between the Deben east bank and Queens Fleet. We agree that works potentially causing disturbance should be avoided during September to March inclusive and recommend that further consideration is given to the definitions used.*	*Clearer wording required particularly with regard to activities over multiple winters. Could wording be aligned with that agreed for EA1*
	SPA features identified in the updated screening report are the only ones for which HRA will be required. • **Deben Estuary SPA** (dark-bellied brent goose); • **Outer Thames Estuary** SPA (**red-throated diver**); • **Alde-Ore Estuary SPA** (lesser black-backed gull); • **Flamborough and Filey Coast pSPA** (gannet, **kittiwake**).	*Agreed*	*Agreed*	*Agreed*
	Updated gannet collision nos. are correct, use of SOSS-04 Gannet PVA report is appropriate and cumulative mortality is not significant.	*Agree that the method is correct in principle* *Project only impact is non-significant*	*We disagree with the use of a 98.9% AR during the breeding season.* *Project only impact is non-*	*n/a*

		Reserve judgement on the significance of impact	*significant for populations considered under EIA* *Reserve judgement on the significance of impact in-combination* *Attribution of mortality to SPAs is required*	
	Updated kittiwake collision numbers are correct, proposed PVA methods are appropriate and preliminary results indicate that cumulative mortality is not significant.	*Agree that the method is correct in principle* *Project only impact is non-significant* *Reserve judgement on the significance of cumulative impact*	*Agree that the method is correct in principle but consider that density independent outputs should be retained and assessed along with density dependent outputs* *Project only impact is non-significant for populations considered under EIA* *Reserve judgement on the significance of cumulative impact* *Attribution of mortality to SPAs is required*	*n/a*
	Evidence base for cumulative gull collisions provides appropriate level of comfort to conclude that current totals are below previously consented levels.	*Subject to confirming the numbers used, would agree that the totals are lower*	*Subject to confirming the numbers used, would agree that the totals are lower*	*n/a*
	Following a review of methods, it is concluded that the existing approach for assessing displacement (based on	*NE would like to see monthly numbers and will respond on the*	*Agree that mortality should be loaded onto seasonal peak*	*n/a*

	peak season) remains precautionary and appropriate. Alternatives introduce considerable uncertainty due to population overlaps, although could base on highest proportional abundance rather than highest absolute abundance.	*appropriate population baseline for assessing the impact*	*numbers, for species present primarily during non-breeding periods. However, this approach should be considered on a species by species basis - where reasonable numbers of an individual species are present during the breeding season it may be appropriate to consider the potential impacts on these birds (and their survival/productivity) even if this doesn't represent the highest proportion of the seasonal BDMPS population.*	
	Nocturnal activity factor sensitivity review indicates a precautionary minimum reduction of 7% should be applied to all collision mortalities for a reduction of 1 level (e.g. from 3 to 2).	*There is no agreed SNCB position on how to use this information at the current time.*	*We cannot agree the proposed reduction in flight activity of 7% for gannet and kittiwake at this stage. The derivation of this figure should be more clearly supported before it can be used.* *As the degree of adjustment for large gulls is not supported by a strong evidence base we do not consider it will be possible to apply any reduction in collision estimates for these species.*	*n/a*
	OETG5			

	That use of season definitions and minimum population sizes is appropriate	*Agree*	*Agree*	
	That potential phasing of construction of offshore components has little / no bearing on assessment	*Agree*	*Would like to see more detail re factors which could increase displacement of red-throated diver, e.g. increase in vessel numbers (as noted in the Phase 3 consultation)*	
	That approach for assessing displacement (alone and cumulative) is appropriate and outputs do not indicate significant impacts	*NE recommend summing the seasonal displacement outputs– noting the caveats in (6) above namely* • *EATL to include full tables of ranges of displacement* • *There needs to be a consideration of how to determine annual mortalities* • *Red throated diver assessment to use a flat displacement rate across buffer*	*Agree – subject to caveats noted by NE (as left)* • *EATL to include consideration of Sizewell C in CIA for red-throated diver*	
	That approach for assessing collision risk (alone and cumulative) is appropriate and outputs do not indicate significant impacts	*Agree with following caveats* • *EATL to provide confirmation of source of cumulative numbers* • *If the argument is made that impacts below previously consented totals are acceptable, the full referencing /audit trail must be provided*	*We will comment on this point once we have seen the PVA outputs for gannet and kittiwake. We also support NE's comments (as left)*	

	That impacts are of such small magnitude that population modelling (PBR or PVA) is unnecessary **EATL will undertake PVA for kittiwake and use SOSS-04 gannet report**	*Agree with following caveats* • *PVA required for gannet & kittiwake*	*Agree that PVA is required for gannet and kittiwake*	
	That gannet avoidance rate is likely to be >98.9% and this should be reflected in the assessment **EATL is no longer challenging the 98.9% AR**	*Advise continue to use 98.9% AR for gannet with Basic Band Model Option 1 and 2 , and outputs calculated using i) mean AR and ± 2 SD and ii) mean, upper and lower 95% CLs of flight density data by month;*	*N/A*	
	That revised collision estimates for East Anglia ONE should be used in the CIA	*Agree*	*Agree*	
	That nocturnal activity factor used in CRM is overestimated and that use of evidence based values is appropriate for the assessment. However, the intention is not to re-work the CRM figures but to provide additional text	*Agree – NE will discuss this matter further with SNCBs if nocturnal activity factors are amended*	*Cannot agree at this stage. We agree that this may provide useful context within the narrative (as noted in the minutes), but consider that it is too early to use this in the assessment.*	
	That the SPA features identified in the screening report are the only ones for which HRA will be required.	*Agree with following caveats* • *Red throated diver (Outer Thames Estuary SPA) screened in* • *Kittiwake (Flamborough and Filey Coast) screened in*	*Agree with following caveats* • *Red throated diver (Outer Thames Estuary SPA) screened in* • *Kittiwake (Flamborough and Filey Coast) screened in*	

	OETG4			
	Discussions focussed on points raised on the detail of the PEIR assessments, the meeting worked through points provided as a draft response to the PEIR by Natural England.	*All points were captured in the final Natural England response to the Section 42 consultation (8th July 2014).*		
	OETG3			
	Discussion surrounded detail of assessments, no agreement as continuing actions.			
	OETG2			
1	**From OETG2 Paper** **Para 30**. Agreement, based on the information supplied at OETG Mtg 1, is sought on: • Sufficient offshore and onshore baseline survey data has been collected to inform the assessment. • No additional survey required for the offshore or onshore cable route (the additional targeted brent goose surveys are not related to baseline information gathering). • Existing onshore data will be augmented with new WeBS data recorded at greater spatial detail and an additional brent goose survey. • Natural England to supply (if it can be made available) its	Agree Agree – with exception of additional brent goose work Agree TBC	*Agree that 18 months of continuous survey data are sufficient.* *Agree that sufficient baseline information already exists* *Agree that this approach is acceptable* *Support the use of NE RTD data within assessment*	

	Outer Thames Estuary RTD survey data to augment the existing offshore cable route data (**Note for inclusion in PEI these data must be supplied by January 2014**)			
	Para 31. Agreement, based on the updated information supplied at OETG Mtg 2, is sought on: • Biological periods – agreed in principle subject to working up the figures	Need for nuanced approach agreed in principle.	*We are satisfied in principle with the revised Biological periods table supplied for OETG Mtg 2*	
2	**Section 4** Agreement of the impacts to be assessed as listed in Section 4.1 (offshore) and 4.2 (onshore)	Agreed	*We support the change to the impacts in Section 4.1 suggested by NE. The operational impacts will also need to include in-combination/ cumulative impacts.*	
3	**Data** Mean peaks shall be used unless there is great disparity between years, in which case contextual data will be consulted for justification of numbers used	Agree in principle but note requirement to present each year's monthly peaks separately (in appendix?) to enable any large discrepancies between years to be identified	*This approach is acceptable.*	
4	**Data** Flight height methodology Agree that the methodology for determining flight height from aerial imagery is a general matter outside of the EP process, NE and APEM to discuss outwith EP meetings	Agree	*We would like to be consulted on any methodology for flight height agreed between NE and APEM.*	
5	**Assessment methodologies – terminology** EAOW will look again at magnitude definitions, but this is not critical to agreement All accept that 'very high' category for sensitivity/magnitude	Agree to need for further consideration of wording to define categories of magnitude. Agree	*We consider revised magnitude definitions are a major improvement. However, they still require some refinement in line with comments of NE and*	

	adds little to assessment and this will not be used		*RSPB at OETG Mt 2.*	
	OETG1	*Note that NE did not provide responses to the minutes prior to OETG2, these responses were added in OETG2*	*Responses provided – 9/11/13* *The RSPB's position is made in relation to the information available to us at this time. However, we reserve the right to alter our position to East Anglia 3 & 4 should new information (i.e research and data) become available which significantly alters the situation.*	
1	**ONSHORE**			
	Data			
	Sufficient baseline survey data have been collected to inform the assessment	Happy with approach in document, that is when these 5 onshore elements are taken together	No the RSPB considers that further survey work will be required in regard to Brent Geese.	
	No additional survey required for the cable route	Happy with approach in document, that is when these 5 onshore elements are taken together	The RSPB supports NE's position on this issue.	
	Existing baseline data will be augmented with new WeBS data	Happy with approach in document, that is when these 5 onshore elements are taken together	The RSPB supports the use of the latest WeBS data to augment the baseline data.	
	If possible new WeBS data to include greater detail on location of birds within the large WeBS count sectors	Happy with approach in document, that is when these 5 onshore elements are taken together	The RSPB agrees in principle that a more detailed understanding of the location	

			of birds on the Deben is essential. However, we will need to see the details of what has been agreed with the BTO before we can make any further comments. *	
	EAOW to undertake additional brent goose survey (winter 2013/2014)	Happy with approach in document, that is when these 5 onshore elements are taken together	The RSPB supports the additional Brent Goose survey being undertaken during the winter of 2013/14.	
	Species			
	Likely species for assessment listed in App 7 & 8	OK	The RSPB agrees with NE's advice on this issue.	
	Species to be selected for assessment on basis that are listed features of Deben Estuary SPA and SSSI or are Schedule 1 breeding species	OK	The RSPB supports this approach	
	Assessment will include both listed features and relevant assemblage species	OK	The RSPB supports this approach	
	Impacts			
	The following impacts will be assessed • Construction 　• Disturbance / Displacement • Operation 　• High-level assessment • Decommissioning 　• Disturbance / Displacement	OK	The RSPB agrees that the impacts proposed for assessment are appropriate.	
2	**OFFSHORE**			
	Data			
	Sufficient baseline survey data have been collected to	OK	The RSPB agrees that 24	

	inform the assessment (24 months of aerial for each site)		months of aerial surveys will provide sufficient baseline data, provided that the data set is continuous and there are no gaps.	
	No additional survey required for the cable route	OK	The RSPB supports NE's position on this issue	
	NE's Outer Thames Estuary RTD survey data will be used if it can be made available	RC happy in principle	The RSPB supports the use of the Red Throated Diver survey data	
	EA ONE and Zone data will be used as contextual information where relevant	OK	The RSPB agrees that using EA1 and zone data as contextual information could be useful.	
	Data analysis			
	Population estimates will be design based but more sophisticated modelling will be applied if the data warrants it and the modelling approach is acceptable	OK	The RSPB supports this approach	
	Flight parameters [awaits information on how flight height method has been validated]	Not part of EP process (APEM and NE, RSPB to deal with)	The RSPB supports NE's position on this issue.	
	Species			
	Species specific bio-periods [awaits feedback from NE to create new bio-period table]	For OETG2	The RSPB supports NE's advice on the bio-period table	
	If a species falls under any one of these criteria it will be taken forward in the assessment: 1) population of regional importance or greater. 2) adult seabirds within maximum foraging distance of SPA or SSSI with that species as interest feature 3) migration modelling shows connectivity and numbers occurring are significant (irrespective of collision risk).	*The proposal will not screen out spp prior to migration modelling, model run using BTO/SoSS and screen on that list* *Assumption <1% of regional population = not significant, based*	The RSPB agrees in principle that the criteria being used are appropriate, However, we would like clarification about point 3, in particular how 'significant' is being defined.	

		upon the BTO approach to definition of migrant populations (waders/waterfowl), still need to define for seabirds – modified migration method approach (awaiting the Scottish methods) ***Action for NE (RC) to look at SNH project and feedback as to whether appropriate***		
	Impacts			

	The following impacts will be assessed
	• Construction
	    • Disturbance / Displacement
	    • Indirect through prey species
	• Operation
	    • Disturbance / Displacement
	    • Indirect through prey species
	    • Collision risk
	    • Barrier effect
	• Decommissioning
	    • Disturbance / Displacement
	    • Indirect through prey species
		OK	The RSPB seeks clarification about whether the assessment will include cumulative, in-combination and transboundary impacts.
			Once this has been clarified then we will be able to provide our position.	

Appendix 13.1 Ends Here