East Anglia
Offshore Wind

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SCOTTISHPOWER RENEWABLES

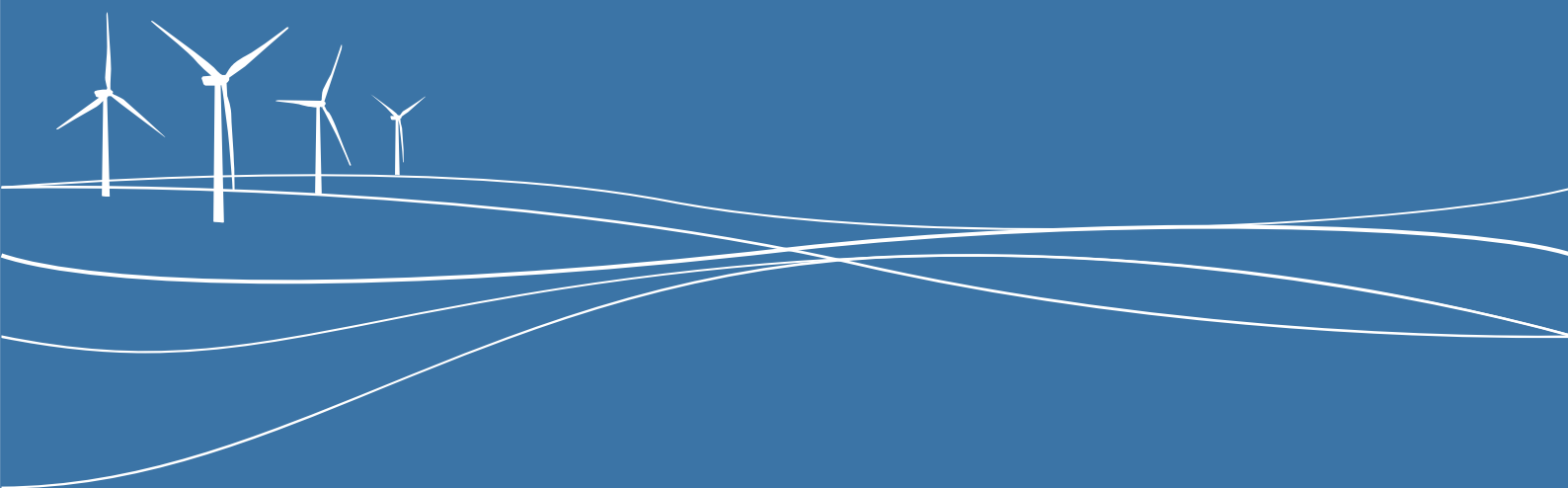
East Anglia THREE

Appendix 12.1

Marine Mammals Evidence Plan

Environmental Statement
Volume 3
Document Reference – 6.3.12 (1)

Author – Royal HaskoningDHV
East Anglia THREE Limited
Date – November 2015
Revision History – Revision A



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12.1 MARINE MAMMALS EVIDENCE PLAN

12.1.1 Introduction

1. This Appendix contains a number of documents which form the Evidence Plan for Marine mammals, these are:

- Evidence plan Marine Mammals Expert Topic Group (ETG) meeting 1- including all documents discussed at this meeting held on the 13th September 2013. Section 12.1.2.
- Evidence plan Marine Mammals ETG meeting 2- including all documents discussed at this meeting held on the 15th November 2013. Section 12.1.3
- Evidence plan Marine Mammals ETG meeting 3- including all documents discussed at this meeting held on the 2nd April 2014. Section 12.1.4
- Evidence plan Marine Mammals ETG meeting 4- including all documents discussed at this meeting held on the 3rd July 2014. Section 12.1.5
- Evidence plan Marine Mammals ETG meeting 5- including all documents discussed at this meeting held on the 6rd June 2014. Section 12.1.6

2. 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 Therefore the timelines and parameters given in section 12.1.2 are now out of date. Furthermore, 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.

12.1.2 Marine Mammals ETG Meeting 1: 13th September 2013

3. Provided in section 12.1.2 are the following documents produced for the 1st Marine Mammal ETG meeting:

- Marine Mammals Evidence Plan Method Statement.
- Minutes of meeting.
- Email agreement of minutes.

12.1.2.1 Marine Mammals Evidence Plan Method Statement.

4. Provided below is the method statement which was circulated to attendees prior to the first East Anglia THREE Marine Mammals Expert Topic Group (ETG) meeting held on the 13th of September 2013.

East Anglia
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SCOTTISHPOWER RENEWABLES

East Anglia THREE and FOUR

Marine Mammals

Evidence Plan

Expert Topic Group Meeting 1
13th September 2013
Document Reference –

Author – Royal HaskoningDHV
East Anglia Offshore Wind Limited
Date – August 2013
Revision History – Revision B

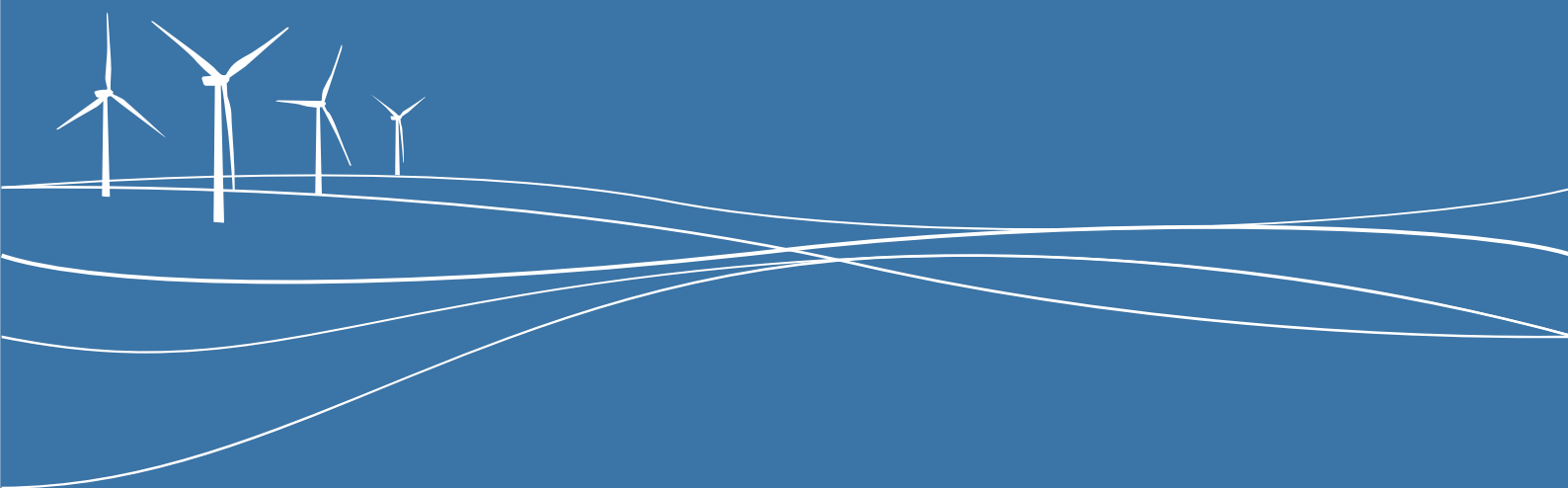

Table of Contents

1 EVIDENCE PLAN PROCESS

1.1 Outline of this document

1. This document provides a summary for the marine mammal expert topic group (ETG) meeting to be held on 13th September 2013. It provides a brief overview of the objectives of the Evidence Plan process with regard to marine mammals, introduction to the project as well as project timelines.

2. It then goes on to detail various aspects of the approach to the marine mammal baseline and impact assessment where it is hoped, the approach applied can be agreed at this meeting, or more details discussion can occur in areas where further information is required, prior to agreement on approach.

1.2 Objectives of the evidence plan process

3. These are described fully in the Evidence Plan document itself but in brief the aims are as follows. 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 DCO application, by:

    - Giving greater certainty to all parties on the amount and range of evidence the Applicants (East Anglia Three Ltd and East Anglia Four Ltd) should collect;
    - 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

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

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

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

- Offshore wind turbines and associated foundations (anticipated to be up to 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.

1.4 Indicative project timelines

Date	Event
August 2013	**Final EA 3 site specific surveys**
13th September 2013	Marine mammals ETG meeting 1 Project Introduction Evidence Plan Process Methods Statement of Common Ground (SoCG)
November 2013	Preliminary survey report
November 2013	*Noise modelling draft report (TBC)*
November 2013	Marine mammals ETG meeting 2: Baseline survey results Approach to HRA screening Approach to cumulative impact assessment Use of PCoD Use of JCP SoCG
December 2013	HRA screening
February 2014	**Final EA 4 site specific surveys**
February 2014	Marine mammals ETG meeting 3 Impact assessment discussion SoCG
April 2014	HRA draft report EA 3 & EA4
May 2014	**PEI submission (draft ES) EA 3 & EA4**
August 2014	HRA final report EA 3
Summer 2014	Marine mammals ETG meeting 4 PEI feedback DCO conditions SoCG
November 2014	**DCO application EA 3**
Spring 2015	**DCO application EA 4**

2 EXISTING ENVIRONMENT

2.1 Site specific baseline

7. The primary data source for each project will be from aerial digital surveys conducted by APEM. These surveys are from two sources:

   - Survey covering the East Anglia Zone conducted since April 2010 (including surveys commissioned by The Crown Estate); and
   - Project specific aerial digital surveys (monthly, high resolution still images on a 500m grid, with a 4km buffer). East Anglia THREE survey was conducted between September 2011 and August 2013 will be analysed to generate project specific estimates of absolute abundance and absolute densities where sufficient data exist. For East Anglia FOUR, comparable project specific surveys from March 2012 until February 2014 will be analysed.

8. Where sufficient data exist to generate robust estimates of project specific densities these will be used in the impact assessment. Data analysis will be completed by APEM (see Appendix 1 for methodology).

9. In addition to these aerial surveys, relevant contextual data including those from survey undertaken for East Anglia ONE will also be used.

2.2 Published data sources

10. 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):

    - SCANS and SCANS II (updated densities from Hammond et al., 2013), and CODA;
    - Inter-Agency Marine Mammals Working Group (IAMMWG) Management Units (June, 2013);
    - SCOS, 2012 (or most recent version where available);
    - Jones et al., 2013 (Grey and harbour seal density maps);
    - JCP (Further discussion on the potential use of this projects outputs is required via the ETB project);
    - Reid et al., 2003 Atlas of Cetacean Distribution;

- The Coastal Directive Project (1995) – JNCC Coasts and Seas of the United Kingdom;
- WWT aerial surveys 2001-2008;
- Relevant SEAs;
- Relevant NAMMCO publications;
- Most recent assessment of conservation status of EPS (anticipated to be updated Autumn 2013)
- Marine Evidence Group (MEG) Report: An analysis of potential broad-scale impacts on 2 harbour porpoise from proposed pile driving activities in the North 3 Sea (2013).

2.3 Species considered in the assessment

11. Based on the data collected from the site specific surveys for East Anglia ONE, the species likely to occur in the in the East Anglia THREE and FOUR project areas are:

- Harbour porpoise;
- White-beaked dolphin;
- Grey seal;
- Harbour seal.

12. It is therefore likely that these four species will be the focus of the assessment.

13. Occasional sightings in the development areas may also occur of bottlenose dolphin, and Risso's dolphin, as well as common dolphin and minke whale. However, due to the very low expected occurrence of these species it is unlikely that they will be considered in the impact assessment.

14. If the site specific surveys provide data which indicate more than 'occasional 'sightings additional species may be included. Full justification for not assessing impacts in any EPS species will be provided, especially with regard to the potential for disturbance from pile driving noise, an agreed as part of the ETG meeting 2.

15. **It is expected that the provisional list of species will be discussed in ETG meeting 1 and agreed with regard to baseline data in ETG meeting 2.**

2.4 Reference populations

2.4.1 Cetaceans

16. The reference populations used for cetacean species in the EIA, and for EPS licence purposes will be based on the IAMMWG agreed management units, and the most recent estimates of population size for these units (currently based on the 2005 SCANS II surveys).

17. There are no UK SACs designated for cetaceans that have the potential to be impacted from East Anglia Three or Four.

18. For harbour porpoise the reference population is the North Sea management unit (MU) (Figure 1). For white-beaked dolphin, the reference population is the British and Irish Waters MU, Figure 2.

19. Final updates to the size and spatial extent of reference populations will be incorporated into the assessment after PEI consultation is completed. Advised changes after this time may or may not be incorporated at the risk of East Anglia Offshore Wind.

20. HRA screening to assess potential impacts on SCIs in other European member states will consider the IAMMWG MU for harbour porpoise as the geographical extent of designations to be considered.

21. **It is expected that the reference populations used for cetacean species in the EIA will be agreed in ETG meeting 1.**

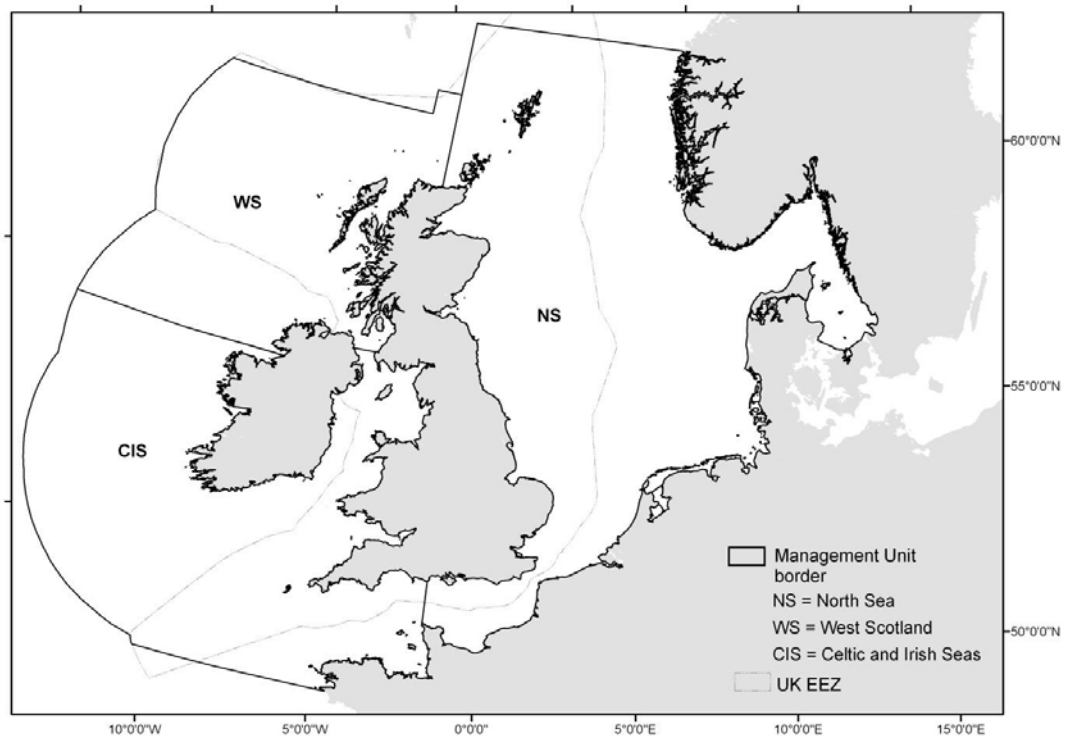

Figure 1: Harbour porpoise management units (IAMMWG, 2013).

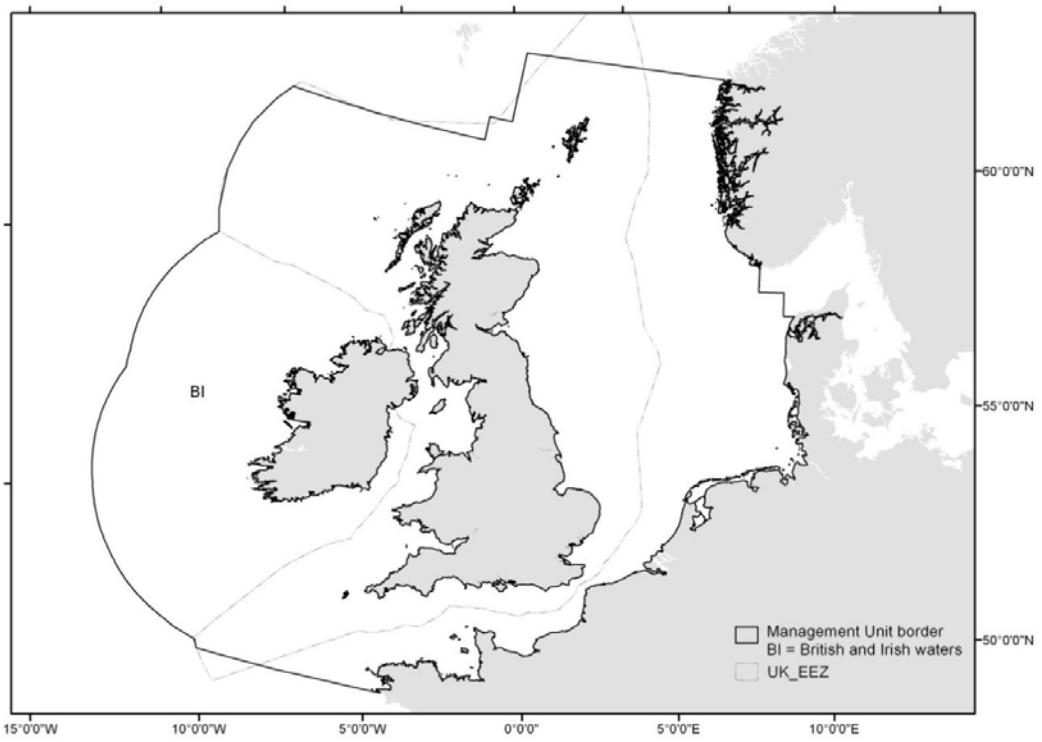

Figure 2: White-beaked dolphin management units (IAMMWG, 2013)

2.4.2 Pinnipeds

22. In the case of harbour and grey seal the IAMMWG MUs will be used as a guide in determining the size of reference populations for EIA purposes (Figure 3). However, it should be noted that these are limited to 12nm. Telemetry data (from the UK and Europe) will be used to examine connectivity to designated sites from which impacted seals may come.

23. Current evidence suggests that harbour seal which occur in the development area could be from the UK and Europe (Jones et al., 2013, IMARES, 2013). As such, the most recent estimates of population size from the Southeast England MU (IAMMWG, 2013 or SCOS, 2012) and Common Wadden Sea Secretariat (available at http://www.waddensea-secretariat.org/monitoring-tmap/topics/marine-mammals) will be used.

24. In the case of grey seal, telemetry data will also be used to define the extent of the reference population, as the area over which connectivity can occur. It is anticipated that this will be the Southeast England and Northeast England MUs as a minimum, as well as relevant any European populations (Common Wadden Sea Secretariat (available at http://www.waddensea-secretariat.org/monitoring-tmap/topics/marine-mammals).

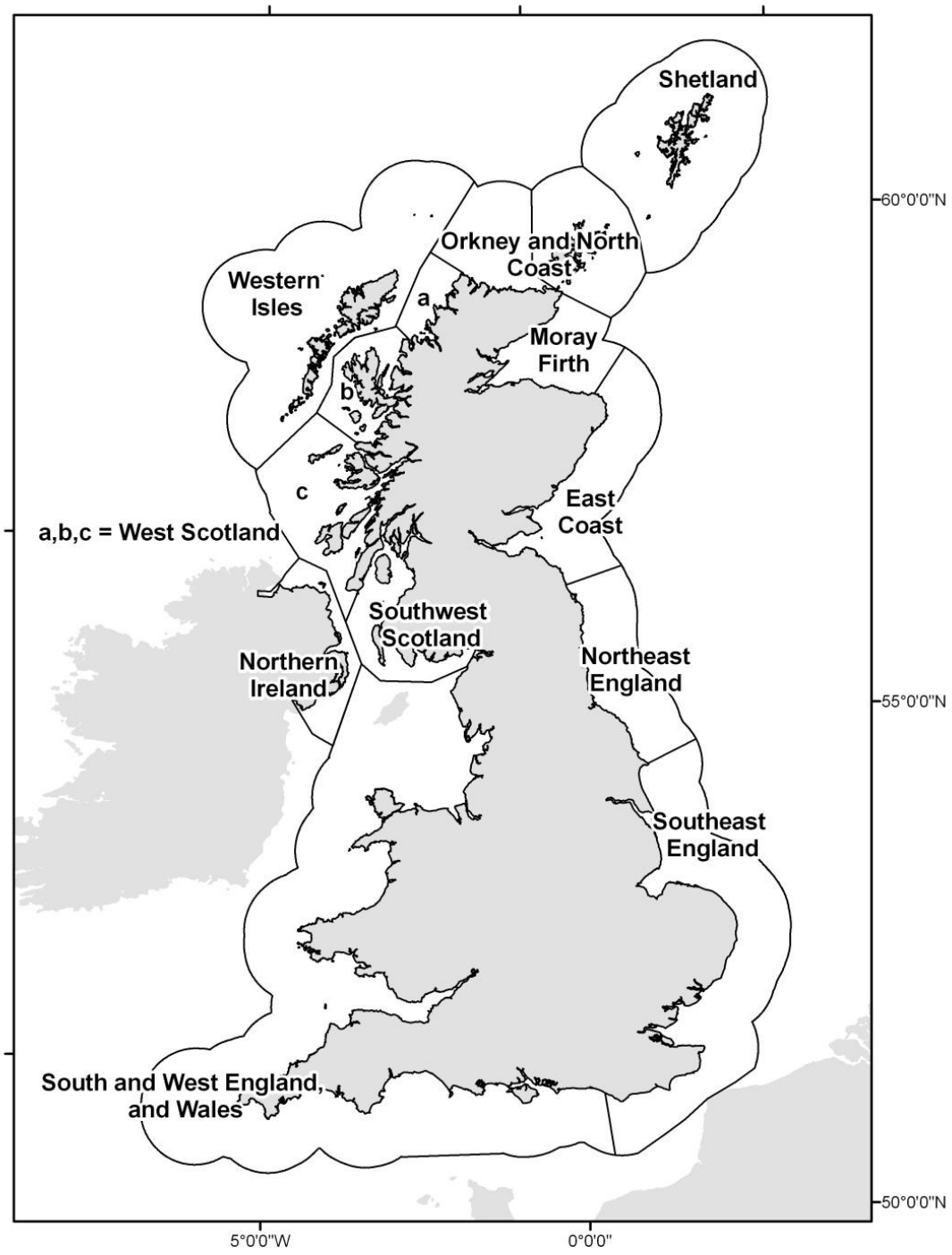

Figure 3: Seal management units in the UK (IAMMWG, 2013)

25. With regard to HRA, impacts will be considered in the context of The Wash and North Norfolk SAC for harbour seal, and any other European sites (for which potential connectivity is shown by telemetry data) that are screened into the

assessment. In the case of grey seal, telemetry data will also be used to examine potential connectivity with UK and European sites in the Screening process.

26. **It is expected that the reference populations used for pinniped species in the EIA will be agreed in ETG meeting 1.**

3 POTENTIAL IMPACTS

27. Following the list of potential impacts set out in Scoping (EAOW, 2012a and 2012b), the assessment will consider the following:

3.1 During construction

- Underwater noise from pile driving, vessels, seabed preparation, rock dumping and cable installation;
- Impacts upon prey species;
- Vessel interaction.

3.2 During operation

- Underwater noise from turbines and vessels;
- Impacts upon prey species;
- Vessel interactions;
- Physical barrier effects.

3.3 During decommissioning

- Underwater noise from vessels, seabed preparation, foundation and cable removal;
- Impacts upon prey species;
- Vessel interactions.

3.4 Impacts scoped out

28. As detailed in the Scoping reports for each project it is proposed that potential impacts on marine mammals from release, remobilisation or re-suspension of contaminated sediments is scoped out of the assessment. Full justification for this with regard to marine mammals will be provided in the ES.

29. **It is expected that the impacts covered in the EIA will be agreed in ETG meeting 1.**

4 APPROACH TO IMPACT ASSESSMENT

4.1 Significance of impacts

30. A matrix approach will be used following best practice and EIA guidance to assess impacts. Receptor sensitivity for an individual from each marine mammal species will be defined within the ES, following definition's set out in Table 1. The potential magnitude of effect will be described for permanent and temporary outcomes, as detailed in Table 2. The significance of impacts will be assessed using the matrix presented in Table 3. Impacts shaded red or orange represent those with the potential to be significant in EIA terms.

31. In the case of marine mammals a large number of species fall within legislative policy; all cetaceans in UK waters are European Protected Species (EPS) and, therefore, internationally important. Grey and harbour seals are also afforded international protection through the designation of Natura 2000 sites, which have seals as a primary reason for site selection. .

32. 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 2 species) but have a low or negligible physical/ecological sensitivity to an effect – it is important not to inflate impact significance simply because a feature is 'valued'. The narrative behind the assessment is important here; the value can be used where relevant as a modifier for the sensitivity (to the effect) already assigned to the receptor.

33. The thresholds for each category defining the potential magnitude of effect that can occur from a particular impact have been determined using expert judgement, current scientific understanding of marine mammal population biology, and JNCC *et al*. (2008) draft guidance on disturbance to EPS species. The JNCC *et al.* (2008) EPS draft guidance suggests definitions for a 'significant group' of individuals or proportion of the population for EPS species. As such this guidance has been considered in defining the thresholds for magnitude of effects. Temporary effects are considered to be of medium magnitude at greater than 5% of the reference population. JNCC *et al*. (2008) draft guidance considered 4% as the maximum level of mortality that could be sustained by a population of most species of cetacean. Furthermore, JNCC considers either 2% or 4% a suitable threshold for determine significance of disturbance in species or populations with Favourable Conservation Status (FCS). In assigning 5% to a temporary impact in this assessment, consideration is given to uncertainty of the individual consequences of temporary disturbance.

34. For permanent effects, greater than 1% of the reference population is considered to be high magnitude in this assessment. The assignment of these levels is informed by the JNCC *et al.* (2008) draft guidance (suggesting between 2% and 4% as being significant) but also reflects the large amount of uncertainty in the potential individual and population level consequences of permanent effects, and what may be considered as the potential rate of increase in a population.

35. The JNCC et al. (2008) draft guidance also considers that species of 'unknown' or 'unfavourable' conservation status should be assigned lower thresholds for significance. In the UK the FCS of harbour porpoise, white-beaked dolphin and grey seal is currently favourable, in the case of harbour seal, the overall assessment was inadequate (JNCC, 2007).

36. The tables below give suggested definitions for sensitivity and magnitude. **It is expected that these definitions will be discussed and agreed in ETG meeting 1.**

Table 1: Suggested definition of terms relating to the sensitivity of marine mammals.

Sensitivity	Definition
High	Individual receptor has very limited capacity to avoid, adapt to, accommodate or recover from the anticipated impact.
Medium	Individual receptor has limited capacity to avoid, adapt to, accommodate or recover from the anticipated impact.
Low	Individual receptor has some tolerance to avoid, adapt to, accommodate or recover from the anticipated impact.
Negligible	Individual receptor is generally tolerant to and can accommodate or recover from the anticipated impact.

Table 2: Suggested definition of terms relating to the magnitude of anticipated effect on marine mammals

Magnitude of effect	Definition
High	Permanent irreversible change to exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that >1% of the reference population are anticipated to be exposed to the effect. OR Temporary effect (limited to phase of development or Project timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that >10% of the reference population are anticipated to be exposed to the effect.
Medium	Permanent irreversible change to exposed receptors or feature(s) of the habitat of particular importance to the receptor. Assessment indicates that >0.01% or <=1% of the reference population anticipated to be exposed to effect. OR Temporary effect (limited to phase of development or Project timeframe) to the

	exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that >5% or <=10% of the reference population anticipated to be exposed to effect.
Low	Permanent irreversible change to exposed receptors or feature(s) of the habitat of particular importance to the receptor. Assessment indicates that >0.001 and <=0.01% of the reference population anticipated to be exposed to effect. OR Intermittent and temporary effect (limited to phase of development or Project timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that >1% or <=5% of the reference population anticipated to be exposed to effect.
Negligible	Permanent irreversible change to exposed receptors or feature(s) of the habitat of particular importance to the receptor. Assessment indicates that <=0.001% of the reference population anticipated to be exposed to effect. OR Intermittent and temporary effect (limited to phase of development or Project timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that <=1% of the reference population anticipated to be exposed to effect.

Table 3: 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

4.2 Noise modelling

37. As suitable contractor will be contracted to undertake the noise propagation modelling in order to assess the potential impacts from pile driving noise. Methods employed by the contractorand the scenarios modelled are to be confirmed, and it is anticipated that these will be discussed at a future Evidence Plan meeting.

38. It is anticipated that the approach to the assessment will follow industry standards and best practice with the application of the Southall et al., 2007 criteria, and any appropriate guidance.

39. The impact assessment will be based on an agreed realistic worst case scenario (including any appropriate imbedded mitigation) in agreement with the members of the Marine Mammal ETG.

4.3 Calculating impacts

4.3.1 EIA

40. The approach to assessing impacts on the receptors considered in the assessment will be quantitative for potential impacts from pile driving noise, but will be qualitative for all other impacts.

41. The pile driving noise assessment will consider the range of impacts of lethal and physical injury (including permanent auditory injury). It will also consider the area of permanent and non-permanent auditory injury, and disturbance in order to calculate the potential number of individuals exposed to the noise thresholds that can lead to an impact. The site specific absolute densities (averaged over the area (or Zone where appropriate) will be used to calculate the number potentially impacted.

42. The number of individuals of each species that could be impacted will be considered as a proportion of appropriate the reference population.

43. Magnitudes and sensitivities will be based on the best available evidence as discussed within the ETG and subject to a cut-off period after which revisions to the assessment will not be possible.

44. Assessments will be made on the baisis of embedded mitigation and available mitigation will be discussed and agreed with the ETG.

45. **It is expected that the impact methodologies will be discussed in ETG meeting 2 and agreed with regard to baseline data in ETG meeting 3.**

4.3.2 European Protected Species

46. The ES will consider the potential for the impacts of injury and disturbance in context of the draft EPS guidelines (JNCC 2008) the most recent assessment of conservation status for each species in UK waters, and the reference populations outlined by the IAMMWG (2013).

47. As such the potential for significant impacts in EIA terms, also considers the potential for significant impacts (injury or disturbance) in EPS terms.

4.3.3 HRA

48. The approach to the HRA will follow the approach taken for the EIA. It is likely that further consideration for determining the potential for likely significant effects (LSE) will be based upon apportioning impacts between the SCIs/SACs where potential connectivity (based on telemetry data) with the development areas exists. The assessment will be based upon available guidance and current best practice and subject to a cut-off period after which revisions to the assessment will not be possible.

49. Given the distance to SCIs/SACs, it is likely that project-level impacts will not lead to LSE and that the cumulative assessment will be most important in the HRA context.

50. **It is expected that the HRA screening will be discussed in ETG meeting 2 and agreed with regard to baseline data in ETG meeting 3.**

4.3.4 PCoD

51. It is anticipated that EA 3 and EA4 will be able to make use of the Population Consequences of Disturbance (PCoD) model in the assessment. However, this will not be confirmed until more is known about timings for delivery of this project, and any associated guidelines on the application to EIA/HRA or CIAs. The absolute cut-off for inclusion of this model in the assessment will be at the close of consultation on the PEI. After this point there will be no time in which to accommodate further changes.

4.3.5 Correction Factors

52. There is on-going discussion about how to adjust population estimates from survey data to account for animals under water. Appropriate correction factors will be discussed and agreed with the ETG.

4.4 Cumulative Impacts

53. The ES will provide an assessment of the potential for cumulative impacts both within and outwith the East Anglia Zone. The approach to the assessment or cumulative impacts from marine mammals will follow a screening process. **The approach to the cumulative assessment for EIA and HRA purposes will be outlined at the ETG meeting 2**.

4.5 Transboundary

54. The potential for transboundary impacts will be addressed via the reference populations and potential linkages to non-UK sites as shown in telemetry data.

EAOW will be continuing to undertake consultation with other Member States to ensure that all transboundary concerns are addressed where practicable.

5 REFERENCES

East Anglia Offshore Wind Limited, 2012a. East Anglia THREE Offshore Windfarm Scoping Report. Available from http://infrastructure.planningportal.gov.uk/wp-content/ipc/uploads/projects/EN010056/1.%20Pre-Submission/EIA/Scoping/Scoping%20Request/121113_EN010056_Scoping%20Report.pdf

East Anglia Offshore Wind Limited, 2012b. East Anglia FOUR Offshore Windfarm Scoping Report. Available from http://infrastructure.planningportal.gov.uk/wp-content/ipc/uploads/projects/EN010057/1.%20Pre-Submission/EIA/Scoping/Scoping%20Request/EN010057_East%20Anglia%20Four_Scoping%20Report_low%20resolution.pdf

Hammond P.S., Macleod K., Berggren P., Borchers D.L., Burt L., Cañadas A., Desportes G., Donovan G.P., Gilles A., Gillespie D., Gordon J., Hiby L., Kuklik I., Leaper R., Lehnert K, Leopold M., Lovell P., Øien N., Paxton C.G.M., Ridoux V., Rogano E., Samarraa F., Scheidatg M., Sequeirap M., Siebertg U., Skovq H., Swifta R., Tasker M.L., Teilmann J., Canneyt O.V. & Vázquez J.A. (2013) Cetacean abundance and distribution in European Atlantic shelf waters to inform conservation and management. Biological Conservation, 164; 107-122.

IAMMWG, 2013. Management Units for marine mammals in UK waters (June 2013).

JNCC, 2007. Second Report by the United Kingdom under Article 17 on the implementation of the Directive from January 2001 to December 2006. Peterborough: JNCC. Available from www.jncc.gov.uk/article17

JNCC, 2008. The deliberate disturbance of marine European Protected Species. Guidance for English and Welsh territorial waters and the UK offshore marine area.

JNCC, 2010. Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise, JNCC, Aberdeen.

Jones, E., McConnell, B., Sparling, C., and Matthiopoulos, J. 2013. , Grey and harbour seal density maps. Marine Mammal Scientific Support. Research Programme MMSS/001/11. Available at: http://www.scotland.gov.uk/Resource/0041/00416981.pdf

APPENDIX 1: MARINE MAMMAL ANALYSIS METHODOLOGY

MARINE MAMMAL ANALYSIS METHODOLOGY

Design-based population estimates will be generated by adding up the raw counts from geo-referenced images and dividing this number by the total number of images to give mean number of mammals per image (*i*). Relative population estimates (*N*) for each survey month will then be generated by multiplying the mean number of mammals per image by the total number of images required to cover the entire study area (*A*). This is analogous to abundance estimation outlined in Borchers *et al.* (2002).

$N = i\,A$

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

Measures of precision will be calculated using a negative binomial estimator, suitable for a pseudo-Poisson over dispersed distribution (Elliott 1977). This will produce a *CV* (coefficient of variation) based on the relationship of the standard error to the mean.

All analysis and data manipulation will be conducted in the R programming language (R Development Core Team 2012) and non-parametric 95% confidence intervals will be generated using the 'boot' library of functions (Canty & Ripley 2010).

REFERENCES

Borchers, D.L., Buckland, S. T. & Zucchini, W. (2002). *Estimating Animal Abundance: Closed Populations.* Springer Verlag, London.

Canty, A. & Ripley, B. (2010). *Boot: Bootstrap R (S-Plus) Functions.* R package version 1. 2-43.

Efron, B. & Tibshirani, R.J. (1993). *An Introduction to the Bootstrap*. Chapman & Hall, London.

Elliott, J.M. (1977). *Some methods for the statistical analysis of samples of benthic invertebrates.* Freshwater Biological Association, Scientific Publication no. 25.

R Development Core Team (2012) R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org/.

12.1.2.2 Minutes of Marine Mammals ETG 1 Meeting.

5. Provided below are the minutes from the 1st Marine Mammal ETG meeting.

EAOW Round 3 Offshore Programme East Anglia THREE & FOUR, Marine Mammals ETG Meeting 1			
Date of Meeting:	13.09.2013	**Venue:**	Tudor Street
Attendees			
Name	**Initials**		**Organisation**
Keith Morrison	KM		EAOW
Jesper Larsen	JL		EAOW
Marcus Cross	MC		EOAW
Claire Ludgate	CL		Natural England
Paolo Pizzolla	PP		Royal HaskoningDHV
Beth Mackey	BM		Royal HaskoningDHV
Document Ref:		**Issue Date:**	17/9/13
9:30-12:30			

ITEM	DESCRIPTION	ACTION
1	Health and Safety – KM introduced this.	
2	Introduction- PP presented the evidence plan expectations in terms of the timeline (driven by availability of data and analysis) see slide 12 The availability of external analyses and data was discussed in particular with regard to Population Consequences Of Disturbances (PCoD) and the Joint Cetacean Protocol (JCP) – these have potential to be used in the East Anglia THREE and East Anglia FOUR assessments if they are available in time. PCoD – expected autumn (potential series of workshops) JCP – expected that report available in autumn NPL will be undertaking the underwater noise assessment, it is likely that NPL will be at next meeting to present their methodology to the ETG.	
3	BM – gave an introduction to the data and analyses (slides 15 – 22) Data collection Full 24 month data collection (complete for East Anglia THREE on-going for East Anglia FOUR) (slide 14) APEM hi-res digital still images, 8 – 10% site coverage, SMRU provide QA of the images Monthly and seasonal estimates of density will be used to characterise the baseline, and an average estimates over the survey period will be used in the quantitative assessment (see slide 15) – CL ok with this Unidentified individuals – 2 approaches are available for dealing with unidentified mammals – 1) as harbour porpoise are the issue, EAOW could just assign all unidentified as harbour porpoise, this would be precautionary and relatively simple OR 2) look at proportions of positively identified	MC contact APEM to elaborate methods for CL

ITEM	DESCRIPTION	ACTION
	animals and allocate the unidentified ones on that basis. It will be necessary to see the data prior to deciding which method is most robust. CL – prefer precautionary approach – look at the 2 versions and then present Correction factors – there is a requirement to correct the densities for the numbers of animals likely to be within the site but beneath the surface. At the moment the favoured approach from EAOW is to ditch sub-surface sightings and add correction factors for surface numbers only. This has been discussed with CREEM and they suggest that this is the most robust method at the present time. CL – this seems like a reasonable approach. BM – again the approach taken is dependent upon the actual data to ensure the approach is valid and sensible. CL – stated that the ZSL Thames seal tagging data may be available to inform the assessment. EAOW will incorporate any relevant data provided they are available within the assessment timeframe.	Undertake both ways of allocation and present at future meeting Look at the numbers and present appropriate correction factor
4	Species (slides 17 – 21) For common/white-beaked/patterned/bottlenose/Risso dolphin – too few sightings to generate robust numbers for a fully quantitative assessment – they would count as 'occasional' and therefore it is considered by EAOW that there is no pathway for significant impact For harbour porpoise/harbour and grey seal – it is possible to undertake more quantitative assessment as the data are available List of potential impacts discussed (slide 23)	
5	Reference populations IAMMWG management units are proposed for majority of reference populations – CL advised that this report still not signed off but MU boundaries unlikely to change	
6	Cumulative It was acknowledged that the CIA will be necessarily more detailed than East Anglia ONE assessment Cumulative methodology to be discussed at next meeting	
7	Next meeting 15th November – the meeting will feature a presentation on methodologies for underwater noise from NPL and have an initial look at the site specific data	

ID	Issue on which EAOW THREE and FOUR seek agreement on	Agreed Position
1	Sufficient survey data have been collected	Agreed – subject to CL getting understanding of APEM methodology 24 months aerial data is sufficient Correction factors to be used dependent upon data – methods agreed in principle Species for assessment – agreed
2	The list of impacts to be assessed are those proposed in the Evidence Plan method statement and the powerpoint presentation.	Agreed
3	It is agreed that the sensitivity and magnitude definitions are appropriate	Agreed in principle – subject to specific paper to be circulated prior to next ETG meeting
	Harbour porpoise reference population	IAMMWG MU - Agreed in principle – (CL noted that the IAMMWG paper has not yet been signed off)
		EAOW data – agreed (will consider with regard to SCANS data)
	White-beaked dolphin or other cetacean species (if sufficient data for impact assessment) reference populations	IAMMWG MU to be used
	Seal reference populations	IAMMWG MU plus European sites with connectivity – harbour seal SE MU (with reference to telemetry data)
		IAMMWG MUs plus European sites with connectivity grey seal – more European issue than harbour (telemetry data will be used)
		Agreed - for transboundary impacts makes more sense for EIA purposes to use biological ref population. The derivation of this will be discussed and agreed at future meeting
	Other available seal data	Agreed – Wash seal tracking data not available until February 2014 will incorporate if available
		Agreed densities for seals – will use SMRU at-sea densities (not site-specific survey data)
	Quantitative assessment for pile driving noise in harbour and grey seal, and harbour porpoise.	Agreed
	Qualitative – for all other impacts	Agreed (e.g. vessel movements quantified, but cannot translate into quantified no. of animals affected)

12.1.2.3 Email Agreement of Minutes for Marine Mammals ETG 1 meeting.

6. Provided below is an email from Natural England agreeing the minutes from the first ETG meeting.

From: Ludgate, Claire (NE)
To: Pizzolla, P. (Paolo)
Cc: Tarrant, D.C. (David)
Subject: RE: East Anglia 3 & 4 - Evidence Plan Expert Topic Group - Marine Mammals
Date: 10 October 2013 15:48:19
Attachments: image006.png
image007.png
image001.png

Hi Paolo,

Natural England has now reviewed the meeting minutes and can confirm they are accurate.

With regard to the definitions of sensitivity and magnitude, we feel we need more time to consider this, particularly the definitions of magnitude. Therefore, we would request that if you are able to expand upon the text in the mammal meeting paper in these areas in the papers prior to the November meeting, it would be very helpful and greatly appreciated.

Thanks,

Claire

Claire Ludgate
MSc AMIMarEST

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We are here to secure a healthy natural environment for people to enjoy, where wildlife is protected and England's traditional landscapes are safeguarded for future generations.

In an effort to reduce Natural England's carbon footprint, I will, wherever possible, avoid travelling to meetings and attend via audio, video or web conferencing.

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Natural England is accredited to the Cabinet Office Customer Service Excellence Standard

12.1.3 Marine Mammals ETG Meeting 2: 15th November 2013

7. Provided in section 12.1.2 are the following documents produced for the 2nd Marine Mammal ETG meeting:

- Marine Mammals Evidence Plan Method Statement;
- Minutes of meeting; and
- Email agreement of minutes.

12.1.3.1 Marine Mammals Evidence Plan Method Statement for ETG 2

8. Provided below is the method statement which was circulated to attendees prior to the second East Anglia THREE Marine Mammals ETG meeting held on the 15th November 2013.

East Anglia
Offshore Wind

VATTENFALL

SCOTTISHPOWER RENEWABLES

East Anglia THREE and FOUR

Marine Mammals

Evidence Plan

Expert Topic Group Meeting 2
15th November 2013
Document Reference –

Author – Royal HaskoningDHV
East Anglia Offshore Wind Limited
Date – October 2013
Revision History – Revision B

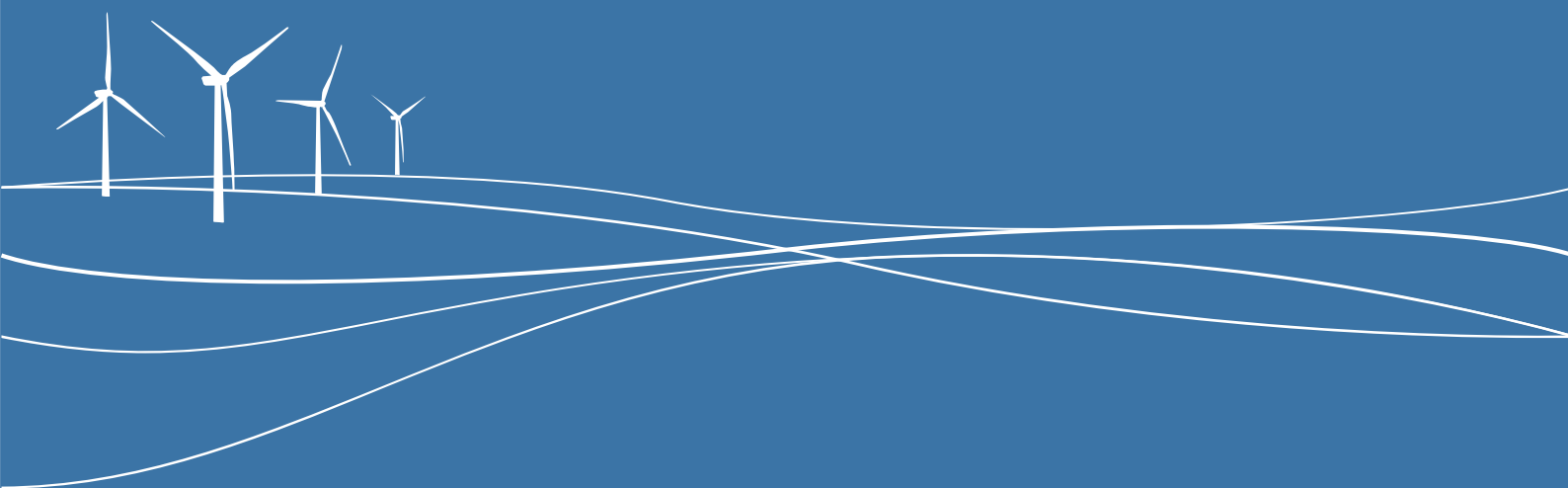


Table of Contents

1 EVIDENCE PLAN PROCESS

1.1 Outline of this document

1. This document is a briefing note prepared for Natural England in advance of the marine mammal expert topic group meeting to be help on 15th November 2013.

2. It details various aspects of the approach to the marine mammal baseline and impact assessment where it is hoped, the approach applied can be agreed at this meeting, or more details discussion can occur in areas where further information is required, prior to agreement on approach.

2 AGENDA ITEMS OUTSTANDING FROM ETG MEETING 1

2.1 Approach to impact assessment – defining value, sensitivity, magnitude and significance

3. There was a preliminary discussion at ETG meeting 1 on the approach to the impact assessment. Natural England requested further clarification on this approach. As such **Appendix A** provides further justification of the planned approach.

4. **Following the further provision of information, EAOW would like confirmation from Natural England that they are content with the approach.**

2.2 Detailed methodology from APEM air surveys

5. Natural England requested further clarification of the field methods used by APEM. Further details on the field methods employed by APEM are provided in **Appendix B**.

2.3 Approach to dealing with unidentified individuals and individuals below the surface in APEM surveys

6. Details on the number of unidentified individuals and proportion of sightings below the surface as well as suitable correction factors are considered in **Appendix C**. **This appendix is to follow.**

2.4 ZSL tagging data

7. The ZSL seal tagging study has been requested from SMRU Ltd as part of the seal telemetry investigation commissioned by EAOW to assist in the definition of the extent of reference population and HRA screening.

8. It has been confirmed that these data are available via SMRU Ltd, and will be incorporated into the baseline data set, and HRA screening report.

3 EXISTING ENVIRONMENT

3.1 Site specific baseline – APEM surveys

9. The primary data source for each project will be site specific aerial digital surveys conducted by APEM. These surveys have conducted over the East Anglia Zone since April 2010 (including surveys commissioned by The Crown Estate).

10. **Appendix C** (to follow) provides a summary of the technical report from the APEM surveys for East Anglia THREE. A similar report will be available for East Anglia FOUR, following completion of the final surveys in February 2014.

3.2 Reference populations for seal species

11. The extent of the reference populations for grey seals have been defined using suitable telemetry data. SMRU Marine have been commissioned to provide appropriate data to review the extent of reference populations for the impact assessment, and connectivity with Natura 2000 sites for the HRA screening and HRA report. Data are not available for inclusion in this version of report, but will be presented to Natural England at the meeting.

12. At sea densities of seals to be used in the assessment are based on UK telemetry data and haul out counts (Jones et al., 2013). Clearly, the densities of animals at sea may be higher than this, when considering animals from the Wadden Sea. As such the maximum densities in any 5x5km grid cell from within each project area is considered suitable to define the numbers of individuals that could be impacted in a UK context. Figures 1-4 show the mean at-sea densities of harbour and grey seal within East Anglia FOUR and East Anglia THREE project areas.

13. Mean at sea densities of harbour and grey seal across each of the project areas are relatively low; between 0 and 1 seal per 25km^2 grid cell.

14. For harbour seal the maximum mean density in the East Anglia THREE, and East Anglia FOUR are 0.0004 and 0.00001 per km^2 respectively. For grey seal maximum mean density in the East Anglia THREE and East Anglia FOUR are 0.015 and 0.012 per km^2 respectively.

3.3 Confirmation of species and considered in the assessment

15. **EAOW would like agreement on the species to be considered in the impact assessment.**

16. **Appendix C** (to follow) provides a summary of the site specific densities for East Anglia THREE, which will be used to quantify the number of individuals impacted from pile driving noise in the assessment. It also provides a comparison to the updated SCANS II densities (Hammond *et al.*, 2013).

Figure 1: Harbour seal mean at sea densities East Anglia THREE

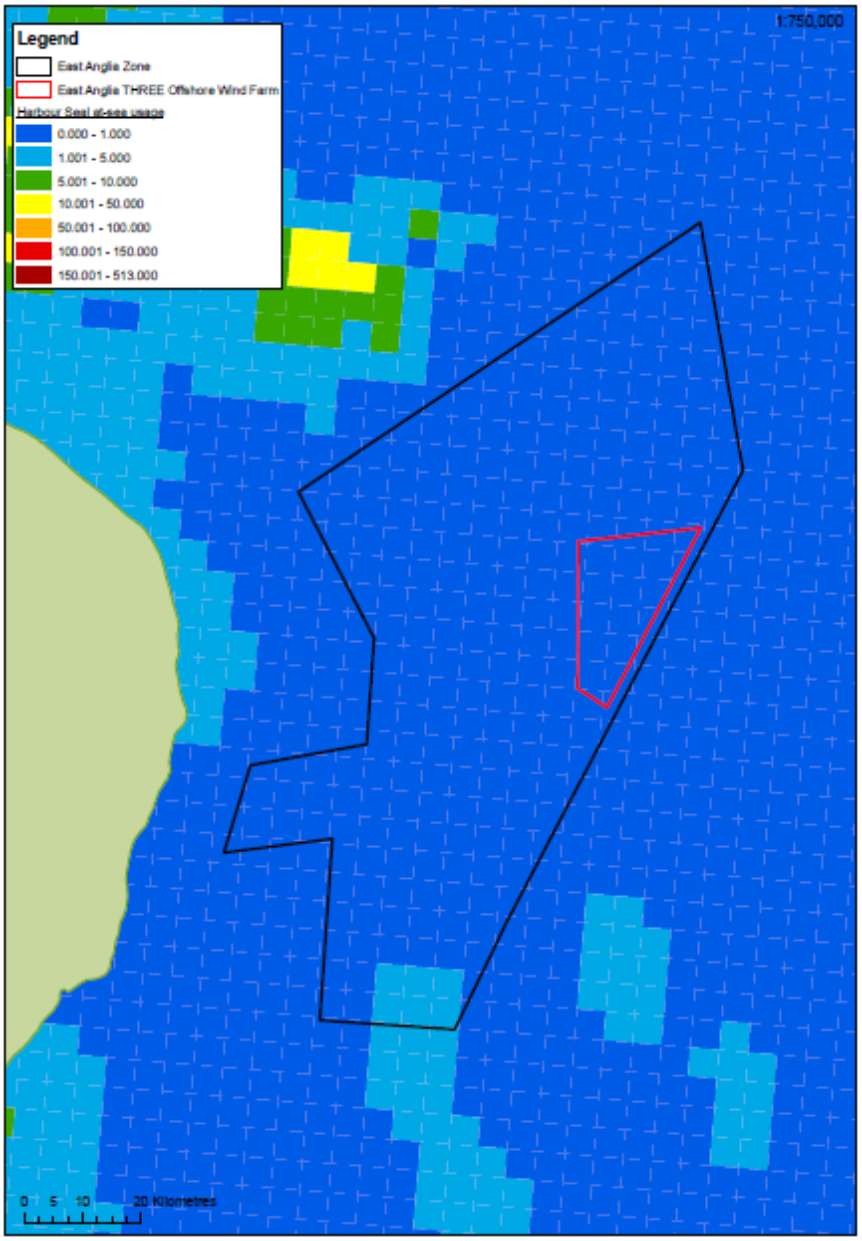


Figure 2: Grey seal mean at sea densities East Anglia THREE

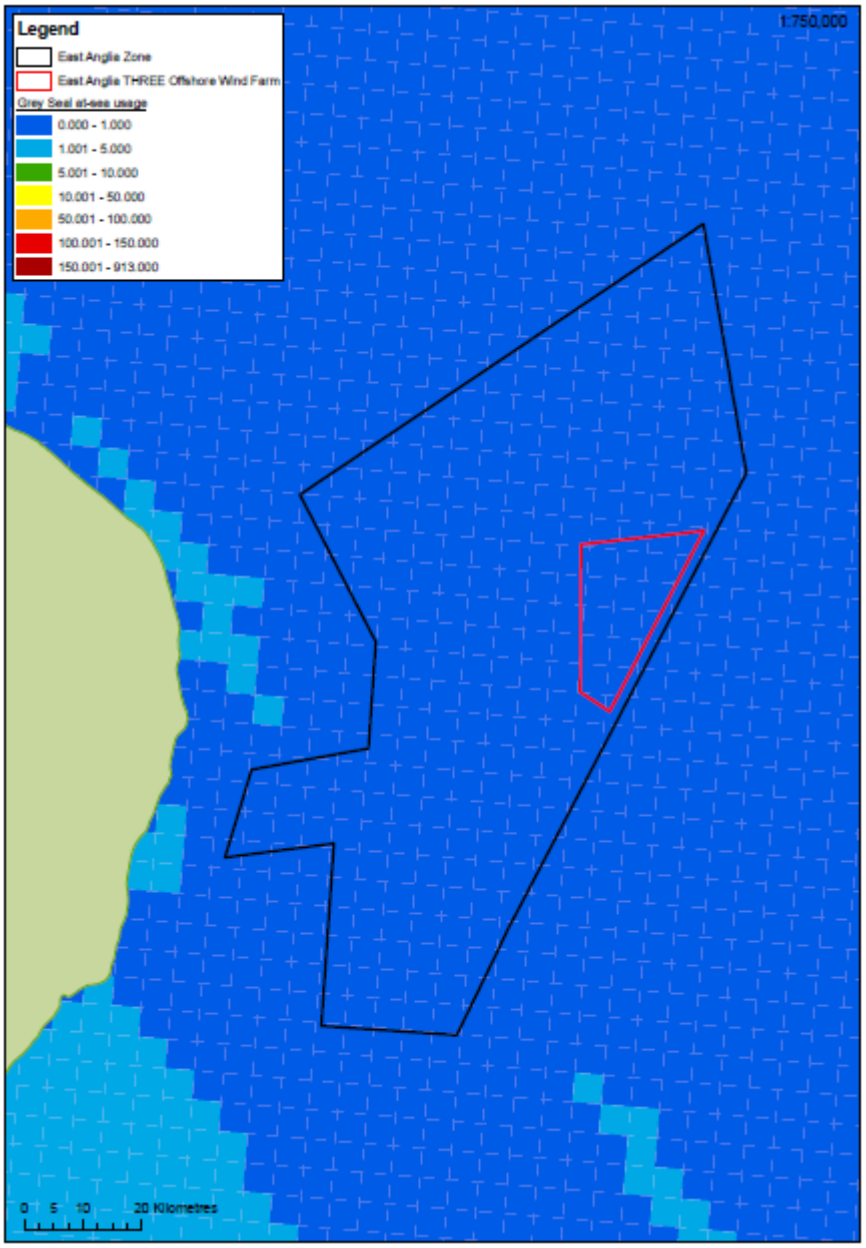


Figure 3: Harbour seal mean at sea densities East Anglia FOUR

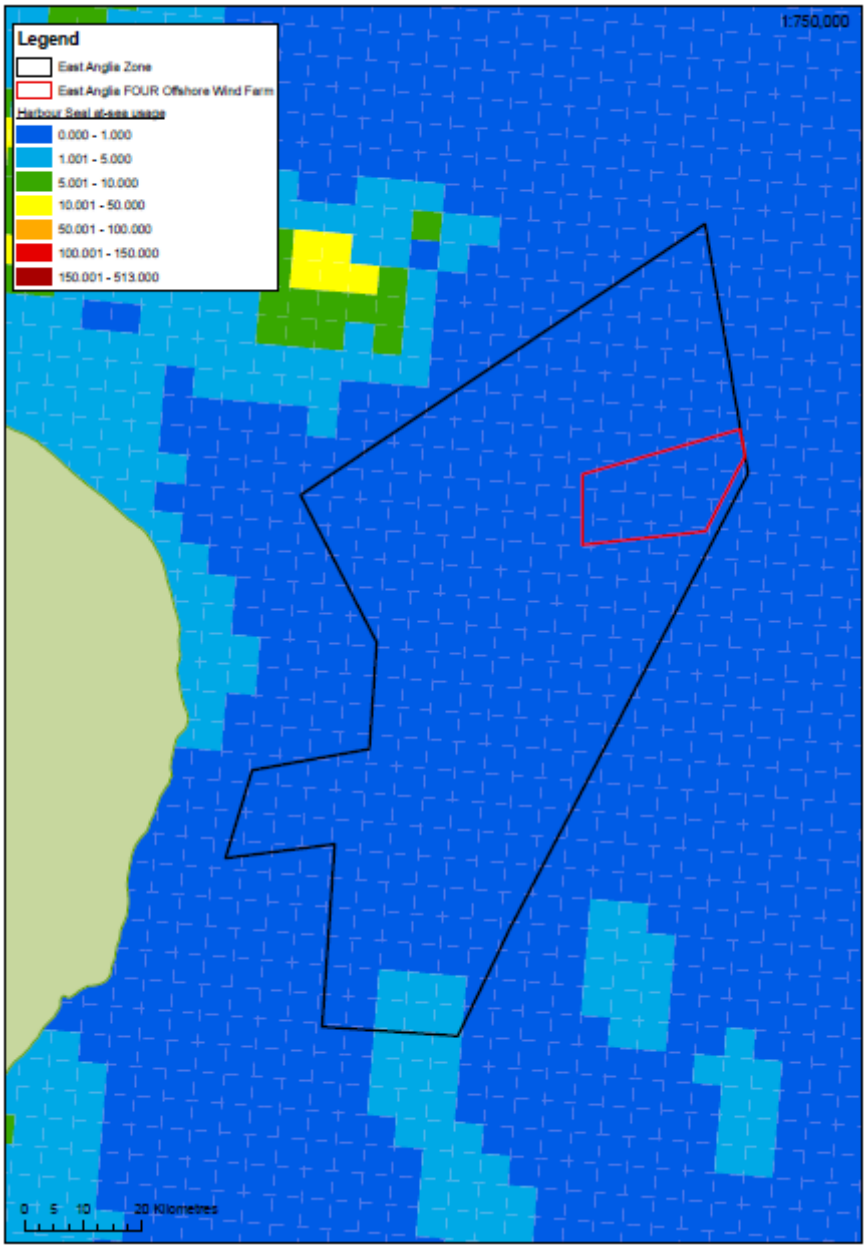
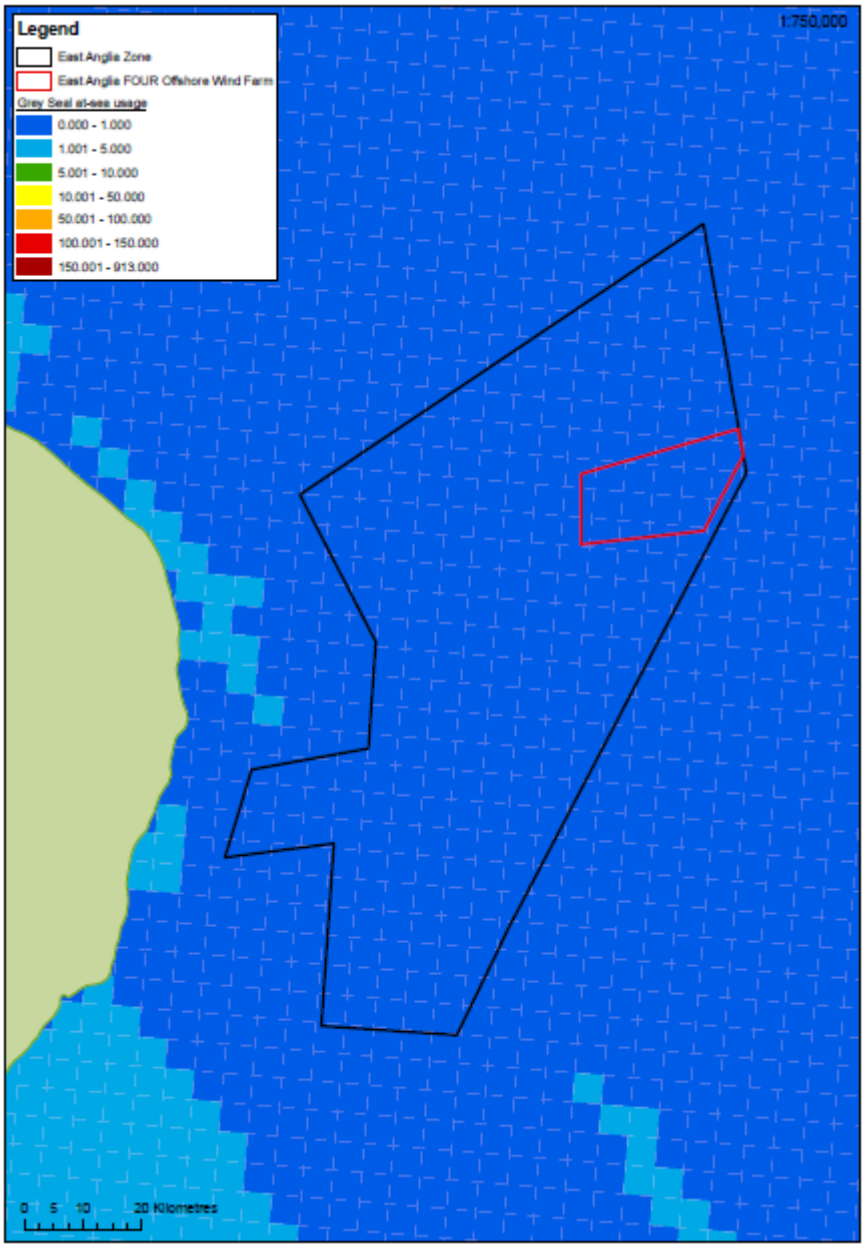


Figure 4: Grey seal mean at sea densities East Anglia FOUR



4 NOISE MODELLING

17. National Physical Laboratory (NPL) have been contracted to undertake the noise propagation modelling in order to assess the potential impacts from pile driving noise. Methods employed by NPL are detailed in **Appendix D.**

18. NPL will also give a presentation on these methods at the ETG 2 meeting.

5 CUMULATIVE IMPACT ASSESSMENT (CIA)

19. The cumulative impact assessment will identify areas where the predicted impacts of the construction, operation, maintenance and decommissioning of the project could interact with impacts from different industry sectors within the same region and impact sensitive receptors.

20. PINS Advice note 9 states that:

"*In assessing cumulative impacts, other major development should be identified through consultation with the local planning authorities and other relevant authorities on the basis of those that are:*

Under construction;

Permitted application(s), but not yet implemented;

Submitted application(s) not yet determined;

Projects on the Planning Inspectorate's Programme of Projects;

Identified in the relevant Development Plan (and emerging Development Plans - with appropriate weight being given as they move closer to adoption) recognising that much information on any relevant proposals will be limited; and

Identified in other plans and programmes (as appropriate) which set the framework for future development consents/approvals, where such development is reasonably likely to come forward."

21. The CIA will therefore include any projects with any potential impacts occurring from the end of the project baseline, as detailed in the ES chapter, until the end of the project.

22. Type of plans or projects to be taken into consideration are:

- Other windfarms;
- Aggregate extraction and dredging;
- Licensed disposal sites;
- Navigation and shipping;
- Planned construction sub-sea cables and pipelines;
- Potential port/harbour development;
- Oil and gas installations; and

23. Note that by-catch based on existing fishing is not been included in this list. Effectively fisheries are part of the baseline (an impacted non-pristine baseline); therefore there are no effective ways of assessing on-going impacts (e.g. impact on benthic communities) cumulatively with the more discrete impacts of plans or projects.

24. Screening of specific plans and projects will be a stepwise process:

    a) Definition of a study area based on receptor ecology and/or footprint of impact (temporal and spatial).

        a. Spatial boundaries will take account both of the relevant spatial scales for individual receptors (foraging distances, migratory routes) and the spatial extent of environmental changes introduced by developments. These spatial boundaries will be analogous to the extent of the reference populations considered in the impact assessment.

        b. Temporal boundaries will take account of the project life cycle and the receptor life cycles and recovery times.

    (b) Establish a source-pathway-receptor rationale. Projects will be screened out where no pathway exists, with clear justification will be provided. This screening process will be species specific.

25. These steps will lead to an initial list of potential projects which could have a cumulative impact with either East Anglia THREE or East Anglia FOUR.

26. The next stage of screening considers the plans or projects where sufficient information exists to undertake an assessment.

27. The CIA will consider projects, plans and activities which have sufficient information available in order to undertake the assessment. Insufficient information will preclude a meaningful quantitative assessment, and it is not appropriate to make assumptions about the detail of future projects in such circumstances. The focus of the assessment will therefore be on those projects or activities where sufficient relevant information exists. Whilst other projects may be acknowledged within the assessment, in the case of inadequate information it is up to the regulator to judge how to take these into account. It is likely that plans or projects with sufficient information to include in the CIA include the stages of developed as outlined in the PINS advice, above.

28. This second screening process will follow a tiered approach analogous to that outlined by JNCC and Natural England (in the document 'Suggested Tiers for Cumulative Impact Assessment').

Table 1: Suggested tiers for undertaking a staged cumulative impact assessment (JNCC and Natural England)

	Tier description	
	Consenting or construction stage	**Data availability**
Tier 1	Built and operational projects should be included within the cumulative assessment where they have not been included within the environmental characterisation survey, i.e. they were not operational when baseline surveys were undertaken, and/or any residual impact may not have yet fed through to and been captured in estimates of "baseline" conditions e.g. "background" distribution or mortality rate for birds.	Pre-construction (and possibly post-construction) survey data from the built project(s) and environmental characterisation survey data from proposed project (including data analysis and interpretation within the ES for the project).
Tier 2	Tier 1 + projects under construction	As Tier 1 but not including post-construction survey data
Tier 3	Tier 2 + projects that have been consented (but construction has not yet commenced)	Environmental characterisation survey data from proposed project (including data analysis and interpretation within the ES for the project) and possibly pre-construction
Tier 4	Tier 3 + projects that have an application submitted to the appropriate regulatory body that have not yet been determined	Environmental characterisation survey data from proposed project (including data analysis and interpretation within the ES for the project)
Tier 5	Tier 4 + projects that the regulatory body are expecting an application to be submitted for determination (e.g. projects listed under the Planning Inspectorate programme of projects)	Possibly environmental characterisation survey data (but strong likelihood that this data will not be publicly available at this stage).
Tier 6	Tier 5 + projects that have been identified in relevant strategic plans or programmes (e.g. projects identified in Round 3 wind farm zone appraisal and planning (ZAP) documents)	Historic survey data collected for other purposes/by other projects or industries or at a strategic level.

29. Each plan or project will be assigned a tier level. The CIA will include all projects classed as tier 1, 2, 3 and 4 in the assessment as a realistic scenario. Consideration will be given to a further assessment including tier 5 and projects, where there is more uncertainty. A list if plans and projects should be agreed within Natural England following screening.

30. Following submission of the draft ES (PEI), reviews will be undertaken to ensure that any new information is incorporated into the CIA. Once issues, plans or projects

have been scoped out and agreed there must be a strong justification for scoping them back in again, and this will be agreed with statutory consultees.

31. Given the fast moving nature of offshore development, it is likely that new projects relevant to the assessment will arise throughout the pre-application period. In order to finalise an assessment, it will be necessary to have a cut-off period after which no more projects will be included. A reasonable cut-off point would be the date of receipt of comments upon the PEI.

32. There will be an inherent level of uncertainty associated with assessments of impacts on this basis. It is important that stakeholders understand that significant cumulative impacts may be the result of an overly precautionary worst case (or precaution built on precaution) and that this will be highlighted within documents and discussions.

6 HRA SCREENING

33. The approach of calculating impacts in the HRA will follow the approach taken for the EIA. Further consideration for determining the potential for likely significant effects by apportioning impacts between the SCIs/SACs where potential connectivity with the development areas exists. The initial approach to screening is high level. The same approach to screening is applied to East Anglia THREE and East Anglia FOUR.

34. For harbour porpoise connectivity is considered between the project and any SAC or SCI within the relevant Inter Agency Marine Mammal Working Group (IAMMWG) management unit (IAMMWG, 2013), where the species id considered a grade A, B or C feature. Screening for harbour porpoise has resulted in the list of sites in Table 2, which will be further considered within the HRA report for potential LSE.

Table 2 List of Natura 2000 sites designated for harbour porpoise to be taken forward to the HRA, following screening

Site code	Country	Site name	Grade of feature	IAMMWG MU
DK00FX112	Denmark	Skagens Gren og Skagerrak	B	NS
DK00VA347	Denmark	Sydlige Nordsø	B	NS
DK00VA171	Denmark	Gilleleje Flak og Tragten	C	NS
DK00VA259	Denmark	Gule Rev	C	NS
DK00VA250	Denmark	Store Middelgrund	C	NS
DK00VA258	Denmark	Store Rev	C	NS
DK00AY176	Denmark	Vadehavet med Ribe Å, Tved Å og Varde Å vest for Varde	C	NS
BEMNZ0002	Belgium	SBZ 1 / ZPS 1	B	NS
BEMNZ0003	Belgium	SBZ 2 / ZPS 2	B	NS
BEMNZ0004	Belgium	SBZ 3 / ZPS 3	B	NS
BEMNZ0005	Belgium	Vlakte van de Raan	C	NS
FR3100478	France	Falaises Du Cran Aux Oeufs Et Du Cap Gris-Nez, Dunes Du Chatelet, Marais De Tardinghen Et Dunes De Wissant	A	NS
FR3102002	France	Bancs Des Flandres	B	NS
FR3102005	France	Baie De Canche Et Couloir Des Trois Estuaires	C	NS
FR3102003	France	Recifs Gris-Nez Blanc-Nez	C	NS
FR3102004	France	Ridens Et Dunes Hydrauliques Du Detroit Du Pas-De-Calais	C	NS
DE0916391	Germany	NTP S-H Wattenmeer und angrenzende Küstengebiete	A	NS
DE1011401	Germany	SPA Östliche Deutsche Bucht	A	NS
DE1209301	Germany	Sylter Außenriff	A	NS
DE1003301	Germany	Doggerbank	B	NS
DE2104301	Germany	Borkum-Riffgrund	C	NS
DE1813391	Germany	Helgoland mit Helgoländer Felssockel	C	NS

Site code	Country	Site name	Grade of feature	IAMMWG MU
DE1714391	Germany	Steingrund	C	NS
NL2008001	Netherlands	Doggersbank	B	NS
NL2008002	Netherlands	Klaverbank	B	NS
NL2003062	Netherlands	Noordzeekustzone	B	NS
NL2008004	Netherlands	Noordzeekustzone II	B	NS
NL2008003	Netherlands	Vlakte van de Raan	B	NS
SE0510186	Sweden	Stora Middelgrund och Röde bank	B	NS
SE0520170	Sweden	Kosterfjorden-Väderöfjorden	C	NS
SE0520001	Sweden	Vrångöskärgården	C	NS
SE0510127	Sweden	Fladen	C	NS
SE0430092	Sweden	Kullaberg	C	NS
SE0510126	Sweden	Lila Middelgrund	C	NS

35. For harbour and grey seal, the initial screening process considered SACs and SCIs where the relevant species is a grade A, B or C feature and the Natura 2000 site it within a specific range of the project area.

36. For harbour seal, all Natura 2000 sites beyond 300km of the either EA3 or EA 4 are screened out of the HRA. The distance of 300km was used as harbour seal exhibit relative short foraging trips from their haul out sites. The range of these trips does vary depending on the surrounding marine habitat (e.g. 25km on the west of Scotland, Cunningham et al., 2009; 30km-45km in the Moray Firth (Tollit et al., 1998, Thompson and Miller, 1990). However, data from The Wash (from 2003- 2005) suggest that harbour seal travel further, and repeatedly forage between 75km and 120km offshore (with one seal travelling 220km; Sharples et al., 2008). Data from the Thames (from 2006) indicate most animals in this regions using short range trips, of 40km, but one animals did have a range of 660km from the southernmost to the northern most extent of its movements (Sharples et al., 2008). Although occasional longer trips do occur, these are often associated with young animals dispersing from sites, and are therefore not considered to indicate repeated connectivity between Natura 2000 sites and East Anglia THREE or East Anglia FOUR. As such, 300km was chosen as a suitable screening distance for connectivity. Table 3, below lists the Natura 2000 sites within 300km of East Anglia THREE and East Anglia FOUR.

37. In the case of grey seal, regular foraging and dispersal between winter breeding sites, and summer foraging and haul out sites can be much greater. As such, Table 4 lists the sites within 1000km of East Anglia THREE or East Anglia FOUR, which have been taken forward to the next stage of the assessment.

38. In both harbour and grey seal, telemetry data from the UK will be used to refine connectivity between tagged animals, use of the development areas for each

project, and use of Natura 2000 sites for hauling out or foraging in order to further screen out sites from the HRA.

Table 3 List of Natura 2000 sites designated for harbour seal to be taken forward to the HRA, following screening

Site code	Country	Site name	Grade of feature
BEMNZ0002	Belgium	SBZ 1 / ZPS 1	B
BEMNZ0003	Belgium	SBZ 2 / ZPS 2	B
BEMNZ0004	Belgium	SBZ 3 / ZPS 3	B
BEMNZ0005	Belgium	Vlakte van de Raan	B
DE1003301	Germany	Doggerbank **(EA 4 only)**	C
DE2104301	Germany	Borkum-Riffgrund	B
DE2306301	Germany	Nationalpark Niedersächsisches Wattenmeer	B
DE2507301	Germany	Hund und Paapsand	C
DE2507331	Germany	Unterems und Außenems	C
FR2200346	France	Estuaires Et Littoral Picards (Baies De Somme Et d'Authie)	A
FR3100474	France	Dunes De La Plaine Maritime Flamande	B
FR3100478	France	Falaises Du Cran Aux Oeufs Et Du Cap Gris-Nez, Dunes Du Chatelet, Marais De Tardinghen Et Dunes De Wissant	C
FR3100480	France	Estuaire De La Canche, Dunes Picardes Plaquees Sur L'ancienne Falaise, Foret D'hardelot Et Falaise D'equihen	C
FR3102002	France	Bancs Des Flandres	C
FR3102003	France	Recifs Gris-Nez Blanc-Nez	C
FR3102004	France	Ridens Et Dunes Hydrauliques Du Detroit Du Pas-De-Calais	C
FR3102005	France	Baie De Canche Et Couloir Des Trois Estuaires	A
NL1000001	Netherlands	Waddenzee	A
NL2007001	Netherlands	Eems-Dollard	B
NL2008001	Netherlands	Doggersbank	C
NL2008002	Netherlands	Klaverbank	C
NL2008003	Netherlands	Vlakte van de Raan	C
NL4000017	Netherlands	Voordelta	C
NL9803061	Netherlands	Westerschelde	C
UK0017075	United Kingdom	The Wash and North Norfolk Coast	A

Table 4 List of Natura 2000 sites designated for harbour seal to be taken forward to the HRA, following screening

Site code	Country	Site name	Grade of feature
BEMNZ0002	Belgium	SBZ 1 / ZPS 1	B
BEMNZ0003	Belgium	SBZ 2 / ZPS 2	B
BEMNZ0004	Belgium	SBZ 3 / ZPS 3	B
BEMNZ0005	Belgium	Vlakte van de Raan	C
DE0916391	Germany	NTP S-H Wattenmeer und angrenzende Küstengebiete	A
DE1011401	Germany	SPA Östliche Deutsche Bucht	A
DE1115391	Germany	Dünenlandschaft Süd-Sylt	C
DE1209301	Germany	Sylter Außenriff	A
DE1251301	Germany	Adlergrund	C
DE1315391	Germany	Küsten- und Dünenlandschaften Amrums	B
DE1343301	Germany	Plantagenetgrund	C
DE1345301	Germany	Erweiterung Libben, Steilküste und Blockgründe Wittow und Arkona	C
DE1346301	Germany	Steilküste und Blockgründe Wittow	C
DE1447302	Germany	Jasmund	C
DE1540302	Germany	Darßer Schwelle	C
DE1541301	Germany	Darß	C
DE1542302	Germany	Recknitz-Ästuar und Halbinsel Zingst	B
DE1544302	Germany	Westrügensche Boddenlandschaft mit Hiddensee	C
DE1647303	Germany	Granitz	C
DE1648302	Germany	Küstenlandschaft Südostrügen	C
DE1714391	Germany	Steingrund	A
DE1747301	Germany	Greifswalder Bodden, Teile des Strelasundes und Nordspitze Usedom	C
DE1749301	Germany	Greifswalder Oie	C
DE1749302	Germany	Greifswalder Boddenrandschwelle und Teile der Pommerschen Bucht	C
DE1813391	Germany	Helgoland mit Helgoländer Felssockel	A
DE1934302	Germany	Wismarbucht	C
DE1934303	Germany	Erweiterung Wismarbucht	C
DE2031301	Germany	Küste Klützer Winkel und Ufer von Dassower See und Trave	C
DE2104301	Germany	Borkum-Riffgrund	C
DK002X110	Denmark	Saltholm og omliggende hav	B
DK003X202	Denmark	Hesselø med omliggende stenrev	B
DK006X238	Denmark	Smålandsfarvandet nord for Lolland, Guldborg Sund, Bøtø Nor og Hyllekrog-Rødsand	B
DK00AY176	Denmark	Vadehavet med Ribe Å, Tved Å og Varde Å vest for Varde	A
DK00DX146	Denmark	Anholt og havet nord for	A
DK00DY156	Denmark	Horsens Fjord, havet øst for og Endelave	B
DK00FX010	Denmark	Strandenge på Læsø og havet syd herfor	B
DK00FX113	Denmark	Hirsholmene, havet vest herfor og Ellinge Å's udløb	C

Site code	Country	Site name	Grade of feature
DK00VA347	Denmark	Sydlige Nordsø	B
FR2500079	France	Chausey	C
FR3100478	France	Falaises Du Cran Aux Oeufs Et Du Cap Gris-Nez, Dunes Du Chatelet, Marais De Tardinghen Et Dunes De Wissant	B
FR3102003	France	Recifs Gris-Nez Blanc-Nez	C
FR3102005	France	Baie De Canche Et Couloir Des Trois Estuaires	B
FR5300009	France	Cote De Granit Rose-Sept-Iles	B
FR5300010	France	Tregor Goëlo	C
FR5300015	France	Baie De Morlaix	C
FR5300017	France	Abers - Côtes Des Legendes	C
FR5300018	France	Ouessant-Molene	A
FR5300019	France	Presqu'ile De Crozon	C
FR5300020	France	Cap Sizun	B
FR5300023	France	Archipel Des Glenan	C
FR5400469	France	Pertuis Charentais	C
FR7200811	France	Panache De La Gironde Et Plateau Rocheux De Cordouan (Système Pertuis Gironde)	C
IE0000101	Ireland	Roaringwater Bay and Islands	C
IE0000147	Ireland	Horn Head and Rinclevan	C
IE0000190	Ireland	Slieve Tooey/Tormore Island/Loughros Beg Bay	B
IE0000204	Ireland	Lambay Island	B
IE0000278	Ireland	Inishbofin and Inishshark	B
IE0000328	Ireland	Slyne Head Islands	C
IE0000495	Ireland	Duvillaun Islands	A
IE0000507	Ireland	Inishkea Islands	B
IE0000707	Ireland	Saltee Islands	B
IE0002172	Ireland	Blasket Islands	A
NL1000001	Netherlands	Waddenzee	A
SE0330123	Sweden	Värnanäs skärgård	C
SE0330174	Sweden	Sydöstra Ölands sjömarker	C
SE0410040	Sweden	Utklippan	C
SE0430095	Sweden	Falsterbohalvön	C
UK0012694	United Kingdom	Monach Islands	A
UK0012696	United Kingdom	North Rona	B
UK0012712	United Kingdom	Cardigan Bay/ Bae Ceredigion	C
UK0013114	United Kingdom	Lundy	C
UK0013116	United Kingdom	Pembrokeshire Marine/ Sir Benfro Forol	B
UK0013117	United Kingdom	Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau	C
UK0013694	United Kingdom	Isles of Scilly Complex	C
UK0017072	United Kingdom	Berwickshire and North Northumberland Coast	B
UK0017096	United Kingdom	Faray and Holm of Faray	B
UK0030170	United Kingdom	Humber Estuary	C
UK0030172	United Kingdom	Isle of May	B

Site code	Country	Site name	Grade of feature
UK0030289	United Kingdom	Treshnish Isles	B

7 REFERENCES

Cunningham, L., Baxter, J. M., Boyd, I. L., Duck, C. D., Lonergan, M., Moss, S. E. & McConnell, B. (2009). Harbour seal movements and haul-out patterns; implications for monitoring and management. Aquatic Conservation: Marine and Freshwater Ecosystems, 19, 398 – 407.

Hammond P.S., Macleod K., Berggren P., Borchers D.L., Burt L., Cañadas A., Desportes G., Donovan G.P., Gilles A., Gillespie D., Gordon J., Hiby L., Kuklik I., Leaper R., Lehnert K, Leopold M., Lovell P., Øien N., Paxton C.G.M., Ridoux V., Rogano E., Samarraa F., Scheidatg M., Sequeirap M., Siebertg U., Skovq H., Swifta R., Tasker M.L., Teilmann J., Canneyt O.V. & Vázquez J.A. (2013) Cetacean abundance and distribution in European Atlantic shelf waters to inform conservation and management. Biological Conservation, 164; 107-122.

IAMMWG, 2013. Management Units for marine mammals in UK waters (June 2013).

JNCC and Natural England (2013) 'Suggested Tiers for Cumulative Impact Assessment

Jones, E., McConnell, B., Sparling, C., and Matthiopoulos, J. 2013. , Grey and harbour seal density maps. Marine Mammal Scientific Support. Research Programme MMSS/001/11. Available at: http://www.scotland.gov.uk/Resource/0041/00416981.pdf

Sharples R. J., J. Matthiopoulos and P. S. Hammond. 2008. Distribution and movements of harbour seals around the coast of Britain: Outer Hebrides, Shetland, Orkney, the Moray Firth, St Andrews Bay, The Wash and the Thames Report to DTI July 2008

Thompson, P. M. and Miller, D. 1990. Summer forgaing activity and movements of radio tagged common seals (Phoca vitulina) in the Moray Firth, Scotland. Journal of Applied Ecology, 63, 24-30.

Tollit, D. J., Black, A. D., Thompson, P. M., Mackay, A., Corpe, H. M., Wilson, B., Van Parjis, S. M., Grellier, K. & Parlane, S. (1998). Variations in harbour seal Phoca vitulina diet and dive-depths in relation to foraging habitat. Journal of Zoology 244, 209 -222.

APPENDIX A: APPROACH TO IMPACT ASSESSMENT – DEFINING VALUE, SENSITIVITY, MAGNITUDE AND SIGNIFICANCE

1. The impact assessment will consider the potential for significant impacts to occur in EIA terms where there may be the potential for biologically significant effects to occur at the reference population level.

2. A matrix approach will be used following best practice and EIA guidance to assess impacts (Table 1). Impacts assessed as moderate or major may have the potentially to have significant reference population level consequences, and are therefore potentially significant in EIA terms.

3. The impact matrix considers the sensitivity (Table 2) of the individual receptor to each impact, placed in context by the magnitude (Table 3) of the predicted effect.

4. Receptor sensitivity for an individual from each marine mammal species will be defined within the ES in relation to each impact following the generic definitions as set out in Table 2.

Table 1: 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

Table 2: Definition of terms relating to the sensitivity of marine mammals.

Sensitivity	Definition
High	Individual receptor has very limited capacity to avoid, adapt to, accommodate or recover from the anticipated impact.
Medium	Individual receptor has limited capacity to avoid, adapt to, accommodate or recover from the anticipated impact.
Low	Individual receptor has some tolerance to avoid, adapt to, accommodate or recover from the anticipated impact.
Negligible	Individual receptor is generally tolerant to and can accommodate or recover from the anticipated impact.

Table 3: Definition of terms relating to the magnitude of anticipated effect on marine mammals

Magnitude of effect	Definition
High	Permanent irreversible change to exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that >1% of the reference population are anticipated to be exposed to the effect. OR Temporary effect (limited to phase of development or Project timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that >10% of the reference population are anticipated to be exposed to the effect.
Medium	Permanent irreversible change to exposed receptors or feature(s) of the habitat of particular importance to the receptor. Assessment indicates that >0.01% or <=1% of the reference population anticipated to be exposed to effect. OR Temporary effect (limited to phase of development or Project timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that >5% or <=10% of the reference population anticipated to be exposed to effect.
Low	Permanent irreversible change to exposed receptors or feature(s) of the habitat of particular importance to the receptor. Assessment indicates that >0.001 and <=0.01% of the reference population anticipated to be exposed to effect. OR Intermittent and temporary effect (limited to phase of development or Project timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that >1% or <=5% of the reference population anticipated to be exposed to effect.
Negligible	Permanent irreversible change to exposed receptors or feature(s) of the habitat of particular importance to the receptor. Assessment indicates that <=0.001% of the reference population anticipated to be exposed to effect. OR Intermittent and temporary effect (limited to phase of development or Project timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that <=1% of the reference population anticipated to be exposed to effect.

5. The sensitivity of marine mammals to impacts from pile driving noise will be considered within the ES in more detail, as this is currently the impact of most concern across the offshore wind sector.

6. The sensitivity to potential impacts of lethality, physical injury, auditory injury or hearing impairment, as well as behavioural disturbance or auditory masking will be considered for each species, using available evidence including published data sources, and any uncertainty in sensitivity will be discussed, and justified.

7. The value of each receptor is not considered explicitly within the impact matrix in this assessment; often sensitivity/value definitions are combined within the matrix. Instead the value of the receptor will be considered in the defining the magnitude of effect.

8. A large number of marine mammal species fall within international legislative policy through the Habitats Directive; all cetaceans in UK waters are EPS and grey and harbour seals are also afforded international protection through the designation of Natura 2000 sites. Therefore, potentially all marine mammal receptors considered in this assessment will be of high value individually, or form part of high value populations. It is therefore appropriate to consider any available guidance or evidence which outlines what could be defined as a 'significant' to these European designated species or populations.

9. Therefore, the thresholds defining each level of magnitude of effect have been determined using expert judgement, current scientific understanding of marine mammal population biology, and JNCC et al. (2008) draft guidance on disturbance to EPS species.

10. The JNCC et al. (2008) EPS draft guidance suggests definitions for a 'significant group' of individuals or proportion of the population for EPS species. As such this guidance has been considered in defining the thresholds for magnitude of effects. In the assessment, temporary effects are considered to be of medium magnitude at greater than 5% of the reference population. JNCC et al. (2008) draft guidance considered 4% as the maximum level of mortality that could be sustained by a population of most species of cetacean.

11. JNCC et *al*. (2008) also considers that:

'for a significant effect on the local distribution or abundance of a species to occur, disturbance would need to produce more than a transient effect, and result in detrimental deviation from the natural variability on the spatio-temporal distribution and abundance of the species and its population within its natural range'

12. Furthermore, JNCC et al. considers either 2% or 4% a suitable threshold for determine significance of disturbance in species or populations with Favourable Conservation Status (FCS).

13. In assigning 5% to a temporary impact in this assessment, consideration is given to uncertainty of the individual consequences of temporary impacts in comparison to a 4% or 2% level for sustainable 'mortality' or a 'more than transient effect' as defined by JNCC et al., (2008).

14. In this assessment permanent effects to greater than 1% of the reference population are considered to be high magnitude. Again, the assignment of these thresholds is informed by the JNCC et al. (2008) draft guidance (suggesting that between 2% and 4% as significant), but it also reflects the large amount of uncertainty in the potential individual and population level consequences of any permanent effects.

15. The assessment also considers any uncertainty as to what may be the potential rate of increase in a population. For example, population modelling of harbour porpoise in the North Sea conducted as part of the SCANS II project (Winship 2009) suggests relatively low rates of potential increase in this population; Even in the absence of by-catch, growth rates were estimated to be approximately 0% (95% probability interval of -6% to +5%) or around 2% (95% probability interval of 0 to 7%) depending on the population model used.

Example

16. The use of disturbance to harbour porpoise from pile driving is considered here as an example of how the definition of sensitivity to impact, and magnitude of effect will combine in the overall level of assessment of significance.

17. Although there is not as great deal of understanding as to the biological consequences of noise related disturbance in harbour porpoise, some available behavioural response studies (Tougaard et al. 2006; Thomsen et al. 2006, Thompson et al., 2013) , and physiology studies (Kastelein et al. 1997) can be used to support the definition of harbour porpoise as having medium sensitivity to disturbance from pile driving noise; the 'Individual receptor has limited capacity to avoid, adapt to, accommodate or recover from the anticipated impact'. As such, if we consider a temporary disturbance to >5% of the reference population the magnitude of effect is considered medium. Using the impact matrix (Table 1) the assessment would conclude a moderate impact, which is considered potentially significant in EIA terms.

18. It should be noted that this approach will flag the potential for a significant effect at the population level, and in EIA terms once disturbance to more than 5% of the

reference population occurs. However, the individual biological consequences and therefore nay long-term population level effects of any such disturbance as already discussed are not well understood. However, it is anticipated that the interim Population Consequences of Disturbance (PCoD) model which is currently being developed will help in further predicting what these consequences may be.

APPENDIX B: METHODS STATEMENT – AERIAL SURVEY

Overview

1. 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

2. 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.

3. 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.

4. 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

5. 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)

6. 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.

Quality Assurance (QA) Procedure

7. 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.

8. Both internal and external quality assurance (QA) are carried out on each survey. SMRU Marine carries out the external QA for marine mammals. 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 / or marine mammals 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.

APPENDIX C: EXISTING ENVIRONMENT

1.1 APEM surveys

1.1.1 Summary of species, densities and reference populations used in the assessment

1. Note that due to the on-going surveys for East Anglia FOUR a full data set is not yet available, we would seek to follow the same approach for those data once ready.

2. Note that this appendix is based on draft reports and there may be slight variations in the final figures presented for the ES.

3. A large number of sightings (44% within the East Anglia THREE site, and 47% within the East Anglia THREE site plus buffer) could not be identified to species. In such cases different groupings were used to classify the sightings to the highest level of identification that could be obtained. Table C.1 provides a summary of the marine mammal identification levels assigned by APEM.

Table C.1 Marine mammals identification levels according to species and species groups used within baseline report.

<table>
<tr><th>Identification level 1</th><th>Identification level 2</th><th>Identification level 3</th><th>Identification level 4</th><th>Identification level 5</th></tr>
<tr><td rowspan="7">Unidentified cetacean species</td><td rowspan="7">Unidentified dolphin/ porpoise</td><td colspan="3">Harbour porpoise Phocoena phocoena</td></tr>
<tr><td rowspan="6">Unidentified dolphin species</td><td colspan="2">Risso’s dolphin Grampus griseus</td></tr>
<tr><td colspan="2">Bottlenose dolphin Tursiops truncatus</td></tr>
<tr><td rowspan="4">Unidentified patterned dolphin species</td><td>White-beaked dolphin Lagenorhynchus albirostris</td></tr>
<tr><td>Atlantic white-sided dolphin Lagenorhynchus acutus</td></tr>
<tr><td>Common dolphin Delphinus delphis</td></tr>
<tr><td>Striped dolphin Stenella coeruleoalba</td></tr>
<tr><td rowspan="2">Phocid species</td><td colspan="4">Grey seal Halichoerus grypus</td></tr>
<tr><td colspan="4">Harbour seal Phoca vitulina</td></tr>
</table>

4. Harbour porpoise were the most frequently sighted species in the surveys, and it is possible that a large number of the unidentified dolphin/porpoise sightings are indeed harbour porpoise. Therefore, a maximum estimate of abundance and density based on the combined sightings of harbour porpoise, and unidentified dolphin/porpoise has also been calculated.

5. A large number of sightings were also made below the surface. Correction factors for availability for photographic capture are not available for sightings below the surface. As such, in order to make the most robust estimates (approximating absolute abundance and absolute density) for use in the impact assessment the sightings data were analysed in two ways. Initial estimates were made of abundance and density using all of the sightings (above and below the surface). Secondly, where species identification was possible (or assumed in the case of dolphin/porpoise being harbour porpoise) surface sightings only were considered, which were then corrected for the proportion of animals likely to be below the surface during the survey. The correction factors (Table C.2) are based on those in the phase II, Joint Cetacean Protocol Report (Paxton *et al*., 2011), and are reflective of 'instantaneous availability' where all animals at the surface are assumed to be 'captured' in the digital image.

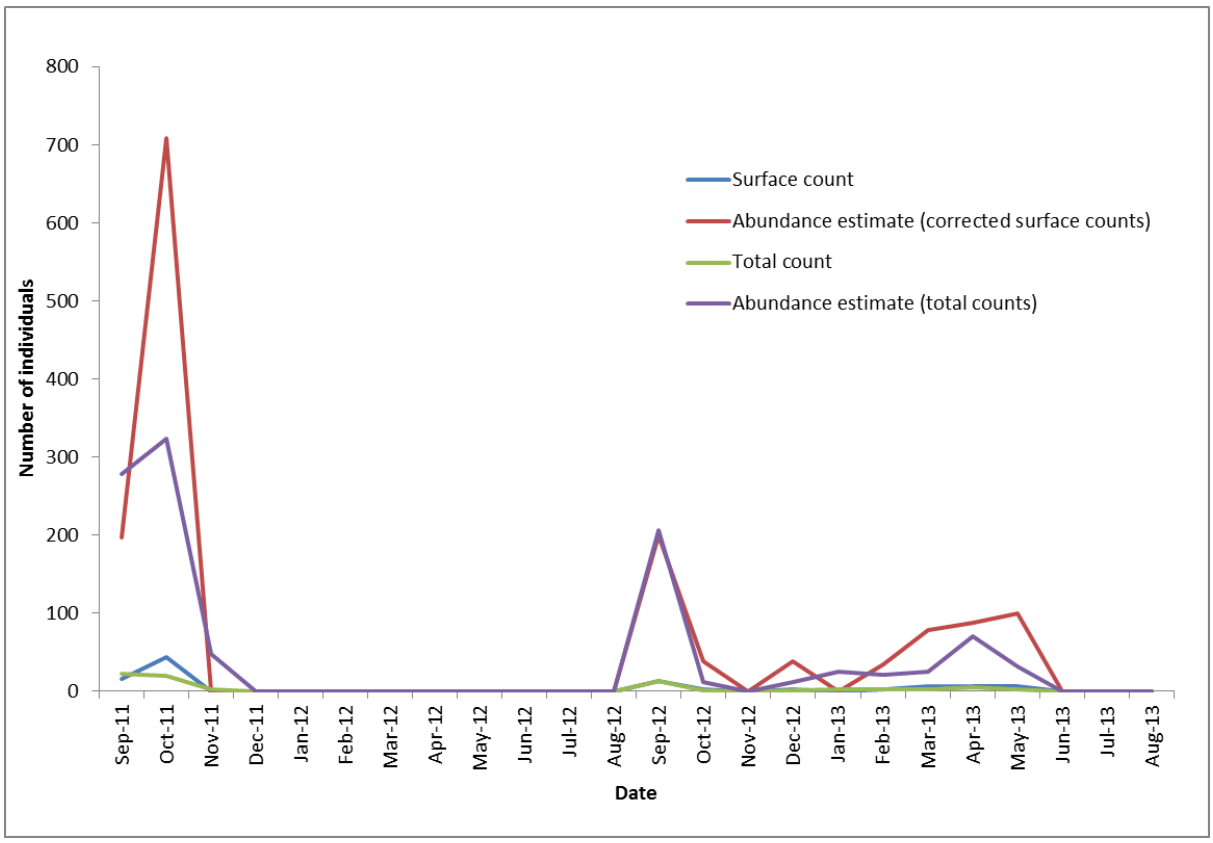
Table C.2 Marine mammal correction factors

Species	Correction factor
Harbour porpoise	0.32
White-beaked dolphin	0.11
Common dolphin	0.63

1.1.2 Harbour porpoise

6. Harbour porpoise were the most frequently sighted species of cetacean on the East Anglia THREE site and buffer. Diagram C1 shows the surface counts and total counts, and estimate of abundance within the East Anglia THREE site based on the total counts and the corrected surface counts.

Diagram C1 Counts of harbour porpoise and estimates of abundance in East Anglia THREE site



7. Diagram C2 provides estimates of abundance each month based on the total sightings and the corrected surface sightings data. The average densities across the entire survey period are also shown as dashed lines.

8. Estimates of abundance (Diagram C3) and density for each month, and averaged over the survey period (Diagram C4), have been calculated for the East Anglia THREE site and East Anglia THREE site plus buffer area combined.

9. Sightings of harbour porpoise in the East Anglia THREE site and in the East Anglia THREE site plus buffer appear to peak in August-October in each survey year, but also remain high in spring 2013.

10. The estimates of abundance peak within the site in October 2011 at 709 (95% CI 303-1,163) based on the corrected surface counts, or 324 (95% CI 178- 485) based on the total counts. This indicates that a large proportion of the sightings were at the surface. These site specific abundance estimates provided peak estimates of density on October 2011 of 1.914 harbour porpoise per km^2 and 0.874 harbour porpoise per km^2 respectively.

11. Abundance estimates were higher when the buffer area was included due to the increase in survey area.

12. Estimates of average harbour porpoise density across the survey period were 0.167 harbour porpoise per km^2 and 0.118 harbour porpoise per km^2 based on the corrected surface counts, and the total counts respectively. The estimates of average density for the East Anglia THREE site and East Anglia THREE site plus buffer were 0.187 harbour porpoise per km^2 and 0.136 harbour porpoise per km^2 based on the corrected surface counts, and the total counts respectively.

13. **It is therefore proposed that higher average density estimate of 0.187 harbour porpoise per km^2 based on the corrected surface counts will be used in the impact assessment.**

Diagram C2 Estimates of harbour porpoise density in East Anglia THREE site

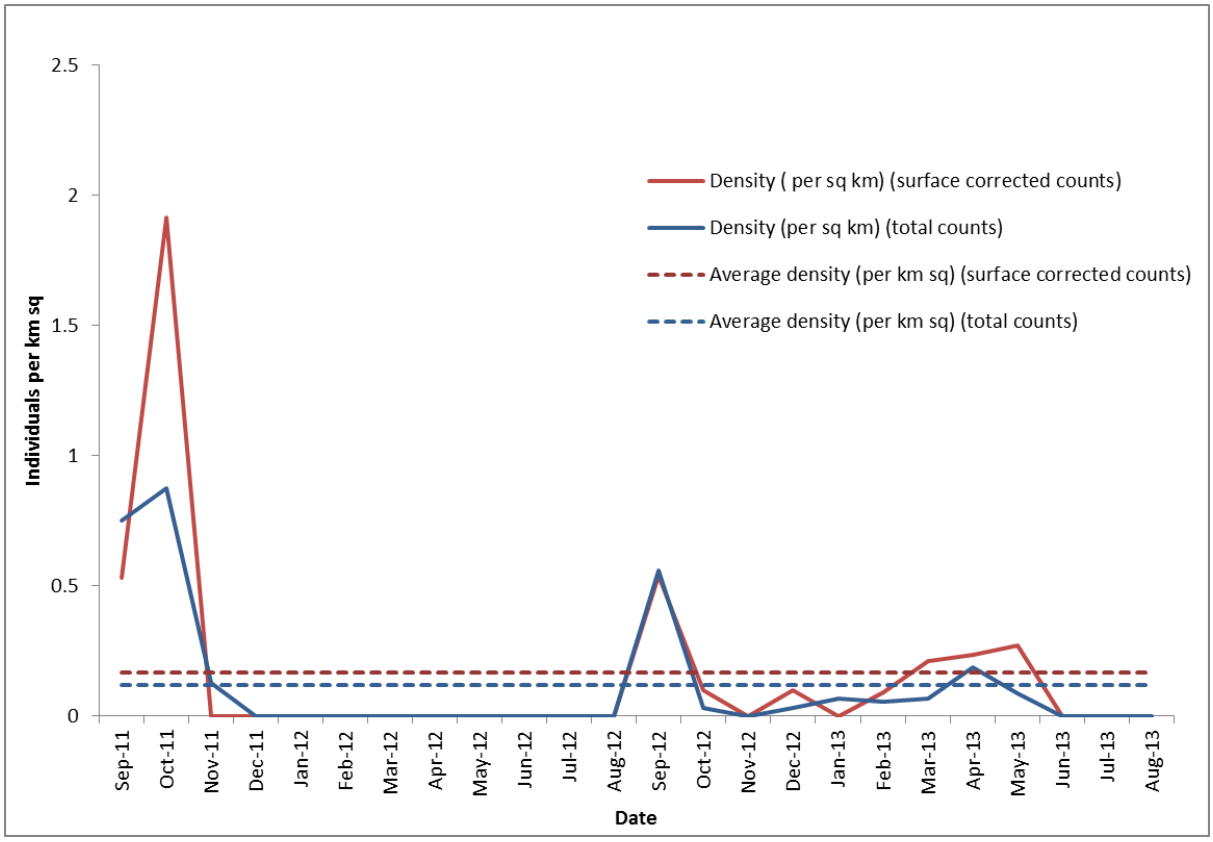


Diagram C3 Counts of harbour porpoise and estimates of abundance in East Anglia THREE site plus buffer

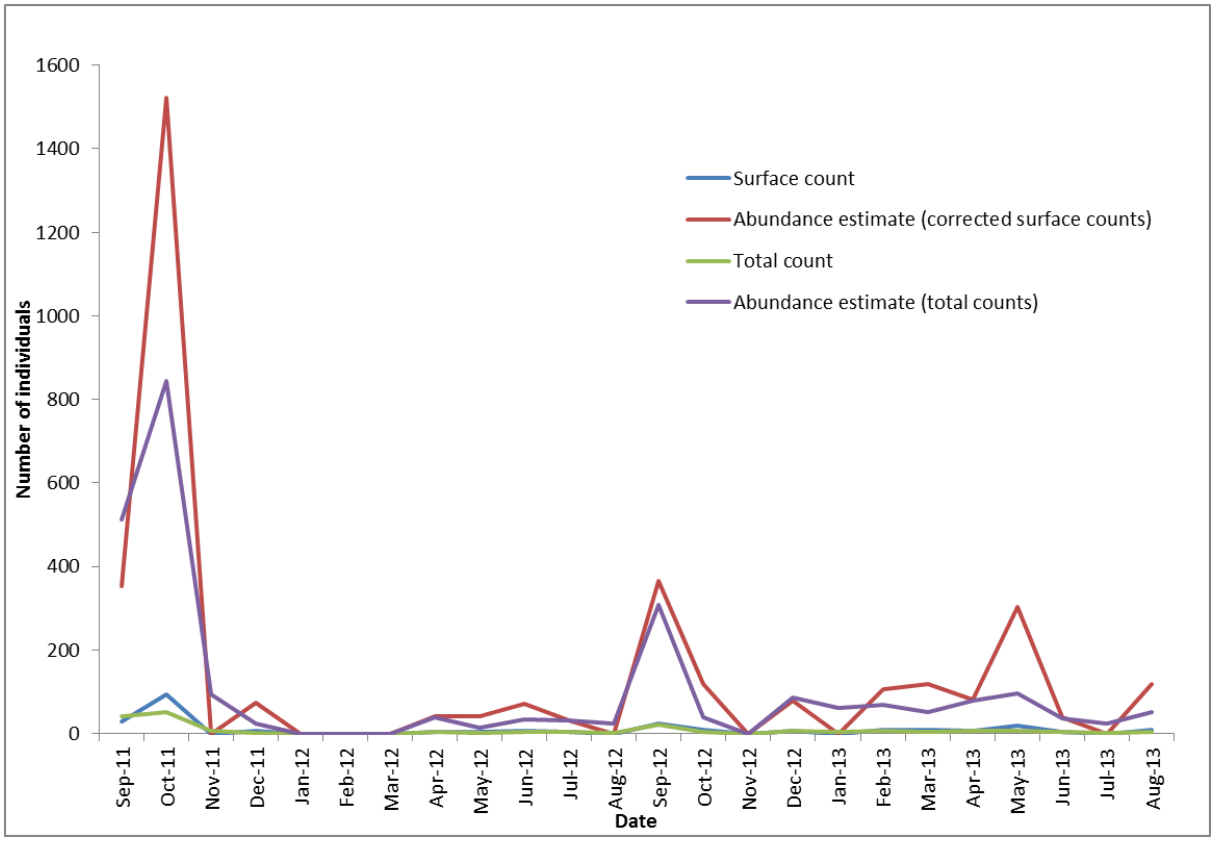
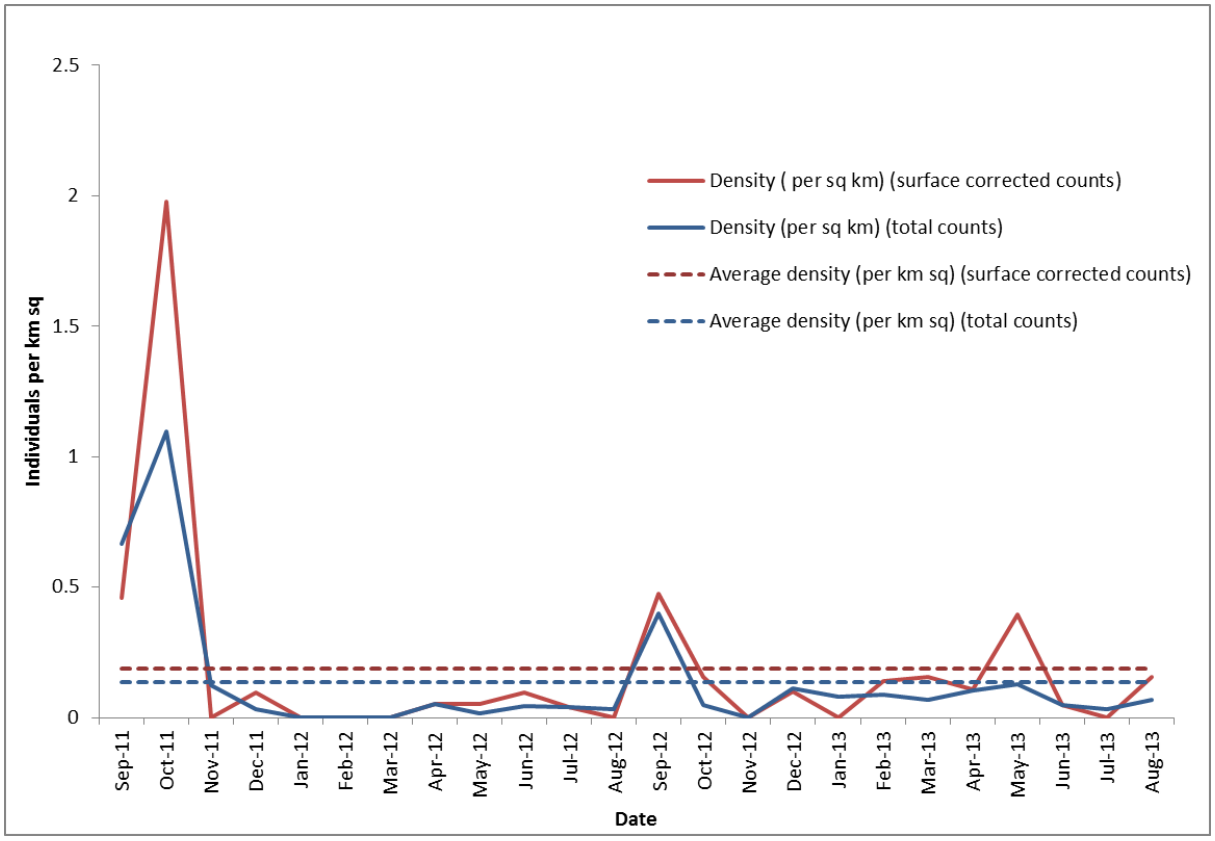


Diagram C4 Estimates of harbour porpoise density in East Anglia THREE site plus buffer



1.1.3 Unidentified dolphin/porpoise

14. A large number of sightings were made of unidentified dolphin/porpoise. Details of the sightings per month and corresponding estimates of abundance and density will be provided in an appendix to the ES. However, the counts of these individuals have been considered in combination with harbour porpoise sightings (see below).

1.1.4 Harbour porpoise and unidentified dolphin/porpoise

15. Estimates of abundance and density across the East Anglia THREE site, and across the East Anglia THREE site plus buffer have been generated from combining the harbour porpoise and unidentified dolphin/porpoise sightings to provide an estimate of maximum density of harbour porpoise. This maximum density will be considered the worst case harbour porpoise density for the impact assessment, and will be provided alongside the assessment based on harbour porpoise only densities.

16. Estimates of abundance across the East Anglia THREE site plus buffer are shown in Figure C5. Figure C6 provides estimates of density. The peak in sightings of harbour porpoise in October 2011 remains a large influence on the data, leading to peak estimates of density across the East Anglia THREE site plus buffer of 2.106 individuals per km^2 and 1.286 individuals per km^2 based on the corrected surface counts, and the total counts respectively.

Diagram C5 Counts and estimates of abundance of harbour porpoise and unidentified dolphin/porpoise in the East Anglia THREE site plus buffer

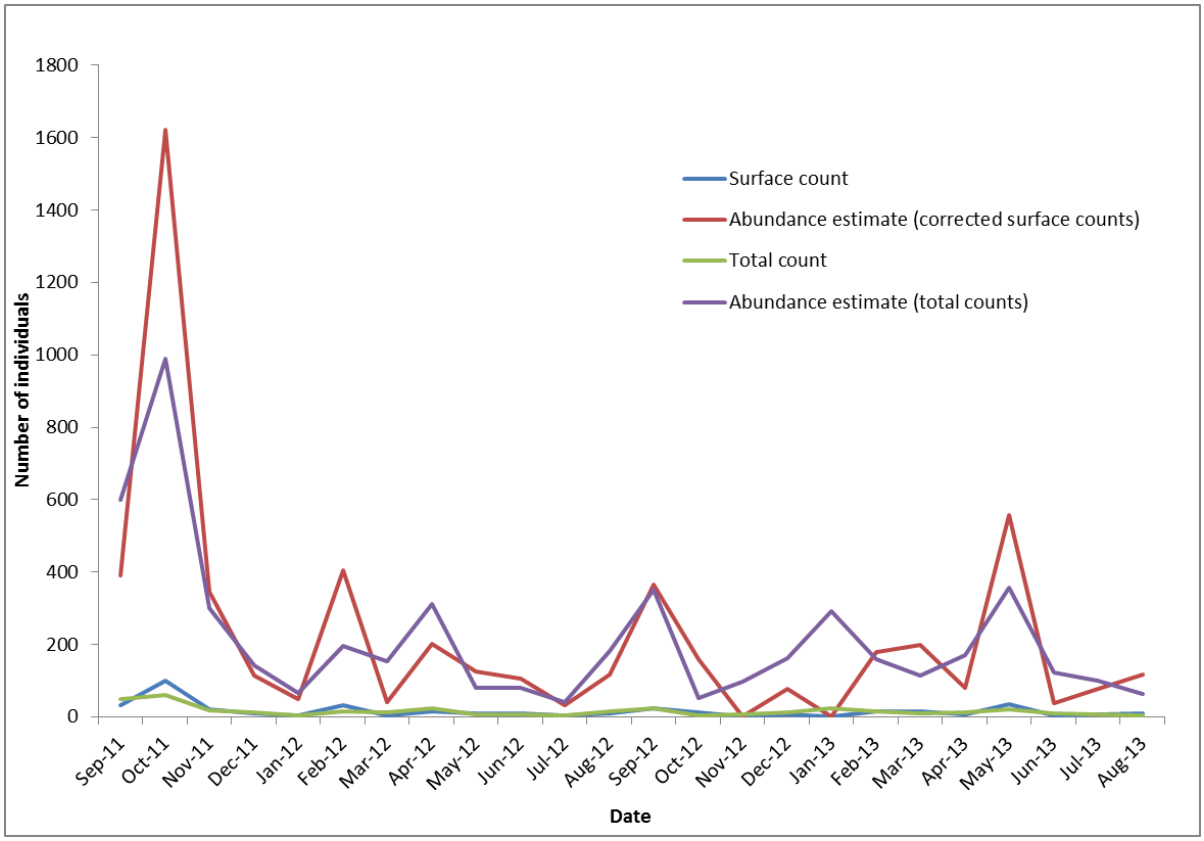
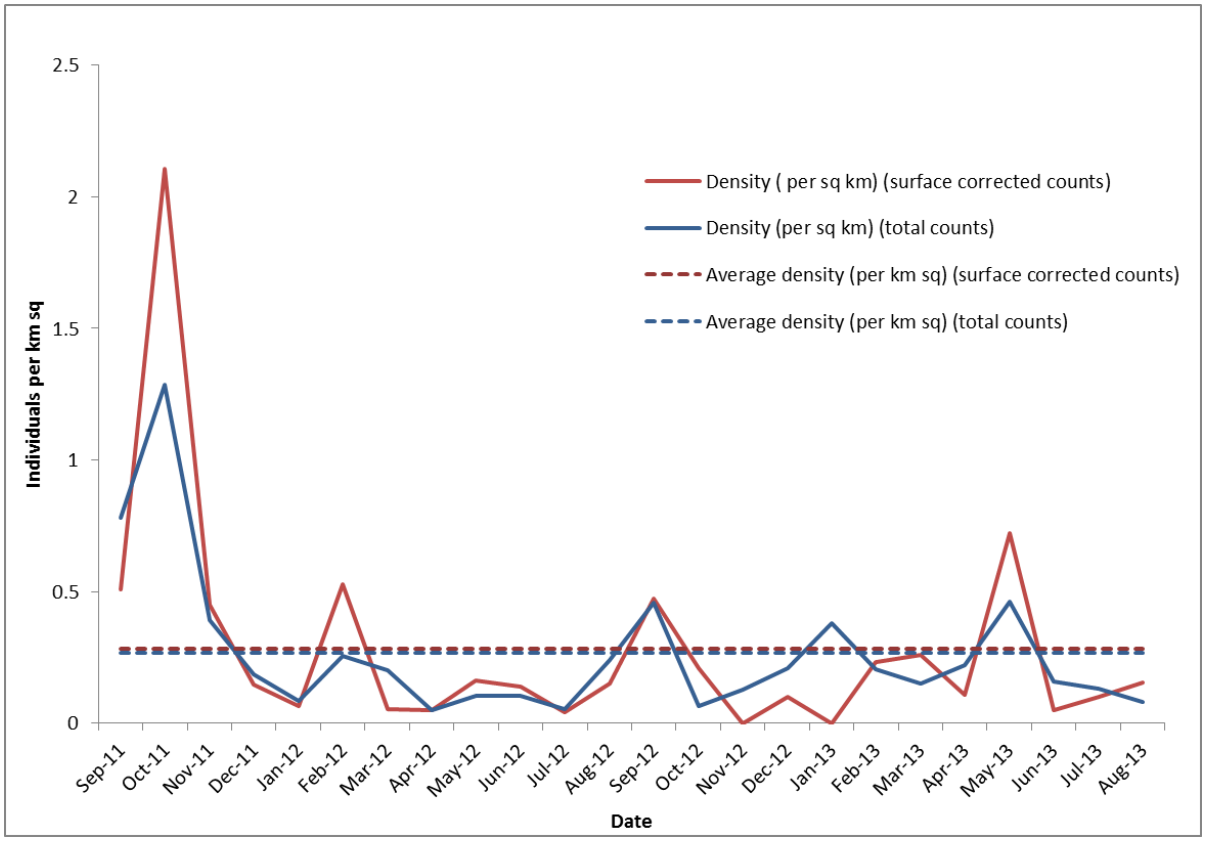


Diagram C6 Estimates of harbour porpoise and unidentified dolphin/porpoise density in the East Anglia THREE site plus buffer



17. Estimates of average density over the survey period across the East Anglia THREE site plus buffer were 0.284 individuals per km^2 and 0.266 individuals per km^2 based on the corrected surface counts, and the total counts respectively. The differences between the surface corrected counts and the total count estimates of density are smaller when the unidentified dolphin/porpoise sightings are included with the harbour porpoise data. This is unsurprising, as it is likely as a larger number of the sightings below the surface are harder to identify to species.

18. **It is therefore proposed that the higher estimate, based on the corrected surface counts will be used in the impact assessment (0.284 individuals per km^2).**

1.1.5 Minke whale

19. No large cetaceans which had the potential to be minke whale were sighted in the East Anglia THREE site or buffer during the aerial surveys.

20. **It is therefore proposed that this species will not be considered in the impact assessment.**

1.1.6 White-beaked dolphin

21. White beaked dolphin were only sighted in one month during the two year survey. A total of 65 dolphin were identified in January 2012within the East Anglia THREE site.

Although it is possible to calculate average abundance and densities from this single month of sightings. Given the sporadic nature of the sightings it is probably not appropriate to assume an average density over the entire survey period.

22. Furthermore there was no SCANS II generated densities for this species in survey block B which contains East Anglia THREE site.

23. **It is therefore proposed that this species will not be taken forward in the impact assessment.**

1.1.7 Common dolphin

24. There was only one sighting of a single common dolphin in December 2011.

25. **It is therefore proposed that this species will not be considered in the assessment.**

1.1.8 Bottlenose dolphin

26. No bottlenose dolphin were positively sighted during the aerial surveys of the site or buffer.

27. **It is therefore proposed that this species will not be considered in the impact assessment.**

1.1.9 Unidentified patterned dolphin

28. There was only one sighting (in August 2012) of an unidentified patterned dolphin. It is possible that this sighting was a white-beaked dolphin, Atlantic white-sided dolphin, common dolphin or striped dolphin. A number of white-beaked dolphin were positively identified during the surveys, and this species is being considered separately in the assessment, a single common dolphin was also identified. The single sighting of this unidentified species has not been incorporated into the baseline densities, as it is not possible to determine which species it is, and only one sighting will not greatly influence the data.

1.1.10 Phocids

29. There were only two sightings of phocids during the two year survey period, both sightings were in the buffer area in July 2011. Average densities over the whole survey period for all phocids was 0.0011 individuals per km^2.

30. As is not possible to differentiate between species using this survey method, it is proposed that the at sea densities of seals (Jones *et al*., 2013) will be used in the impact assessment (see ETG2 Paper paragraph 14).

1.1.11 Summary

31. Table C3 provides a summary of the species proposed to be forward in the impact assessment, the densities to be used in any quantitative assessment, and the reference populations for each species against which the impacts will be assessed.

Table C3: Species of cetacean considered in the impact assessment for East Anglia THREE, appropriate site specific densities and reference population size and extent

Species	Site specific density (see text for derivation)	Year of site specific estimate	SCANS II updated density (Hammond et al., 2013)	Year of density estimate	Reference population	Year of reference population estimate
Harbour porpoise	0.187	EA 3: Sept 2011-Aug 2013	0.331 (CV 0.38) (SCANS II survey block B)	2005	227,298 (CV 0.13; 95% CI 176,360 – 292,948) North Sea Management Unit (IAMMWG, 2013)	2005
Harbour porpoise and possible harbour porpoise combined	0.284			2005		2005

1.2 Reference populations for seal species

32. Preliminary data are available in a draft version of a report East Anglia Offshore Wind have commissioned from SMRU Marine. As the report is in draft form there may be slight variations in the final figures presented for the ES.

1.2.1 Harbour seal

33. Data from tagging in the UK (Diagram C7) show localised movement of harbour seal around The Wash, and Thames Estuary, all within the southeast England management unit (IAMMWG, 2013). The telemetry data suggest that it is unlikely that harbour seal in the East Anglia THREE site or East Anglia FOUR site originating from the UK will come from haul-out sites outside this management unit. There is also evidence that seals tagged at European haul-out sites may use the East Anglia THREE site or East Anglia FOUR site (preliminary data shown in Diagram C8).

34. **Therefore, it is proposed that the reference population of harbour seal for the impact assessment is based on the combination of the most recent population estimates of the southeast England management unit** (with a maximum haul-out count of 3,567 in 2011; IAMMWG, 2013) **and the Wadden Sea** (with a total count of 26,220 harbour seals in 2012, composed of 3,966 in Denmark, 9,268 in Schleswig-Holstein, 6,457 in Lower Saxony and Hamburg and 6,529 in the Netherlands, IMARES, 2012a).

35. These data give a minimum reference population estimate (based on the maximum haul-out counts) of 29,787.

36. Table C4 summarises the reference population and densities proposed to be used in the impact assessment.

1.2.2 Grey seal

37. Tagging data from the UK (Diagram C9 for pups and C10 for adults) and IMARES (Diagram C8) both show limited use of the East Anglia THREE and East Anglia FOUR site by grey seals. Defining the extent of a reference population for grey seals occurring in the East Anglia THREE or East Anglia FOUR sites is not as clear-cut as for harbour seal.

38. Occasional tracks of tagged seals do pass through the southern North Sea region, and individuals which have used haul-out sites in the Netherlands, have moved to the Thames area, the Farne Islands and Scottish waters. None of the seals tagged in the UK have hauled-out on the continent, but tracks in in the southern North Sea are from seals which have hauled-out further north along the UK coast in England and Scotland.

39. These tracks support the suggestion that any grey seals within the East Anglia THREE or East Anglia FOUR zone could be part of the wider North Sea population, extending to from mainland Europe to Scotland.

40. **As such, we propose that the reference population for grey seal in the impact assessment should be based on the combination of the southeast England, northeast England, and east coast (Scotland) management units (IAMMWG, 2013) and the Wadden Sea population.**

41. It is probable that grey seals also range from the Orkney and North coast management unit, and the Moray Firth (see Diagram C8) into the southern North Sea and waters surrounding the East Anglia Zone. However, increasing the extent and size of the reference population over this may represent an insufficiently precautionary approach in the assessment in order to deal with uncertainty.

42. Table C4 summarises the reference population and densities proposed to be used in the impact assessment.

Table C4: Species of seal considered in the impact assessment for East Anglia THREE, appropriate site specific densities and reference population size and extent

Species	Site specific density (maximum mean density from Jones et al., 2013)	Year of density estimate	Reference population extent	Reference population size	Year of reference population estimate
Harbour seal	East Anglia THREE 0.0004 per km^2 East Anglia FOUR 0.00001 per km^2	Telemetry data 1991-2012, and haul out data 1988-2012	UK southeast England management unit Plus Wadden Sea	3,567 Plus 26,220 **TOTAL =**	2011 2012

				29,787	
Grey seal	East Anglia THREE 0.015 per km^2 East Anglia FOUR 0.012 per km^2	Telemetry data 1991-2011 and haul out data 1988-2012	UK SE England NE England East coast (Scotland) Plus Wadden Sea	 10,350 7,800 6,800 4,039 **TOTAL = 28,989**	 2010/2011 2008/2011 2007/2011 2012

Diagram C7: The extent of tracks of all harbour seals tagged in the UK.

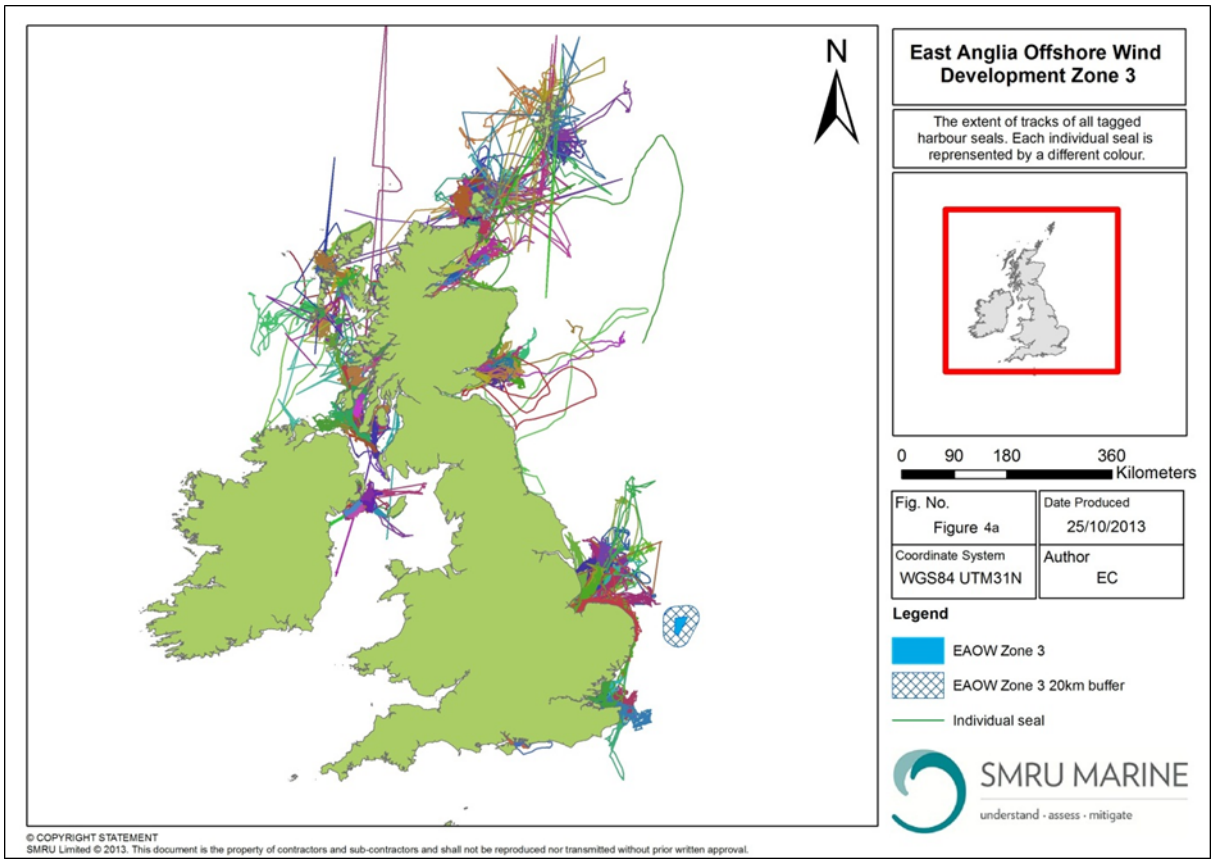


Diagram C8 Draft map showing the extent of harbour and grey seal tracks in UK waters that have been tagged by IMARES in Dutch waters.

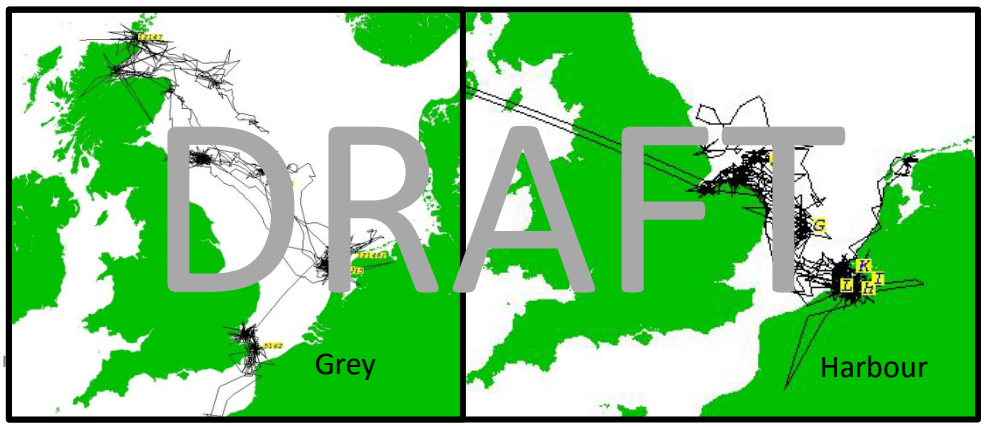


Diagram C9: The extent of tracks of all grey seal pups tagged in the UK.

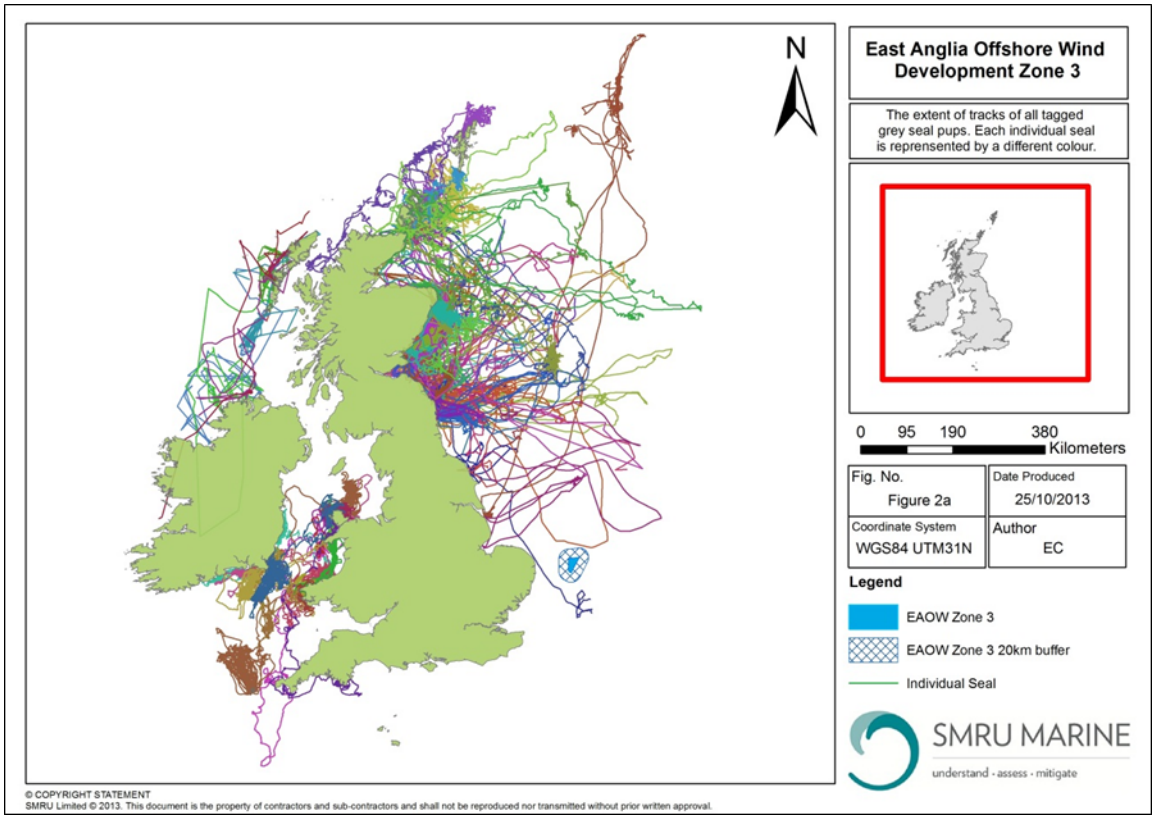
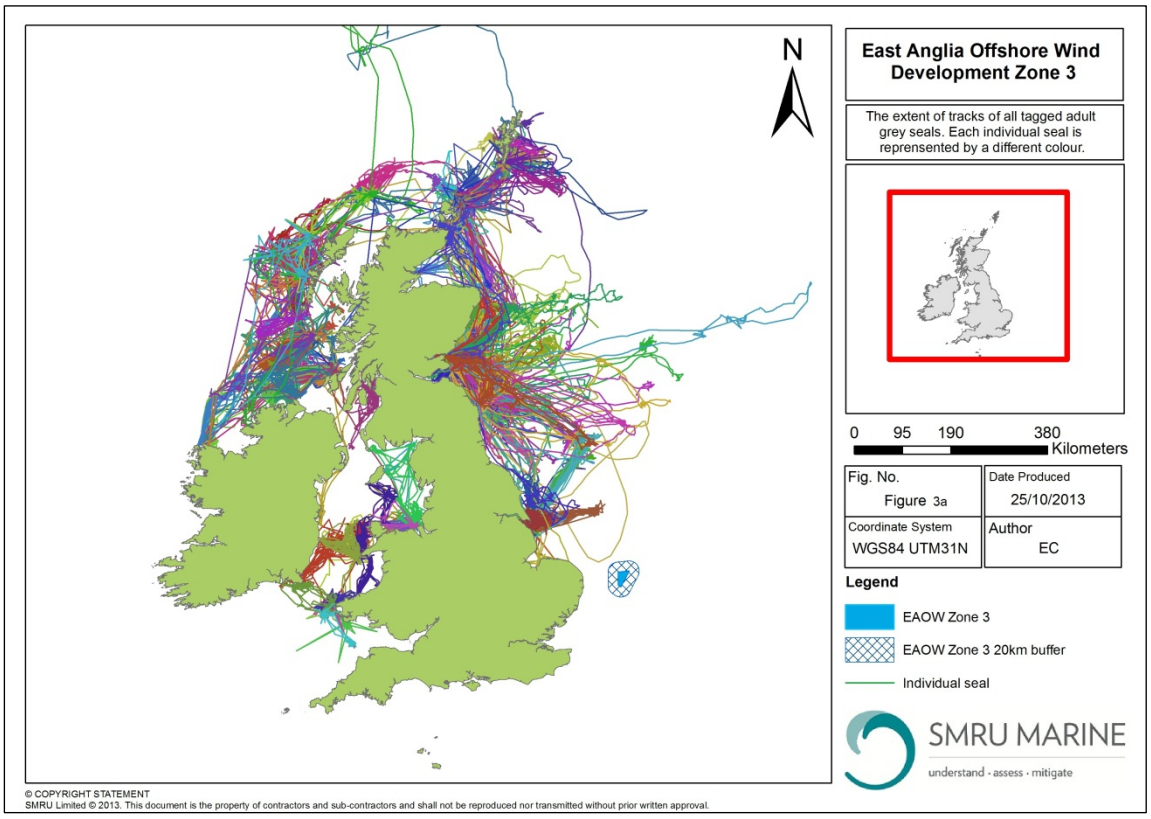


Diagram C10: The extent of tracks of all grey seal adults tagged in the UK.



1.3 References

Hammond P.S., Macleod K., Berggren P., Borchers D.L., Burt L., Cañadas A., Desportes G., Donovan G.P., Gilles A., Gillespie D., Gordon J., Hiby L., Kuklik I., Leaper R., Lehnert K, Leopold M., Lovell P., Øien N., Paxton C.G.M., Ridoux V., Rogano E., Samarraa F., Scheidatg M., Sequeirap M., Siebertg U., Skovq H., Swifta R., Tasker M.L., Teilmann J., Canneyt O.V. & Vázquez J.A. 2013. Cetacean abundance and distribution in European Atlantic shelf waters to inform conservation and management. Biological Conservation, 164:107–122.

IAMMWG, 2013. Management Units for marine mammals in UK waters (June 2013).

Jones, E., McConnell, B., Sparling, C., and Matthiopoulos, J. 2013. , Grey and harbour seal density maps. Marine Mammal Scientific Support. Research Programme MMSS/001/11. Available at: http://www.scotland.gov.uk/Resource/0041/00416981.pdf

Paxton, C.G.M, M. Mackenzie, M.L Burt, E. Rexstad & L. Thomas (2011). Phase II Data Analysis of Joint Cetacean Protocol Data Resource Centre for Research into Ecological and Environmental Modelling University of St Andrews August 2011

APPENDIX D: NOISE ASSESSMENT METHODOLOGY

Background

1. By convention, sound levels are expressed in decibels (dB) relative to a reference pressure, which is 1 µPa for underwater sound. Common parameters to describe the received level of a sound pulse are the zero to peak sound pressure level (hereafter referred to as peak pressure level) expressed in dB re 1 µPa, and the sound exposure level (SEL) expressed in dB re 1 $\mu Pa^2 \cdot s$ which is related to the energy contained in the sound pulse.

2. The output amplitude of a sound source is commonly described in terms of a source level, which may be considered to be the sound pressure level that would exist at a range of 1 m from the acoustic centre of an equivalent simple 'point' source which radiates the same acoustic power into the medium as the source in question in the absence of any boundary reflections. As with received level, the source level can be described in terms of peak pressure level source level (in dB re 1 µPa·m, often expressed as dB re 1 µPa at 1 m) or as an SEL source level (in dB re 1 $\mu Pa^2 \cdot s \cdot m^2$, often expressed as dB re 1 $\mu Pa^2 \cdot s$ at 1 m). It should be noted that for marine piling, the received level measured at 1 m would not be equivalent to the source level due to the complex sound field in such close proximity to the pile.

3. Another important characteristic of sound is its frequency, described as the number of oscillations per second. The unit of frequency is the hertz (Hz). The frequency range of applications in underwater acoustics is very large, with seismic exploration involving frequencies of less than 1 Hz, and with acoustic current profilers operating at frequencies of millions of hertz, for example, while marine piling tends to generate noise with most of the energy between around 100 Hz and 400 Hz, with the noise levels outside of this frequency range significantly reduced. It is common to see the frequency range divided up into third-octave bands. Third-octave bands are also commonly used in underwater acoustics as a convenient way of expressing the sound level as a function of frequency, where each band is one third of an octave, an octave representing a doubling of frequency.

4. To assess the impact on marine fauna of underwater noise resulting from wind farm construction requires:

   i) the received level as a function of distance from the source to be established; and
   ii) the assessment of the impact of these received levels against established criteria.

5. The proposed assessment methodology is designed to predict the received levels at distances away from the source as accurately as possible using well established, benchmarked, underwater acoustic propagation models and uses the current state-of-the-art noise impact criteria in the peer-reviewed literature for the specific noise types to establish the potential for impact of noise on marine mammals and fish.

6. The metrics that will be used during this assessment are peak pressure level and SEL which are suitable descriptors for impulsive sounds such as impact pile-driving. The use of these metrics maintains consistency with the Marine Strategy Framework Directive and widely accepted criteria for assessing impact on marine mammals and fish (Southall *et al*., 2007; FHWG, 2008), and are also consistent with the metrics described in the German and Dutch guidance documents (Mueller and Zerbs, 2011; De Jong et al, 2011).

Ambient noise

7. Underwater ambient noise levels are subject to substantial variability depending on a number of natural and anthropogenic factors. Factors such as sea-state, rain, surf noise in coastal waters, movement of seabed material during tidal flows, shipping traffic and marine animal vocalisations all influence ambient noise levels. These often lead to a diurnal and seasonal variation in the natural ambient noise level in the oceans or regional seas and can also result in significant location dependency. The contributions of anthropogenic noise sources can also be highly variable depending on factors such as traffic in shipping lanes, oil & gas activity and fishing concentration for example.

8. This makes monitoring to establish a baseline difficult due to the large number of measurement locations needed and the long-term monitoring duration required to obtain a representative baseline. A DEFRA-funded project titled ‘Monitoring ambient noise for the Marine Strategy Framework Directive’ (project no. ME5210) is currently being completed by Cefas which should inform the requirement for ambient noise monitoring within the scope of the Marine Strategy Framework Directive.

9. There have been numerous ‘snap-shot’ measurements of ambient noise undertaken in the UK waters (Nedwell *et al*., 2007; Theobald *et al*., 2010; Robinson *et al*., 2011) which show substantial variability based on location and time, thus providing a guide to the range of ambient noise which might be expected, although these are generally biased towards survey vessel measurements during ‘fair-weather’ conditions.

10. The expected trend in the local ambient noise conditions during the lifetime of the wind farm can be informed by an assessment of likely sources of noise and how

these may increase or change over time. Though available data is limited, current evidence indicates that deep-water ambient noise levels may have been increasing over the last few decades, and recent studies have indicated that there may have been a trend of increasing deep-ocean ambient noise as a result of shipping (McDonald *et al*., 2008). There is little data for shallow-water ambient noise for coastal shelf waters, but it is quite possible that an increase in shipping capacity and numbers in the future may result in an increase in ambient noise levels throughout the North Sea.

11. The assessment will aim to establish if ambient noise levels in and around the wind farm area are likely to be consistent with the variation seen in the previous data.

Modelling of piling noise

12. To predict the received level as a function of range from the source requires both the source level and the propagation or transmission loss to be known. If these are known then the received level (RL) is simply calculated by:

$$RL = SL - PL,$$

where SL is the source level which describes the sound radiated into the acoustic far-field, and PL is the propagation loss expressed as a positive number in dB (dependent on frequency, seabed, bathymetry, *etc*.).

13. Numerical propagation models will be used to establish the received levels as a function of range, and as a function of depth in the water column; in addition, the modelling will be used to estimate the received levels resulting from use of multiple piling vessels, the dependence of sound levels on the hammer energy during the soft-start and the cumulative exposure resulting from the piling activity.

14. The primary model used for the long range propagation will employ an NPL implementation of the energy flux solution by Weston (1976) which is capable of propagation over large distances whilst accounting for range-dependent bathymetry, frequency-dependent absorption (Thorpe, 1967), surface scattering (Coates, 1988; Medwin and Clay, 1998; Ainslie *et al*., 1994) and seabed properties (Hamilton, 1980; Lurton, 2003). The NPL implementation of the Weston energy-flux model has been benchmarked, with good agreement, against other “standard” transmission loss models published in the literature, which are publically available, including the Range-dependent Acoustic Model (RAM) implementation of the parabolic equation solution (Collins, 1993) based on AcTUP V2.2L (Maggi and Duncan, 2010), an image source model (Urick, 1983), a wavenumber integration transmission loss model (OASES), and a normal mode model (Kraken).

15. The source level to be used in the models is derived from the SEL spectral source level published by Ainslie *et al*. (2012) from tens of hertz to a kilohertz, and scaled in level based on the hammer energy. The source level is then propagated out in third-octave bands to obtain the third-octave band received levels across the frequencies most relevant for the source in question.

16. The propagation models calculate the propagation loss, with proportionality to acoustic energy. For a pulse it is the SEL source level which is used to predict the received levels as a function of range (the SEL is proportional to pulse energy). The peak pressure level of the sound pulse generated by the impact piling will decay at a slightly higher rate compared to the energy in the pulse. This is due to the temporal dilation of the pulse that results from multiple reflections from the seabed and the sea surface as the sound pulse propagates. To allow the peak pressure level to be determined as a function of range, an extra loss term is applied to the Weston energy-flux model to account for the more rapid peak pressure level decay. This loss term is established using the OASES wavenumber integration transmission loss model to establish the difference in transmission loss between the pulse energy and the peak pulse pressure across bathymetry transects that are representative of the area being modelled.

17. The assessment will be undertaken for a number of locations chosen to represent the geographical extent of the wind farm boundary and to account for bathymetric features so as to suitably capture the variability in the regional underwater sound propagation. These will be modelled for the highest anticipated hammer energies employed for a given foundation, and will include lower energies likely during the soft-start period. This will inform of the variation in the potential impact ranges in relation to the hammer energy used.

18. The underwater noise modelling will also be used to illustrate the potential effect of multiple piling vessels operating concurrently within each project and with neighbouring projects within the zone which may have construction windows which overlap. A similar approach will also be taken to assess the potential for any cumulative effects with other offshore wind farm projects which have construction windows that may overlap temporally and may be close enough for the estimated impact zones to overlap.

Proposed injury and behavioural disturbance criteria for piling noise

19. The likely impacts are to be assessed on the basis of risk of physical injury (hearing damage) and behavioural disturbance. These will be presented as impact zones or zones of risk based on internationally accepted criteria (for example, the marine

mammal injury criteria proposed by the US Marine Mammal Criteria Group of the National Marine Fisheries Service (NMFS) (Southall *et al*., 2007)) and other state-of-the-art evidence available in the peer-reviewed literature, including empirical evidence based on observational studies.

20. For marine mammals, the criteria proposed by the NMFS Marine Mammal Criteria Group for mid and low-frequency cetaceans applied to pulse type sounds when considering construction noise from impact piling will be adopted (Southall *et al*., 2007). Due to the lack of information in the NMFS Marine Mammal criteria regarding high-frequency cetaceans for pulse type sounds, these will be supplemented with specific data for the harbour porpoise (*Phocoena phocoena*) (Lucke *et al*., 2009) and empirical evidence obtained from observational studies in Denmark (Brandt *et al*., 2011 and Tougaard *et al*., 2009). The observational study by Brandt *et al*. (2011) provides valuable information on avoidance duration of harbour porpoise which will be considered as part of the assessment.

21. The potential for cumulative sound exposure will also be considered and presented for marine mammals for illustration. This is useful for informing any increased risk of auditory injury to an animal in the form of permanent threshold shift (PTS) (Theobald *et al*., 2009; Lepper *et al*., 2011) from continued exposure, in addition to the risk of PTS associated with exposure to the first pile strike at close range. Whilst the summed up sound exposure can assume that the animal swims away at the commencement of the soft-start with a given swim speed (Otani *et al*., 2000), there are a number of knowledge gaps regarding the animal depth during fleeing, inter-pulse hearing recovery and effective quiet levels. Due to these knowledge gaps, calculating the potential for auditory injury from the summed up, cumulative, sound exposure over the piling duration will only be used for illustration purposes i.e. to assess the benefit of soft-start.

Other noise sources

22. Other noise will be considered qualitatively, using the available scientific literature to identify the likely noise levels associated with these sources and their resulting potential for impact. These other noise sources may include surface vessel movements, cable trenching and laying, installation of non-piled foundations etc. It should also be noted that some of these noise sources (i.e. support vessel movement) would also be associated with the operational phase of the wind farm along with the underwater noise from the operational turbines. These will be addressed in the same way using the scientific literature and available survey reports in the case of underwater noise from operational wind turbines.

Summary

23. The methodology adopted for the subsea noise assessment will be based on an open, traceable approach, using standard propagation models available in the peer-reviewed literature which produce absolute received levels which can be compared with measured data. Similarly, the criteria adopted for marine mammals will be based on relevant, state-of-the-art knowledge available in the literature, using peer-reviewed publications where possible. The limited data on which the applied criteria are based is acknowledged and any evidence which comes to light during the assessment process will be incorporated where possible, and the adoption of a realistic worst case project envelope will help ensure that the assessment is suitably precautionary. The estimation of absolute received levels in the assessment will allow openness so that any future criteria can be applied to the modelled data for comparison purposes if required.

References

Ainslie, M. A., Harrison, C. H. and Burns, P. W. (1994) "Reverberation modelling with INSIGHT. *Proc Institute of Acoustics*, 16, (6), 105-112.

Ainslie, M. A., de Jong, C. A. F., Robinson, S. P., Lepper, P. A., (2012) What is the Source Level of Pile Driving Noise in Water?, *The Effects of Noise on Aquatic Life, Advances in Experimental Medicine and Biology*, Vol. 730, edited by A. N. Popper and A, Hawkins, Springer, pp. 445-448.

Brandt, M., Diederichs, A., Betke, K. and Nehls, G. (2011) Responses of harbour porpoises to pile driving at the Horns Rev II offshore wind farm in the Danish North Sea. *Marine Ecology Progress Series*, 421, 205-216.

Coates, R. (1988) An Empirical Formula for Computing the Beckmann-Spizzichino Surface Reflection Loss Coefficient. *IEEE Trans Ultrason. Ferroelectr. Freq. Control,* 35(4), 522-523.

Collins, M. D. (1993) A split-step Pade solution for parabolic equation method. *J. Acoust. Soc. Am*. 93, pp. 1736-1742.

De Jong C. A. F., Ainslie M. A., Blacquière G. (2011) *Standard for measurement and monitoring of underwater noise, Part II: procedures for measuring underwater noise in connection with offshore wind farm licensing*, TNO Report TNO-DV 2011 C251.

FHWG (2008) Memorandum - *Agreement in Principle for Interim Criteria for Injury to Fish from Pile Driving Activities,* sent to NOAA, US Fish and Wildlife Service, Caltrans, California Dept. of Fish and Game, Oregon Dept of Trans. And Washington State Dept. of Trans.

Hamilton, E. L. (1980) Geoacoustic modeling of the sea floor. J. Acoust. Soc. Am., vol. 68(5), pp. 1313-1340.

Lepper, P. A., Pangerc, T. Robinson, S. P. and Theobald, P. D. (2011) Theoretical comparison of cumulative sound exposure estimates from jacket and tripod foundation construction. Proceedings 4th International Conference on Underwater Acoustic Measurement: Technologies and Results. Pp. 731-738.

Lucke, K., Siebert, U., Lepper, P. A. and Blanchet, M. A. (2009) Temporary shift in masked hearing thresholds in a harbor porpoise (*Phocoena phocoena*) after exposure to seismic airgun stimuli, *J. Acoust. Soc. Am.*, 125 (6), pp. 4060-4070.

Lurton, X (2003). An introduction to underwater acoustics, Elsevier.

McDonald, M. A., Hildebrand, J. A., Wiggins, S. M. And Ross, D. (2008) A 50 year comparison of ambient ocean noise near San Clement Island: A bathymetrically complex coastal region off Southern California. *J. Acoust. Soc. Am.*, 124, 1985-1992.

Medwin, H. and Clay, C. (1998) *Fundamentals of Acoustical Oceanography*. Academic Press, Boston.

Maggi, A. L. and Duncan, A. J. (2010) *Underwater Acoustic Propagation Modelling software – AcTUP V2.2L*. Centre for Marine Science and Technology (CMST), Curtin University of Technology in Australia, (2010).

MSFD (2008) *Marine Strategy Framework Directive. Directive 2008/56/EC of the European Parliament and of the Council*. 17 June 2008, Commission Decision of 1st September 2010, Official Journal of the European Union, L232/14.

Mueller, A. and Zerbs C. (2011) *Offshore wind farms - Measuring instruction for underwater sound monitoring*, Report/protocol for Bundesamt für Seeschifffahrt und Hydrographie, Germany.

Nedwell, J. R., Parvin, S. J., Edwards, B., Workman, R., Brooker, A. G. and Kynoch, J. E. (2007) *Measurement and Interpretation of Underwater Noise During Construction and Operation of Windfarms in UK waters*, Subacoustech Report No. 544R0738, COWRIE Ltd, ISBN: 978-0-9554279-5-4.

Otani, S., Naito, Y., Kato, A. and Kawamura, A. (2000) Diving behaviour and swimming speed for free-ranging harbour porpoise, Phocean phocena. *Marine Mammal Science*, l6(4), pp. 811-814.

Robinson, S. P., Hayman, G. Lepper, P. A., Cucknell, A. C., Horswill, C., Duthie, N. (2009) *Greater Gabbard offshore wind farm - Underwater noise monitoring during marine piling*. Gardline Environmental Report 7963 (Draft V.2) to Fluor Ltd July 2009.

Robinson, S. P., Theobald, P. D., Hayman, G., Wang, L-S., Lepper, P. A., Humphrey, V. and Mumford, S. (2011) *Measurement of noise arising from marine aggregate dredging operations*, MALSF (MEPF Ref no. 09/P108).

Southall, B. L., Bowles, A. E., Ellison, W. T., Finneran, J. J., Gentry, R. L., Greene Jr., C. R., Kastak, David, Ketten, D. R., Miller, J. H., Nachtigall, P. E., Richardson, W. J., Thomas, J. A., and Tyack, P. L. (2007) Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations, *Aquatic Mammals*, 33 (4), pp. 411-509.

Theobald, P. D., Lepper, P. A., Robinson, S. P., and Hazelwood, R. A. (2009) Cumulative noise exposure assessment for marine using Sound Exposure Level as a metric. *Proceedings of the 3rd International Conference & Exhibition on "Underwater Acoustic Measurements: Technologies & Results"*, Napflion, Greece, June 2009, ISBN; 978-960-98883-4-9.

Theobald, P. D., Robinson, S. P., Lepper, P. A., Pangerc, T., Lloyd, N. (2010) Underwater noise monitoring during marine piling. Gardline Environmental Report 8503 to Fluor Ltd September 2010. Gardline Environmental Report 8503 to Fluor Ltd September 2010.

Thorpe, W. H. (1967) Analytic description of the low frequency attenuation coefficient. *J. Acoust. Soc. Am.*, 42, pp. 270-270.

Tougaard, J., Carstensen, J. and Teilmann, J. (2009) Pile driving zone of responsiveness extends beyond 20 km for harbour porpoises (*Phocoena phocoena* (L.)) (L). *J. Acoust. Soc. Am*., 126, pp. 11-14.

Tougaard, J. and Henriksen, O. D. (2009) Underwater noise form three types of offshore wind turbines: Estimation of impact zones for harbor porpoises and harbor seals. *J. Acoust. Soc. Am*., 125, pp. 3766-3773.

Urick, R. J. (1983) *Principles of Underwater Sound*, Peninsula Publishing, New York.

Weston, D. (1976) Propagation in water with uniform sound velocity but variable-depth lossy bottom. *Journal of Sound and Vibration*, 47, pp. 473-483.

12.1.3.2 Minutes of Marine Mammals ETG 2 Meeting

9. Provided below are the minutes from the 2nd Marine Mammal ETG meeting.

EAOW Round 3 Offshore Programme East Anglia THREE & FOUR, Marine Mammals ETG Meeting 2			
Date of Meeting:	15.11.2013	**Venue:**	Tudor Street
Attendees			
Name	**Initials**		**Organisation**
Keith Morrison	KM		EAOW
JesperKyed Larsen	JL		EAOW
Claire Ludgate	CL		Natural England
Paolo Pizzolla	PP		Royal HaskoningDHV
Beth Mackey	BM		Royal HaskoningDHV
Pete Theobold	PT		NPL
Tanja Pangerc	TP		NPL
Document Ref:		**Issue Date:**	XX/XX/13
10.00-15.00			

ITEM	DESCRIPTION	ACTION
1	Health and Safety	No actions
2	Timeline Noise modelling slipped – first report (for internal EAOW review) before xmas	
3	Summary of actions and review agreement Outstanding actions Approach to impact assessment – App A (ETG2 paper) – for the definitions of sensitivity and magnitude CL – NE discussed with JNCC – agreed Methodology for aerial survey – CL happy Zoological Society London (ZSL) Thames tagging data – available and included within SMRU tracking data report undertaken for EA3 & 4 Baseline and species for inclusion in the assessment – part of App C (ETG2 paper)	 AGREED – definitions AGREED – happy with survey methodology AGREED – will incorporate these data
4	Noise modelling NPL - presentation PT & TP presented methodology for noise modelling work Likely that simple noise model (1 pile) undertaken by December, multiple pile assessment in the new year – both should be available for the next ETG meeting	
5	Baseline results High number of unidentified individuals Harbour porpoise most common spp sighted Below surface sightings Abundance and density based on 2 methods – 1) all sightings and 2) surface + correction factor Harbour porpoise Peak in autumn 2011 (not site specific, this pattern seen across southern North Sea in 2011) JL – little difference statistically whether site or site + buffer BM – will therefore use the most precautionary Would like to use the average estimate (0.187) for HP Would like to use the average estimate (0.284) for Harbour porpoise + unidentified White-beaked dolphin – proposed to leave out of assessment	 ACTION - CL will consider this ACTION - CL will consider this

ITEM	DESCRIPTION	ACTION
	1 sighting of a group, average this out would be unrealistic Minke – no sightings of large cetaceans within the surveys – proposed to leave out of assessment Common dolphin – 1 sighting – proposed to leave out of assessment Bottlenose dolphin – no positive sightings– proposed to leave out of assessment 1 sighting of unidentified patterned dolphin Harbour porpoise is only spp. proposed to take forward in the assessment, EAOW propose to use site specific density as it is most contemporary (the HP +unindent value is also comparable to SCANS II (2005) value). The reference population used with be the IAMMWG North Sea management Unit population estimate Seals Only 2 sightings from site-specific data – therefore SMRU at sea densities most appropriate to use in the assessment SMRU at sea densities (max average density within project area to be used) Harbour seal telemetry – these data show some movement through Zone, linkage to continental haul out sites, therefore reference population should include Waddenzee numbers Grey seal –clearly any animals part of a wider North Sea population. Reference population is proposed to be Waddenzee and up to the east coast Scotland.	ACTION - CL will consider this ACTION - CL will consider this ACTION - CL will consider this ACTION - CL will consider this ACTION - CL will consider this
6	Approach to cumulative impact assessment (CIA) Definition of spatial and temporal boundaries Source-pathway-receptor – rationale will be used in line with project specific assessment Tiered approach – EAOW accept that the CIA will follow the principle of a tiered assessment, note suggested change to paragraph 29 of ETG2 paper *"Each plan or project will be assigned a tier level, based upon data confidence and knowledge of each project. EAOW will consider the JNCC and Natural England advice note in assigning these tiers. A list of plans and projects should be agreed with Natural England following screening."* It was noted that CIA was discussed at Ornithology ETG and Steering Group meetings and this was recognised as an issue which is greater than project level and action must be taken at a wider level to develop CIA approach (e.g. will be taken up by DECC coping strategy discussions)	CL agreed with proposed approach
7	Approach to HRA and HRA programme Initial long list – list as shown in ETG2 paper (section 6, tables 2 – 4), the initial screening will make no further attempt to reduce this number which is based upon MU (for harbour porpoise), 300km range for	CL agreed with approach to screening.

ITEM	DESCRIPTION	ACTION
	harbour seal and 1000km range for grey seal Refinement – this will be based upon telemetry data for seals – stage 2 of the assessment LSE test for any sites left in – stage 3 if required	
8	Actions and agreements See table below	
9	AoB PCoD & JCP –Clarification due next week after inter-agency meeting – CL to forward if anything pertinent EPS licence – recent advice note from NE suggests that draft licence/letter of comfort required for NSIP applications CL – stated that NE would not expect this for any marine projects	 ACTION – CL to inform ACTION – PP to circulate guidance note to CL and KM ACTION – CL to clarify
10	Next meeting 26th Feb	

ID	Issue on which EAOW THREE and FOUR seek agreement on	Agreed Position	NE comments
	ETG2		
	Assessment methodology	Agreed with general approach and NE comfortable with definitions of magnitude and sensitivity	
	Apem methodology	Agreed – NE happy with aerial survey methodology and sugfficiency	
	Noise methodology - Parameters to be confirmed	Agreed in principle	
	Baseline		
	species	CL to agree by 29th November	
	data	CL to agree by 29th November	
	Reference populations	CL to agree by 29th November	
	Approach to CIA	Agreed in principle	
	Approach to HRA	Agreed in principle	
	ETG1		
1	Sufficient survey data have been collected	Agreed – subject to CL getting understanding of APEM methodology 24 months aerial data is sufficient Correction factors to be used dependent upon data – methods agreed in principle Species for assessment – agreed	Will return to correction factors in ETG2
2	The list of impacts to be assessed are those proposed in the Evidence Plan method statement and the powerpoint presentation.	Agreed	
3	It is agreed that the sensitivity and magnitude definitions are appropriate	Agreed in principle – subject to specific paper to be circulated prior to next ETG meeting	To run thru at ETG2
	Harbour porpoise reference population	IAMMWG MU - Agreed in principle – (CL noted that the IAMMWG paper has not yet been signed off)	To run thru at ETG2
		EAOW data – agreed (will consider with regard to SCANS data)	To run thru at ETG2
	White-beaked dolphin or other cetacean species (if sufficient data for impact assessment) reference populations	IAMMWG MU to be used	To run thru at ETG2
	Seal reference populations	IAMMWG MU plus European sites with connectivity –	To run thru at ETG2

		harbour seal SE MU (with reference to telemetry data)	
		IAMMWG MUs plus European sites with connectivity grey seal – more European issue than harbour (telemetry data will be used)	To run thru at ETG2
		Agreed - for transboundary impacts makes more sense for EIA purposes to use biological ref population. The derivation of this will be discussed and agreed at future meeting	To run thru at ETG2
	Other available seal data	Agreed – Wash seal tracking data not available until February 2014 will incorporate if available	To run thru at ETG2
		Agreed densities for seals – will use SMRU at-sea densities (not site-specific survey data)	To run thru at ETG2
	Quantitative assessment for pile driving noise in harbour and grey seal, and harbour porpoise.	Agreed	
	Qualitative – for all other impacts	Agreed (e.g. vessel movements quantified, but cannot translate into quantified no. of animals affected)	

12.1.3.3 Email Agreement of Minutes for Marine Mammals ETG 2.

10. Provided below is an email from Natural England agreeing the minutes from the second ETG meeting.

From: Ludgate, Claire (NE)
To: Pizzolla, P. (Paolo); keith.morrison@ScottishPower.com
Cc: JesperKved.Larsen@vattenfall.com; M.Cross@ScottishPower.com; Mackey, B.L. (Beth)
Subject: RE: East Anglia 3 & 4 ETG2 minutes
Date: 28 November 2013 17:22:41

Dear All,

Thank you for sending through the minutes of the MM ETG 2 meeting of 15th November. Natural England has now reviewed the minutes are I can confirm we are satisfied they accurately reflect the meeting. We are also satisfied with the below suggested amendment to paragraph 29 of the ETG 2 background paper.

Baseline results – Annex C
Natural England have considered the information provided in Annex C regarding the preliminary surveys results and proposed approach to assessment. I can confirm we are satisfied with the approach to be taken for the assessment and the species to be included therein however, we would recommend providing full justification for this in the ES.

Natural England is also satisfied with the proposed inclusion of the Wadden Sea seal population in the reference population for the assessment. Would you be able to supply a copy of the IMARES 2012 paper please?

EPS licence clarification
With regard to the Natural England NSIP EPS licence advice note discussed at the meeting, I can confirm that this advice is only applicable to **terrestrial EPS**. Natural England will not be requesting a draft EPS licence application for marine species as we do not issue these licences and any required letter of comfort would be issued by the MMO as they are responsible for issuing the licence. The requirement for terrestrial EPS will be discussed as part of the onshore ecology ETG.

Many thanks,

Claire

Claire Ludgate
MSc AMIMarEST

Marine Lead Adviser
Southern North Sea Team

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We are here to secure a healthy natural environment for people to enjoy, where

12.1.4 Marine Mammals ETG Meeting 3: 2nd April 2014

11. Provided in section 12.1.4 are the following documents produced for the 3rd Marine Mammal ETG meeting:

- Marine Mammals Evidence Plan Method Statement;
- Minutes of meeting; and
- Email agreement of minutes.

12.1.4.1 Marine Mammals Evidence Plan Method Statement for ETG 3

12. Provided below is the method statement which was circulated to attendees prior to the third East Anglia THREE Marine Mammals ETG meeting held on the 2nd April 2014.

East Anglia
Offshore Wind

VATTENFALL

SCOTTISHPOWER RENEWABLES

East Anglia THREE and FOUR

Marine Mammals

Evidence Plan

Expert Topic Group Meeting 3
2nd April 2014
Document Reference –

Author – Royal HaskoningDHV
East Anglia Offshore Wind Limited
Date – March 2014
Revision History – Revision Final

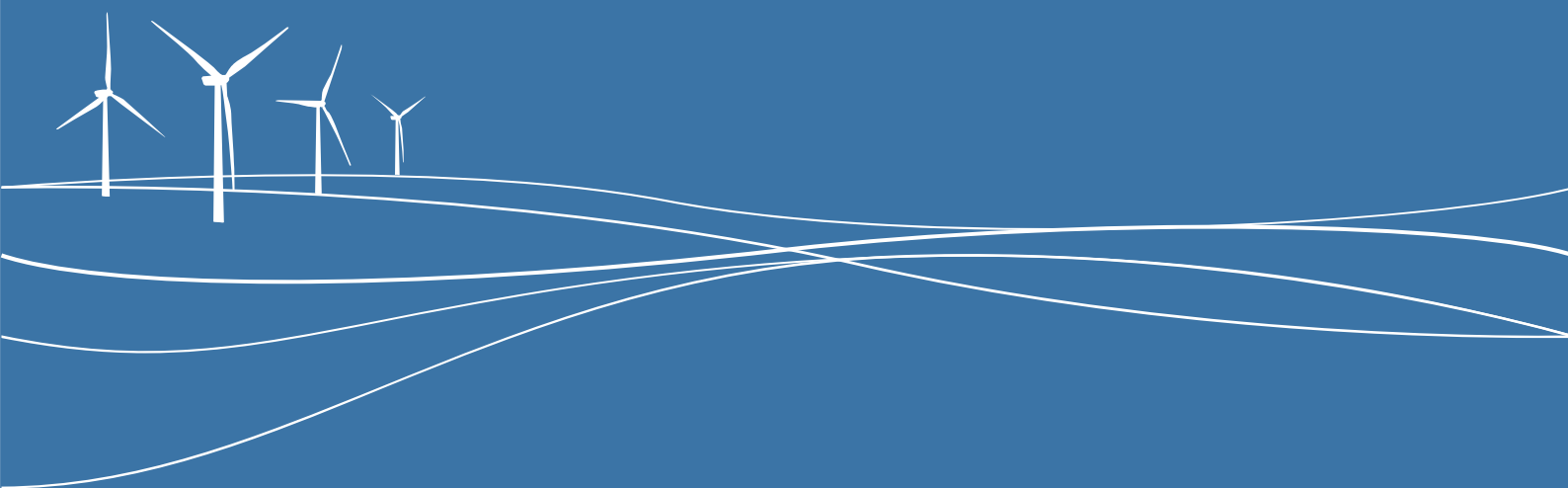

Table of Contents

1 EVIDENCE PLAN PROCESS

1.1 Outline of this document

1. This document is a briefing note prepared for Natural England in advance of the third marine mammal expert topic group meeting to be held on 2nd April 2014.

2. It details various aspects of the approach to the marine mammal impact assessment where it is hoped, the approach can be agreed at this meeting, or more details discussion can occur in areas where further information is required, prior to agreement on approach.

3. Topics covered include:

    a. Agenda items outstanding from ETG meeting 2.

    b. HRA screening

    c. Worst case scenario for the impact assessment.

    d. Preliminary results of the noise impact assessment (single pile driving)

    e. Approach to cumulative impact assessment and list of plans or projects taken forward in the assessment

2 AGENDA ITEMS OUTSTANDING FROM ETG MEETING 2

2.1 Baseline results

4. Natural England considered the information provided in Annex C, and have confirmed they are happy with the approach to be taken for the assessment (email from Claire Ludgate dated 28/11/2013).

2.2 EPS licence clarification

5. Natural England will not be requesting a draft EPS licence application for marine species as they do not issue these licences and any required letter of comfort would be issued by the MMO as they are responsible for issuing the licence (email from Claire Ludgate dated 28/11/2013).

2.3 Minutes

6. Minutes have been agreed by Natural England (email from Claire Ludgate dated 28/11/2013).

3 HRA SCREENING

7. HRA screening has been undertaken in line with the discussions undertaken at the last ETG meeting (15th December 2013). This document is provided separately from this background paper.

4 WORST CASE SCENARIO/PROJECT DESCRIPTION

8. Details of the project description are not yet available. They will be discussed at the ETG 3 meeting, if available, and will be provide to Natural England for review following the meeting.

5 NOISE MODELLING – SINGLE PILE ASSESSMENT

9. National Physical Laboratory (NPL) have been contracted to undertake the noise propagation modelling in order to assess the potential impacts from pile driving noise.

10. Preliminary results from the noise assessment are available (Appendix 1 and Appendix 2), but these may be refined dependent upon the results of site-specific pile driving analysis.

11. Noise propagation modelling has been completed at 20 locations across the East Anglia THREE site (Figure 1) and 21 across the East Anglia FOUR sites (Figure 2).

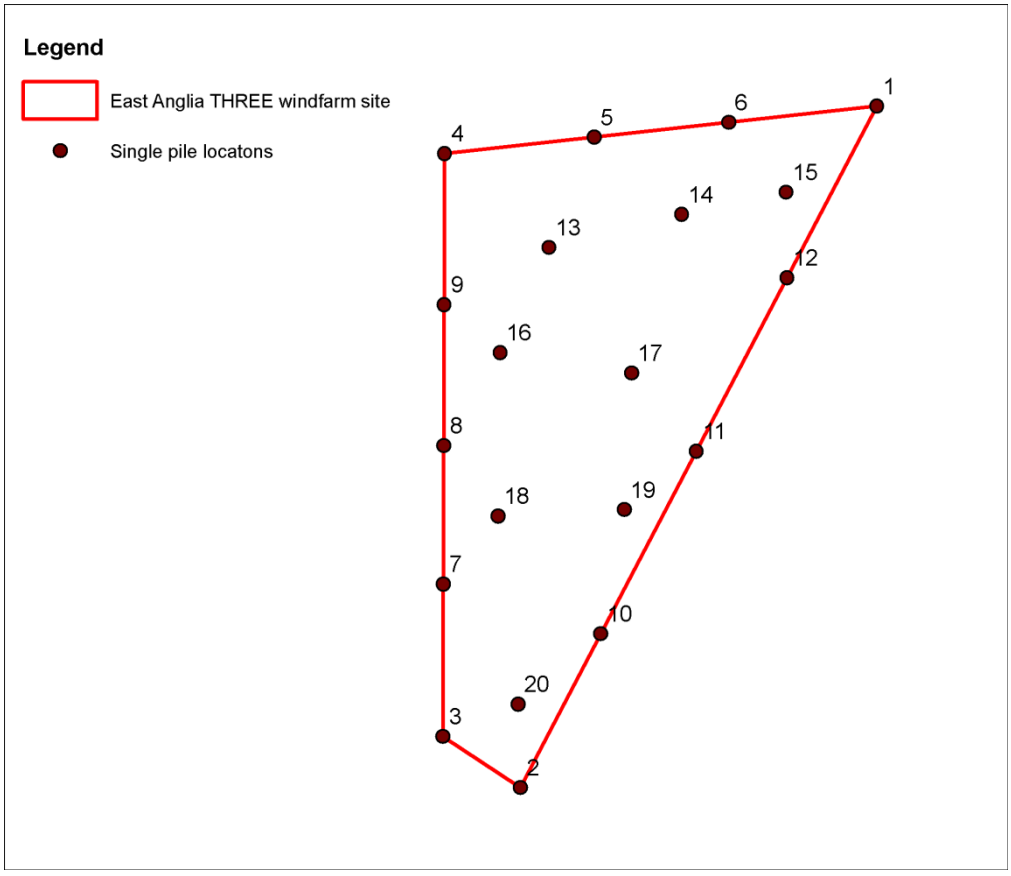

Figure1 East Anglia THREE single pile sound propagation modelling locations

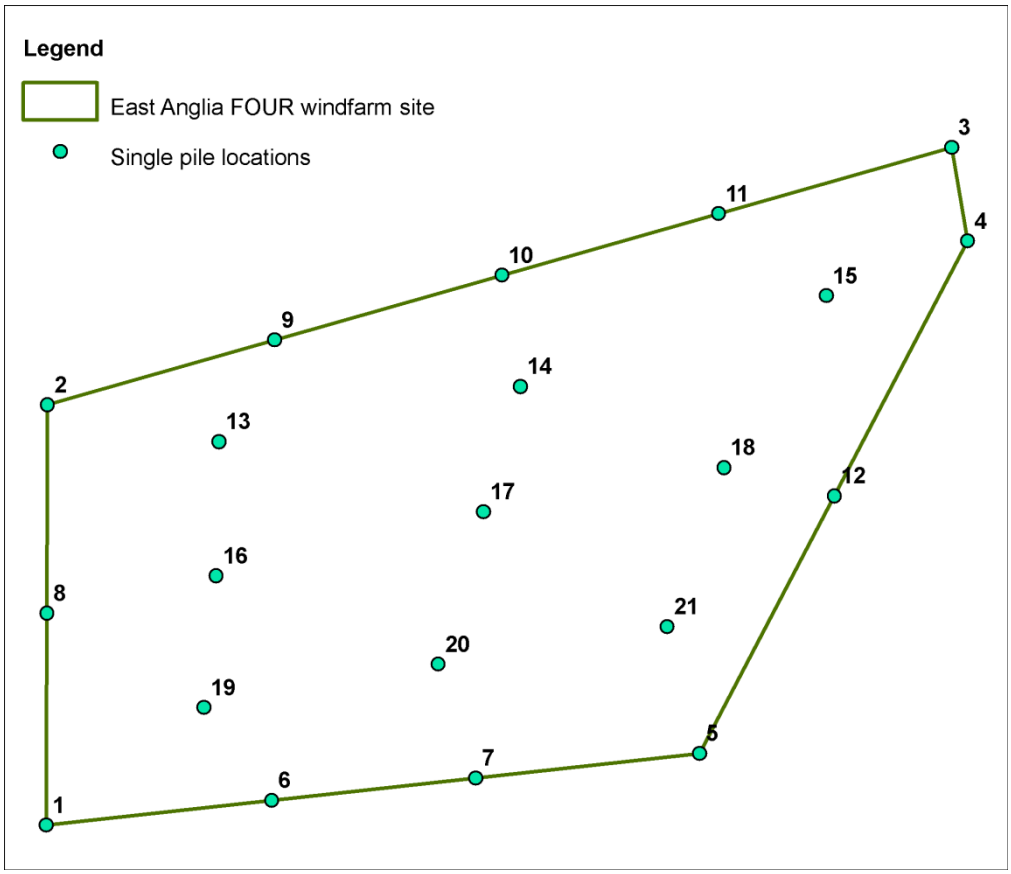

Figure2 East Anglia FOUR single pile sound propagation modelling locations

5.1 Hammer energies

12. The worst case hammer energy within the Rochdale Envelope is 3,500kJ; this will be considered for the monopile foundations. The 400 kJ hammer strike energy was chosen as generic soft start energy for both the jacket and monopile foundations.

13. The maximum hammer energy for the jacket foundation is still to be confirmed.

5.2 Pinnipeds

14. The pinniped maximum impact ranges for pile driving at any of the locations modelled within East Anglia THREE are summarised in Table 1,and in Table 2 for East Anglia FOUR.

Table 1 Summary of pinniped maximum impact range estimates for pile driving during construction at East Anglia THREE for different hammer energies. Impact ranges are rounded up to the nearest 500m for distances of 3 km and less, and rounded up to the nearest 1 km for distances greater than 3 km.

Impact Criterion	Estimated impact distance for pinnipeds around mid-water column (km)				
	1,400 kJ hammer energy	2,000 kJ hammer energy	2,300 kJ hammer energy	3,000 kJ hammer energy	3,500 kJ hammer energy
Instantaneous injury/PTS * (M_{pw} weighted 186 dB re 1 $\mu Pa^2 \cdot s$)	<0.5	<0.5	<0.5	<0.5	<0.5
Fleeing response/ Likely avoidance (M_{pw} weighted 171 dB re 1 $\mu Pa^2 \cdot s$) **	<1.5	<1.5	<2.0	<2.0	<2.5

**Southall et al. (2007) Injury Criteria, **Southall et al. (2007) Single pulse behavioural disturbance.*

Table 2 Summary of pinniped maximum impact range estimates for pile driving during construction at East Anglia FOUR for different hammer energies. Impact ranges are rounded up to the nearest 500 m for distances of 3 km and less, and rounded up to the nearest 1 km for distances greater than 3 km.

Impact Criterion	Estimated impact range for pinnipeds around mid-water column (km)				
	1,400 kJ hammer energy	2,000 kJ hammer energy	2,300 kJ hammer energy	3,000 kJ hammer energy	3,500 kJ hammer energy
Instantaneous injury/PTS * (M_{pw} weighted 186 dB re 1 $\mu Pa^2 \cdot s$)	<0.5	<0.5	<0.5	<0.5	<0.5
Fleeing response/ Likely avoidance (M_{pw} weighted 171 dB re 1 $\mu Pa^2 \cdot s$) **	<1.5	<1.5	<2.0	<2.0	<2.5

**Southall et al. (2007) Injury Criteria, **Southall et al. (2007) Single pulse behavioural disturbance.*

Table 3 Summary of harbour porpoise maximum impact range estimates for pile driving during construction at East Anglia THREE for different hammer energies. Impact ranges are rounded up to the nearest 500 m for distances of 3 km and less, and rounded up to the nearest 1 km for distances greater than 3 km.

Impact Criterion	Estimated impact range for harbour porpoise around mid-water column (km)				
	1,400 kJ hammer energy	2,000 kJ hammer energy	2,300 kJ hammer energy	3,000 kJ hammer energy	3,500 kJ hammer energy
Instantaneous injury/PTS * (M_{pw} weighted 179 dB re 1 $\mu Pa^2 \cdot s$)	<0.5	<0.5	<0.5	<1	<1
Fleeing response/ Likely avoidance (M_{pw} weighted 164 dB re 1 $\mu Pa^2 \cdot s$) **	3-5	4-6	4-6	5-8	5-8
Possible avoidance (M_{pw} weighted 145 dB re 1 $\mu Pa^2 \cdot s$) **	24-44*	29-51*	31-54*	34-59*	37-62*

**95% percentile impact range*

Table 4 Summary of harbour porpoise maximum impact range estimates for pile driving during construction at East Anglia THREE for different hammer energies. Impact ranges are rounded up to the nearest 500 m for distances of 3 km and less, and rounded up to the nearest 1 km for distances greater than 3 km.

Impact Criterion	Estimated impact range for harbour porpoise around mid-water column (km)				
	1,400 kJ hammer energy	2,000 kJ hammer energy	2,300 kJ hammer energy	3,000 kJ hammer energy	3,500 kJ hammer energy
Instantaneous injury/PTS * (M_{pw} weighted 179 dB re 1 $\mu Pa^2 \cdot s$)	<0.5	<1	<1	<1	<1
Fleeing response/ Likely avoidance (M_{pw} weighted 164 dB re 1 $\mu Pa^2 \cdot s$) **	3-5	4-6	4-7	4-8	5-8
Possible avoidance (M_{pw} weighted 145 dB re 1 $\mu Pa^2 \cdot s$) **	24-40*	26-48*	31-51*	34-57*	36-61*

**95% percentile impact range*

5.3 Cetaceans

15. A summary of impact ranges for harbour porpoise, are shown in Table 3, for East Anglia THREE, and Table 4, for East Anglia FOUR. Impacts ranges have also been modelled for other species of cetacean (Appendix 1 and Appendix 2), but due to the low frequency of concurrence they will not be taken forward in any quantified impact assessment.

5.4 Auditory injury (PTS)

16. The potential to cause PTS in pinnipeds, or as an injury offence to EPS is considered based on the range of instantaneous auditory injury at the onset of the soft start. The hammer energy at the start of the sort start for the monopiles and jackets is yet to be confirmed however the results from the full piling assessment for East Anglia THREE (Table 1) and East Anglia FOUR (Table 2) indicate that for the establishment of an exclusion zone around pile driving to a minimum of 500m (flowing current JNCC Guidelines) should prevent injury to seals.

17. In the case of harbour porpoise exposure to noise thresholds that can lead to instantaneous auditory injury (PTS) could occur up to 1km based on the 2,300kJ and above hammer energies at East Anglia THREE (Table 3). At East Anglia FOUR (Table 4) this could occur at 2,000kJ and above. However, these instantaneous ranges take account of the soft start, and the potential of animals moving away from the noise source during this time. Therefore, for harbour porpoise to be exposed to noise thresholds that could lead to the onset of PTS injury at the ranges stated in Table 3 and Table 4, animals would have to remain stationary, or move towards the noise source during the soft start.

18. A Marine Mammal Mitigation Protocol (MMMP) will be developed post consent in consultation with Natural England to ensure that potential for exposure to noise thresholds that can lead to PTS will be mitigated through the establishment of exclusion zones. It is proposed that the MMMP will not include the use of Marine Mammal Observers and be further details will be agreed post consent, when the Rochdale enveloped for construction parameters has been further refined.

19. **Do Natural England agree with the preliminary interpretation of the noise assessment and proposed approach to developing the MMMP?**

5.5 Disturbance

20. Disturbance to pinnipeds and harbour porpoise will be assessed by estimating the number of individuals that could be displaced within the areas of ensonification.

21. Following this approach preliminary investigations have been made into the areas over which likely avoidance (164 dB re 1 $\mu Pa^2 \cdot s$, Table 6) and possible avoidance (145 dB re 1 $\mu Pa^2 \cdot s$, Table 7) may occur in harbour porpoise using a 3,500kJ hammer at East Anglia THREE.

22. The number of harbour porpoise that could be within these areas, based on the site specific maximum mean density estimates derived from APEM data for harbour porpoise, and harbour porpoise and unidentified small cetaceans combined (in brackets). Both density estimates use the highest mean densities; based on the site plus buffer surveys, using surface only corrected counts). These data are summarised in Table 6 and 7, along with the magnitude of the effect.

23. Calculating the magnitude of effect as shown in Table 6 and Table 7 assumes that 100% of the individuals within the ensonified area respond to the noise stimulus. However, further from the noise source not all individuals may respond to the stimulus. Therefore we propose that less than 100% of the individuals respond within the possible avoidance range. The exact proportion that responds will be discussed at ETG3.

24. **Do Natural England agree to the proposed approach to quantifying the number of animals which could be displaced?**

25. Impacts of disturbance from a single pile driving event are temporary. However, within the assessment consideration will be given to the cumulative duration of multiple pile driving during the construction of the entire windfarm once details of this have been confirmed within the project description.

26. **Do Natural England currently foresee any issues with the potential magnitude of disturbance effect for harbour porpoise?**

Table 5 Area within likely avoidance and possible avoidance contours for harbour porpoise when pile driving using a 3,500kJ hammer at East Anglia THREE.

Location	Maximum hammer energy (kJ)	Area within likely avoidance contour (km^2)	Area within possible avoidance contour (km^2)
3	3,500	137	8,625
2	3,500	134	8,927
1	3,500	127	7,312
4	3,500	138	7,988

Table 6 Estimate of the number of harbour porpoise likely to avoid the area around pile driving using a 3,500kJ hammer at East Anglia THREE. Estimates are based on the harbour porpoise (and the harbour porpoise and unidentified small cetaceans combined) densities.

Location	Maximum hammer energy (kJ)	No. of harbour porpoise likely to avoid area	% of reference population	Magnitude of effect*
3	3,500	26 (39)	0.01 (0.02)	Negligible
2	3,500	25 (38)	0.01 (0.02)	Negligible
1	3,500	24 (36)	0.01 (0.02)	Negligible
4	3,500	26 (39)	0.01 (0.02)	Negligible

* Based on definitions agreed from Marine mammal ETG1 meeting.

Table 7 Estimate of the number of harbour porpoise that may possibly avoid the area around pile driving using a 3,500kJ hammer at East Anglia THREE. Estimates are based on the harbour porpoise (and the harbour porpoise and unidentified small cetaceans combined) densities.

Location	Maximum hammer energy (kJ)	No. of harbour porpoise possibly avoiding area	% of reference population	Magnitude of effect*
3	3,500	1,613 (2,450)	0.71 (1.08)	Negligible (Low)
2	3,500	1,669 (2,535)	0.73 (1.12)	Negligible (Low)
1	3,500	1,367 (2,077)	0.6 (0.91)	Negligible
4	3,500	1,494 (2,269)	0.66 (1.00)	Negligible (Low)

* Based on definitions agreed from Marine mammal ETG1 meeting.

6 CUMULATIVE IMPACT ASSESSMENT

27. The cumulative impact assessment follows on the previously agreed approach as discussed at ETG meeting 2.

28. Type of plans or projects to be taken into consideration are:

- Other windfarms;
- Aggregate extraction and dredging;
- Licensed disposal sites;
- Navigation and shipping;
- Planned construction of sub-sea cables and pipelines;
- Potential port/harbour development; and
- Oil and gas installations.

29. Cumulative impacts have been considered for the impacts listed in Table 8.

30. Plans or projects in construction, operational or decommissioning phases have been screened in where there has been a change in phase post the end of the baseline. For example, an offshore windfarm that was in construction during 2012 was part of the project baseline (and not considered in the CIA), but if it became operational post the end of the baseline, cumulative impacts are considered for aspects during the operational and decommissioning phases.

31. The East Anglia THREE baseline ended in August 2013, the East Anglia FOUR baseline ended in February 2014.

Table 8: Impacts considered within the CIA

Phase of plan or project	Impact	Details
Construction	Noise	Pile driving noise, vessel noise, seabed preparation/rock dumping, cable laying, surveying
	Indirect impact	Prey species
	Direct interaction	Collision risk (hull impacts, ducted propellers)
Operation	Noise	Wind turbine or other mechanical operational noise, vessel noise, disposal noise, dredging noise.
	Indirect impact	Prey species
	Direct interaction	Collision risk (hull impacts, ducted propellers, tidal turbines)
Decommissioning	Noise	Vessel noise, seabed preparation/rock dumping/foundation/cable removal, disposal, explosives
	Indirect impact	Prey species
	Direct interaction	Collision risk (hull impacts, ducted propellers)

32. Plans and projects within the agreed reference population boundaries for harbour porpoise, harbour seal and grey seal have been screened in for each species as appropriate.

33. The next stage of screening considered the plans or projects where sufficient information exists to undertake an assessment. This followed a tiered approach analogous to that outlined by JNCC and Natural England (in the document 'Suggested Tiers for Cumulative Impact Assessment', Table 9).

34. Each plan or project was assigned a tier level. In a reflection of the available data from UK based projects in comparisons to other European projects, the CIA will include all in the relevant tiers as summarised in Table 10.

35. **Do Natural England agree with the suggested tiers for projects which are screened in to the marine mammals assessment?**

36. A summary of the result of the screening process is shown for offshore windfarm projects in Table 11.

37. The results of the screening process of each other type of plan or project will be detailed within the PEIR chapter.

Table 9: Suggested tiers for undertaking a staged cumulative impact assessment (JNCC and Natural England)

	Tier description	
	Consenting or construction stage	**Data availability**
Tier 1	Built and operational projects should be included within the cumulative assessment where they have not been included within the environmental characterisation survey, i.e. they were not operational when baseline surveys were undertaken, and/or any residual impact may not have yet fed through to and been captured in estimates of "baseline" conditions e.g. "background" distribution or mortality rate for birds.	Pre-construction (and possibly post-construction) survey data from the built project(s) and environmental characterisation survey data from proposed project (including data analysis and interpretation within the ES for the project).
Tier 2	Tier 1 + projects under construction	As Tier 1 but not including post-construction survey data
Tier 3	Tier 2 + projects that have been consented (but construction has not yet commenced)	Environmental characterisation survey data from proposed project (including data analysis and interpretation within the ES for the project) and possibly pre-construction
Tier 4	Tier 3 + projects that have an application submitted to the appropriate regulatory body that have not yet been determined	Environmental characterisation survey data from proposed project (including data analysis and interpretation within the ES for the project)
Tier 5	Tier 4 + projects that the regulatory body are expecting an application to be submitted for determination (e.g. projects listed under the Planning Inspectorate programme of projects)	Possibly environmental characterisation survey data (but strong likelihood that this data will not be publicly available at this stage).
Tier 6	Tier 5 + projects that have been identified in relevant strategic plans or programmes (e.g. projects identified in Round 3 windfarm zone appraisal and planning (ZAP) documents)	Historic survey data collected for other purposes/by other projects or industries or at a strategic level.

Table 10: Tiers in relation to project category which have been screened into the CIA

Project category	UK	Other
Offshore windfarms	Tier 1,2,3,4,5	Tier 1,2,3
Renewable energy (tidal and wave)	Tier 1,2,3,4,5	Tier 1,2,3
Aggregate extraction and dredging	Tier 1,2,3	Screened out
Oil and Gas	Tier 1,2,3	Screened out
Navigation and shipping	Tier 1,2,3	Screened out
Cables and pipelines	Tier 1,2,3	Screened out
Licenced disposals	Tier 1,2,3	Screened out
Port and harbour developments	Tier 1,2,3	Screened out

Table 8: Results of screening for offshore windfarm projects taken forward in the CIA (status at time of end of East Anglia THREE baseline). Phases of plans or projects in the CIA are Construction (C), Operation (O) or Decommissioning (D).

East Anglia FOUR shown in bold italics if different

Name of Project	Country	Status	Tier	Phase of plan or project considered in CIA			Species relevant to CIA with plan or project		
				C	O	D	Harbour porpoise	Grey seal	Harbour seal
Riffgat	Germany	Commissioned	1		Y	Y	Y		
Lincs	UK	Commissioned	1		Y	Y	Y	Y	Y
Greater Gabbard	UK	Commissioned	1		Y	Y	Y	Y	Y
Thornton Bank phase III	Belgium	Commissioned	1		Y	Y	Y	Y	
Thornton Bank phase II	Belgium	Commissioned	1		Y	Y	Y	Y	
Anholt	Denmark	Commissioned	1		Y	Y	Y		
Meerwind Ost Sud	Germany	Commissioned	1		Y	Y	Y		
Dan Tysk	Germany	Construction ***Commissioned***	2/ **1**		Y	Y	Y		
Nordsee Ost	Germany	Commissioned	1		Y	Y	Y		
Alpha Ventus	Germany	Commissioned	1			Y	Y		
Egmond aan Zee (aka OWEZ)	Netherlands	Commissioned	1			Y	Y		
Prinses Amalia Windpark (formerly Q7)	Netherlands	Commissioned	1			Y	Y		
Teesside	UK	Commissioned	1			Y	Y	Y	
Inner Dowsing	UK	Commissioned	1			Y	Y	Y	Y
Sheringham Shoal	UK	Commissioned	1			Y	Y	Y	Y
Beatrice - demonstrator project	UK	Commissioned	1			Y	Y		
Scroby Sands	UK	Commissioned	1			Y	Y	Y	Y

Name of Project	Country	Status	Tier	Phase of plan or project considered in CIA			Species relevant to CIA with plan or project		
				C	O	D	Harbour porpoise	Grey seal	Harbour seal
Lynn	UK	Commissioned	1			Y	Y	Y	Y
London Array phase 1	UK	Commissioned	1			Y	Y	Y	Y
Gunfleet Sands I+II	UK	Commissioned	1			Y	Y	Y	Y
Gunfleet Sands 3	UK	Commissioned	1			Y	Y	Y	Y
Kentish Flats	UK	Commissioned	1			Y	Y	Y	Y
Thanet	UK	Commissioned	1			Y	Y	Y	Y
BARD Offshore 1	Germany	Commissioned	1			Y	Y		
Thornton Bank phase I	Belgium	Commissioned	1			Y	Y	Y	
Belwind 1	Belgium	Commissioned	1			Y	Y	Y	
Belwind Alstom Haliade Demonstration	Belgium	Commissioned	1			Y	Y	Y	
Horns Rev 1	Denmark	Commissioned	1			Y	Y		
Horns Rev 2	Denmark	Commissioned	1			Y	Y		
Frederikshavn	Denmark	Commissioned	1			Y	Y		
Humber Gateway	UK	Consented/ ***Construction***	2	N ***Y***	Y	Y	Y	Y	Y
Amrumbank West	Germany	Construction / ***Construction***	2	N ***Y***	Y	Y	Y		
Northwind	Belgium	Construction	2		Y	Y	Y	Y	
Trianel Windpark Borkum Phase 1 (Borkum West II phase 1)	Germany	Construction	2		Y	Y	Y		
Borkum Riffgrund I	Germany	Construction	2		Y	Y	Y		
Dudgeon	UK	Consented	3	Y	Y	Y	Y	Y	Y

Name of Project	Country	Status	Tier	Phase of plan or project considered in CIA			Species relevant to CIA with plan or project		
				C	O	D	Harbour porpoise	Grey seal	Harbour seal
Race Bank	UK	Consented	3	Y	Y	Y	Y	Y	Y
Westermost Rough	UK	Consented	3	Y	Y	Y	Y	Y	Y
Triton Knoll phase 1-3	UK	Consented	3	Y	Y	Y	Y	Y	Y
Narec / Blyth demonstration site	UK	Consented	3	Y	Y	Y	Y	Y	
Galloper	UK	Consented	3	Y	Y	Y	Y	Y	Y
WIN 2	France	Consented	3	Y	Y	Y	Y	Y	
European Offshore Wind Deployment Centre EOWDC	UK	Consented	3	Y	Y	Y	Y	Y	
2-B Energy Test Site	UK	Consented	3	Y	Y	Y	Y		
Kentish Flats Extension	UK	Consented	3	Y	Y	Y	Y	Y	Y
Kaikas	Germany	Consented	3	Y	Y	Y	Y		
Deutsche Bucht	Germany	Consented	3	Y	Y	Y	Y		
Veja Mate	Germany	Consented	3	Y	Y	Y	Y		
EnBW He Dreiht	Germany	Consented	3	Y	Y	Y	Y		
EnBW Hohe See (Hochsee Windpark 'Nordsee')	Germany	Consented	3	Y	Y	Y	Y		
Albatros	Germany	Consented	3	Y	Y	Y	Y		
Butendiek (Offshore- Bürger-windpark)	Germany	Consented	3	Y	Y	Y	Y		
Sandbank	Germany	Consented	3	Y	Y	Y	Y		
Nordlicher Grund	Germany	Consented	3	Y	Y	Y	Y		
Borkum Riffgrund West	Germany	Consented	3	Y	Y	Y	Y		

Name of Project	Country	Status	Tier	Phase of plan or project considered in CIA			Species relevant to CIA with plan or project		
				C	O	D	Harbour porpoise	Grey seal	Harbour seal
Borkum Riffgrund II	Germany	Consented	3	Y	Y	Y	Y		
Gemini	Netherlands	Consented	3	Y	Y	Y	Y	Y	Y
Trianel Windpark Borkum Phase 2 (aka Borkum West II phase 2)	Germany	Consented	3	Y	Y	Y	Y		
MEG offshore 1	Germany	Consented	3	Y	Y	Y	Y		
Delta Nordsee 1	Germany	Consented	3	Y	Y	Y	Y		
Delta Nordsee 2 (OWP Delta Nordsee 2)	Germany	Consented	3	Y	Y	Y	Y		
Nordsee One (Innogy Nordsee I)	Germany	Consented	3	Y	Y	Y	Y		
Gode Wind I	Germany	Consented	3	Y	Y	Y	Y		
Gode Wind II	Germany	Consented	3	Y	Y	Y	Y		
Gode Wind IV	Germany	Consented	3	Y	Y	Y	Y		
Nordergrunde	Germany	Consented	3	Y	Y	Y	Y		
Beaufort (formerly Katwijk)	Netherlands	Consented	3	Y	Y	Y	Y	Y	Y
Breeveertien II	Netherlands	Consented	3	Y	Y	Y	Y	Y	Y
Brown Ridge Oost	Netherlands	Consented	3	Y	Y	Y	Y	Y	Y
Clearcamp (aka EP Offshore NL1)	Netherlands	Consented	3	Y	Y	Y	Y	Y	Y
Dan Helder I	Netherlands	Consented	3	Y	Y	Y	Y	Y	Y
Eneco Luchterduinen	Netherlands	Consented	3	Y	Y	Y	Y	Y	Y
Gemini	Netherlands	Consented	3	Y	Y	Y	Y	Y	Y
Q4	Netherlands	Consented	3	Y	Y	Y	Y	Y	Y

Name of Project	Country	Status	Tier	Phase of plan or project considered in CIA			Species relevant to CIA with plan or project		
				C	O	D	Harbour porpoise	Grey seal	Harbour seal
Q4 West	Netherlands	Consented	3	Y	Y	Y	Y	Y	Y
Tromp Binnen	Netherlands	Consented	3	Y	Y	Y	Y	Y	Y
Westermeerdijk buitendijks - Windpark Noordoostpolder	Netherlands	Consented	3	Y	Y	Y	Y	Y	Y
RENTEL	Belgium	Consented	3	Y	Y	Y	Y	Y	Y
Norther	Belgium	Consented	3	Y	Y	Y	Y	Y	Y
Belwind 2 (zone 3, Bligh Bank)	Belgium	Consented	3	Y	Y	Y	Y	Y	Y
Kattegat	Sweden	Consented	3	Y	Y	Y	Y		
Beatrice	UK	Examination/ Determination (now Consented)	3	Y	Y	Y	Y		
Telford	UK	Examination/ Determination (now Consented)	3	Y	Y	Y	Y		
MacColl	UK	Examination/ Determination (now Consented)	3	Y	Y	Y	Y		
Stevenson	UK	Examination/ Determination (now Consented)	3	Y	Y	Y	Y		
Hornsea Project One	UK	Examination/ Determination	4	Y	Y	Y	Y	Y	Y
Dogger Bank Zone Creyke Beck A	UK	Examination/ Determination	4	Y	Y	Y	Y	Y	Y
Dogger Bank Zone Creyke Beck B	UK	Examination/ Determination	4	Y	Y	Y	Y	Y	Y

Name of Project	Country	Status	Tier	Phase of plan or project considered in CIA			Species relevant to CIA with plan or project		
				C	O	D	Harbour porpoise	Grey seal	Harbour seal
East Anglia One	UK	Examination /Determination	4	Y	Y	Y	Y	Y	Y
Rampion	UK	Examination/ Determination	4	Y	Y	Y	Y	Y	
Inch Cape	UK	Examination/ Determination	4	Y	Y	Y	Y	Y	
Neart na Gaoithe	UK	Examination/ Determination	4	Y	Y	Y	Y	Y	
Firth of Forth Phase 1 Seagreen Alpha and Bravo	UK	Examination/ Determination	4	Y	Y	Y	Y	Y	
Hornsea Project Two	UK		5	Y	Y	Y	Y	Y	Y
Dogger Bank Zone Teesside A	UK	Full draft ES	5	Y	Y	Y	Y	Y	Y
Dogger Bank Zone Teesside B	UK	Full draft ES	5	Y	Y	Y	Y	Y	Y
Dogger Bank Zone Teesside C	UK	Scoping	5	Y	Y	Y	Y	Y	Y
Dogger Bank Zone Teesside D	UK	Scoping	5	Y	Y	Y	Y	Y	Y
East Anglia THREE OR FOUR	UK	Full draft ES	5	Y	Y	Y	Y	Y	Y
Navitus Bay windpark	UK	Full draft ES	5	Y	Y	Y	Y	Y	
Firth of Forth Phase 2	UK	Scoping	5	Y	Y	Y	Y	Y	
Firth of Forth Phase 3	UK	Scoping	5	Y	Y	Y	Y	Y	

6.1.1 Concurrent pile driving

38. Projects at Tier 3 or above will be considered in this quantified assessment.

39. In the CIA a quantitative assessment of impacts from pile driving noise during the construction of offshore windfarms will be completed. In anticipation of forthcoming advice from statutory consultees the assessment will consider that once projects are consented, construction can commence up to seven years post approval, and is not constrained to the timelines indicated within the projects ES chapters.

40.

41. Based on the screening exercise a total of 67 offshore windfarms are considered in the harbour porpoise CIA for construction impacts (with the potential for concurrent pile driving) with East Anglia THREE and East Anglia FOUR. For harbour seal a total of 31 projects are considered for East Anglia THREE and East Anglia FOUR. For grey seal a total of 41 projects are considered for East Anglia THREE and East Anglia FOUR. It is assumed that projects currently under construction will be completed prior to the commencement of construction at either East Anglia THREE or East Anglia FOUR.

42. **Do Natural England agree with the list of Windfarm projects screened into the marine mammal CIA?**

6.1.2 Review and updates

43. Following submission of the draft ES (PEIR), reviews will be undertaken to ensure that any new information is incorporated into the CIA. Once issues, plans or projects have been scoped out and agreed there must be a strong justification for scoping them back in again, and this will be agreed with statutory consultees.

44. There will be an inherent level of uncertainty associated with assessments of impacts on this basis. It is important that stakeholders understand that significant cumulative impacts may be the result of an overly precautionary worst case (or precaution built on precaution) and that this will be highlighted within documents and discussions. **EAOW would like Natural England to acknowledge that there is a large amount on uncertainty with regard to the construction timing of projects which will lead to a very precautionary assessment of the cumulative impacts, especially for pile driving.**

7 APPENDIX 1 UNDERWATER NOISE MODELLING FOR EAST ANGLIA THREE

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Underwater noise modelling for East Anglia THREE

March 2014

National Measurement System

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Underwater noise assessment for East Anglia THREE

- **Assessment description**
- **Example propagation modelling outputs**

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Assessment description

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Underwater noise modelling at project level

Single piling (to estimate impact distances)

Underwater sound propagation modelling carried out:

- Assuming a number of **hammer strike energies** representative of commercial hammers currently in use, or under development (including 3,500 kJ; 3,000 kJ; 2,300 kJ; 2,000 kJ; 1400 kJ)
- At various **locations** (n=20)
  - Locations were chosen to capture a range of bathymetric profiles in the area and to capture the geometrical extent of the project.
- Parameters for modelling, including the modelled single pile locations, were chosen to identify the range of impact distances which might be expected for relevant marine receptors. The worst case scenario should be receptor driven and may dependent on the receptor.

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Underwater noise modelling at project level

Footprint modelling*

Modelling carried out:

- Assuming a number of **hammer strike energies**
  (3,500 kJ; 3,000 kJ; 2,300 kJ; 2,000 kJ; 1,400 kJ)
- For various **locations** along the windfarm site boundary (n=12)
- For acoustic sediment properties representative of the best acoustic propagation which might occur in the region encompassed by the contours

* Illustrates the area around the windfarm site where the potential for impact from pile driving would be expected to be contained during construction

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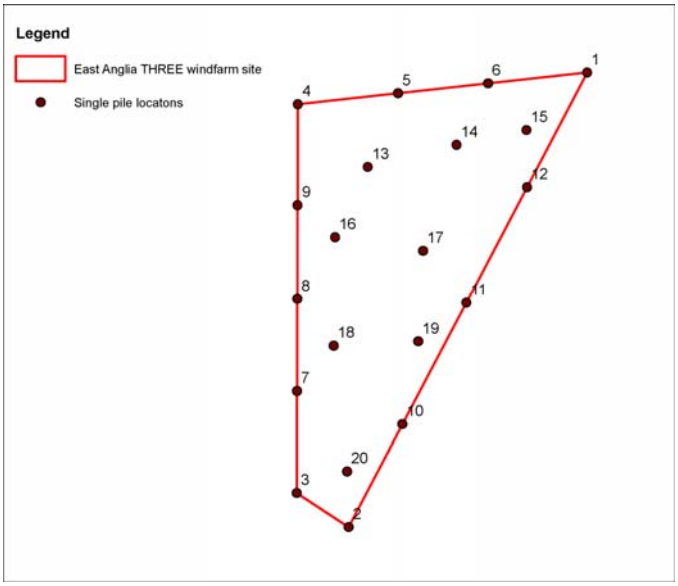
Modelled positions



All locations – Single pile sound propagation modelling
Locations # 1 to #12 – Footprint modelling

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Project level modelling outputs

The injury and behaviour criteria outlined in Appendix A have been applied to the outputs of the underwater noise modelling to estimate the potential impact ranges

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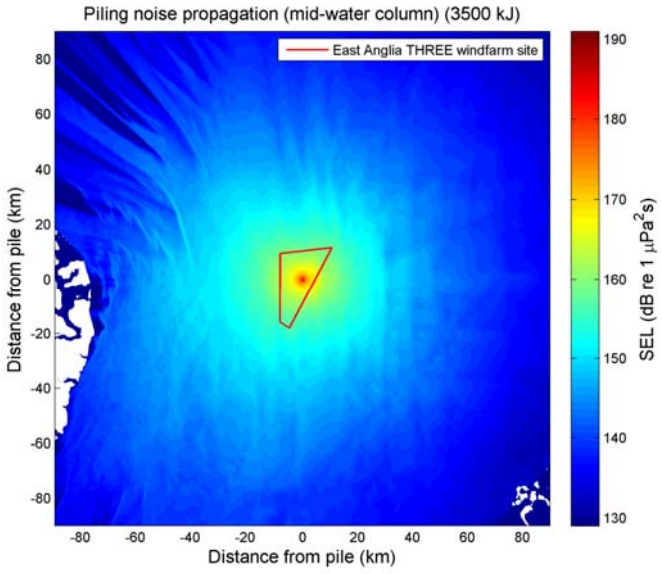
Single piling

Example propagation model output for impact pile driving at the East Anglia THREE offshore windfarm site (single pile location # 17) assuming a 3,500 kJ hammer strike energy.



White indicates a depth of < 0 m for tidal height modelled (Highest astronomical tide (HAT))

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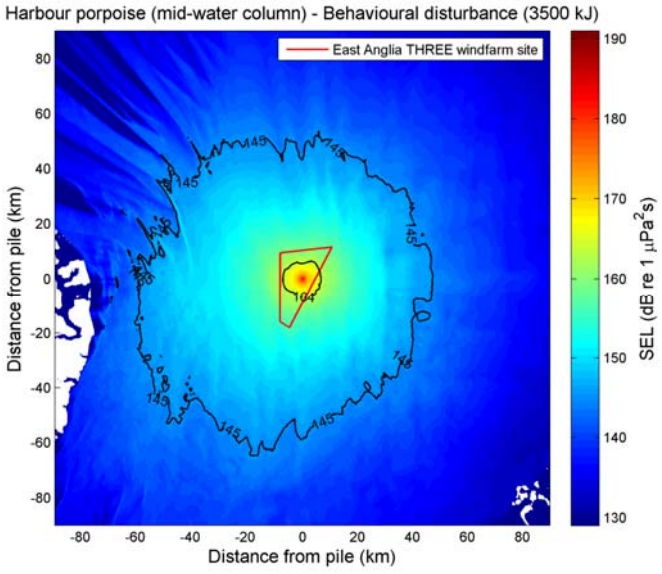
Single piling – harbour porpoise

Example propagation model output for harbour porpoise behavioural disturbance from impact pile driving at the East Anglia THREE offshore windfarm site (single pile location #17) assuming a 3,500 kJ hammer strike energy.



White indicates a depth of < 0 m for tidal height modelled (Highest astronomical tide (HAT))

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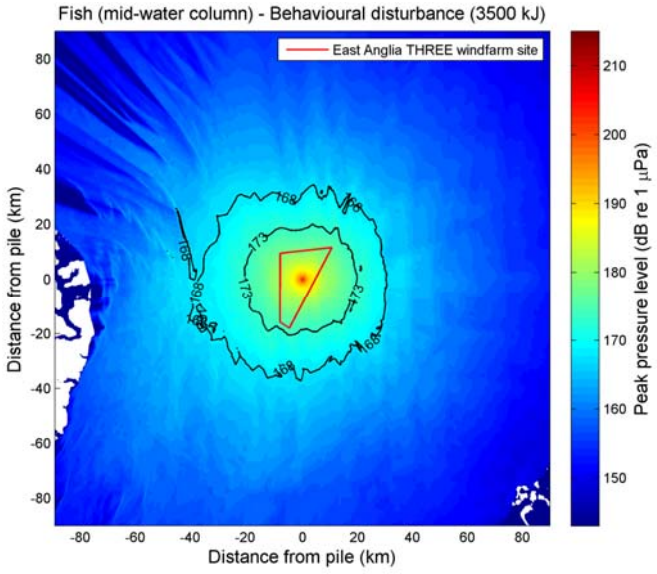
Single piling – fish

Example propagation model output for fish behavioural disturbance from impact pile driving at the East Anglia THREE offshore windfarm site (single pile location # 17) assuming a 3,500 kJ hammer strike energy.



White indicates a depth of < 0 m for tidal height modelled (Highest astronomical tide (HAT))

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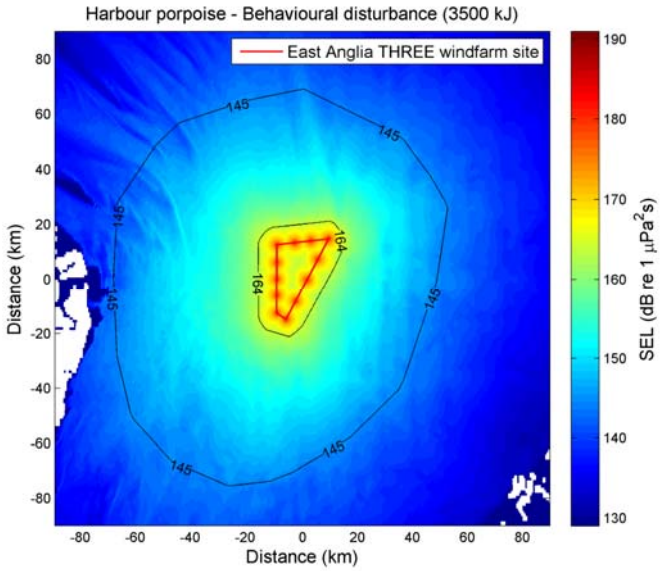
Footprints – Harbour porpoise

Example propagation model output of behavioural disturbance footprint for harbour porpoise around the East Anglia THREE offshore windfarm site assuming a 3,500 kJ hammer strike energy.



White indicates a depth of < 0 m for tidal height modelled (Highest astronomical tide (HAT))

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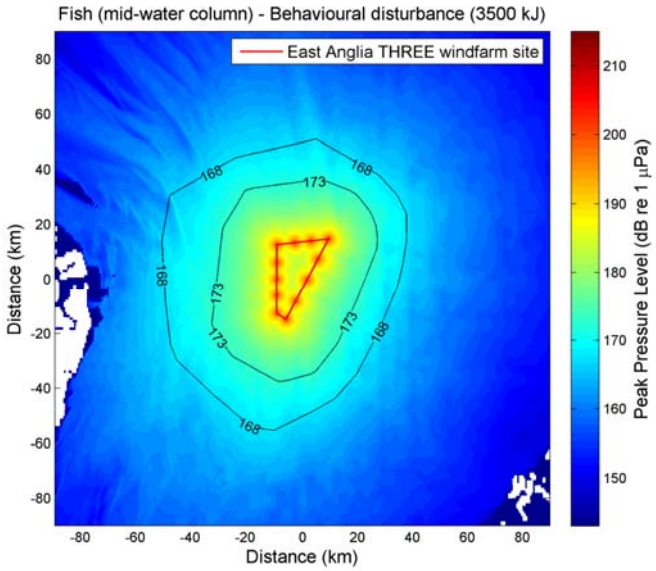
Footprints – Fish near mid-water column

Example propagation model output of behavioural disturbance footprint for pelagic fish around the East Anglia THREE offshore windfarm site assuming a 3,500 kJ hammer strike energy.



White indicates a depth of < 0 m for tidal height modelled (Highest astronomical tide (HAT))

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Indicative impact range estimates

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Marine Mammals – 3,500 kJ

- Modelling of sound propagation assuming foundation installation using a maximum hammer blow energy at 3,500 kJ indicates that:
  - Onset of PTS/instantaneous auditory injury for the marine mammal functional groups is unlikely to occur at ranges exceeding 500 m from the pile, but for harbour porpoise where the equivalent estimate is <1 km.
  - Onset of TTS/fleeing response in harbour porpoise (*Phocoena phocoena*) may occur at ranges up to about 8 km from the pile, an equivalent response for mid-frequency cetaceans (*e.g.* dolphin species) and low-frequency cetaceans (*e.g.* minke whale) was estimated out to less than about 500 m from the pile.
  - Onset of TTS/fleeing response in pinnipeds (in water) may occur at ranges up to about 2.5 km from the pile.
  - Avoidance response in harbour porpoise may occur at ranges up to about 70 km from the pile.
  - Avoidance response in dolphin species and baleen whales may occur at ranges up to about 13 km and 93 km from the pile, respectively.

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Fish – 3,500 kJ

- Modelling of sound propagation assuming foundation installation using a maximum hammer blow energy at 3,500 kJ indicates that:
  - Instantaneous injury for fish is unlikely at ranges greater than ~250 m from the pile.
  - Startle response in fish is unlikely at ranges greater than about 1 km from the pile.
  - Avoidance response in fish at depths around the mid-water column is unlikely at ranges more than about 48 km from the pile.

For hearing sensitive species dwelling near or on the seabed at distances of a few kilometres from the pile, the range for disturbance or avoidance can be expected to be smaller due to lower sound levels compared to those around the mid-water column.

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Context (1)

- The response of the animal is also likely to depend on its physiological state, motivation, etc
- The estimated impact distances represent the highest anticipated hammer blow energy and characterise the longer expected impact ranges for the East Anglia THREE offshore wind farm construction phase, from a given foundation location.
- The gradual ramp-up in hammer strike energy, initiated with a soft-start, will result in reduced ranges for injury and behavioural response predicted for a full piling hammer strike energy.
- There is considerable variability in the extent of the potential impact ranges due to variable bathymetry across and beyond the site. In general, the noise propagated efficiently over down-sloping seabed which in places was followed by shallower channels, confining the sound energy. To the east and the south of the windfarm site this was the primary cause of the longer impact distances.

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Context (2)

- Also, sound pressure levels will vary through the water column and mammals near the surface will be exposed to lower sound pressure levels than predicted
- Estimated impact ranges are reported as a ‘spread of distances’ and are tabulated for various hammer strike energies in Appendix B.

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Appendix A – Summary of Metrics and Criteria

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Metrics used for assessment

- Metrics of source level/received level chosen to be consistent with the Marine Strategy Framework Directive, the Marine Mammal Noise Exposure Criteria and the Interim Fish Injury Criteria
- These are (received levels or source levels):
  - Peak pressure level (dB re 1 μPa or dB re 1 μPa·m)
  - Sound exposure level (SEL) (dB re 1 $\mu Pa^2 \cdot s$ or dB re 1 $\mu Pa^2 \cdot m^2 \cdot s$)
  - SEL can also be summed up for cumulative SEL
- These should be compatible with any future thresholds adopted within the European and international community
- These metrics have also been put forward to ISO as part of a standard on quantities and units relating to underwater noise

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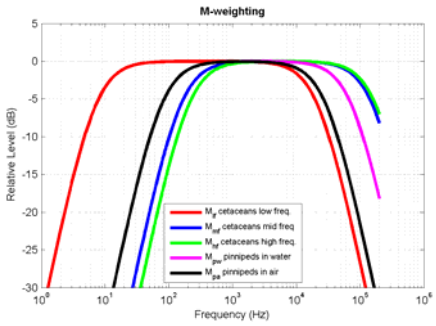
Impact criteria – marine mammals

Injury:

- Marine Mammal Noise Exposure Criteria and M-weighting (Southall et al., 2007)
- Harbour porpoise (Lucke et al., 2009)



Behaviour:

- Marine Mammal Noise Exposure Criteria and M-weighting (Southall *et al*., 2007)
- Harbour porpoise (Lucke *et al*., 2009)

- Other studies considered
  - Tougaard *et al*. (2009)
  - Brandt *et al*. (2011)
  - recent Kastelein *et al*. publications

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Injury criteria for marine mammals and fish

- Marine Mammal Noise Exposure Criteria and M-weighting (PTS)
- Harbour porpoise data from Lucke et al. (2009) (PTS extrapolated from TTS using guidance from Southall et al. (2007)

Species	Peak Pressure Level (dB re 1 µPa)	SEL (dB re 1 µPa^2·s)
Harbour porpoise - Instantaneous injury/ PTS	200	179 (single strike SEL)
Mid/Low-frequency cetaceans - Instantaneous injury/ PTS	230	198 (M_{hf}, M_{mf} or M_{lf} weighted)
Pinniped - Instantaneous injury/ PTS	218	186 (M_{pw} weighted)
Fish * - Instantaneous injury/PTS	206	

*Popper et al., 2006, Carlson et al., 2007

- Cumulative SEL injury for high-frequency cetaceans may still use Southall et al. (2007) criteria, as Lucke *et al.* (2009) is based on single strike TTS – extrapolation would assume the equal energy hypothesis

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Behavioural criteria for marine mammals

- Marine Mammal Noise Exposure Criteria for low & mid-frequency cetaceans (Southall et al., 2007)
  - Based on the severity scale 5 to 6 (indicated the onset of avoidance behaviour)
- Harbour porpoise (Lucke *et al.,* 2009)

Species	Peak Pressure Level (dB re 1 µPa)	SEL (dB re 1 $\mu Pa^2 \cdot s$)
Harbour porpoise - Fleeing response	194	164
Harbour porpoise - Possible avoidance of area	168	145
Low - frequency cetacean - Fleeing response	224	183 (Mmf or Mlf weighted)
Mid- frequency cetacean - Fleeing response	224	183 (Mmf or Mlf weighted)
Low- frequency cetacean - Possible avoidance of area		152 to142*
Mid frequency cetacean - Possible avoidance of area		160 to 170*
Pinniped - Fleeing response	212	171 (Mpw weighted)

*Obtained from Southall *et al.* (2007) behavioural response to multiple pulses by subtracting 10 dB and 8 dB from the root-mean-square Sound Pressure Level (SPL) value. 8 dB was applied to ranges farther away from the pile, as expected for low-frequency cetacean avoidance impact, whilst 10 dB was applied for shorter distances such as those corresponding to mid-frequency cetacean avoidance criterion.

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Behavioural criteria for fish

- Adopted from McCauley et al., 2000 and Pearson et al., 1992

Potential response	Peak Pressure Level (dB re 1 µPa)
General behavioural response	168 - 173*
Startle response / C-turn reaction	200*

*These levels were established from seismic airgun and should therefore only be applied for impulsive sound sources for fish that are sensitive to sound below around 500Hz.

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Appendix B – Summary of Estimated Impact Ranges

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Harbour porpoise

Summary of harbour porpoise impact distances estimated for pile driving during construction at East Anglia THREE for different hammer energies. Possible avoidance of area is stated as the *minimum to the 95th percentile* impact distance, where the actual impact distance within this range will depend on the transect and piling location. Larger impact distances may occur along limited transects for some locations (their approximate extent is indicated in brackets). Impact distances are rounded up to the nearest 500 m for distances of 3 km and less, and rounded up to the nearest 1 km for distances greater than 3 km.

Impact Criterion	Estimated impact distance for harbour porpoise around mid-water column				
	1,400 kJ hammer energy	2,000 kJ hammer energy	2,300 kJ hammer energy	3,000 kJ hammer energy	3,500 kJ hammer energy
Instantaneous injury/PTS (pulse SEL 179 dB re 1 $\mu Pa^2 \cdot s$)*	<500 m (mitigated by mitigation zone‡)	<500 m (mitigated by mitigation zone‡)	<500 m (mitigated by mitigation zone‡)	<1 km	<1 km
Fleeing response (pulse SEL 164 dB re 1 $\mu Pa^2 \cdot s$)*	~3.0 to 5 km	~4 to 6 km	~4 to 6 km	~5 to 8 km	~5 to 8 km
Possible avoidance of area (pulse SEL 145 dB re 1 $\mu Pa^2 \cdot s$)*	~24 to 44† km (~55 km)	~29 to 51† km (~58 km)	~31 to 54† km (~60 km)	~34 to 59† km (~66 km)	~37 to 62† km (~70 km)

**Lucke et al. (2009), †95th percentile impact range, ‡ Assumes a 500 m mitigation zone.*

Comment (applies to the marine mammal group): *Once the piling soft-start profile has been established, we will be able to determine if the potential for instantaneous injury at the higher hammer energies could be mitigated by the soft-start.*

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Mid-frequency cetacean

Summary of mid-frequency cetacean functional hearing group impact distances estimated for pile driving during construction at East Anglia THREE for different hammer energies. Possible avoidance of area is stated as the *minimum to the 95th percentile* impact distance, where the actual impact distance within this range will depend on the transect and piling location. Larger impact distances may occur along limited transects for some locations (their approximate extent is indicated in brackets). Impact distances are rounded up to the nearest 500 m for distances of 3 km and less, and rounded up to the nearest 1 km for distances greater than 3 km.

Impact Criterion	Estimated impact distance for mid-frequency cetacean around mid-water column				
	1,400 kJ hammer energy	2,000 kJ hammer energy	2,300 kJ hammer energy	3,000 kJ hammer energy	3,500 kJ hammer energy
Instantaneous injury/PTS (M_{mf} weighted 198 dB re 1 $\mu Pa^2 \cdot s$)*	<500 m (mitigated by mitigation zone‡)	<500 m (mitigated by mitigation zone‡)	<500 m (mitigated by mitigation zone‡)	<500 m (mitigated by mitigation zone‡)	<500 m (mitigated by mitigation zone‡)
Fleeing response (M_{mf} weighted 183 dB re 1 $\mu Pa^2 \cdot s$)*	<500 m	<500 m	<500 m	<500 m	<500 m
Likely avoidance of area (pulse SEL 170 dB re 1 $\mu Pa^2 \cdot s$)***	~1.5 to 2.0 km	~2.0 to 2.5 km	~2.0 to 2.5 km	~2.5 to 3.0 km	~2.5 to 4 km
Possible avoidance of area/Change in swimming behaviour (pulse SEL 160 dB re 1 $\mu Pa^2 \cdot s$)***	~5 to 8† km (~8 km)	~6 to 9† km (~10 km)	~6 to 10† km (~11 km)	~7 to 11† km (~12 km)	~8 to 12† km (~13 km)

Southall et al. (2007) Injury Criteria, **Southall et al. (2007) Single pulse behavioural disturbance.*Southall et al. (2007) Multiple pulses severity scoring behavioural disturbance (RMS SPL converted to pulse SEL by subtraction of 10 dB), †95th percentile impact range, ‡ Assumes a 500 m mitigation zone.*

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Low-frequency cetacean

Summary of low-frequency cetacean functional hearing group impact distances estimated for pile driving during construction at East Anglia THREE for different hammer energies. Possible avoidance of area is stated as the *minimum to the 95th percentile* impact distance, where the actual impact distance within this range will depend on the transect and piling location. Larger impact distances may occur along limited transects for some locations (their approximate extent is indicated in brackets). Impact distances are rounded up to the nearest 500 m for distances of 3 km and less, and rounded up to the nearest 1 km for distances greater than 3 km.

Impact Criterion	Estimated impact distance for low-frequency cetacean around mid-water column				
	1,400 kJ hammer energy	2,000 kJ hammer energy	2,300 kJ hammer energy	3,000 kJ hammer energy	3,500 kJ hammer energy
Instantaneous injury/PTS (M_{lf} weighted 198 dB re 1 µPa²·s)*	<500 m (mitigated by mitigation zone‡)	<500 m (mitigated by mitigation zone‡)	<500 m (mitigated by mitigation zone‡)	<500 m (mitigated by mitigation zone‡)	<500 m (mitigated by mitigation zone‡)
Fleeing response (M_{lf} weighted 183 dB re 1 µPa²·s)*	<500 m	<500 m	<500 m	<500 m	<500 m
Likely avoidance of area (pulse SEL 152 dB re 1 µPa²·s)***	~12 to 22 km	~16 to 26 km	~17 to 27 km	~19 to 32 km	~20 to 35 km
Possible avoidance of area/Change in swimming behaviour (pulse SEL 142 dB re 1 µPa²·s)***	~34 to 57† km (~66 km)	~39 to 66† km (~74 km)	~40 to 69† km (~79 km)	~41 to 75† km (~84 km)	~42 to 79† km (~93 km)

Southall et al. (2007) Injury Criteria, **Southall et al. (2007) Single pulse behavioural disturbance.*Southall et al. (2007) Multiple pulses severity scoring behavioural disturbance (RMS SPL converted to pulse SEL by subtraction of 8 dB), †95th percentile impact range, ‡ Assumes a 500 m mitigation zone.*

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Pinniped

Summary of pinniped functional hearing group impact range estimates for pile driving during construction at East Anglia THREE for different hammer energies. Impact distances are rounded up to the nearest 500 m for distances of 3 km and less, and rounded up to the nearest 1 km for distances greater than 3 km.

Impact Criterion	Estimated impact distance for pinnipeds around mid-water column				
	1,400 kJ hammer energy	2,000 kJ hammer energy	2,300 kJ hammer energy	3,000 kJ hammer energy	3,500 kJ hammer energy
Instantaneous injury/PTS * (M_{pw} weighted 186 dB re 1 $\mu Pa^2 \cdot s$)	<500 m (mitigated by mitigation zone‡)	<500 m (mitigated by mitigation zone‡)	<500 m (mitigated by mitigation zone‡)	<500 m (mitigated by mitigation zone‡)	<500 m (mitigated by mitigation zone‡)
Fleeing response (M_{pw} weighted 171 dB re 1 $\mu Pa^2 \cdot s$) **	<1.5 km	<1.5 km	<2.0 km	<2.0 km	<2.5 km

**Southall et al. (2007) Injury Criteria, **Southall et al. (2007) Single pulse behavioural disturbance, ‡ Assumes a 500 m mitigation zone.*

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Fish near mid-water column

Summary of impact distances for fish around mid-water column (pelagic fish), estimated for pile driving during construction at East Anglia THREE for different hammer energies. Behavioural disturbance of area is stated as the *minimum to the 95th percentile* impact distance, where the actual impact distance within this range will depend on the transect and piling location. Larger impact distances may occur along limited transects for some locations (their approximate extent is indicated in brackets). Impact distances are rounded up to the nearest 50 m for distance of 500 m and less, up to the nearest 500 m for distances of 3 km and less, and up to the nearest 1 km for distances greater than 3 km.

Impact Criterion	Estimated impact distance for fish around mid-water column				
	1,400 kJ hammer energy	2,000 kJ hammer energy	2,300 kJ hammer energy	3,000 kJ hammer energy	3,500 kJ hammer energy
Instantaneous injury/PTS (peak pressure level 206 dB re 1 µPa)	<100 m	<150 m	<150 m	<200 m	<250 m
Startle response/ C-turn reaction (peak pressure level 200 dB re 1 µPa)	<350 m	<500 m	<500 m	<1.0 km	<1.0 km
General behavioural response (peak pressure level 168 - 173 dB re 1 µPa)	~10 to 25† km (~28 km)	~12 to 30† km (~35 km)	~12 to 32† km (~37 km)	~14 to 37† km (~44 km)	~16 to 40† km (~48 km)

†95th percentile impact range.

* Final ranges are consistent with preliminary results, with a few revisions

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Fish near sea bed*

Summary of impact distances for fish near the sea bed (demersal fish), estimated for pile driving during construction at East Anglia THREE for different hammer energies. Behavioural disturbance of area is stated as the *minimum to the 95th percentile* impact distance, where the actual impact distance within this range will depend on the transect and piling location. Larger impact distances may occur along limited transects for some locations (their approximate extent is indicated in brackets). Impact distances are rounded up to the nearest 50 m for distance of 500 m and less, up to the nearest 500 m for distances of 3 km and less, and up to the nearest 1 km for distances greater than 3 km.

Impact Criterion	Estimated impact distance for fish near the sea bed				
	1,400 kJ hammer energy	2,000 kJ hammer energy	2,300 kJ hammer energy	3,000 kJ hammer energy	3,500 kJ hammer energy
Instantaneous injury/PTS (peak pressure level 206 dB re 1 µPa)	<100 m	<150 m	<150 m	<200 m	<250 m
Startle response/ C-turn reaction (peak pressure level 200 dB re 1 µPa)	<350 m	<500 m	<500 m	<1.0 km	<1.0 km
General behavioural response (peak pressure level 168 - 173 dB re 1 µPa)	~7 to 20† km (~22 km)	~9 to 23† km (~26 km)	~10 to 24† km (~27 km)	~10 to 27† km (~31 km)	~11 to 30† km (~34 km)

†95th percentile impact range.

* Final ranges are consistent with preliminary results, with a few revisions

12.1.4.2 Minutes of Marine Mammals ETG 3 Meeting

13. Provided below are the minutes from the third Marine Mammals ETG meeting

EAOW Round 3 Offshore Programme East Anglia THREE & FOUR, Marine Mammals ETG Meeting 3			
Date of Meeting:	14/04/02	**Venue:**	Tudor Street
Attendees			
Name	**Initials**		**Organisation**
Keith Morrison	KM		EAOW
Jesper Larsen	JL		EAOW
Marcus Cross	MC		EAOW
Claire Ludgate	CL		Natural England
Francesca Shapland	FS		Natural England
Paolo Pizzolla	PP		Royal HaskoningDHV
Beth Mackey	BM		Royal HaskoningDHV
Document Ref:		**Issue Date:**	11/4/14

10.00-15.00

ITEM	DESCRIPTION	ACTION
1	Health and Safety Introductions	None
2	Project update – KM Defer PEI EA4 – January 2015, DCO later 2015, allows focus on EA3. Opportunity to think about better design options. Onshore cables and options - revised	ACTION – KM to ensure that NE are informed of any further programme changes and details for EA4 when confirmed
3	Previous minutes – actions Email dated 28/11/13 NE agreed the approach taken for the assessment. **Baseline results** • Harbour porpoise, grey seal and harbour seal only taken forward in the assessment. • Seal densities based on SMRU at sea data. • Harbour porpoise densities based on highest values from APEM survey (e.g. EA THREE site plus buffer, surface only corrected sightings) • Harbour porpoise & small cetacean used as WCS harbour porpoise density • Reference populations have been agreed **EPS licence clarification** NE confirmed no expectation of draft EPS licences for marine species.	None – all agreed
4	HRA screening HRA screening was provided on the basis of discussions at ETG2.	No action
5	Worst Case Scenario Slide 5 of the presentation lists the assumptions to be used in the assessment.	PP provide to Natural England post meeting
6	Noise PP – at present no plans to refine the vessel distance, dependent upon the assessment. Likewise no plan to redo modelling based on site specific piling study. FS – do we have an avoidance rate approach like ornithology? BM – explained the dose response. Likely avoidance we can expect a 100% response, but moving towards the possible avoidance range assuming avoidance by 100% of the individuals is not appropriate. Can show a range within the assessment.	

ITEM	DESCRIPTION	ACTION
	BM – mitigation of PTS for HP covers other EPS, therefore no need to do anything specific for other species BM – modelling includes soft start but ranges reported (and used in assessment) are from instantaneous single strike model Metrics modelled consistent with requirements of MSFD BM – will commit to mitigation out to PTS range for HP, within the MMMP which is to be developed post consent **AGREE – no commitment to methodology but commitment to agreement within MMMP - 'may not include MMOs'** JKL – what is NE thinking about ADD? CL – ORJIP BM – guidance and techniques may be changing – therefore we need flexibility Current JNCC protocol currently advises using MMO and PAM to establish a 'mitigation zone' (30min prior to piling) – but this is may be subject to change Therefore appropriate to agree methods post consent. BM – results of assessment of impact of disturbance on HP Assumption on 100% response Magnitude based on agreed definitions from ETG1 **AGREE – can present range of response – 75/50% - but 100% in appendix (will be some justification around these figures in the PEI)** **AGREE Quantification of disturbance using – Apem site specific data for harbour porpoise/SMRU from seals** **NE – ok with project specific impacts, EA3 or EA4 in isolation not likely to have significant impact from pile driving**	
7	CIA Tiers – difference of approach between UK and other countries, more detail available for UK therefore able to include more projects ➢ 67 offshore wind farms in the harbour porpoise CIA with East Anglia THREE and East Anglia FOUR; ➢ 31 projects are considered in the CIA East Anglia THREE and East Anglia FOUR for harbour seal; ➢ 41 projects are considered in the CIA for East Anglia THREE and East Anglia FOUR for grey seal; BM – slight differences in baseline position (survey period) for the projects included for EA3 and EA4 CL – any borderline projects – were some project just outside geographic limits for CIA assessment BM - A few projects just on the edge for HRA (transboundary) but not for UK projects	

ITEM	DESCRIPTION	ACTION
	BM – anything in commencing construction post-baseline but pre-submission of application will be completed therefore concurrent pile driving will not be assessed BM – if no usable data then projects will drop out of assessment (i.e. the numbers may be reduced from those presented). We will review the list of projects for the final assessment and ensure that this is up to date **Agree uncertainty?** CL – NE appreciates this points JKL – simultaneous cumulative unrealistic. BM - ensure methodology is clear. PP – assume EA4 project description as per EA3.There will be no zone level assessment.	
8	Horizon scan JKL – nothing from Depons in time. May provide support for conclusions within the examination. BM – interim PCoD – no time for consultation on use of this prior to DCO. ES will provide information that could be used in examination period. CL – no dates for PCoD workshops, no agreement on use. Not reasonable to expect use of this in assessment. Discussion on who should be using PCoD and how. CL – nothing from ORJIP this summer. BM – MMO review of FEPA may come through and influence wording of potential licence conditions. CL – wash seals data / papers– chase KM – some things may come through in time for EA4	Action – BM/CL to chase MMO ACTION – CL to chase outputs with John Hartley
9	AOB PP – workshop at the end of June. PP look at dates – factor in Creyke Beck CL - ok KM – don't feel constrained by set dates	

ID	Issue on which EAOW THREE and FOUR seek agreement on	Agreed Position	NE comments
	ETG3		
	Noise assessment – interoperation of preliminary results	Agree on interpretation	
	Development and methods for MMMP post consent	Agree	
	Approach to quantifying disturbance from piling noise	Agree	
	No issues with the potential magnitude of disturbance effect for harbour porpoise?	Agree	
	CIA – tiers included in the assessment	Agree	
	CIA – list of Windfarm projects screened in	Agree	
	CIA- Acknowledge large amount of uncertainty	Agree	
	ETG2		
	Assessment methodology	Agreed	
	Apem methodology	Agreed	
	Noise methodology - Parameters to be confirmed	Agreed in principle	
	Baseline		
	species	CL to agree by 29th November	Agreed via email 28/11/13
	data	CL to agree by 29th November	Agreed via email 28/11/13
	Reference populations	CL to agree by 29th November	Agreed via email 28/11/13
	Approach to CIA	Agreed in principle	
	Approach to HRA	Agreed in principle	
	ETG1		
1	Sufficient survey data have been collected	Agreed – subject to CL getting understanding of APEM methodology 24 months aerial data is sufficient Correction factors to be used dependent upon data – methods agreed in principle Species for assessment – agreed	Will return to correction factors in ETG2
2	The list of impacts to be assessed are those proposed in the Evidence Plan method statement	Agreed	

	and the powerpoint presentation.		
3	It is agreed that the sensitivity and magnitude definitions are appropriate	Agreed in principle – subject to specific paper to be circulated prior to next ETG meeting	To run thru at ETG2
	Harbour porpoise reference population	IAMMWG MU - Agreed in principle – (CL noted that the IAMMWG paper has not yet been signed off)	To run thru at ETG2
		EAOW data – agreed (will consider with regard to SCANS data)	To run thru at ETG2
	White-beaked dolphin or other cetacean species (if sufficient data for impact assessment) reference populations	IAMMWG MU to be used	To run thru at ETG2
	Seal reference populations	IAMMWG MU plus European sites with connectivity – harbour seal SE MU (with reference to telemetry data)	To run thru at ETG2
		IAMMWG MUs plus European sites with connectivity grey seal – more European issue than harbour (telemetry data will be used)	To run thru at ETG2
		Agreed - for transboundary impacts makes more sense for EIA purposes to use biological ref population. The derivation of this will be discussed and agreed at future meeting	To run thru at ETG2
	Other available seal data	Agreed – Wash seal tracking data not available until February 2014 will incorporate if available	To run thru at ETG2
		Agreed densities for seals – will use SMRU at-sea densities (not site-specific survey data)	To run thru at ETG2
	Quantitative assessment for pile driving noise in harbour and grey seal, and harbour porpoise.	Agreed	
	Qualitative – for all other impacts	Agreed (e.g. vessel movements quantified, but cannot translate into quantified no. of animals affected)	

12.1.4.3 Email Agreement of Marine Mammals ETG 3 minutes.

David Tarrant

From: Ludgate, Claire (NE) <Claire.Ludgate@naturalengland.org.uk>
Sent: 17 April 2014 15:10
To: Pizzolla, P. (Paolo)
Cc: Mackey, B.L. (Beth); Morrison, K (Keith) - Scottish Power Renewables; Mandy.gloyer@scottishpower.com
Subject: RE: East Anglia 3/4 ETG3 mammals minutes

Hi Paolo,

I have no further comments to make on the meeting minutes so these can be finalised.

With regard to EPS licensing, I am in the process of chasing clarification over whether a draft terrestrial EPS lic application would be required and will send this to you as soon as I have it, so please don't think I've forgotter

I'll reply to you separately regarding the fish/benthic/physical processes.

Many thanks,

Claire

Claire Ludgate
MSc AMIMarEST

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12.1.5 Marine Mammals ETG Meeting 4: 3rd July 2014

14. The format for the Marine Mammals ETG 4 followed was slightly different to that of the previous meetings in that no method statement was produced prior to the meeting. The purpose of the meeting was to consult on the Marine Mammals PEIR Chapter and therefore below are the following documents produced for the 4th Marine Mammal ETG meeting:

- The presentation given to the ETG ; and
- Minutes of meeting; and
- Further comments which were submitted post meeting by Natural England.

12.1.5.1 The presentation given to the ETG

East Anglia Offshore Wind

PEIR/Evidence Plan Meeting 4

Marine Mammals – Expert Topic Group

EAOW Office, Tudor St, London
3rd July 2014
EAOW & RHDHV

East Anglia Offshore Wind

Agenda

- Discuss the results of the assessment
- Clarify any matters
- Clarify any outstanding issues
- Discuss any updates/decisions/advice for final ES
- Next steps for HRA
- Next steps for Examination – SCGs, Licence conditions
- AOB

East Anglia Offshore Wind

Summary of the noise assessment

PTS onset ranges

Species or species group	Impact criteria SEL (dB re 1 μPa²·s)	Maximum hammer energy kJ		
		1,400	2,000	3,500
Harbour porpoise	179	<500m	<500m	<1km
Pinnipeds (in water)	186	<500m	<500m	<500m
Low-frequency cetaceans	198	<500m	<500m	<500m
Mid-frequency cetaceans	198	<500m	<500m	<500m

Fleeing response/TTS ranges

Species or species group	Impact criteria SEL (dB re 1 μPa²·s)	Maximum hammer energy kJ	
		2,000	3,500
Harbour porpoise	164	~4-6km	~5-8km
Pinnipeds (in water)	179	<1.5km	<2.5km

East Anglia Offshore Wind

Summary of the noise assessment

Fleeing response/TTS areas and magnitude of effect

Scenario	Hammer energy	Area (km²)	Density (individuals per km²)	No. individuals	Percent of reference population (227,298)
Spatial worst case (two vessels monopiles, no overlap, disturbance 28% of two years)	3,500kJ	281.6	0.187 (harbour porpoise)	53	0.023%
			0.284 (harbour porpoise and unidentified dolphin and porpoise)	80	0.035%
Temporal worst case (single vessel jacket disturbance for 41% of two years)	2,000kJ	72.1	0.187 (harbour porpoise)	13	0.006%
			0.284 (harbour porpoise and unidentified dolphin and porpoise)	20	0.009%

Possible avoidance areas and magnitude of effect (footprint approach)

Scenario	Hammer energy	Footprint area (km²)	Density (individuals per km²)	No. individuals affected assuming response by75% of those exposed to the stimulus		
				50%	75%	100%
Spatial worst case (monopiles)	3,500kJ	13,469	0.187 (harbour porpoise)	1,259	**1,889**	2,519
			0.284 (harbour porpoise and unidentified dolphin and porpoise)	1,913	**2,869 (1.26% ref. pop)**	3,825
Temporal worst case (jackets)	2,000kJ	10,027	0.187 (harbour porpoise)	937	**1,406**	1,875
			0.284 (harbour porpoise and unidentified dolphin and porpoise)	1,423	**2,135**	2,848

East Anglia Offshore Wind

Summary of the assessment

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Construction						
Underwater noise – pile driving – Lethal and physical injury effects	Harbour porpoise, grey seal and harbour seal	High	No change	**No impact**	No further mitigation suggested beyond embedded mitigation (soft start and MMMP)	**No cimpact**
Underwater noise – pile driving – auditory injury (PTS)	Harbour porpoise	Medium	No change	**No impact**		**No impact**
	Grey seal and harbour seal	Low	Low	**Minor adverse**		**Minor adverse**
Behavioural response (avoidance of area)	Harbour porpoise	Medium	Low	**Minor adverse**		**Minor adverse**
	Grey seal and harbour seal	Low	Negligible	**Negligible**		**Negligible**
Underwater noise - vessels	Harbour porpoise	Medium	Negligible	**Negligible**	None	**Negligible**
	Grey seal and harbour seal	Low	Negligible	**Negligible**		**Negligible**
Underwater noise - seabed preparations, rock dumping and cable installation	Harbour porpoise	Medium	Negligible	**Negligible**	None	**Negligible**
	Grey seal and harbour seal	Low	Negligible	**Negligible**		**Negligible**
Impacts upon prey species	Harbour seal and harbour porpoise	Medium	Negligible	**Negligible**	No further mitigation suggested beyond embedded mitigation.	**Negligible**
	Grey seal	Low	Negligible	**Negligible**		**Negligible**
Vessel interactions – ship strikes	Harbour porpoise	High	Negligible	**Minor adverse**	None	**Minor adverse**
	Grey and harbour seal	Negligible	Low	**Negligible**		**Negligible**
Vessel interactions – ducted propellers	Grey seal and harbour seal	High	Negligible	**Minor adverse**	None	**Minor adverse**

East Anglia Offshore Wind

Summary of the assessment

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Operation						
Underwater noise - turbines	Harbour porpoise	Medium	Low	**Minor adverse**	None	**Minor adverse**
	Grey seal and harbour seal	Low	Low	**Minor adverse**		**Minor adverse**
Underwater noise - vessels	Harbour porpoise	Medium	Low	**Minor adverse**	None	**Minor adverse**
	Grey seal and harbour seal	Low	Low	**Minor adverse**		**Minor adverse**
Impacts upon prey species	Harbour seal and harbour porpoise	Medium	Low	**Minor adverse**	None	**Minor adverse**
	Grey seal	Low	Low	**Minor adverse**		**Minor adverse**
Vessel interactions – ship strikes	Harbour porpoise	High	Negligible	**Minor adverse**	None	**Minor adverse**
	Grey and harbour seal	Negligible	Negligible	**Negligible**		**Negligible**
Vessel interactions – ducted propellers	Grey seal and harbour seal	High	Negligible	**Minor adverse**	None	**Minor adverse**
Physical barrier	Harbour porpoise, grey seal and harbour seal	Negligible	Low	**Negligible**	None	**Negligible**
Decommissioning						
Underwater noise – all sources	Harbour porpoise	Medium	Negligible	**Negligible**	None	**Negligible**
	Grey seal and harbour seal	Low	Negligible	**Negligible**		**Negligible**
Impacts upon prey species	Harbour seal and harbour porpoise	Medium	Negligible	**Negligible**	No further mitigation suggested beyond embedded mitigation.	**Negligible**
	Grey seal	Low	Negligible	**Negligible**		**Negligible**
Vessel interactions – ship strikes	Harbour porpoise	High	Negligible	**Minor adverse**	None	**Minor adverse**
	Grey and harbour seal	Negligible	Low	**Negligible**		**Negligible**
Vessel interactions – ducted propellers	Grey seal and harbour seal	High	Negligible	**Minor adverse**	None	**Minor adverse**

Summary of the CIA

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Underwater noise – all sources	Harbour porpoise	Medium	High	**Major adverse**	No further mitigation suggested beyond embedded mitigation (soft start and MMMP)	**Major adverse**
	Grey seal	Low	Medium	**Minor adverse**		**Minor adverse**
	Harbour seal (UK level)	Low	Medium (High)	**Minor adverse (Moderate adverse)**		**Minor adverse (Moderate adverse)**
Impacts upon prey species	Harbour porpoise	Medium	Medium	**Moderate adverse**	None	**Moderate adverse**
	Grey seal	Low	Low	**Minor adverse**		**Minor adverse**
	Harbour seal (UK level)	Medium	Low (Medium)	**Minor adverse (Moderate adverse)**		**Minor adverse (Moderate adverse)**
Vessel interactions	Harbour porpoise	High	Medium	**Major adverse**	None	**Major adverse**
	Grey seal	High	Medium	**Major adverse**		**Major adverse**
	Harbour seal (UK level)	High	Medium (High)	**Major adverse**		**Major adverse**

Any clarifications required?

- *Are there any areas what NE require clarification on?*
  (If possible please provide details in advance of the meeting).

Any outstanding issues?

- *Are there any areas that NE believe to be outstanding?*
  (If possible please provide details in advance of the meeting).

Updates since PEIR?

- *No further updates to the Project Description which would alter the worst case scenario for marine mammals;*
- *No new Guidance that EAOW are aware of:*
  - *MMO Review of post consent monitoring is available, this may feed into wording for DML?;*
  - *Interim PCoD report is available, but no programme code, so this can't be used as a tool in the ES;*
- *Any further advice from NE?*

HRA – next steps

Update the Screening report using methods and results of impact assessment to include an assessment against the conservation objectives of the screened in sites.

Likely significant effects tests, including assessment of in-combination effects.

Timelines:

Draft for review by Natural England prior to September ETG meeting.
Final submission in parallel with final ES.

Next steps - Draft SCG

Matters of agreement from Evidence Plan process

ID	Statement on which EAOL seek agreement	EAOL position	NE position
Consultation			
1-a	The principal guidance documents used to inform the assessment of potential impacts on marine mammals are appropriate for this assessment.	Agree	Agree
Existing environment			
2-a	Site specific survey methods, duration and data analysis are sufficient to characterise the existing environment.	Agree	Agree
2-b	The use of harbour porpoise and unidentified individuals represents a precautionary approach to calculating harbour porpoise density across the Project area.	Agree	Agree
2-c	Suitable correction factors have been used to account for marine mammals below the surface during aerial surveys.	Agree	Agree
2-d	Harbour porpoise, grey seal and harbour seal are the only species of marine mammal to be considered in the impact assessment.	Agree	Agree
2-3	The reference populations as defined in the ES are appropriate.	Agree	Agree
Assessment methodology			
3-a	The definitions used of sensitivity and magnitude in the impact assessment are appropriate.	Agree	Agree
3-b	The potential impacts considered in the assessment are appropriate.	Agree	Agree
3-c	The worst case scenario presented in the Environmental Statement is appropriate.	Agree	Agree
3-d	The approach to assessment of impacts from pile driving noise for marine mammals follows current best practice and is therefore appropriate for this assessment.	Agree	Agree
3-e	Underwater noise impact from pile driving is the only impact where a quantified assessment can be made.	Agree	Agree
3-f	The approach to screening in plans and projects for consideration the cumulative impact assessment, and the resulting lists of plans and projects for each receptor is appropriate.	Agree	Agree

Next steps - Draft SCG

Matters of agreement from Evidence Plan process

ID	Statement on which EAOL seek agreement	EAOL position	NE position
Conclusions of impact assessment			
4-a	Natural England agree with the conclusions of the impact assessment. The assessment is robust and is based on a precautionary approach.	Agree	
4-b	At a Project level impacts on harbour porpoise, grey seal and harbour seal will not have significant impacts.	Agree	Agreed in principle at ETG3
4-c	The conclusions of the CIA are highly precautionary, based on the large amount of uncertainty in the number and construction timing of the projects included in the assessment	Agree	Agreed in principle at ETG3
Mitigation			
5-a	A marine mammal mitigation protocol (MMMP) will be developed post consent in consultation with the Natural England and JNCC. The details of the methods used in the MMMP do not need to be confirmed pre-consent and will follow best practice.	Agree	Agree
Habitats Regulation Assessment and European Protected Species Licence			
6-a	The methods used for HRA screening are appropriate	Agree	Agree
6-b	The EPS licence will be applied for after the Development Consent Order (DCO) application is consented, prior to the onset of construction, once more detailed design work has been carried out and is available to inform the licence application, and in consultation with the relevant Statutory Nature Conservation Agencies.	Agree	Agree
6-b	Expect some agreement on the conclusions of the HRA LSE tests in post submission SCGs version.		

Next steps - Draft SCG

Can we confirm that there are currently no unresolved issues?

Would Natural England include a copy of this Table in the PEIR consultation responses,, so the level of agreement to date can be confirmed?

Next steps – Licence Conditions

Monitoring:
Not expecting any requirements for site specific pre-construction monitoring, which will be of limited value at this site.
Contributions to strategic work is more valuable, does this need to be secured through a specific condition?
What are the views on Natural England and the MMO?

MMMP:
Specific reference to mitigation is only expected in relation to auditory injury from pile driving in the conditions.
What are the views on Natural England and the MMO?

AOB

12.1.5.2 Minutes of Marine Mammals ETG 4 Meeting

15. Provided below are the minutes to Marine Mammals ETG 4

Name	Initials	Organisation
Mandy Gloyer	MG	EATL
Kathy Wood	KW	EATL
Jesper Kyed Larsen	JKL	EATL
Lou Burton	LB	Natural England
Francesca Shapland	FS	Natural England
Kathleen Mongan	KM	MMO
Holly Drake	HD	Cefas
Dean Foden	DF	Cefas
Paul Whomersley	PW	Cefas
Louise Cox	LC	Cefas
Paolo Pizzolla	PP	Royal HaskoningDHV
Beth Mackey	BM	Royal HaskoningDHV
Nick Cooper	NC	Royal HaskoningDHV
Apologies		

AGENDA		
Item	**Description**	**Action**
1	Health and Safety Introductions - All	n/a
2	**Project update**	
6	**Marine mammals**	
	Approach NE/Cefas – generally content with the approach taken and the assessment. No comment on the baseline information provided PP – clarified that the assessment was completed, no further noise modelling will be undertaken. *Corkscrew injuries* LB – Likely to be raised by other parties and therefore DML wording to be changed to cover all injuries (i.e. more generic to cover noise and collisions) – a standard condition on this to be included in the DML. *Mitigation* LB – whilst NE recognise that the impact of EA3 in isolation is not significant and contribution to overall cumulative impact is minimal, it would be worth including a willingness to consider mitigation in the assessment. In particular, look at the alternatives narrative and make it clear why alternative foundations not considered. PP – given the limited impacts any reduction in piling energy or at source, related mitigation would have	ACTION - add to project description rationale for different types of foundations included, cross reference within MM assessment. ACTION - add note on developing position of potential of mitigation.

	negligible impact on the wider cumulative impact. *Comment 112 – EPS licence* BM – EPS – we assume EPS only likely for harbour porpoise? LB – Keep this generic for all cetacean species for now, at time of application will be specific to spp. *PCOD* BM – we do not anticipate using this to inform the assessment as it will not be available in time	
	HRA EAOW will undertake the full assessment by September. We would suggest a short meeting to discuss the conclusions	ACTION – date needed for September
	MMMP BM – EAOW believe site specific monitoring of limited value, especially in a site such as EA3 where there are few marine mammals. More in strategic work (such as DEPONS) would be of greater value. How do we capture this? LB – NE recognises limits to outcome of site specific monitoring, and want investment in strategic work. NE will provide wording used for other projects which it believes covers this approach. LB – there is a need to be pragmatic, site specific work could easily relate to a zone rather than a specific project within it, or a project/strategic work elsewhere with a better opportunity to address specific questions. PP – are MMO happy with a move away from traditional site-specific monitoring? KM – MMO content with this	
7	**All topics**	
	Agreement log LB – NE cannot sign off on conclusions of the assessment, this can only be done once the DCO is submitted. The agreement log is welcome as an indication of what will be covered by the SoCG *Project description* There are areas of the project description – particularly in relation to duration of individual activities – which could be better defined to improve understanding of the impacts *In principle monitoring plan* NE would welcome the inclusion of an in-principle monitoring plan within the DCO covering offshore topics. This would be high-level rather than	ACTION – circulate agreement logs for information only

	prescriptive. This would be referred to in the DML conditions. In particular this would be worded to allow for alternatives to site-specific monitoring to be used to discharge licence conditions.	

12.1.5.3 Follow up to Marine Mammals ETG meeting 4

16. Provided below are a further set off comments that were submitted by Natural England following the ETG 4 meeting. This built on the original comments that were submitted under the Section 42 consultation on the PEIR.

NE Point	Page	Section	Reviewer	Comment	NE Comments following workshop with developer on 03/07/14
93	85	273	SU	As noted above, IHLS data should be acknowledged with respect to herring spawning.	No further comment
Chapter 12 Marine Mammals					
94					*General update from workshop*: Schedule to plan to discuss draft HRA mid-August for a meeting in September. Round up of evidence plan and provide dates for meeting. Monitoring site specific during and post construction is going to pretty limited. Vattenfall strategic issues leading on DEPONS, or zonal monitoring/site specific. Condition included for DBCB within DML's 1&2 condition 9(1)(e) and DML3&4 condition 8(1)(e) that could be adopted : "*Appropriate surveys (i.e. such as those included within the Disturbance Effects on Harbour Porpoise of the North Sea (DEPONS) project or agreed alternative monitoring) of existing marine mammal activity*

NE Point	Page	Section	Reviewer	Comment	NE Comments following workshop with developer on 03/07/14
					inside the area(s) within the Order limits in which it is proposed to carry out construction works or any wider area(s) as appropriate which is required to test predictions in the environmental statement concerning key marine mammal interests of relevance to the authorised scheme." It may be appropriate to amend ',, alternative monitoring..' with '…or agreed East Anglia zone/site specific monitoring…'?
95		GENERAL	VC	Natural England notes that the planned development of renewable energy in UK waters could involve multiple piling events occurring concurrently and sequentially across a species' range, over several years. This has the potential to have a detrimental impact on the favourable conservation status of populations of cetacean species occurring in UK waters. Continued strategic discussion is required between UK Regulators and SNCBs to consider the wider issues of an EPS licensing framework across UK waters as a whole.	No further comment
96		GENERAL	VC	Given the potential impacts on marine mammals described, it is clear that mitigation will play a key role in	EA 3 to consider this further and provide wording in final ES.

NE Point	Page	Section	Reviewer	Comment	NE Comments following workshop with developer on 03/07/14
				any wind farm developments in the North Sea, in particular in the context of this development, reduce cumulative effects arising from *disturbance*. It will therefore be beneficial if all developers make a concerted attempt to reduce the acoustic output from pile driving (e.g. sleeving), to investigate alternative installation methods (e.g. suction bucket) and to plan activities within the scope of what is proposed to reduce the potential that they contribute to negative effects on populations.	
97		GENERAL	VC	Natural England welcomes the Applicant's commitment to implementing the JNCC's piling guidelines as mitigation and will review the development of an effective marine mammal mitigation plan (MMMP) near construction time. Natural England also recommend that the applicant keeps a watching brief on the work carried out under ORJIP on Acoustic Mitigation Devices and any further developments of best practice in relation to mitigation options.	No Further Comment
98		GENERAL	VC	Cumulative impact of underwater noise during construction has potential to disturb >20% harbour porpoise population and we agree that this has potential to be a major adverse effect and this is of considerable concern to Natural England. We note that East Anglia THREE is only making a relatively small contribution to	No Further comment

NE Point	Page	Section	Reviewer	Comment	NE Comments following workshop with developer on 03/07/14
				this impact (as with all predicted impacts to marine mammals (para 567)) with a worst case of 1.26% of the reference population assessed as being disturbed using the footprint approach	
99		GENERAL	VC	Construction programming may need to be considered across all projects and the applicant should be prepared to work with other developers, alongside Regulators and SNCBs, in order to reduce cumulative effects as required.	No further comment
100		Para 52	VC	An EPS license will be required to cover the risk of disturbance to all cetacean species identified as likely to be in the area under regulations 39(1)(a) and (b) of the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended). For this, the consideration of less noisy alternatives to piling, the total area of impact, the duration of impact and the number of animals likely to be affected would need to be clearly presented.	Recognised by developer at the workshop
101		Para 67	VC	We note that population growth rate accepted as default for cetaceans (IWC/Ascobans) is 4% but that evidence seems to show 0-2% in North Sea populations and that this lower rate has been used in the assessment.	No further comment
102		Para 69-70	VC	We note that 5% temporary effect on population in one year equates to medium magnitude and that 1%	No further comment

NE Point	Page	Section	Reviewer	Comment	NE Comments following workshop with developer on 03/07/14
				permanent effect equates to high magnitude.	
103	70	12.6.11	VC	We agree that the most significant risk of impact on marine mammals is the effects of underwater noise from pile driving.	No Further comment
104		Para 246	VC	We support the use of the more precautionary TTS and behavioural criteria being used in this assessment.	No further comment
105		Para 268	VC	We agree that, based on the assessment of auditory injury (PTS), the establishment of a mitigation zone out to at least 500m (following current JNCC 2010a guidelines) would prevent exposure of individuals to noise thresholds which could lead to instantaneous onset of PTS. This should form part of the marine mammal mitigation plan which should be a condition for development to proceed.	No further comment.
106		Para 269	VC	We agree that the maximum distance of a mitigation zone (likely to be 1km or less) can be confirmed during development of a MMMP once piling parameters have been confirmed. We also confirm that an injury offence to EPS species is unlikely to be committed but note that disturbance offence may require an EPS licence.	No further comment
108		Para 317	VC	Agree that impacts are expected to be low for both	Noted that further clarity from NE is required on this point when

NE Point	Page	Section	Reviewer	Comment	NE Comments following workshop with developer on 03/07/14
				species of seal and harbour porpoise and that additional mitigation (beyond embedded mitigation) is not necessary.	Victoria Copley is available later on this week. Unfortunately this was not available at the time of providing our S42 response
109		Para 336	VC	Agree that no additional mitigation is necessary for shipping noise.	No further comment
110		Para 337	VC	Agree that no additional mitigation is necessary for other noise inducing impacts.	No further comment

12.1.6 Marine Mammals ETG Meeting 5: 6th July 2015

17. Provided in section 12.1.6 are the following documents produced for the 5th Marine Mammal ETG meeting:

- HRA Method Statement Marine Mammals Final Screening (draft);
- Minutes of meeting; and
- Email agreement of minutes.

12.1.6.1 Marine Mammals Evidence Plan Method Statement for ETG 5

18. Provided below is the HRA method statement which was circulated to attendees prior to the third East Anglia THREE Marine Mammals ETG meeting held on the 6th July 2015.

East Anglia
Offshore Wind

VATTENFALL

SCOTTISHPOWER
RENEWABLES

East Anglia THREE

HRA Method Statement

Marine Mammals Final Screening (draft)

Author – Royal HaskoningDHV
East Anglia Offshore Wind Limited
Date – June 2015
Revision History

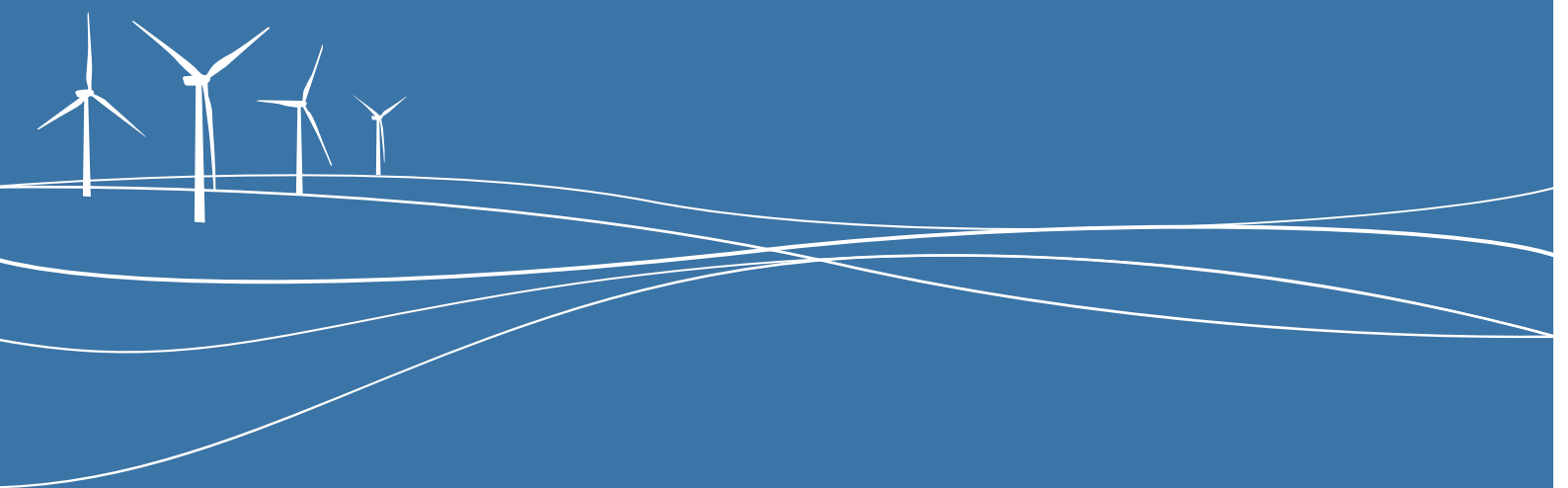

Table of Contents

1 INTRODUCTION

1.1 Purpose of this document

1. This document considers the Special Areas of Conservation (SACs) and Sites of Community Importance (SCI) and their marine mammal features that were included in the high level screening for the proposed East Anglia THREE project by APEM Ltd 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 SACs, SCIs and marine mammal features requiring further consideration because LSE cannot be ruled out at this stage.

2 SCREENING OF MARINE MAMMALS DESIGNATED SITES

2.1 High level screening summary

2. A High-Level Screening Report was provided by APEM Ltd and Royal HaskoningDHV (2014). The report listed SACs and SCIs that were initially screened in for harbour porpoise *Phocoena phocoena*, grey seal *Halichoerus grypus* and harbour seal *Phoca vitulina*.

3. For marine mammals in the initial approach to high level screening the key factor was the potential for connectivity between individual marine mammals from designated populations at the proposed East Anglia THREE project (i.e. demonstration of a clear source-pathway-receptor relationship). This approach was discussed and agreed with Natural England as part of the Evidence Plan process (November 2013). Sites were screened in that were within agreed ranges for each species.

2.1.1 Harbour porpoise

4. For harbour porpoise connectivity was considered possible between the East Anglia THREE site and any Natura 2000 site within the North Sea management unit (MU) (IAMMWG 2015). The extent of the North Sea MU has been agreed during consultation with Natural England (November 2013), as the most appropriate population which any harbour porpoise occurring within the East Anglia THREE site may be part of.

5. The initial high level HRA screening considered any Natura 2000 site within the harbour porpoise North Sea MU, where the species is considered as a grade A, B or C feature. Grade D indicates a non-significant population (JNCC 2009). All Natura 2000 sites outwith the harbour porpoise North Sea MU area were screened out from further consideration. The initial screening listed 34 Natura 2000 sites for harbour porpoise to be considered for any potential LSE.

2.1.2 Grey seal

6. For grey seal, the initial screening process considered SACs and SCIs where the species is a grade A, B or C feature and the site was within 1,000km of the East Anglia THREE site.

7. Following screening for distance from the East Anglia THREE site and potential connectivity based on telemetry data, 21 Natura 2000 sites were identified in the initial screening to be considered for any potential LSE on grey seal features.

2.1.3 Harbour seal

8. For harbour seal, the initial screening process considered SACs and SCIs where it is a grade A, B or C feature and the site was within 300km of the East Anglia THREE site.

9. All of the Natura 2000 sites for harbour seal within 300km of East Anglia THREE site were considered, this list was then refined based on the available telemetry data that provided evidence of connectivity. Sites with no connectivity were screened out from further consideration. The initial screening listed 18 Natura 2000 sites for harbour seal to be considered for any potential LSE.

2.2 Updated screening

10. The initial screening lists of proposed Natura 2000 sites for harbour porpoise, grey seal or harbour seal were checked for any updates (http://natura2000.eea.europa.eu/#).

11. Draft SACs (dSACs) for harbour porpoise in UK waters are currently being consulted upon. Therefore the possible sites located within the North Sea MU for harbour porpoise have now been included *Table 1.1*. Note that 7 sites were included for harbour porpoise in the high level screening that are actually outwith the North Sea MU and this error has been corrected.

12. The updated screening listed 33 Natura 2000 sites for harbour porpoise (*Table 1.1*) 24 sites for grey seal (*Table 1.2*) and 18 sites for harbour seal (*Table 1.3*) to be considered for any potential LSE.

Do you agree that the updated site lists for each species is correct?

Table 1.1 Updated screening list of SACs and SCIs for harbour porpoise to be taken forward to next stage of screening for HRA. Shaded rows have been screened out from further consideration.

Site code	Country	Site name	Designation	Screened in	Notes
BEMNZ0002	Belgium	SBZ 1 / ZPS 1	SPA	Y	
BEMNZ0003	Belgium	SBZ 2 / ZPS 2	SPA	Y	
BEMNZ0004	Belgium	SBZ 3 / ZPS 3	SPA	Y	
BEMNZ0005	Belgium	Vlakte van de Raan	SCI	Y	
DE0916391	Germany	NTP S-H Wattenmeer und angrenzende Küstengebiete	SAC	Y	
DE1011401	Germany	SPA Östliche Deutsche Bucht	SPA	Y	
DE1209301	Germany	Sylter Außenriff	SCI	Y	
DE1003301	Germany	Doggerbank	SCI	Y	
DE2104301	Germany	Borkum-Riffgrund	SCI	Y	
DE1813391	Germany	Helgoland mit Helgoländer Felssockel	SAC	Y	
DE1714391	Germany	Steingrund	SAC	Y	
DE2016301	Germany	Hamburgisches Wattenmeer	SCI	Y	Included after initial screening
DE2018331	Germany	Unterelbe	SCI	Y	Included after initial screening
DE2306301	Germany	Nationalpark Niedersächsisched Wattenmeer	SCI	Y	Included after initial screening
DK00FX112	Denmark	Skagens Gren og Skagerrak	SAC	Y	
DK00VA347	Denmark	Sydlige Nordsø	SAC	Y	
DK00VA171	Denmark	Gilleleje Flak og Tragten	SAC	N	Outwith NS MU
DK00VA259	Denmark	Gule Rev	SCI	Y	
DK00VA250	Denmark	Store Middelgrund	SAC	N	Outwith NS MU
DK00VA258	Denmark	Store Rev	SCI	Y	
DK00AY176	Denmark	Vadehavet med Ribe Å, Tved Å og Varde Å vest for Varde	SAC	Y	
FR3100478	France	Falaises Du Cran Aux Oeufs Et Du Cap Gris-Nez, Dunes Du Chatelet, Marais De Tardinghen Et Dunes De Wissant	SCI	Y	
FR3102002	France	Bancs Des Flandres	SCI	Y	

Site code	Country	Site name	Designation	Screened in	Notes
FR3102005	France	Baie De Canche Et Couloir Des Trois Estuaires	SCI	Y	
FR3102003	France	Recifs Gris-Nez Blanc-Nez	SCI	Y	
FR3102004	France	Ridens Et Dunes Hydrauliques Du Detroit Du Pas-De-Calais	SCI	Y	
FR2502021	France	Baie de Seine orientale	SCI	Y	Recently designated 11-2013
FR2502020	France	Baie de Seine occidentale	SCI	Y	
NL2008001	Netherlands	Doggersbank	SCI	Y	
NL2008002	Netherlands	Klaverbank	SCI	Y	
NL9802001	Netherlands	Noordzeekustzone	SAC	Y	Updated site number
NL2008004	Netherlands	Noordzeekustzone II		N	No site details
NL2008003	Netherlands	Vlakte van de Raan	SAC	Y	
SE0520170	Sweden	Kosterfjorden-Väderöfjorden	SAC	Y	
SE0510186	Sweden	Stora Middelgrund och Röde bank	SCI	N	Outwith NS MU
SE0520001	Sweden	Vrångöskärgården	SAC	N	Outwith NS MU
SE0510127	Sweden	Fladen	SAC	N	Outwith NS MU
SE0430092	Sweden	Kullaberg	SAC	N	Outwith NS MU
SE0510126	Sweden	Lila Middelgrund	SAC	N	Outwith NS MU
	UK	Southern North Sea	dSAC		Included after initial screening
	UK	Outer Moray Firth	dSAC		Included after initial screening

Table 1.2 Updated screening list of SACs and SCIs for grey seal to be taken forward to the next stage of screening in the HRA

Site code	Country	Site name	Designation	Screened in	Notes
BEMNZ0002	Belgium	SBZ 1 / ZPS 1	SPA	Y	
BEMNZ0003	Belgium	SBZ 2 / ZPS 2	SPA	Y	
BEMNZ0004	Belgium	SBZ 3 / ZPS 3	SPA	Y	
BEMNZ0005	Belgium	Vlakte van de Raan	SPA	Y	
DE2104301	Germany	Borkum-Riffgrund	SCI	Y	
FR2500079	France	Chausey	SCI	Y	
FR3100478	France	Falaises Du Cran Aux Oeufs Et Du Cap Gris-Nez, Dunes Du Chatelet, Marais De Tardinghen Et Dunes De Wissant	SCI	Y	
FR3102002	France	Bancs Des Flandres	SCI	Y	Included after initial screening
FR3102003	France	Recifs Gris-Nez Blanc-Nez	SCI	Y	
FR3102005	France	Baie De Canche Et Couloir Des Trois Estuaires	SCI	Y	
FR5300009	France	Cote De Granit Rose-Sept-Iles	SAC	Y	
FR5300010	France	Tregor Goëlo	SAC	Y	
FR5300015	France	Baie De Morlaix	SAC	Y	
FR5300017	France	Abers - Côtes Des Legendes	SAC	Y	
FR5300018	France	Ouessant-Molene	SAC	Y	
FR5300019	France	Presqu'ile De Crozon	SAC	Y	
FR5300020	France	Cap Sizun	SAC	Y	
FR5300023	France	Archipel Des Glenan	SAC	Y	
NL1000001	Netherlands	Waddenzee	SAC	Y	
NL2008003	Netherlands	Vlakte van de Raan	SAC	Y	Included after initial screening
NL4000017	Netherlands	Voordelta	SAC	Y	Included after initial screening
UK0017072	UK	Berwickshire and North Northumberland Coast	SAC	Y	

Site code	Country	Site name	Designation	Screened in	Notes
UK0030170	UK	Humber Estuary	SAC	Y	
UK0030172	UK	Isle of May	SAC	Y	

Table 1.3 Updated screening list of SACs and SCIs for harbour seal to be taken forward to the next stage of screening in the HRA

Site code	Country	Site name	Designation	Screened in	Notes
BEMNZ0002	Belgium	SBZ 1 / ZPS 1	SPA	Y	
BEMNZ0003	Belgium	SBZ 2 / ZPS 2	SPA	Y	
BEMNZ0004	Belgium	SBZ 3 / ZPS 3	SPA	Y	
BEMNZ0005	Belgium	Vlakte van de Raan	SPA	Y	
DE2104301	Germany	Borkum-Riffgrund	SCI	Y	
DE2306301	Germany	Nationalpark Niedersächsisches Wattenmeer	SCI	Y	
DE2507301	Germany	Hund und Paapsand	SCI	Y	
DE2507331	Germany	Unterems und Außenems	SCI	Y	
FR3100474	France	Dunes De La Plaine Maritime Flamande	SAC	Y	
FR3102002	France	Bancs Des Flandres	SAC	Y	
NL1000001	Netherlands	Waddenzee	SAC	Y	
NL2007001	Netherlands	Eems-Dollard	SCI	Y	
NL2008001	Netherlands	Doggersbank	SCI	Y	
NL2008002	Netherlands	Klaverbank	SCI	Y	
NL2008003	Netherlands	Vlakte van de Raan	SAC	Y	
NL4000017	Netherlands	Voordelta	SAC	Y	
NL9803061	Netherlands	Westerschelde & Saeftinghe	SAC	Y	Updated name
UK0017075	UK	The Wash and North Norfolk Coast	SAC	Y	

3 REFERENCE POPULATIONS

3.1 Harbour porpoise

13. The reference population used in the assessment for harbour porpoise is the North Sea MU (IAMMWG 2015) with an estimated abundance of 227,298 (CV 0.13, 95% CI 176,360 – 292,948) based on the Hammond et al. (2013) analysis of the SCANS II data. This reference population has been agreed with Natural England in consultation (November 2013).

14. All potential impacts associated with proposed East Anglia THREE project will be assessed for this reference population.

3.2 Grey seal

15. Based on the evidence from telemetry studies (see Chapter 12 Marine Mammal Ecology and *Appendix 12.3 and Appendix 12.4* of East Anglia THREE Environmental Statement as previously present for the Preliminary Environmental Information Report (PEIR EATL 2014)), the reference population extent for grey seal will incorporate the South-east England, North-east England and East Coast IAMMWG MUs and, given the movement of seals between UK and Dutch colonies, the Waddenzee population. This has been agreed with Natural England in consultation.

16. The most recent estimate of the Dutch Waddenzee population is 4,276 seals (TSEG 2014a). The South-east England MU has an estimated population size of 10,350; the North-east England MU has an estimated population size of 7,800; and the East Coast Scotland MU has an estimated population size of 6,800 (IAMMWG 2013).

17. This total reference population is therefore 29,226 grey seal.

18. All potential impacts associated with proposed East Anglia THREE project will be assessed for this reference population.

3.3 Harbour seal

19. Based on the evidence from telemetry studies (UK and Dutch data, see Chapter 12 Marine Mammal Ecology and *Appendix 12.3 and Appendix 12.4* of East Anglia THREE ES as previously presented for the PEIR (EATL 2014)), the reference population for harbour seal will include the South-east England MU (with a population estimate of 3,567 based on the 2011 survey; IAMMWG, 2013) and the Waddenzee region (with a population of approximately 39,100 seals, TSEG 2014b).

20. The total reference population of 42,667 harbour seal has been agreed with Natural England in consultation (November 2013). However, given the large difference

between the UK and Waddenzee contribution to this total, impacts will also be placed in context against the UK South-east England MU.

Can you confirm that the reference populations are appropriate?

4 PROPOSED APPROACH FOR ASSESSMENT OF POTENTIAL IMPACTS ON MARIME MAMMAL DESIGNATED SITES

4.1 Potential impacts

21. The potential impacts on marine mammals and the integrity of their designated sites resulting from proposed East Anglia THREE development could relate to:

- Potential disturbance and displacement as a result of increased noise levels generated during construction work;
- Changes in prey availability, and
- Increased collision risk with vessels during construction and operation.

Do you agree that the potential impacts to be assessed on marine mammal reference populations and designated sites are appropriate?

4.1.1 Underwater noise

22. The potential impacts associated with underwater noise as a result of increased noise levels generated as a result of the construction of the proposed East Anglia THREE project will be assessed for each of the reference populations agreed for harbour porpoise, grey seal and harbour seal.

23. In addition the potential for any direct impact on the list of designated sites will be determined.

24. The greatest potential spatial impact associated with the East Anglia THREE project that could affect marine mammals is pile driving during construction. The National Physical Laboratory (NPL) completed underwater noise propagation modelling based on a range of hammer energies across the East Anglia THREE site (ES Chapter 9 Underwater Noise, Vibration and Magnetic Fields and *Appendix 9.1* as previously presented for the PEIR (EATL 2014)).

25. The maximum distance for potential disturbance during monopile installation using the maximum hammer energy of 3,500kJ is considered to approximate to the worst case scenario for spatial impact (*Table 1.4*).

26. It is proposed that individual sites outwith the estimated maximum distance of potential disturbance for harbour porpoise, grey seal and harbour seal will have no direct impact associated with the proposed development of the East Anglia THREE site and therefore no potential for any LSE.

Table 1.4 Summary of fleeing response /TTS onset and possible avoidance distances for single strike with 3,500kJ hammer energy during construction at East Anglia THREE

Species or species group	Impact criteria SEL (dB re 1 µPa^2·s)	Distance for 3,500kJ hammer energy
Harbour porpoise	Fleeing response / TTS onset (pulse SEL 164dB re 1 µPa^2·s)	~5-8km
	Possible avoidance of area (pulse SEL 145dB re 1 µPa^2·s)	~37-70km
Grey and harbour seal	Fleeing response / TTS onset (pulse SEL 179dB re 1 µPa^2·s)	<2.5km

Do you agree that individual sites located outwith the maximum distance for potential disturbance to marine mammals can be screened out, given that any potential impacts will be assessed on the reference population for each species?

4.1.2 Impacts on prey

27. Potential impacts on marine mammal prey species have been assessed in Chapter 11 Fish and Shellfish Ecology of the East Anglia THREE ES (as previously presented for the PEIR (EATL 2014)) using the appropriate realistic worst case scenario for these receptors.

28. Potential impacts on fish species during construction can result from increased suspended sediment concentrations and sediment re-deposition and underwater noise (leading to mortality, physical injury, auditory injury or behavioural responses). None of the potential impacts were assessed as being significant, minor adverse at worst (see Chapter 11 Fish and Shellfish Ecology for East Anglia THREE ES).

29. Any potential impacts on marine mammals will be localised and temporary and are therefore unlikely to have any significant effect at the population level.

30. It is proposed that the maximum distance for potential disturbance to marine mammal prey species is used to determine the individual designated sites which can be screened or out from further assessment. For demersal fish the maximum range at which there could be a behavioural response is 34km and for pelagic fish the range is 49km.

Do you agree that individual sites located outwith the maximum distance for potential disturbance to prey species can be screened out?

4.1.3 Collision risk with vessels

31. The potential collision risk to marine mammals will be limited to the East Anglia THREE site, export cable corridor and interconnector cable corridor, but could have implications at a population level.

32. It is therefore proposed to assess any potential impacts associated with collision risk as a result of the proposed East Anglia THREE project on the reference populations agreed for harbour porpoise, grey seal and harbour seal, rather than individual designated sites. Note that it is more realistic to look at just the potential impacts on the reference population rather than individual sites. It is anticipated, based on ES assessment, that numbers will be too small to calculate for individual sites, however this will be assessed and included if there is any potential impact on designated sites.

Do you agree that individual sites outwith the East Anglia THREE project area can be screened out for collision risk, given any potential impacts will be assessed on the reference population for each species?

4.1.4 Cumulative impact assessment (CIA)

33. The CIA will identify areas where the predicted impacts of the construction, operation, maintenance and decommissioning of the proposed East Anglia THREE project could interact with impacts from different industry sectors within the same region and impact sensitive receptors.

34. The types of plans and projects to be taken into consideration are:

- Other offshore windfarms;
- Other renewables developments;
- Aggregate extraction and dredging;
- Licenced disposal sites;
- Navigation and shipping;
- Planned construction sub-sea cables and pipelines;
- Potential port/harbour developments; and
- Oil and gas installations.

35. Following a tiered approach the list of projects will then be refined based on the level of information available for this list of projects. The tiered approach to be used

is consistent to that outlined by JNCC and Natural England for ornithology interests. The definition of the tiers and impacts considered within the CIA was agreed with Natural England at ETG meeting 2 and 3 (November 2013 and April 2014).

36. The CIA will consider projects, plans and activities which have sufficient information available in order to undertake the assessment.

37. It is proposed to assess any potential cumulative impacts upon the reference populations agreed for harbour porpoise, grey seal and harbour seal. The potential impacts on individual designated sites can then be assessed based on the population size at each site, relative to the reference population.

Do you agree that cumulative impacts should be assessed on the reference population for each species, rather than individual sites?

4.2 Proposed approach for assessing potential impacts

4.2.1 Underwater noise

4.2.1.1 Reference populations

38. The potential impacts of underwater noise, based on the spatial worst-case, will be assessed on each of the reference populations for harbour porpoise, grey seal and harbour seal. The potential number of animals that could be in the maximum area potential impact will be estimated based on densities for harbour porpoise from the SCANS-II data (Hammond et al. 2013) and densities for grey and harbour seals from the SMRU seals at sea density data (Jones et al. 2013). The number of animals will then be assessed as a percentage of the reference population.

4.2.1.2 Designated sites

39. Any potential direct impacts associated with underwater noise, based on the worst-case scenario, for designated sites within the estimated maximum area of potential disturbance will be assessed. The population numbers for the specific sites will be used, if available. If not available the estimated number of animals in the sites that could be affected will be estimated based on the size of the sites and the density estimates for harbour porpoise from the SCANS-II data (Hammond et al. 2013) and densities for grey and harbour seals from the SMRU seals at sea density data (Jones et al. 2013).

40. If the entire site is within the maximum area of potential disturbance it will be assumed that all animals within the site could be disturbed. If only part of the site

could be potentially affected, then the appropriate proportion of animals at the site will be estimated.

4.2.2 Impacts on prey

4.2.2.1 Reference populations

41. The potential impacts on prey, based on the spatial worst-case of disturbance to prey species, will be assessed on each of the reference populations for harbour porpoise, grey seal and harbour seal. The potential number of individuals that could be in the maximum area potential impact will be estimated based on densities for harbour porpoise from the SCANS-II data (Hammond et al. 2013) and densities for grey and harbour seals from the SMRU seals at sea density data (Jones et al. 2013). The number of individuals will then be assessed as a percentage of the reference population.

4.2.2.2 Designated sites

42. Any potential direct impacts associated with disturbance to prey species, based on the worst-case scenario, for designated sites within the estimated maximum area of potential disturbance will be assessed. The population numbers for the specific sites will be used, if available. If not available the estimated number of marine mammals in the sites that could be affected will be estimated based on the size of the sites and the density estimates for harbour porpoise from the SCANS-II data (Hammond et al. 2013) and densities for grey and harbour seals from the SMRU seals at sea density data (Jones et al. 2013).

43. If the entire site is within the maximum area of potential disturbance it will be assumed that all prey within the site could be disturbed to some degree with a discussion of the likely effects based on our understanding of their sensitivity to noise. If only part of the site could be potentially affected, then the appropriate proportion of prey affected at the site will be estimated.

44. This will be a qualitative assessment based on the information on prey species distribution from the Chapter 11 Fish and Shellfish Ecology of the East Anglia THREE ES (as previously presented for the PEIR (EATL 2014)) assessment and taking into account any effect of the mammals themselves being displaced.

4.2.3 Collision risk with vessels

4.2.3.1 Reference populations

45. The potential impacts of collision risk will be based on the number of animals that could be present within the East Anglia THREE site, export cable corridor and interconnector cable corridor that could come into contact with vessels. The size of

vessels and number of trips will also be taken into account, along with avoidance behaviour. The potential number of animals that could be in the maximum area potential impact will be estimated based on abundances of harbour porpoise, grey seal and harbour seal at the East Anglia THREE. The number of animals will then be assessed as a percentage of the reference population.

4.2.4 In combination impacts

4.2.4.1 Reference populations

46. The in-combination impacts will be based on the number of animals that could be impacted by each project, where the information is available. The total number of animals affected for each species will then be assessed as a percentage of the relevant reference population.

Do you agree with the proposed approach for assessing potential impacts on reference population and designated sites that have been screened in?

5 FINAL SCREENING

47. The sites from the updated lists that can be screened out because there is no potential for LSE are presented in *Table 1.5* for harbour porpoise sites, *Table 1.6*. For grey seal sites and *Table 1.7* for harbour seal sites.

48. For harbour porpoise all sites greater than 70km from the East Anglia THREE site and for grey and harbour seal all sites greater than 3.5km have been screened out as greatest potential range from any direct impacts of underwater noise during piling operations.

49. For potential impacts on prey species, all sites greater than 49km from the East Anglia THREE site for harbour porpoise, grey seal and harbour seal have been screened out.

Do you agree with the sites that have been screened in and out?

Table 1.5 List of SACs and SCIs for harbour porpoise and summarised screening decision. Shaded rows have been screened out from further consideration for site specific noise impacts, prey impacts and collision risk.

Site code	Country	Site name	Designation	Distance from EA3 site boundary (km)*	Screened in for noise impacts	Screened in for prey impacts	Screened in for collision risk
BEMNZ0002	Belgium	SBZ 1 / ZPS 1	SPA	142.9	N	N	N
BEMNZ0003	Belgium	SBZ 2 / ZPS 2	SPA	128.1	N	N	N
BEMNZ0004	Belgium	SBZ 3 / ZPS 3	SPA	127.6	N	N	N
BEMNZ0005	Belgium	Vlakte van de Raan	SCI	120.9	N	N	N
DE0916391	Germany	NTP S-H Wattenmeer und angrenzende Küstengebiete	SAC	374.4	N	N	N
DE1011401	Germany	SPA Östliche Deutsche Bucht	SPA	367.8	N	N	N
DE1209301	Germany	Sylter Außenriff	SCI	324.2	N	N	N
DE1003301	Germany	Doggerbank	SCI	298.3	N	N	N
DE2104301	Germany	Borkum-Riffgrund	SCI	244.5	N	N	N
DE1813391	Germany	Helgoland mit Helgoländer Felssockel	SAC	357.8	N	N	N
DE1714391	Germany	Steingrund	SAC	363.9	N	N	N
DE2016301	Germany	Hamburgisches Wattenmeer	SCI	374.1	N	N	N
DE2018331	Germany	Unterelbe	SCI	404.3	N	N	N
DE2306301	Germany	Nationalpark Niedersächsisched Wattenmeer	SCI	254.6	N	N	N
DK00FX112	Denmark	Skagens Gren og Skagerrak	SAC	691.6	N	N	N
DK00VA347	Denmark	Sydlige Nordsø	SAC	381.5	N	N	N
DK00VA171	Denmark	Gilleleje Flak og Tragten	SAC	707.6	N	N	N
DK00VA259	Denmark	Gule Rev	SCI	587.3	N	N	N
DK00VA250	Denmark	Store Middelgrund	SAC	720.8	N	N	N
DK00VA258	Denmark	Store Rev	SCI	670.8	N	N	N
DK00AY176	Denmark	Vadehavet med Ribe Å, Tved Å og Varde Å vest for Varde	SAC	439.8	N	N	N
FR3100478	France	Falaises Du Cran Aux Oeufs Et Du Cap Gris-Nez, Dunes Du Chatelet, Marais De Tardinghen Et Dunes De Wissant	SCI	194.3	N	N	N

Site code	Country	Site name	Designation	Distance from EA3 site boundary (km)*	Screened in for noise impacts	Screened in for prey impacts	Screened in for collision risk
FR3102002	France	Bancs Des Flandres	SCI	136.3	N	N	N
FR3102005	France	Baie De Canche Et Couloir Des Trois Estuaires	SCI	231.1	N	N	N
FR3102003	France	Recifs Gris-Nez Blanc-Nez	SCI	188.2	N	N	N
FR3102004	France	Ridens Et Dunes Hydrauliques Du Detroit Du Pas-De-Calais	SCI	195.0	N	N	N
FR2502021	France	Baie de Seine orientale	SCI	390.7	N	N	N
FR2502020	France	Baie de Seine occidentale	SCI	417.9	N	N	N
NL2008001	Netherlands	Doggersbank	SCI	208.5	N	N	N
NL2008002	Netherlands	Klaverbank	SCI	148.4	N	N	N
NL9802001	Netherlands	Noordzeekustzone	SAC	117.3	N	N	N
NL2008004	Netherlands	Noordzeekustzone II			N	N	N
NL2008003	Netherlands	Vlakte van de Raan	SAC	108.9	N	N	N
SE0520170	Sweden	Kosterfjorden-Väderöfjorden	SAC	849.1	N	N	N
SE0510186	Sweden	Stora Middelgrund och Röde bank	SCI	753.2	N	N	N
SE0520001	Sweden	Vrångöskärgården	SAC	797.9	N	N	N
SE0510127	Sweden	Fladen	SAC	768.8	N	N	N
SE0430092	Sweden	Kullaberg	SAC	758.1	N	N	N
SE0510126	Sweden	Lila Middelgrund	SAC	761.6	N	N	N
	UK	**Southern North Sea**	**dSAC**	**0**	**Y**	**Y**	**Y**
	UK	Outer Moray Firth	dSAC	594.6	N	N	N

*Distance measured from the closest point of the East Anglia THREE site to the closest point of the SAC or SCI site

Table 1.6 List of SACs and SCIs for grey seal and summarised screening decision. Shaded rows have been screened out from further consideration for site specific noise impacts, prey impacts and collision risk.

Site code	Country	Site name	Designation	Distance from EA3 site boundary (km)*	Screened in for noise impacts	Screened in for prey impacts	Screened in for collision risk
BEMNZ0002	Belgium	SBZ 1 / ZPS 1	SPA	142.9	N	N	N
BEMNZ0003	Belgium	SBZ 2 / ZPS 2	SPA	128.1	N	N	N
BEMNZ0004	Belgium	SBZ 3 / ZPS 3	SPA	127.6	N	N	N
BEMNZ0005	Belgium	Vlakte van de Raan	SPA	120.9	N	N	N
DE2104301	Germany	Borkum-Riffgrund	SCI	244.5	N	N	N
FR2500079	France	Chausey	SCI	498.6	N	N	N
FR3100478	France	Falaises Du Cran Aux Oeufs Et Du Cap Gris-Nez, Dunes Du Chatelet, Marais De Tardinghen Et Dunes De Wissant	SCI	194.3	N	N	N
FR3102002	France	Bancs Des Flandres	SCI	136.3	N	N	N
FR3102003	France	Recifs Gris-Nez Blanc-Nez	SCI	188.2	N	N	N
FR3102005	France	Baie De Canche Et Couloir Des Trois Estuaires	SCI	231.1	N	N	N
FR5300009	France	Cote De Granit Rose-Sept-Iles	SAC	579.1	N	N	N
FR5300010	France	Tregor Goëlo	SAC	565.1	N	N	N
FR5300015	France	Baie De Morlaix	SAC	618.8	N	N	N
FR5300017	France	Abers - Côtes Des Legendes	SAC	665.4	N	N	N
FR5300018	France	Ouessant-Molene	SAC	696.6	N	N	N
FR5300019	France	Presqu'ile De Crozon	SAC	696.6	N	N	N
FR5300020	France	Cap Sizun	SAC	706.5	N	N	N
FR5300023	France	Archipel Des Glenan	SAC	705.6	N	N	N
NL1000001	Netherlands	Waddenzee	SAC	139.1	N	N	N
NL2008003	Netherlands	Vlakte van de Raan	SAC	108.9	N	N	N
NL4000017	Netherlands	Voordelta	SAC	95.1	N	N	N
UK0017072	UK	Berwickshire and North Northumberland Coast	SAC	426.4	N	N	N
UK0030170	UK	Humber Estuary	SAC	201.6	N	N	N
UK0030172	UK	Isle of May	SAC	536.5	N	N	N

*Distance measured from the closest point of the East Anglia THREE site to the closest point of the SAC or SCI site

Table 1.7 List of SACs and SCIs for harbour seal and summarised screening decision. Shaded rows have been screened out from further consideration for site specific noise impacts, prey impacts and collision risk.

Site code	Country	Site name	Designation	Distance from EA3 site boundary (km)*	Screened in for noise impacts	Screened in for prey impacts	Screened in for collision risk
BEMNZ0002	Belgium	SBZ 1 / ZPS 1	SPA	142.9	N	N	N
BEMNZ0003	Belgium	SBZ 2 / ZPS 2	SPA	128.1	N	N	N
BEMNZ0004	Belgium	SBZ 3 / ZPS 3	SPA	127.6	N	N	N
BEMNZ0005	Belgium	Vlakte van de Raan	SPA	120.9	N	N	N
DE2104301	Germany	Borkum-Riffgrund	SCI	244.5	N	N	N
DE2306301	Germany	Nationalpark Niedersächsisches Wattenmeer	SCI	254.6	N	N	N
DE2507301	Germany	Hund und Paapsand	SCI	266.7	N	N	N
DE2507331	Germany	Unterems und Außenems	SCI	267.6	N	N	N
FR3100474	France	Dunes De La Plaine Maritime Flamande	SAC	157.4	N	N	N
FR3102002	France	Bancs Des Flandres	SAC	136.3	N	N	N
NL1000001	Netherlands	Waddenzee	SAC	139.1	N	N	N
NL2007001	Netherlands	Eems-Dollard	SCI	291.2	N	N	N
NL2008001	Netherlands	Doggersbank	SCI	208.5	N	N	N
NL2008002	Netherlands	Klaverbank	SCI	148.4	N	N	N
NL2008003	Netherlands	Vlakte van de Raan	SAC	108.9	N	N	N
NL4000017	Netherlands	Voordelta	SAC	95.1	N	N	N
NL9803061	Netherlands	Westerschelde & Saeftinghe	SAC	117.3	N	N	N
UK0017075	UK	The Wash and North Norfolk Coast	SAC	124.8	N	N	N

*Distance measured from the closest point of the East Anglia THREE site to the closest point of the SAC or SCI site

6 REFERENCES

APEM Ltd and Royal HaskoningDHV (2014). East Anglia THREE HRA Screening: Report on High Level Screening, May 2014. Stockport: APEM.

East Anglia THREE Limited (EATL) 2014 East Anglia THREE Preliminary Environmental Information Report

Hammond P.S., Macleod K., Berggren P., Borchers D.L., Burt L., Cañadas A., Desportes G., Donovan G.P., Gilles A., Gillespie D., Gordon J., Hiby L., Kuklik I., Leaper R., Lehnert K, Leopold M., Lovell P., Øien N., Paxton C.G.M., Ridoux V., Rogano E., Samarraa F., Scheidatg M., Sequeirap M., Siebertg U., Skovq H., Swifta R., Tasker M.L., Teilmann J., Canneyt O.V. and Vázquez J.A. (2013). Cetacean abundance and distribution in European Atlantic shelf waters to inform conservation and management. Biological Conservation 164, 107-122.

IAMMWG (2013). Management Units for marine mammals in UK waters (June 2013).

IAMMWG (2015). Management Units for cetaceans in UK waters (January 2015). JNCC Report No. 547, JNCC Peterborough.

JNCC (2009) Selection criteria and guiding principles for selection of special areas of conservation (SACs) for Marine Annex I Habitats and Annex II Species in the UK. Version 1.0 (11/05/09). JNCC, Peterborough.

Jones, E., McConnell, B., Sparling, C and Matthiopolous, J. (2013). Grey and harbour seal density maps. Marine Mammal Scientific Support Research Programme MMSS/001/11. Available at: http://www.scotland.gov.uk/Resource/0041/00416981.pdf

TSEG (2014a). Grey seals in the Wadden Sea and Helgoland in 2013-2014. Available at: http://www.waddensea-secretariat.org/sites/default/files/CWSS_Internal/TMAP/Marine_Mammals/grey_seal_report_2014.pdf

TSEG (2014b). Aerial surveys of harbour seals in the Wadden Sea in 2014. Available at: http://www.waddensea-secretariat.org/sites/default/files/downloads/TMAP_downloads/Seals/harbour_seal_report_2014_b.pdf

12.1.6.2 Minutes of Marine Mammals ETG 5 Meeting

19. Provided below are the minutes for the sixth Marine Mammal ETG meeting

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East Anglia Offshore Wind Limited - East Anglia THREE

East Anglia THREE, Marine Mammals ETG Meeting 5 – 06/07/15

Attendees		
Name	**Initials**	**Organisation**
Marcus Cross	MC	EAOW
Holly Cartwright	HC	EAOW
Rachel Furlong	RF	EAOW (phone)
Claire Ludgate	CL	Natural England
Lou Burton	LB	Natural England
Rebecca Walker	RW	Natural England
Paolo Pizzolla	PP	Royal HaskoningDHV
Jen Learmonth	JL	Royal HaskoningDHV
Apologies	Keith Morrison, Senior Project manager, EAOW	

AGENDA		
Item	**Description**	**Action**
1	Health and Safety – HC Introductions - All	n/a
2	Discussion on current position on proposed dSAC RF – EAOW welcome ongoing discussion and are keen to understand the process and consultation timelines for the proposed dSAC going forward for the SAC RF – Important to note that EAOW have concerns with the data used to underpin the proposed designation and the modelling undertaken to identify the proposed dSACs, in particular the JNCC modelling suggest that there are high densities of harbour porpoise (HP) in the zone which contrasts with data from the EAOW survey data. EAOW have offered to provide EAOW full survey data and have asked Defra and JNCC for this to be used in refining the site RF – EAOW will proceed with shadow HRA process as this is best practice, with caveat of issues with data stated above, however seek clarity on when the consultation material will be made available to help support the assessment. RW – no further information available on the timing of the consultation at this point. The Impact Assessment (IA) had to be finalised prior to consultation on the site, consultation unlikely to start in July but will be 'as soon as possible' MC – EAOW has fed back to ABPMer on the	

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	assumptions used in the IA, in particular on the potential management measures RW – NE have already fed back industry comments on the IA in particular with regard to realism of the potential management measures	
3	HRA assumptions **List of sites in updated screening** JL – some sites excluded for HP as these were outside the MU, the list has been updated with the latest information RW – why are some SPAs included? JL – French sites include HP as a feature in some of the sites **Reference populations agreed for EIA are appropriate for the HRA** Grey Seal– RW – noted that tagged seals from the Isle of May going to Germany JL - These are included in the Waddensee population Harbour seal JL – the assessment will look at effects in terms of both the south east management unit population and the UK level RW – no comment Harbour porpoise No comments **Impacts to be assessed in the HRA** • Disturbance from construction noise • Changes in prey availability • Increased collision risk - construction, operation and decommissioning RW – should injury and death from noise be included? JL – already screened out as no potential for this as already mitigated. Will check that this has been taken into account. JL – with regard to noise injury – proposed to look at the maximum areas – TTS and possible avoidance. Therefore we will look at the reference population as a whole than trying to assess on a site by site basis JL – prey impacts based on potential disturbance from noise footprint.	ACTION – the sites listed in Tables 1.1 – 1.3 of the HRA Method Statement form the basis of the HRA ACTION – the reference populations listed in Section 3 of the HRA Method Statement will be used to assess any likely significant effects ACTION – these impacts will form the basis of the assessment ACTION – ensure that injury/death from noise is taken into account and justification if screened out

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	JL – collision risk – looking at population level RW/CL – no comments JL – by capturing the population level effects we capture the dSAC – it is not important to know the site boundary or area LB – agreed RW – NE are currently undertaking work using the interim Population Consequences of Disturbance (Interim PCoD) model which considered strategic level impacts JL – PCoD will not be used as part of our assessment. RW – update on interim PCoD. Additional work being undertaken over the summer – would like to use more of a dose/response curve aspect in this. Workshop on the week of 20th July and facilitated by Cormac Booth (SMRU Consulting) & Sonia Mendes (JNCC) and MC invited to attend and input into discussions RW – output was a mix, therefore need to do some refinements. Outputs should be available in November MC – enquired if conservation objectives would consider disturbance and mortality – so these should both be discussed RW – agree JL – have screened out all the sites for all species with the exception of the S North Sea HP site RW – agree that these should be screened out	ACTION – there is no expectation that PCoD will be used within the assessment. ACTION – RW to send invite to MC ACTION – the only site for which there will be a full assessment is the dSAC, therefore EAOW will undertake a shadow assessment, noting the caveats from earlier discussion
4	CIA methodology JL – the assessment looks at project overlaps during the lifetime, employing a tiered approach RW – are oil & gas seismic included in this? JL – yes will look at all sites included in the 27th and 28th rounds CL – previous advice to include anything within the 7 years from consent. LB – if you can definitely state that projects will not overlap, then this can be excluded PP – do you want to see the list of projects prior to seeing the full report? LB – yes it would be useful to see this	ACTION – send thru the list of CIA projects to NE, next week
5	Monitoring & MMMP PP – MMMP will not be provided with application CL - agreed MC – no update on monitoring	NOTE- EATL would like to leave the option open to provide a draft MMMP with the application given on-going discussions on the dSAC

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	JL – not envisaging any site specific monitoring	
6	AOB PP – what are NE expectations regarding review of documents prior to submission of the applications? CL – highlight those areas where there have been material changes LB – would require at least 20 working days HC – next workshop would go through the DML & in-principle monitoring plan	ACTION - HRA doc to NE 27th July – returned by 14th August – just for the HRA documents - written comments only DML / DCO – potentially w/c 10th august

12.1.6.3 Email agreement of Marine Mammals ETG 5 Minutes.

20. Provided below is email agreement on the minutes of the 5th Marine Mammal ETG meeting.

From: Ludgate, Claire (NE)
To: Paolo Pizzolla; Walker, Rebecca (NE); Burton, Louise (NE)
Cc: holly.cartwright@scottishpower.com; Morrison, (Keith) - Scottish Power Renewables; Jen Learmonth; Cross, (Marcus) - Scottish Power Renewables
Subject: RE: 150706_ETG_Mtg5_minutes_V3.docx
Date: 31 July 2015 14:15:02

Hi Paolo,

Apologies for the delay in reviewing these minutes. I am satisfied they accurately reflect the meeting.

Many thanks,

Claire

Claire Ludgate
MSc AMIMarEST

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In an effort to reduce Natural England's carbon footprint, I will, wherever possible, avoid travelling to meetings and attend via audio, video or web conferencing.

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Appendix 12.1 Ends Here